

Thermodynamics of Enzyme-Catalyzed Reactions Part 3. Hydrolases

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Equilibrium constants and enthalpy changes for reactions catalyzed by the hydrolase class of enzymes have been compiled. For each reaction the following information is given: the reference for the data; the reaction studied; the name of the enzyme used and its Enzyme Commission number; the method of measurement; the conditions of measurement (temperature, pH, ionic strength, and the buffer(s) and cofactor(s) used); the data and an evaluation of it; and, sometimes, commentary on the data and on any corrections which have been applied to it or any calculations for which the data have been used. The data from 146 references have been examined and evaluated. Chemical Abstract Service registry numbers are given for the substances involved in these various reactions. There is a cross reference between the substances and the Enzyme Commission numbers of the enzymes used to catalyze the reactions in which the substances participate.

Key words: apparent equilibrium constants; enthalpies of reaction; enzyme-catalyzed reactions; evaluated data; hydrolases; transformed thermodynamic properties.

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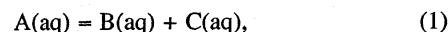
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1. Introduction

This review is a continuation of the first two papers in this series¹⁻² that dealt, respectively, with the thermodynamics of the reactions catalyzed by the oxidoreductases and by the transferases. These are the first two class of enzymes classified by the Nomenclature Committee of the International Union of Biochemistry.³ In the current review a critical compilation of thermodynamic data is provided for the reactions catalyzed by the third class of enzymes – the hydrolases. These reactions play significant roles in metabolic processes such as glycolysis, oxidative phosphorylation, glycogen and starch utilization, in the action of muscles, and in the synthesis of genetic material. There is also an interest in many of these reactions due to their importance in the utilization of biomass and cellulosic materials. The data presented herein is limited to equilibrium and calorimetric measurements performed on these reactions under *in vitro* conditions. Thus, the thermodynamic quantities which are generally given are apparent equilibrium constants K' and calorimetrically determined enthalpies of reaction $\Delta_r H$ (cal). Apparent equilibrium constants calculated from kinetic data are also tabulated. If the change in binding of hydrogen ion $\Delta_r N(\text{H}^+)$ in a biochemical reaction is known, the standard transformed enthalpy of reaction $\Delta_r H^\circ$ can be calculated from the calorimetrically determined enthalpy of reaction.⁴ Equilibrium constants K and standard molar enthalpies of reaction $\Delta_r H^\circ$ for chemical reference reac-

tions are also given if they have been reported in the literature. The standard transformed enthalpy of reaction $\Delta_r H^\circ$ can be used to calculate the temperature dependence of apparent equilibrium constants K' in the same way that the standard enthalpy of reaction $\Delta_r H^\circ$ is used to calculate the temperature dependence of the equilibrium constant K .

The data are presented in the same format as in Parts 1 and 2.¹⁻² Thus, the following information is given for each entry in this review: the reference for the data; the biochemical reaction studied; the name of the enzyme used and its Enzyme Commission number; the method of measurement; the conditions of measurement (temperature, pH, ionic strength, and the buffer(s) and cofactor(s) used); the data and an evaluation of it; and, sometimes, commentary on the data and on any corrections which have been applied to it or any calculations for which the data have been used. The absence of a piece of information indicates that it was not found in the paper cited. The arrangement of the data, its evaluation, and the thermodynamic conventions have been discussed previously.¹ In this regard one should note that equilibrium constants should be expressed as dimensionless quantities. However, the numerical value obtained for the equilibrium constant of an unsymmetrical reaction will depend upon the measure of composition and standard concentration selected for the reactants and products. Thus, for the chemical reaction



$K_c = c(\text{B})c(\text{C})/\{c(\text{A})c^\circ\}$, $K_m = m(\text{B})m(\text{C})/\{m(\text{A})m^\circ\}$, and $K_x = x(\text{B})x(\text{C})/x(\text{A})$. Here, c , m , and x are, respectively, concentration, molality, and mole fraction, $c^\circ = 1 \text{ mol dm}^{-3}$, and $m^\circ = 1 \text{ mol kg}^{-1}$. The equilibrium constant expressed in terms of mole fractions is automatically dimensionless. Similar definitions and considerations apply to the apparent equilibrium constant K' . The symbols used in this review are given in the Glossary.

The subjective evaluation of the data in this review consisted of the assignment of a rating: A (high quality), B (good), C (average), or D (low quality). In making these assignments we considered the various experimental details which were provided in the study. These details include the method of measurement, the number of data points determined, and the extent to which the effects of varying temperature, pH, and ionic strength were investigated. A low rating was generally given when few details of the investigation were reported. For example, in many of the papers cited, the major aim of the study was the isolation and purification of the enzyme of interest. Thus, the equilibrium data were obtained as only a small part of an investigation to characterize many of the properties of that enzyme.

This effort has been given additional impetus by the recent completion of the IUBMB-IUPAC document "Recommendations for Nomenclature and Tables in Biochemical Thermodynamics".⁵ The work described in this review paper has also been accepted by the Thermodynamics Commission and by the Steering Committee on Biophysical Chemistry of IUPAC as a project of particular timeliness and importance. The project has therefore been conducted under the auspices of these bodies, has been endorsed by them, and has been written to be

consistent with recommended IUPAC nomenclature. It is hoped that this work will encourage additional efforts towards systematic data collection and evaluation for biochemical substances and reactions.

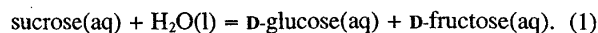
2. Some Aspects and Uses of Thermodynamic Data on Biochemical Reactions

While a full discussion of the applications of thermodynamic data would be beyond the scope of this review, it seems useful to indicate briefly the utility of the information presented in this review. The primary motivation for many of those performing thermodynamic studies on biochemical reactions is to determine the position of equilibrium of the reaction(s) studied as well as to establish definitely the substrates that participate in the biochemical reaction. This information is concisely summarized in terms of the apparent equilibrium constants given herein. These apparent equilibrium constants can be conveniently used to calculate the extent of reaction under the stated set of conditions and thus can be very useful to engineers concerned with the optimization of product yield in bioreactors. The enthalpy changes accompanying these reactions are also needed to know how much heating or cooling is required to keep a bioreactor at its proper temperature. To perform this calculation one needs to know both the standard transformed enthalpy of reaction $\Delta_r H'^\circ$, the change in binding of the hydrogen ion $\Delta_r N(H^+)$, and the enthalpy of protonation of the buffer(s) in the bioreactor. In general, both $\Delta_r H'^\circ$ and $\Delta_r N(H^+)$ are functions of temperature, pH, ionic strength, and the concentration of free metal ion(s).

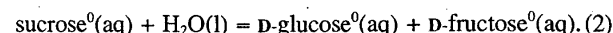
Apparent equilibrium constants obtained from studies of *in vitro* systems can also be used to calculate the position of equilibrium in metabolic processes involving several reactions. Glycolysis is probably the best example of a situation where data are available and for which such calculations have been performed.^{6,7} The results of these calculations can then be compared with information on the concentrations of the various substrates obtained from the analysis of *in vivo* systems. This comparison can provide valuable insight into the chemical machinery of living systems.

For many biochemical reactions, the apparent equilibrium constant is a function of temperature, pH, pX, and ionic strength. Thus, when performing Hess' Law and thermochemical cycle calculations, it is necessary that the data for all of the reactions in such a calculation refer to the same set of conditions. The dependencies of apparent equilibrium constants and standard transformed enthalpies of reaction on the conditions of reaction can be very complex and the reduction of such results to a common standard state generally requires auxiliary information on the binding of protons and metal ions to the various reactants as well as information on or assumptions about the activity coefficients of the species in solution. Calculations of this type have been performed by Kuby and Noltmann,⁸ Alberty,^{9,10} Guynn, Gelberg, and Veech,¹¹ Langer *et al.*,¹² Goldberg and Tewari,¹³ and others.

For the situation where none of the reactants or products in a given biochemical reaction have ionizable groups or bind metal ions under the conditions of the study and when there are no hydrogen or metal ions as reactants in the chemical reference reaction, thermodynamic quantities for the chemical reference reaction correspond directly to the transformed thermodynamic quantities for the overall biochemical reaction. For example, the biochemical reaction for the hydrolysis of sucrose to D-glucose and D-fructose is:



A chemical reference reaction involving specific species is:



Here, the charges of the reference species have been specified to distinguish these species from the biochemical reactants which, in principle, can consist of a mixture of pseudoisomer species.⁷ Since the extent of ionization of these sugars for pH < 10 is negligible, sucrose⁰, D-glucose⁰, and D-fructose⁰ are the predominant species and for pH < 10, $K'(1) = K(2)$, $\Delta_r H'^\circ(1) = \Delta_r H^\circ(2)$, and $\Delta_r G'^\circ(1) = \Delta_r G^\circ(2)$. Also, since $\Delta_r N(H^+) = 0$ for reaction (2), $\Delta_r H(\text{cal}) = \Delta_r H'^\circ(2)$. This type of situation is frequently encountered for the hydrolysis reactions of the di- and oligosaccharides found in this review.

Tables of standard formation properties¹⁴ have proven to be a useful way of generalizing upon and presenting thermodynamic data for many chemical substances. However, tables of this type have been prepared for only limited classes of biochemical substances.¹⁵⁻¹⁷ It has recently been shown¹⁸ how it is possible to prepare tables of standard transformed formation properties for biochemical reactants (i.e. sums of species) as distinct from standard formation properties for individual biochemical species. The adenosine 5'-triphosphate series was used as a prototype for this purpose. Thus, it appears likely and desirable that several different types of thermodynamic tables will eventually appear in the literature. Clearly, the larger the scope of such tables, the more useful they are for calculating thermodynamic quantities for reactions which have not been the subject of a direct investigation.

3. Acknowledgments

We thank Drs. Ellen Anderson and Edgar Etz for their assistance with the papers written in German and Dr. Mikhail V. Rekharsky for his help with the papers in Russian. We thank Drs. Frank Howard, Keith McKenney, Prasad Reddy, and David Vanderah for helpful discussions on the chemistry of some of these reactions. Dr. A. D. McNaught helped us to make the chemical nomenclature consistent with IUPAC recommendations. Ms. Kari Fazio and Donna Bell provided valuable assistance in the early collection of the references containing the data and in the preliminary abstracting of information. Continuing discussions with Dr. Robert A. Alberty on various aspects of biochemical thermodynamics are gratefully acknowledged.

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5. Table of Equilibrium Constants and Enthalpies of Reaction

5.1. Enzyme: triacylglycerol lipase (EC 3.1.1.3)

n -decanoic acid glycerol diester(sln) + H₂O(sln) = n -decanoic acid(sln) + n -decanoic acid glycerol monoester(sln)

$\frac{T}{K}$	K
308.15	2.0

Reference: 93JAN/PAD
Method: HPLC
Evaluation: B

Janssen *et al.* measured the equilibrium mole fractions of the reactants and products (including dissolved water) in the organic phase in which this reaction occurred. Janssen *et al.* also used estimated activity coefficients to calculate the value of the equilibrium constant given here. The isomeric forms of the monoester and diester were not distinguished in the calculation of this equilibrium constant.

n -decanoic acid glycerol monoester(sln) + H₂O(sln) = n -decanoic acid(sln) + glycerol(sln)

$\frac{T}{K}$	K
308.15	0.91

Reference: 93JAN/PAD
Method: HPLC
Evaluation: B

Janssen *et al.* measured the equilibrium mole fractions of the reactants and products (including dissolved water) in the organic phase in which this reaction occurred. Janssen *et al.* also used estimated activity coefficients to calculate the value of the equilibrium constant given here. The isomeric forms of the monoester were not distinguished in the calculation of this equilibrium constant.

n -decanoic acid glycerol triester(sln) + H₂O(sln) = n -decanoic acid(sln) + n -decanoic acid glycerol diester(sln)

$\frac{T}{K}$	K
308.15	2.5

Reference: 93JAN/PAD
Method: HPLC
Evaluation: B

Janssen *et al.* measured the equilibrium mole fractions of the reactants and products (including dissolved water) in the organic phase in which this reaction occurred. Janssen *et al.* also used estimated activity coefficients to calculate the value of the equilibrium constant given here. The isomeric forms of the diester were not distinguished in the calculation of this equilibrium constant.

n -octanoic acid glycerol diester(sln) + H₂O(sln) = n -octanoic acid(sln) + n -octanoic acid glycerol monoester(sln)

$\frac{T}{K}$	K
308.15	0.91

Reference: 93JAN/PAD
Method: HPLC
Evaluation: B

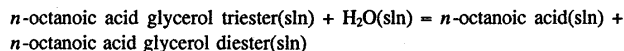
Janssen *et al.* measured the equilibrium mole fractions of the reactants and products (including dissolved water) in the organic phase in which this reaction occurred. Janssen *et al.* also used estimated activity coefficients to calculate the value of the equilibrium constant given here. The isomeric forms of the monoester and diester were not distinguished in the calculation of this equilibrium constant.

n -octanoic acid glycerol monoester(sln) + H₂O(sln) = n -octanoic acid(sln) + glycerol(sln)

$\frac{T}{K}$	K
308.15	0.71

Reference: 93JAN/PAD
Method: HPLC
Evaluation: B

Janssen *et al.* measured the equilibrium mole fractions of the reactants and products (including dissolved water) in the organic phase in which this reaction occurred. Janssen *et al.* also used estimated activity coefficients to calculate the value of the equilibrium constant given here. The isomeric forms of the monoester were not distinguished in the calculation of this equilibrium constant.



$\frac{T}{K}$	K
308.15	1.7

Reference: 93JAN/PAD

Method: HPLC

Evaluation: B

Janssen *et al.* measured the equilibrium mole fractions of the reactants and products (including dissolved water) in the organic phase in which this reaction occurred. Janssen *et al.* also used estimated activity coefficients to calculate the value of the equilibrium constant given here. The isomeric forms of the diester were not distinguished in the calculation of this equilibrium constant.



$\frac{T}{K}$	K'
333.15	0.020

Reference: 92LOR/TRA

Method: HPLC

Evaluation: B

The isomeric forms of the monoester and diester were not distinguished in the calculation of this apparent equilibrium constant. The pH was not reported.



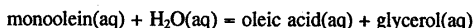
$\frac{T}{K}$	K
308.15	1.3

Reference: 93JAN/PAD

Method: HPLC

Evaluation: B

Janssen *et al.* measured the equilibrium mole fractions of the reactants and products (including dissolved water) in the organic phase in which this reaction occurred. Janssen *et al.* also used estimated activity coefficients to calculate the value of the equilibrium constant given here. The isomeric forms of the monoester and diester were not distinguished in the calculation of this equilibrium constant.



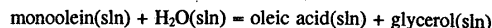
$\frac{T}{K}$	K'
333.15	0.48

Reference: 92LOR/TRA

Method: HPLC

Evaluation: B

The isomeric forms of the monoester were not distinguished in the calculation of this apparent equilibrium constant. The pH was not reported.



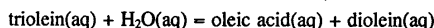
$\frac{T}{K}$	K
308.15	0.91

Reference: 93JAN/PAD

Method: HPLC

Evaluation: B

Janssen *et al.* measured the equilibrium mole fractions of the reactants and products (including dissolved water) in the organic phase in which this reaction occurred. Janssen *et al.* also used estimated activity coefficients to calculate the value of the equilibrium constant given here. The isomeric forms of the monoester were not distinguished in the calculation of this equilibrium constant.



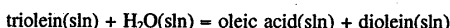
$\frac{T}{K}$	K'
333.15	0.083

Reference: 92LOR/TRA

Method: HPLC

Evaluation: B

The isomeric forms of the diester were not distinguished in the calculation of this apparent equilibrium constant. The pH was not reported.



$\frac{T}{K}$	K
308.15	1.7

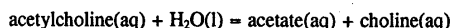
Reference: 93JAN/PAD

Method: HPLC

Evaluation: B

Janssen *et al.* measured the equilibrium mole fractions of the reactants and products (including dissolved water) in the organic phase in which this reaction occurred. Janssen *et al.* also used estimated activity coefficients to calculate the value of the equilibrium constant given here. The isomeric forms of the diester were not distinguished in the calculation of this equilibrium constant.

5.2. Enzyme: acetylcholinesterase (EC 3.1.1.7)



$\frac{T}{K}$	pH	K'
296.15	5.1	538

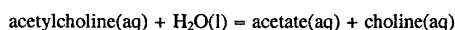
Reference: 49HES

Method: spectrophotometry

pH: 5.1

Evaluation: C

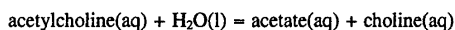
The apparent equilibrium constant given here was calculated from the results given in Hestrin's Table I.



$\frac{T}{K}$	pH	K_c'
296.15	5.1	510
296.15	5.9	2175

Reference: 50HES
Method: spectrophotometry
Buffer: phosphate
pH: 5.1-5.9
Evaluation: B

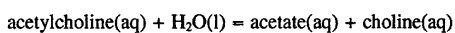
The apparent equilibrium constants given here were calculated from the results given on page 314 in Hestrin's paper.



$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	7.1	-3.57

Reference: 72STU
Method: calorimetry
Buffer: phosphate
pH: 7.1
Evaluation: A

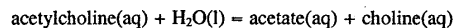
Sturtevant applied buffer protonation and ionization corrections to obtain $\Delta_r H^\circ(T = 298.15 \text{ K}) = 1.17 \text{ kJ mol}^{-1}$ for the chemical reference reaction: $\text{acetylcholine}^+(\text{aq}) + \text{H}_2\text{O(l)} = \text{acetate}^-(\text{aq}) + \text{choline}^+(\text{aq}) + \text{H}^+(\text{aq})$.



$\frac{T}{K}$	pH	buffer	$\frac{\Delta_r H^\circ(\text{cal})}{\text{kJ mol}^{-1}}$
310.15	7.2	phosphate	-4.4
310.15	?	none	-3.90

Reference: 85DAS/BRO
Method: calorimetry
Buffer: phosphate (0.1 mol dm⁻³)
pH: 7.2
Evaluation: C

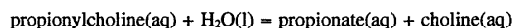
The first result given here is the average of six measurements (see Das *et al.*'s Table 2) carried out with phosphate buffer. Das *et al.* also gave a result for the reaction in Tris buffer after correction for the enthalpy of buffer protonation. However, they did not state how this correction was made.



$\frac{T}{K}$	pH	media	$\frac{\Delta_r H^\circ(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	7.0	sodium phosphate buffer	-2.76
298.15	7.0	acetylcholine receptor membrane vesicles	-1.63

Reference: 92WAN/CHE
Method: calorimetry
Buffer: sodium phosphate (0.05 mol dm⁻³)
pH: 7.0
Cofactor(s): CaCl₂ (0.003 mol dm⁻³) + MgCl₂ (0.002 mol dm⁻³)
Evaluation: A

Wang and Chen applied a buffer protonation correction to obtain $\Delta_r H'^\circ(T = 298.15 \text{ K}, \text{pH} = 7.0) = -0.54 \text{ kJ mol}^{-1}$. They also found that there was essentially no effect on $\Delta_r H'^\circ$ for $c(\text{ethanol}) \leq 0.30 \text{ mol dm}^{-3}$.

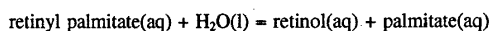


$\frac{T}{K}$	pH	K_c'
291.15	5.0	4.8E2
291.15	5.8	1.73E3

Reference: 50HES
Method: spectrophotometry
Buffer: phosphate
pH: 5.0-5.8
Evaluation: B

The apparent equilibrium constants given here were calculated from the results given on page 315 in Hestrin's paper.

5.3. Enzyme: retinyl-palmitate esterase (EC 3.1.1.21)

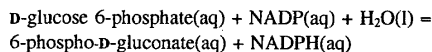


$\frac{T}{K}$	pH	K_c'
310.15	7.5	2.8E-3

Reference: 90OCO/BUT
Method: spectrophotometry
Buffer: Tris (0.1 mol dm⁻³)
pH: 7.5
Evaluation: C

This approximate result was calculated from kinetic data.

5.4. Enzyme: 6-phosphogluconolactonase (EC 3.1.1.31)



$\frac{T}{\text{K}}$	pH	K'
311.15	6.03	1.5E3
311.15	6.47	8.9E3
311.15	7.03	8.3E4

Reference: 86CAS/VEE

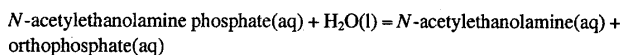
Method: enzymatic assay and spectrophotometry

pH: 6.03–7.03

Evaluation: B

Glucose-6-phosphate dehydrogenase (EC 1.1.1.49) was also present. The apparent equilibrium constants given here were calculated from the results given in Table VII in the mini-print section of Casazza and Veech's paper. The reaction mixture may not have reached equilibrium.

5.5. Enzyme: alkaline phosphatase (EC 3.1.3.1)



$\frac{T}{\text{K}}$	pH	K_c'
298.15	8.0	≈ 31

Reference: 63DAY/WIL

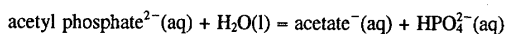
Method: spectrophotometry

Buffer: KH_2PO_4 (0.047 mol dm⁻³) + NaOH

pH: 8.0

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Dayan and Wilson's Table II.



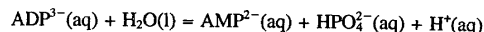
$\frac{T}{\text{K}}$	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	-26.8

Reference: 70GEO/WIT

Method: calorimetry

Evaluation: C

George *et al.* reported $\Delta_r H^\circ(I_c \leq 0.01 \text{ mol dm}^{-3}) = -26.8 \text{ kJ mol}^{-1}$ for this chemical reference reaction. They did not report the calorimetrically determined enthalpy of reaction or the conditions of measurement. Also see data given under acid phosphatase (EC 3.1.3.2).



$\frac{T}{\text{K}}$	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	-24.3

Reference: 69GEO/TRA

Method: calorimetry

pH: 8–9

Evaluation: C

George *et al.* reported $\Delta_r H^\circ(I_c \leq 0.01 \text{ mol dm}^{-3}) = -24.3 \text{ kJ mol}^{-1}$ for this chemical reference reaction. They did not report the calorimetrically determined enthalpy of reaction or the conditions of measurement.



$\frac{T}{\text{K}}$	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	0.4

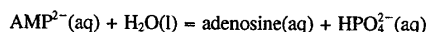
Reference: 69GEO/TRA

Method: calorimetry

pH: 8–9

Evaluation: C¹

George *et al.* reported $\Delta_r H^\circ(I_c \leq 0.01 \text{ mol dm}^{-3}) = 0.4 \text{ kJ mol}^{-1}$ for this chemical reference reaction. They did not report the calorimetrically determined enthalpy of reaction or the conditions of measurement.



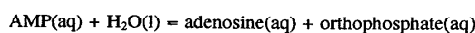
$\frac{T}{\text{K}}$	$\frac{I_c}{\text{mol dm}^{-3}}$	K_c
298.15	0	48

Reference: 70GEO/WIT

Method: chromatography and enzymatic assay

Evaluation: C

George *et al.* reported $\Delta_r G^\circ(T = 298.15 \text{ K}, I_c = 0) = -9.6 \text{ kJ mol}^{-1}$ for this chemical reference reaction. This corresponds to $K_c(T = 298.15 \text{ K}, I = 0) = 48$. They stated that this result was based upon an equilibrium measurement but gave few details.



$\frac{T}{\text{K}}$	pH	pMg	$\frac{I_m}{\text{mol kg}^{-1}}$	K_m'
298.15	8.86	4.50	1.40	189

Reference: 93LAR/TEW

Method: HPLC

Buffer: phosphate

pH: 8.86

Cofactor(s): MgCl_2

Evaluation: A

Larson *et al.* calculated $K_m(T = 298.15 \text{ K}, I = 0) = (189 \pm 25)$ for the chemical reference reaction: $\text{AMP}^{2-}(\text{aq}) + \text{H}_2\text{O(l)} = \text{adenosine(aq)} + \text{HPO}_4^{2-}(\text{aq})$. Also see data given under 5'-nucleosidase (EC 3.1.3.5).

AMP(aq) + H₂O(l) = adenosine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{m(\text{MgCl}_2)}{\text{mol kg}^{-1}}$	$\frac{I_m}{\text{mol kg}^{-1}}$	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	8.02	0.0010	0.078	2.44
298.15	8.42	0.0010	0.052	1.76
298.15	8.85	0.0010	0.052	0.55
304.55	7.78	0.0010	0.086	2.53
310.15	7.62	0.0010	0.083	3.50

Reference: 93LAR/TEW

Method: calorimetry

Buffer: Tris + HCl

pH: 7.62–8.85

Cofactor(s): MgCl₂

Evaluation: A

The pMg was in the range 3.34 to 3.41. Larson *et al.* calculated $\Delta_r H^\circ(T = 298.15 \text{ K}, I = 0) = (0.9 \pm 0.4) \text{ kJ mol}^{-1}$ for the chemical reference reaction: AMP²⁻(aq) + H₂O(l) = adenosine(aq) + HPO₄²⁻.

ethylene glycol phosphate(aq) + H₂O(l) = ethylene glycol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	K_c'
308.15	7.0	0	60
308.15	7.0	0.10	59

Reference: 89ROM/DEM

Method: chromatography and radioactivity

Buffer: Mops (0.10 mol dm⁻³) + KOH

pH: 7.0

Cofactor(s): MgCl₂

Evaluation: B

The apparent equilibrium constants given here were calculated from the standard transformed Gibbs energies of reaction given in Romero and de Meis' Table II.

D-fructose 1,6-biphosphate(aq) + H₂O(l) = D-fructose 1-phosphate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	K_c'
311.15	8.5	14

Reference: 49MEY/GRE

Method: chemical analysis

pH: 8.5

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table II. Also see data given under acid phosphatase (EC 3.1.3.2).

D-fructose 1,6-biphosphate(aq) + H₂O(l) = D-fructose 6-phosphate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	K_c'
311.15	8.5	6.3

Reference: 49MEY/GRE

Method: chemical analysis

pH: 8.5

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table II. Also see data given under acid phosphatase (EC 3.1.3.2) and under fructose biphosphatase (EC 3.1.3.11).

D-fructose 1-phosphate(aq) + H₂O(l) = D-fructose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	K_c'
311.15	8.5	53

Reference: 49MEY/GRE

Method: chemical analysis

pH: 8.5

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table II. Also see data given under acid phosphatase (EC 3.1.3.2).

D-fructose 6-phosphate(aq) + H₂O(l) = D-fructose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	K_c'
311.15	8.5	124

Reference: 49MEY/GRE

Method: chemical analysis

pH: 8.5

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table II. Also see data given under acid phosphatase (EC 3.1.3.2).

D-fructose 6-phosphate(aq) + H₂O(l) = D-fructose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{I_c}{\text{mol dm}^{-3}}$	K_c'
298.15	8.4	0.29	262

Reference: 88TEW/STE

Method: enzymatic assay and chromatography

Buffer: Tris (0.1 mol dm⁻³) + HCl

pH: 8.4

Cofactor(s): MgCl₂ (0.0011 mol dm⁻³)

Evaluation: A

Tewari *et al.* applied ionization corrections to obtain $K'_c(T = 298.15 \text{ K}, I = 0) = 251$ for the chemical reference reaction: D-fructose 6-phosphate²⁻(aq) + H₂O(l) = D-fructose(aq) + HPO₄²⁻(aq).

D-fructose 6-phosphate(aq) + H₂O(l) = D-fructose(aq) + orthophosphate(aq)

$\frac{T}{\text{K}}$	pH	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	$\frac{c(\text{Tris})}{\text{mol dm}^{-3}}$	$\Delta_r H^\circ(\text{cal})$ kJ mol ⁻¹
311.15	7.87	0.0061	0.10	-5.52
311.15	8.42	0.0061	0.10	-6.70
311.15	8.54	0.0061	0.10	-6.90
311.15	8.62	0.0061	0.10	-6.82
311.15	8.99	0.0061	0.10	-6.95
311.15	8.8	0.00054	0.10	-8.08
311.15	8.8	0.0011	0.10	-7.99
311.15	8.8	0.0032	0.10	-7.07
311.15	8.8	0.0056	0.10	-7.29
311.15	8.8	0.00078	0.30	-8.52
311.15	8.8	0.00078	0.64	-9.25
298.15	8.85	0.00054	0.10	-7.43
304.80	8.85	0.00054	0.10	-7.58

Reference: 88TEW/STE

Method: calorimetry

Buffer: Tris

pH: 7.87–8.99

Cofactor(s): MgCl₂

Evaluation: A

Tewari *et al.* applied buffer protonation and ionization corrections to obtain $\Delta_r H^\circ = -7.61 \text{ kJ mol}^{-1}$ and $\Delta_r C_p^\circ = -28 \text{ J K}^{-1} \text{ mol}^{-1}$ for the chemical reference reaction: D-fructose 6-phosphate²⁻(aq) + H₂O(l) = D-fructose(aq) + HPO₄²⁻(aq).

D-galactose 6-phosphate(aq) + H₂O(l) = D-galactose(aq) + orthophosphate(aq)

$\frac{T}{\text{K}}$	pH	K'_c
311.15	8.5	87

Reference: 49MEY/GRE

Method: chemical analysis

pH: 8.5

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table VI.

GDP(aq) + 2 H₂O(l) = guanosine(aq) + 2 orthophosphate(aq)

$\frac{T}{\text{K}}$	pH	buffer	$\frac{c(\text{KCl})}{\text{mol dm}^{-3}}$	$\Delta_r H^\circ(\text{cal})$ kJ mol ⁻¹
298.15	8.0	Hepes	0.60	-43.6
298.15	9.0	Hepes	0.60	-42.8
298.15	9.0	Tris	0.60	-69.2

Reference: 81HIN/POL

Method: calorimetry

Buffer: Tris and Hepes

pH: 8.0–9.0

Evaluation: A

Hinz *et al.* gave results that lead to $\Delta_r H^\circ(T = 298.15 \text{ K}, I_c = 0.6 \text{ mol dm}^{-3}) = -21.5 \text{ kJ mol}^{-1}$ for the chemical reference reaction: GDP³⁻(aq) + 2 H₂O(l) = guanosine(aq) + 2 HPO₄²⁻(aq) + H⁺(aq).

