

SOLUTIONS TO PROBLEMS

Chapter 1

1. An amino or imino group gives a molecule a positive charge; a carboxylate or phosphoryl group gives a molecule a negative charge.
2. **A** Thiol (sulfhydryl) group
B Carbonyl group
C Amide linkage
D Phosphoanhydride (pyrophosphoryl) linkage
E Phosphoryl group (P_i)
F Hydroxyl group
3. Hydrolysis reactions tend to occur with an increase in entropy, because the highly ordered polymer is broken down into separate units.
4. Typical prokaryotic cells are 1–10 μm in diameter, so *E. coli* is about 10–300 times larger (or has 1000 to 27 million times the volume). Typical eukaryotic cells are 10–100 μm in diameter, so *E. coli* is about the same size or up to 30 times larger (or has the same to 27,000 times the volume).
5. The data indicate that eukaryotes are more similar to the archaea than to the eubacteria.
6. (a) Liquid water; (b) ice has less entropy at the lower temperature.
7. (a) Decreases; (b) increases; (c) increases; (d) no change.
8. No. When the change in enthalpy is positive and the change in entropy is negative, the free energy change for the process is greater than zero, which makes the process unfavorable.
9. (a) False. A spontaneous reaction occurs in only one direction.
(b) False. Thermodynamics does not specify the rate of a reaction.
(c) True. (d) True. A reaction is spontaneous as long as $\Delta S > \Delta H/T$.
10. (a) $T = 273 + 10 = 283 \text{ K}$
 $\Delta G = \Delta H - T\Delta S$
 $\Delta G = 15 \text{ kJ} - (283 \text{ K})(0.05 \text{ kJ} \cdot \text{K}^{-1})$
 $= 15 - 14.15 \text{ kJ} = 0.85 \text{ kJ}$
 ΔG is greater than zero, so the reaction is not spontaneous.
(b) $T = 273 + 80 = 353 \text{ K}$
 $\Delta G = \Delta H - T\Delta S$
 $\Delta G = 15 \text{ kJ} - (353 \text{ K})(0.05 \text{ kJ} \cdot \text{K}^{-1})$
 $= 15 - 17.65 \text{ kJ} = -2.65 \text{ kJ}$
 ΔG is less than zero, so the reaction is spontaneous.
11. $\Delta G = \Delta H - T\Delta S$
 $\Delta G = -7000 \text{ J} \cdot \text{mol}^{-1} - (298 \text{ K})(-25 \text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1})$
 $\Delta G = -7000 + 7450 \text{ J} \cdot \text{mol}^{-1} = 450 \text{ J} \cdot \text{mol}^{-1}$
The reaction is not spontaneous because $\Delta G > 0$. The temperature must be decreased in order to decrease the value of the $T\Delta S$ term.
12. $\Delta G^{\circ} = -RT \ln \frac{[C]}{[A][B]}$
 $= -(8.314 \text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1})(298 \text{ K}) \ln \frac{(0.009)}{(0.002)(0.003)}$
 $= -18,000 \text{ J} \cdot \text{mol}^{-1} = -18 \text{ kJ} \cdot \text{mol}^{-1}$
13. $\Delta G^{\circ} = -RT \ln K_{eq} = -RT \ln \frac{[C][D]}{[A][B]}$
 $= -(8.314 \text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1})(298 \text{ K}) \ln \frac{(3 \times 10^{-3})(5 \times 10^{-3})}{(10 \times 10^{-3})(15 \times 10^{-3})}$
 $= 5700 \text{ J} \cdot \text{mol}^{-1} = 5.7 \text{ kJ} \cdot \text{mol}^{-1}$

Since ΔG° is positive, the reaction is endergonic under standard conditions.

