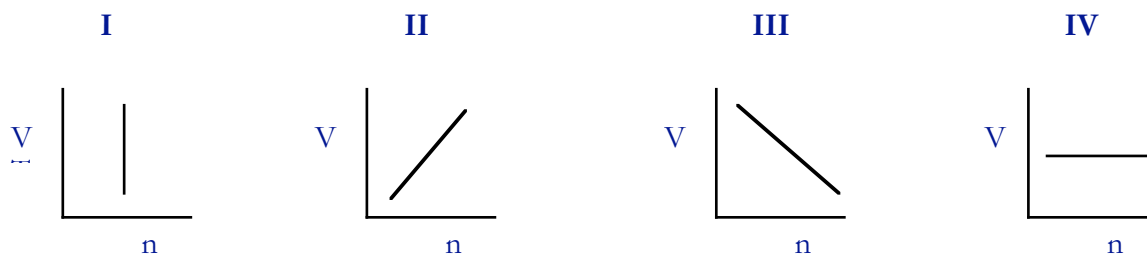


Representative Questions—Exam 3

- The kinetic-molecular theory of gases assumes which of the following?
 - gas samples are mostly empty space
 - the average kinetic energy is proportional to the Kelvin temperature
 - when gas particles collide with each other, they do so without losing energy
 - a and b**
 - all of the above**
- A fixed amount of gas occupies a flask with a volume of 2.55 L. What is the effect on the pressure of the gas if the temperature is increased?
 - The pressure increases.
 - The pressure decreases.
 - The pressure remains the same.
 - The pressure might increase or decrease depending on the number of moles present.
 - There is not enough information to determine the effect on the pressure.**
- Which of the following best represents the behavior of V and n for an ideal gas when both pressure (P) and amount (T) are fixed?



- I
 - II
 - III
 - IV
 - none of the above
- Which is/are true?
 - $P \propto T$ with fixed n , V
 - $V \propto T$ with fixed n , P
 - $V \propto 1/P$ with fixed n , T
 - $V = kT$ with fixed n , P
 - all of the above**
 - A fixed amount of gas occupies a flask with a volume of 2.55 L. What is the effect on the pressure of the gas if the temperature is increased?
 - The pressure increases.
 - The pressure decreases.
 - The pressure remains the same.
 - The pressure might increase or decrease depending on the number of moles present.
 - There is not enough information to determine the effect on the pressure.

6. A gas occupies 2.0 L at 800 torr and 30°C. Which of the following is true if the volume is held constant and the pressure is reduced to 600 torr?
- Temperature decreases by less than 100 K.
 - Temperature decreases by more than 100 K.
 - Temperature increases by less than 100 K.
 - Temperature increases by more than 100 K.
 - Temperature does not change.
7. Calculate the pressure when 3.0 moles of an ideal gas occupy a volume of 3.0 L and the temperature is 400 K?
- 33 atm
 - 67 atm
 - 296 atm
 - 3.1×10^{-2} atm
 - 3.1×10^2 atm
8. What is the volume of 2 moles of neon gas at 0°C and 1 atm?
- 22.4 L
 - 44.8 L
 - 67.2 L
 - 11.2 L
 - 33.6 L
9. What is the volume of a half mole of nitrogen gas at 0°C if the pressure is 760 torr?
- 22.4 L
 - 44.8 L
 - 11.2 L
 - 67.2 L
 - 33.6 L
10. Assume n and P are fixed for a sample of gas that occupies 200. mL at 350. K. What is the temperature if the volume is 300. mL?
300. K
 - 233 K
 350. K
 - 525 K
 200. K
11. A balloon occupies 2 L at 1 atm at 200 K. What is the volume at 6 atm and 1200 K?
- 0.056 L
 - 1 L
 - 72 L
 - 18 L
 - 2 L

