Thermodynamics of Enzyme-Catalyzed Reactions Part 3. Hydrolases

Robert N. Goldberg and Yadu B. Tewari

Biotechnology Division, National Institute of Standards and Technology, Gaithersburg, MD 20899–0001

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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.

Contents

1. Introduction

This review is a continuation of the first two papers in this series[1-2] 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 $\Delta_r N(H^+)$ 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 reactions 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

$$A(aq) = B(aq) + C(aq), \quad (1)$$

$K_c = c(B)c(C)/\{c(A)c^\circ\}$, $K_m = m(B)m(C)/\{m(A)m^\circ\}$, and $K_x = x(B)x(C)/x(A)$. Here, c, m, and x are, respectively, concentration, molality, and mole fraction, $c^\circ = 1$ mol dm^{-3}, and $m^\circ = 1$ 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:

$$\text{sucrose(aq)} + H_2O(l) = \text{D-glucose(aq)} + \text{D-fructose(aq)}. \quad (1)$$

A chemical reference reaction involving specific species is:

$$\text{sucrose}^0\text{(aq)} + H_2O(l) = \text{D-glucose}^0\text{(aq)} + \text{D-fructose}^0\text{(aq)}. \quad (2)$$

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, sucrose^0, D-glucose^0, and D-fructose^0 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 properties[14] 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 shown[18] 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.

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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) + H_2O(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) + H_2O(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) + H_2O(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) + H_2O(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) + H_2O(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.

n-octanoic acid glycerol triester(sln) + H_2O(sln) = *n*-octanoic acid(sln) + *n*-octanoic acid glycerol diester(sln)

$\frac{T}{K}$	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.

diolein(aq) + H_2O(aq) = oleic acid(aq) + monoolein(aq)

$\frac{T}{K}$	K_c'
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.

diolein(sln) + H_2O(sln) = oleic acid(sln) + monoolein(sln)

$\frac{T}{K}$	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.

monoolein(aq) + H_2O(aq) = oleic acid(aq) + glycerol(aq)

$\frac{T}{K}$	K_c'
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.

monoolein(sln) + H_2O(sln) = oleic 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.

triolein(aq) + H_2O(aq) = oleic acid(aq) + diolein(aq)

$\frac{T}{K}$	K_c'
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.

triolein(sln) + H_2O(sln) = oleic acid(sln) + diolein(sln)

$\frac{T}{K}$	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)

acetylcholine(aq) + H_2O(l) = acetate(aq) + choline(aq)

$\frac{T}{K}$	pH	K_c'
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.

acetylcholine(aq) + H_2O(l) = acetate(aq) + choline(aq)

$\frac{T}{K}$	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.

acetylcholine(aq) + H_2O(l) = acetate(aq) + choline(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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 $\Delta_r H°(T = 298.15\ \text{K}) = 1.17\ \text{kJ mol}^{-1}$ for the chemical reference reaction: acetylcholine$^+$(aq) + H_2O(l) = acetate$^-$(aq) + choline$^+$(aq) + H^+(aq).

acetylcholine(aq) + H_2O(l) = acetate(aq) + choline(aq)

$\frac{T}{K}$	pH	buffer	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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.

acetylcholine(aq) + H_2O(l) = acetate(aq) + choline(aq)

$\frac{T}{K}$	pH	media	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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): $CaCl_2$ (0.003 mol dm^{-3}) + $MgCl_2$ (0.002 mol dm^{-3})
Evaluation: A

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

propionylcholine(aq) + H_2O(l) = propionate(aq) + choline(aq)

$\frac{T}{K}$	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)

retinyl palmitate(aq) + H_2O(l) = retinol(aq) + palmitate(aq)

$\frac{T}{K}$	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)

D-glucose 6-phosphate(aq) + NADP(aq) + H_2O(l) = 6-phospho-D-gluconate(aq) + NADPH(aq)

$\frac{T}{K}$	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)

N-acetylethanolamine phosphate(aq) + H_2O(l) = *N*-acetylethanolamine(aq) + orthophosphate(aq)

$\frac{T}{K}$	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.

acetyl $phosphate^{2-}$(aq) + H_2O(l) = $acetate^-$(aq) + HPO_4^{2-}(aq)

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

Reference: 70GEO/WIT
Method: calorimetry
Evaluation: C

George *et al.* reported $\Delta_r H°(I_c \leq 0.01\ mol\ dm^{-3}) = -26.8\ kJ\ mol^{-1}$ 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).

ADP^{3-}(aq) + H_2O(l) = AMP^{2-}(aq) + HPO_4^{2-}(aq) + H^+(aq)

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

Reference: 69GEO/TRA
Method: calorimetry
pH: 8−9
Evaluation: C

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

AMP^{2-}(aq) + H_2O(l) = adenosine(aq) + HPO_4^{2-}(aq)

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

Reference: 69GEO/TRA
Method: calorimetry
pH: 8−9
Evaluation: C

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

AMP^{2-}(aq) + H_2O(l) = adenosine(aq) + HPO_4^{2-}(aq)

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

Reference: 70GEO/WIT
Method: chromatography and enzymatic assay
Evaluation: C

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

AMP(aq) + H_2O(l) = adenosine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	pMg	$\frac{I_m}{mol\ kg^{-1}}$	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 $K_m(T = 298.15\ K, I = 0) = (189 \pm 25)$ for the chemical reference reaction: AMP^{2-}(aq) + H_2O(l) = adenosine(aq) + HPO_4^{2-}(aq). Also see data given under 5′-nucleosidase (EC 3.1.3.5).

AMP(aq) + H_2O(l) = adenosine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{m(MgCl_2)}{mol\ kg^{-1}}$	$\frac{I_m}{mol\ kg^{-1}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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): $MgCl_2$
Evaluation: A

The pMg was in the range 3.34 to 3.41. Larson *et al.* calculated $\Delta_r H°(T = 298.15\ K, I = 0) = (0.9 \pm 0.4)\ kJ\ mol^{-1}$ for the chemical reference reaction: $AMP^{2-}(aq) + H_2O(l) = adenosine(aq) + HPO_4^{2-}$.

ethylene glycol phosphate(aq) + H_2O(l) = ethylene glycol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	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): $MgCl_2$
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) + H_2O(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) + H_2O(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) + H_2O(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) + H_2O(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) + H_2O(l) = D-fructose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{I_c}{mol\ dm^{-3}}$	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): $MgCl_2$ (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-phosphate^{2-}(aq) + H_2O(l) = D-fructose(aq) + HPO_4^{2-}(aq).

D-fructose 6-phosphate(aq) + H_2O(l) = D-fructose(aq) + orthophosphate(aq)

T/K	pH	c(MgCl$_2$)/mol dm^{-3}	c(Tris)/mol dm^{-3}	$\Delta_r H$(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): $MgCl_2$
Evaluation: A

Tewari *et al.* applied buffer protonation and ionization corrections to obtain $\Delta_r H° = -7.61$ kJ mol^{-1} and $\Delta_r C_p° = -28$ J K^{-1} mol^{-1} for the chemical reference reaction: D-fructose 6-phosphate^{2-}(aq) + H_2O(l) = D-fructose(aq) + HPO_4^{2-}(aq).

D-galactose 6-phosphate(aq) + H_2O(l) = D-galactose(aq) + orthophosphate(aq)

T/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 H_2O(l) = guanosine(aq) + 2 orthophosphate(aq)

T/K	pH	buffer	c(KCl)/mol dm^{-3}	$\Delta_r H$(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 $\Delta_r H°(T = 298.15\ \text{K}, I_c \approx 0.6\ \text{mol dm}^{-3}) = -21.5$ kJ mol^{-1} for the chemical reference reaction: GDP^{3-}(aq) + 2 H_2O(l) = guanosine(aq) + 2 HPO_4^{2-}(aq) + H^+(aq).

D-glucose 6-phosphate(aq) + H_2O(l) = D-glucose(aq) + orthophosphate(aq)

T/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) + H_2O(l) = D-glucose(aq) + orthophosphate(aq)

T/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 $K_c'c°/c(H_2O)$ reported by Ginodman in his Table 6.

D-glucose 6-phosphate(aq) + H_2O(l) = D-glucose(aq) + orthophosphate(aq)

T/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): $MgCl_2$ (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].

D-glucose 6-phosphate^{2-}(aq) + H_2O(l) = D-glucose(aq) + HPO_4^{2-}(aq)

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

Reference: 70GEO/WIT
Method: calorimetry
Evaluation: C

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

D-glucose 6-phosphate(aq) + H_2O(l) = D-glucose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	pMg	$\frac{I_c}{mol\ dm^{-3}}$	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): $MgCl_2$ (0.00604 mol dm^{-3})
Evaluation: A

D-glucose 6-phosphate(aq) + H_2O(l) = D-glucose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(ZnCl_2)}{mol\ dm^{-3}}$	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	$\frac{I_c}{mol\ dm^{-3}}$	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): $MgCl_2$ and $ZnCl_2$
Evaluation: A

D-glucose 6-phosphate(aq) + H_2O(l) = D-glucose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	$\frac{c(Tris)}{mol\ dm^{-3}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 HNO_3)
pH: 7.87−9.15
Cofactor(s): $MgCl_2$
Evaluation: A

Tewari *et al.* applied buffer protonation and ionization corrections to obtain $\Delta_r H° = 0.91\ kJ\ mol^{-1}$ and $\Delta_r C_p° = -48\ J\ K^{-1}\ mol^{-1}$ for the chemical reference reaction: D-glucose 6-phosphate^{2-}(aq) + H_2O(l) = D-glucose(aq) + HPO_4^{2-}(aq).