14. $K_{eq} = e^{-\Delta G^{\circ}/RT} = e^{-(-20,000 \text{ J} \cdot \text{mol}^{-1})/(8.314 \text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1})(298 \text{ K})}$
 $= 4.6 \times 10^3$
15. From Eq. 1-17, $K_{eq} = [\text{G6P}]/[\text{G1P}] = e^{-\Delta G^{\circ}/RT}$
 $[\text{G6P}]/[\text{G1P}] = e^{-(-7100 \text{ J} \cdot \text{mol}^{-1})/(8.314 \text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1})(298 \text{ K})}$
 $[\text{G6P}]/[\text{G1P}] = 17.6$
 $[\text{G1P}]/[\text{G6P}] = 0.057$
16. The cell membrane must be semipermeable so that the cell can retain essential compounds while allowing nutrients to enter and wastes to exit.
17. Membrane-enclosed cellular compartments are typical of eukaryotic but not prokaryotic cells.
18. Concentration = (number of moles)/(volume)
Volume = $(4/3)\pi r^3 = (4/3)\pi(5 \times 10^{-7} \text{ m})^3$
 $= 5.24 \times 10^{-22} \text{ m}^3 = 5.24 \times 10^{-16} \text{ L}$
Moles of protein = (2 molecules)/(6.022 $\times 10^{23}$ molecules $\cdot \text{mol}^{-1}$)
 $= 3.32 \times 10^{-24} \text{ mol}$
Concentration = $(3.32 \times 10^{-24} \text{ mol})/(5.24 \times 10^{-16} \text{ L})$
 $= 6.3 \times 10^{-9} \text{ M} = 6.3 \text{ nM}$
19. Number of molecules = (molar conc.)(volume) $(6.022 \times 10^{23} \text{ molecules} \cdot \text{mol}^{-1})$
 $= (1.0 \times 10^{-3} \text{ mol} \cdot \text{L}^{-1})(5.24 \times 10^{-16} \text{ L})$
 $(6.022 \times 10^{23} \text{ molecules} \cdot \text{mol}^{-1})$
 $= 3.2 \times 10^2 \text{ molecules}$
20. In order for ΔG to have a negative value (a spontaneous reaction), $T\Delta S$ must be greater than ΔH .
 $T\Delta S > \Delta H$
 $T > \Delta H/\Delta S$
 $T > 7000 \text{ J} \cdot \text{mol}^{-1}/20 \text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$
 $T > 350 \text{ K}$ or 77°C
21. (a) Because $K_{eq} = \frac{[R]}{[Q]} = 25$, at equilibrium, the concentration of R is 25 times greater than the concentration of Q. When equal concentrations of Q and R are mixed, molecules of Q will be converted to molecules of R.
(b) Let x = amount of Q converted to R, so that [R] will be $50 \mu\text{M} + x$ and [Q] will be $50 \mu\text{M} - x$. Since $K_{eq} = \frac{[R]}{[Q]} = 25$,
$$\frac{50 + x}{50 - x} = 25(50 - x)$$

$$50 + x = 1250 - 25x$$

$$26x = 1200$$

$$x = 46.15$$

$$[R] = 50 \mu\text{M} + 46.15 \mu\text{M} = 96.15 \mu\text{M}$$

$$[Q] = 50 \mu\text{M} - 46.15 \mu\text{M} = 3.85 \mu\text{M}$$
22. At $10^{\circ}\text{C} = 283 \text{ K}$ ($1/T = 0.00353$), $K_{eq} = 100$ and $\ln K = 4.61$.
At $30^{\circ}\text{C} = 303 \text{ K}$ ($1/T = 0.00330$), $K_{eq} = 10$ and $\ln K = 2.30$.
These two points generate a line on a van't Hoff plot ($\ln K_{eq}$ versus $1/T$) with a positive slope that is equal to $(-\Delta H^{\circ}/R)$. ΔH° must therefore be negative, indicating that enthalpy decreases during the reaction (heat is given off).

Voet Voet Pratt Fundamentals Biochemistry Solution Manual

**Miguel Ángel Medina Torres, Fernanda
Suárez Marín, Francisco José Alonso
Carrión**

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Recursos para la enseñanza/aprendizaje del metabolismo Miguel Ángel Medina Torres, Fernanda Suárez Marín, Francisco José Alonso Carrión, 2019-10-16 Recursos para la enseñanza aprendizaje del metabolismo es producto de la experiencia de más de treinta años de docencia universitaria y de proyectos de innovación educativa. Contiene información relevante sobre la bibliografía disponible prácticas de laboratorio recursos TIC y de otro tipo útiles para el estudio del metabolismo así como una experiencia singular desarrollada por nuestros propios estudiantes el programa de radio La bicicleta de Krebs. En sus contenidos han colaborado un nutrido grupo de profesores y estudiantes. Confiamos en que esta obra sea una valiosa aunque modesta aportación para cuantos interesados en la docencia del metabolismo se acerquen a su lectura o consulta. Este libro es uno de los productos derivados del Proyecto de Innovación Educativa PIE17/145 de la Universidad de Málaga.