D-glucose 6-phosphate(aq) + H₂O(l) = D-glucose(aq) + orthophosphate(aq)

$\frac{T}{\text{K}}$	pH	K'_c
311.15	8.5	62

Reference: 49MEY/GRE

Method: chemical analysis

pH: 8.5

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table V.

D-glucose 6-phosphate(aq) + H₂O(l) = D-glucose(aq) + orthophosphate(aq)

$\frac{T}{\text{K}}$	pH	K'_c
310.15	8.2	55

Reference: 54GIN

Method: radioactivity

pH: 8.2

Evaluation: B

The value of K'_c given here was calculated from the average of values of $K'_c \cdot c(\text{H}_2\text{O})$ reported by Ginodman in his Table 6.

D-glucose 6-phosphate(aq) + H₂O(l) = D-glucose(aq) + orthophosphate(aq)

$\frac{T}{\text{K}}$	pH	K'_c
298.15	7.0	263

Reference: 61ATK/JOH

Method: enzymatic assay and spectrophotometry

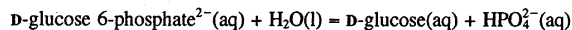
Buffer: NaOH + HCl

pH: 7.0

Cofactor(s): MgCl₂ (0–0.005 mol dm⁻³)

Evaluation: A

The apparent equilibrium constant given here is the average of the five experimental results reported by Atkinson *et al.* These results are also given in an earlier paper by Atkinson *et al.* [59ATK/JOH].



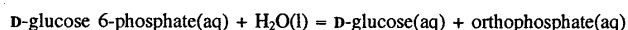
$\frac{T}{\text{K}}$	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	-2.5

Reference: 70GEO/WIT

Method: calorimetry

Evaluation: C

George *et al.* reported $\Delta_r H^\circ(I_c \leq 0.01 \text{ mol dm}^{-3}) = -2.5 \text{ kJ mol}^{-1}$ for this chemical reference reaction. They did not report the calorimetric enthalpy of reaction or the conditions of measurement.



$\frac{T}{\text{K}}$	pH	pMg	$\frac{I_c}{\text{mol dm}^{-3}}$	K'_c
310.15	6.99	3.0	0.25	110

Reference: 76LAW/GUY

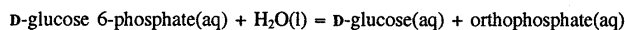
Method: enzymatic assay; spectrophotometry

Buffer: phosphate (0.098 mol dm⁻³)

pH: 6.99

Cofactor(s): MgCl₂ (0.00604 mol dm⁻³)

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{c(\text{ZnCl}_2)}{\text{mol dm}^{-3}}$	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	$\frac{I_c}{\text{mol dm}^{-3}}$	K'_c
310.15	6.99	2.5E-5	0	0.25	109
310.15	6.99	0	0.00604	0.25	110

Reference: 79LAW/VEE

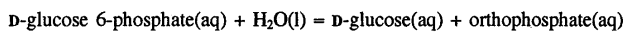
Method: enzymatic assay; spectrophotometry

Buffer: phosphate (0.098 mol dm⁻³)

pH: 6.99

Cofactor(s): MgCl₂ and ZnCl₂

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	$\frac{c(\text{Tris})}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
311.15	7.87	0.0063	0.10	2.46
311.15	8.53	0.0063	0.10	1.17
311.15	8.58	0.0063	0.10	1.09
311.15	8.68	0.0063	0.10	1.37
311.15	9.15	0.0063	0.10	0.95
311.15	8.8	0.00054	0.10	0.47
311.15	8.8	0.00108	0.10	0.42
311.15	8.8	0.0032	0.10	0.80
311.15	8.8	0.0063	0.10	1.17
311.15	8.83	0.00066	0.30	0.18
311.15	8.83	0.00066	0.64	-0.44
298.15	8.9	0.00054	0.10	0.99
298.15	8.9	0.0010	0.10	0.94
304.80	8.9	0.00054	0.10	0.76

Reference: 88TEW/STE

Method: calorimetry

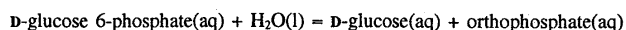
Buffer: Tris + (HCl or HNO₃)

pH: 7.87-9.15

Cofactor(s): MgCl₂

Evaluation: A

Tewari *et al.* applied buffer protonation and ionization corrections to obtain $\Delta_r H^\circ = 0.91 \text{ kJ mol}^{-1}$ and $\Delta_r C_p^\circ = -48 \text{ J K}^{-1} \text{ mol}^{-1}$ for the chemical reference reaction: $\text{D-glucose 6-phosphate}^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l}) = \text{D-glucose}(\text{aq}) + \text{HPO}_4^{2-}(\text{aq})$.



$\frac{T}{\text{K}}$	pH	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	K'_c
308.15	7.0	0	55
308.15	7.0	0.100	56

Reference: 89ROM/DEM

Method: chromatography and radioactivity

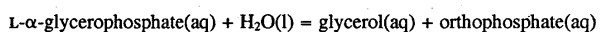
Buffer: Mops (0.10 mol dm⁻³) + KOH

pH: 7.0

Cofactor(s): MgCl₂

Evaluation: B

The apparent equilibrium constants given here were calculated from the standard transformed Gibbs energies of reaction given in Romero and de Meis' Table II.



$\frac{T}{\text{K}}$	pH	K'_c
311.15	8.5	≈ 16

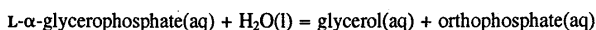
Reference: 49MEY/GRE

Method: chemical analysis

pH: 8.5

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table VII. Also see data given under acid phosphatase (EC 3.1.3.2).



$\frac{T}{\text{K}}$	pH	K'_c
310.15	6.7	40
310.15	7.5	55
310.15	7.8	46
310.15	8.3	24
310.15	8.8	36

Reference: 54GIN

Method: radioactivity

Buffer: acetate-barbital

pH: 6.7-8.8

Evaluation: B

The values of K'_c given here were calculated from the values of $K'_c/c(\text{H}_2\text{O})$ reported by Ginodman.

L- α -glycerophosphate(aq) + H₂O(l) = glycerol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	added solute	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	K_c'
308.15	7.0	none	0	68
308.15	7.0	none	0.100	73
308.15	8.0	none	0.0009	26
308.15	8.0	dimethyl sulfoxide (50% v/v)	0.0009	22
308.15	8.0	poly(ethylene glycol) (50% w/v)	0.0009	9

Reference: 89ROM/DEM

Method: chromatography and radioactivity

Buffer: Mops (0.10 mol dm⁻³) + KOH

pH: 7.0

Cofactor(s): MgCl₂

Evaluation: B

The first two apparent equilibrium constants given here were calculated from the standard transformed Gibbs energies of reaction given in Romero and de Meis' Table II.

GMP(aq) + H₂O(l) = guanosine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	buffer	$\frac{c(\text{KCl})}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H^\circ(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	9.0	Tris	0.60	2.6
298.15	9.0	Hepes	0.60	2.7

Reference: 81HIN/POL

Method: calorimetry

Buffer: Tris and Hepes

pH: 9.0

Evaluation: A

Hinz *et al.* gave results that lead to $\Delta_r H^\circ(T = 298.15 \text{ K}, I_c = 0.6 \text{ mol dm}^{-3}) = 2.7 \text{ kJ mol}^{-1}$ for the chemical reference reaction: $\text{GMP}^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l}) = \text{guanosine}(\text{aq}) + \text{HPO}_4^{2-}(\text{aq})$.

GTP(aq) + 3 H₂O(l) = guanosine(aq) + 3 orthophosphate(aq)

$\frac{T}{K}$	pH	buffer	$\frac{c(\text{KCl})}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H^\circ(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	8.0	Hepes	0.60	-90.0
298.15	9.0	Hepes	0.60	-88.7
298.15	9.0	Tris	0.60	-141.8
308.15	9.0	Tris	0.60	-141.6

Reference: 81HIN/POL

Method: calorimetry

Buffer: Tris and Hepes

pH: 8.0-9.0

Evaluation: A

Hinz *et al.* gave results that lead to $\Delta_r H^\circ(T = 298.15 \text{ K}, I_c = 0.6 \text{ mol dm}^{-3}) = -46 \text{ kJ mol}^{-1}$ for the chemical reference reaction: $\text{GTP}^{4-}(\text{aq}) + 3 \text{H}_2\text{O}(\text{l}) = \text{guanosine}(\text{aq}) + 3 \text{HPO}_4^{2-}(\text{aq}) + 2 \text{H}^+(\text{aq})$.

3-hydroxypropyl phosphate(aq) + H₂O(l) = 1,3-propanediol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^\circ}{\text{kJ mol}^{-1}}$
298.15	7.3	1.5

Reference: 75GER/WES

Method: calorimetry

Buffer: Pipes (0.05 mol dm⁻³)

pH: 7.3

Evaluation: A

Gerlt *et al.* applied corrections for protonation of the buffer to obtain the value of $\Delta_r H'^\circ$ given here.

IMP(aq) + H₂O(l) = inosine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	pMg	$\frac{I_m}{\text{mol kg}^{-1}}$	K_m'
298.15	8.55	4.44	1.53	158

Reference: 93LAR/TEW

Method: HPLC

Buffer: phosphate

pH: 8.55

Cofactor(s): MgCl₂

Evaluation: A

Larson *et al.* calculated $K_m(T = 298.15 \text{ K}, I = 0) = (158 \pm 7)$ for the chemical reference reaction: $\text{IMP}^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l}) = \text{inosine}(\text{aq}) + \text{HPO}_4^{2-}(\text{aq})$.

IMP(aq) + H₂O(l) = inosine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{m(\text{MgCl}_2)}{\text{mol kg}^{-3}}$	$\frac{I_m}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H^\circ(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	8.15	0.0010	0.083	1.54
298.15	8.55	0.0010	0.063	-0.62
298.15	9.14	0.0010	0.045	-1.89
304.55	7.92	0.0010	0.087	-1.83
310.15	7.81	0.0010	0.087	2.30

Reference: 93LAR/TEW

Method: calorimetry

Buffer: Tris + HCl

pH: 7.81-9.14

Cofactor(s): MgCl₂

Evaluation: A

The pMg was in the range 3.32 to 3.42. Larson *et al.* calculated $\Delta_r H^\circ(T = 298.15 \text{ K}, I = 0) = (1.7 \pm 0.2) \text{ kJ mol}^{-1}$ for the chemical reference reaction: $\text{IMP}^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l}) = \text{inosine}(\text{aq}) + \text{HPO}_4^{2-}(\text{aq})$.

D-mannose 6-phosphate(aq) + H₂O(l) = D-mannose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	K'
311.15	8.5	39

Reference: 49MEY/GRE
Method: chemical analysis
pH: 8.5
Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table VI.

D-mannose 6-phosphate(aq) + H₂O(l) = D-mannose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	8.6	1.78
304.65	8.6	1.48
310.15	8.6	1.22

Reference: 88TEW/STE
Method: calorimetry
Buffer: Tris
pH: 8.6
Cofactor(s): MgCl₂ (0.00010 mol dm⁻³)
Evaluation: A

Tewari *et al.* applied buffer protonation and ionization corrections to obtain $\Delta_r H^\circ = 1.40 \text{ kJ mol}^{-1}$ and $\Delta_r C_p^\circ = -46 \text{ J K}^{-1} \text{ mol}^{-1}$ for the chemical reference reaction: D-mannose 6-phosphate²⁻(aq) + H₂O(l) = D-mannose(aq) + HPO₄²⁻(aq).

methyl α -D-glucopyranoside 6-phosphate(aq) + H₂O(l) =
methyl α -D-glucopyranose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	7.3	0.0

Reference: 75GER/WES
Method: calorimetry
Buffer: Pipes (0.05 mol dm⁻³)
pH: 7.3
Evaluation: A

Gerlt *et al.* applied a correction for protonation of the buffer to obtain the value of $\Delta_r H^\circ$ given here.

methyl β -D-ribofuranoside 5-phosphate(aq) + H₂O(l) =
methyl β -D-ribofuranose + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	7.3	-1.3

Reference: 75GER/WES
Method: calorimetry
Buffer: Pipes (0.05 mol dm⁻³)
pH: 7.3
Evaluation: A

Gerlt *et al.* applied corrections for protonation of the buffer to obtain the value of $\Delta_r H^\circ$ given here.

monoethyl phosphate(aq) + H₂O(l) = ethanol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	7.3	-0.4

Reference: 75GER/WES
Method: calorimetry
Buffer: Pipes (0.05 mol dm⁻³)
pH: 7.3
Evaluation: A

Gerlt *et al.* applied a correction for protonation of the buffer to obtain the value of $\Delta_r H^\circ$ given here.

1-naphthyl phosphate(aq) + H₂O(l) = 1-naphthol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	10.4	-6.53

Reference: 87ANT
Method: calorimetry
Buffer: carbonate + hydrogen carbonate
pH: 10.4
Evaluation: A

4-nitrophenyl phosphate(aq) + H₂O(l) = 4-nitrophenol(aq) +
orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
302.15	9.6	-19.0

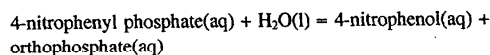
Reference: 52OHL/SHA
Method: calorimetry
Buffer: barbital + acetate (0.02 mol dm⁻³)
pH: 9.6
Evaluation: B

Also see data given under acid phosphatase (EC 3.1.3.2).

4-nitrophenyl phosphate(aq) + H₂O(l) = 4-nitrophenol(aq) +
orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	10.4	-11.9

Reference: 87ANT
Method: calorimetry
Buffer: carbonate + hydrogen carbonate
pH: 10.4
Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	8.50	-43.2

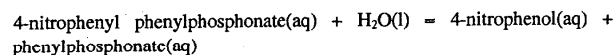
Reference: 92REK/TIS

Method: calorimetry

Buffer: Tris (0.05 mol dm⁻³) + HCl

pH: 8.50

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
303.15	8.0	-72.2

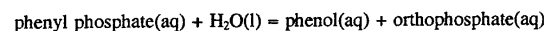
Reference: 79LAB/DEB

Method: calorimetry

Buffer: Tris + HCl

pH: 8.0

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	10.4	-7.45

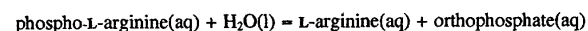
Reference: 87ANT

Method: calorimetry

Buffer: carbonate + hydrogen carbonate

pH: 10.4

Evaluation: A



$\frac{T}{\text{K}}$	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
293.15	-31.0

Reference: 35MEY/SCH

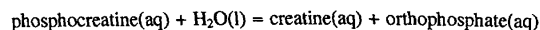
Method: calorimetry

Buffer: phosphate

Cofactor(s): MgCl₂

Evaluation: C

It was assumed that the L forms of phospho-L-arginine and of L-arginine were used. $\Delta_r H(\text{cal}) = -33.5 \text{ kJ mol}^{-1}$ was obtained for the acid catalyzed hydrolysis reaction. The pH was not reported.



$\frac{T}{\text{K}}$	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
293.15	-44.8

Reference: 35MEY/SCH

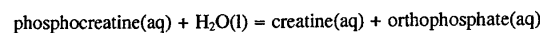
Method: calorimetry

Buffer: phosphate

Cofactor(s): MgCl₂

Evaluation: C

The pH was not reported.



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	9.0	-35.6

Reference: 65PIN

Method: calorimetry

Buffer: Tris (0.1 mol dm⁻³)

pH: 9.0

Cofactor(s): MgSO₄ (0.001 mol dm⁻³)

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	6.10	-20.0
298.15	7.10	-28.0
298.15	7.78	-34.0
298.15	8.33	-37.5
298.15	8.73	-40.0

Reference: 72WOL

Method: calorimetry

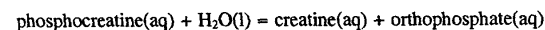
Buffer: histidine + ammonia

pH: 6.1-8.73

Cofactor(s): MgCl₂

Evaluation: C

The calorimetrically determined enthalpies of reaction given here were taken from Woledge's Fig. 2.



$\frac{T}{\text{K}}$	pH	buffer	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
273.15	8.0	carosine	43
298.15	8.0	carosine	42
310.15	8.0	Tris	44

Reference: 87WOL/REI

Method: calorimetry

Buffer: Tris (0.025 mol dm⁻³) or carosine (0.010 mol dm⁻³)

pH: 8.0

Evaluation: B

This reaction was also studied non-enzymatically using acid hydrolysis.

3-phospho-D-glycerate(aq) + H₂O(l) = (R)-glycerate(aq) + orthophosphate(aq)

$\frac{T}{K}$	$\frac{\Delta_r H^\circ(\text{cal})}{\text{kJ mol}^{-1}}$
293.15	-34.5

Reference: 35MEY/SCH

Method: calorimetry

Buffer: phosphate

Cofactor(s): MgCl₂

Evaluation: C

The pH was not reported.

3-phospho-D-glycerate(aq) + H₂O(l) = (R)-glycerate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$c(\text{MgCl}_2)$ mol dm ⁻³	I_c mol dm ⁻³	K_c
311.15	7.00	0.0010	0.25	294
311.15	7.00	0.00099	0.25	336
311.15	7.00	0.0048	0.25	269
311.15	7.00	0.0091	0.25	303
311.15	7.00	0.0001	0.25	332
311.15	7.00	0.00099	0.25	319
311.15	7.00	0.0048	0.25	310
311.15	7.00	0.0091	0.25	294
311.15	6.95	0	0.25	288
311.15	6.86	0	0.25	341
311.15	6.95	0.0010	0.25	338
311.15	6.92	0.0040	0.25	301
311.15	6.89	0.0070	0.25	260
311.15	6.87	0.0100	0.25	247
311.15	6.96	0.0010	0.25	384
311.15	6.93	0.0040	0.25	297
311.15	6.90	0.0070	0.25	255
311.15	6.88	0.0100	0.25	270
311.15	6.73	0.0010	0.25	307
311.15	6.72	0.0010	0.25	306
311.15	6.91	0	0.25	298
311.15	6.92	0	0.25	290

Reference: 82GUY

Method: spectrophotometry

Buffer: potassium phosphate (0.025 mol dm⁻³)

pH: 6.72-7.00

Cofactor(s): MgCl₂

Evaluation: A

Guynn calculated $K_c(T = 311.15 \text{ K}, I_c = 0.25 \text{ mol dm}^{-3}) = 364$ for the chemical reference reaction: 3-phospho-D-glycerate³⁻(aq) + H₂O(l) = (R)-glycerate⁻(aq) + HPO₄²⁻(aq).

phosphoguanidinoacetate(aq) + H₂O(l) = guanidinoacetate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	9.0	-30.1

Reference: 65PIN

Method: calorimetry

Buffer: Tris (0.1 mol dm⁻³)

pH: 9.0

Cofactor(s): MgSO₄ (0.001 mol dm⁻³)

Evaluation: A

phosphoenolpyruvate(aq) + H₂O(l) = pyruvate⁻(aq) + orthophosphate(aq)

$\frac{T}{K}$	$\frac{\Delta_r H^\circ(\text{cal})}{\text{kJ mol}^{-1}}$
293.15	-35.4

Reference: 35MEY/SCH

Method: calorimetry

Buffer: phosphate

Cofactor(s): MgCl₂

Evaluation: C

The pH was not reported.

phosphoenolpyruvate³⁻(aq) + H₂O(l) = pyruvate⁻(aq) + HPO₄²⁻(aq)

$\frac{T}{K}$	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	-25.1

Reference: 70GEO/WIT

Method: calorimetry

Evaluation: C

George *et al.* reported $\Delta_r H^\circ(I_c \leq 0.01 \text{ mol dm}^{-3}) = -25.1 \text{ kJ mol}^{-1}$ for this chemical reference reaction. They did not report the calorimetric enthalpy of reaction or the conditions of measurement.

phosphorylcholine(aq) + H₂O(l) = choline(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	$\frac{I_c}{\text{mol dm}^{-3}}$	K_c'
311.15	6.90	0.0014	0.25	49.6
311.15	6.90	0.0005	0.25	49.0
311.15	6.90	0.0050	0.25	34.4
311.15	6.95	0.0005	0.25	34.6
311.15	6.94	0.0019	0.25	39.0
311.15	6.92	0.0047	0.25	36.8
311.15	6.90	0.0082	0.25	37.3
311.15	6.88	0.0114	0.25	38.9
311.15	6.86	0.0141	0.25	39.3
311.15	6.90	0.0065	0.25	51.4
311.15	6.90	0.0029	0.25	49.9
311.15	6.88	0.0050	0.25	44.5
311.15	6.88	0.0050	0.25	43.1
311.15	7.15	0.0050	0.25	35.9
311.15	7.15	0.0050	0.25	36.9
311.15	7.32	0.0050	0.25	33.5
311.15	7.32	0.0050	0.25	34.4
311.15	6.95	0.0005	0.25	39.9
311.15	6.95	0.0005	0.25	40.1
311.15	6.95	0.0005	0.25	39.4
311.15	7.09	0.0005	0.25	30.4
311.15	7.09	0.0005	0.25	28.2
311.15	7.23	0.0005	0.25	31.3
311.15	7.23	0.0005	0.25	34.1
311.15	7.99	0.0005	0.25	21.6
311.15	7.99	0.0005	0.25	28.9
311.15	7.08	0.0005	0.25	32.4
311.15	7.08	0.0005	0.25	31.6
311.15	7.22	0.0005	0.25	26.7
311.15	7.92	0.0005	0.25	24.1
311.15	7.92	0.0005	0.25	25.5
311.15	6.90	0.0017	0.25	44.6
311.15	6.90	0.0120	0.25	38.3
311.15	6.90	0.0005	0.25	46.9
311.15	6.90	0.0050	0.25	34.4
311.15	6.91	0.0005	0.25	29.9
311.15	6.89	0.0050	0.25	39.9
311.15	6.87	0.0087	0.25	35.7
311.15	6.95	0.0121	0.25	37.4
311.15	6.85	0.0150	0.25	40.0
311.15	6.90	0.0056	0.25	43.3
311.15	6.90	0.0026	0.25	45.0
311.15	6.88	0.0050	0.25	44.7
311.15	6.88	0.0050	0.25	41.3
311.15	7.16	0.0050	0.25	34.0
311.15	7.35	0.0050	0.25	33.6
311.15	7.35	0.0050	0.25	36.8
311.15	6.94	0.0005	0.25	36.1
311.15	6.94	0.0005	0.25	36.5
311.15	6.94	0.0005	0.25	37.6

Reference: 76GUY

Method: spectrophotometry

Buffer: Tris + HCl

pH: 6.90–7.35

Cofactor(s): Mg²⁺

Evaluation: A

Guyon calculated $K_c(T = 311.15 \text{ K}, I_c = 0.25 \text{ mol dm}^{-3}) = 16.4$ for the chemical reference reaction: phosphorylcholine⁻(aq) + H₂O(l) = choline⁺(aq) + HPO₄²⁻(aq).

L-O-phosphoserine(aq) + H₂O(l) = L-serine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	buffer	added solute	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	K'_c
308.15	5.0	succinic acid (0.050 mol dm ⁻³) + NaOH	none	0	3.20E2
308.15	5.0	succinic acid (0.050 mol dm ⁻³) + NaOH	none	0.010	2.14E2
308.15	6.0	Mes (0.05 mol dm ⁻³) + KOH	none	0	1.56E2
308.15	6.0	Mes (0.05 mol dm ⁻³) + KOH	none	0.010	1.00E2
308.15	6.1	Mes (0.10 mol dm ⁻³) + KOH	none	0	1.4E2
308.15	6.1	Mes (0.10 mol dm ⁻³) + KOH	none	0.0010	1.4E2
308.15	6.1	Mes (0.10 mol dm ⁻³) + KOH	none	0.0021	1.2E2
308.15	6.1	Mes (0.10 mol dm ⁻³) + KOH	none	0.0050	1.2E2
308.15	6.1	Mes (0.10 mol dm ⁻³) + KOH	none	0.010	1.1E2
308.15	6.1	Mes (0.10 mol dm ⁻³) + KOH	none	0.019	1.0E2
308.15	6.1	Mes (0.10 mol dm ⁻³) + KOH	none	0.050	9.6E1
308.15	6.1	Mes (0.10 mol dm ⁻³) + KOH	none	0.100	8.3E1
308.15	6.1	Mes (0.10 mol dm ⁻³) + KOH	none	0.174	7.4E1
308.15	7.0	Mops (0.05 mol dm ⁻³) + KOH	none	0	6.3E1
308.15	7.0	Mops (0.10 mol dm ⁻³) + KOH	none	0	5.6E1
308.15	7.0	Mops (0.10 mol dm ⁻³) + KOH	none	0	4.9E1
308.15	7.0	Mops (0.05 mol dm ⁻³) + KOH	none	0.0010	5.6E1
308.15	7.0	Mops (0.10 mol dm ⁻³) + KOH	none	0.0010	5.6E1
308.15	7.0	Mops (0.10 mol dm ⁻³) + KOH	none	0.0019	5.6E1
308.15	7.0	Mops (0.10 mol dm ⁻³) + KOH	none	0.0021	5.6E1
308.15	7.0	Mops (0.10 mol dm ⁻³) + KOH	none	0.0050	3.9E1
308.15	7.0	Mops (0.10 mol dm ⁻³) + KOH	none	0.0050	6.1E1
308.15	7.0	Mops (0.05 mol dm ⁻³) + KOH	none	0.010	6.3E1
308.15	7.0	Mops (0.10 mol dm ⁻³) + KOH	none	0.100	4.6E1
308.15	7.0	Mops (0.10 mol dm ⁻³) + KOH	none	0.100	6.1E1
308.15	7.0	Mops (0.10 mol dm ⁻³) + KOH	none	0.200	5.6E1
308.15	7.0	Mops (0.05 mol dm ⁻³) + KOH	poly(ethylene glycol) (50% w/v)	0.008	2.1E1
308.15	7.2	Mops (0.050 mol dm ⁻³) + KOH	none	0.008	5.8E1
308.15	7.2	Mops (0.050 mol dm ⁻³) + KOH	dimethyl sulfoxide (50% v/v)	0.008	5.6E1
308.15	7.2	Mops (0.050 mol dm ⁻³) + KOH	dimethyl sulfoxide (50% v/v)	0.008	2.9E1
308.15	7.8	glycylglycine (0.10 mol dm ⁻³) + KOH	none	0	4.5E1
308.15	7.8	glycylglycine (0.05 mol dm ⁻³) + KOH	none	0.001	4.7E1
308.15	7.8	glycylglycine (0.10 mol dm ⁻³) + KOH	none	0.010	4.5E1
308.15	7.8	glycylglycine (0.10 mol dm ⁻³) + KOH	none	0.050	4.9E1
308.15	7.8	glycylglycine (0.10 mol dm ⁻³) + KOH	none	0.100	4.5E1
308.15	8.0	glycylglycine (0.050 mol dm ⁻³) + KOH	none	0	4.7E1
308.15	8.0	glycylglycine (0.050 mol dm ⁻³) + KOH	none	0.0009	4.2E1
308.15	8.0	glycylglycine (0.050 mol dm ⁻³) + KOH	none	0.010	5.3E1
308.15	8.0	glycylglycine (0.050 mol dm ⁻³) + KOH	poly(ethylene glycol) (50% w/v)	0.0009	1.2E1
308.15	9.0	glycine (0.050 mol dm ⁻³) + KOH	none	0	4.7E1
308.15	10.0	glycine (0.050 mol dm ⁻³) + KOH	none	0	4.7E1
298.2	7.8	Mops (0.10 mol dm ⁻³) + KOH	none	0.010	6.2E2
298.2	7.8	Mops (0.10 mol dm ⁻³) + KOH	none	0.050	4.9E2
303.5	7.8	Mops (0.10 mol dm ⁻³) + KOH	none	0.010	5.0E2
303.5	7.8	Mops (0.10 mol dm ⁻³) + KOH	none	0.050	5.3E2
308.2	7.8	Mops (0.10 mol dm ⁻³) + KOH	none	0.010	4.9E2
308.2	7.8	Mops (0.10 mol dm ⁻³) + KOH	none	0.050	5.5E2
311.0	7.8	Mops (0.10 mol dm ⁻³) + KOH	none	0.010	4.4E2
311.0	7.8	Mops (0.10 mol dm ⁻³) + KOH	none	0.050	5.3E2
313.4	7.8	Mops (0.10 mol dm ⁻³) + KOH	none	0.010	4.0E2
313.4	7.8	Mops (0.10 mol dm ⁻³) + KOH	none	0.050	4.9E2

Reference: 89ROM/DEM

Method: chromatography and radioactivity

Buffer: Mops + KOH

pH: 6.1–10.0

Cofactor(s): MgCl₂

Evaluation: B

Several of the apparent equilibrium constants given here were taken from Romero and de Meis' Figs. 3, 4, and 5. Romero and de Meis also reported $\Delta_r H'^{\circ}(c(\text{MgCl}_2) = 0, \text{pH} = 7.8) = -7.5 \text{ kJ mol}^{-1}$ for this reaction.

phosphotaurocyamine(aq) + H₂O(l) = taurocyamine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	9.0	-31.0

Reference: 65PIN

Method: calorimetry

Buffer: Tris (0.1 mol dm⁻³)

pH: 9.0

Cofactor(s): MgSO₄ (0.001 mol dm⁻³)

Evaluation: A

pyrophosphate(aq) + H₂O(l) = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	K_c'
298.15	7.3	6.9E4