D-glucose 6-phosphate(aq) + H_2O(l) = D-glucose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	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): $MgCl_2$
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.

L-α-glycerophosphate(aq) + H_2O(l) = glycerol(aq) + orthophosphate(aq)

$\frac{T}{K}$	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).

L-α-glycerophosphate(aq) + H_2O(l) = glycerol(aq) + orthophosphate(aq)

$\frac{T}{K}$	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 $K_c' c°/c(H_2O)$ reported by Ginodman.

L-α-glycerophosphate(aq) + H_2O(l) = glycerol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	added solute	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	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): $MgCl_2$
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) + H_2O(l) = guanosine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	buffer	$\frac{c(KCl)}{mol\ dm^{-3}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H°(T = 298.15\ K, I_c \approx 0.6\ mol\ dm^{-3}) = 2.7\ kJ\ mol^{-1}$ for the chemical reference reaction: $GMP^{2-}(aq) + H_2O(l) = guanosine(aq) + HPO_4^{2-}(aq)$.

GTP(aq) + 3 H_2O(l) = guanosine(aq) + 3 orthophosphate(aq)

$\frac{T}{K}$	pH	buffer	$\frac{c(KCl)}{mol\ dm^{-3}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H°(T = 298.15\ K, I_c \approx 0.6\ mol\ dm^{-3}) = -46\ kJ\ mol^{-1}$ for the chemical reference reaction: $GTP^{4-}(aq) + 3\ H_2O(l) = guanosine(aq) + 3\ HPO_4^{2-}(aq) + 2\ H^+(aq)$.

3-hydroxypropyl phosphate(aq) + H_2O(l) = 1,3-propanediol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'°}{kJ\ mol^{-1}}$
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 $\Delta_r H'°$ given here.

IMP(aq) + H_2O(l) = inosine(aq) + orthophosphate(aq)

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

Reference: 93LAR/TEW
Method: HPLC
Buffer: phosphate
pH: 8.55
Cofactor(s): $MgCl_2$
Evaluation: A

Larson *et al.* calculated $K_m(T = 298.15\ K, I = 0) = (158 \pm 7)$ for the chemical reference reaction: $IMP^{2-}(aq) + H_2O(l) = inosine(aq) + HPO_4^{2-}(aq)$.

IMP(aq) + H_2O(l) = inosine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{m(MgCl_2)}{mol\ kg^{-3}}$	$\frac{I_m}{mol\ dm^{-3}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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): $MgCl_2$
Evaluation: A

The pMg was in the range 3.32 to 3.42. Larson *et al.* calculated $\Delta_r H°(T = 298.15\ K, I = 0) = (1.7 \pm 0.2)\ kJ\ mol^{-1}$ for the chemical reference reaction: $IMP^{2-}(aq) + H_2O(l) = inosine(aq) + HPO_4^{2-}(aq)$.

D-mannose 6-phosphate(aq) + H_2O(l) = D-mannose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	K_c'
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) + H_2O(l) = D-mannose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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): $MgCl_2$ (0.00010 mol dm^{-3})
Evaluation: A

Tewari *et al.* applied buffer protonation and ionization corrections to obtain $\Delta_r H° = 1.40$ kJ mol^{-1} and $\Delta_r C_p° = -46$ J K^{-1} mol^{-1} for the chemical reference reaction: D-mannose 6-phosphate^{2-}(aq) + H_2O(l) = D-mannose(aq) + HPO_4^{2-}(aq).

methyl α-D-glucopyranoside 6-phosphate(aq) + H_2O(l) = methyl α-D-glucopyranose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'°}{\text{kJ mol}^{-1}}$
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 $\Delta_r H'°$ given here.

methyl β-D-ribofuranoside 5-phosphate(aq) + H_2O(l) = methyl β-D-ribofuranose + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'°}{\text{kJ mol}^{-1}}$
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 $\Delta_r H'°$ given here.

monoethyl phosphate(aq) + H_2O(l) = ethanol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'°}{\text{kJ mol}^{-1}}$
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 $\Delta_r H'°$ given here.

1-naphthyl phosphate(aq) + H_2O(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) + H_2O(l) = 4-nitophenol(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) + H_2O(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

4-nitrophenyl phosphate(aq) + $H_2O(l)$ = 4-nitrophenol(aq) + orthophosphate(aq)

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

Reference: 92REK/TIS
Method: calorimetry
Buffer: Tris (0.05 mol dm^{-3}) + HCl
pH: 8.50
Evaluation: A

4-nitrophenyl phenylphosphonate(aq) + $H_2O(l)$ = 4-nitrophenol(aq) + phenylphosphonate(aq)

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

Reference: 79LAB/DEB
Method: calorimetry
Buffer: Tris + HCl
pH: 8.0
Evaluation: A

phenyl phosphate(aq) + $H_2O(l)$ = phenol(aq) + orthophosphate(aq)

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

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

phospho-L-arginine(aq) + $H_2O(l)$ = L-arginine(aq) + orthophosphate(aq)

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

Reference: 35MEY/SCH
Method: calorimetry
Buffer: phosphate
Cofactor(s): $MgCl_2$
Evaluation: C

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

phosphocreatine(aq) + $H_2O(l)$ = creatine(aq) + orthophosphate(aq)

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

Reference: 35MEY/SCH
Method: calorimetry
Buffer: phosphate
Cofactor(s): $MgCl_2$
Evaluation: C

The pH was not reported.

phosphocreatine(aq) + $H_2O(l)$ = creatine(aq) + orthophosphate(aq)

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

Reference: 65PIN
Method: calorimetry
Buffer: Tris (0.1 mol dm^{-3})
pH: 9.0
Cofactor(s): $MgSO_4$ (0.001 mol dm^{-3})
Evaluation: A

phosphocreatine(aq) = creatine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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): $MgCl_2$
Evaluation: C

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

phosphocreatine(aq) + $H_2O(l)$ = creatine(aq) + orthophosphate(aq)

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

Reference: 87WOL/REI
Method: calorimetry
Buffer: Tris (0.025 mol dm^{-3}) or carnosine (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) + H_2O(l) = (*R*)-glycerate(aq) + orthophosphate(aq)

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

Reference: 35MEY/SCH
Method: calorimetry
Buffer: phosphate
Cofactor(s): $MgCl_2$
Evaluation: C

The pH was not reported.

3-phospho-D-glycerate(aq) + H_2O(l) = (*K*)-glycerate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(MgCl_2)}{\text{mol dm}^{-3}}$	$\frac{I_c}{\text{mol dm}^{-3}}$	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): $MgCl_2$
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-glycerate^{3-}(aq) + H_2O(l) = (*R*)-glycerate$^-$(aq) + HPO_4^{2-}(aq).

phosphoguanidinoacetate(aq) + H_2O(l) = guanidinoacetate(aq) + orthophosphate(aq)

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

Reference: 65PIN
Method: calorimetry
Buffer: Tris (0.1 mol dm^{-3})
pH: 9.0
Cofactor(s): $MgSO_4$ (0.001 mol dm^{-3})
Evaluation: A

phospho*enol*pyruvate(aq) + H_2O(l) = pyruvate$^-$(aq) + orthophosphate(aq)

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

Reference: 35MEY/SCH
Method: calorimetry
Buffer: phosphate
Cofactor(s): $MgCl_2$
Evaluation: C

The pH was not reported.

phospho*enol*pyruvate^{3-}(aq) + H_2O(l) = pyruvate$^-$(aq) + HPO_4^{2-}(aq)

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

Reference: 70GEO/WIT
Method: calorimetry
Evaluation: C

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

phosphorylcholine(aq) + H_2O(l) = choline(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	$\frac{I_c}{mol\ dm^{-3}}$	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): Mg^{2+}
Evaluation: A

Guynn calculated $K_c(T = 311.15\ K, I_c = 0.25\ mol\ dm^{-3}) = 16.4$ for the chemical reference reaction: phosphorylcholine$^-$(aq) + H_2O(l) = choline$^+$(aq) + HPO_4^{2-}(aq).

L-*O*-phosphoserine(aq) + H_2O(l) = L-serine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	buffer	added solute	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	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): $MgCl_2$
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 $\Delta_r H'°(c(MgCl_2) = 0, pH = 7.8) = -7.5$ kJ mol^{-1} for this reaction.

phosphotaurocyamine(aq) + $H_2O(l)$ = taurocyamine(aq) + orthophosphate(aq)

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

Reference: 65PIN
Method: calorimetry
Buffer: Tris (0.1 mol dm^{-3})
pH: 9.0
Cofactor(s): $MgSO_4$ (0.001 mol dm^{-3})
Evaluation: A

pyrophosphate(aq) + $H_2O(l)$ = 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): Mg^{2+}
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) + $H_2O(l)$ = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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) + $H_2O(l)$ = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	buffer	added solute	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	K_c'
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): $MgCl_2$
Evaluation: B

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

D-ribose 5-phosphate(aq) + H_2O(l) = D-ribose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H° = -5.69$ kJ mol^{-1} and $\Delta_r C_p° = -63$ J K^{-1} mol^{-1} at $T = 298.15$ K for the chemical reference reaction: D-ribose 5-phosphate^{2-}(aq) + H_2O(l) = D-ribose(aq) + HPO_4^{2-}(aq).

