

CHEM 160-01
Practice Final Exam
(150 points)

Name _____

May 8, 2006

General Instructions

1. The format of this exam is 75 **multiple-choice** questions, **2 points each**. There is only one correct answer to each question. If you make a mistake, completely erase your mistake. If you fail to erase your first answer, you will not receive credit for the problem. NO partial question will be awarded, so there is no penalty for guessing.

2. **Useful constants:**

1 amu	= 1.66054×10^{-27} kg
1 atm	= 760 Torr
	= 760 mm Hg
Boltzmann constant (k)	= 1.38065×10^{-23} J K ⁻¹
Gas constant (R)	= 0.08205 L atm mole ⁻¹ K ⁻¹
	= 8.31447 J mole ⁻¹ K ⁻¹
Avogadro's number (N _a)	= 6.02214×10^{23} mole ⁻¹
Ion Product of Water (K _w)	= 1.000×10^{-14} at 25.0 °C
Faraday constant (F)	= 96,485 C mole ⁻¹
RT/F	= 0.0257 V at 25°C

3. Assume a temperature of 298 K unless otherwise specified.

4. A useful exam strategy is to look over the entire exam briefly when you receive it and to work the problems or questions that you know how to do first. Then go back and try the questions that you are not so certain you know how to work.

5. A periodic table and table of standard reduction potentials are attached to the end of the exam for your reference.

6. Some common ions and their charges are:

F ⁻ , fluoride	S ₂ O ₃ ²⁻ , thiosulfate
Cl ⁻ , chloride	C ₂ O ₄ ²⁻ , oxalate
Br ⁻ , bromide	CN ⁻ , cyanide
I ⁻ , iodide	SCN ⁻ , thiocyanate
NO ₃ ⁻ , nitrate	ClO ₄ ⁻ , perchlorate
NO ₂ ⁻ , nitrite	SO ₃ ²⁻ , sulfite
SO ₄ ²⁻ , sulfate	edta ⁴⁻ , ethylenediaminetetraacetate

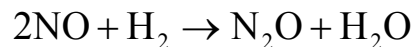
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- Which one of the following substances should exhibit hydrogen bonding in the liquid state?
A. PH_3 B. H_2 C. H_2S D. CH_4 E. NH_3
- Which of the following substances should have the highest boiling point?
A. CH_4 B. Cl_2 C. Kr D. CH_3Cl E. N_2
- Which of the following liquids would have the highest viscosity at 25°C ?
A. CH_3OCH_3
B. CH_2Cl_2
C. $\text{C}_2\text{H}_5\text{OH}$
D. CH_3Br
E. $\text{HOCH}_2\text{CH}_2\text{OH}$
- Which of the following properties indicates the presence of weak intermolecular forces in a liquid?
A. a high heat of vaporization
B. a high critical temperature
C. a high vapor pressure
D. a high boiling point
E. None of the above.

5. Which of the following would be expected to have the lowest vapor pressure at room temperature?
- A. ethanol bp = 78°C
 - B. methanol bp = 65°C
 - C. water bp = 100°C
 - D. acetone bp = 56°C
6. Arrange the following in order of increasing boiling point: RbCl, CH₃Cl, CH₃OH, CH₄.
- A. CH₃OH < CH₃Cl < RbCl < CH₄
 - B. CH₃OH < CH₄ < CH₃Cl < RbCl
 - C. RbCl < CH₃Cl < CH₃OH < CH₄
 - D. CH₄ < CH₃OH < CH₃Cl < RbCl
 - E. CH₄ < CH₃Cl < CH₃OH < RbCl
7. Which of the following atoms does NOT participate in hydrogen bonding?
- A. S
 - B. O
 - C. F
 - D. N
8. The number of atoms in a face-centered cubic unit cell is
- A. 1
 - B. 2
 - C. 3
 - D. 4
 - E. 8
9. A liquid boils when its
- A. vapor pressure is exactly 1 atmosphere.
 - B. vapor pressure is equal to, or greater than, the external pressure pushing on it.
 - C. temperature is equal to 273 K (standard temperature).
 - D. temperature is greater than room temperature.

