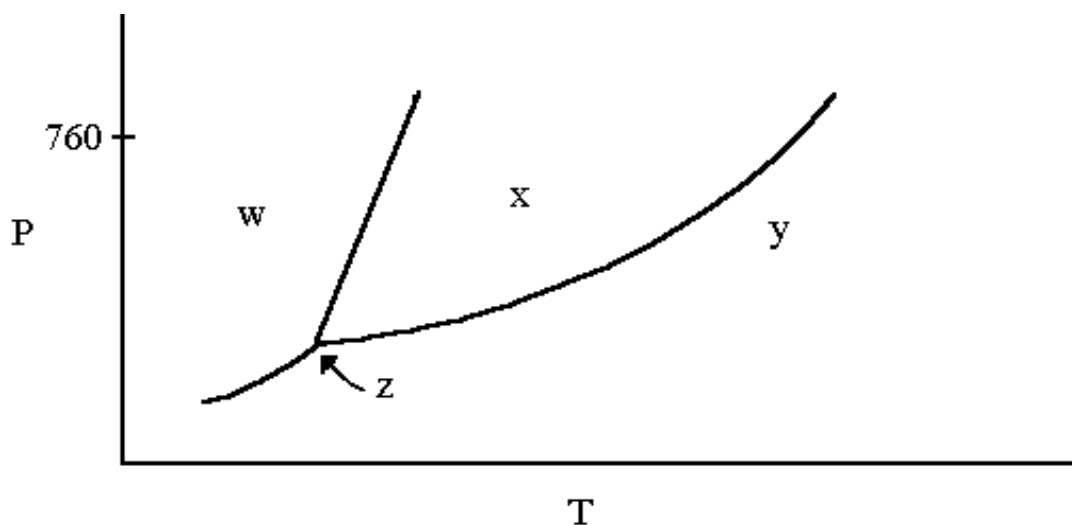


MULTIPLE CHOICE

1. Which one of the following exhibits dipole-dipole attraction between molecules?
 - a) XeF_4
 - b) AsH_3
 - c) CO_2
 - d) BCl_3
 - e) Cl_2
2. What is the predominant intermolecular force in AsH_3 ?
 - a) London-dispersion forces
 - b) ion-dipole attraction
 - c) ionic bonding
 - d) dipole-dipole attraction
 - e) hydrogen-bonding
3. Hydrogen bonding is a special case of _____.
 - a) London-dispersion forces
 - b) ion-dipole attraction
 - c) dipole-dipole attractions
 - d) none of these
 - e) ion-ion interactions
4. The heat of fusion of water is 6.01 kJ/mol. The heat capacity of liquid water is 75.2 J/mol-K. The conversion of 50.0 g of ice at 0.0°C to liquid water at 22.0°C requires _____ kJ of heat.
 - a) 3.8×10^2
 - b) 21.3
 - c) 17.2
 - d) 0.469
 - e) Insufficient data is given.

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5. The phase diagram of a substance is given below. The region that corresponds to the solid phase is _____.
- w
 - x
 - y
 - z
 - x and y



6. What is the molarity of an aqueous sodium chloride solution that is 13.0% sodium chloride by mass and that has a density of 1.10 g/mL?
- 143
 - 2.45
 - 2.56
 - 2.23
 - 1.43×10^{-2}
7. Which produces the greatest number of ions when one mole dissolves in water?
- NaCl
 - NH_4NO_3
 - NH_4Cl
 - Na_2SO_4
 - sucrose
8. In the reaction
- $$2\text{NO}_2 \rightarrow 2\text{NO} + \text{O}_2$$
- at 300°C , $[\text{NO}_2]$ drops from 0.0100 to 0.00650 M in 100 s. The rate of appearance of O_2 for this period is _____ M/s.
- 0.0000175
 - 0.0000350
 - 0.0000700
 - 0.00350
 - 0.00700

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9. Given the data below for the reaction
 $yY + zZ \rightarrow \text{products}$
 the rate law is rate = _____.