Histological and Histochemical Methods, fifth edition John Kiernan, 2015-06-08 This fifth edition of *Histological and Histochemical Methods* continues to provide a clear and consistent introduction to the techniques description and analysis of the chemical and physical principles of fixation tissue processing staining enzyme location immunohistochemistry and other key procedures. The overall structure of the book remains unchanged but the content has been heavily revised to update the techniques used in line with recent technological advances. Additionally there are new sections on Artefacts and troubleshooting. Methods for microorganisms and fungi in sections. Methods for various pigments and mineral deposits in tissues. Methods for skeletal elements bone cartilage in whole mounts. *Histological and Histochemical Methods 5e* is essential reading for students lecturers researchers and professionals using histological and histochemical techniques. From reviews *Histological and Histochemical Methods* is a tour de force wholly suited to the modern age of histology and Professor Kiernan has triumphed again. To cover so much ground clearly and concisely while including the justification of the underlying chemistry makes this book unique. There should not be a histology laboratory or an undergraduate library that does not own a copy. *Biotechnic Histochemistry* 2016 91 2 145 This book should be present on the bookshelves of every research or analysis laboratory where histology and histochemistry are routinely used as an essential reference source of basic and practical information for scientists and technicians. *European Journal of Histochemistry* 2016 vol 60 Modern Experimental Biochemistry Rodney Boyer, 2000 This successful text provides students majoring in biochemistry chemistry biology and related fields with a modern and complete experience in experimental biochemistry. Its unique two part organization offers flexibility to accommodate various requirements of the course and allows students to reference detailed theory sections for clarification during labs. Part I Theory and Experimental Techniques provides in depth theoretical discussion organized around important techniques. A valuable reference for instructors and students it is particularly useful to instructors who prefer to use their own customized experiments. Part II Experiments offers optimum flexibility through 15 tested experiments designed to accommodate the capabilities of laboratories and students at most four year schools.

Alternate methods are suggested and labs may be divided into manageable hour segments **The British National**

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Fundamental Overview of Essential Principles is a companion workbook to Chemistry A Fundamental Overview of Essential Principles The original problems from the textbook are included in full along with detailed explanations that reference the related sections of the main textbook This solutions manual can also be used as a source of additional problems to supplement any basic chemistry text or course It can also serve as an excellent reference resource for multidisciplinary researchers as the manual covers essential concepts in chemistry Jason Yarbrough is an assistant professor of chemistry at West Texas A M University in Canyon Texas where he has served on the faculty since 2014 After earning a Ph D in chemistry from Texas A M University in College Station Texas in 2003 Dr Yarbrough went on to conduct post doctoral research at the University of North Carolina at Chapel Hill Following this Dr Yarbrough worked in the polymer industry for several years before joining the faculty at West Texas A M University He holds multiple patents and his writings can be found in numerous peer reviewed journals such as the Journal of the American Chemical Society Macromolecules and Inorganic Chemistry to name a few David Khan is an associate professor of chemistry and biochemistry at West Texas A M University in Canyon Texas where he has served as a member of the faculty since 2009 and currently serves as the chair of the Department of Chemistry and Physics He received a Ph D in chemistry from Florida Atlantic University in Boca Raton Florida in 2007 before going on to post doctoral research with Dr Edna Cukierman s laboratory at Fox Chase Cancer Center in Philadelphia Dr Khan s writings have been published in numerous peer reviewed journals such as the Journal of the American Chemical Society and Chemical Biology and Drug Design as well as BMC Cancer Other Cognella titles by Jason C Yarbrough Chemistry A Fundamental Overview of Essential Principles First Edition Other Cognella titles by David R Khan Chemistry A Fundamental Overview of Essential Principles First Edition **Biochemistry 2E with Solutions Manual and Fob 2002 Supplements Set** Voet,2002-06-07 **Complete Solutions Manual for Biochemistry, 4/e** Christopher K. Mathews,2013-10-10

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