Reference: 65STI/DIA

Method: paper chromatography and radioactivity

Buffer: Tris + maleate

pH: 6.8-7.7

Cofactor(s): Mg²⁺

Evaluation: D

Few details were given in this preliminary communication. This is an approximate result. Also see data given under inorganic pyrophosphatase (EC 3.6.1.1).

pyrophosphate(aq) + H₂O(l) = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	6.76	-15.5
298.15	6.93	-14.6
298.15	6.88	-14.6
298.15	6.89	-16.3

Reference: 67WU/WIT

Method: calorimetry

Buffer: none

pH: 6.76-6.93

Evaluation: A

pyrophosphate(aq) + H₂O(l) = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	buffer	added solute	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	K'_2
308.15	6.0	imidazole (0.050 mol dm ⁻³) + HCl	none	0.010	1.34E3
308.15	6.1	imidazole (0.050 mol dm ⁻³) + HCl	none	0.0019	1.5E4
308.15	6.1	imidazole (0.050 mol dm ⁻³) + HCl	none	0.0042	3.1E3
308.15	6.1	imidazole (0.050 mol dm ⁻³) + HCl	none	0.010	1.3E3
308.15	6.1	imidazole (0.050 mol dm ⁻³) + HCl	none	0.036	4.2E2
308.15	6.1	imidazole (0.050 mol dm ⁻³) + HCl	none	0.100	1.3E2
308.15	6.1	imidazole (0.050 mol dm ⁻³) + HCl	none	0.200	7.3E1
308.15	6.53	imidazole (0.050 mol dm ⁻³) + HCl	none	0.010	8.38E2
308.15	6.97	imidazole (0.050 mol dm ⁻³) + HCl	none	0.010	3.01E2
308.15	7.0	imidazole (0.050 mol dm ⁻³) + HCl	none	0.0007	2.0E4
308.15	7.0	imidazole (0.050 mol dm ⁻³) + HCl	none	0.001	3.9E3
308.15	7.0	imidazole (0.050 mol dm ⁻³) + HCl	none	0.0010	3.7E3
308.15	7.0	imidazole (0.050 mol dm ⁻³) + HCl	none	0.0042	4.9E2
308.15	7.0	imidazole (0.050 mol dm ⁻³) + HCl	none	0.010	2.9E2
308.15	7.0	imidazole (0.050 mol dm ⁻³) + HCl	none	0.019	1.6E2
308.15	7.0	imidazole (0.050 mol dm ⁻³) + HCl	none	0.042	1.0E2
308.15	7.0	imidazole (0.050 mol dm ⁻³) + HCl	none	0.100	5.8E1
308.15	7.0	imidazole (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) (50% w/v)	0.008	0.9
308.15	7.2	imidazole (0.050 mol dm ⁻³) + HCl	none	0.008	2.56E2
308.15	7.2	imidazole (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (50% v/v)	0.008	1.4E1
308.15	7.8	Tris (0.05 mol dm ⁻³) + HCl	none	0.001	1.4E3
308.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.001	1.6E3
308.15	7.8	Tris (0.05 mol dm ⁻³) + HCl	none	0.0021	5.9E2
308.15	7.8	Tris (0.05 mol dm ⁻³) + HCl	none	0.0042	3.3E2
308.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.010	3.13E2
308.15	7.8	Tris (0.05 mol dm ⁻³) + HCl	none	0.010	1.84E2
308.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.010	3.57E2
308.15	7.8	Tris (0.05 mol dm ⁻³) + HCl	none	0.010	1.8E2
308.15	7.8	Tris (0.05 mol dm ⁻³) + HCl	none	0.042	8.3E1
308.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.050	1.12E2
308.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.050	1.00E2
308.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	none	0.0009	3.46E2
308.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	poly(ethylene glycol) (50% w/v)	0.0009	0.2
308.15	8.83	Tris (0.05 mol dm ⁻³) + HCl	none	0.010	1.27E2
293.2	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.010	8.67E2
293.2	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.050	2.18E2
299.9	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.010	5.49E2
299.9	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.050	1.58E2
302.3	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.010	4.58E2
302.3	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.050	1.28E2
313.2	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.050	8.2E1

Reference: 89ROM/DEM

Method: chromatography and radioactivity

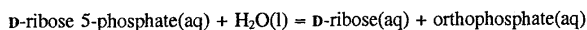
Buffer: Tris (0.10 mol dm⁻³) + HCl

pH: 7.0–8.0

Cofactor(s): MgCl₂

Evaluation: B

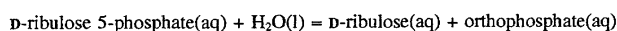
Several of the apparent equilibrium constants given here were taken from Romero and de Meis' Figs. 3, 4, and 5.



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	8.4	-5.03
304.65	8.4	-5.57
310.15	8.4	-5.76

Reference: 88TEW/STE
 Method: calorimetry
 Buffer: Tris
 pH: 8.4
 Cofactor(s): MgCl_2
 Evaluation: A

Tewari *et al.* applied buffer protonation and ionization corrections to obtain $\Delta_r H^\circ = -5.69 \text{ kJ mol}^{-1}$ and $\Delta_r C_p^\circ = -63 \text{ J K}^{-1} \text{ mol}^{-1}$ at $T = 298.15 \text{ K}$ for the chemical reference reaction: $\text{D-ribose 5-phosphate}^{2-}(\text{aq}) + \text{H}_2\text{O(l)} = \text{D-ribose(aq)} + \text{HPO}_4^{2-}(\text{aq})$.

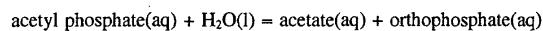


$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	8.5	-11.96
304.65	8.5	-12.46
310.15	8.5	-13.07

Reference: 88TEW/STE
 Method: calorimetry
 Buffer: Tris
 pH: 8.5
 Cofactor(s): MgCl_2
 Evaluation: A

Tewari *et al.* applied buffer protonation and ionization corrections to obtain $\Delta_r H^\circ = -12.43 \text{ kJ mol}^{-1}$ and $\Delta_r C_p^\circ = -84 \text{ J K}^{-1} \text{ mol}^{-1}$ at $T = 298.15 \text{ K}$ for the chemical reference reaction: $\text{D-ribulose 5-phosphate}^{2-}(\text{aq}) + \text{H}_2\text{O(l)} = \text{D-ribulose(aq)} + \text{HPO}_4^{2-}(\text{aq})$.

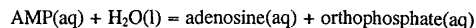
5.6. Enzyme: acid phosphatase (EC 3.1.3.2)



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
306.15	5.6	29.9

Reference: 52MEY/SHA
 Method: calorimetry
 Buffer: sodium acetate + acetic acid
 pH: 5.5
 Evaluation: B

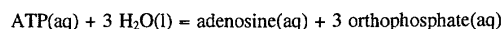
Also see data given under alkaline phosphatase (EC 3.1.3.1).



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
297.45	3.7	-6.49

Reference: 45OHL
 Method: calorimetry
 Buffer: citrate ($0.015 \text{ mol dm}^{-3}$)
 pH: 3.7
 Evaluation: B

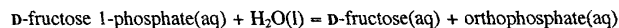
This same result was also reported later by Ohlmeyer [46OHL2]. Also see data given under alkaline phosphatase (EC 3.1.3.1).



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
297.45	3.7	-107.9

Reference: 45OHL
 Method: calorimetry
 Buffer: citrate ($0.015 \text{ mol dm}^{-3}$)
 pH: 3.7
 Evaluation: B

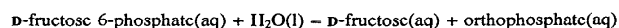
This same result was also reported later by Ohlmeyer [46OHL2].



$\frac{T}{\text{K}}$	pH	K_c'
311.15	5.8	168

Reference: 49MEY/GRE
 Method: chemical analysis
 pH: 5.8
 Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table II. Also see data given under alkaline phosphatase (EC 3.1.3.1).



$\frac{T}{\text{K}}$	pH	K_c'
311.15	5.8	260

Reference: 49MEY/GRE
 Method: chemical analysis
 pH: 5.8
 Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table II. Also see data given under alkaline phosphatase (EC 3.1.3.1).

D-fructose 1,6-biphosphate(aq) + H₂O(l) = D-fructose 1-phosphate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	K_c'
311.15	5.8	8

Reference: 49MEY/GRE
Method: chemical analysis
pH: 5.8
Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table II. Also see data given under alkaline phosphatase (EC 3.1.3.1).

D-fructose 1,6-biphosphate(aq) + H₂O(l) = D-fructose 6-phosphate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	K_c'
311.15	5.8	5.3

Reference: 49MEY/GRE
Method: chemical analysis
pH: 5.8
Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table II. Also see data given under alkaline phosphatase (EC 3.1.3.1) and under fructose-biphosphatase (EC 3.1.3.11).

L- α -glycerophosphate(aq) + H₂O(l) = glycerol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
297.45	4.5	-5.2

Reference: 45OHL
Method: calorimetry
Buffer: citrate (0.015 mol dm⁻³)
pH: 4.5
Evaluation: B

This same result was also reported by Ohlmeyer in 1946 [46OHL, 46OHL2]. Also see data given under alkaline phosphatase (EC 3.1.3.1).

L- α -glycerophosphate(aq) + H₂O(l) = glycerol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(\text{glycerol})}{\text{mol dm}^{-3}}$	K_c'
274	5.8	10.86	22
293	5.8	2.72	75
293	5.8	11.1	21
310	5.8	10.86	19

Reference: 46OHL
Method: chemical analysis

Buffer: phosphate
pH: 5.8
Evaluation: B

The apparent equilibrium constants given here were calculated from the values of $K_c'c(\text{H}_2\text{O})$ reported by Ohlmeyer. Also see data given under alkaline phosphatase (EC 3.1.3.1).

L- α -glycerophosphate(aq) + H₂O(l) = glycerol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	K_c'
311.15	5.8	40

Reference: 49MEY/GRE
Method: chemical analysis
pH: 5.8
Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations given in Meyerhof and Green's Table VII.

4-nitrophenyl phosphate(aq) + H₂O(l) = 4-nitrophenol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{I_c}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	5.85	0.046	-17.0
298.15	5.37	0.040	-20.0
298.15	5.27	0.039	-20.6
298.15	4.76	0.025	-24.2
298.15	4.74	0.025	-24.2
298.15	4.32	0.014	-25.7
298.15	3.82	0.0050	-26.1
298.15	3.72	0.050	-26.1
298.15	3.62	0.0025	-26.4

Reference: 55STU
Method: calorimetry
Buffer: acetate (0.05 mol dm⁻³)
pH: 3.62–5.85
Evaluation: A

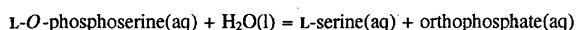
Sturtevant applied buffer protonation and ionization corrections to obtain $\Delta_r H^\circ(T = 298.15 \text{ K}, I_c = 0.03 \text{ mol dm}^{-3}) = -26.3 \text{ kJ mol}^{-1}$ for the chemical reference reaction: 4-nitrophenyl phosphate⁻(aq) + H₂O(l) = 4-nitrophenol(aq) + H₂PO₄⁻(aq). Also see data given under alkaline phosphatase (EC 3.1.3.1).

4-nitrophenyl phosphate(aq) + H₂O(l) = 4-nitrophenol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	3.00	-25.9

Reference: 92REK/TIS
Method: calorimetry
Buffer: acetate (0.05 mol dm⁻³)
pH: 3.00
Evaluation: A

5.7. Enzyme: phosphoserine phosphatase (EC 3.1.3.3)



$\frac{T}{K}$	pH	K_c'
308.15	7.05	673
308.15	9.7	287

Reference: 61VLA/KOM

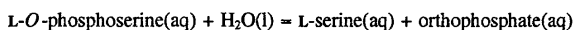
Method: chromatography and radioactivity

Buffer: barbital (0.9 mol dm⁻³)

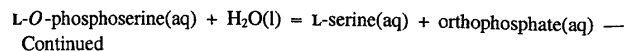
pH: 7.05–9.7

Cofactor(s): MgCl₂ (0.05 mol dm⁻³)

Evaluation: B



$\frac{T}{K}$	pH	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	$\frac{I_c}{\text{mol dm}^{-3}}$	K_c'
311.15	5.90	0	0.25	125
311.15	5.99	0	0.25	122.3
311.15	6.47	0	0.25	76.8
311.15	6.49	0	0.25	68.6
311.15	6.52	0	0.25	70.4
311.15	6.53	0	0.25	74.2
311.15	6.89	0	0.25	56.5
311.15	6.89	0	0.25	55.1
311.15	6.89	0	0.25	58.4
311.15	6.89	0	0.25	55.1
311.15	6.91	0	0.25	59.8
311.15	6.91	0	0.25	59.4
311.15	6.91	0	0.25	57.7
311.15	6.92	0	0.25	59.8
311.15	6.95	0	0.25	57.2
311.15	6.95	0	0.25	57.2
311.15	6.95	0	0.25	52.8
311.15	6.95	0	0.25	57.2
311.15	6.98	0	0.25	54.9
311.15	7.36	0	0.25	49.8
311.15	7.43	0	0.25	46.1
311.15	7.66	0	0.25	45.0
311.15	7.73	0	0.25	46.8
311.15	8.02	0	0.25	47.0
311.15	8.13	0	0.25	49.4
311.15	8.12	0	0.25	48.3
311.15	8.16	0	0.25	51.0
311.15	7.00	0	0.25	49.9
311.15	7.00	0	0.25	47.4
311.15	7.00	0.0067	0.25	47.8
311.15	7.00	0.0067	0.25	47.4
311.15	7.00	0.010	0.25	47.8
311.15	7.00	0.010	0.25	49.8
311.15	7.00	0.0133	0.25	50.0
311.15	7.00	0.0133	0.25	49.8
311.15	7.00	0.0200	0.25	50.0
311.15	7.00	0.0200	0.25	51.1
311.15	6.98	0	0.12	54.8
311.15	6.98	0	0.12	50.6
311.15	6.98	0	0.41	58.9
311.15	6.98	0	0.41	56.1
311.15	6.98	0	0.56	57.5



Continued

$\frac{T}{K}$	pH	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	$\frac{I_c}{\text{mol dm}^{-3}}$	K_c'
311.15	6.98	0	0.56	53.9
311.15	6.98	0	0.71	58.2
311.15	6.98	0	0.71	55.8
311.15	6.98	0	1.0	58.9
311.15	6.98	0	1.0	55.8

Reference: 82GUY/THA

Method: spectrophotometry

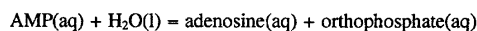
pH: 5.90–8.16

Cofactor(s): MgCl₂

Evaluation: A

Gynn and Thames calculated $K_c(T = 311.15 \text{ K}, I_c = 0.25 \text{ mol dm}^{-3}) = 34.2$ for the chemical reference reaction: L-O-phosphoserine²⁻(aq) + H₂O(l) = L-serine(aq) + HPO₄²⁻(aq).

5.8 Enzyme: 5'-nucleosidase (EC 3.1.3.5)



$\frac{T}{K}$	pH	$\frac{c(\text{Mg}^{2+})}{\text{mol dm}^{-3}}$	$\frac{I_c}{\text{mol dm}^{-3}}$	K_c'
311.15	7.0	0.001	0.25	176

Reference: 92KIM/KIN

Method: enzymatic assay

Buffer: Mops

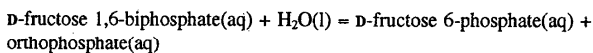
pH: 7.0

Cofactor(s): Mg²⁺

Evaluation: A

Also see data given under alkaline phosphatase (EC 3.1.3.1).

5.9 Enzyme: fructose-biphosphatase (EC 3.1.3.11)



$\frac{T}{K}$	pH	pMg	$\frac{I_c}{\text{mol dm}^{-3}}$	K_c'
310.15	6.99	3.05	0.25	174

Reference: 76LAW/GUY

Method: enzymatic assay; spectrophotometry

Buffer: phosphate (0.104 mol dm⁻³)

pH: 6.99

Cofactor(s): MgCl₂ (0.00605 mol dm⁻³)

Evaluation: A

Also see data given under alkaline phosphatase (EC 3.1.3.1) and under acid phosphatase (EC 3.1.3.2).

D-fructose 1,6-biphosphate(aq) + H₂O(l) = D-fructose 6-phosphate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(\text{MnCl}_2)}{\text{mol dm}^{-3}}$	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	$\frac{I_c}{\text{mol dm}^{-3}}$	K'_c
310.15	6.99	2.5E-5	0	0.25	227
310.15	6.99	0	0.00604	0.25	174

Reference: 79LAW/VEE

Method: enzymatic assay; spectrophotometry

Buffer: phosphate (0.104 mol dm⁻³)

pH: 6.99

Cofactor(s): MgCl₂ and MnCl₂

Evaluation: A

D-fructose 1,6-biphosphate(aq) + H₂O(l) = D-fructose 6-phosphate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	K'_c
288.15	7.5	47

Reference: 91LIU/FRO

Method: NMR

Buffer: Tris (0.05 mol dm⁻³) + HCl

pH: 7.5

Cofactor(s): MgSO₄ (0.005 mol dm⁻³)

Evaluation: C

This is an approximate result.

5.10. Enzyme: phosphodiesterase I (EC 3.1.4.1)

adenosine 3',5'-(cyclic)phosphate(aq) + H₂O(l) = AMP(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^{\circ}}{\text{kJ mol}^{-1}}$
298.15	7.3	-59.0

Reference: 69GRE/RUD

Method: calorimetry

Buffer: sodium phosphate

pH: 7.3

Cofactor(s): MgCl₂

Evaluation: A

Greengard *et al.* applied a correction for the enthalpy of buffer protonation to obtain the value of $\Delta_r H'^{\circ}$ given here. Also see data given under 3',5'-cyclic-nucleotide phosphodiesterase (EC 3.1.4.17).

2'-deoxyadenosine 3',5'-(cyclic)phosphate(aq) + H₂O(l) = 2'-deoxyadenosine 5'-monophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^{\circ}}{\text{kJ mol}^{-1}}$
298.15	7.3	-54.4

Reference: 71RUD/JOH

Method: calorimetry

Buffer: potassium phosphate (0.036 mol dm⁻³) and imidazole (0.001 mol dm⁻³)

pH: 7.3

Cofactor(s): MgCl₂ (0.001 mol dm⁻³)

Evaluation: B

Rudolph *et al.* applied a correction for the enthalpy of buffer protonation to obtain the value of $\Delta_r H'^{\circ}$ given here.

guanosine 3',5'-(cyclic)phosphate(aq) + H₂O(l) = GMP(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^{\circ}}{\text{kJ mol}^{-1}}$
298.15	7.3	-43.8

Reference: 69GRE/RUD

Method: calorimetry

Buffer: sodium phosphate

pH: 7.3

Cofactor(s): MgCl₂

Evaluation: A

Greengard *et al.* applied a correction for the enthalpy of buffer protonation to obtain the value of $\Delta_r H'^{\circ}$ given here.

inosine 3',5'-(cyclic)phosphate(aq) + H₂O(l) = IMP(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^{\circ}}{\text{kJ mol}^{-1}}$
298.15	7.3	-56.1

Reference: 71RUD/JOH

Method: calorimetry

Buffer: potassium phosphate (0.036 mol dm⁻³) and imidazole (0.001 mol dm⁻³)

pH: 7.3

Cofactor(s): MgCl₂ (0.001 mol dm⁻³)

Evaluation: B

Rudolph *et al.* applied a correction for the enthalpy of buffer protonation to obtain the value of $\Delta_r H'^{\circ}$ given here.

uridine 3',5'-(cyclic)phosphate(aq) + H₂O(l) = UMP(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^{\circ}}{kJ\ mol^{-1}}$
298.15	7.3	-50.2

Reference: 71RUD/JOH

Method: calorimetry

Buffer: potassium phosphate (0.036 mol dm⁻³) and imidazole (0.001 mol dm⁻³)

pH: 7.3

Cofactor(s): MgCl₂ (0.001 mol dm⁻³)

Evaluation: B

Rudolph *et al.* applied a correction for the enthalpy of buffer protonation to obtain the value of $\Delta_r H'^{\circ}$ given here.

5.11. Enzyme: 3',5'-cyclic-nucleotide phosphodiesterase (EC 3.1.4.17)

adenosine 3',5'-(cyclic)phosphate(aq) + H₂O(l) = AMP(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'(\text{cal})}{kJ\ mol^{-1}}$
298.15	7.8	-61.1

Reference: 74CHE/PAT

Method: calorimetry

Buffer: phosphate (0.040 mol dm⁻³)

pH: 7.8

Cofactor(s): Mn²⁺ (0.0001 mol dm⁻³)

Evaluation: B

Cheung *et al.* applied a buffer protonation correction to obtain $\Delta_r H'^{\circ}(T = 298.15\ K, \text{pH} = 7.8) = -55.6\ kJ\ mol^{-1}$. Also see data given under phosphodiesterase I (EC 3.1.4.1).

adenosine 3',5'-(cyclic)phosphate(aq) + H₂O(l) = AMP(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^{\circ}}{kJ\ mol^{-1}}$
298.15	7.2	-50.6
310.15	7.3	-55.4

Reference: 75GER/WES

Method: calorimetry

Buffer: potassium phosphate (0.036 mol dm⁻³)

pH: 7.2-7.3

Cofactor(s): MgCl₂

Evaluation: A

Gerlt *et al.* applied corrections for protonation of the buffer to obtain the values of $\Delta_r H'^{\circ}$ given here.

5.12. Enzyme: hydrolase (unclassified) (EC 3.1.4.a)

adenosine 3',5'-(cyclic)phosphate(aq) + H₂O(l) = adenosine 3'-monophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(\text{MgCl}_2)}{\text{mol}\ \text{dm}^{-3}}$	$\frac{\Delta_r H'^{\circ}}{kJ\ mol^{-1}}$
298.15	7.3	0.001	-48.1
310.15	7.2	0.001	-46.4

Reference: 75GER/WES

Method: calorimetry

Buffer: Pipes (0.05 mol dm⁻³)

pH: 7.2-7.3

Cofactor(s): MgCl₂

Evaluation: A

Gerlt *et al.* applied corrections for protonation of the buffer to obtain the values of $\Delta_r H'^{\circ}$ given here.

diethyl phosphate(aq) + H₂O(l) = monoethyl phosphate(aq) + ethanol(aq)

$\frac{T}{K}$	pH	buffer	$\frac{\Delta_r H'(\text{cal})}{kJ\ mol^{-1}}$
298.15	7.3	Pipes	-20.1

Reference: 73STU/GER

Method: calorimetry

Buffer: Pipes (0.05 mol dm⁻³)

pH: 7.3

Evaluation: B

Sturtevant *et al.* applied a buffer protonation correction to obtain $\Delta_r H'^{\circ}(T = 298.15\ K, \text{pH} = 7.3) = -11.1\ kJ\ mol^{-1}$.

diethyl phosphate(aq) + H₂O(l) = monoethyl phosphate(aq) + ethanol(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^{\circ}}{kJ\ mol^{-1}}$
298.15	7.3	-10.5

Reference: 75GER/WES

Method: calorimetry

Buffer: Pipes (0.05 mol dm⁻³)

pH: 7.3

Evaluation: A

Gerlt *et al.* applied a buffer protonation correction to obtain the value of $\Delta_r H'^{\circ}$ given here.

ethylene phosphate(aq) + H₂O(l) = 2-hydroxyethyl phosphate(aq)

$\frac{T}{K}$	pH	buffer	$\frac{\Delta_r H^\circ}{kJ mol^{-1}}$
298.15	7.3	Pipes	-39.5
298.15	7.3	Tris	-69.5

Reference: 73STU/GER

Method: calorimetry

Buffer: Pipes (0.05 mol dm⁻³) and Tris (0.05 mol dm⁻³)

pH: 7.3

Evaluation: B

Sturtevant *et al.* applied buffer protonation corrections to obtain $\Delta_r H^\circ(T = 298.15 K, pH = 7.3) \approx -28.5 kJ mol^{-1}$.ethylene phosphate(aq) + H₂O(l) = 2-hydroxyethyl phosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ}{kJ mol^{-1}}$
298.15	7.3	-28.9
310.15	7.2	-32.3

Reference: 75GER/WES

Method: calorimetry

Buffer: Pipes (0.05 mol dm⁻³)

pH: 7.2-7.3

Evaluation: A

Gerlt *et al.* applied buffer protonation corrections to obtain the values of $\Delta_r H^\circ$ given here.methyl α -D-glucopyranoside 4,6-(cyclic)phosphate(aq) + H₂O(l) = methyl α -D-glucopyranoside 6-phosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ}{kJ mol^{-1}}$
298.15	7.3	-28.7

Reference: 75GER/WES

Method: calorimetry

Buffer: Pipes (0.05 mol dm⁻³)

pH: 7.3

Evaluation: A

Gerlt *et al.* applied a buffer protonation correction to obtain the value of $\Delta_r H^\circ$ given here.methyl β -D-ribofuranoside 3,5-(cyclic)phosphate(aq) + H₂O(l) = methyl β -D-ribofuranoside 5-phosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ}{kJ mol^{-1}}$
298.15	7.3	-49.1
310.15	7.2	-50.3

Reference: 75GER/WES

Method: calorimetry

Buffer: Pipes (0.05 mol dm⁻³)

pH: 7.2-7.3

Evaluation: A

Gerlt *et al.* applied buffer protonation corrections to obtain the values of $\Delta_r H^\circ$ given here.tetramethylene phosphate(aq) + H₂O(l) = 4-hydroxybutyl phosphate(aq)

$\frac{T}{K}$	pH	buffer	$\frac{\Delta_r H^\circ}{kJ mol^{-1}}$
298.15	7.3	Pipes	-19.6

Reference: 73STU/GER

Method: calorimetry

Buffer: Pipes (0.05 mol dm⁻³)

pH: 7.3

Evaluation: B

Sturtevant *et al.* applied buffer protonation corrections to obtain $\Delta_r H^\circ(T = 298.15 K, pH = 7.3) \approx -11.0 kJ mol^{-1}$.tetramethylene phosphate(aq) + H₂O(l) = 4-hydroxybutyl phosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ}{kJ mol^{-1}}$
298.15	7.3	-11.0

Reference: 75GER/WES

Method: calorimetry

Buffer: Pipes (0.05 mol dm⁻³)

pH: 7.3

Evaluation: A

Gerlt *et al.* applied a buffer protonation correction to obtain the value of $\Delta_r H^\circ$ given here.trimethylene phosphate(aq) + H₂O(l) = 3-hydroxypropyl phosphate(aq)

$\frac{T}{K}$	pH	buffer	$\frac{\Delta_r H^\circ}{kJ mol^{-1}}$
298.15	7.3	Pipes	-24.8
298.15	7.3	Tris	-54.4

Reference: 73STU/GER

Method: calorimetry

Buffer: Pipes (0.05 mol dm⁻³) and Tris (0.05 mol dm⁻³)

pH: 7.3

Evaluation: B

Sturtevant *et al.* applied buffer protonation corrections to obtain $\Delta_r H^\circ(T = 298.15 K, pH = 7.3) \approx -14.9 kJ mol^{-1}$.

trimethylene phosphate(aq) + H₂O(l) = 3-hydroxypropyl phosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^{\circ}}{kJ\ mol^{-1}}$
298.15	7.3	-16.0

Reference: 75GER/WES

Method: calorimetry

Buffer: Pipes (0.05 mol dm⁻³)

pH: 7.3

Evaluation: A

Gerlt *et al.* applied a buffer protonation correction to obtain the value of $\Delta_r H'^{\circ}$ given here.

5.13. Enzyme: ribonuclease T₂ (EC 3.1.27.1)

adenosine 2',3'-(cyclic)phosphate(aq) + H₂O(l) =
adenosine 3'-monophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^{\circ}}{kJ\ mol^{-1}}$
298.15	6.5	-39.5

Reference: 71RUD/JOH

Method: calorimetry

Buffer: potassium phosphate (0.036 mol dm⁻³) or (Tris + HCl)
(0.20 mol dm⁻³)

pH: 6.5

Evaluation: B

Rudolph *et al.* applied a correction for the enthalpy of buffer protonation to obtain the value of $\Delta_r H'^{\circ}$ given here.

guanosine 2',3'-(cyclic)phosphate(aq) + H₂O(l) =
guanosine 3'-monophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^{\circ}}{kJ\ mol^{-1}}$
298.15	6.5	-39.7

Reference: 71RUD/JOH

Method: calorimetry

Buffer: potassium phosphate (0.036 mol dm⁻³) or (Tris + HCl)
(0.20 mol dm⁻³)

pH: 6.5

Evaluation: B

Rudolph *et al.* applied a correction for the enthalpy of buffer protonation to obtain the value of $\Delta_r H'^{\circ}$ given here.