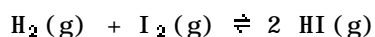
Experiment Number	[Y]/M	[Z]/M	Initial Rate (M/s)
1	0.100	0.100	4.0×10^{-5}
2	0.200	0.100	1.6×10^{-4}
3	0.100	0.200	8.0×10^{-5}

- a) $k[Y][Z]$
 b) $k[Y]^2[Z]$
 c) $k[Y]^2[Z]^2$
 d) $k[Y][Z]^2$
 e) $k[Y]^3[Z]^2$
10. The rate constant for a particular reaction is $1.3 \times 10^{-4} \text{M}^{-1}\text{s}^{-1}$ at 150°C , and $1.1 \times 10^{-3} \text{M}^{-1}\text{s}^{-1}$ at 200°C . What is the energy of activation for this reaction at 250°C ?
 a) 132
 b) 56
 c) 99
 d) 71
 e) 22
11. The reaction
 $2\text{NO}_2 \rightarrow 2\text{NO} + \text{O}_2$
 follows second-order kinetics. At 300°C , $[\text{NO}_2]$ drops from 0.0100 to 0.00650 M in 100 s. Use of the integrated form of the proper rate equation affords a value of _____ L/mol·s for the rate constant k.
 a) 0.096
 b) 0.65
 c) 0.81
 d) 1.2
 e) 0.54
12. The reaction
 $\text{CH}_3\text{-N}\equiv\text{C} \rightarrow \text{CH}_3\text{-C}\equiv\text{N}$
 is a first-order reaction. At 230.3°C , $k = 6.29 \times 10^{-4} \text{s}^{-1}$. If $[\text{CH}_3\text{-N}\equiv\text{C}]_0$ is 0.00100 M, $[\text{CH}_3\text{-N}\equiv\text{C}]$ in M after 1.000×10^3 s is
 a) 5.33×10^{-4}
 b) 2.34×10^{-4}
 c) 1.88×10^{-3}
 d) 4.27×10^{-3}
 e) 1.00×10^{-5}
13. The activation energy of a reaction whose rate constant increases by a factor of 10.0 when the temperature is increased from 303 K to 333 K is _____ kJ.
 a) 30
 b) 33
 c) 46
 d) 64
 e) 89

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14. At a certain temperature, a flask at equilibrium contains 0.0114 M HCl, 0.0931 M Cl_2 , and 0.0154 M H_2 . What is the value of K_c for the equilibrium: $2 \text{HCl}(g) \rightleftharpoons \text{Cl}_2(g) + \text{H}_2(g)$?
- 0.0909
 - 11.0
 - 1.63×10^{-5}
 - 6.25×10^4
 - 0.126

15. The value of K_c for the equilibrium



is 794 at 25°C. At this temperature, what is the value of K_c for $1/2 \text{H}_2(g) + 1/2 \text{I}_2(g) \rightleftharpoons \text{HI}(g)$?

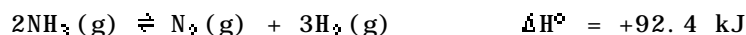
- 397
 - 0.035
 - 28
 - 1588
 - 0.0013
16. Consider the reaction shown below:



Determine the value of the equilibrium constant for this reaction if an initial concentration of $\text{N}_2\text{O}_4(g)$ of 0.0400 mol/L is reduced to 0.0055 mol/L at equilibrium. There is no $\text{NO}_2(g)$ present at the start of the reaction.

- 0.87
 - 13
 - 0.22
 - 0.022
 - 2.2×10^{-4}
17. For the vapor-phase reaction $2\text{AZ} \rightleftharpoons \text{A}_2 + \text{Z}_2$
 $K_c = 16$ at 523 K. If 0.030 mol AZ is introduced into an evacuated 1.00 L vessel at 523 K, then at equilibrium $[\text{Z}_2]$ is _____ M.
- 0.003
 - 0.013
 - 0.017
 - 0.24
 - 0.0052

18. Consider the following reaction at equilibrium:



Adding $\text{N}_2(g)$ to the system at equilibrium will _____.