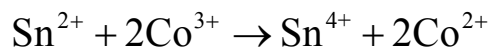
10. The heat capacity for liquid water is $4.18 \text{ J/g}\cdot^\circ\text{C}$ and the heat of vaporization ($\Delta H_{\text{vap}}^\circ$) is 40.7 kJ/mol . How many kilojoules (kJ) of heat must be provided to convert one gram of liquid water at 67°C into one gram of steam at 100°C ?
- A. 22.6 kJ B. 40.8 kJ C. 2.2 kJ D. 2,400 J E. 40.8 J
11. Which of the following is NOT an endothermic process?
- A. melting of a solid
B. vaporization
C. raising the temperature of a gas
D. condensation of water vapor
E. sublimation of dry ice
12. The vapor pressure of ethanol is 400 mmHg at 63.5°C . Its molar heat of vaporization ($\Delta H_{\text{vap}}^\circ$) is 39.3 kJ/mol . What is the vapor pressure of ethanol, in mmHg, at 34.9°C ?
- A. 1,510 mmHg
B. 100 mmHg
C. 200 mmHg
D. 0.0099 mmHg
E. 4.61 mmHg
13. The reaction
- $$\text{A} + 2\text{B} \rightarrow \text{products}$$
- was found to follow the rate law: $\text{rate} = k[\text{A}]^2[\text{B}]$. Predict by what factor the rate of reaction will increase when the concentration of A is doubled and the concentration of B is tripled, and the temperature remains constant.
- A. 5
B. 6
C. 12
D. 18
E. None of the above.

14. Nitric oxide reacts with hydrogen to form nitrous oxide, and water. Use the following data to determine the rate law for the reaction.



<u>Expt. #</u>	<u>[NO]₀</u>	<u>[H₂]₀</u>	<u>Initial rate</u>
1	0.021	0.065	1.46 M/min
2	0.021	0.260	1.46 M/min
3	0.042	0.065	5.84 M/min

- A. rate = $k[\text{NO}]$
B. rate = $k[\text{NO}]^2$
C. rate = $k[\text{NO}][\text{H}_2]$
D. rate = $k[\text{NO}]^2[\text{H}_2]$
E. rate = $k[\text{NO}]^2[\text{H}_2]^2$
15. A certain first-order reaction $\text{A} \rightarrow \text{B}$ is 25% complete in 42 min at 25°C. What is the half-life of the reaction?
- A. 21 min B. 42 min C. 84 min D. 101 min E. 120 min
16. A first-order reaction has a rate constant of $3.0 \times 10^{-3}/\text{s}$. The time required for the reaction to be 75% complete is:
- A. 95.8 s B. 201 s C. 231 s D. 462 s E. 41.7 s
17. The activation energy for the following reaction is 60 kJ/mol.



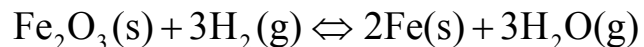
By what factor (how many times) will the rate constant increase when the temperature is raised from 10°C to 28°C?

- A. 1.002 B. 4.6 C. 5.6 D. 2.8 E. 696

18. When the concentrations of reactant molecules are increased, the rate of reaction increases. The best explanation is: As the reactant concentration increases;

- A. the average kinetic energy of molecules increases.
- B. the frequency of molecular collisions increases.
- C. the rate constant increases.
- D. the activation energy increases.
- E. the order of reaction increases.

19. Which is the correct equilibrium constant expression for the following reaction?



- A. $K_c = \frac{[\text{Fe}_2\text{O}_3][\text{H}_2]^3}{[\text{Fe}]^2[\text{H}_2\text{O}]^3}$ B. $K_c = \frac{[\text{H}_2]}{[\text{H}_2\text{O}]}$ C. $K_c = \frac{[\text{H}_2]^3}{[\text{H}_2\text{O}]^3}$
- D. $K_c = \frac{[\text{Fe}]^2[\text{H}_2\text{O}]^3}{[\text{Fe}_2\text{O}_3][\text{H}_2]^3}$ E. $K_c = \frac{[\text{Fe}][\text{H}_2\text{O}]}{[\text{Fe}_2\text{O}_3][\text{H}_2]}$

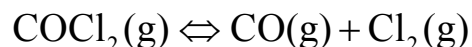
20. Which of the following is a true statement about chemical equilibria in general?

- A. At equilibrium, the total concentration of products equals the total concentration of reactants, that is $[\text{products}] = [\text{reactants}]$.
- B. Equilibrium is the result of the cessation of all chemical change.
- C. There is only one set of equilibrium concentrations that equals the K_c value.
- D. At equilibrium, the rate constant of the forward reaction is equal to the rate constant for the reverse reaction.
- E. At equilibrium, the rate of the forward reaction is equal to as the rate of the reverse reaction.