12. A gas (4.0 mol) occupies 3.00 L at 200.0 K. What is the pressure?
- 12 atm
 - 22 atm
 - 90 atm
 - 273 atm
 - 4.9×10^{-3} atm
13. Suppose a 4.00 L flask contains 21.45 g of a gas at 400.0 K and a pressure of 2.00 atm, what is the molecular weight of the gas? Hint: Substitute mass/molar mass for n in the ideal gas equation.
- 22.4 g/mol
 - 42.9 g/mol
 - 86.0 g/mol
 - 88.1 g/mol
 - 176 g/mol
14. A syringe contains a gas that has a volume of 20.0 cc at 11.5 psi. If the tip is blocked so that the gas can't escape, what pressure is required to decrease the volume to 1.50 cc?
- 0.863 psi
 - 345 psi
 - 153 psi
 - 230 psi
 - 2.61 psi
15. The gases in this problem are all at the same temperature. Which of the following shows the gases listed correctly in order of increasing average velocity?
- Ne < H₂ < Ar < Cl₂
 - Cl₂ < Ar < Ne < H₂
 - Ar < Ne < Cl₂ < H₂
 - Cl₂ < Ne < H₂ < Ar
 - Cl₂ < Ne < Ar < H₂

16. A flask contains the following gases:

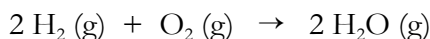
Xe	CH ₄	N ₂	He
I	II	III	IV

Arrange the gases in order of increasing average speed.

- I < II < III < IV
- IV < III < II < I
- III < I < IV < II
- IV < II < I < III
- I < III < II < IV

17. What is the partial pressure of Ne gas if a closed flask contains 40 g of Ne and 40 g of Ar and the total pressure is 120 torr?
- 40 torr
 - 80 torr
 - 180 torr
 - 240 torr
 - 360 torr
18. A flask contains 0.80 L of helium and 0.20 L of neon at 2.0 atm. What is the partial pressure of helium? *Hint:* Remember the total of the partial pressures equals the total pressure.
- 2.0 atm
 - 1.6 atm
 - 1.2 atm
 - 0.8 atm
 - 0.4 atm
19. A gas in a 2.0 liter container with rigid walls is initially at 300. K and a pressure of 3.0 atm. If the gas is warmed to 400. K, what is the pressure inside the container?
- 0.5 atm
 - 1.0 atm
 - 2.0 atm
 - 4.0 atm
 - 8.0 atm
20. A sample of gas occupies 200 mL at 300 K. What is the temperature if the gas occupies a volume of 500 mL?
- 60.0 K
 120. K
 - 273 K
 - 333 K
 - 750 K
21. Since pressure and temperature are directly proportional to each other (for a fixed amount of gas at constant volume) we mathematically say that
- $P = k(1/T)$
 - $P = kT$
 - $PT = k$
 - $1/k = (P)(T)$
 - $P_1T_1 = P_2T_2$
22. Suppose that the pressure on a sample of gas is 0.0250 atm when the temperature is 80.0 K and the gas occupies a volume of 24.00 L. If the pressure increases to 10.0 atm and the temperature increases to 200.0 K, what is the new volume occupied by this gas sample?
- 0.0240 L
 - 15.0 L
 - 0.00417 L
 - 0.150 L
 - 2.40 L

23. A flask contains 4 g of helium at 0 °C and 1 atm. What is the volume of the gas?
- 0.0100 L
 - 0.0500 L
 - 2.30 L
 - 22.4 L
 - 89.6 L
24. What is the temperature of 5.0 moles of argon gas occupying 8.00 L at 3 atm?
- 0.0170 K
 - 0.390 K
 - 273 K
 - 162 K
 - 58.5 K
25. Assuming that the temperature and pressure remain constant, how much water will be produced from 2.5 L of hydrogen?



- 10 L
 - 5.0 L
 - 2.5 L
 - 1.3 L
 - 0.63 L
26. Three liters of nitrogen and 6 L of oxygen reacted and produced 3 L of product (all gases at the same temperature and pressure). Which equation best describes what must have occurred?

Hint: This is an application of Avogadro's Law.