- decrease the concentration of $\text{NH}_3(g)$ at equilibrium
- decrease the concentration of $\text{H}_2(g)$ at equilibrium
- increase the value of the equilibrium constant
- cause the reaction to shift to the right
- remove all of the $\text{H}_2(g)$

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19. What is the pH of a 0.015 M solution of barium hydroxide?
- 12.48
 - 12.18
 - 1.82
 - 10.35
 - 1.52
20. What is the pH of an aqueous solution at 25°C in which $[\text{OH}^-]$ is 0.0025 M?
- +2.60
 - 2.60
 - +11.40
 - 11.40
 - 2.25
21. Calculate the concentration (in M) of hydronium ions in a solution at 25°C with a pOH of 4.223.
- 5.98×10^{-5}
 - 1.67×10^{-10}
 - 1.67×10^9
 - 5.99×10^{-13}
 - 1.00×10^{-7}
22. The pH of a 0.011 M NaOH solution at 25°C is _____.
- 1.96
 - 4.51
 - 12.04
 - 12.90
 - 1.96
23. The $[\text{H}^+]$ and pH of a 0.021 M HNO_3 solution at 25°C are _____ M and _____, respectively
- 4.8×10^{-13} , 12.32
 - 4.8×10^{-13} , -12.32
 - 0.021, +1.68
 - 0.021, -1.68
 - 4.8×10^{-6} , +5.32
24. Of the following, _____ is a weak acid.
- HF
 - HCl
 - HBr
 - HNO_3
 - HClO_4
25. HZ is a weak acid. An aqueous solution of HZ is prepared by dissolving 0.020 mol of HZ in sufficient water to yield 1.00 L of solution. The pH of the solution was 4.93 at 25°C. The K_a of HZ is _____.
- 1.2×10^{-5}
 - 7.0×10^{-9}
 - 1.4×10^{-10}
 - 9.9×10^{-2}
 - 2.8×10^{-12}

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26. The pH of a 0.15 M aqueous solution of HOAc at 25°C is _____. The K_a for HOAc is 1.8×10^{-5} .
- 5.57
 - 7.35
 - 2.78
 - 9.18
 - 5.57
27. The pH of a 0.10 M solution of a weak base is 9.82. What is the K_b for this base?
- 2.1×10^{-4}
 - 4.3×10^{-8}
 - 8.8×10^{-8}
 - 6.6×10^{-4}
 - 2.0×10^{-5}
28. Calculate the pOH of a 0.0827 M aqueous sodium cyanide solution at 25°C (for CN^- , $K_b = 4.9 \times 10^{-10}$).
- 9.31
 - 10.39
 - 5.20
 - 1.08
 - 8.80
29. A solution containing which one of the following pairs of substances will be a buffer solution?
- NaI, HI
 - KBr, HBr
 - RbCl, HCl
 - CsF, HF
 - none of these
30. Calculate the pH of a solution prepared by dissolving 0.37 mol of formic acid (HCO_2H) and 0.23 mol of sodium formate (NaCO_2H) in 1.00 L of solution. $K_a = 1.8 \times 10^{-4}$ for formic acid.
- 2.09
 - 10.46
 - 3.54
 - 2.30
 - 3.95
31. Consider the titration of 25.00 mL of 0.723 M HClO_4 with 0.273 M KOH. The H_3O^+ concentration after addition of 10.0 mL of KOH is _____ M.
- 0.438
 - 1.00×10^{-7}
 - 0.723
 - 2.81×10^{-13}
 - 0.273
32. Consider the titration of 25.0 mL of 0.723 M HClO_4 with 0.273 M KOH. The H_3O^+ concentration after addition of 66.2 mL of KOH is _____ M.
- 0.439
 - 1.00×10^{-7}
 - 0.723
 - 2.81×10^{-13}
 - 0.273