21. 1.25 moles of NOCl were placed in a 2.50 L reaction chamber at 427°C. After equilibrium was reached, 1.10 moles of NOCl remained. Calculate the equilibrium constant, K_c , for the reaction:

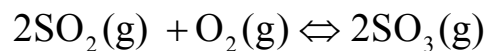


- A. 3.0×10^{-4} B. 1.8×10^3 C. 1.4×10^{-3} D. 5.6×10^{-4} E. 4.1×10^{-3}
22. Phosgene, COCl_2 , a poisonous gas, decomposes according to the equation:



Calculate K_p for this reaction if $K_c = 0.083$ at 900°C.

- A. 0.125 B. 8.0 C. 6.1 D. 0.16 E. 0.083
23. At 700 K, the reaction



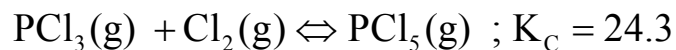
has an equilibrium constant $K_c = 4.3 \times 10^6$, and the following concentrations are present:

$[\text{SO}_2] = 0.10 \text{ M}$; $[\text{SO}_3] = 10 \text{ M}$; $[\text{O}_2] = 0.10 \text{ M}$.

Is the mixture at equilibrium? If not at equilibrium, in which direction, left to right, or right to left, will reaction occur to reach equilibrium?

- A. yes, the mixture is at equilibrium.
B. no, left to right
C. no, right to left
D. There is not enough information to tell.

24. For the reaction



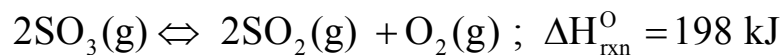
a system is prepared with:

$$[\text{PCl}_3] = 0.10 \text{ M} \quad [\text{Cl}_2] = 0.15 \text{ M} \quad [\text{PCl}_5] = 0.60 \text{ M}.$$

Which response is correct? The reaction

- A. is at equilibrium.
- B. will form more PCl_5 until equilibrium is reached.
- C. will form PCl_3 and Cl_2 until equilibrium is reached.
- D. None of the above.

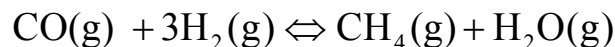
25. For the following reaction at equilibrium



if we increase the reaction temperature, the equilibrium will

- A. shift to the right.
- B. shift to the left.
- C. stay the same.
- D. The question cannot be answered because K_{eq} is not given.

26. Which of the following will result if some $\text{CH}_4(\text{g})$ is removed from the following reaction system at equilibrium?



- A. H_2O will be consumed.
 - B. More CH_4 and H_2O will be produced.
 - C. K_p will decrease.
 - D. More CO will be produced.
 - E. No change will occur.
27. Consider the following gas phase equilibrium system:



Which of the following statements is false?

- A. Increasing the concentration of $\text{PCl}_5(\text{g})$ shifts the equilibrium to the right.
 - B. Increasing the temperature shifts the equilibrium to the right.
 - C. A catalyst speeds up the approach to equilibrium and shifts the position of equilibrium to the right.
 - D. Decreasing the total pressure of the system shifts the equilibrium to the right.
 - E. Increasing the temperature causes the equilibrium constant to increase.
28. Which one of the following statements about strong acids is true?
- A. All strong acids have H atoms bonded to electronegative oxygen atoms.
 - B. Strong acids are 100% ionized in water.
 - C. The conjugate base of a strong acid is itself a strong base.
 - D. Strong acids are very concentrated acids.
 - E. Strong acids produce solutions with a higher pH than weak acids.

29. A Brønsted-Lowry base is defined as a substance that _____.

- A. tastes bitter
- B. increases $[\text{OH}^-]$ when placed in H_2O
- C. acts as a proton donor
- D. acts as an electron pair donor
- E. acts as a proton acceptor

30. A Lewis acid is defined as a substance that _____.

- A. increases $[\text{H}^+]$ when placed in H_2O
- B. tastes sour
- F. acts as an electron pair acceptor
- G. acts as an electron pair donor
- H. acts as a proton donor

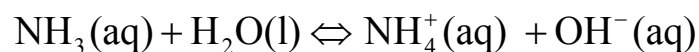
31. The OH^- concentration in $7.5 \times 10^{-3} \text{ M Ca(OH)}_2$ is

- A. $7.50 \times 10^{-3} \text{ M}$.
- B. $1.50 \times 10^{-2} \text{ M}$.
- C. $1.30 \times 10^{-12} \text{ M}$.
- D. $1.00 \times 10^{-7} \text{ M}$.
- E. $1.00 \times 10^{-14} \text{ M}$.