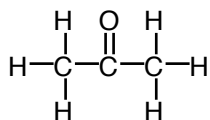
- $\text{N}_2 + \text{O}_2 \rightarrow \text{N}_2\text{O}_2$
 - $\text{N}_2 + 2 \text{O}_2 \rightarrow 2 \text{NO}_2$
 - $2 \text{N}_2 + \text{O}_2 \rightarrow 2 \text{N}_2\text{O}$
 - $\text{N}_2 + 2 \text{O}_2 \rightarrow \text{N}_2\text{O}_4$
 - $\text{N}_2 + 3 \text{O}_2 \rightarrow 2 \text{NO}_3$
27. Which intermolecular forces are present within a pure sample of CH_3F ?
- only dipole-dipole forces
 - only hydrogen-bonding forces
 - only London dispersion forces
 - London dispersion forces **and** dipole-dipole forces
 - London dispersion forces **and** dipole-dipole forces **and** hydrogen-bonding forces
28. All of the following molecules experience London dispersion forces. Which of these is also capable of dipole-dipole interactions?
- | | |
|------------------|-------------------|
| a. BH_3 | d. CCl_4 |
| b. NH_3 | e. CO_2 |
| c. CH_4 | |

29. The ability of water to form intermolecular hydrogen bonds is responsible for
- its surprisingly low specific heat.
 - its low heat of vaporization.
 - its surprisingly high boiling point.
 - the increase in density when liquid water freezes.
 - all of the above**
30. What types of intermolecular forces exist **between** molecules of compound A and molecules of compound B?

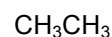
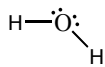
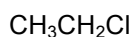


- London dispersion forces
 - dipole-dipole forces
 - hydrogen bonding
 - a and b**
 - all of the above**
31. Place the following in order of increasing boiling point.
- | | | | |
|---------------|----------------------|------------|-----------|
| NH_3 | H_2O | Ne | NO |
| I | II | III | IV |
- $\text{I} < \text{II} < \text{III} < \text{IV}$
 - $\text{IV} < \text{III} < \text{II} < \text{I}$
 - $\text{III} < \text{II} < \text{I} < \text{IV}$
 - $\text{III} < \text{IV} < \text{I} < \text{II}$
 - $\text{II} < \text{I} < \text{III} < \text{IV}$
32. Which of the following is capable of hydrogen-bonding?
- CBr_4
 - CH_3OH
 - CHCl_3
 - HCN
 - H_2
33. Which of the following is capable of dipole-dipole interactions, but can't H-bond?
- BH_3
 - CH_3OH
 - H_2S
 - SiH_4
 - NH_3

34. Molecules of pentane, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$, interact with each other via which type(s) of intermolecular forces?
- London dispersion forces
 - Dipole-dipole forces
 - Hydrogen bonding forces
 - London dispersion forces and dipole-dipole forces
 - London dispersion forces, dipole-dipole forces, and hydrogen bonding forces
35. Which of the following intermolecular forces are present in a sample of acetone?



- only hydrogen-bonding forces
 - only dipole-dipole forces
 - only London dispersion forces
 - hydrogen-bonding *and* dipole-dipole forces
 - London dispersion *and* dipole-dipole forces
36. Predict the order of *increasing* boiling point based on the intermolecular forces present.



I

II

III

- $\text{I} < \text{II} < \text{III}$
 - $\text{III} < \text{I} < \text{II}$
 - $\text{II} < \text{III} < \text{I}$
 - $\text{III} < \text{II} < \text{I}$
 - $\text{I} < \text{III} < \text{II}$
37. Which is an endothermic transformation?
- liquid to solid
 - solid to liquid
 - gas to solid
 - gas to liquid
 - none of the above**
38. How much heat is needed to melt 22.4 g of ice at 0°C to form liquid water at 0°C ? **Caution: Units!**
- 3.56 cal
 - 22.4 cal
 - 99.2 cal
 - 1.79 kcal
 - 12.1 kcal