5.14. Enzyme: pancreatic ribonuclease (EC 3.1.27.5)

cytidine 2',3'-(cyclic)phosphate(aq) + H₂O(l) =
cytidine 3'-monophosphate(aq)

$\frac{T}{K}$	pH	K'
298.15	5.0	360
298.15	6.0	1060

Reference: 65BAH/CAT

Method: radioactivity

Buffer: acetate (0.05 mol dm⁻³)

pH: 5.0-6.0

Evaluation: A

Bahr *et al.* reported $K(T = 298.15\ K, I_c = 0.1\ mol\ dm^{-3}) \approx 1020$ for the chemical reference reaction: cytidine 2',3'-(cyclic)phosphate(aq) + H₂O(l) = cytidine 3'-monophosphate(aq).

cytidine 2',3'-(cyclic)phosphate(aq) + H₂O(l) =
cytidine 3'-monophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'(\text{cal})}{kJ\ mol^{-1}}$
298.15	8.4	-50.6

Reference: 65BAH/CAT

Method: calorimetry

Buffer: Tris (0.20 mol dm⁻³)

pH: 8.4

Evaluation: A

Bahr *et al.* applied a buffer protonation correction to obtain $\Delta_r H'^{\circ}(T = 298.15\ K, pH = 8.4) = -2.1\ kJ\ mol^{-1}$. Bahr *et al.* also reported ionization constants for the substances in this reaction and calculated $\Delta_r H'^{\circ}(T = 298.15\ K) = -2.1\ kJ\ mol^{-1}$ for the chemical reference reaction: cytidine 2',3'-(cyclic)phosphate⁻(aq) + H₂O(l) = cytidine 3'-monophosphate²⁻(aq) + H⁺(aq). They also calculated $\Delta_r H'^{\circ}(T = 298.15\ K) = -12.0\ kJ\ mol^{-1}$ for the chemical reference reaction: cytidine 2',3'-(cyclic)phosphate(aq) + H₂O(l) = cytidine 3'-monophosphate(aq).

cytidine 2',3'-(cyclic)phosphate(aq) + H₂O(l) =
cytidine 3'-monophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^{\circ}}{kJ\ mol^{-1}}$
298.15	7.3	-33.9

Reference: 71RUD/JOH

Method: calorimetry

Buffer: potassium phosphate (0.036 mol dm⁻³)

pH: 7.3

Evaluation: B

Rudolph *et al.* applied a correction for the enthalpy of buffer protonation to obtain the value of $\Delta_r H'^{\circ}$ given here.

cytidine 2',3'-(cyclic)phosphate(aq) + H₂O(l) =
cytidine 3'-monophosphate(aq)

$\frac{T}{K}$	pH	$\frac{I_c}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H^\circ(\text{cal})}{\text{kJ mol}^{-1}}$
8.15	5.0	0.1	-33.9

Reference: 76TRI/PAR

Method: calorimetry

Buffer: acetate

pH: 5.0

Evaluation: C

Tribout *et al.* also reported $\Delta_r H^\circ(\text{cal})(T = 298.15 \text{ K, acetate buffer, pH} = 5.0) = 35.1 \text{ J g}^{-1}$ for the hydrolysis of RNA. The products of this hydrolysis reaction were not identified.

uridine 2',3'-(cyclic)phosphate(aq) + H₂O(l) = uridine 3'-monophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	7.3	-32.4

Reference: 71RUD/JOH

Method: calorimetry

Buffer: potassium phosphate (0.036 mol dm⁻³)

pH: 7.3

Evaluation: B

Rudolph *et al.* applied a correction for the enthalpy of buffer protonation to obtain the value of $\Delta_r H^\circ$ given here.

5.15. Enzyme: ribonuclease (unclassified) (EC 3.1.27.a)

adenylyl(3'→5')adenosine(aq) = adenosine 2',3'-(cyclic)phosphate(aq) +
adenosine(aq)

$\frac{T}{K}$	pH	K'_c
273.15	7.0	≈ 8

Reference: 72KHA/ZHE

Method: chromatography, electrophoresis, and spectrophotometry

Buffer: phosphate (0.2 mol dm⁻³)

pH: 7.0

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations and percent yields given in Khabarova and Zhenodarova's Table 1.

adenylyl(3'→5')cytidine(aq) = adenosine 2',3'-(cyclic)phosphate(aq) +
cytidine(aq)

$\frac{T}{K}$	pH	K'_c
273.15	7.0	≈ 0.6

Reference: 72KHA/ZHE

Method: chromatography, electrophoresis, and spectrophotometry

Buffer: phosphate (0.2 mol dm⁻³)

pH: 7.0

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations and percent yields given in Khabarova and Zhenodarova's Table 1.

adenylyl(3'→5')uridine(aq) = adenosine 2',3'-(cyclic)phosphate(aq) +
uridine(aq)

$\frac{T}{K}$	pH	K'_c
273.15	7.0	≈ 4

Reference: 72KHA/ZHE

Method: chromatography, electrophoresis, and spectrophotometry

Buffer: phosphate (0.2 mol dm⁻³)

pH: 7.0

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations and percent yields given in Khabarova and Zhenodarova's Table 1.

cytidylyl(3'→5')cytidine(aq) = cytidine 2',3'-(cyclic)phosphate(aq) +
cytidine(aq)

$\frac{T}{K}$	pH	buffer	K'_c
273.15	5.2	acetate	≈ 6
273.15	7.0	imidazole	≈ 5
273.15	7.0	phosphate	≈ 5

Reference: 72KHA/ZHE

Method: chromatography, electrophoresis, and spectrophotometry

Buffer: acetate (0.2 mol dm⁻³), imidazole (0.05 mol dm⁻³), and phosphate (0.2 mol dm⁻³)

pH: 7.0

Evaluation: C

The apparent equilibrium constants given here were calculated from the concentrations and percent yields given in Khabarova and Zhenodarova's Table 1.

cytidyl(3'→5')uridine(aq) = cytidine 2',3'-(cyclic)phosphate(aq) + uridine(aq)

$\frac{T}{K}$	pH	K_c'
273.15	7.0	≈ 14

Reference: 72KHA/ZHE

Method: chromatography, electrophoresis, and spectrophotometry

Buffer: phosphate (0.2 mol dm⁻³)

pH: 7.0

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations and percent yields given in Khabarova and Zhenodarova's Table 1.

guanylyl(3'→5')adenosine(aq) = guanosine 2',3'-(cyclic)phosphate(aq) + adenosine(aq)

$\frac{T}{K}$	pH	K_c'
273.15	7.0	≈ 8

Reference: 72KHA/ZHE

Method: chromatography, electrophoresis, and spectrophotometry

Buffer: phosphate (0.2 mol dm⁻³)

pH: 7.0

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations and percent yields given in Khabarova and Zhenodarova's Table 1.

guanylyl(3'→5')cytidine(aq) = guanosine 2',3'-(cyclic)phosphate(aq) + cytidine(aq)

$\frac{T}{K}$	pH	K_c'
273.15	4.65	≈ 1
273.15	5.2	≈ 6

Reference: 72KHA/ZHE

Method: chromatography, electrophoresis, and spectrophotometry

Buffer: acetate (0.2 mol dm⁻³)

pH: 4.65–5.2

Evaluation: C

The apparent equilibrium constants given here were calculated from the concentrations and percent yields given in Khabarova and Zhenodarova's Table 1.

guanylyl(3'→5')uridine(aq) = guanosine 2',3'-(cyclic)phosphate(aq) + uridine(aq)

$\frac{T}{K}$	pH	K_c'
273.15	7.0	≈ 4

Reference: 72KHA/ZHE

Method: chromatography, electrophoresis, and spectrophotometry

Buffer: phosphate (0.2 mol dm⁻³)

pH: 7.0

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations and percent yields given in Khabarova and Zhenodarova's Table 1.

uridylyl(3'→5')cytidine(aq) = uridine 2',3'-(cyclic)phosphate(aq) + cytidine(aq)

$\frac{T}{K}$	pH	buffer	K_c'
273.15	5.2	acetate	≈ 6
273.15	7.0	phosphate	≈ 4

Reference: 72KHA/ZHE

Method: chromatography, electrophoresis, and spectrophotometry

Buffer: acetate (0.2 mol dm⁻³) and phosphate (0.2 mol dm⁻³)

pH: 5.2–7.0

Evaluation: C

The apparent equilibrium constants given here were calculated from the concentrations and percent yields given in Khabarova and Zhenodarova's Table 1.

uridylyl(3'→5')uridine(aq) = uridine 2',3'-(cyclic)phosphate(aq) + uridine(aq)

$\frac{T}{K}$	pH	K_c'
273.15	7.0	≈ 9

Reference: 72KHA/ZHE

Method: chromatography, electrophoresis, and spectrophotometry

Buffer: phosphate (0.2 mol dm⁻³)

pH: 7.0

Evaluation: C

The apparent equilibrium constant given here was calculated from the concentrations and percent yields given in Khabarova and Zhenodarova's Table 1.

5.16. Enzyme: α-amylase (EC 3.2.1.1)

cyclomaltoheptaose(aq) + 7 H₂O(l) = 7 D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	5.0	-48.7

Reference: 72TAK/ONO

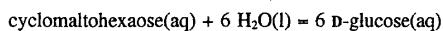
Method: calorimetry

Buffer: acetate (0.02 mol dm⁻³)

pH: 5.0

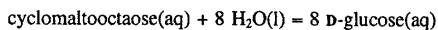
Evaluation: A

Cyclomaltoextrin glucanotransferase (EC 2.4.1.19) was also present.



$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	5.0	-53.5

Reference: 72TAK/ONO
 Method: calorimetry
 Buffer: acetate (0.02 mol dm⁻³)
 pH: 5.0
 Evaluation: A

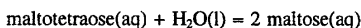


$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	5.0	-53.0

Reference: 72TAK/ONO
 Method: calorimetry
 Buffer: acetate (0.02 mol dm⁻³)
 pH: 5.0
 Evaluation: A

Cyclomaltodextrin glucoanotransferase (EC 2.4.1.19) was also present.

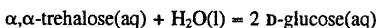
5.17. Enzyme: β -amylase (EC 3.2.1.2)



$\frac{T}{K}$	K'_e
303.15	335

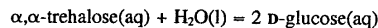
Reference: 78OKA/GEN
 Method: paper chromatography
 Evaluation: C

The apparent equilibrium constant was calculated from the results given in Okada *et al.*'s Table 2. Okada *et al.* did not report what the buffer and the pH were. Equilibrium was approached from only one direction.



$\frac{T}{K}$	pH	K'_m
286.45	5.65	122
292.25	5.65	123
298.15	5.65	119
304.55	5.65	118
310.25	5.65	115

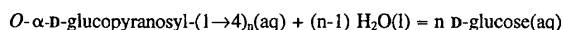
Reference: 91TEW/GOL
 Method: HPLC
 Buffer: sodium acetate (0.1 mol dm⁻³)
 pH: 5.65
 Evaluation: A



$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	5.65	4.73

Reference: 91TEW/GOL
 Method: calorimetry
 Buffer: sodium acetate (0.1 mol dm⁻³)
 pH: 5.65
 Evaluation: A

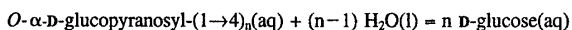
5.18. Enzyme: glucan 1,4- α -glucosidase (EC 3.2.1.3)



$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{(\text{kJ mol}^{-1})(n-1)}$
298.15	4.5	-4.31

Reference: 65TAK/HIR
 Method: calorimetry
 Buffer: acetate (0.02 mol dm⁻³)
 pH: 4.5
 Evaluation: A

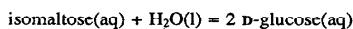
O- α -D-glucopyranosyl-(1 \rightarrow 4)_n is amylose.



$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{(\text{kJ mol}^{-1})(n-1)}$
298.15	5.31	-3.53

Reference: 91GOL/BEL
 Method: calorimetry
 Buffer: sodium acetate (0.57 mol dm⁻³)
 pH: 5.31
 Evaluation: A

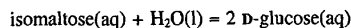
The result given here is the average of the results obtained for two different samples of amylose. Ethanol was also present.



$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	4.5	5.44

Reference: 65TAK/YOS
 Method: calorimetry
 Buffer: acetate (0.02 mol dm⁻³)
 pH: 4.5
 Evaluation: A

Also see data given under oligo-1,6-glucosidase (EC 3.2.1.10).



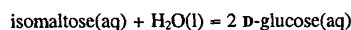
$\frac{T}{\text{K}}$	K'_c
≈ 328	34

Reference: 80BEY/ROE

Method: HPLC

Evaluation: C

van Beynum *et al.* reported $K'_c/c(\text{H}_2\text{O}) = 0.6$. Their experiments were carried out over the temperature range 318 - 338 K. The pH was not reported.



$\frac{T}{\text{K}}$	pH	K'_c
313	5.0	18

Reference: 84ADA/UED

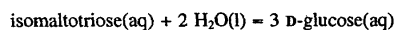
Method: HPLC and enzymatic assay

Buffer: acetate (0.010 mol dm⁻³)

pH: 5.0

Evaluation: C

Adachi *et al.* reported $\{K'_c/c(\text{H}_2\text{O})\}^{-1} = 0.28$ based upon kinetic data. The apparent equilibrium constant given here was calculated from this result.



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	4.44	11.4

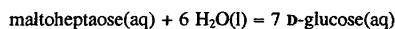
Reference: 91GOL/BEL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 4.44

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	4.44	-26.81
304.65	4.44	-27.14
311.15	4.44	-26.38

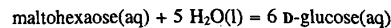
Reference: 91GOL/BEL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 4.44

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	4.44	-22.40
304.65	4.44	-22.63
311.15	4.44	-22.16

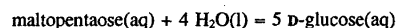
Reference: 91GOL/BEL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 4.44

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	4.44	-18.12

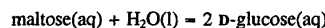
Reference: 91GOL/BEL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 4.44

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	4.5	-4.59
308.15	4.5	-4.75

Reference: 65ONO/HIR

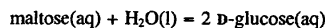
Method: calorimetry

Buffer: acetate (0.02 mol dm⁻³)

pH: 4.5

Evaluation: A

Also see data given under α -glucosidase (EC 3.2.1.20).



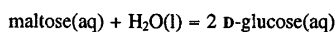
$\frac{T}{\text{K}}$	K'_c
303.15	322

Reference: 78OKA/GEN

Method: paper chromatography

Evaluation: C

The apparent equilibrium constant was calculated from the results given in Okada *et al.*'s Table 1. Okada *et al.* did not report what the buffer and the pH were. Equilibrium was approached from only one direction.



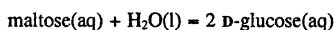
$\frac{T}{\text{K}}$	K'_c
≈ 328	197

Reference: 80BEY/ROE

Method: HPLC

Evaluation: C

van Beynum *et al.* reported $K'_c/c(\text{H}_2\text{O}) = 3.5$. The apparent equilibrium constant given here was calculated from this result. Their experiments were carried out over the temperature range 318 to 338 K. The pH was not reported.



$\frac{T}{\text{K}}$	pH	K'_c
313	5.0	200

Reference: 84ADA/UED

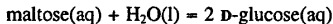
Method: HPLC and enzymatic assay

Buffer: acetate (0.010 mol dm⁻³)

pH: 5.0

Evaluation: C

Adachi *et al.* reported $\{K'_c/c(\text{H}_2\text{O})\}^{-1} = 0.28$ based upon kinetic data. The apparent equilibrium constant given here was calculated from this result.



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	4.44	-4.55

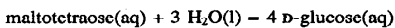
Reference: 91GOL/BEL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 4.44

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	4.44	-13.79

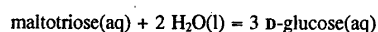
Reference: 91GOL/BEL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 4.44

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	4.5	-8.83

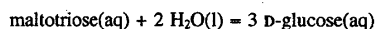
Reference: 65TAK/HIR

Method: calorimetry

Buffer: acetate (0.02 mol dm⁻³)

pH: 4.5

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	4.44	-9.03

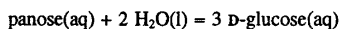
Reference: 91GOL/BEL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 4.44

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	4.5	0.59

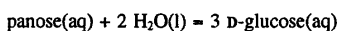
Reference: 65TAK/YOS

Method: calorimetry

Buffer: acetate (0.02 mol dm⁻³)

pH: 4.5

Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	6.00	1.46

Reference: 91GOL/BEL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 6.00

Evaluation: A

phenyl α -maltoside(aq) + H₂O(l) = phenyl α -D-glucopyranoside(aq) + D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	4.5	-4.47
308.15	4.5	-4.74

Reference: 65ONO/HIR

Method: calorimetry

Buffer: acetate (0.02 mol dm⁻³)

pH: 4.5

Evaluation: A

5.19. Enzyme: oligo-1,6-glucosidase (EC 3.2.1.10)

isomaltose(aq) + H₂O(l) = 2 D-glucose(aq)

$\frac{T}{K}$	pH	K'_m
286.35	5.65	15.8
292.45	5.65	16.2
298.15	5.65	17.2
304.15	5.65	18.0
310.25	5.65	19.4
316.35	5.65	19.7

Reference: 89TEW/GOL

Method: HPLC

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Evaluation: A

Also see data given under glucan 1,4-glucosidase (EC 3.2.1.3).

isomaltose(aq) + H₂O(l) = 2 D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	5.65	5.93
304.55	5.65	5.67
310.15	5.65	6.35
316.15	5.65	5.98

Reference: 89TEW/GOL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Evaluation: A

palatinose(aq) + H₂O(l) = D-glucose(aq) + D-fructose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	4.44	-4.44

Reference: 91TEW/GOL

Method: calorimetry

Buffer: sodium acetate (0.02 mol dm⁻³)

pH: 4.44

Evaluation: A

5.20. Enzyme: α -glucosidase (EC 3.2.1.20)

maltose(aq) + H₂O(l) = 2 D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	5.65	-4.02
304.55	5.65	-3.74

Reference: 89TEW/GOL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Evaluation: B

Also see data given under glucan 1,4- α -glucosidase (EC 3.2.1.3).

D-turanose(aq) + H₂O(l) = D-glucose(aq) + D-fructose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	5.65	-2.68

Reference: 91TEW/GOL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Evaluation: A

5.21. Enzyme: β -glucosidase (EC 3.2.1.21)

1-butyl β -D-glucopyranoside(aq) + H₂O(l) = 1-butanol(aq) + D-glucose(aq)

$\frac{T}{K}$	K'_c
277.15	8.63
303.15	9.48

Reference: 36VEI

Method: polarimetry

Evaluation: C

The apparent equilibrium constants given here were calculated from the data in Veibel's Tables VII and VIII. The pH was not reported.

2-butyl β -D-glucopyranoside(aq) + H₂O(l) = (\pm)-2-butanol(aq) + D-glucose(aq)

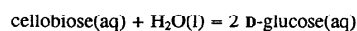
$\frac{T}{K}$	K'_c
277.15	18.5
303.15	21.1

Reference: 36VEI

Method: polarimetry

Evaluation: C

The apparent equilibrium constants given here were calculated from the data in Veibel's Tables VII and VIII. The pH was not reported.



$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	5.65	-2.37
304.55	5.65	-2.56
310.15	5.65	-2.34

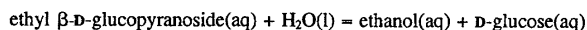
Reference: 89TEW/GOL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Evaluation: A



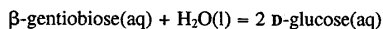
$\frac{T}{K}$	K'_c
277.15	7.08
303.15	7.88

Reference: 36VEI

Method: polarimetry

Evaluation: C

The apparent equilibrium constants given here were calculated from the data in Veibel's Tables VII and VIII. The pH was not reported.



$\frac{T}{K}$	pH	K'_m
285.75	5.65	17.2
292.25	5.65	17.5
298.15	5.65	17.7
304.15	5.65	17.9
310.35	5.65	18.5
316.15	5.65	19.5

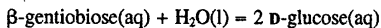
Reference: 89TEW/GOL

Method: HPLC

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Evaluation: A



$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	5.65	2.36
304.55	5.65	1.91
310.15	5.65	2.11

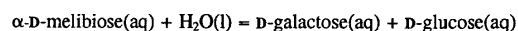
Reference: 89TEW/GOL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Evaluation: A



$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	5.65	-0.88

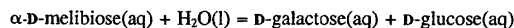
Reference: 91TEW/GOL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Evaluation: A



$\frac{T}{K}$	pH	K'_m
298.15	5.65	123

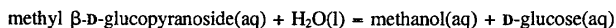
Reference: 91TEW/GOL

Method: HPLC

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Evaluation: A



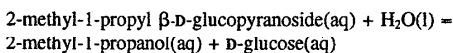
$\frac{T}{K}$	K'_c
277.15	4.50
303.15	4.73

Reference: 36VEI

Method: polarimetry

Evaluation: C

The apparent equilibrium constants given here were calculated from the data in Veibel's Tables VII and VIII. The pH was not reported.



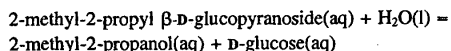
$\frac{T}{K}$	K'_c
277.15	11.2
303.15	11.9

Reference: 36VEI

Method: polarimetry

Evaluation: C

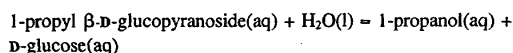
The apparent equilibrium constants given here were calculated from the data in Veibel's Tables VII and VIII. The pH was not reported.



$\frac{T}{\text{K}}$	K'_c
277.15	45.0
303.15	57.0

Reference: 36VEI
Method: polarimetry
Evaluation: C

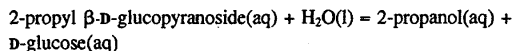
The apparent equilibrium constants given here were calculated from the data in Veibel's Tables VII and VIII. The pH was not reported.



$\frac{T}{\text{K}}$	K'_c
277.15	8.92
303.15	9.98

Reference: 36VEI
Method: polarimetry
Evaluation: C

The apparent equilibrium constants given here were calculated from the data in Veibel's Tables VII and VIII. The pH was not reported.

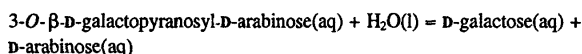


$\frac{T}{\text{K}}$	K'_c
277.15	19.0
303.15	22.7

Reference: 36VEI
Method: polarimetry
Evaluation: C

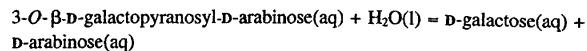
The apparent equilibrium constants given here were calculated from the data in Veibel's Tables VII and VIII. The pH was not reported.

5.22. Enzyme: β -galactosidase (EC 3.2.1.23)



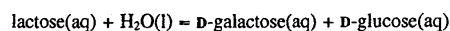
$\frac{T}{\text{K}}$	pH	K'_m
286.15	5.65	108
292.15	5.65	108
298.15	5.65	104

Reference: 91TEW/GOL
Method: HPLC
Buffer: sodium acetate (0.1 mol dm⁻³)
pH: 5.65
Evaluation: A



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	4.44	2.97

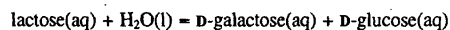
Reference: 91TEW/GOL
Method: calorimetry
Buffer: sodium acetate (0.02 mol dm⁻³)
pH: 4.44
Evaluation: A



$\frac{T}{\text{K}}$	pH	K'_c
298.15	7.0	86

Reference: 86HUB/HUR
Method: gas-liquid chromatography
Buffer: Tes
pH: 7.0
Evaluation: C

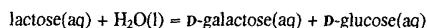
Huber and Hurlburt reported that *allo* lactose constituted about 50 percent of the total lactose in this reaction. The position of equilibrium was not approached from both directions.



$\frac{T}{\text{K}}$	pH	K'_m
286.15	5.65	35.2
292.15	5.65	32.2
298.15	5.65	34.0
304.15	5.65	32.4
310.15	5.65	34.8

Reference: 89GOL/TEW
Method: HPLC
Buffer: sodium acetate (0.1 mol dm⁻³)
pH: 5.65
Evaluation: A

Goldberg and Tewari also calculated $\Delta_r H^\circ = -(0.3 \pm 3.6) \text{ kJ mol}^{-1}$ from the temperature dependence of K'_c . This is in agreement with the calorimetric result obtained in this study.



$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	5.65	0.466
304.65	5.65	0.469
310.15	5.65	0.540
316.15	5.65	0.612

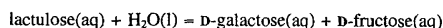
Reference: 89GOL/TEW

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Evaluation: A

Goldberg and Tewari also calculated $\Delta_r C_p^\circ = 9 \text{ J K}^{-1} \text{ mol}^{-1}$.

$\frac{T}{K}$	pH	K_m'
298.15	5.65	128

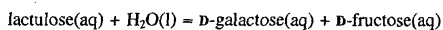
Reference: 91TEW/GOL

Method: HPLC

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Evaluation: A



$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	5.65	2.21

Reference: 91TEW/GOL

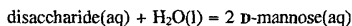
Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Evaluation: A

5.23. Enzyme: α -mannosidase (EC 3.2.1.24)



$\frac{T}{K}$	pH	K_c'
328.15	5.5	≈ 6

Reference: 89JOH/HED

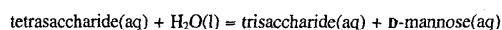
Method: HPLC and gas-liquid chromatography with mass spectrometry

Buffer: Na₂HPO₄ (0.02 mol dm⁻³) + citric acid (0.01 mol dm⁻³)

pH: 5.5

Evaluation: C

The apparent equilibrium constant given here was calculated from the equilibrium data given in Johansson *et al.*'s Table 1. The "disaccharide" in the reaction given here refers to a mixture of four disaccharides which were characterized by (gas-liquid chromatography + mass spectrometry) and by NMR.



$\frac{T}{K}$	pH	K_c'
328.15	5.5	≈ 6

Reference: 89JOH/HED

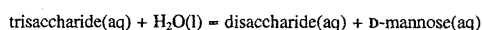
Method: HPLC and gas-liquid chromatography with mass spectrometry

Buffer: Na₂HPO₄ (0.02 mol dm⁻³) + citric acid (0.01 mol dm⁻³)

pH: 5.5

Evaluation: C

The apparent equilibrium constant given here was calculated from the equilibrium data given in Johansson *et al.*'s Table 1. The "tetrasaccharide" and "trisaccharide" were each a complex mixture of ≈ 20 tetrasaccharides and 13 trisaccharides. Only a few of these could be identified.



$\frac{T}{K}$	pH	K_c'
328.15	5.5	≈ 6

Reference: 89JOH/HED

Method: HPLC and gas-liquid chromatography with mass spectrometry

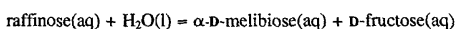
Buffer: Na₂HPO₄ (0.02 mol dm⁻³) + citric acid (0.01 mol dm⁻³)

pH: 5.5

Evaluation: C

The apparent equilibrium constant given here was calculated from the equilibrium data given in Johansson *et al.*'s Table 1. The "trisaccharide" was a complex mixture of 13 trisaccharides. Only a few of these could be identified. The "disaccharide" in the reaction given here refers to a mixture of four disaccharides which were characterized by (gas-liquid chromatography + mass spectrometry) and by NMR.

5.24. Enzyme: β -fructofuranosidase (EC 3.2.1.26)



$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	6.00	-15.25

Reference: 91GOL/BEL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 6.00

Evaluation: A

stachyose(aq) + H₂O(l) = D-fructose(aq) +
O- α -D-galactopyranosyl-(1 \rightarrow 6)-O- α -D-galactopyranosyl-(1 \rightarrow 6)-
 α -D-glucopyranose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	6.00	-14.93

Reference: 91GOL/BEL

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 6.00

Evaluation: A

sucrose(aq) + H₂O(l) = D-glucose(aq) + D-fructose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
303.15	4.5	-13.9

Reference: 52BAU/GEM

Method: calorimetry

Buffer: acetate (0.03 mol dm⁻³)

pH: 4.5

Evaluation: B

sucrose(aq) + H₂O(l) = D-glucose(aq) + D-fructose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	5.65	15.003
304.15	5.65	14.523
310.15	5.65	14.227
316.15	5.65	13.948

Reference: 89GOL/TEW2

Method: calorimetry

Buffer: sodium acetate (0.1 mol dm⁻³)

pH: 5.65

Cofactor(s): none

Evaluation: A

This calorimetric result is in excellent agreement with the (non-enzymatic) result obtained by Sturtevant [37STU] using acid hydrolysis. Goldberg *et al.* also obtained $\Delta_r C_p^\circ = 57 J K^{-1} mol^{-1}$ and, using a thermodynamic cycle, calculated $K_m(T = 298.15 K, I = 0) = 4.44E4$ for the chemical reference reaction: sucrose(aq) + H₂O(l) = D-glucose(aq) + D-fructose(aq).

5.25. Enzyme: α -dextrin endo-1,6- α -glucosidase (EC 3.2.1.41)

maltosyl- β -cyclomaltoheptaose(aq) + H₂O(l) = cyclomaltoheptaose(aq) +
maltose(aq)

$\frac{T}{K}$	cosolvent	K_c'
285.7	none	3.0E3
294.1	none	1.6E3
303.0	none	8.1E2
312.5	none	4.0E2
322.6	none	2.9E2
333.3	none	2.0E2
285.7	poly(ethylene glycol) 6000, 10 % (w/w)	8.6E2
294.1	poly(ethylene glycol) 6000, 10 % (w/w)	5.1E2
303.0	poly(ethylene glycol) 6000, 10 % (w/w)	3.5E2
312.5	poly(ethylene glycol) 6000, 10 % (w/w)	2.2E2
322.6	poly(ethylene glycol) 6000, 10 % (w/w)	1.5E2
333.3	poly(ethylene glycol) 6000, 10 % (w/w)	1.1E2

Reference: 92LEE/HAN

Method: HPLC

Buffer: citrate + NaOH

pH: 4.9

Evaluation: B

The apparent equilibrium constants given here were taken from Lee and Han's Fig. 5. From the temperature dependencies of the apparent equilibrium constants we calculate $\Delta_r H'^\circ = -(46 \pm 7) kJ mol^{-1}$ and $\Delta_r H'^\circ = -(34 \pm 3) kJ mol^{-1}$ for this reaction in the absence and presence of poly(ethylene glycol) 6000, 10% (w/w), respectively, at $\bar{T} = 310 K$ and pH = 4.9.