32. What is the H^+ ion concentration in a $4.8 \times 10^{-2} \text{ M KOH}$ solution?

- A. $4.8 \times 10^{-2} \text{ M}$
- B. $1.0 \times 10^{-7} \text{ M}$
- C. $4.8 \times 10^{-11} \text{ M}$
- D. $4.8 \times 10^{-12} \text{ M}$
- E. $2.1 \times 10^{-13} \text{ M}$

33. The pH of a 0.55M aqueous solution of hypobromous acid (**a weak acid**), HBrO, at 25 °C is 4.48. What is the value of K_a for HBrO?
- A. 6.0×10^{-5}
B. 3.0×10^4
C. 1.1×10^{-9}
D. 2.0×10^{-9}
E. 3.3×10^{-5}
34. Consider a weak acid CH₃COOH (acetic acid). Given that a 0.048 M CH₃COOH solution is 5.2% ionized, determine the [H₃O⁺] concentration at equilibrium.
- A. 0.25 M
B. 9.2×10^{-3} M
C. 0.048 M
D. 0.052 M
E. 2.5×10^{-3} M
35. A 0.10 M NH₃ solution is 1.3% ionized. Calculate the H⁺ ion concentration.



- A. 1.3×10^{-3} M
B. 7.7×10^{-2} M
C. 7.7×10^{-14} M
D. 0.13 M
E. 0.10 M
36. Determine the pH of a KOH solution made from 0.251 g KOH and enough water to make 100.0 mL of solution.
- A. 1.35 B. 2.35 C. 7.00 D. 11.65 E. 12.65

37. Calculate the H^+ ion concentration in lemon juice of $\text{pH} = 2.4$.
- A. $4.0 \times 10^{-2} \text{ M}$
 - B. 250 M
 - C. 0.38 M
 - D. $4.0 \times 10^{-3} \text{ M}$
 - E. 11.6 M
38. What is the pH of 10.0 mL of 0.0020 M HCl ?
- A. 0.70
 - B. 2.70
 - C. 3.70
 - D. 5.70
 - E. 10.0
39. What is the pH of 0.014 M Ca(OH)_2 solution?
- A. 1.85
 - B. 1.55
 - C. 12.15
 - D. 12.45
 - E. 15.85
40. The pH of tomato juice is about 4.5. Calculate the molar concentration of hydroxide ions.
- A. $3.2 \times 10^{-10} \text{ M}$
 - B. $3.2 \times 10^{-5} \text{ M}$
 - C. $5.0 \times 10^{-4} \text{ M}$
 - D. 4.5 M
 - E. $3.2 \times 10^{10} \text{ M}$
41. The pH of coffee is approximately 5.0. How many times greater is the $[\text{H}^+]$ in coffee than in neutral water?
- A. 200
 - B. 100
 - C. 5.0
 - D. 1.4
 - E. 0.01

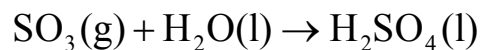
42. What is the pH of a solution prepared by mixing 10.0 mL of a strong acid solution with pH = 2.00 and 10.0 mL of a strong acid solution with pH = 6.00?
- A. 2.0 B. 2.3 C. 4.0 D. 6.0 E. 8.0
43. Which solution will have the lowest pH?
- A. 0.10 MHCN
B. 0.10 MHNO₃
C. 0.10 MNaCl
D. 0.10 MH₂CO₃
E. 0.10 MNaOH
43. Which one of the following salts will form a neutral solution on dissolving in water?
- A. NaCl
B. KNO₂
C. NaCN
D. NH₄NO₃
E. FeCl₃
45. Which one of the following salts will form a basic solution on dissolving in water?
- A. NaCl
B. KCN
C. NaNO₃
D. NH₄NO₃
E. FeCl₃
46. What is the pH of a 0.20M solution of NH₄Cl? Given $K_b(\text{NH}_3) = 1.8 \times 10^{-5}$.
- A. 3.74 B. 4.98 C. 6.53 D. 9.02 E. 10.25