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33. The pH of a solution prepared by mixing 45 mL of 0.183 M KOH with 65 mL of 0.145 M HCl is _____.
- 1.31
 - 2.92
 - 0.74
 - 1.97
 - 70.145
34. What is the molarity of an HOAc solution if 25.5 mL of this solution required 37.5 mL of 0.175 M NaOH to reach the equivalence point?
- 0.119
 - 1.83×10^{-4}
 - 0.257
 - 0.365
 - 0.175
35. The pH at the equivalence point of an HOAc solution if 25.5 mL of this solution required 37.5 mL of 0.175 M NaOH to reach the equivalence point is closest to _____.
- 4
 - 7
 - 9
 - 12
 - 0
36. 50.50 mL of 0.116 M HF is titrated with 0.1200 M NaOH. What is the pH when 25.00 mL of base have been added? (K_a for HF is 6.8×10^{-4})
- 5.118
 - 3.146
 - 6.168
 - 3.547
 - 3.189
37. Given the following table of K_{sp} values, determine which compound listed has the smallest solubility.
- | compound | K_{sp} |
|------------|-----------------------|
| $CdCO_3$ | 5.2×10^{-12} |
| $Cd(OH)_2$ | 2.5×10^{-14} |
| AgI | 8.3×10^{-17} |
| $Fe(OH)_3$ | 4×10^{-38} |
| $ZnCO_3$ | 1.4×10^{-11} |
- $ZnCO_3$
 - $Cd(OH)_2$
 - $CdCO_3$
 - AgI
 - $Fe(OH)_3$
38. Calculate the molar solubility of silver carbonate ($K_{sp} = 6.15 \times 10^{-12}$).
- 1.15×10^{-4}
 - 2.48×10^{-6}
 - 6.20×10^{-7}
 - 1.24×10^{-6}
 - 2.33×10^{-4}

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39. Given the following table of thermodynamic data,

substance	ΔH_f°	S°
$I_2(g)$	62.25 kJ/mol	260.57 J/mol-K
$I_2(s)$	0	116.73

determine the normal sublimation point (in $^\circ\text{C}$) of iodine.

- a) 432.8
b) 143.8
c) 159.8
d) 133.0
e) 273.3
40. Some standard entropies (at 25°C in J/mol K) are given:
 $\text{Ca}^{2+}(\text{aq})$ -55.2, $\text{F}^-(\text{aq})$ -9.6, $\text{CaF}_2(\text{s})$ +68.87. ΔS° for the reaction
 $\text{CaF}_2(\text{s}) \rightarrow \text{Ca}^{2+}(\text{aq}) + 2\text{F}^-(\text{aq})$
 at 25°C in J/K is _____.
- a) -133.7
b) +133.7
c) -5.5
d) -143.3
e) +143.3

41. Given the following table of thermodynamic data,

substance	S°
$\text{C}_2\text{H}_2(g)$	200.8 J/mol-K
$\text{C}_2\text{H}_4(g)$	219.4
$\text{C}_2\text{H}_6(g)$	229.5
$\text{H}_2(g)$	130.58

determine the ΔS° (in J/mol-K) for the reaction:

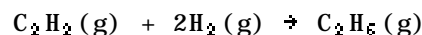
- $\text{C}_2\text{H}_2(g) + \text{H}_2(g) \rightarrow \text{C}_2\text{H}_4(g)$
- a) -111.98
b) -101.88
c) -232.46
d) +111.98
e) +101.88

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42. Consider the following table of thermodynamic data. All values are tabulated for 25°C.

Substance	ΔG_f° (kJ/mol)	S° (J/mol·K)
$C_2H_2(g)$	209	201
$C_2H_4(g)$	68	219
$C_2H_6(g)$	-33	230
$H_2(g)$	0	131
$H_2O(g)$	-229	189
$C_2H_5OH(l)$	-175	161

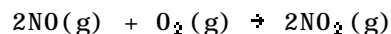
What is the value of ΔH° (in kJ) for the reaction described below? Assume the reaction is performed at 25°C.



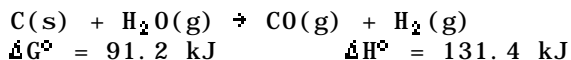
- a) -173
b) 236
c) -311
d) -248
e) 149
43. Consider the following table of thermodynamic data.

Substance	ΔG_f° (kJ/mol)	S° (J/mol·K)
$NO(g)$	86.7	211
$NO_2(g)$	51.8	240
$NOCl(g)$	66.3	264
$N_2O(g)$	103.6	220

Determine the value of ΔG° (kJ) for the following reaction taking place at 25°C.



- a) -69.8
b) -34.9
c) 104.7
d) -104.7
e) insufficient information is given
44. Consider the following reaction at 25°C.

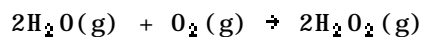


What is the value of ΔS° (J/K) for this reaction at 25°C?