5.26. Enzyme: AMP nucleosidase (EC 3.2.2.4)

AMP(aq) + H₂O(l) = adenine(aq) + D-ribose 5-phosphate(aq)

$\frac{T}{K}$	pH	K_c'
303.15	8.0	170

Reference: 86DEW/EMI

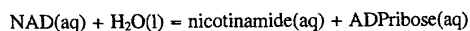
Method: HPLC

Buffer: triethanolamine (0.1 mol dm⁻³) + HCl

pH: 8.0

Cofactor(s): MgCl₂ (0.024 mol dm⁻³)

Evaluation: B

5.27. Enzyme: NAD⁺ nucleosidase (EC 3.2.2.5)

$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	7.4	25.8

Reference: 89BER/MUD

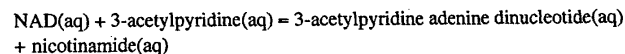
Method: calorimetry

Buffer: Bis-tris (0.2 mol dm⁻³)

pH: 7.4

Evaluation: B

Berger *et al.* applied a correction for the enthalpy of buffer protonation to obtain the value of $\Delta_r H^\circ$ given here.

5.28. Enzyme: NAD(P)⁺ nucleosidase (EC 3.2.2.6)

$\frac{T}{K}$	pH	K'
312.15	6.0	1.15

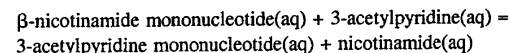
Reference: 89IMA

Method: spectrophotometry

Buffer: Tris maleate (0.05 mol dm⁻³)

pH: 6.0

Evaluation: B



$\frac{T}{K}$	pH	K'
312.15	6.0	0.61

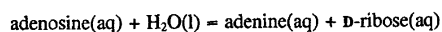
Reference: 89IMA

Method: spectrophotometry

Buffer: Tris maleate (0.05 mol dm⁻³)

pH: 6.0

Evaluation: B

5.29. Enzyme: adenosine nucleosidase (EC 3.2.2.7)

$\frac{T}{K}$	pH	K'
298.15	7.0	53

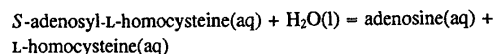
Reference: 80CAM/SGA

Method: spectrophotometry

Buffer: Tris + HCl (0.107 mol dm⁻³)

pH: 7.0

Evaluation: B

5.30. Enzyme: adenosylhomocysteinase (EC 3.3.1.1)

$\frac{T}{K}$	pH	K'
310.15	6.3	1.4E-6

Reference: 59HAB/CAN

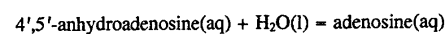
Method: enzymatic assay

Buffer: potassium phosphate (0.04 mol dm⁻³)

pH: 6.3

Evaluation: B

The same result was later reported by Cantoni [61CAN].



$\frac{T}{K}$	pH	K'
310.15	7.0	0.48

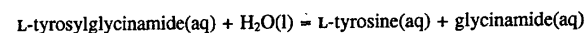
Reference: 85HER/AY

Method: HPLC

Buffer: potassium phosphate (0.010 mol dm⁻³)

pH: 7.0

Evaluation: C

5.31. Enzyme: leucyl aminopeptidase (EC 3.4.11.1)

$\frac{T}{K}$	pH	$\frac{\Delta_r H^\circ(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	8.0	-5.4
298.15	8.2	-5.3
298.15	8.6	-5.5

Reference: 61RAW/WAD

Method: calorimetry

Buffer: Tris (\approx 0.04 mol dm⁻³) + HCl

pH: 8.0-8.6

Evaluation: A

5.32. Enzyme: dipeptidyl-peptidase I (EC 3.4.14.1)

glycyl-L-phenylalaninamide(aq) + H₂O(l) = glycyl-L-phenylalanine(aq) + ammonia(aq)

$\frac{T}{K}$	pH	Buffer	$\Delta_r H$ (cal) kJ mol ⁻¹
298.15	4.69	sodium phosphate + sodium acetate	-24.6
298.15	4.85	sodium phosphate	-26.3
298.15	5.09	sodium phosphate	-26.4
298.15	5.11	sodium phosphate	-27.4
298.15	5.65	sodium phosphate	-25.6

Reference: 53STU

Method: calorimetry

Buffer: sodium phosphate (0.05 mol dm⁻³) and/or sodium acetate (0.05 mol dm⁻³)

pH: 4.69–5.65

Evaluation: A

5.33. Enzyme: carboxypeptidase A (EC 3.4.17.1)

benzyloxycarbonylglycyl-L-leucine(aq) + H₂O(l) =
benzyloxycarbonylglycine(aq) + L-leucine(aq)

$\frac{T}{K}$	pH	$\Delta_r H$ (cal) kJ mol ⁻¹
298.15	6.46	-8.7
298.15	6.77	-8.7
298.15	6.81	-8.6
298.15	7.24	-9.2
298.15	7.44	-9.1
298.15	7.45	-8.9

Reference: 53STU

Method: calorimetry

Buffer: sodium phosphate (0.05 mol dm⁻³)

pH: 6.46–7.45

Evaluation: A

benzyloxycarbonylglycyl-L-phenylalanine(aq) + H₂O(l) =
benzyloxycarbonylglycine(aq) + L-phenylalanine(aq)

$\frac{T}{K}$	pH	$\Delta_r H$ (cal) kJ mol ⁻¹
298.15	6.67	-10.84
298.15	6.71	-10.21
298.15	7.00	-10.84
298.15	7.03	-10.38
298.15	7.28	-9.50
298.15	7.29	-9.58
298.15	7.31	-10.21
298.15	7.85	-8.70

Reference: 52DOB/STU

Method: calorimetry

Buffer: lithium phosphate

pH: 6.67–7.85

Evaluation: A

The ionic strength was ≈ 0.3 mol dm⁻³. Dobry and Sturtevant calculated $\Delta_r H^\circ(T = 298.15 \text{ K}) = -10.67$ kJ mol⁻¹ for the chemical reference reaction: benzyloxycarbonylglycyl-L-phenylalanine⁻(aq) + H₂O(l) = benzyloxycarbonylglycine⁻(aq) + L-phenylalanine(aq).

5.34. Enzyme: gly-X carboxypeptidase (EC 3.4.17.4)

N-benzoyl-L-tyrosine(aq) + H₂O(l) = benzoic acid(aq) + L-tyrosine(aq)

$\frac{T}{K}$	pH	$\Delta_r H$ (cal) kJ mol ⁻¹
298.15	7.05	-8.85
298.15	7.15	-7.95
298.15	7.50	-8.12
298.15	7.95	-9.04
298.15	8.05	-9.08

Reference: 61RAW/WAD

Method: calorimetry

Buffer: Tris (≈ 0.04 mol dm⁻³) + HCl

pH: 7.05–8.05

Evaluation: A

N-benzoyl-L-tyrosylglycine(aq) + H₂O(l) = N-benzoyl-L-tyrosine(aq) + glycine(aq)

$\frac{T}{K}$	pH	$\Delta_r H$ (cal) kJ mol ⁻¹
298.15	7.0	-5.0
298.15	7.5	-5.9
298.15	8.0	-6.2

Reference: 61RAW/WAD

Method: calorimetry

Buffer: Tris (≈ 0.04 mol dm⁻³) + HCl

pH: 7.0–8.0

Evaluation: A

5.35. Enzyme: γ -glu-X carboxypeptidase (EC 3.4.19.9)

pteroylglutamate(aq) + H₂O(l) = pterooate(aq) + L-glutamate(aq)

$\frac{T}{K}$	pH	K'_c
310.15	7.3	15.6

Reference: 71MCC/CHA

Method: spectrophotometry

Buffer: Tris (0.05 mol dm⁻³) + HCl

pH: 7.3

Cofactor(s): ZnCl₂ (0.0001 mol dm⁻³)

Evaluation: B

5.36. Enzyme: chymotrypsin (EC 3.4.21.1)

N-acetyl-L-phenylalanine methyl ester(aq) + H₂O(l) =
N-acetyl-L-phenylalanine(aq) + methanol(aq)

$\frac{T}{K}$	pH	K'_c
293.15	5.5	588

Reference: 77ANT/GIN

Method: chemical assay

Buffer: acetate (0.1 mol dm⁻³)

pH: 5.5

Evaluation: C

N-acetyl-L-phenylalanine methyl ester(aq) + H₂O(l) =
N-acetyl-L-phenylalanine(aq) + methanol(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	7.0	-4.81

Reference: 84REK/RUM

Method: calorimetry

Buffer: phosphate (0.05 mol dm⁻³)

pH: 7.0

Evaluation: A

The same result was also reported by Rekharsky *et al.* [84REK/RUM2].

N-acetyl-L-phenylalanyl-glycinamide(aq) + H₂O(l) =
N-acetyl-L-phenylalanine(aq) + glycineamide(aq)

$\frac{T}{K}$	pH	K'_c
293.15	5.5	2.0
293.15	7.3	2.5
293.15	8.2	5.9

Reference: 77ANT/GIN

Method: chemical assay

Buffer: acetate (0.1 mol dm⁻³)

pH: 5.5-8.2

Evaluation: C

Acetate buffer (0.1 mol dm⁻³) was used for the experiment at pH = 5.5. Antonov *et al.* state that KCl (0.1 mol dm⁻³) was used for the experiments at pH = 7.3 and pH = 8.2. It is not clear how these pHs were maintained.

N-acetyl-L-tyrosine ethyl ester(aq) + H₂O(l) = *N*-acetyl-L-tyrosine(aq) + ethanol(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	7.8	-48.4

Reference: 77GRI/LOC

Method: calorimetry

Buffer: Tris + HCl

pH: 7.8

Evaluation: B

N-benzoyl-L-tyrosinamide(aq) + H₂O(l) = *N*-benzoyl-L-tyrosine(aq)
+ ammonia(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	6.06	-23.60
298.15	6.27	-25.02
298.15	6.49	-23.64
298.15	6.51	-22.80
298.15	6.76	-29.25
298.15	6.83	-19.12
298.15	6.99	-25.96
298.15	7.08	-21.00
298.15	7.09	-24.06
298.15	7.11	-22.84
298.15	7.14	-23.64
298.15	7.21	-24.77
298.15	7.27	-24.89
298.15	7.28	-24.89

Reference: 52DOB/STU

Method: calorimetry

Buffer: lithium phosphate

pH: 6.06-7.28

Evaluation: A

The ionic strength was ≈ 0.3 mol dm⁻³. Since, several of the experiments used the racemic mixture (*N*-benzoyl-L-tyrosinamide + *N*-benzoyl-D-tyrosinamide), the results given here were obtained on the assumption that there was no reaction with the D isomer. Dobry and Sturtevant calculated $\Delta_r H^\circ(T = 298.15 \text{ K}) = -(24.4 \pm 0.9) \text{ kJ mol}^{-1}$ for the chemical reference reaction: *N*-benzoyl-L-tyrosinamide(aq) + H₂O(l) = *N*-benzoyl-L-tyrosine⁻(aq) + NH₄⁺(aq).

N-acetyl-L-tyrosine hydroxamic acid(aq) + H₂O(l) =
N-acetyl-L-tyrosine(aq) + hydroxylamine(aq)

$\frac{T}{K}$	pH	K'_c
298.15	6.14	4.90
298.15	6.21	5.85
298.15	6.22	5.65
298.15	6.59	10.4
298.15	6.67	13.0
298.15	6.67	11.5

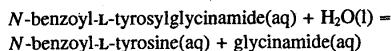
Reference: 63JEN/CAP

Method: chemical analysis and spectrophotometry

pH: 6.14-6.67

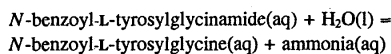
Evaluation: A

The ionic strength was 2.0 mol dm⁻³.



$\frac{T}{\text{K}}$	pH	K_c'
298.15	8.0	5

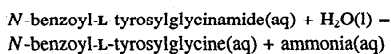
Reference: 51FRU/JOH
Method: radioactivity
pH: 8.0
Evaluation: C



$\frac{T}{\text{K}}$	pH	K_c'
298.15	7.90	3.9

Reference: 52DOB/FRU
Method: isotopic tracer method
Buffer: phosphate (0.5 mol dm⁻³)
pH: 7.90
Evaluation: A

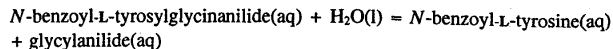
The apparent equilibrium constant given here was calculated from the concentrations of reactants and products measured by Dobry *et al.* Dobry *et al.* calculated $\Delta_r G^\circ(T = 298.15 \text{ K}) = -(1.8 \pm 0.4) \text{ kJ mol}^{-1}$ for the chemical reference reaction: $N\text{-benzoyl-L-tyrosylglycinamide(aq)} + \text{H}_2\text{O(l)} = N\text{-benzoyl-L-tyrosylglycine}^-(\text{aq}) + \text{NH}_4^+(\text{aq})$.



$\frac{T}{\text{K}}$	pH	$\Delta_r H^\circ(\text{cal})$ kJ mol ⁻¹
298.15	6.30	-5.19
298.15	6.40	-5.73
298.15	6.41	-5.67
298.15	6.61	-5.16
298.15	6.73	-4.00
298.15	6.86	-3.54
298.15	6.87	-3.54

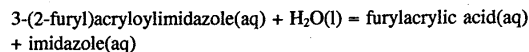
Reference: 52DOB/FRU
Method: calorimetry
Buffer: phosphate (0.05 mol dm⁻³)
pH: 6.30-6.87
Evaluation: A

The ionic strength was $\approx 0.3 \text{ mol dm}^{-3}$. Dobry *et al.* calculated $\Delta_r H^\circ(T = 298.15 \text{ K}, I_c \approx 0.3 \text{ mol dm}^{-3}) = -(6.49 \pm 0.4) \text{ kJ mol}^{-1}$ for the chemical reference reaction: $N\text{-benzoyl-L-tyrosylglycinamide(aq)} + \text{H}_2\text{O(l)} = N\text{-benzoyl-L-tyrosylglycine}^-(\text{aq}) + \text{NH}_4^+(\text{aq})$.



$\frac{T}{\text{K}}$	pH	K_c'
296.15	6.5	10

Reference: 61GAW/GLA
Method: spectrophotometry
Buffer: phosphate
pH: 6.5
Evaluation: C

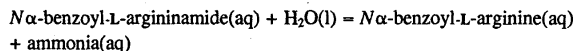


$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	7.85	-47.2

Reference: 80SLI/BOL
Method: calorimetry
pH: 7.85
Evaluation: B

Slightom and Bolen applied a correction for the enthalpy of buffer protonation to obtain the value of $\Delta_r H^\circ$ given here.

5.37. Enzyme: trypsin (EC 3.4.21.4)



$\frac{T}{\text{K}}$	pH	Buffer and/or salt	I_c mol dm ⁻³	$\Delta_r H^\circ(\text{cal})$ kJ mol ⁻¹
298.15	6.50	phosphate	0.00057	-24.8
298.15	6.60	none	0.00065	-25.1
298.15	6.82	NH ₄ Cl	0.00081	-26.0
298.15	6.62	phosphate	0.00247	-26.7
298.15	6.78	NH ₄ Cl	0.00271	-25.5
298.15	7.01	NH ₄ Cl	0.00282	-28.1
298.15	7.13	phosphate	0.00401	-24.1
298.15	7.15	NH ₄ Cl	0.01041	-26.7
298.15	6.81	NaCl	0.01060	-26.7
298.15	6.82	NaCl	0.01060	-27.2
298.15	7.16	NH ₄ Cl	0.01081	-28.2
298.15	6.45	phosphate	0.01256	-25.9
298.15	7.15	NH ₄ Cl	0.0406	-27.4
298.15	7.30	Tris	0.0506	-28.7
298.15	7.43	Tris	0.0643	-28.2
298.15	7.41	NaCl + Tris	0.138	-27.9
298.15	7.30	NaCl + Tris	0.550	-29.6
298.15	6.67	NaCl + Tris	2.001	-26.2
298.15	6.55	NaCl	2.001	-26.5
298.15	6.40	NaCl + Tris	2.001	-26.7
298.15	6.49	NaCl	2.001	-26.9
298.15	6.67	NaCl + Tris	2.001	-27.4
298.15	6.96	NaCl + Tris	2.001	-28.7
298.15	6.50	NH ₄ Cl + CaCl ₂	0.165	-27.2
298.15	7.43	NH ₄ Cl	0.20	-27.1
298.15	7.24	NH ₄ Cl + CaCl ₂	0.256	-25.5
298.15	7.40	NH ₄ Cl	0.40	-27.8
298.15	7.38	NH ₄ Cl	0.40	-26.6
298.15	7.40	NH ₄ Cl	0.40	-28.3

*N*α-benzoyl-L-argininamide(aq) + H₂O(l) = *N*α-benzoyl-L-arginine(aq)
+ ammonia(aq) — Continued

$\frac{T}{K}$	pH	Buffer and/or salt	I_c mol dm ⁻³	$\Delta_r H$ (cal) kJ mol ⁻¹
298.15	7.43	NH ₄ Cl	0.40	-26.7
298.15	7.34	NH ₄ Cl + CaCl ₂	0.655	-27.6
298.15	7.42	NH ₄ Cl	0.80	-25.3
298.15	7.44	NH ₄ Cl	0.80	-26.9
298.15	7.42	NH ₄ Cl	0.96	-27.8
298.15	7.39	NH ₄ Cl	0.96	-23.3
298.15	7.33	NH ₄ Cl + CaCl ₂	1.295	-24.7
298.15	7.30	NH ₄ Cl	1.44	-24.5
298.15	7.31	NH ₄ Cl	1.60	-22.6
298.15	7.35	NH ₄ Cl	1.76	-23.6

Reference: 56FOR/GUT
Method: calorimetry
Buffer: phosphate, Tris, and NH₄Cl
pH: 6.50–7.43
Evaluation: A

Forrest *et al.* extrapolated their results to $I_c = 0$ and obtained $\Delta_r H$ (cal) = -25.1 kJ mol⁻¹ at $T = 298.15$ K.

(L-lysine)_n(aq) + (n-1) H₂O(l) = n L-lysine(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{(\text{kJ mol}^{-1})(n-1)}$
298.15	7.6	-1.34

Reference: 55STU2
Method: calorimetry
Buffer: Tris
pH: 7.6
Evaluation: A

(L-lysine)_n is poly-L-lysine.

5.38. Enzyme: papain (EC 3.4.22.2)

hippurylanilide(aq) + H₂O(l) = hippuric acid(aq) + aniline(aq)

$\frac{T}{K}$	pH	K'_c
312.15	5.0	11

Reference: 65CAR/KIR
Method: spectrophotometry
Buffer: citrate
pH: 5.0
Evaluation: C

5.39. Enzyme: pepsin A (EC 3.4.23.1)

N-acetyl-L-phenylalanine-L-dibromotyrosine ethyl ester(aq) + H₂O(l) =
N-acetyl-L-phenylalanine(aq) + L-dibromotyrosine ethyl ester(aq)

$\frac{T}{K}$	pH	K'_c
293.15	4.1	2.3

Reference: 75KAP/BAR
Method: radioactivity
Buffer: acetate (0.2 mol dm⁻³)
pH: 4.1
Evaluation: C

The apparent equilibrium constant given here was calculated from the standard transformed Gibbs energy of reaction given by Kapitannikov *et al.*

N-acetyl-L-phenylalanyl-L-phenylalanyl-glycine(aq) + H₂O(l) =
N-acetyl-L-phenylalanine(aq) + L-phenylalanyl-glycine(aq)

$\frac{T}{K}$	pH	K'_c
293.15	4.6	4.7

Reference: 75KAP/BAR
Method: radioactivity
Buffer: acetate (0.2 mol dm⁻³)
pH: 4.6
Evaluation: C

The apparent equilibrium constant given here was calculated from the standard transformed Gibbs energy of reaction given by the Kapitannikov *et al.*

N-acetyl-L-phenylalanyl-L-phenylalanyl-glycine methyl ester(aq) + H₂O(l) =
N-acetyl-L-phenylalanine(aq) + L-phenylalanyl-glycine methyl ester(aq)

$\frac{T}{K}$	pH	K'_c
293.15	4.6	1.3

Reference: 75KAP/BAR
Method: radioactivity
Buffer: acetate (0.2 mol dm⁻³)
pH: 4.6
Evaluation: C

5.40. Enzyme: chymosin (EC 3.4.23.4)

The reaction is the cleavage of a single bond in casein κ .

$\frac{T}{K}$	pH	Buffer	Protein	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	6.6	Tris	sodium caseinate	-13.4
298.15	6.6	Tris	casein κ	-9.6
298.15	6.6	phosphate	casein κ	-7.5

Reference: 63CHE/RAW
 Method: calorimetry
 Buffer: Tris and phosphate
 pH: 6.6
 Evaluation: C

These are approximate results. Other processes may have been present that made substantial contributions to the calorimetrically determined enthalpies of reaction.

5.41. Enzyme: thermolysin (EC 3.4.24.27)

benzyloxycarbonylglycyl-L-phenylalaninamide(aq) + H₂O(l) =
 benzyloxycarbonylglycine(aq) + L-phenylalaninamide(aq)

$\frac{T}{K}$	pH	K'_c
298.15	7.2	1.81
311.15	7.1	1.39
333.15	7.0	1.03

Reference: 79FLE/TAT
 Method: radioactivity
 Buffer: Tris (0.02 mol dm⁻³) + HCl
 pH: 7.0-7.2
 Cofactor(s): CaCl₂
 Evaluation: C

The apparent equilibrium constants given in column 6 in Flegmann and Tatersall's Table 2 do not agree with what is calculated from the data given in columns 3, 4, and 5 in that table.

5.42. Enzyme: asparaginase (EC 3.5.1.1)

L-asparagine(aq) + H₂O(l) = L-aspartate(aq) + ammonia(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
295.0	8.5	-23.9

Reference: 59KIT/HEM
 Method: calorimetry
 Buffer: borate (0.01 mol dm⁻³)
 pH: 8.5
 Evaluation: A

L-asparagine(aq) + H₂O(l) = L-aspartate(aq) + ammonia(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	6.86	-24.56

Reference: 85REK/SLO
 Method: calorimetry
 Buffer: phosphate (0.05 mol dm⁻³)
 pH: 6.86
 Evaluation: A

5.43. Enzyme: glutaminase (EC 3.5.1.2)

L-glutamine(aq) + H₂O(l) = L-glutamate(aq) + ammonia(aq)

$\frac{T}{K}$	pH	K'_c
298.15	5.5	850

Reference: 56BEN/HEM
 Method: calorimetry
 pH: 5.5
 Evaluation: B

The result given here is the average obtained from measurements performed at three different concentrations of reactants and products. The pH is assumed to be \approx 5.5 based upon the results given by Benzinger *et al.* [59BEN/KIT].

L-glutamine(aq) + H₂O(l) = L-glutamate(aq) + ammonia(aq)

$\frac{T}{K}$	pH	K'_c
298.15	5.5	896

Reference: 59BEN/KIT
 Method: calorimetry
 pH: 5.5
 Evaluation: B

The result given here is the average obtained from measurements performed at three different concentrations of reactants and products.

L-glutamine(aq) + H₂O(l) = L-glutamate(aq) + ammonia(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
295.0	4.5	-21.6

Reference: 59KIT/HEM
 Method: calorimetry
 Buffer: acetate (0.010 mol dm⁻³)
 pH: 4.5
 Evaluation: A

γ -glutamohydroxamic acid(aq) + H₂O(l) = L-glutamate(aq)
+ hydroxylamine(aq)

$\frac{T}{K}$	pH	K_c'
310.15	7.2	3.0

Reference: 63EHR/MAR

Method: spectrophotometry

Buffer: imidazole (0.050 mol dm⁻³) + HCl

pH: 7.2

Evaluation: B

5.44. Enzyme: urease (EC 3.5.1.5)

ammonium carbamate(aq) + 2 H₂O(l) = 2 ammonia(aq) + carbon dioxide(aq)

$\frac{T}{K}$	pH	Percent (dimethylsulfoxide)	K_c'
293.15	6.5	0	1.92E3
293.15	6.5	5	1.71E3
293.15	6.5	10	1.50E3
293.15	6.5	20	1.23E3
310.15	6.5	0	1.03E3

Reference: 80TER/RAB

Method: spectrophotometry

pH: 6.5

Evaluation: B

Terekhina and Rabovskaya did not state what the percent of dimethyl sulfoxide was — i.e. volume percent, mass percent, or mole percent.

urea(aq) + 2 H₂O(l) = 2 ammonia(aq) + carbon dioxide(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
303.15	7.14	-56.6

Reference: 52BAU/GEM

Method: calorimetry

Buffer: sodium phosphate (0.2 mol dm⁻³)

pH: 7.14

Evaluation: B

urea(aq) + 2 H₂O(l) = 2 ammonia(aq) + carbon dioxide(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
313.15	6.70	phosphate	-58.7
313.15	?	none	-17.8

Reference: 60ISH

Method: calorimetry

Buffer: phosphate

pH: 6.70

Evaluation: B

urea(aq) + 2 H₂O(l) = 2 ammonia(aq) + carbon dioxide(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	6.95	-33.1

Reference: 73BEE/STE

Method: calorimetry

Buffer: Na₂HPO₄(0.5 mol dm⁻³) + NaH₂PO₄(0.25 mol dm⁻³)

pH: 6.95

Evaluation: B

urea(aq) + 2 H₂O(l) = 2 ammonia + carbon dioxide(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	6.7	phosphate	-48.2
298.15	7.5	phosphate	-61.3
298.15	6.7	maleate	-56.7
298.15	6.7	citrate	-21.9
298.15	7.5	Tris	-18.7

Reference: 75JES

Method: calorimetry

Buffer: phosphate, maleate, citrate, and Tris

pH: 6.7–7.5

Evaluation: B

Jespersen reported that ammonium carbamate is formed as a product in citrate and Tris buffers.

urea(aq) + 2 H₂O(l) = 2 ammonia(aq) + carbon dioxide(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
300.15	7.0	-7.1

Reference: 76SCH/KRI

Method: calorimetry

Buffer: Tris (0.05 mol dm⁻³) + HCl

pH: 7.0

Evaluation: B

urea(aq) + 2 H₂O(l) = 2 ammonia(aq) + carbon dioxide(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	6.9	phosphate	-61
298.15	7.9	Tris	-20

Reference: 87OWU/TRE

Method: calorimetry

Buffer: {Tris (0.2 mol dm⁻³) + HCl} or sodium phosphate (0.2 mol dm⁻³)

pH: 6.9–7.9

Evaluation: B

5.45. Enzyme: penicillin amidase (EC 3.5.1.11)

ampicillin(aq) + H₂O(l) = 6-aminopenicillanic acid(aq) +
D(-)-α-aminophenylacetic acid(aq)

$\frac{T}{K}$	pH	K'_c
298.15	4.5	6E-3
298.15	5.0	1.3E-2

Reference: 80SVE/MAR
Method: spectrophotometry
Buffer: citrate
pH: 4.5–5.0
Evaluation: B

cephalexin(aq) + H₂O(l) = 7-aminodeacetoxycephalosporanic acid(aq) +
D(-)-α-aminophenylacetic acid(aq)

$\frac{T}{K}$	pH	K'_c
298.15	5.8	4.4E-2

Reference: 80SVE/MAR
Method: spectrophotometry
Buffer: citrate
pH: 5.8
Evaluation: B

cephaloridine(aq) + H₂O(l) = 2-thienylacetic acid(aq) +
7-amino-3-(1-pyridyl-methyl)-3-cephem-4-carboxylic acid(aq)

$\frac{T}{K}$	pH	K'_c
298.15	5.0	1.5E-2

Reference: 80SVE/MAR
Method: spectrophotometry
Buffer: citrate
pH: 5.0
Evaluation: B

cephalothin(aq) + H₂O(l) = 2-thienylacetic acid(aq) +
7-aminocephalosporanic acid(aq)

$\frac{T}{K}$	pH	K'_c
298.15	5.0	7.0E-3

Reference: 80SVE/MAR
Method: spectrophotometry
Buffer: citrate
pH: 5.0
Evaluation: B

penicillin G(aq) + H₂O(l) = 6-aminopenicillanic acid(aq) +
phenylacetic acid(aq)

$\frac{T}{K}$	pH	K'_c
298.15	5.0	3.0E-3
298.15	6.0	2.2E-2

Reference: 76BER/KLE
pH: 5.0–6.0
Evaluation: C

The ionic strength was $\approx 0.1 \text{ mol dm}^{-3}$.

penicillin G(aq) + H₂O(l) = 6-aminopenicillanic acid(aq) +
phenylacetic acid(aq)

$\frac{T}{K}$	pH	K'_c
298.15	5.0	4.0E-3
298.15	6.0	2.0E-2

Reference: 80SVE/MAR
Method: spectrophotometry
Buffer: citrate
pH: 5.0–6.0
Evaluation: B

penicillin G⁻(aq) + H₂O(l) = 6-aminopenicillanic acid⁻(aq) +
phenylacetic acid(aq)

$\frac{T}{K}$	K_c
298.15	3E-4

Reference: 83HAA/KAR
Evaluation: C

Haagensen *et al.* reported $K_c(T = 298.15 \text{ K}) = 0.0003$ for this chemical reference reaction. Few experimental details were given.

penicillin G(aq) + H₂O(l) = 6-aminopenicillanic acid(aq) + phenylacetic acid(aq)

$\frac{T}{K}$	pH	$\frac{m(KCl)}{\text{mol kg}^{-1}}$	K'_m
292.15	6.67	0.0	0.330
292.15	6.68	0.0	0.275
298.15	6.71	0.0	0.445
298.15	6.59	0.0	0.382
304.15	6.68	0.0	0.579
304.15	6.54	0.0	0.469
310.15	6.10	0.0	0.221
310.15	6.02	0.0	0.194
310.15	6.30	0.0	0.416
310.15	6.07	0.0	0.247
310.15	6.54	0.2	0.694
310.15	6.43	0.2	0.590
310.15	6.61	0.0	0.756
310.15	6.39	0.0	0.524
310.15	6.68	0.0	0.644
310.15	6.59	0.0	0.565
310.15	6.74	0.0	1.051
310.15	6.46	0.0	0.536
310.15	7.05	0.0	1.71
310.15	6.85	0.0	1.13
310.15	7.55	0.0	7.46
310.15	7.32	0.0	4.16
316.15	6.65	0.0	0.879
316.15	6.59	0.0	0.725
322.15	6.75	0.0	1.19
322.15	6.53	0.0	0.776

Reference: 88TEW/GOL

Method: HPLC

Buffer: phosphate (0.1 mol dm⁻³)

pH: 6.67–7.55

Evaluation: A

Tewari and Goldberg calculated $K_m = 7.35 \times 10^{-8}$, $\Delta_r H^\circ = 29.7 \text{ kJ mol}^{-1}$, and $\Delta_r C_p^\circ = -240 \text{ J K}^{-1} \text{ mol}^{-1}$ at $T = 298.15 \text{ K}$ and $I = 0$ for the chemical reference reaction: penicillin G⁻(aq) = 6-aminopenicillanic acid⁻(aq) + phenylacetic acid⁻(aq) + H⁺(aq).

penicillin G(aq) + H₂O(l) = 6-aminopenicillanic acid(aq) + phenylacetic acid(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	6.00	19.73
298.15	6.54	22.95
298.15	7.00	23.80
304.40	6.00	19.63
304.40	6.54	22.91
304.40	7.00	23.44
304.40	7.44	23.26
310.15	6.00	19.60
310.15	6.54	22.61
310.15	7.00	23.48

Reference: 88TEW/GOL

Method: calorimetry

Buffer: phosphate (0.1 mol dm⁻³)

pH: 6.00–7.44

Evaluation: A

Tewari and Goldberg calculated $\Delta_r H^\circ = 29.7 \text{ kJ mol}^{-1}$, and $\Delta_r C_p^\circ = -240 \text{ J K}^{-1} \text{ mol}^{-1}$ at $T = 298.15 \text{ K}$ and $I = 0$ for the chemical reference reaction: penicillin G⁻(aq) = 6-aminopenicillanic acid⁻(aq) + phenylacetic acid⁻(aq) + H⁺(aq).

penicillinoic acid(aq) + H₂O(l) = penicic acid(aq) + phenylacetic acid(aq)

$\frac{T}{K}$	pH	K'_c
298.15	7.0	1.8

Reference: 80SVE/MAR

Method: spectrophotometry

Buffer: citrate

pH: 7.0

Evaluation: B

phenoxymethylpenicillin⁻(aq) + H₂O(l) = 6-aminopenicillanate⁻(aq) + phenoxyacetate(aq)

$\frac{T}{K}$	K_c
298.15	1.28E-3

Reference: 83HAA/KAR

pH: 6–6.74

Evaluation: C

Haagensen *et al.* reported $K_c(T = 298.15 \text{ K}) = 0.00128$ for this chemical reference reaction. Few experimental details were given.