47. Which one of the following salts will form an acidic solution on dissolving in water?
- A. LiBr B. NaF C. KOH D. FeCl₃ E. NaCN
48. Which one of the following is a buffer solution?
- A. 0.40 M HCN and 0.10 M KCN
B. 0.20 M CH₃COOH
C. 1.0 M HNO₃ and 1.0 M NaNO₃
D. 0.10 M KCN
E. 0.50 M HCl and 0.10 M NaCl
49. Which of the following is the most acidic solution?
- A. 0.10 M CH₃COOH and 0.10 M CH₃COONa
B. 0.10 M CH₃COOH
C. 0.10 M HNO₂
D. 0.10 M HNO₂ and 0.10 M NaNO₂
E. 0.10 M CH₃COONa
50. Calculate the pH of a buffer solution that contains 0.25 M benzoic acid (C₆H₅CO₂H) and 0.15 M sodium benzoate (C₆H₅COONa). Given $K_a = 6.5 \times 10^{-5}$ for benzoic acid.
- A. 3.97 B. 4.83 C. 4.19 D. 3.40 E. 4.41
51. Consider a buffer solution prepared from HOCl and NaOCl. Which is the net ionic equation for the reaction that occurs when NaOH is added to this buffer?
- A. $\text{OH}^- + \text{HOCl} \rightarrow \text{H}_2\text{O} + \text{OCl}^-$
B. $\text{OH}^- + \text{OCl}^- \rightarrow \text{HOCl} + \text{O}^{2-}$
C. $\text{Na}^+ + \text{HOCl} \rightarrow \text{NaCl} + \text{OH}^-$
D. $\text{H}^+ + \text{HOCl} \rightarrow \text{H}_2 + \text{OCl}^-$
E. $\text{NaOH} + \text{HOCl} \rightarrow \text{H}_2\text{O} + \text{NaCl}$

52. 50.00 mL of 0.10 M HNO_2 (nitrous acid) was titrated with 0.10 M KOH solution. After 25.00 mL of KOH solution was added, the pH in the titration flask will be (Given $K_a = 4.5 \times 10^{-4}$ for HNO_2)
- A. 2.17 B. 3.35 C. 2.41 D. 1.48 E. 7.00
53. The solubility of lead iodide is 0.064 g/100 mL at 20°C. What is the solubility product (K_{sp}) for PbI_2 ?
- A. 1.1×10^{-8} B. 3.9×10^{-6} C. 1.1×10^{-11} D. 2.7×10^{-12} E. 1.4×10^{-3}
54. The K_{sp} for Ag_3PO_4 is 1.8×10^{-18} . Calculate the molar solubility of Ag_3PO_4 .
- A. 1.6×10^{-5} M
B. 2.1×10^{-5} M
C. 3.7×10^{-5} M
D. 7.2×10^{-1} M
E. 1.8×10^{-1} M
55. The K_{sp} for Ag_3PO_4 is 1.8×10^{-18} . Determine the Ag^+ ion concentration in a saturated solution of Ag_3PO_4 .
- A. 1.6×10^{-5} M
B. 2.1×10^{-5} M
C. 3.7×10^{-5} M
D. 1.1×10^{-13} M
E. 4.8×10^{-5} M

56. Calculate the minimum concentration of Cr^{3+} that must be added to 0.095 M NaF solution in order to initiate a precipitate of chromium (III) fluoride. For CrF_3 , $K_{\text{sp}} = 6.6 \times 10^{-11}$
- A. 0.023 M
 - B. 0.032 M
 - C. 7.7×10^{-8} M
 - D. 2.9×10^{-9} M
 - E. 6.9×10^{-10} M
57. Silver chloride ($\text{AgCl}(\text{s})$) will be most soluble in a solution of:
- A. 0.10 M AgNO_3
 - B. distilled water
 - C. 0.10 M NaCl
 - D. 0.10 M HCl
 - E. 0.10 M aqueous NH_3
58. Which of the following species has the highest entropy (S°) at 25°C?
- A. $\text{CH}_3\text{OH}(\text{l})$
 - B. $\text{CO}(\text{g})$
 - C. $\text{MgCO}_3(\text{s})$
 - D. $\text{H}_2\text{O}(\text{l})$
 - E. $\text{Ni}(\text{s})$