D-ribulose 5-phosphate(aq) + H_2O(l) = D-ribulose(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H° = -12.43$ kJ mol^{-1} and $\Delta_r C_p° = -84$ J K^{-1} mol^{-1} at $T = 298.15$ K for the chemical reference reaction: D-ribulose 5-phosphate^{2-}(aq) + H_2O(l) = D-ribulose(aq) + HPO_4^{2-}(aq).

5.6. Enzyme: acid phosphatase (EC 3.1.3.2)

acetyl phosphate(aq) + H_2O(l) = acetate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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).

AMP(aq) + H_2O(l) = adenosine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
297.45	3.7	−6.49

Reference: 45OHL
Method: calorimetry
Buffer: citrate (0.015 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).

ATP(aq) + 3 H_2O(l) = adenosine(aq) + 3 orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
297.45	3.7	−107.9

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

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

D-fructose 1-phosphate(aq) + H_2O(l) = D-fructose(aq) + orthophosphate(aq)

$\frac{T}{K}$	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).

D-fructose 6-phosphate(aq) + H_2O(l) = D-fructose(aq) + orthophosphate(aq)

$\frac{T}{K}$	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) + H_2O(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) + H_2O(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) + H_2O(l) = glycerol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(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 $K_c'c°/c(H_2O)$ reported by Ohlmeyer. Also see data given under alkaline phosphatase (EC 3.1.3.1).

L-α-glycerophosphate(aq) + H_2O(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) + H_2O(l) = 4-nitrophenol(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{I_c}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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 $\Delta_r H°(T = 298.15\text{ K}, I_c \approx 0.03\text{ mol dm}^{-3}) = -26.3\text{ kJ mol}^{-1}$ for the chemical reference reaction: 4-nitrophenyl phosphate$^-$(aq) + H_2O(l) = 4-nitrophenol (aq) + $H_2PO_4^-$(aq). Also see data given under alkaline phosphatase (EC 3.1.3.1).

4-nitrophenyl phosphate(aq) + H_2O(l) = 4-nitrophenol(aq) + orthophosphate(aq)

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

L-*O*-phosphoserine(aq) + H_2O(l) = L-serine(aq) + orthophosphate(aq)

$\frac{T}{K}$	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): $MgCl_2$ (0.05 mol dm^{-3})
Evaluation: B

L-*O*-phosphoserine(aq) + H_2O(l) = L-serine(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	$\frac{I_c}{mol\ dm^{-3}}$	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

L-*O*-phosphoserine(aq) + H_2O(l) = L-serine(aq) + orthophosphate(aq) — Continued

$\frac{T}{K}$	pH	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	$\frac{I_c}{mol\ dm^{-3}}$	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): $MgCl_2$
Evaluation: A

Guynn and Thames calculated $K_c(T = 311.15\ K, I_c = 0.25\ mol\ dm^{-3}) = 34.2$ for the chemical reference reaction: L-*O*-phosphoserine^{2-} (aq) + H_2O(l) = L-serine(aq) + HPO_4^{2-} (aq).

5.8 Enzyme: 5′-nucleosidase (EC 3.1.3.5)

AMP(aq) + H_2O(l) = adenosine(aq) + orthophosphate(aq)

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

Reference: 92KIM/KIN
Method: enzymatic assay
Buffer: Mops
pH: 7.0
Cofactor(s): Mg^{2+}
Evaluation: A

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

5.9 Enzyme: fructose-biphosphatase (EC 3.1.3.11)

D-fructose 1,6-biphosphate(aq) + H_2O(l) = D-fructose 6-phosphate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	pMg	$\frac{I_c}{mol\ dm^{-3}}$	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): $MgCl_2$ (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) + $H_2O(l)$ = D-fructose 6-phosphate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(MnCl_2)}{mol\ dm^{-3}}$	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	$\frac{I_c}{mol\ dm^{-3}}$	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): $MgCl_2$ and $MnCl_2$
Evaluation: A

D-fructose 1,6-biphosphate(aq) + $H_2O(l)$ = D-fructose 6-phosphate(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	K_c'
288.15	7.5	17

Reference: 91LIU/FRO
Method: NMR
Buffer: Tris (0.05 mol dm^{-3}) + HCl
pH: 7.5
Cofactor(s): $MgSO_4$ (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) + $H_2O(l)$ = AMP(aq)

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

Reference: 69GRE/RUD
Method: calorimetry
Buffer: sodium phosphate
pH: 7.3
Cofactor(s): $MgCl_2$
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) + $H_2O(l)$ = 2'-deoxyadenosine 5'-monophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^\circ}{kJ\ mol^{-1}}$
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): $MgCl_2$ (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) + $H_2O(l)$ = GMP(aq)

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

Reference: 69GRE/RUD
Method: calorimetry
Buffer: sodium phosphate
pH: 7.3
Cofactor(s): $MgCl_2$
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) + $H_2O(l)$ = IMP(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'^\circ}{kJ\ mol^{-1}}$
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): $MgCl_2$ (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) + H_2O(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): $MgCl_2$ (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) + H_2O(l) = AMP(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
298.15	7.8	−61.1

Reference: 74CHE/PAT
Method: calorimetry
Buffer: phosphate (0.040 mol dm^{-3})
pH: 7.8
Cofactor(s): Mn^{2+} (0.0001 mol dm^{-3})
Evaluation: B

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

adenosine 3′,5′-(cyclic)phosphate(aq) + H_2O(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): $MgCl_2$
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) + H_2O(l) = adenosine 3′-monophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	$\frac{\Delta_r H'^\circ}{kJ\ mol^{-1}}$
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): $MgCl_2$
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) + H_2O(l) = monoethyl phosphate(aq) + ethanol(aq)

$\frac{T}{K}$	pH	buffer	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H'^\circ(T = 298.15\ K, pH = 7.3) = -11.1\ kJ\ mol^{-1}$.

diethyl phosphate(aq) + H_2O(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) + $H_2O(l)$ = 2-hydroxyethyl phosphate(aq)

$\frac{T}{K}$	pH	buffer	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H'°(T$ = 298.15 K, pH = 7.3) ≈ −28.5 kJ mol^{-1}.

ethylene phosphate(aq) + $H_2O(l)$ = 2-hydroxyethyl phosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'°}{kJ\ mol^{-1}}$
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 $\Delta_r H'°$ given here.

methyl α-D-glucopyranoside 4,6-(cyclic)phosphate(aq) + $H_2O(l)$ = methyl α-D-glucopyranoside 6-phosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'°}{kJ\ mol^{-1}}$
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 $\Delta_r H'°$ given here.

methyl β-D-ribofuranoside 3,5-(cyclic)phosphate(aq) + $H_2O(l)$ = methyl β-D-ribofuranoside 5-phosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'°}{kJ\ mol^{-1}}$
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 $\Delta_r H'°$ given here.

tetramethylene phosphate(aq) + $H_2O(l)$ = 4-hydroxybutyl phosphate(aq)

$\frac{T}{K}$	pH	buffer	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H'°(T$ = 298.15 K, pH = 7.3) = −11.0 kJ mol^{-1}.

tetramethylene phosphate(aq) + $H_2O(l)$ = 4-hydroxybutyl phosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'°}{kJ\ mol^{-1}}$
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 $\Delta_r H'°$ given here.

trimethylene phosphate(aq) + $H_2O(l)$ = 3-hydroxypropyl phosphate(aq)

$\frac{T}{K}$	pH	buffer	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H'°(T$ = 298.15 K, pH = 7.3) ≈ −14.9 kJ mol^{-1}.

trimethylene phosphate(aq) + H_2O(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 T_2 (EC 3.1.27.1)

adenosine 2',3'-(cyclic)phosphate(aq) + H_2O(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) + H_2O(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) + H_2O(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) + H_2O(l) = cytidine 3'-monophosphate(aq).

cytidine 2',3'-(cyclic)phosphate(aq) + H_2O(l) =
cytidine 3'-monophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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) + H_2O(l) = cytidine 3'-monophosphate^{2-} (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) + H_2O(l) = cytidine 3'-monophosphate(aq).

cytidine 2',3'-(cyclic)phosphate(aq) + H_2O(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) + H_2O(l) = cytidine 3′-monophosphate(aq)

$\frac{T}{K}$	pH	$\frac{I_c}{mol\ dm^{-3}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H$(cal)(T = 298.15 K, acetate buffer, pH = 5.0) = 35.1 J g^{-1} for the hydrolysis of RNA. The products of this hydrolysis reaction were not identified.

uridine 2′,3′-(cyclic)phosphate(aq) + H_2O(l) = uridine 3′-monophosphate(aq)

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

cytidylyl(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 H_2O(l) = 7 D-glucose(aq)

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

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

Cyclomaltodextrin glucanotransferase (EC 2.4.1.19) was also present.

cyclomaltohexaose(aq) + 6 $H_2O(l)$ = 6 D-glucose(aq)

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

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

cyclomaltooctaose(aq) + 8 $H_2O(l)$ = 8 D-glucose(aq)

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

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

Cyclomaltodextrin glucanotransferase (EC 2.4.1.19) was also present.