7-phenylacetamidodeacetoxycephalosporanic acid(aq) + H₂O(l) = 7-aminodeacetoxycephalosporanic acid(aq) + phenylacetic acid(aq)

$\frac{T}{K}$	pH	K'_c
298.15	5.0	7.0E-4

Reference: 80SVE/MAR

Method: spectrophotometry

Buffer: citrate

pH: 5.0

Evaluation: B

phenylacetyl-glycine(aq) + H₂O(l) = phenylacetic acid(aq) + glycine(aq)

$\frac{T}{K}$	pH	K'_c
298.15	7.0	1.2

Reference: 80SVE/MAR

Method: spectrophotometry

Buffer: citrate

pH: 7.0

Evaluation: B

phenylacetyl-L-phenylglycine(aq) + H₂O(l) = phenylacetic acid(aq) + L-phenylglycine(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	6.86	-8.58

Reference: 87REK/EGO

Method: calorimetry

Buffer: phosphate (0.05 mol dm⁻³)

pH: 6.86

Evaluation: A

5.46. Enzyme: aminoacylase (EC 3.5.1.14)

N-acetyl-L-alanine(aq) + H₂O(l) = acetate(aq) + L-alanine(aq)

$\frac{T}{K}$	pH	K_c'
298.15	7.5	5.6

Reference: 82GAL/SVE

Method: spectrophotometry

Buffer: phosphate (0.1 mol dm⁻³)

pH: 7.5

Evaluation: C

N-acetyl-L-alanine(aq) + H₂O(l) = acetate(aq) + L-alanine(aq)

$\frac{T}{K}$	pH	K_c'
298.15	4.5	33
298.15	5.0	25
298.15	5.5	12
298.15	6.0	7
298.15	6.5	9
298.15	7.0	9
298.15	7.5	12
298.15	8.0	10
298.15	9.0	8
298.15	9.5	18

Reference: 86ROH/ETT

Method: enzymatic assay and spectrophotometry

Buffer: acetate (1.25 mol dm⁻³), phosphate (0.125 mol dm⁻³), and borate (0.125 mol dm⁻³)

pH: 4.5-9.5

Evaluation: C

The results given here were obtained from Fig. 4 in Röhms and Van Etten's paper. The ionic strength was 2.0 mol dm⁻³.

N-acetyl-L- α -amino-n-butyrate(aq) + H₂O(l) = acetate(aq) + L- α -amino-n-butyrate(aq)

$\frac{T}{K}$	pH	K_c'
298.15	7.5	5.5

Reference: 82GAL/SVE

Method: spectrophotometry

Buffer: phosphate (0.1 mol dm⁻³)

pH: 7.5

Evaluation: C

N-acetyl-L-glycine(aq) + H₂O(l) = acetate(aq) + glycine(aq)

$\frac{T}{K}$	pH	K_c'
298.15	7.5	4.5

Reference: 82GAL/SVE

Method: spectrophotometry

Buffer: phosphate (0.1 mol dm⁻³)

pH: 7.5

Evaluation: C

N-acetyl-L-methionine(aq) + H₂O(l) = acetate(aq) + L-methionine(aq)

$\frac{T}{K}$	pH	K_c'
298.15	7.5	3.6

Reference: 80SVE/GAL

Buffer: none

pH: 7.5

Evaluation: B

N-acetyl-L-methionine(aq) + H₂O(l) = acetate(aq) + L-methionine(aq)

$\frac{T}{K}$	pH	K_c'
298.15	7.5	3.7

Reference: 82GAL/SVE

Method: spectrophotometry

Buffer: phosphate (0.1 mol dm⁻³)

pH: 7.5

Evaluation: C

N-acetyl-L-methionine(aq) + H₂O(l) = acetate(aq) + L-methionine(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	6.86	-1.3

Reference: 86REK/SKY

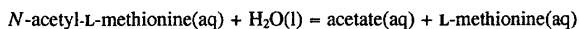
Method: calorimetry

Buffer: phosphate (0.05 mol dm⁻³)

pH: 6.86

Evaluation: C

Few details were given. This result was also reported by Rekharsky *et al.* in several other papers: [89REK/SIK], [87REK/EGO] and [84REK/RUM].



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	6.86	-2.4

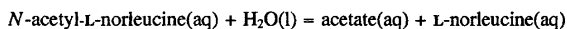
Reference: 89REK/SIK

Method: calorimetry

Buffer: phosphate (0.05 mol dm⁻³)

pH: 6.86

Evaluation: B



$\frac{T}{\text{K}}$	pH	K'_c
298.15	7.5	12.5

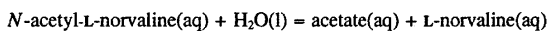
Reference: 82GAL/SVE

Method: spectrophotometry

Buffer: phosphate (0.1 mol dm⁻³)

pH: 7.5

Evaluation: C



$\frac{T}{\text{K}}$	pH	K'_c
298.15	7.5	10.5

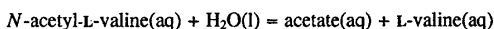
Reference: 82GAL/SVE

Method: spectrophotometry

Buffer: phosphate (0.1 mol dm⁻³)

pH: 7.5

Evaluation: C



$\frac{T}{\text{K}}$	pH	K'_c
323.15	7.0	7.51
323.15	7.5	6.75
323.15	7.8	5.47
323.15	8.0	5.09
323.15	8.5	6.49
323.15	9.0	7.47

Reference: 92IBO/OBO

Method: spectrophotometry

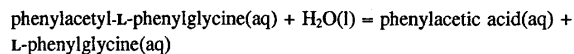
Buffer: acetate + NaOH

pH: 7.0-9.0

Cofactor(s): CoCl₂ (0.0005 mol dm⁻³)

Evaluation: B

The results given here were obtained from Fig. 2 in Iborra *et al.*'s paper. Iborra *et al.* also reported that the direction of this reaction was shifted towards the synthesis of *N*-acetyl-L-valine with the addition of polyols (xylitol, *meso*-erythritol, glycerol, ethylene glycol, 1,4-butanediol, ethanol, and 2-propanol).



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
98.15	6.86	-8.58

Reference: 86REK/SKY

Method: calorimetry

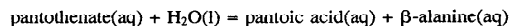
Buffer: phosphate (0.05 mol dm⁻³)

pH: 6.86

Evaluation: C

Few details were given in this paper.

5.47. Enzyme: pantothenase (EC 3.5.1.22)



$\frac{T}{\text{K}}$	pH	K'_c
284.95	8.1	0.0383
287.75	8.1	0.0411
292.35	8.1	0.0664
295.65	8.1	0.0655
298.15	8.1	0.0790
299.25	8.1	0.0764

Reference: 89AIR

Method: paper chromatography and radioactivity

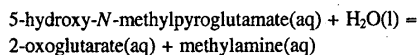
Buffer: Tris (0.025 mol dm⁻³) and Tricine (0.025 mol dm⁻³)

pH: 8.1

Evaluation: B

The results given here are based on the data shown in Airas' Fig. 4-F. The numerical values are a personal communication from R. K. Airas. Airas also calculated $\Delta_r H^\circ(T = 292 \text{ K}, \text{pH} = 8.1) = 37 \text{ kJ mol}^{-1}$ from the temperature dependency of K'_c .

5.48. Enzyme: *N*-methyl-2-oxoglutarate hydrolase (EC 3.5.1.36)



$\frac{T}{\text{K}}$	pH	K'_c
303.15	8.0	2E-3

Reference: 70HER

Method: enzymatic assay

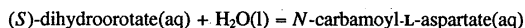
Buffer: Tricine (0.2 mol dm⁻³)

pH: 8.0

Evaluation: B

Hersh found that *N*-methyl-2-oxoglutarate, the substrate for the enzyme-catalyzed reaction, cyclized rapidly to 5-hydroxy-*N*-methylpyroglutamate.

5.49. Enzyme: dihydroorotase (EC 3.5.2.3)



$\frac{T}{K}$	pH	K'
303.15	6.1	1.9

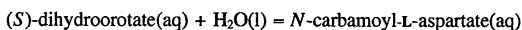
Reference: 54LIE/KOR

Method: spectrophotometry and radioactivity

Buffer: phosphate (0.017 mol dm⁻³)

pH: 6.1

Evaluation: B



$\frac{T}{K}$	pH	K'
310.15	6.5	5.9

Reference: 74KEN

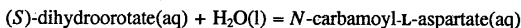
Method: spectrophotometry

Buffer: sodium phosphate (0.10 mol dm⁻³) or {Tris ((0.10 mol dm⁻³) + HCl)}

pH: 6.5

Evaluation: C

The apparent equilibrium constant given here was calculated from kinetic data.



$\frac{T}{K}$	pH	K'
310.15	7.50	10.8

Reference: 78CHR/MAT

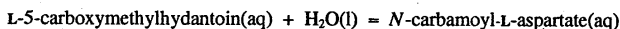
Method: chromatography and radioactivity

Buffer: Hepes (0.060 mol dm⁻³)

pH: 7.50

Evaluation: C

5.50. Enzyme: carboxymethylhydantoinase (EC 3.5.2.4)



$\frac{T}{K}$	pH	K'
307.15	6.1	0.53

Reference: 54LIE/KOR

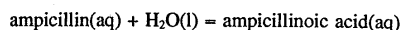
Method: spectrophotometry and radioactivity

Buffer: phosphate (0.017 mol dm⁻³)

pH: 6.1

Evaluation: B

5.51. Enzyme: β-lactamase (EC 3.5.2.6)



$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	7.5	-125.8

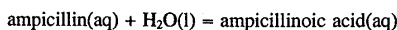
Reference: 79GRI/TAN

Method: calorimetry

Buffer: Tris + HCl

pH: 7.5

Evaluation: B



$\frac{T}{K}$	pH	$\frac{I_m}{\text{mol kg}^{-1}}$	K'
282.35	5.55	0.15	95

Reference: 94KIS/TEW

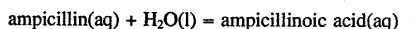
Method: HPLC

Buffer: acetate

pH: 5.55

Evaluation: A

The apparent equilibrium constant given here is the average of the results obtained from both directions of reaction. Kishore *et al.* also performed calorimetric measurements (see below) and calculated $K = (6.0 \pm 3.0)E-6$, $\Delta_r G^\circ = (29.8 \pm 1.7) \text{ kJ mol}^{-1}$, $\Delta_r H^\circ = -(70.0 \pm 7.5) \text{ kJ mol}^{-1}$, and $\Delta_r S^\circ = -(335 \pm 26) \text{ J K}^{-1} \text{ mol}^{-1}$ for the chemical reference reaction: ampicillin⁻(aq) + H₂O(l) = ampicillinoic acid²⁻(aq) + H⁺(aq) at $T = 298.15 \text{ K}$ and $I_m = 0$.



$\frac{T}{K}$	pH	$\frac{I_m}{\text{mol kg}^{-1}}$	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	6.51	0.241	-76.4
298.15	7.06	0.287	-76.9
298.15	7.50	0.296	-83.2
298.15	7.96	0.300	-84.0
304.65	6.58	0.254	-78.0

Reference: 94KIS/TEW

Method: HPLC

Buffer: phosphate

pH: 6.51-7.96

Evaluation: A

Kishore *et al.* used the results given here to calculate $\Delta_r H^\circ(T = 298.15 \text{ K}, I_m = 0) = -(70.0 \pm 7.5) \text{ kJ mol}^{-1}$ for the chemical reference reaction: ampicillin⁻(aq) + H₂O(l) = ampicillinoic acid²⁻(aq) + H⁺(aq). Calorimetric results were also reported for the hydrolysis of cephalosporin C, but they cannot be assigned to a definite reaction.

penicillin G(aq) + H₂O(l) = penicillinoic acid(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	7.5	-114.7

Reference: 79GRI/TAN

Method: calorimetry

Buffer: Tris + HCl

pH: 7.5

Evaluation: B

penicillin G(aq) + H₂O(l) = penicillinoic acid(aq)

$\frac{T}{K}$	pH	$\frac{I_m}{mol kg^{-1}}$	K'
298.15	6.01	0.25	2.9

Reference: 94KIS/TEW

Method: HPLC

Buffer: phosphate

pH: 6.01

Evaluation: A

The apparent equilibrium constant given here is the average of the results obtained from both directions of reaction. Kishore *et al.* also performed calorimetric measurements and calculated $K = (9.4 \pm 3.1)E-7$, $\Delta_r G^\circ = (34.4 \pm 1.0) kJ mol^{-1}$, $\Delta_r H^\circ = -(73.7 \pm 0.4) kJ mol^{-1}$, and $\Delta_r S^\circ = -(363 \pm 4) J K^{-1} mol^{-1}$ for the chemical reference reaction: penicillin G⁻(aq) + H₂O(l) = penicillinoic acid²⁻(aq) + H⁺(aq) at $T = 298.15 K$ and $I_m = 0$.

penicillin G(aq) + H₂O(l) = penicillinoic acid(aq)

$\frac{T}{K}$	pH	$\frac{I_m}{mol kg^{-1}}$	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	6.01	0.297	-79.5
298.15	6.98	0.478	-77.1
298.15	7.00	0.279	-78.4
298.15	7.01	0.782	-78.9
298.15	7.51	0.296	-77.7
304.65	6.53	0.253	-77.1
310.15	6.53	0.255	-76.5

Reference: 94KIS/TEW

Method: calorimetry

Buffer: phosphate

pH: 6.01-7.51

Evaluation: A

Kishore *et al.* used these results to calculate $\Delta_r H^\circ(T = 298.15 K, I_m = 0) = -(73.7 \pm 0.4) kJ mol^{-1}$ for the chemical reference reaction: penicillin G⁻(aq) + H₂O(l) = penicillinoic acid²⁻(aq) + H⁺(aq). Calorimetric results were also reported for the hydrolysis of cephalosporin C, but they cannot be assigned to a specific reaction.

phenoxymethylpenicillin(aq) + H₂O(l) = phenoxymethylpenicillinoic acid(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	7.5	-120.5

Reference: 79GRI/TAN

Method: calorimetry

Buffer: Tris + HCl

pH: 7.5

Evaluation: B

5.52. Enzyme: arginase (EC 3.5.3.1)

L-arginine(aq) + H₂O(l) = L-ornithine(aq) + urea(aq)

$\frac{T}{K}$	pH	$\frac{I_m}{mol kg^{-1}}$	$\frac{\Delta_r H}{kJ mol^{-1}}$
298.15	6.47	0.254	-21.83
298.15	6.94	0.271	-21.51
298.15	7.46	0.294	-21.22
298.15	7.67	0.303	-21.15
298.15	7.79	0.818	-21.53
298.15	7.83	0.493	-21.31
298.15	7.94	0.304	-20.94
298.15	8.27	0.306	-21.01
304.65	7.87	0.298	-21.47
310.25	7.86	0.297	-22.03

Reference: 93TEW/KIS

Method: calorimetry

Buffer: phosphate

pH: 6.47-8.27

Evaluation: A

Tewari *et al.* applied buffer protonation and ionization corrections to obtain $\Delta_r H^\circ(T = 298.15 K, I_m = 0) = -(21.4 \pm 0.5) kJ mol^{-1}$ for the chemical reference reaction: L-arginine⁺(aq) + H₂O(l) = L-ornithine⁺(aq) + urea(aq).

5.53. Enzyme: allantoicase (EC 3.5.3.4)

allantoate(aq) + H₂O(l) = (-)-ureidoglycolate(aq) + urea(aq)

$\frac{T}{K}$	pH	K'
303.15	7.5	0.21

Reference: 67TRI/VOG

Method: polarimetry

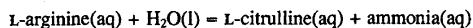
Buffer: triethanolamine (0.087 mol dm⁻³) + HCl

pH: 7.5

Cofactor(s): MnSO₄ (0.00087 mol dm⁻³)

Evaluation: B

5.54. Enzyme: arginine deiminase (EC 3.5.3.6)



$\frac{T}{K}$	pH	I_m mol kg ⁻¹	$\Delta_r H^\circ$ (cal) kJ mol ⁻¹
298.15	5.70	0.305	-32.03
298.15	5.87	0.896	-31.90
298.15	5.92	0.519	-31.96
298.15	6.15	0.329	-32.23
298.15	6.55	0.352	-32.52
298.15	7.21	0.394	-33.56
304.65	6.10	0.324	-32.42
310.15	6.13	0.329	-32.92

Reference: 93TEW/KIS

Method: calorimetry

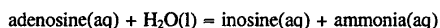
Buffer: phosphate

pH: 5.70-7.21

Evaluation: A

Tewari *et al.* applied buffer protonation and ionization corrections to obtain $\Delta_r H^\circ(T = 298.15 \text{ K}, I_m = 0) = -(31.9 \pm 0.8) \text{ kJ mol}^{-1}$ for the chemical reference reaction: L-arginine⁺(aq) + H₂O(l) = L-citrulline(aq) + NH₄⁺(aq).

5.55. Enzyme: adenosine deaminase (EC 3.5.4.4)



$\frac{T}{K}$	pH	K_c'
298.15	6.53	8333
298.15	7.50	1175
298.15	8.12	587
298.15	8.52	255
298.15	8.88	212
298.15	9.23	191
298.15	9.71	302
298.15	10.18	908
298.15	9.16	267
298.15	9.16	242
298.15	9.16	318
298.15	9.16	345
298.15	6.50	2231
298.15	9.32	1321
298.15	9.13	352

Reference: 67WOL

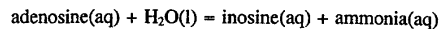
Method: radioactivity

Buffer: ammonia + HCl

pH: 6.53-10.18

Evaluation: B

The apparent equilibrium constants given here were calculated from results given in Wolfenden's Table I and Figs. 1 and 2.



$\frac{T}{K}$	pH	Buffer	$\frac{m(\text{KCl})}{\text{mol kg}^{-1}}$	I_m mol kg ⁻¹	$\Delta_r H^\circ$ (cal) kJ mol ⁻¹
298.15	7.09	phosphate	0	0.277	-43.72
298.15	7.19	Tris	0	0.099	-2.07
298.15	7.38	Tris	0	0.095	-2.16
298.15	7.47	Tris	0.206	0.299	-2.06
298.15	7.49	Tris	0.109	0.202	-1.73
298.15	7.86	Tris	0	0.075	-2.88
298.15	8.17	Tris	0	0.057	-5.50
298.15	8.83	Tris	0	0.023	-11.7
304.55	7.97	Tris	0	0.060	-5.20
310.15	7.84	Tris	0	0.060	-4.77

Reference: 93LAR/TEW

Method: calorimetry

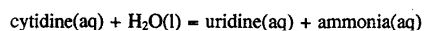
Buffer: phosphate and (Tris + HCl)

pH: 7.09-8.83

Evaluation: A

Larson *et al.* calculated $\Delta_r H^\circ(T = 298.15 \text{ K}, I = 0) = -(49.4 \pm 0.7) \text{ kJ mol}^{-1}$ for the chemical reference reaction: adenosine(aq) + H₂O(l) + H⁺(aq) = inosine(aq) + NH₄⁺(aq).

5.56. Enzyme: cytidine deaminase (EC 3.5.4.5)



$\frac{T}{K}$	pH	K_c'
298.15	7.00	1.03E4
298.15	7.92	1.86E3
298.15	8.48	6.22E2
298.15	8.84	3.79E2
298.15	9.31	3.18E2
298.15	9.77	4.39E2
298.15	10.69	2.43E3

Reference: 71COH/WOL

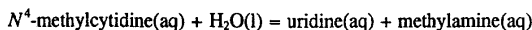
Method: spectrophotometry

Buffer: ammonia (2.0 mol dm⁻³) + HCl

pH: 7.0-10.69

Evaluation: C

The apparent equilibrium constants given here were calculated from the percent conversion data given in Cohen and Wolfenden's Fig. 3.



$\frac{T}{K}$	pH	K_c'
298.15	7.50	488
298.15	8.87	43
298.15	9.50	22
298.15	10.17	21
298.15	10.60	37
298.15	11.00	163

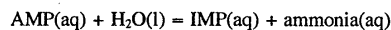
Reference: 71COH/WOL

Method: spectrophotometry

Buffer: methylamine (0.32 mol dm⁻³) + HCl

pH: 7.5-11.0

Evaluation: C

5.57. Enzyme: AMP deaminase (EC 3.5.4.6)

$\frac{T}{K}$	pH	Buffer	$\frac{m(\text{KCl})}{\text{mol kg}^{-1}}$	$\frac{I_m}{\text{mol kg}^{-1}}$	$\Delta_r H(\text{cal})$ kJ mol^{-1}
298.15	7.08	phosphate	0	0.307	-44.26
298.15	7.34	Tris	0	0.112	-7.75
298.15	7.63	Tris	0	0.107	-4.13
298.15	7.93	Tris	0.50	0.594	-4.00
298.15	8.02	Tris	0	0.085	-3.65
298.15	8.20	Tris	0.10	0.181	-4.07
298.15	8.23	Tris	0.20	0.282	-4.59
298.15	8.38	Tris	0	0.059	-4.97
298.15	8.96	Tris	0	0.046	-7.71
304.65	7.91	Tris	0	0.084	-5.56
310.15	7.79	Tris	0	0.085	-5.43

Reference: 93LAR/TEW

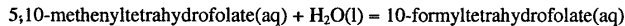
Method: calorimetry

Buffer: phosphate and (Tris + HCl)

pH: 7.08-8.96

Evaluation: A

Larson *et al.* calculated $\Delta_r H^\circ(T = 298.15 \text{ K}, I = 0) = -(49.6 \pm 0.5) \text{ kJ mol}^{-1}$ for the chemical reference reaction: $\text{AMP}^{2-}(\text{aq}) + \text{H}_2\text{O(l)} = \text{adenosine(aq)} + \text{HPO}_4^{2-}(\text{aq})$.

5.58. Enzyme: methenyltetrahydrofolate cyclohydrolase (EC 3.5.4.9)

$\frac{T}{K}$	pH	Buffer	K'
298.15	4.74	phosphate	0.0733
298.15	5.20	acetate	0.127
298.15	5.20	acetate	0.221
298.15	5.70	phosphate	0.818
298.15	7.00	acetate	11.0
298.15	7.13	citrate	12.7

Reference: 60KAY/OSB

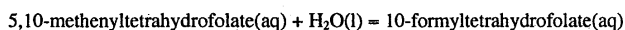
Method: spectrophotometry

Buffer: citrate, phosphate, and acetate

pH: 4.75-7.13

Evaluation: B

The temperature is assumed to be 298.15 K. The apparent equilibrium constants given here were calculated from the results given in Kay *et al.*'s Table I. Kay *et al.* also reported equilibrium data for the reaction: $5,10\text{-methenyltetrahydrofolate(aq)} + \text{H}_2\text{O(l)} = 5\text{-formyltetrahydrofolate(aq)}$.



$\frac{T}{K}$	pH	K'
298.15	6.5	4.2

Reference: 63GRE

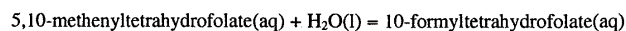
Method: spectrophotometry

Buffer: potassium maleate (1.0 mol dm⁻³)

pH: 6.5

Evaluation: C

Greenberg reported $K'c(\text{H}^+)/c(\text{H}_2\text{O}) = 2.4\text{E}-8$ at pH = 6.5. The apparent equilibrium constant given here was calculated from this result. This reaction proceeds in the absence of an enzyme in neutral and alkaline solutions.



$\frac{T}{K}$	pH	K'
298.15	6.5	1.84

Reference: 67LOM/GRE

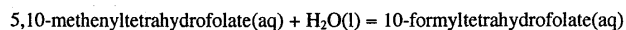
Method: spectrophotometry

Buffer: potassium citrate (0.11 mol dm⁻³)

pH: 6.5

Evaluation: C

The result given here was obtained from kinetic data.



$\frac{T}{K}$	pH	K'
298.15		50

Reference: 73SUZ/IWA

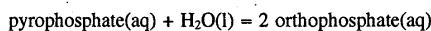
Method: spectrophotometry

Buffer: potassium maleate

pH: 7.0

Evaluation: C

The result given here was obtained from kinetic data.

5.59. Enzyme: inorganic pyrophosphatase (EC 3.6.1.1)

$\frac{T}{K}$	pH	$\Delta_r H(\text{cal})$ kJ mol^{-1}
302.15	7.2	-37.4

Reference: 52OHL/SHA

Method: calorimetry

Buffer: barbital + acetate (0.024 mol dm⁻³)

pH: 7.2

Cofactor(s): MgCl₂ (0.00025 mol dm⁻³)

Evaluation: B

Also see data given under alkaline phosphatase (EC 3.1.3.1).

pyrophosphate(aq) + H₂O(l) = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{c(\text{MgSO}_4)}{\text{mol dm}^{-3}}$	I_c mol dm ⁻³	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
298.15	7.35	barbital	3.75E-4	0.1	-30.3
298.15	7.49	barbital	2.50E-4	0.1	-30.3
298.15	7.51	barbital	2.50E-4	0.1	-30.6
298.15	7.64	barbital	3.75E-4	0.1	-31.0
298.15	7.45	phosphate	5.00E-4	0.1	-32.1
298.15	7.48	phosphate	5.00E-4	0.1	-30.7
298.15	6.98	phosphate	3.02E-4	0.6	-28.6
298.15	7.15	phosphate	3.01E-4	0.6	-25.9
298.15	7.27	phosphate	2.26E-4	0.075	-29.1
298.15	7.60	phosphate	2.25E-4	0.075	-26.3
298.15	7.61	phosphate	2.25E-4	0.075	-25.9
298.15	7.16	phosphate	3.00E-4	0.6	-25.3
298.15	6.87	phosphate	2.52E-4	0.1	-27.9
298.15	6.87	phosphate	2.54E-4	0.1	-26.1
298.15	7.36	phosphate	2.08E-4	0.1	-28.6
298.15	7.47	phosphate	2.54E-4	0.1	-27.6
298.15	7.88	phosphate	2.55E-4	0.1	-27.9
298.15	7.19	phosphate	3.01E-4	0.6	-27.8
298.15	7.18	phosphate	3.03E-4	0.6	-24.8
298.15	7.27	phosphate	3.04E-4	0.6	-24.7
298.15	7.27	phosphate	3.03E-4	0.6	-24.3
298.15	7.27	phosphate	3.02E-4	0.6	-25.4
298.15	7.22	phosphate	5.08E-4	1.0	-23.8
298.15	7.30	phosphate	3.04E-4	0.6	-23.6
298.15	7.22	phosphate	5.08E-4	1.0	-24.7
298.15	7.28	phosphate	5.08E-4	1.0	-24.1
298.15	7.37	phosphate	3.06E-4	0.6	-23.8

Reference: 54GIN/STU

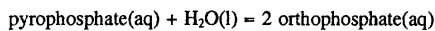
Method: calorimetry

Buffer: barbital (0.05 mol dm⁻³) and phosphate

pH: 6.87-7.61

Cofactor(s): MgSO₄

Evaluation: A



$\frac{T}{K}$	pH	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	$\frac{c(\text{KCl})}{\text{mol dm}^{-3}}$	$\frac{c(\text{tetra-n-propylammonium}^+)}{\text{mol dm}^{-3}}$	K_c'
298.15	7.4	0.025	0	0.045	0	1.20E4
298.15	7.4	0.050	0	0.090	0	1.57E4
298.15	7.4	0.050	0	0	0.090	1.70E4
298.15	7.4	0.0025	0.0001	0.0045	0	2.5E3
298.15	7.4	0.0050	0.0001	0.0090	0	2.63E3
298.15	7.4	0.020	0.005	0.036	0	1.18E3
298.15	7.4	0.010	0.005	0.018	0	4.93E2
298.15	7.4	0.010	0.010	0.018	0	2.15E2
298.15	7.4	0.010	0.020	0.018	0	1.15E2
298.15	7.4	0.010	0.040	0.018	0	1.01E2
298.15	7.4	0.020	0.0005	0.0445	0	3.77E3
298.15	7.4	0.025	0.0010	0.045	0	3.53E3
298.15	7.4	0.050	0.0010	0.207	0	7.00E3
298.15	7.4	0.010	0.0050	0.044	0	5.56E2
298.15	7.4	0.025	0.0050	0.215	0	8.62E2
298.15	7.4	0.050	0.0050	0.195	0	1.35E3
298.15	7.4	0.075	0.0050	0.0535	0	1.85E3
298.15	7.4	0.050	0.0100	0.180	0	1.35E3
298.15	7.4	0.010	0.0050	0	0.018	3.87E2
298.15	7.4	0.010	0.0200	0	0.018	1.11E2
298.15	7.4	0.010	0.0050	0	0.220	4.69E2
298.15	7.4	0.010	0.0200	0	0.220	1.36E2
277.9	7.4	0.025	0.0010	0.045	0	6.31E3
283.1	7.4	0.025	0.0010	0.045	0	5.83E3
292.9	7.4	0.025	0.0010	0.045	0	3.93E3
303.0	7.4	0.025	0.0010	0.045	0	3.12E3
312.7	7.4	0.025	0.0010	0.045	0	2.46E3

Reference: 74FLO/FLE

Method: radioactivity

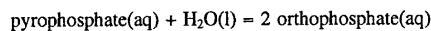
Buffer: phosphate

pH: 7.4

Cofactor(s): MgCl₂

Evaluation: A

The apparent equilibrium constants given here were taken from Flodgaard and Fleron's Table II and Fig. 4. From the temperature dependence of K_c' , Flodgaard and Fleron calculated $\Delta_r H^{\circ}(\bar{T} = 296 \text{ K}, \text{pH} = 7.4, \text{pMg} = 3.5, I_c = 0.068 \text{ mol dm}^{-3}) = -(20.6 \pm 3.4) \text{ kJ mol}^{-1}$. They also calculated $K_c(T = 298.15 \text{ K}, I = 0) = (2.41 \pm 0.20)\text{E}-4$ for the chemical reference reaction: $\text{pyrophosphate}^{3-}(\text{aq}) + \text{H}_2\text{O(l)} = 2 \text{ orthophosphate}^{2-}(\text{aq}) + \text{H}^+(\text{aq})$.