39. Steam (36 grams at 120.0°C) is cooled until the entire sample condenses to liquid at 100.0°C. How much heat is released? The specific heat for H₂O in the vapor phase is 0.480 cal/g°C.
- Note: Some additional useful information is available on the front of the exam.
- a. 0.346 kcal
 - b. 1.43 kcal
 - c. 19.1 kcal
 - d. 19.8 kcal
 - e. 734 kcal
40. What is the total amount of heat needed to boil and vaporize 10.0 g of water that is initially at 50.0°C? (Hint: Two separate calculations are necessary! See the front of the exam for useful data.)
- a. 0.50 kcal
 - b. 1.3 kcal
 - c. 4.9 kcal
 - d. 5.4 kcal
 - e. 5.9 kcal
41. Which illustrates the “like dissolves like” principle for a solid solute and a liquid solvent?
- a. a polar compound is soluble in a polar solvent
 - b. a nonpolar compound is soluble in a nonpolar solvent
 - c. an ionic compound is soluble in a very polar solvent
 - d. **all of the above**
 - e. **none of the above**
42. Which of the following is likely to be a soluble combination (at least to some significant extent)?
- a. CCl₄ and water
 - b. CaCl₂ and CCl₄
 - c. KCl and octane (C₈H₁₈)
 - d. K₂SO₄ and CCl₄
 - e. CBr₄ and CCl₄
43. The volume of solute in mL, divided by the volume of solution in mL, expressed as a percent, is the concentration unit that is abbreviated
- a. M
 - b. w/v %
 - c. v/v %
 - d. w/w %
 - e. ppm
44. Suppose 250 mL of a solution contains 20. g of CaO. What is its w/v %?
- a. 8% (w/v)
 - b. 16% (w/v)
 - c. 24% (w/v)
 - d. 32% (w/v)
 - e. 64% (w/v)

45. What is the v/v % of a 500 mL solution containing 75 mL of methanol?
- 0.75 %
 - 38 %
 - 67 %
 - 75 %
 - 15 %
46. How would you correctly prepare 500.0 mL of a solution that is 2.0% (w/v) Na_2SO_4 ?
- dissolve 2.0 g Na_2SO_4 in water and dilute to a total volume of 500.0 mL.
 - dissolve 4.0 g Na_2SO_4 in water and dilute to a total volume of 500.0 mL.
 - dissolve 10.0 g Na_2SO_4 in water and dilute to a total volume of 500.0 mL.
 - combine 2.0 g Na_2SO_4 and 500.0 g of water.
 - combine 2.0 g Na_2SO_4 and 500.0 mL of water.
47. Suppose 15.0 g of methanol (CH_3OH) and 85.0 g of water are combined. What is the concentration of the solution that is produced?
- 1.76 % (w/w)
 - 0.176 % (w/w)
 - 17.6 % (w/w)
 - 0.15 % (w/w)
 - 15.0 % (w/w)
48. What is the approximate molarity of a solution of NaOH that is 5.0% w/v?
- 1.6 M
 - 0.80 M
 - 12.5 M
 - 0.039 M
 - 1.25 M
49. How many grams of salt are needed to make 300. mL of a solution that is 3.0% (w/v)?
- 0.18 g
 - 0.90 g
 - 3.0 g
 - 9.0 g
 - 15 g
50. What is the molarity of a solution prepared by dissolving 80.0 g of NaOH in water and diluting until the total volume is 1.0 L?
- 0.5 M
 - 1 M
 - 2 M
 - 4 M
 - 8 M

51. If 500 mL of water were added to 500 mL of 0.50 M silver nitrate, what would be the approximate concentration of the resulting solution?
- 0.05 M
 - 0.25 M
 - 0.50 M
 - 0.75 M
 - 1.0 M
52. A sample collected from a lake is found to contain 3.6 ppm mercury. What is the concentration if 150 mL of the sample is diluted to a total volume of 600 mL?
- 50 ppm
 - 1.8×10^2 ppm
 - 14 ppm
 - 0.25 ppm
 - 0.90 ppm
53. If 400.0 mL of 10.0 % (w/v) fructose ($C_6H_{12}O_6$) solution were evaporated to dryness, how many grams of the fructose would we have?
- 2.5 g
 - 4.0 g
 - 25.0 g
 - 40.0 g
 - 72.0 g
54. If 100 mL of 1.0 M $CaCl_2$ and 300 mL of water are combined, what is the approximate **chloride ion** concentration in the resulting solution?
- 0.33 M
 - 0.25 M
 - 0.50 M
 - 3.0 M
 - 4.0 M
55. Which one of the following, when prepared as a 0.1M solution in water, would have its freezing point depressed the most relative to pure water?
- NaCl
 - glucose
 - $CaCl_2$
 - KI
 - CsI
56. If 500 mL of 2.5 M KF solution were evaporated to dryness, how many grams of the KF salt would be recovered?
- 2.5 g
 - 7.3 g
 - 11.6 g
 - 73 g
 - 130 g