5.17. Enzyme: β-amylase (EC 3.2.1.2)

maltotetraose(aq) + $H_2O(l)$ = 2 maltose(aq)

$\frac{T}{K}$	K_c'
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.

α,α-trehalose(aq) + $H_2O(l)$ = 2 D-glucose(aq)

$\frac{T}{K}$	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

α,α-trehalose(aq) + $H_2O(l)$ = 2 D-glucose(aq)

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

O-α-D-glucopyranosyl-$(1\rightarrow4)_n$(aq) + (n-1) $H_2O(l)$ = n D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{(kJ\ mol^{-1})(n-1)}$
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-$(1\rightarrow4)_n$ is amylose.

O-α-D-glucopyranosyl-$(1\rightarrow4)_n$(aq) + (n−1) $H_2O(l)$ = n D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{(kJ\ mol^{-1})(n-1)}$
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.

isomaltose(aq) + $H_2O(l)$ = 2 D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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).

isomaltose(aq) + H_2O(l) = 2 D-glucose(aq)

$\frac{T}{K}$	K_c'
≈ 328	34

Reference: 80BEY/ROE
Method: HPLC
Evaluation: C

van Beynum *et al.* reported $K_c'c^\circ/c(H_2O)$ = 0.6. Their experiments were carried out over the temperature range 318 - 338 K. The pH was not reported.

isomaltose(aq) + H_2O(l) = 2 D-glucose(aq)

$\frac{T}{K}$	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 $\{K_c'c^\circ/c(H_2O)\}^{-1}$ = 0.28 based upon kinetic data. The apparent equilibrium constant given here was calculated from this result.

isomaltotriose(aq) + 2 H_2O(l) = 3 D-glucose(aq)

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

Reference: 91GOL/BEL
Method: calorimetry
Buffer: sodium acetate (0.1 mol dm^{-3})
pH: 4.44
Evaluation: A

maltoheptaose(aq) + 6 H_2O(l) = 7 D-glucose(aq)

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

maltohexaose(aq) + 5 H_2O(l) = 6 D-glucose(aq)

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

maltopentaose(aq) + 4 H_2O(l) = 5 D-glucose(aq)

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

Reference: 91GOL/BEL
Method: calorimetry
Buffer: sodium acetate (0.1 mol dm^{-3})
pH: 4.44
Evaluation: A

maltose(aq) + H_2O(l) = 2 D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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).

maltose(aq) + H_2O(l) = 2 D-glucose(aq)

$\frac{T}{K}$	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.

maltose(aq) + H_2O(l) = 2 D-glucose(aq)

$\frac{T}{K}$	K_c'
≈ 328	197

Reference: 80BEY/ROE
Method: HPLC
Evaluation: C

van Beynum *et al.* reported $K_c'c°/c(H_2O) = 3.5$. 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.

maltose(aq) + H_2O(l) = 2 D-glucose(aq)

$\frac{T}{K}$	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 $\{K_c'c°/c(H_2O)\}^{-1} = 0.28$ based upon kinetic data. The apparent equilibrium constant given here was calculated from this result.

maltose(aq) + H_2O(l) = 2 D-glucose(aq)

$\frac{T}{K}$	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

maltotetraose(aq) + 3 H_2O(l) = 4 D-glucose(aq)

$\frac{T}{K}$	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

maltotriose(aq) + 2 H_2O(l) = 3 D-glucose(aq)

$\frac{T}{K}$	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

maltotriose(aq) + 2 H_2O(l) = 3 D-glucose(aq)

$\frac{T}{K}$	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

panose(aq) + 2 H_2O(l) = 3 D-glucose(aq)

$\frac{T}{K}$	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

panose(aq) + 2 H_2O(l) = 3 D-glucose(aq)

$\frac{T}{K}$	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) + H_2O(l) = phenyl α-D-glucopyranoside(aq) + D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(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) + H_2O(l) = 2 D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(l) = D-glucose(aq) + D-fructose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(l) = 2 D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(l) = D-glucose(aq) + D-fructose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(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) + H_2O(l) = (±)-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.

cellobiose(aq) + $H_2O(l)$ = 2 D-glucose(aq)

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

ethyl β-D-glucopyranoside(aq) + $H_2O(l)$ = ethanol(aq) + D-glucose(aq)

$\frac{T}{K}$	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.

β-gentiobiose(aq) + $H_2O(l)$ = 2 D-glucose(aq)

$\frac{T}{K}$	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

β-gentiobiose(aq) + $H_2O(l)$ = 2 D-glucose(aq)

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

α-D-melibiose(aq) + $H_2O(l)$ = D-galactose(aq) + D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
298.15	5.65	−0.88

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

α-D-melibiose(aq) + $H_2O(l)$ = D-galactose(aq) + D-glucose(aq)

$\frac{T}{K}$	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

methyl β-D-glucopyranoside(aq) + $H_2O(l)$ = methanol(aq) + D-glucose(aq)

$\frac{T}{K}$	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.

2-methyl-1-propyl β-D-glucopyranoside(aq) + $H_2O(l)$ = 2-methyl-1-propanol(aq) + D-glucose(aq)

$\frac{T}{K}$	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.

2-methyl-2-propyl β-D-glucopyranoside(aq) + H_2O(l) = 2-methyl-2-propanol(aq) + D-glucose(aq)

$\frac{T}{K}$	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.

1-propyl β-D-glucopyranoside(aq) + H_2O(l) = 1-propanol(aq) + D-glucose(aq)

$\frac{T}{K}$	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.

2-propyl β-D-glucopyranoside(aq) + H_2O(l) = 2-propanol(aq) + D-glucose(aq)

$\frac{T}{K}$	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)

3-*O*-β-D-galactopyranosyl-D-arabinose(aq) + H_2O(l) = D-galactose(aq) + D-arabinose(aq)

$\frac{T}{K}$	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

3-*O*-β-D-galactopyranosyl-D-arabinose(aq) + H_2O(l) = D-galactose(aq) + D-arabinose(aq)

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

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

lactose(aq) + H_2O(l) = D-galactose(aq) + D-glucose(aq)

$\frac{T}{K}$	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.

lactose(aq) + H_2O(l) = D-galactose(aq) + D-glucose(aq)

$\frac{T}{K}$	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 $\Delta_r H'^\circ = -(0.3 \pm 3.6)$ kJ mol^{-1} from the temperature dependence of K_c'. This is in agreement with the calorimetric result obtained in this study.

lactose(aq) + H_2O(l) = D-galactose(aq) + D-glucose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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 $\Delta_r C_p^\circ \approx 9$ J K^{-1} mol^{-1}.

lactulose(aq) + H_2O(l) = D-galactose(aq) + D-fructose(aq)

$\frac{T}{K}$	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

lactulose(aq) + H_2O(l) = D-galactose(aq) + D-fructose(aq)

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

disaccharide(aq) + H_2O(l) = 2 D-mannose(aq)

$\frac{T}{K}$	pH	K_c'
328.15	5.5	≈ 6

Reference: 89JOH/HED
Method: HPLC and gas-liquid chromatography with mass spectrometry
Buffer: Na_2HPO_4 (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.

tetrasaccharide(aq) + H_2O(l) = trisaccharide(aq) + D-mannose(aq)

$\frac{T}{K}$	pH	K_c'
328.15	5.5	≈ 6

Reference: 89JOH/HED
Method: HPLC and gas-liquid chromatography with mass spectrometry
Buffer: Na_2HPO_4 (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.

trisaccharide(aq) + H_2O(l) = disaccharide(aq) + D-mannose(aq)

$\frac{T}{K}$	pH	K_c'
328.15	5.5	≈ 6

Reference: 89JOH/HED
Method: HPLC and gas-liquid chromatography with mass spectrometry
Buffer: Na_2HPO_4 (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)

raffinose(aq) + H_2O(l) = α-D-melibiose(aq) + D-fructose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(l) = D-fructose(aq) + *O*-α-D-galactopyranosyl-(1→6)-*O*-α-D-galactopyranosyl-(1→6)-α-D-glucopyranose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(l) = D-glucose(aq) + D-fructose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(l) = D-glucose(aq) + D-fructose(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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 $K_m(T = 298.15\text{ K}, I = 0)$ = 4.44E4 for the chemical reference reaction: sucrose(aq) + H_2O(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) + H_2O(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) + H_2O(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): $MgCl_2$ (0.024 mol dm^{-3})
Evaluation: B

5.27. Enzyme: NAD$^+$ nucleosidase (EC 3.2.2.5)

NAD(aq) + H_2O(l) = nicotinamide(aq) + ADPribose(aq)

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

NAD(aq) + 3-acetylpyridine(aq) = 3-acetylpyridine adenine dinucleotide(aq) + nicotinamide(aq)

$\frac{T}{K}$	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

β-nicotinamide mononucleotide(aq) + 3-acetylpyridine(aq) = 3-acetylpyridine mononucleotide(aq) + nicotinamide(aq)

$\frac{T}{K}$	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)

adenosine(aq) + H_2O(l) = adenine(aq) + D-ribose(aq)

$\frac{T}{K}$	pH	K_c'
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)

S-adenosyl-L-homocysteine(aq) + H_2O(l) = adenosine(aq) + L-homocysteine(aq)

$\frac{T}{K}$	pH	K_c'
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].