- a) -135
b) 1.6
c) -1.6
d) 135
e) 223

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45. Determine the value of ΔG° (kJ) for the following reaction using data from the table below.



Substance	ΔG_f° (kJ/mol)
$\text{H}_2\text{O}(g)$	-228
$\text{H}_2\text{O}_2(g)$	-105

- a) -246
b) 666
c) 246
d) -666
e) More data are needed.
46. Consider the reaction: $\text{Ag}^+(aq) + \text{Cl}^-(aq) \rightarrow \text{AgCl}(s)$
Given the following table of thermodynamic data,

substance	ΔH_f°	S°
$\text{Ag}^+(aq)$	105.90 kJ/mol	73.93 J/mol-K
$\text{Cl}^-(aq)$	-167.2	56.5
$\text{AgCl}(s)$	-127.0	96.11

determine the value of ΔG° (in kJ/mol) for the reaction at 25°C.

- a) 1.02×10^4
b) 150.5
c) -55.5
d) -37.6
e) -104
47. Consider the following reaction.
- $$\text{A} + \text{B} \rightarrow \text{C}$$
- This reaction will always be spontaneous if ΔH is _____ and ΔS is _____.
- a) +, +
b) -, -
c) -, +
d) +, -
e) +, 0
48. The equilibrium constant for a reaction is 0.48 at 25°C. What is the value of ΔG° (kJ) at this temperature? ($R = 8.314 \text{ J/K}\cdot\text{mol}$)
- a) 1.8
b) -4.2
c) 1.5×10^2
d) 4.2
e) More information is needed.

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1. b	Chapter: 11	QUESTION: 9
2. d	Chapter: 11	QUESTION: 10
3. c	Chapter: 11	QUESTION: 27
4. b	Chapter: 11	QUESTION: 50
5. a	Chapter: 11	QUESTION: 74
6. b	Chapter: 13	QUESTION: 71
7. d	Chapter: 13	QUESTION: 91
8. a	Chapter: 14	QUESTION: 3
9. b	Chapter: 14	QUESTION: 29
10. d	Chapter: 14	QUESTION: 42
11. e	Chapter: 14	QUESTION: 45
12. a	Chapter: 14	QUESTION: 46
13. d	Chapter: 14	QUESTION: 78
14. b	Chapter: 15	QUESTION: 24
15. c	Chapter: 15	QUESTION: 31
16. a	Chapter: 15	QUESTION: 61

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17. b

Chapter: 15 QUESTION: 67

18. b

Chapter: 15 QUESTION: 74

19. a

Chapter: 16 QUESTION: 18

20. c

Chapter: 16 QUESTION: 23

21. b

Chapter: 16 QUESTION: 30

22. c

Chapter: 16 QUESTION: 40

23. c

Chapter: 16 QUESTION: 47

24. a

Chapter: 16 QUESTION: 58

25. b

Chapter: 16 QUESTION: 60

26. c

Chapter: 16 QUESTION: 67

27. b

Chapter: 16 QUESTION: 87

28. c

Chapter: 16 QUESTION: 97

29. d

Chapter: 17 QUESTION: 14

30. c

Chapter: 17 QUESTION: 24

31. a

Chapter: 17 QUESTION: 49

32. b

Chapter: 17 QUESTION: 50

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33. d

Chapter: 17 QUESTION: 59

34. c

Chapter: 17 QUESTION: 61

35. c

Chapter: 17 QUESTION: 62

36. e

Chapter: 17 QUESTION: 73

37. e

Chapter: 17 QUESTION: 82

38. a

Chapter: 17 QUESTION: 89

39. c

Chapter: 19 QUESTION: 19

40. d

Chapter: 19 QUESTION: 40

41. a

Chapter: 19 QUESTION: 43

42. c

Chapter: 19 QUESTION: 54

43. a

Chapter: 19 QUESTION: 55

44. d

Chapter: 19 QUESTION: 58

45. c

Chapter: 19 QUESTION: 60

46. c

Chapter: 19 QUESTION: 64

47. c

Chapter: 19 QUESTION: 72

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48. a

Chapter: 19 QUESTION: 83