57. Sodium bicarbonate is only somewhat soluble in water, such that a solution of NaHCO_3 in water that is 9.6% (w/v) is a saturated solution. Which of the following is (are) true?
- A solution prepared by combining 5 g of NaHCO_3 and 100 mL of water is saturated.
 - Adding sodium chloride to a NaHCO_3 solution will increase the Na^+ concentration in the solution.
 - Adding additional sodium bicarbonate to an already saturated solution will cause a further reduction in the vapor pressure of the solution.
 - A saturated solution always has excess solid present.
 - all of the above*
58. If 2.0 L of 0.40 M LiCl and 2.0 L of 0.60 M LiNO_3 are combined, what is the **lithium ion** concentration in the resulting solution?
- 0.2 M
 - 0.4 M
 - 0.5 M
 - 0.6 M
 - 1.0 M
59. How much potassium chloride is needed to prepare 500 mL of a KCl solution that is 30 w/v %?
30. g
 - 150 g
 - 6.0 g
 - 0.17 g
 - 0.67 g
60. If 400 mL of water are added to 0.40 mole of potassium nitrate, what would be the approximate concentration of the resulting solution?
- 1.0 M
 - 0.75 M
 - 0.50 M
 - 0.10 M
 - 0.050 M
61. Which of the following is 40. ppm?
- 4.0 mL in 1.0×10^2 mL of solution
 - 4.0 mL in 1.0×10^4 mL of solution
 - 4.0 mL in 1.0×10^5 mL of solution
 - 4.0 mL in 1.0×10^6 mL of solution
 - 4.0 mL in 1.0×10^9 mL of solution
62. What mass of barium chloride is needed to prepare 500 mL of 0.28 M BaCl_2 solution?
- | | |
|-----------|------------|
| a. 7.3 g | d. 116.6 g |
| b. 48.4 g | e. 372 g |
| c. 29.2 g | |

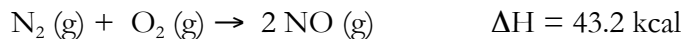
63. A solution is prepared by dissolving 25.0 g of SrCl_2 in water and diluting to a volume of 500 mL. What is the concentration of the resulting solution?
- 13.0 M
 - 5.00 M
 - 0.0500 M
 - 0.315 M
 - 31.5 M
64. What is the concentration if 200 mL of a 4.0 M salt solution is diluted with water until the total volume is 800 mL?
- 32 M
 - 0.2 M
 - 0.3 M
 - 0.5 M
 - 1.0 M
65. Which solution has the highest concentration of sodium ions?
- 0.1 M NaBr
 - 0.2 M Na_2SO_4
 - 0.2 M Na_3PO_4
 - 0.3 M NaCl
 - All of the solutions have the same concentration of sodium ions.**
66. A solution containing 50 g of sugar in 500 g of water would:
- have a higher vapor pressure than pure water
 - have a vapor pressure less than pure water
 - boil at a temperature below 100°C
 - freeze at a temperature above 0°C
 - none of the above**
67. Relative to pure solvent, a solution containing a non-volatile solute has a _____ vapor pressure and a _____ boiling point.
- lower, higher
 - lower, lower
 - higher, lower
 - higher, higher
 - none of the above
68. Decreasing the total pressure above a liquid (for example: by taking the liquid to a higher elevation) will cause the boiling point of the liquid to
- increase.
 - decrease.
 - remain the same.
 - depends on the density of the liquid (could increase, decrease or stay the same)
 - depends on the molar mass of the liquid (could increase, decrease or stay the same)