4',5'-anhydroadenosine(aq) + H_2O(l) = adenosine(aq)

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

Reference: 85HER/AIY
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)

L-tyrosylglycinamide(aq) + H_2O(l) = L-tyrosine(aq) + glycinamide(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 (≈ 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) + $H_2O(l)$ = glycyl-L-phenylalanine(aq) + ammonia(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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) + $H_2O(l)$ = benzyloxycarbonylglycine(aq) + L-leucine(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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) + $H_2O(l)$ = benzyloxycarbonylglycine(aq) + L-phenylalanine(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H°(T = 298.15\ K) = -10.67\ kJ\ mol^{-1}$ for the chemical reference reaction: benzyloxycarbonylglycyl-L-phenylalanine$^-$(aq) + $H_2O(l)$ = benzyloxycarbonylglycine$^-$(aq) + L-phenylalanine(aq).

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

N-benzoyl-L-tyrosine(aq) + $H_2O(l)$ = benzoic acid(aq) + L-tyrosine(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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) + $H_2O(l)$ = *N*-benzoyl-L-tyrosine(aq) + glycine(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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) + $H_2O(l)$ = pteroate(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): $ZnCl_2$ (0.0001 mol dm^{-3})
Evaluation: B

5.36. Enzyme: chymotrypsin (EC 3.4.21.1)

N-acetyl-L-phenylalanine methyl ester(aq) + $H_2O(l)$ = *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) + H_2O(l) = *N*-acetyl-L-phenylalanine(aq) + methanol(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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-phenylalanylglycinamide(aq) + H_2O(l) = *N*-acetyl-L-phenylalanine(aq) + glycinamide(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) + H_2O(l) = *N*-acetyl-L-tyrosine(aq) + ethanol(aq)

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

Reference: 77GRI/LOC
Method: calorimetry
Buffer: Tris + HCl
pH: 7.8
Evaluation: B

N-benzoyl-L-tyrosinamide(aq) + H_2O(l) = *N*-benzoyl-L-tyrosine(aq) + ammonia(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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 $\Delta_r H°(T = 298.15\ \text{K}) = -(24.4 \pm 0.9)$ kJ mol^{-1} for the chemical reference reaction: *N*-benzoyl-L-tyrosinamide(aq) + H_2O(l) = *N*-benzoyl-L-tyrosine$^-$(aq) + NH_4^+(aq).

N-acetyl-L-tyrosine hydroxamic acid(aq) + H_2O(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}.

N-benzoyl-L-tyrosylglycinamide(aq) + H_2O(l) = *N*-benzoyl-L-tyrosine(aq) + glycinamide(aq)

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

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

N-benzoyl-L-tyrosylglycinamide(aq) + H_2O(l) = *N*-benzoyl-L-tyrosylglycine(aq) + ammonia(aq)

$\frac{T}{K}$	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 $\Delta_r G°(T = 298.15\ K) = -(1.8 \pm 0.4)$ kJ mol^{-1} for the chemical reference reaction: *N*-benzoyl-L-tyrosylglycinamide(aq) + H_2O(l) = *N*-benzoyl-L-tyrosylglycine$^-$(aq) + NH_4^+(aq).

N-benzoyl-L-tyrosylglycinamide(aq) + H_2O(l) = *N*-benzoyl-L-tyrosylglycine(aq) + ammonia(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 ≈ 0.3 mol dm^{-3}. Dobry *et al*. calculated $\Delta_r H°(I = 298.15\ K, I_c \approx 0.3\ mol\ dm^{-3}) = -(6.49 \pm 0.4)$ kJ mol^{-1} for the chemical reference reaction: *N*-benzoyl-L-tyrosylglycinamide(aq) + H_2O(l) = *N*-benzoyl-L-tyrosylglycine$^-$(aq) + NH_4^+(aq).

N-benzoyl-L-tyrosylglycinanilide(aq) + H_2O(l) = *N*-benzoyl-L-tyrosine(aq) + glycylanilide(aq)

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

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

3-(2-furyl)acryloylimidazole(aq) + H_2O(l) = furylacrylic acid(aq) + imidazole(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H'°}{kJ\ mol^{-1}}$
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 $\Delta_r H'°$ given here.

5.37. Enzyme: trypsin (EC 3.4.21.4)

Nα-benzoyl-L-argininamide(aq) + H_2O(l) = Nα-benzoyl-L-arginine(aq) + ammonia(aq)

$\frac{T}{K}$	pH	Buffer and/or salt	$\frac{I_c}{mol\ dm^{-3}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
298.15	6.50	phosphate	0.00057	−24.8
298.15	6.60	none	0.00065	−25.1
298.15	6.82	NH_4Cl	0.00081	−26.0
298.15	6.62	phosphate	0.00247	−26.7
298.15	6.78	NH_4Cl	0.00271	−25.5
298.15	7.01	NH_4Cl	0.00282	−28.1
298.15	7.13	phosphate	0.00401	−24.1
298.15	7.15	NH_4Cl	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_4Cl	0.01081	−28.2
298.15	6.45	phosphate	0.01256	−25.9
298.15	7.15	NH_4Cl	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	$NH_4Cl + CaCl_2$	0.165	−27.2
298.15	7.43	NH_4Cl	0.20	−27.1
298.15	7.24	$NH_4Cl + CaCl_2$	0.256	−25.5
298.15	7.40	NH_4Cl	0.40	−27.8
298.15	7.38	NH_4Cl	0.40	−26.6
298.15	7.40	NH_4Cl	0.40	−28.3

$N\alpha$-benzoyl-L-argininamide(aq) + H_2O(l) = $N\alpha$-benzoyl-L-arginine(aq) + ammonia(aq) — Continued

$\frac{T}{K}$	pH	Buffer and/or salt	$\frac{I_c}{mol\ dm^{-3}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
298.15	7.43	NH_4Cl	0.40	−26.7
298.15	7.34	NH_4Cl + $CaCl_2$	0.655	−27.6
298.15	7.42	NH_4Cl	0.80	−25.3
298.15	7.44	NH_4Cl	0.80	−26.9
298.15	7.42	NH_4Cl	0.96	−27.8
298.15	7.39	NH_4Cl	0.96	−23.3
298.15	7.33	NH_4Cl + $CaCl_2$	1.295	−24.7
298.15	7.30	NH_4Cl	1.44	−24.5
298.15	7.31	NH_4Cl	1.60	−22.6
298.15	7.35	NH_4Cl	1.76	−23.6

Reference: 56FOR/GUT
Method: calorimetry
Buffer: phosphate, Tris, and NH_4Cl
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.

$(L\text{-lysine})_n$(aq) + (n-1) H_2O(l) = n L-lysine(aq)

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

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

$(L\text{-lysine})_n$ is poly-L-lysine.

5.38. Enzyme: papain (EC 3.4.22.2)

hippurylanilide(aq) + H_2O(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) + H_2O(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-phenylalanylglycine(aq) + H_2O(l) = *N*-acetyl-L-phenylalanine(aq) + L-phenylalanylglycine(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-phenylalanylglycine methyl ester(aq) + H_2O(l) = *N*-acetyl-L-phenylalanine(aq) + L-phenylalanylglycine 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	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(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): $CaCl_2$
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) + H_2O(l) = L-aspartate(aq) + ammonia(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(l) = L-aspartate(aq) + ammonia(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(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 ≈ 5.5 based upon the results given by Benzinger *et al.* [59BEN/KIT].