$\frac{T}{K}$	pH	$c(\text{MgCl}_2)$ mol dm ⁻³	K'_c
308.15	6.0	0.010	3.03E2
308.15	6.0	0.025	5.20E2
308.15	6.0	0.050	9.49E2
308.15	6.0	0.100	2.66E3
308.15	7.0	0.0001	7.9E1
308.15	7.0	0.001	1.25E2
308.15	7.0	0.063	2.31E2
308.15	7.0	0.025	6.87E2
308.15	7.0	0.050	2.06E3
308.15	7.0	0.100	1.24E4
293.15	7.8	0.010	1.26E2
299.15	7.8	0.010	1.56E2
303.15	7.8	0.010	1.87E2
308.15	7.8	0.010	2.35E2
313.15	7.8	0.010	2.94E2
293.15	7.8	0.025	3.20E2
299.15	7.8	0.025	3.72E2
303.15	7.8	0.025	4.66E2
308.15	7.8	0.025	5.72E2
313.15	7.8	0.025	8.65E2

Reference: 82DEM

Method: radioactivity

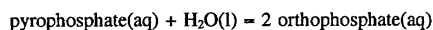
Buffer: Tris + maleate (0.10 mol dm⁻³)

pH: 6.0–7.8

Cofactor(s): MgCl₂

Evaluation: B

The apparent equilibrium constants given here were taken from de Meis' Figs. 8 and 9.



$\frac{T}{K}$	pH	Buffer	Cosolvent	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	K'_c
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.002	0.004	2.5E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	<i>N,N</i> -dimethylformamide (30 %)	0.002	0.004	3.1E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.002	0.004	1.8E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	methanol (30 %)	0.002	0.004	3.6E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.004	3.72E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (15 %)	0.004	0.004	1.42E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.004	0.004	3.2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	methanol (15 %)	0.004	0.004	1.19E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	methanol (30 %)	0.004	0.004	5.65E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (30 %)	0.004	0.004	1.33E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.004	0.004	2.75E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (30 %)	0.004	0.004	5.05E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.004	0.004	3.2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.001	0.001	3.7E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.002	0.001	5.0E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.001	1.5E3
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.012	0.001	3.0E3
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.001	0.010	6.1E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.002	0.010	7.2E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.010	1.8E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.012	0.010	4.3E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.001	0.001	3.7E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.002	0.002	3.1E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.004	3.7E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.005	0.005	4.5E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.012	0.012	4.0E2

pyrophosphate(aq) + H₂O(l) = 2 orthophosphate(aq) — Continued

$\frac{T}{K}$	pH	Buffer	Cosolvent	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	K_c
308.15	6.15	imidazole (0.050 mol dm ⁻³)	none	0.004	0.010	1.2E3
308.15	6.42	imidazole (0.050 mol dm ⁻³)	none	0.004	0.010	5.7E2
308.15	7.00	imidazole (0.050 mol dm ⁻³)	none	0.004	0.010	2.7E2
308.15	7.82	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.010	1.8E2
308.15	8.93	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.010	1.3E2
308.15	6.2	imidazole (0.050 mol dm ⁻³)	none	0.004	0.004	2.6E3
308.15	6.2	imidazole (0.050 mol dm ⁻³)	none	0.004	0.010	1.2E3
308.15	6.2	imidazole (0.050 mol dm ⁻³)	none	0.004	0.040	4.2E2
308.15	6.2	imidazole (0.050 mol dm ⁻³)	none	0.004	0.100	1.4E2
308.15	7.0	imidazole (0.050 mol dm ⁻³)	none	0.004	0.001	4.0E3
308.15	7.0	imidazole (0.050 mol dm ⁻³)	none	0.004	0.004	6.9E2
308.15	7.0	imidazole (0.050 mol dm ⁻³)	none	0.004	0.010	2.8E2
308.15	7.0	imidazole (0.050 mol dm ⁻³)	none	0.004	0.020	1.7E2
308.15	7.0	imidazole (0.050 mol dm ⁻³)	none	0.004	0.040	9.8E1
308.15	7.0	imidazole (0.050 mol dm ⁻³)	none	0.004	0.100	6.6E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.001	1.5E3
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.002	6.5E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.004	3.7E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.010	1.8E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.020	1.1E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.040	8.2E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.100	7.4E1
308.15	6.2	imidazole (0.050 mol dm ⁻³)	none	0.012	0.010	2.6E3
308.15	6.2	imidazole (0.050 mol dm ⁻³)	none	0.012	0.025	9.2E2
308.15	6.2	imidazole (0.050 mol dm ⁻³)	none	0.012	0.050	5.1E2
308.15	6.2	imidazole (0.050 mol dm ⁻³)	none	0.012	0.100	3.1E2
308.15	7.0	imidazole (0.050 mol dm ⁻³)	none	0.012	0.010	1.2E3
308.15	7.0	imidazole (0.050 mol dm ⁻³)	none	0.012	0.025	4.0E2
308.15	7.0	imidazole (0.050 mol dm ⁻³)	none	0.012	0.050	1.9E2
308.15	7.0	imidazole (0.050 mol dm ⁻³)	none	0.012	0.100	8.9E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.012	0.001	3.0E3
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.012	0.004	1.0E3
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.012	0.010	4.4E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.012	0.025	1.8E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.012	0.050	1.1E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.012	0.100	7.4E1
313.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.010	8.3E2
308.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.010	6.6E2
302.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.010	4.9E2
299.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.010	4.2E2
293.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.010	2.8E2
313.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.025	3.2E2
308.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.025	2.3E2
302.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.025	2.1E2
299.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.025	1.6E2
293.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.025	1.3E2
313.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.050	2.3E2
308.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.050	1.7E2
302.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.050	1.4E2
299.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.050	1.1E2
293.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.050	8.2E1
308.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.100	1.6E2
302.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.100	1.1E2
299.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.100	1.0E2
293.15	7.8	Tris (0.10 mol dm ⁻³) + HCl	none	0.012	0.100	8.1E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.001	0.0005	5.4E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.001	0.001	3.7E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.001	0.002	2.7E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.001	0.004	1.3E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.001	0.006	9.7E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.001	0.008	7.1E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.001	0.010	7.2E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.001	0.001	1.2E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.001	0.002	7.2E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.001	0.004	2.1E1

pyrophosphate(aq) + H₂O(l) = 2 orthophosphate(aq) — Continued

$\frac{T}{K}$	pH	Buffer	Cosolvent	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	K_c'
08.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.001	0.006	1.4E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.001	0.008	1.1E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.001	0.010	7.9
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.001	0.001	3.0E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.001	0.002	2.1E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.001	0.004	1.3E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.001	0.006	9.3
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.001	0.008	6.7
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.001	0.010	6.1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.001	0.001	1.8E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.001	0.002	6.7
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.001	0.004	6.4
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.001	0.006	4.3
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.001	0.008	4.0
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.001	0.010	4.0
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	methanol (30 %)	0.001	0.001	2.0E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	methanol (30 %)	0.001	0.002	1.6E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	methanol (30 %)	0.001	0.004	2.7E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	methanol (30 %)	0.001	0.006	1.9E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	methanol (30 %)	0.001	0.008	1.8E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	methanol (30 %)	0.001	0.010	1.6E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.001	0.001	1.0E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.001	0.002	5.1E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.001	0.004	2.3E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.001	0.006	1.4E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.001	0.008	1.2E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.001	0.010	8.7
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.002	0.0005	9.0E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.002	0.001	5.3E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.002	0.002	3.1E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.002	0.004	1.7E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.002	0.006	1.1E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.002	0.008	9.7E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.002	0.010	8.2E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.002	0.0005	4.6E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.002	0.001	1.72E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.002	0.002	8.4E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.002	0.004	3.1E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.002	0.008	1.4E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.002	0.0005	5.2E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.002	0.001	6.3E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.002	0.002	3.2E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.002	0.004	2.0E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.002	0.006	1.7E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.002	0.010	9.5
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.002	0.0005	8.4E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.002	0.001	3.9E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.002	0.002	2.3E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.002	0.004	9.2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.002	0.006	4.6
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.002	0.008	4.6
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60 %)	0.002	0.010	4.6
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	<i>N,N</i> -dimethylformamide (30 %)	0.002	0.001	1.8E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	<i>N,N</i> -dimethylformamide (30 %)	0.002	0.002	5.0E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	<i>N,N</i> -dimethylformamide (30 %)	0.002	0.004	3.0E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	<i>N,N</i> -dimethylformamide (30 %)	0.002	0.006	1.5E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	<i>N,N</i> -dimethylformamide (30 %)	0.002	0.008	9.9
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	<i>N,N</i> -dimethylformamide (30 %)	0.002	0.010	6.1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.002	0.001	7.2E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.002	0.002	3.2E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.002	0.004	2.1E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.002	0.006	1.2E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.002	0.008	7.6
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.002	0.010	5.0
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.001	0.001	3.5E2

pyrophosphate(aq) + H₂O(l) = 2 orthophosphate(aq) — Continued

$\frac{T}{K}$	pH	Buffer	Cosolvent	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	K'
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.002	0.002	3.1E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	none	0.004	0.004	4.0E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.001	0.001	1.2E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.002	0.002	8.0E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	dimethyl sulfoxide (30 %)	0.004	0.004	3.3
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.001	0.001	3.0E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.002	0.002	3.0E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	glycerol (60 %)	0.004	0.004	2.7E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.001	0.001	1.0E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.002	0.002	2.1E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethanol (30 %)	0.004	0.004	2.7E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	methanol (30 %)	0.001	0.001	2.0E2
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	methanol (30 %)	0.002	0.02	6.4E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	methanol (30 %)	0.004	0.004	6.0E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60%)	0.001	0.001	2.0E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60%)	0.002	0.002	2.1E1
308.15	7.8	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol (60%)	0.004	0.004	4.0

Reference: 84DEM

Method: radioactivity

Buffer: (Tris + HCl) and imidazole

pH: 6.15–8.93

Cofactor(s): MgCl₂

Evaluation: B

With the exception of the first 13 results, the apparent equilibrium constants given here were taken from de Meis' Figs. 2, 3, 4, 7, 8, and 9. It is not clear what convention (e.g. (w/v), (v/v), or (w/w)) de Meis used when reporting the percent composition of the cosolvents.

THERMODYNAMICS OF ENZYME-CATALYZED REACTIONS

pyrophosphate(aq) + H₂O(l) = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	Buffer	Cosolvent	$x(\text{cosolvent})$	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	K_c'
303.15	6.2	Mes (0.050 mol dm ⁻³)	none	0	0.001	0.004	329
303.15	6.2	Mes (0.050 mol dm ⁻³)	none	0	0.001	0.010	133
303.15	6.2	Mes (0.050 mol dm ⁻³)	none	0	0.001	0.020	100
303.15	6.2	Mes (0.050 mol dm ⁻³)	ethylene glycol, 66 % (w/v)	?	0.001	0.004	75
303.15	6.2	Mes (0.050 mol dm ⁻³)	ethylene glycol, 66 % (w/v)	?	0.001	0.010	35
303.15	6.2	Mes (0.050 mol dm ⁻³)	ethylene glycol, 66 % (w/v)	?	0.001	0.020	22
303.15	6.2	Mes (0.050 mol dm ⁻³)	ethylene glycol, 66 % (w/v)	?	0.001	0.040	15
303.15	6.2	Mes (0.050 mol dm ⁻³)	poly(ethylene glycol) 3500, 50 % (w/v)	?	0.001	0.004	75
303.15	6.2	Mes (0.050 mol dm ⁻³)	poly(ethylene glycol) 3500, 50 % (w/v)	?	0.001	0.010	42
303.15	6.2	Mes (0.050 mol dm ⁻³)	poly(ethylene glycol) 3500, 50 % (w/v)	?	0.001	0.020	29
303.15	6.2	Mes (0.050 mol dm ⁻³)	poly(ethylene glycol) 3500, 50 % (w/v)	?	0.001	0.040	15
303.15	6.2	Mes (0.050 mol dm ⁻³)	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.004	41
303.15	6.2	Mes (0.050 mol dm ⁻³)	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.010	24
303.15	6.2	Mes (0.050 mol dm ⁻³)	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.020	11
303.15	6.2	Mes (0.050 mol dm ⁻³)	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.040	7.1
303.15	7.2	Mops (0.050 mol dm ⁻³)	none	0	0.001	0.001	619
303.15	7.2	Mops (0.050 mol dm ⁻³)	none	0	0.001	0.002	406
303.15	7.2	Mops (0.050 mol dm ⁻³)	none	0	0.001	0.004	224
303.15	7.2	Mops (0.050 mol dm ⁻³)	none	0	0.001	0.006	136
303.15	7.2	Mops (0.050 mol dm ⁻³)	none	0	0.001	0.010	79
303.15	7.2	Mops (0.050 mol dm ⁻³)	none	0	0.001	0.008	85.5
303.15	7.2	Mops (0.050 mol dm ⁻³)	dimethyl sulfoxide, 50 % (w/v)	0.210	0.001	0.008	28.9
303.15	7.2	Mops (0.050 mol dm ⁻³)	ethylene glycol, 50 % (w/v)	0.172	0.001	0.008	20.8
303.15	7.2	Mops (0.050 mol dm ⁻³)	ethylene glycol, 66 % (w/v)	?	0.001	0.001	62
303.15	7.2	Mops (0.050 mol dm ⁻³)	ethylene glycol, 66 % (w/v)	?	0.001	0.002	38
303.15	7.2	Mops (0.050 mol dm ⁻³)	ethylene glycol, 66 % (w/v)	?	0.001	0.004	24
303.15	7.2	Mops (0.050 mol dm ⁻³)	ethylene glycol, 66 % (w/v)	?	0.001	0.007	16
303.15	7.2	Mops (0.050 mol dm ⁻³)	ethylene glycol, 66 % (w/v)	?	0.001	0.010	12
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 400, 50 % (w/v)	0.039	0.001	0.008	11.3
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 1450, 50 % (w/v)	0.011	0.001	0.008	6.0
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 3500, 50 % (w/v)	0.005	0.001	0.008	2.7
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 3500, 50 % (w/v)	?	0.001	0.001	62
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 3500, 50 % (w/v)	?	0.001	0.002	29
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 3500, 50 % (w/v)	?	0.001	0.004	10
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 3500, 50 % (w/v)	?	0.001	0.010	22
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.001	15
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.002	3.8
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.004	0.91
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.006	0.62
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.010	0.48
303.15	7.2	Mops (0.050 mol dm ⁻³)	poly(ethylene glycol) 8000, 50 % (w/v)	0.002	0.001	0.008	0.7
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	none	0	0.001	0.001	345.6
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	none	0	0.001	0.005	584
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	none	0	0.001	0.007	413
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	none	0	0.001	0.009	400
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol, 50 % (w/v)	0.172	0.001	0.001	31.3
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol, 66 % (w/v)	?	0.001	0.0004	53
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol, 66 % (w/v)	?	0.001	0.0005	29
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol, 66 % (w/v)	?	0.001	0.0006	22
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	ethylene glycol, 66 % (w/v)	?	0.001	0.0009	21
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 400, 50 % (w/v)	0.039	0.001	0.001	12.3
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 1450, 50 % (w/v)	0.011	0.001	0.001	13.3
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 3500, 50 % (w/v)	0.005	0.001	0.001	3.8
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 3500, 50 % (w/v)	?	0.001	0.0004	23
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 3500, 50 % (w/v)	?	0.001	0.0005	6.5
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 3500, 50 % (w/v)	?	0.001	0.0006	4.5
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 3500, 50 % (w/v)	?	0.001	0.0009	4.2
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 8000, 50 % (w/v)	0.002	0.001	0.001	0.1
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.0001	0.0004	0.74
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.0001	0.0005	0.068
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.0001	0.0006	0.046
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.0001	0.0009	0.035
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.0004	12
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.0005	0.46

pyrophosphate(aq) + H₂O(l) = 2 orthophosphate(aq) — Continued

$\frac{T}{K}$	pH	Buffer	Cosolvent	$x(\text{cosolvent})$	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	K'_c
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.0006	0.20
303.15	8.0	Tris (0.050 mol dm ⁻³) + HCl	poly(ethylene glycol) 8000, 50 % (w/v)	?	0.001	0.0009	0.12

Reference: 85DEM/BEH

Method: radioactivity

Buffer: Mops (0.050 mol dm⁻³) or {Tris (0.050 mol dm⁻³) + HCl} or Mes (0.050 mol dm⁻³)

pH: 6.2–8.0

Cofactor(s): MgCl₂

Evaluation: B

$x(\text{cosolvent})$ is the mole fraction of cosolvent added. With the exception of the first 13 results, the apparent equilibrium constants given here were taken from de Meis *et al.*'s Fig. 5.

pyrophosphate(aq) + H₂O(l) = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{c(\text{MgCl}_2)}{\text{mol dm}^{-3}}$	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	K'_c
303.15	7.3	Tris (0.05 mol dm ⁻³) + Mes (0.05 mol dm ⁻³)	0.0010	0.005	3.30E3
303.15	7.3	Tris (0.05 mol dm ⁻³) + Mes (0.05 mol dm ⁻³)	0.0025	0.005	1.50E3
303.15	7.3	Tris (0.05 mol dm ⁻³) + Mes (0.05 mol dm ⁻³)	0.0050	0.005	9.80E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0010	0.0025	1.28E3
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0025	0.0025	4.95E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0050	0.0025	3.00E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0075	0.0025	1.95E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0110	0.0025	1.52E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0150	0.0025	1.16E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0010	0.0050	1.87E3
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0025	0.0050	6.50E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0050	0.0050	3.30E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0075	0.0050	2.15E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0110	0.0050	1.58E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0150	0.0050	1.26E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0010	0.0075	2.23E3
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0025	0.0075	7.72E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0050	0.0075	4.20E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0075	0.0075	2.55E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0110	0.0075	1.84E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0150	0.0075	1.44E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0010	0.0100	2.82E3
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0025	0.0100	1.05E3
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0050	0.0100	5.36E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0075	0.0100	3.30E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0110	0.0100	2.28E2
303.15	8.0	Tris (0.05 mol dm ⁻³) + HCl	0.0150	0.0100	1.67E2

Reference: 86DAL/REN

Method: spectrophotometry

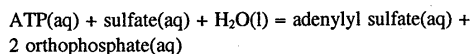
Buffer: Tris (0.05 mol dm⁻³) + HCl

pH: 7.3–8.0

Cofactor(s): Mg²⁺

Evaluation: B

With the exception of the first three results, the apparent equilibrium constants given here were taken from Daley *et al.*'s Figs. 2A and 2B.



$\frac{T}{K}$	pH	K'
303.15	7.5	6E-7

Reference: 58WIL/BAN

Method: chemical analysis and radioactivity

Buffer: Tris (0.02 mol dm⁻³) + HCl

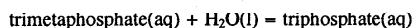
pH: 7.5

Cofactor(s): MgCl₂ (0.001 mol dm⁻³)

Evaluation: C

Sulfate adenylyltransferase (EC 2.7.7.4) was also present. This is an approximate result.

5.60. Enzyme: trimetaphosphatase (EC 3.6.1.2)



$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
306.15	6.95	-80.8

Reference: 53MEY/SHA

Method: calorimetry

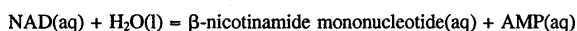
Buffer: sodium maleate (0.03 mol dm⁻³)

pH: 6.95

Cofactor (s): MgSO₄ (0.02 mol dm⁻³)

Evaluation: B

5.61. Enzyme: nucleotide pyrophosphatase (EC 3.6.1.9)



$\frac{T}{K}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
306.15	7.0	-54.6

Reference: 52OHL/SHA

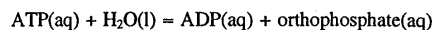
Method: calorimetry

Buffer: potassium phosphate (0.097 mol dm⁻³)

pH: 7.0

Evaluation: B

5.62. Enzyme: myosin ATPase (EC 3.6.1.32)



$\frac{T}{K}$	pH	Buffer	$\frac{c(\text{KCl})}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H}{\text{cal mol dm}^{-3}}$
293.15	8.0	Tris	0.60	-68.5
293.15	8.0	Tris	0.15	-66.2
293.15	8.0	Tris	0.01	-66.5
292.4	8.0	phosphate	0.60	-28.6
291.6	8.0	phosphate	0.60	-28.3

Reference: 55KIT/BEN

Method: calorimetry

Buffer: (Tris + HCl) and phosphate

pH: 8.0

Cofactor(s): Ca²⁺

Evaluation: A

The results given here, when corrected for the enthalpy of buffer protonation, lead to $\Delta_r H''(T = 293 \text{ K}, \text{pH} = 8.0) = -20.4 \text{ kJ mol}^{-1}$.



$\frac{T}{K}$	pH	$\frac{c(\text{KCl})}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	8.0	0.60	-66.5

Reference: 55POD/STU

Method: calorimetry

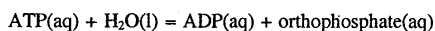
Buffer: Tris (0.10 mol dm⁻³)

pH: 8.0

Cofactor(s): CaCl₂ (0.001 mol dm⁻³)

Evaluation: A

Podolovsky and Sturtevant applied buffer protonation and ionization corrections to obtain $\Delta_r H^\circ(T = 298.15 \text{ K}, I_c = 0.6 \text{ mol dm}^{-3}) = -22.2 \text{ kJ mol}^{-1}$ for the chemical reference reaction: $\text{ATP}^{4-}(\text{aq}) + \text{H}_2\text{O(l)} = \text{ADP}^{3-}(\text{aq}) + \text{HPO}_4^{2-}(\text{aq}) + \text{H}^+(\text{aq})$.



$\frac{T}{\text{K}}$	pH	Buffer	$\frac{c(\text{CaCl}_2)}{\text{mol dm}^{-3}}$	$\frac{c(\text{KCl})}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
293.15	8.0	Tris (0.10 mol dm ⁻³)	0.001	0.60	-68.6
293.15	8.0	Tris (0.10 mol dm ⁻³)	0	0.60	-67.8
292.2	8.0	phosphate (0.05 mol dm ⁻³)	0	0.60	-27.8
293.15	8.0	Tris (0.05 mol dm ⁻³)	0	0.15	-68.6
293.15	8.0	Tris (0.05 mol dm ⁻³)	0	0.01	-64.4
293.15	8.0	glycylglycine (0.1 mol dm ⁻³)	0.001	0.60	-67.4

Reference: 56POD/MOR

Method: calorimetry

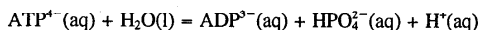
Buffer: Tris, glycylglycine, and phosphate

pH: 8.0

Cofactor(s): CaCl₂

Evaluation: A

Podolovsky and Morales applied buffer protonation and ionization corrections to obtain $\Delta_r H^\circ(T = 293.15 \text{ K}, I_c \approx 0.6 \text{ mol dm}^{-3}) = -19.7 \text{ kJ mol}^{-1}$ for the chemical reference reaction: $\text{ATP}^{4-}(\text{aq}) + \text{H}_2\text{O(l)} = \text{ADP}^{3-}(\text{aq}) + \text{HPO}_4^{2-}(\text{aq}) + \text{H}^+(\text{aq})$



$\frac{T}{\text{K}}$	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$
298.15	-24.3

Reference: 69GEO/TRA

Method: calorimetry

pH: 8-9

Evaluation: C

George *et al.* reported $\Delta_r H^\circ(I_c \leq 0.01 \text{ mol dm}^{-3}) = -24.3 \text{ kJ mol}^{-1}$ for this chemical reference reaction. They did not report the calorimetrically determined enthalpy of reaction or the conditions of measurement.



$\frac{T}{\text{K}}$	pH	$\frac{c(\text{Tris})}{\text{mol dm}^{-3}}$	$\frac{c(\text{KCl})}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	6.42	0.10	0	-54.88
298.15	7.16	0.10	0	59.40
298.15	7.55	0.10	0	-65.32
298.15	7.90	0.10	0	-65.87
298.15	8.32	0.10	0	-67.57
298.15	8.41	0.10	0	-68.28
298.15	8.59	0.10	0	-68.03
298.15	8.63	0.10	0	-67.50
298.15	8.80	0.10	0	-68.10
298.15	8.57	0.25	0	-68.66
298.15	8.53	0.60	0	-70.23
298.15	8.55	1.00	0	-71.75
298.15	7.86	0.10	0.60	-67.07
298.15	8.14	0.10	0.60	-68.28
298.15	8.19	0.10	0.60	-68.17
298.15	8.45	0.10	0.60	-68.11
304.15	8.42	0.10	0	-69.16
309.95	8.42	0.10	0	-70.25

Reference: 86GAJ/STE

Method: calorimetry

Buffer: Tris + HCl

pH: 6.42-8.80

Cofactor(s): CaCl₂ (0.00158 mol dm⁻³)

Evaluation: A

Gajewski *et al.* calculated $\Delta_r H^\circ(T = 298.15 \text{ K}, I = 0) = -20.5 \text{ kJ mol}^{-1}$ and $\Delta_r C_p^\circ = -237 \text{ J K}^{-1} \text{ mol}^{-1}$ for the chemical reference reaction: $\text{ATP}^{4-}(\text{aq}) + \text{H}_2\text{O(l)} = \text{ADP}^{3-}(\text{aq}) + \text{HPO}_4^{2-}(\text{aq}) + \text{H}^+(\text{aq})$.



$\frac{T}{\text{K}}$	pH	$\frac{c(\text{KCl})}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.15	8.0	0.60	-70.6
298.15	9.0	0.60	-71.4

Reference: 81HIN/POL

Method: calorimetry

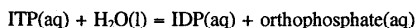
Buffer: Tris (0.1 mol dm⁻³)

pH: 8.0-9.0

Cofactor(s): CaCl₂ (0.001 mol dm⁻³)

Evaluation: A

Hinz *et al.* gave results that lead to $\Delta_r H^\circ(T = 298.15 \text{ K}, I_c \approx 0.6 \text{ mol dm}^{-3}) = -22.3 \text{ kJ mol}^{-1}$ for the chemical reference reaction: $\text{GTP}^{4-}(\text{aq}) + \text{H}_2\text{O(l)} = \text{GDP}^{3-}(\text{aq}) + \text{HPO}_4^{2-}(\text{aq}) + \text{H}^+(\text{aq})$.



$\frac{T}{\text{K}}$	pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
293.15	8.0	-68.6

Reference: 55KIT/BEN

Method: calorimetry

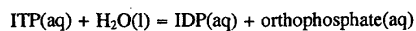
Buffer: Tris + HCl

pH: 8.0

Cofactor(s): Ca²⁺

Evaluation: A

The results given here when corrected for the enthalpy of buffer protonation lead to $\Delta_r H^\circ(T = 293 \text{ K}, \text{pH} = 8.0) \approx -20 \text{ kJ mol}^{-1}$.