69. The addition of a soluble, non-volatile solute, such as KI, to water
- lowers its boiling point.
 - raises its freezing point.
 - decreases its conductivity.
 - increases its vapor pressure.
 - decreases its vapor pressure.
70. Which of the following, when placed in water, is a strong electrolyte?
- CH_3OH
 - BaSO_4
 - Na_3PO_4
 - PbCl_2
 - sugar
71. Which of these aqueous solutions would have the lowest freezing point?
- 1.0 M $\text{Al}_2(\text{SO}_4)_3$
 - 2.5 M NaCl
 - 5.0 M sucrose (table sugar)
 - 1.5 M BaCl_2
 - 1.5 M AlCl_3
72. Compared to pure water, a 1.0 M solution of CsCl will have a
- higher boiling point and a higher freezing point.
 - higher boiling point and a lower freezing point.
 - lower boiling point and a higher freezing point.
 - lower boiling point and a lower freezing point.
 - none of the above**
73. Which of the following is true when a non-volatile solute, such as MgSO_4 , is added to water?
- Freezing point increases
 - Boiling point decreases
 - Conductivity increases
 - all of the above**
 - none of the above**
74. When a liquid evaporates
- entropy increases and heat is absorbed.
 - entropy increases and heat is released.
 - entropy decreases and heat is absorbed.
 - entropy decreases and heat is released.
 - ΔS and ΔH are both zero.
75. An exothermic reaction is one where heat is _____ and ΔH is _____ zero.
- absorbed, less than
 - released, less than
 - absorbed, greater than
 - released, greater than
 - Don't mark E!**

76. Which would have a negative value for ΔS ?
- $\text{CO}_2(\text{s}) \rightarrow \text{CO}_2(\text{g})$
 - $\text{Ag}^+(\text{aq}) + \text{I}^-(\text{aq}) \rightarrow \text{AgI}(\text{s})$
 - $\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \rightarrow 2 \text{NH}_3(\text{g})$
 - a and b**
 - b and c**

77. Which would have a negative value for ΔS ? In other words, which involves entropy decreasing?
- nitrogen gas and hydrogen gas reacting to form $\text{NH}_3(\text{g})$
 - a new deck of playing cards being shuffled
 - a few drops of water evaporating
 - a and b**
 - b and c**

78. Based on the reaction shown, which of the following is true?



- 43.2 kcal are consumed when 1.00 g of N_2 reacts.
 - 43.2 kcal are consumed when 1.00 g of O_2 reacts.
 - 43.2 kcal are consumed when 1.00 mol of N_2 reacts.
 - 43.2 kcal are consumed when 1.00 mol of NO is produced
 - 43.2 kcal are released when 1.00 mol of NO is produced.
79. About how much heat is released when 16.0 grams of SO_2 is converted into SO_3 in the following reaction?
- $$2 \text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2 \text{SO}_3(\text{g}) + 198.2 \text{ kJ}$$
- 793 kJ
 - 396 kJ
 - 49.6 kJ
 - 203 kJ
 - 24.8 kJ

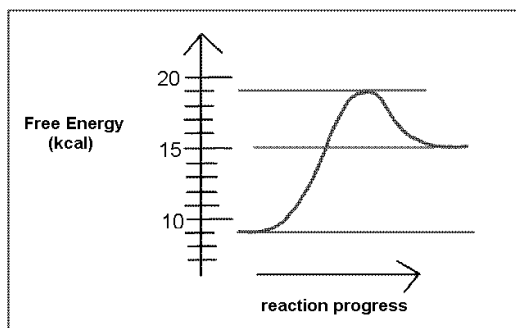
80. What is the value of ΔG at 27°C for a reaction if $\Delta H = -17.4 \text{ kcal}$ and $\Delta S = 0.0272 \text{ kcal/K}$.
- 25.6 kcal
 - 25.6 kcal
 - 8100 kcal
 - 9.24 kcal
 - 16.7 kcal

81. What is the value of ΔG at 25°C for the reaction of 2 moles of bismuth and 3 moles of sulfur according to the equation: $2 \text{Bi}(\text{s}) + 3 \text{S}(\text{s}) \rightarrow \text{Bi}_2\text{S}_3(\text{s})$? **Caution: Watch your units!**

For this reaction, $\Delta H = -43.7 \text{ kcal}$ and $\Delta S = -15.2 \text{ cal/K}$.