L-glutamine(aq) + H_2O(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) + H_2O(l) = L-glutamate(aq) + ammonia(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + H_2O(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 H_2O(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 H_2O(l) = 2 ammonia(aq) + carbon dioxide(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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 H_2O(l) = 2 ammonia(aq) + carbon dioxide(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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 H_2O(l) = 2 ammonia(aq) + carbon dioxide(aq)

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

Reference: 73BEE/STE
Method: calorimetry
Buffer: Na_2HPO_4(0.5 mol dm^{-3}) + NaH_2PO_4(0.25 mol dm^{-3})
pH: 6.95
Evaluation: B

urea(aq) + 2 H_2O(l) = 2 ammonia + carbon dioxide(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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 H_2O(l) = 2 ammonia(aq) + carbon dioxide(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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 H_2O(l) = 2 ammonia(aq) + carbon dioxide(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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) + $H_2O(l)$ = 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) + $H_2O(l)$ = 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) + $H_2O(l)$ = 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

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

cephalothin(aq) + $H_2O(l)$ = 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) + $H_2O(l)$ = 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 ≈ 0.1 mol dm^{-3}.

penicillin G(aq) + $H_2O(l)$ = 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) + $H_2O(l)$ = 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 $K_c(T = 298.15\,K) = 0.0003$ for this chemical reference reaction. Few experimental details were given.

penicillin G(aq) + H_2O(l) = 6-aminopenicillanic acid(aq) + phenylacetic acid(aq)

$\frac{T}{K}$	pH	$\frac{m(KCl)}{mol\ kg^{-1}}$	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 $K_m = 7.35\times10^{-8}$, $\Delta_rH° = 29.7$ kJ mol^{-1}, and $\Delta_rC_p° = -240$ J K^{-1} mol^{-1} at $T = 298.15$ K and $I = 0$ for the chemical reference reaction: penicillin G^-(aq) = 6-aminopenicillanic $acid^-$(aq) + phenylacetic $acid^-$(aq) + H^+(aq).

penicillin G(aq) + H_2O(l) = 6-aminopenicillanic acid(aq) + phenylacetic acid(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_rH(cal)}{kJ\ mol^{-1}}$
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 $\Delta_rH° = 29.7$ kJ mol^{-1}, and $\Delta_rC_p° = -240$ J K^{-1} mol^{-1} at $T = 298.15$ K and $I = 0$ for the chemical reference reaction: penicillin G^-(aq) = 6-aminopenicillanic $acid^-$(aq) + phenylacetic $acid^-$(aq) + H^+(aq).

penicillinoic acid(aq) + H_2O(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) + H_2O(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 $K_c(T = 298.15\ K) = 0.00128$ for this chemical reference reaction. Few experimental details were given.

7-phenylacetamidodeacetoxycephalosporanic acid(aq) + H_2O(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

phenylacetylglycine(aq) + H_2O(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) + $H_2O(l)$ = phenylacetic acid(aq) + L-phenylglycine(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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) + $H_2O(l)$ = 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) + $H_2O(l)$ = 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 Röhm and Van Etten's paper. The ionic strength was 2.0 mol dm^{-3}.

N-acetyl-L-α-amino-n-butyrate(aq) + $H_2O(l)$ = 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) + $H_2O(l)$ = 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) + $H_2O(l)$ = 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) + $H_2O(l)$ = 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) + $H_2O(l)$ = acetate(aq) + L-methionine(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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].

N-acetyl-L-methionine(aq) + H_2O(l) = acetate(aq) + L-methionine(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
298.15	6.86	−2.4

Reference: 89REK/SIK
Method: calorimetry
Buffer: phosphate (0.05 mol dm^{-3})
pH: 6.86
Evaluation: B

N-acetyl-L-norleucine(aq) + H_2O(l) = acetate(aq) + L-norleucine(aq)

$\frac{T}{K}$	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

N-acetyl-L-norvaline(aq) + H_2O(l) = acetate(aq) + L-norvaline(aq)

$\frac{T}{K}$	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

N-acetyl-L-valine(aq) + H_2O(l) = acetate(aq) + L-valine(aq)

$\frac{T}{K}$	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): $CoCl_2$ (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).

phenylacetyl-L-phenylglycine(aq) + H_2O(l) = phenylacetic acid(aq) + L-phenylglycine(aq)

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

pantothenate(aq) + H_2O(l) = pantoic acid(aq) + β-alanine(aq)

$\frac{T}{K}$	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 $\Delta_r H'^{\circ}(\overline{T} = 292\ K, pH = 8.1) = 37\ kJ\ mol^{-1}$ from the temperature dependency of K_c'.

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

5-hydroxy-*N*-methylpyroglutamate(aq) + H_2O(l) = 2-oxoglutarate(aq) + methylamine(aq)

$\frac{T}{K}$	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-oxoglutaramate, the substrate for the enzyme-catalyzed reaction, cyclized rapidly to 5-hydroxy-*N*-methylpyroglutamate.

5.49. Enzyme: dihydroorotase (EC 3.5.2.3)

(*S*)-dihydroorotate(aq) + H_2O(l) = *N*-carbamoyl-L-aspartate(aq)

$\frac{T}{K}$	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

(*S*)-dihydroorotate(aq) + H_2O(l) = *N*-carbamoyl-L-aspartate(aq)

$\frac{T}{K}$	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.

(*S*)-dihydroorotate(aq) + H_2O(l) = *N*-carbamoyl-L-aspartate(aq)

$\frac{T}{K}$	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)

L-5-carboxymethylhydantoin(aq) + H_2O(l) = *N*-carbamoyl-L-aspartate(aq)

$\frac{T}{K}$	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)

ampicillin(aq) + H_2O(l) = ampicillinoic acid(aq)

$\frac{T}{K}$	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

ampicillin(aq) + H_2O(l) = ampicillinoic acid(aq)

$\frac{T}{K}$	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 $K = (6.0\pm3.0)\text{E}-6$, $\Delta_r G° = (29.8\pm1.7)$ kJ mol^{-1}, $\Delta_r H° = -(70.0\pm7.5)$ kJ mol^{-1}, and $\Delta_r S° = -(335\pm26)$ J K^{-1} mol^{-1} for the chemical reference reaction: ampicillin$^-$(aq) + H_2O(l) = ampicillinoic acid^{2-}(aq) + H^+(aq) at $T = 298.15$ K and $I_m = 0$.

ampicillin(aq) + H_2O(l) = ampicillinoic acid(aq)

$\frac{T}{K}$	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 $\Delta_r H°(T = 298.15$ K, $I_m = 0) = -(70.0\pm7.5)$ kJ mol^{-1} for the chemical reference reaction: ampicillin$^-$(aq) + H_2O(l) = ampicillinoic acid^{2-}(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) + H_2O(l) = penicillinoic acid(aq)

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

Reference: 79GRI/TAN
Method: calorimetry
Buffer: Tris + HCl
pH: 7.5
Evaluation: B

penicillin G(aq) + H_2O(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±3.1)E−7, $\Delta_r G°$ = (34.4±1.0) kJ mol^{-1}, $\Delta_r H°$ = −(73.7±0.4) kJ mol^{-1}, and $\Delta_r S°$ = −(363±4) J K^{-1} mol^{-1} for the chemical reference reaction: penicillin G^-(aq) + H_2O(l) = penicillinoic $acid^{2-}$(aq) + H^+(aq) at T = 298.15 K and I_m = 0.

penicillin G(aq) + H_2O(l) = penicillinoic acid(aq)

$\frac{T}{K}$	pH	$\frac{I_m}{mol\ kg^{-1}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H°$(T = 298.15 K, I_m = 0) =−(73.7±0.4) kJ mol^{-1} for the chemical reference reaction: penicillin G^-(aq) + H_2O(l) = penicillinoic $acid^{2-}$(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) + H_2O(l) = phenoxymethylpenicillinoic acid(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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) + H_2O(l) = L-ornithine(aq) + urea(aq)

$\frac{T}{K}$	pH	$\frac{I_m}{mol\ kg^{-1}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H°$(T = 298.15 K, I_m = 0) =−(21.4±0.5) kJ mol^{-1} for the chemical reference reaction: L-$arginine^+$(aq) + H_2O(l) = L-$ornithine^+$(aq) + urea(aq).

5.53. Enzyme: allantoicase (EC 3.5.3.4)

allantoate(aq) + H_2O(l) = (-)-ureidoglycolate(aq) + urea(aq)

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

Reference: 67TRI/VOG
Method: polarimetry
Buffer: triethanolamine (0.087 mol dm^{-3}) + HCl
pH: 7.5
Cofactor(s): $MnSO_4$ (0.00087 mol dm^{-3})
Evaluation: B

5.54. Enzyme: arginine deiminase (EC 3.5.3.6)

L-arginine(aq) + H_2O(l) = L-citrulline(aq) + ammonia(aq)

$\frac{T}{K}$	pH	$\frac{I_m}{mol\ kg^{-1}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H°(T = 298.15\ K, I_m = 0) = -(31.9 \pm 0.8)\ kJ\ mol^{-1}$ for the chemical reference reaction: L-arginine$^+$(aq) + H_2O(l) = L-citrulline(aq) + NH_4^+(aq).

5.55. Enzyme: adenosine deaminase (EC 3.5.4.4)

adenosine(aq) + H_2O(l) = inosine(aq) + ammonia(aq)

$\frac{T}{K}$	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.

adenosine(aq) + H_2O(l) = inosine(aq) + ammonia(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{m(KCl)}{mol\ kg^{-1}}$	$\frac{I_m}{mol\ kg^{-1}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H°(T = 298.15\ K, I = 0) = -(49.4 \pm 0.7)\ kJ\ mol^{-1}$ for the chemical reference reaction: adenosine(aq) + H_2O(l) + H^+(aq) = inosine(aq) + NH_4^+(aq).

5.56. Enzyme: cytidine deaminase (EC 3.5.4.5)

cytidine(aq) + H_2O(l) = uridine(aq) + ammonia(aq)

$\frac{T}{K}$	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.

N^4-methylcytidine(aq) + H_2O(l) = uridine(aq) + methylamine(aq)

$\frac{T}{K}$	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)

AMP(aq) + H_2O(l) = IMP(aq) + ammonia(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{m(KCl)}{mol\ kg^{-1}}$	$\frac{I_m}{mol\ kg^{-1}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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 $\Delta_r H°(T = 298.15\ K, I = 0) = -(49.6 \pm 0.5)$ kJ mol^{-1} for the chemical reference reaction: AMP^{2-}(aq) + H_2O(l) = adenosine(aq) + HPO_4^{2-}(aq).