$\frac{T}{K}$ pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
293.158.0	-68.6

Reference: 56POD/MOR

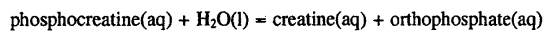
Method: calorimetry

Buffer: Tris

pH: 8.0

Cofactor(s): Ca^{2+}

Evaluation: B



$\frac{T}{K}$ pH	$\frac{\Delta_r H}{\text{kJ mol}^{-1}}$
298.158.0	-37.4

Reference: 60GEL/STU

Method: calorimetry

Buffer: Tris (0.045 mol dm⁻³)

pH: 8.0

Cofactor(s): CaCl_2 (0.001 mol dm⁻³)

Evaluation: A

Creatine kinase (EC 2.7.3.2) was also present. Gellert and Sturtevant obtained $\Delta_r H^\circ(T = 298.15 \text{ K}, \text{pH} = 8.0) = -37.4 \text{ kJ mol}^{-1}$ for the above reaction using $\Delta_r N(\text{H}^+) = 0$.

5.63. Enzyme: Ca^{2+} -transporting ATPase (EC 3.6.1.38)

$\frac{T}{K}$ pH K'
295.157.04E4

Reference: 85FAG/DEW

Method: spectrophotometry

Buffer: Mops (0.050 mol dm⁻³)

pH: 7.0

Cofactor(s): CaCl_2

Evaluation: C

This result was obtained from kinetic data with a very long extrapolation to $\Delta(\text{pCa}) = 0$.

6. List of Substances With Chemical Abstract Service (CAS) Registry Numbers With Cross References to Enzyme Commission Numbers

Substance	CAS Registry Number ^a	Enzyme Commission Numbers
acetate	64-19-7	3.1.1.7, 3.1.3.1, 3.1.3.2, 3.5.1.14
<i>N</i> -acetyl-L-alanine	97-69-8	3.5.1.14
<i>N</i> -acetyl-L- α -amino- <i>n</i> -butyrate	19146-51-1	3.5.1.14
acetylcholine	51-84-3	3.1.1.7
<i>N</i> -acetyethanolamine	142-26-7	3.1.3.1
<i>N</i> -acetyethanolamine phosphate	89603-45-2	3.1.3.1
<i>N</i> -acetyl-L-glycine	543-24-8	3.5.1.14
<i>N</i> -acetyl-L-methionine	65-82-7	3.5.1.14
<i>N</i> -acetyl-L-norleucine	15891-49-3	3.5.1.14
<i>N</i> -acetyl-L-norvaline	15891-50-6	3.5.1.14
<i>N</i> -acetyl-L-phenylalanine	2018-61-3	3.4.21.1, 3.4.23.1
<i>N</i> -acetyl-L-phenylalanine-L-dibromotyrosine ethyl ester	66146-61-0	3.4.23.1
<i>N</i> -acetyl-L-phenylalanine methyl ester	3618-96-0	3.4.21.1
<i>N</i> -acetyl-L-phenylalanyl-glycinamide	29701-43-7	3.4.21.1
<i>N</i> -acetyl-L-phenylalanyl-L-phenylalanyl-glycine	22004-29-1	3.4.23.1
<i>N</i> -acetyl-L-phenylalanyl-L-phenylalanyl-glycine methyl ester	155614-11-2	3.4.23.1
acetyl phosphate	94249-01-1	3.1.3.1, 3.1.3.2
3-acetylpyridine	350-03-8	3.2.2.6
3-acetylpyridine adenine dinucleotide	86-08-8	3.2.2.6
3-acetylpyridine mononucleotide	153-59-3	3.2.2.6
<i>N</i> -acetyl-L-tyrosine	1948-71-6	3.4.21.1
<i>N</i> -acetyl-L-tyrosine ethyl ester	36546-50-6	3.4.21.1
<i>N</i> -acetyl-L-tyrosine hydroxamic acid	41656-83-1	3.4.21.1
<i>N</i> -acetyl-L-valine	96-81-1	3.5.1.14
adenine	73-24-5	3.2.2.4, 3.2.2.7
adenosine	58-61-7	3.1.3.1, 3.1.3.2, 3.1.3.5, 3.1.27.a, 3.2.2.7, 3.3.1.1, 3.5.4.4
adenosine 2',3'-(cyclic)phosphate	37063-35-7	3.1.27.1, 3.1.27.a
adenosine 3',5'-(cyclic)phosphate	60-92-4	3.1.4.1, 3.1.4.17, 3.1.4.a
adenosine 5'-diphosphate	58-64-0	3.1.3.1, 3.6.1.32, 3.6.1.38
adenosine 5'-diphosphoribose	68414-18-6	3.2.2.5
adenosine 3'-monophosphate	84-21-9	3.1.4.a, 3.1.27.1
adenosine 5'-monophosphate	18422-05-4	3.1.3.1, 3.1.3.2, 3.1.3.5, 3.1.4.1, 3.1.4.17, 3.2.2.4, 3.5.4.6, 3.6.1.9
adenosine 5'-triphosphate	56-65-5	3.1.3.2, 3.6.1.1, 3.6.1.32, 3.6.1.38
<i>S</i> -adenosyl-L-homocysteine	979-92-0	3.3.1.1
adenylyl(3'→5')adenosine	2391-46-0	3.1.27.a
adenylyl(3'→5')cytidine	4833-63-0	3.1.27.a
adenylyl sulfate	102029-95-8	3.6.1.1
adenylyl(3'→5')uridine	93839-87-3	3.1.27.a
L-alanine	56-41-7	3.5.1.14
β -alanine	107-95-9	3.5.1.22
allantoate	99-16-1	3.5.3.4
L- α -amino- <i>n</i> -butyrate	1492-24-6	3.5.1.14
7-aminocephalosporanic acid	957-68-6	3.5.1.11
7-aminodeacetoxycephalosporanic acid	22252-43-3	3.5.1.11
6-aminopenicillanic acid	551-16-6	3.5.1.11
D(-)- α -aminophenylacetic acid	875-74-1	3.5.1.11
7-amino-3-(1-pyridyl-methyl)-3-cephem-4-carboxylic acid	3432-88-0	3.5.1.11
ammonia	1336-21-6	3.4.14.1, 3.4.21.1, 3.4.21.4, 3.5.1.1, 3.5.1.2, 3.5.1.5, 3.5.3.6, 3.5.4.4, 3.5.4.5, 3.5.4.6
ammonium carbamate	111-78-0	3.5.1.5
ampicillin	69-53-4	3.5.1.11, 3.5.2.6
ampicillinoic acid	32746-94-4	3.5.2.6
amylose	9005-84-9	3.2.1.3
4',5'-anhydroadenosine	81919-30-4	3.3.1.1
aniline	62-53-3	3.4.22.2
D-arabinose	28697-53-2	3.2.1.23
L-arginine	74-79-3	3.1.3.1, 3.5.3.1, 3.5.3.6
L-asparagine	70-47-3	3.5.1.1
L-aspartate	56-84-8	3.5.1.1
benzoic acid	65-85-0	3.4.17.4
<i>N</i> α -benzoyl-L-argininamide	965-03-7	3.4.21.4
<i>N</i> α -benzoyl-L-arginine	154-92-7	3.4.21.4

6. List of Substances With Chemical Abstract Service (CAS) Registry Numbers
With Cross References to Enzyme Commission Numbers — Continued

Substance	CAS Registry Number ^a	Enzyme Commission Numbers
<i>N</i> -benzoyl-L-tyrosinamide	58690-81-6	3.4.21.1
<i>N</i> -benzoyl-L-tyrosine	2566-23-6	3.4.17.4, 3.4.21.1
<i>N</i> -benzoyl-L-tyrosylglycinamide	7369-86-0	3.4.21.1
<i>N</i> -benzoyl-L-tyrosylglycine	78233-53-1	3.4.17.4, 3.4.21.1
<i>N</i> -benzoyl-L-tyrosylglycinanilide	102135-28-4	3.4.21.1
benzyloxycarbonylglycine	1138-80-3	3.4.17.1, 3.4.24.27
benzyloxycarbonylglycyl-L-leucine	1421-69-8	3.4.17.1
benzyloxycarbonylglycyl-L-phenylalaninamide	5513-69-9	3.4.24.27
benzyloxycarbonylglycyl-L-phenylalanine	1170-76-9	3.4.17.1
1-butanol	71-36-3	3.2.1.21
(±)-2-butanol	15892-23-6	3.2.1.21
1-butyl β-D-glucopyranoside	5391-18-4	3.2.1.21
2-butyl β-D-glucopyranoside	58044-56-7	3.2.1.21
<i>N</i> -carbamoyl-L-aspartate	16649-79-9	3.5.2.3, 3.5.2.4
carbon dioxide	124-38-9	3.5.1.5
L-5-carboxymethylhydantoin	5427-26-9	3.5.2.4
casein κ	9000-71-9	3.4.23.4
cellobiose	528-50-7	3.2.1.21
cephalexin	15686-71-2	3.5.1.11
cephaloridine	50-59-9	3.5.1.11
cephalothin	58-71-9	3.5.1.11
choline	62-49-7	3.1.1.7, 3.1.3.1
L-citrulline	372-75-8	3.5.3.6
creatine	57-00-1	3.1.3.1, 3.6.1.32
cyclomaltoheptaose	7585-39-9	3.2.1.1, 3.2.1.41
cyclomaltohexaose	10016-20-3	3.2.1.1
cyclomaltooctaose	17465-86-0	3.2.1.1
cytidine	65-46-3	3.1.27.a, 3.5.4.5
cytidine 2',3'-(cyclic)phosphate	15718-51-1	3.1.27.5, 3.1.27.a
cytidine 3'-monophosphate	84-52-6	3.1.27.5
cytidyl(3'→5')cytidine	27552-98-3	3.1.27.a
cytidyl(3'→5')uridine	27552-97-2	3.1.27.a
<i>n</i> -decanoic acid	334-48-5	3.1.1.3
<i>n</i> -decanoic acid glycerol diester	53988-07-1	3.1.1.3
<i>n</i> -decanoic acid glycerol monoester	26402-22-2	3.1.1.3
<i>n</i> -decanoic acid glycerol triester	621-71-6	3.1.1.3
2'-deoxyadenosine 3',5'-(cyclic)phosphate	93839-95-3	3.1.4.1
2'-deoxyadenosine 5'-monophosphate	653-63-4	3.1.4.1
L-dibromotyrosine ethyl ester	91384-03-1	3.4.23.1
diethyl phosphate	598-02-7	3.1.4.a
(<i>S</i>)-dihydroorotate	5988-19-2	3.5.2.3
diolm	2465-32-9	3.1.1.3
ethanol	64-17-5	3.1.3.1, 3.1.4.a, 3.2.1.21, 3.4.21.1
ethylene glycol	107-21-1	3.1.3.1
ethylene glycol phosphate	52012-13-2	3.1.3.1
ethylene phosphate	36885-49-1	3.1.4.a
ethyl β-D-glucopyranoside	27214-60-4	3.2.1.21
5-formyltetrahydrofolate	58-05-9	3.5.4.9
10-formyltetrahydrofolate	2800-34-2	3.5.4.9
D-fructose	57-48-7	3.1.3.1, 3.1.3.2, 3.2.1.10, 3.2.1.20, 3.2.1.23, 3.2.1.26
D-fructose 1,6-biphosphate	488-69-7	3.1.3.1, 3.1.3.2, 3.1.3.11
D-fructose 1-phosphate	103213-46-3	3.1.3.1, 3.1.3.2
D-fructose 6-phosphate	26177-86-6	3.1.3.1, 3.1.3.2, 3.1.3.11
furylacrylic acid	539-47-9	3.4.21.1
3-(2-furyl)acryloylimidazole	2172-16-9	3.4.21.1
3- <i>O</i> -β-D-galactopyranosyl-D-arabinose	6057-48-3	3.2.1.23
<i>O</i> -α-D-galactopyranosyl-(1→6)- <i>O</i> -α-D-galactopyranosyl- (1→6)-α-D-glucopyranose	95463-58-4	3.2.1.26
D-galactose	59-23-4	3.1.3.1, 3.2.1.21, 3.2.1.23
D-galactose 6-phosphate	32972-52-4	3.1.3.1
β-gentiobiose	554-91-6	3.2.1.21
D-glucose	50-99-7	3.1.3.1, 3.2.1.1, 3.2.1.2, 3.2.1.3, 3.2.1.10, 3.2.1.20, 3.2.1.21, 3.2.1.23, 3.2.1.26

6. List of Substances With Chemical Abstract Service (CAS) Registry Numbers
With Cross References to Enzyme Commission Numbers — Continued

Substance	CAS Registry Number ^a	Enzyme Commission Numbers
D-glucose 6-phosphate	56-73-5	3.1.1.31, 3.1.3.1
L-glutamate	56-86-0	3.4.19.9, 3.5.1.2
L-glutamine	56-85-9	3.5.1.2
γ -glutamohydroxamic acid	1955-67-5	3.5.1.2
(R)-glycerate	6000-40-4	3.1.3.1
glycerol	142-10-9	3.1.1.3, 3.1.3.1, 3.1.3.2
L- α -glycerophosphate	93805-66-4	3.1.3.1, 3.1.3.2
glycinamide	1668-10-6	3.4.11.1, 3.4.21.1
glycine	56-40-6	3.4.17.4, 3.5.1.11, 3.5.1.14
glycylanilide	555-48-6	3.4.21.1
glycyl-L-phenylalanine	3321-03-7	3.4.14.1
glycyl-L-phenylalaninamide	1510-04-9	3.4.14.1
guanidinoacetate	352-97-6	3.1.3.1
guanosine	118-00-3	3.1.3.1
guanosine 2',3'-(cyclic)phosphate	15718-49-7	3.1.27.1, 3.1.27.a
guanosine 3',5'-(cyclic)phosphate	40732-48-7	3.1.4.1
guanosine 5'-diphosphate	146-91-8	3.1.3.1, 3.6.1.32
guanosine 3'-monophosphate	6027-83-4	3.1.27.1
guanosine 5'-monophosphate	85-32-5	3.1.3.1, 3.1.4.1
guanosine 5'-triphosphate	36051-31-7	3.1.3.1, 3.6.1.32
guanylyl(3' \rightarrow 5')adenosine	103192-56-9	3.1.27.a
guanylyl(3' \rightarrow 5')cytidine	98046-67-4	3.1.27.a
guanylyl(3' \rightarrow 5')uridine	103213-30-5	3.1.27.a
H ₂ O	7732-18-5	3.1.1.3, 3.1.1.7, 3.1.1.21, 3.1.1.31, 3.1.3.1, 3.1.3.2, 3.1.3.3, 3.1.3.5, 3.1.3.11, 3.1.4.1, 3.1.4.17, 3.1.4.a, 3.1.27.1, 3.1.27.5, 3.2.1.1, 3.2.1.2, 3.2.1.3, 3.2.1.10, 3.2.1.20, 3.2.1.21, 3.2.1.23, 3.2.1.24, 3.2.1.26, 3.2.1.41, 3.2.2.4, 3.2.2.5, 3.2.2.7, 3.3.1.1, 3.4.11.1, 3.4.14.1, 3.4.17.1, 3.4.17.4, 3.4.19.9, 3.4.21.1, 3.4.21.4, 3.4.22.2, 3.4.23.1, 3.4.23.4, 3.4.24.27, 3.5.1.1, 3.5.1.2, 3.5.1.5, 3.5.1.11, 3.5.1.14, 3.5.1.22, 3.5.1.36, 3.5.2.3, 3.5.2.4, 3.5.2.6, 3.5.3.1, 3.5.3.4, 3.5.3.6, 3.5.4.4, 3.5.4.5, 3.5.4.6, 3.5.4.9, 3.6.1.1, 3.6.1.2, 3.6.1.9, 3.6.1.32, 3.6.1.38
hippuric acid	495-69-2	3.4.22.2
hippurylanilide	3106-11-4	3.4.22.2
L-homocysteine	6027-13-0	3.3.1.1
4-hydroxybutyl phosphate	10305-36-9	3.1.4.a
2-hydroxyethyl phosphate	1892-26-8	3.1.4.a
hydroxylamine	5470-11-1	3.4.21.1, 3.5.1.2
5-hydroxy-N-methylpyroglutamate	22671-35-8	3.5.1.36
3-hydroxypropyl phosphate	13507-42-1	3.1.3.1, 3.1.4.a
imidazole	288-32-4	3.4.21.1
inosine	58-63-9	3.1.3.1, 3.5.4.4
inosine 3',5'-(cyclic)phosphate	41092-64-2	3.1.4.1
inosine 5'-diphosphate	81012-88-6	3.6.1.32
inosine 5'-monophosphate	131-99-7	3.1.3.1, 3.1.4.1, 3.5.4.6
inosine 5'-triphosphate	35908-31-7	3.6.1.32
isomaltose	499-40-1	3.2.1.3, 3.2.1.10
isomaltotriose	3371-50-4	3.2.1.3
lactose	63-42-3	3.2.1.23
lactulose	4618-18-2	3.2.1.23
L-leucine	61-90-5	3.4.17.1
L-lysine	56-87-1	3.4.21.4
maltoheptaose	34620-78-5	3.2.1.3
maltohexaose	34620-77-4	3.2.1.3
maltopentaose	123333-77-7	3.2.1.3
maltose	69-79-4	3.2.1.2, 3.2.1.3, 3.2.1.20, 3.2.1.41
maltosyl- β -cyclomaltoheptaose	104723-60-6	3.2.1.41
maltotetraose	34612-38-9	3.2.1.2, 3.2.1.3

6. List of Substances With Chemical Abstract Service (CAS) Registry Numbers
With Cross References to Enzyme Commission Numbers — Continued

Substance	CAS Registry Number ^a	Enzyme Commission Numbers
maltotriose	1109-28-0	3.2.1.3
D-mannose	3458-28-4	3.1.3.1, 3.2.1.24
D-mannose 6-phosphate	70442-25-0	3.1.3.1
α -D-melibiose	585-99-9	3.2.1.21, 3.2.1.26
methanol	67-56-1	3.2.1.21, 3.4.21.1
5,10-methenyltetrahydrofolate	3432-99-3	3.5.4.9
L-methionine	63-68-3	3.5.1.14
methylamine	74-89-5	3.5.1.36, 3.5.4.5
<i>N</i> ⁴ -methylcytidine	10578-79-7	3.5.4.5
methyl α -D-glucopyranose	13224-94-7	3.1.3.1
methyl β -D-glucopyranoside	709-50-2	3.2.1.21
methyl α -D-glucopyranoside 4,6-(cyclic)phosphate	16727-59-6	3.1.4.a
methyl α -D-glucopyranoside 6-phosphate	15416-98-5	3.1.3.1, 3.1.4.a
2-methyl-1-propanol	78-83-1	3.2.1.21
2-methyl-2-propanol	76-65-0	3.2.1.21
2-methyl-1-propyl β -D-glucopyranoside	5391-20-8	3.2.1.21
2-methyl-2-propyl β -D-glucopyranoside	29074-04-2	3.2.1.21
methyl β -D-ribofuranose	7473-45-2	3.1.3.1
methyl β -D-ribofuranoside 3,5-(cyclic)phosphate	56366-52-0	3.1.4.a
methyl β -D-ribofuranoside 5-phosphate	56390-42-2	3.1.3.1, 3.1.4.a
monoethyl phosphate	1623-14-9	3.1.3.1, 3.1.4.a
monoolein	111-03-5	3.1.1.3
1-naphthol	90-15-3	3.1.3.1
1-naphthyl phosphate	1136-89-6	3.1.3.1
nicotinamide	98-92-0	3.2.2.5, 3.2.2.6
β -nicotinamide-adenine dinucleotide (oxidized)	53-84-9	3.2.2.5, 3.2.2.6, 3.6.1.9
β -nicotinamide-adenine dinucleotide phosphate (oxidized)	53-59-8	3.1.1.31
β -nicotinamide-adenine dinucleotide phosphate (reduced)	2646-71-1	3.1.1.31
β -nicotinamide mononucleotide	1094-61-7	3.2.2.6, 3.6.1.9
4-nitrophenol	100-02-7	3.1.3.1, 3.1.3.2
4-nitrophenyl phenylphosphonate	57072-35-2	3.1.3.1
4-nitrophenyl phosphate	123334-11-2	3.1.3.1, 3.1.3.2
L-norleucine	327-57-1	3.5.1.14
L-norvaline	6600-40-4	3.5.1.14
<i>n</i> -octanoic acid	124-07-2	3.1.1.3
<i>n</i> -octanoic acid glycerol diester	36534-80-0	3.1.1.3
<i>n</i> -octanoic acid glycerol monoester	26402-26-6	3.1.1.3
<i>n</i> -octanoic acid glycerol triester	538-23-8	3.1.1.3
oleic acid	112-80-1	3.1.1.3
L-ornithine	70-26-8	3.5.3.1
orthophosphate	10049-21-5	3.1.3.1, 3.1.3.2, 3.1.3.3, 3.1.3.5, 3.1.3.11, 3.6.1.1, 3.6.1.32, 3.6.1.38
2-oxoglutarate	328-50-7	3.5.1.36
palatinose	13718-94-0	3.2.1.10
palmitate	57-10-3	3.1.1.21
panose	33401-87-5	3.2.1.3
pantoic acid	470-29-1	3.5.1.22
pantothenate	867-81-2	3.5.1.22
penicic acid	37727-80-3	3.5.1.11
penicillin G	61-33-6	3.5.1.11, 3.5.2.6
penicillinoic acid	13057-98-2	3.5.1.11, 3.5.2.6
phenol	108-95-2	3.1.3.1
phenoxyacetate	122-59-8	3.5.1.11
phenoxymethylpenicillin	87-08-1	3.5.1.11, 3.5.2.6
phenoxymethylpenicillinoic acid	1049-84-9	3.5.2.6
7-phenylacetamidodeacetoxycephalosporanic acid	27255-72-7	3.5.1.11
phenylacetic acid	103-82-2	3.5.1.11, 3.5.1.14
phenylacetyl glycine	500-98-1	3.5.1.11
phenylacetyl-L-phenylglycine	24003-71-2	3.5.1.11, 3.5.1.14
L-phenylalaninamide	5241-58-7	3.4.24.27
L-phenylalanine	63-91-2	3.4.17.1
L-phenylalanyl glycine	721-90-4	3.4.23.1
L-phenylalanyl glycine methyl ester	65559-51-5	3.4.23.1
phenyl α -D-glucopyranoside	4630-62-0	3.2.1.3
L-phenylglycine	2935-35-5	3.5.1.11, 3.5.1.14

6. List of Substances With Chemical Abstract Service (CAS) Registry Numbers
With Cross References to Enzyme Commission Numbers — Continued

Substance	CAS Registry Number ^a	Enzyme Commission Numbers
phenyl α -maltoside	1175-37-7	3.2.1.3
phenyl phosphate	3279-54-7	3.1.3.1
phenylphosphonate	1571-33-1	3.1.3.1
phospho-L-arginine	1189-11-3	3.1.3.1
phosphocreatine	6190-45-0	3.1.3.1, 3.6.1.32
6-phospho-D-gluconate	5341-70-4	3.1.1.31
3-phospho-D-glycerate	80731-10-8	3.1.3.1
phosphoguanidinoacetate	5115-19-5	3.1.3.1
phosphoenolpyruvate	4265-07-0	3.1.3.1
phosphorylcholine	108321-32-0	3.1.3.1
L-O-phosphoserine	407-41-0	3.1.3.1, 3.1.3.3
phosphotaurocyamine	4189-99-5	3.1.3.1
poly-L-lysine	26124-78-7	3.4.21.4
1,3-propanediol	504-63-2	3.1.3.1
1-propanol	71-23-8	3.2.1.21
2-propanol	27-63-0	3.2.1.21
propionate	79-09-4	3.1.1.7
propionylcholine	2365-13-1	3.1.1.7
1-propyl β -D-glucopyranoside	34384-77-5	3.2.1.21
2-propyl β -D-glucopyranoside	5391-17-3	3.2.1.21
pteroate	119-24-4	3.4.19.9
pteroylglutamate	75708-92-8	3.4.19.9
pyrophosphate	2466-09-3	3.1.3.1, 3.6.1.1
pyruvate	127-17-3	3.1.3.1
raffinose	512-69-6	3.2.1.26
retinol	68-26-8	3.1.1.21
retinyl palmitate	79-81-2	3.1.1.21
D-ribose	50-69-1	3.1.3.1, 3.2.2.7
D-ribose 5-phosphate	4300-28-1	3.1.3.1, 3.2.2.4
D-ribulose	488-84-6	3.1.3.1
D-ribulose 5-phosphate	108321-99-9	3.1.3.1
ribonucleic acid	63231-63-0	3.1.27.5
L-serine	56-45-1	3.1.3.1, 3.1.3.3
stachyose	10094-58-3	3.2.1.26
sucrose	57-50-1	3.2.1.26
sulfate	7664-93-9	3.6.1.1
taurocyamine	543-18-0	3.1.3.1
tetramethylene phosphate	51374-71-1	3.1.4.a
2-thienylacetic acid	1918-77-0	3.5.1.11
α,α -trehalose	99-20-7	3.2.1.2
trimetaphosphate	7785-84-4	3.6.1.2
trimethylene phosphate	13507-10-3	3.1.4.a
triolein	122-32-7	3.1.1.3
triphosphate	7758-29-4	3.6.1.2
D-turanose	547-25-1	3.2.1.20
L-tyrosine	60-18-4	3.4.11.1, 3.4.17.4
L-tyrosylglycinamide	46834-67-7	3.4.11.1
urea	57-13-6	3.5.1.5, 3.5.3.1, 3.5.3.4
(-)-ureidoglycolate	103192-53-6	3.5.3.4
uridine	58-96-8	3.1.4.1, 3.1.27.a, 3.5.4.5
uridine 2',3'-(cyclic)phosphate	15718-50-0	3.1.27.5, 3.1.27.a
uridine 3',5'-(cyclic)phosphate	56632-58-7	3.1.4.1
uridine 3'-monophosphate	35170-03-7	3.1.27.5
uridine 5'-monophosphate	58-97-9	3.1.4.1
uridylyl(3' \rightarrow 5')cytidine	108347-78-0	3.1.27.a
uridylyl(3' \rightarrow 5')uridine	27552-95-0	3.1.27.a
L-valine	72-18-4	3.5.1.14

^aIn some cases the CAS registry number refers to a salt of the substance.

7. Abbreviations

ADP	adenosine 5'-diphosphate	Mes	2-(<i>N</i> -morpholino)ethanesulfonic acid
AMP	adenosine 5'-monophosphate	Mops	3-(<i>N</i> -morpholino)propanesulfonic acid
ATP	adenosine 5'-triphosphate	NAD	β -nicotinamide-adenine dinucleotide (oxidized)
Bis-tris	bis(2-hydroxyethyl)iminotris(hydroxymethyl)methane	NADP	β -nicotinamide-adenine dinucleotide phosphate (oxidized)
GDP	guanosine 5'-diphosphate	NADPH	β -nicotinamide-adenine dinucleotide phosphate (reduced)
GMP	guanosine 5'-monophosphate	Pipes	piperazine- <i>N,N'</i> -bis(2-ethanesulfonic acid)
GTP	guanosine 5'-triphosphate	RNA	ribonucleic acid
Hepes	<i>N</i> -(2-hydroxyethyl)piperazine- <i>N'</i> -2-ethanesulfonic acid	Tes	<i>N</i> -tris(hydroxymethyl)methyl-2-aminoethanesulfonic acid
IDP	inosine 5'-diphosphate	Tricine	<i>N</i> -[tris(hydroxymethyl)methyl]glycine
IMP	inosine 5'-monophosphate	Tris	tris(hydroxymethyl)aminomethane
ITP	inosine 5'-triphosphate	UMP	uridine 5'-monophosphate

8. Glossary of Symbols

Symbol	Name	Unit
c	concentration	mol dm ⁻³
c°	standard concentration ($c^\circ = 1 \text{ mol dm}^{-3}$)	mol dm ⁻³
$\Delta_r C_p^\circ$	standard heat capacity of reaction at constant pressure	J K ⁻¹ mol ⁻¹
$\Delta_r G^\circ$	standard Gibbs energy of reaction	kJ mol ⁻¹
$\Delta_r G'^\circ$	standard transformed Gibbs energy of reaction	kJ mol ⁻¹
$\Delta_r H^\circ$	standard enthalpy of reaction	kJ mol ⁻¹
$\Delta_r H'^\circ$	standard transformed enthalpy of reaction	kJ mol ⁻¹
$\Delta_r H(\text{cal})$	calorimetrically determined enthalpy of reaction	kJ mol ⁻¹
I_c	ionic strength, concentration basis	mol dm ⁻³
I_m	ionic strength, molality basis	mol kg ⁻¹
K	equilibrium constant ^a	dimensionless
K'	apparent equilibrium constant ^a	dimensionless
m	molality	mol kg ⁻¹
m°	standard molality ($m^\circ = 1 \text{ mol kg}^{-1}$)	mol kg ⁻¹
$\Delta_r N(\text{H}^+)$	change in binding of hydrogen ion in a biochemical reaction	dimensionless
pH	$-\log_{10}\{c(\text{H}^+)/c^\circ\}$ ^b	dimensionless
pX	$-\log_{10}\{c(X)/c^\circ\}$	dimensionless
$\Delta_r S^\circ$	standard entropy of reaction	J K ⁻¹ mol ⁻¹
T	thermodynamic temperature	K
x	mole fraction	dimensionless

^aWhen needed, a subscript c , m , or x is added to these quantities to designate a concentration, molality, or mole fraction basis.

^bThis is an approximate definition. The IUPAC Green Book (I. Mills, T. Cvitaš, K. Homann, N. Kallay, and K. Kuchitsu, "Quantities, Units and Symbols in Physical Chemistry", Blackwell Scientific Publications, Oxford, 1993) contains a discussion of the operational definition of pH.

9. Reference Codes and References in the Table

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