- | | |
|---------------|---------------|
| a. -39.2 kcal | d. -43.3 kcal |
| b. 39.2 kcal | e. -48.2 kcal |
| c. 43.3 kcal | |

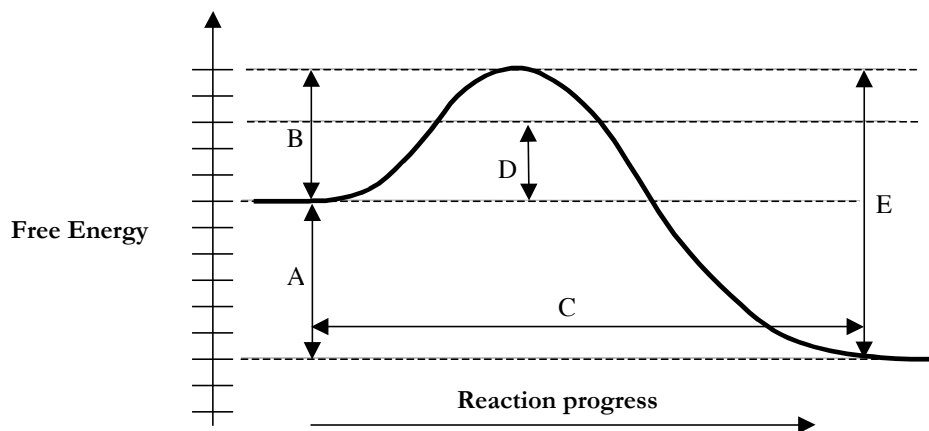
Refer to the following energy diagram for problems 82 through 84.



82. What is ΔG for this reaction?
- +6 kcal
 - +10 kcal
 - +19 kcal
 - 6 kcal
 - 15 kcal
83. What is the activation energy (E_a) for this reaction?
- +4 kcal
 - +6 kcal
 - +10 kcal
 - +15 kcal
 - +19 kcal
84. In the reverse direction, this reaction is _____ and ΔG is _____.
- not spontaneous, +9 kcal
 - not spontaneous, +15 kcal
 - spontaneous, -6 kcal
 - spontaneous, -9 kcal
 - spontaneous, -15 kcal
85. *Exothermic* means
- heat is a product and $\Delta H < 0$.
 - heat is a reactant and $\Delta H < 0$.
 - heat is a product and $\Delta H > 0$.
 - heat is a reactant and $\Delta H > 0$.
 - $\Delta G > 0$.
86. Which of the following is likely true for the reaction below?
- $$\text{C}_6\text{H}_5\text{OH}(\text{g}) + 7 \text{O}_2(\text{g}) \rightarrow 6 \text{CO}_2(\text{g}) + 3 \text{H}_2\text{O}(\text{g})$$
- exothermic and entropy increases
 - endothermic and entropy increases
 - exothermic and entropy decreases
 - endothermic and entropy decreases
 - $\Delta H = 0$ and $\Delta S = 0$

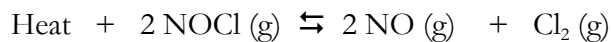
87. Which of the following conditions will result in a spontaneous reaction regardless of the temperature?
- $\Delta H < 0$ and $\Delta S < 0$
 - $\Delta H > 0$ and $\Delta S < 0$
 - $\Delta H < 0$ and $\Delta S > 0$
 - $\Delta H > 0$ and $\Delta S > 0$
 - $\Delta H > 0$ and $\Delta S = 0$
88. A reaction is *certainly* spontaneous if
- ΔS is positive.
 - ΔS is negative.
 - ΔH is positive.
 - ΔG is positive.
 - ΔG is negative.
89. An endothermic reaction is one where heat is _____ and ΔH is _____ zero.
- absorbed, less than
 - released, less than
 - absorbed, greater than
 - released, greater than
 - Don't mark E!**
90. The enthalpy change is -43.2 kcal for the reaction: $2 \text{NO} \rightarrow \text{N}_2 + \text{O}_2$
 Formation of 84 g of nitrogen gas will result in _____ kcal being _____.
 Hint: nitrogen gas, N_2 , is 28 g/mol.
- 43.2 kcal; released
 - 130 kcal ; released
 - 14.4 kcal ; released
 - 43.2 kcal ; absorbed
 - 130 kcal ; absorbed

Consider the following diagram when answering questions 91–94. Each “tick mark” on the y-axis represents an energy difference of 1 kcal.