5.58. Enzyme: methenyltetrahydrofolate cyclohydrolase (EC 3.5.4.9)

5,10-methenyltetrahydrofolate(aq) + H_2O(l) = 10-formyltetrahydrofolate(aq)

$\frac{T}{K}$	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-methenyltetrahydrofolate(aq) + H_2O(l) = 5-formyltetrahydrofolate(aq).

5,10-methenyltetrahydrofolate(aq) + H_2O(l) = 10-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 $K'c(H^+)/c(H_2O)$ = 2.4E−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.

5,10-methenyltetrahydrofolate(aq) + H_2O(l) = 10-formyltetrahydrofolate(aq)

$\frac{T}{K}$	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.

5,10-methenyltetrahydrofolate(aq) + H_2O(l) = 10-formyltetrahydrofolate(aq)

$\frac{T}{K}$	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)

pyrophosphate(aq) + H_2O(l) = 2 orthophosphate(aq)

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

Reference: 52OHL/SHA
Method: calorimetry
Buffer: barbital + acetate (0.024 mol dm^{-3})
pH: 7.2
Cofactor(s): $MgCl_2$ (0.00025 mol dm^{-3})
Evaluation: B

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

pyrophosphate(aq) + $H_2O(l)$ = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{c(MgSO_4)}{mol\ dm^{-3}}$	$\frac{I_c}{mol\ dm^{-3}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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): $MgSO_4$
Evaluation: A

pyrophosphate(aq) + H_2O(l) = 2 orthophosphate(aq)

T/K	pH	c(orthophosphate)/mol dm^{-3}	c($MgCl_2$)/mol dm^{-3}	c(KCl)/mol dm^{-3}	c(tetra-n-propylammonium$^+$)/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): $MgCl_2$
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: pyrophosphate^{3-}(aq) + H_2O(l) = 2 orthophosphate^{2-}(aq) + H^+(aq).

pyrophosphate(aq) + $H_2O(l)$ = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	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): $MgCl_2$
Evaluation: B

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

pyrophosphate(aq) + $H_2O(l)$ = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	Buffer	Cosolvent	$\frac{c(orthophosphate)}{mol\ dm^{-3}}$	$\frac{c(MgCl_2)}{mol\ dm^{-3}}$	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	*N,N*-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) + $H_2O(l)$ = 2 orthophosphate(aq) — Continued

$\frac{T}{K}$	pH	Buffer	Cosolvent	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	$\frac{c(MgCl_2)}{\text{mol dm}^{-3}}$	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) + $H_2O(l)$ = 2 orthophosphate(aq) — Continued

$\frac{T}{K}$	pH	Buffer	Cosolvent	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	$\frac{c(MgCl_2)}{\text{mol dm}^{-3}}$	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	0.08	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	0.08	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	*N,N*-dimethylformamide (30 %)	0.002	0.001	1.8E2
308.15	7.8	Tris (0.050 mol dm^{-3}) + HCl	*N,N*-dimethylformamide (30 %)	0.002	0.002	5.0E2
308.15	7.8	Tris (0.050 mol dm^{-3}) + HCl	*N,N*-dimethylformamide (30 %)	0.002	0.004	3.0E1
308.15	7.8	Tris (0.050 mol dm^{-3}) + HCl	*N,N*-dimethylformamide (30 %)	0.002	0.006	1.5E1
308.15	7.8	Tris (0.050 mol dm^{-3}) + HCl	*N,N*-dimethylformamide (30 %)	0.002	0.08	9.9
308.15	7.8	Tris (0.050 mol dm^{-3}) + HCl	*N,N*-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	0.08	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) + $H_2O(l)$ = 2 orthophosphate(aq) — Continued

$\frac{T}{K}$	pH	Buffer	Cosolvent	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	$\frac{c(MgCl_2)}{\text{mol dm}^{-3}}$	K_c'
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): $MgCl_2$
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.

pyrophosphate(aq) + H_2O(l) = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	Buffer	Cosolvent	x(cosolvent)	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	$\frac{c(MgCl_2)}{\text{mol dm}^{-3}}$	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) + H_2O(l) = 2 orthophosphate(aq) — Continued

$\frac{T}{K}$	pH	Buffer	Cosolvent	x(cosolvent)	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	$\frac{c(MgCl_2)}{\text{mol dm}^{-3}}$	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): $MgCl_2$
;Evaluation: B

x(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) + H_2O(l) = 2 orthophosphate(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{c(MgCl_2)}{\text{mol dm}^{-3}}$	$\frac{c(\text{orthophosphate})}{\text{mol dm}^{-3}}$	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): Mg^{2+}
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.

ATP(aq) + sulfate(aq) + H_2O(l) = adenylyl sulfate(aq) + 2 orthophosphate(aq)

$\frac{T}{K}$	pH	K_c'
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): $MgCl_2$ (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)

trimetaphosphate(aq) + H_2O(l) = triphosphate(aq)

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

Reference: 53MEY/SHA
Method: calorimetry
Buffer: sodium maleate (0.03 mol dm^{-3})
pH: 6.95
Cofactor (s): $MgSO_4$ (0.02 mol dm^{-3})
Evaluation: B

5.61. Enzyme: nucleotide pyrophosphatase (EC 3.6.1.9)

NAD(aq) + H_2O(l) = β-nicotinamide mononucleotide(aq) + AMP(aq)

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

ATP(aq) + H_2O(l) = ADP(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{c(\text{KCl})}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H(\text{cal})}{\text{mol dm}^{-3}}$
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): Ca^{2+}
Evaluation: A

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

ATP(aq) + H_2O(l) = ADP(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(\text{KCl})}{\text{mol dm}^{-3}}$	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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): $CaCl_2$ (0.001 mol dm^{-3})
Evaluation: A

Podolosky and Sturtevant applied buffer protonation and ionization corrections to obtain $\Delta_r H°(T = 298.15\ \text{K}, I_c = 0.6\ \text{mol dm}^{-3}) = -22.2\ \text{kJ mol}^{-1}$ for the chemical reference reaction: $ATP^{4-}(aq) + H_2O(l) = ADP^{3-}(aq) + HPO_4^{2-}(aq) + H^+(aq)$.

ATP(aq) + H_2O(l) = ADP(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	Buffer	$\frac{c(CaCl_2)}{mol\ dm^{-3}}$	$\frac{c(KCl)}{mol\ dm^{-3}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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): $CaCl_2$
Evaluation: A

Podolosky and Morales applied buffer protonation and ionization corrections to obtain $\Delta_r H°(T = 293.15\ K, I_c \approx 0.6\ mol\ dm^{-3}) = -19.7\ kJ\ mol^{-1}$ for the chemical reference reaction: $ATP^{4-}(aq) + H_2O(l) = ADP^{3-}(aq) + HPO_4^{2-}(aq) + H^+(aq)$

$ATP^{4-}(aq) + H_2O(l) = ADP^{3-}(aq) + HPO_4^{2-}(aq) + H^+(aq)$

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

Reference: 69GEO/TRA
Method: calorimetry
pH: 8−9
Evaluation: C

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

ATP(aq) + H_2O(l) = ADP(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(Tris)}{mol\ dm^{-3}}$	$\frac{c(KCl)}{mol\ dm^{-3}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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): $CaCl_2$ (0.00158 mol dm^{-3})
Evaluation: A

Gajewski *et al.* calculated $\Delta_r H°(T = 298.15\ K, I = 0) = -20.5\ kJ\ mol^{-1}$ and $\Delta_r C_p° = -237\ J\ K^{-1}\ mol^{-1}$ for the chemical reference reaction: $ATP^{4-}(aq) + H_2O(l) = ADP^{3-}(aq) + HPO_4^{2-}(aq) + H^+(aq)$.

GTP(aq) + H_2O(l) = GDP(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{c(KCl)}{mol\ dm^{-3}}$	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
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): $CaCl_2$ (0.001 mol dm^{-3})
Evaluation: A

Hinz *et al.* gave results that lead to $\Delta_r H°(T = 298.15\ K, I_c \approx 0.6\ mol\ dm^{-3}) = -22.3\ kJ\ mol^{-1}$ for the chemical reference reaction: $GTP^{4-}(aq) + H_2O(l) = GDP^{3-}(aq) + HPO_4^{2-}(aq) + H^+(aq)$.

ITP(aq) + H_2O(l) = IDP(aq) + orthophosphate(aq)

$\frac{T}{K}$	pH	$\frac{\Delta_r H(cal)}{kJ\ mol^{-1}}$
293.15	8.0	−68.6

Reference: 55KIT/BEN
Method: calorimetry
Buffer: Tris + HCl
pH: 8.0
Cofactor(s): Ca^{2+}
Evaluation: A

The results given here when corrected for the enthalpy of buffer protonation lead to $\Delta_r H'°(T = 293\ K, pH = 8.0) \approx -20\ kJ\ mol^{-1}$.