91. Which line segment (†) represents the free energy change, ΔG , for this reaction?
- A
 - B
 - C
 - D
 - E
92. Which line segment (†) could represent E_a for this reaction **if a catalyst was present**?
- A
 - B
 - C
 - D
 - E
93. Which line segment (†) represents the activation energy for the **reverse** reaction?
- A
 - B
 - C
 - D
 - E
94. Based on the energy diagram shown, which of the following could be the values for ΔG and E_a ?
- $\Delta G = +6$ kcal and $E_a = +5$ kcal
 - $\Delta G = -6$ kcal and $E_a = +5$ kcal
 - $\Delta G = +5$ kcal and $E_a = -6$ kcal
 - $\Delta G = +11$ kcal and $E_a = +6$ kcal
 - $\Delta G = -6$ kcal and $E_a = +11$ kcal
95. Consider the reversible reaction $2A \rightleftharpoons 3B$. What is the value of the equilibrium constant if the equilibrium concentration of A is 0.124 M and the equilibrium concentration of B is 0.327 M?
- 2.27
 - 0.440
 - 2.64
 - 21.3
 - 4.05×10^{-2}

Use the following reaction for problems 96–98.

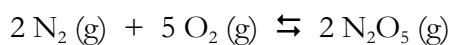


96. The equilibrium expression for the above reaction is:

- | | | | |
|----|--|----|--|
| a. | $\frac{[\text{NOCl}]^2}{[\text{NO}]^2[\text{Cl}_2]}$ | d. | $\frac{2[\text{NOCl}]}{2[\text{NO}][\text{Cl}_2]}$ |
| b. | $\frac{[\text{NOCl}]^2[\text{Cl}_2]}{[\text{NO}]^2}$ | e. | $\frac{[\text{NO}]^2[\text{Cl}_2]}{[\text{NOCl}]^2}$ |
| c. | $\frac{[\text{NO}]^2[\text{Cl}_2]}{[\text{NOCl}]}$ | | |

97. Which of the following would result from decreasing the temperature in the reaction vessel?
- The equilibrium shifts to the right.
 - The equilibrium shifts to the left.
 - More NO will form.
 - More chlorine will form.
 - none of the above**
98. Increasing the concentration of NO has which of the following consequences?
- NOCl will decompose to form chlorine and nitric oxide.
 - The equilibrium shifts to the right.
 - More Cl₂ will form.
 - Heat will be released.
 - all of the above**

Use the following reaction for problems 99 – 100.



99. In the above equilibrium, increasing the pressure in the reaction vessel has which of the following consequences?
- More oxygen will form.
 - More nitrogen will form.
 - The equilibrium shifts to the left.
 - The equilibrium shifts to the right.
 - The value of the equilibrium constant is increased.
100. In the above equilibrium, removing N₂O₅ from the reaction vessel has which of the following consequences?
- More oxygen will form.
 - More nitrogen will form.
 - The equilibrium shifts to the left.
 - The equilibrium shifts to the right.
 - The value of the equilibrium constant is increased.
101. In which of the following reactions would **increasing** the pressure cause a shift in the equilibrium so that **more products are produced**? Note: All reactants and products are gases.
- $2 \text{CO} + 2 \text{NO} \rightleftharpoons \text{N}_2 + 2 \text{CO}_2$
 - $4 \text{NH}_3 + 5 \text{O}_2 \rightleftharpoons 4 \text{NO} + 6 \text{H}_2\text{O}$
 - $2 \text{N}_2\text{O}_5 \rightleftharpoons 2 \text{N}_2 + 5 \text{O}_2$
 - $2 \text{NBr}_3 \rightleftharpoons \text{N}_2 + 3 \text{Br}_2$
 - none of the above**