ITP(aq) + H_2O(l) = IDP(aq) + orthophosphate(aq)

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

Reference: 56POD/MOR
Method: calorimetry
Buffer: Tris
pH: 8.0
Cofactor(s): Ca^{2+}
Evaluation: B

phosphocreatine(aq) + H_2O(l) = creatine(aq) + orthophosphate(aq)

$\frac{T}{K}$pH	$\frac{\Delta_r H(\text{cal})}{\text{kJ mol}^{-1}}$
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 $\Delta_r V(H^+) = 0$.

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

ATP(aq) + H_2O(l) = ADP(aq) + orthophosphate(aq)

$\frac{T}{K}$pH K_t'
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
N-acetyl-L-alanine	97-69-8	3.5.1.14
N-acetyl-L-α-amino-*n*-butyrate	19146-51-1	3.5.1.14
acetylcholine	51-84-3	3.1.1.7
N-acetylethanolamine	142-26-7	3.1.3.1
N-acetylethanolamine phosphate	89603-45-2	3.1.3.1
N-acetyl-L-glycine	543-24-8	3.5.1.14
N-acetyl-L-methionine	65-82-7	3.5.1.14
N-acetyl-L-norleucine	15891-49-3	3.5.1.14
N-acetyl-L-norvaline	15891-50-6	3.5.1.14
N-acetyl-L-phenylalanine	2018-61-3	3.4.21.1, 3.4.23.1
N-acetyl-L-phenylalanine-L-dibromotyrosine ethyl ester	66146-61-0	3.4.23.1
N-acetyl-L-phenylalanine methyl ester	3618-96-0	3.4.21.1
N-acetyl-L-phenylalanylglycinamide	29701-43-7	3.4.21.1
N-acetyl-L-phenylalanyl-L-phenylalanylglycine	22004-29-1	3.4.23.1
N-acetyl-L-phenylalanyl-L-phenylalanylglycine 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
N-acetyl-L-tyrosine	1948-71-6	3.4.21.1
N-acetyl-L-tyrosine ethyl ester	36546-50-6	3.4.21.1
N-acetyl-L-tyrosine hydroxamic acid	41656-83-1	3.4.21.1
N-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
S-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-*n*-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
Nα-benzoyl-L-argininamide	965-03-7	3.4.21.4
Nα-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
N-benzoyl-L-tyrosinamide	58690-81-6	3.4.21.1
N-benzoyl-L-tyrosine	2566-23-6	3.4.17.4, 3.4.21.1
N-benzoyl-L-tyrosylglycinamide	7369-86-0	3.4.21.1
N-benzoyl-L-tyrosylglycine	78233-53-1	3.4.17.4, 3.4.21.1
N-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
N-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
cytidylyl(3'→5')cytidine	27552-98-3	3.1.27.a
cytidylyl(3'→5')uridine	27552-97-2	3.1.27.a
n-decanoic acid	334-48-5	3.1.1.3
n-decanoic acid glycerol diester	53988-07-1	3.1.1.3
n-decanoic acid glycerol monoester	26402-22-2	3.1.1.3
n-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
(*S*)-dihydroorotate	5988-19-2	3.5.2.3
diolein	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-*O*-β-D-galactopyranosyl-D-arabinose	6057-48-3	3.2.1.23
O-α-D-galactopyranosyl-(1→6)-*O*-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	6027-83-1	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'→5')adenosine	103192-56-9	3.1.27.a
guanylyl(3'→5')cytidine	98046-67-4	3.1.27.a
guanylyl(3'→5')uridine	103213-30-5	3.1.27.a
H_2O	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
N^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
n-octanoic acid	124-07-2	3.1.1.3
n-octanoic acid glycerol diester	36534-80-0	3.1.1.3
n-octanoic acid glycerol monoester	26402-26-6	3.1.1.3
n-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
phenylacetylglycine	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-phenylalanylglycine	721-90-4	3.4.23.1
L-phenylalanylglycine 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
phospho*enol*pyruvate	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'→5')cytidine	108347-78-0	3.1.27.a
uridylyl(3'→5')uridine	27552-95-0	3.1.27.a
L-valine	72-18-4	3.5.1.14

[a]In some cases the CAS registry number refers to a salt of the substance.

7. Abbreviations

ADP	adenosine 5'-diphosphate
AMP	adenosine 5'-monophosphate
ATP	adenosine 5'-triphosphate
Bis-tris	bis(2-hydroxyethyl)iminotris (hydroxymethyl)methane
GDP	guanosine 5'-diphosphate
GMP	guanosine 5'-monophosphate
GTP	guanosine 5'-triphosphate
Hepes	*N*-(2-hydroxyethyl)piperazine-*N*'-2-ethanesulfonic acid
IDP	inosine 5'-diphosphate
IMP	inosine 5'-monophosphate
ITP	inosine 5'-triphosphate
Mes	2-(*N*-morpholino)ethanesulfonic acid
Mops	3-(*N*-morpholino)propanesulfonic acid
NAD	β-nicotinamide-adenine dinucleotide (oxidized)
NADP	β-nicotinamide-adenine dinucleotide phosphate (oxidized)
NADPH	β-nicotinamide-adenine dinucleotide phosphate (reduced)
Pipes	piperazine-*N*,*N*'-bis(2-ethanesulfonic acid)
RNA	ribonucleic acid
Tes	*N*-tris(hydroxymethyl)methyl-2-aminoethanesulfonic acid
Tricine	*N*-[tris(hydroxymethyl)methyl]glycine
Tris	tris(hydroxymethyl)aminomethane
UMP	uridine 5'-monophosphate

8. Glossary of Symbols

Symbol	Name	Unit
c	concentration	mol dm^{-3}
$c°$	standard concentration ($c°$ = 1 mol dm^{-3})	mol dm^{-3}
$\Delta_r C_p°$	standard heat capacity of reaction at constant pressure	J K^{-1} mol^{-1}
$\Delta_r G°$	standard Gibbs energy of reaction	kJ mol^{-1}
$\Delta_r G'°$	standard transformed Gibbs energy of reaction	kJ mol^{-1}
$\Delta_r H°$	standard enthalpy of reaction	kJ mol^{-1}
$\Delta_r H'°$	standard transformed enthalpy of reaction	kJ mol^{-1}
$\Delta_r H$(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 ($m°$ = 1 mol kg^{-1})	mol kg^{-1}
$\Delta_r N(H^+)$	change in binding of hydrogen ion in a biochemical reaction	dimensionless
pH	$-\log_{10}\{c(H^+)/c°\}$[b]	dimensionless
pX	$-\log_{10}\{c(X)/c°\}$	dimensionless
$\Delta_r S°$	standard entropy of reaction	J K^{-1} mol^{-1}
T	thermodynamic temperature	K
x	mole fraction	dimensionless

[a]When needed, a subscript c, m, or x is added to these quantities to designate a concentration, molality, or mole fraction basis.

[b]This 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

35MEY/SCH Meyerhof, O.; Schulz, W.; Biochem. Z.; **281,** 292 (1935).

36VEI Veibel, S.; Enzymologia; **1,** 124 (1936).

37STU Sturtevant, J.M.; J. Am. Chem. Soc.; **59,** 1528 (1937).

45OHL Ohlmeyer, P.; Hoppe-Seyler's Z. Physiol. Chem.; **282,** 37 (1945).

46OHL Ohlmeyer, P.; Z. Naturforsch.; **1,** 30 (1946).

46OHL2 Ohlmeyer, P.; Z. Naturforsch.; **1,** 18 (1946).

49HES Hestrin, S.; J. Biol. Chem.; **180,** 879 (1949).

49MEY/GRE Meyerhof, O.; Green, H.; J. Biol. Chem.; **178,** 655 (1949).

50HES Hestrin, S.; Biochim. Biophys. Acta; **4,** 310 (1950).

51FRU/JOH Fruton, J.S.; Johnston, R.B.; Fried, M.; J. Biol. Chem.; **190,** 39 (1951).

52BAU/GEM Bauer, C.R.; Gemmill, C.L.; Arch. Biochem. Biophys.; **35,** 110 (1952).

52DOB/FRU Dobry, A.; Fruton, J.S.; Sturtevant, J.M.; J. Biol. Chem.; **195,** 149 (1952).

52DOB/STU Dobry, A.; Sturtevant, J.M.; J. Biol. Chem.; **195,** 141 (1952).

52MEY/SHA Meyerhof, O.; Shatas, R.; Arch. Biochem. Biophys.; **40,** 253 (1952).

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53MEY/SHA Meyerhof, O.; Shatas, R.; Kaplan, A.; Biochim. Biophys. Acta; **12,** 121 (1953).

53STU Sturtevant, J.M.; J. Am. Chem. Soc.; **75,** 2016 (1953).

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54GIN Ginodman, L.M.; Biokhimiya; **19,** 666 (1954).

54LIE/KOR Lieberman, I.; Kornberg, A.; J. Biol. Chem.; **207,** 911 (1954).

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55KIT/BEN Kitzinger, C.; Benzinger, T.; Z. Naturforsch.; **10b,** 375 (1955).

55POD/STU Podolsky, R.J.; Sturtevant, J.M.; J. Biol. Chem.; **217,** 603 (1955).

55STU Sturtevant, J.M.; J. Am. Chem. Soc.; **77,** 255 (1955).

55STU2 Sturtevant, J.M.; J. Am. Chem. Soc.; **77,** 1495 (1955).

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