59. Determine ΔS° for the following reaction.

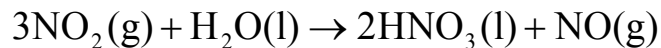


Given the following absolute entropies;

	<u>$S^\circ(\text{J/K}\cdot\text{mol})$</u>
SO_3	256.2
H_2O	69.9
H_2SO_4	156.9

- A. $\Delta S^\circ = 169.3 \text{ J/K}$
B. $\Delta S^\circ = 1343.2 \text{ J/K}$
C. $\Delta S^\circ = -169.3 \text{ J/K}$
D. $\Delta S^\circ = -29.4 \text{ J/K}$
E. $\Delta S^\circ = 29.4 \text{ J/K}$
60. The entropy change on vaporization (ΔS_{vap}) of a compound or element is
- A. always negative.
B. always positive.
C. sometimes is positive and sometimes is negative.
D. usually zero.
61. A negative sign for ΔG indicates that, at constant T and P,
- A. the reaction is exothermic.
B. the reaction is endothermic.
C. the reaction is fast.
D. the reaction is spontaneous.
E. ΔS must be > 0 .

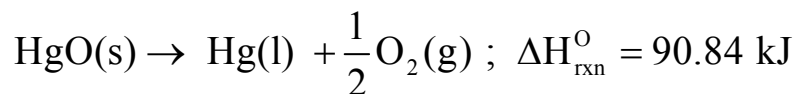
62. Calculate ΔG° for the following reaction



Given the following free energies of formation

	<u>$\Delta G^\circ_f(\text{kJ/mol})$</u>
$\text{H}_2\text{O}(\text{l})$	-237.2
$\text{HNO}_3(\text{l})$	-79.9
$\text{NO}(\text{g})$	86.7
$\text{NO}_2(\text{g})$	51.8

- A. 8.7 kJ B. 192 kJ C. -414 kJ D. -192 kJ E. -155 kJ
63. Hydrogen iodide (HI) has a normal boiling point of -35.4°C , and its ΔH_{vap} is 21.16 kJ/mol. Calculate the molar entropy of vaporization (ΔS_{vap}).
- A. 598 J/K•mol
B. 68.6 J/K•mol
C. 75.2 J/K•mol
D. 0.068 J/K•mol
E. 89.0 J/K•mol
64. The element oxygen was prepared by Joseph Priestley in 1774 by heating mercury(II) oxide.

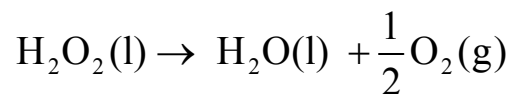


Use the data given below to estimate the temperature at which this reaction will become spontaneous under standard state conditions.

$$\begin{aligned} S^\circ(\text{Hg}) &= 76.02 \text{ J/K}\cdot\text{mol} \\ S^\circ(\text{O}_2) &= 205.0 \text{ J/K}\cdot\text{mol} \\ S^\circ(\text{HgO}) &= 70.29 \text{ J/K}\cdot\text{mol} \end{aligned}$$

- A. 108 K B. 430 K C. 620 K D. 775 K E. 840 K

65. Hydrogen peroxide (H_2O_2) decomposes according to the equation:



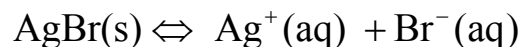
From the following data calculate K_p for this reaction at 25°C .

$$\Delta H^\circ = -98.2 \text{ kJ}$$

$$\Delta S^\circ = 70.1 \text{ J/K}$$

- A. 1.3×10^{-21}
- B. 20.9
- C. 3.46×10^{17}
- D. 7.7×10^{20}
- E. 8.6×10^4

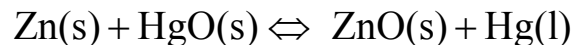
66. The equilibrium constant for the reaction:



is the solubility product constant, $K_{\text{sp}} = 7.7 \times 10^{-13}$ at 25°C . Calculate ΔG for the reaction when $[\text{Ag}^+] = 1.0 \times 10^{-2} \text{ M}$ and $[\text{Br}^-] = 1.0 \times 10^{-3} \text{ M}$. Is the reaction spontaneous or nonspontaneous at these concentrations?

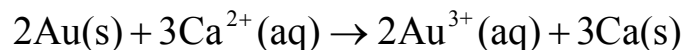
- A. $\Delta G = 69.1 \text{ kJ}$, nonspontaneous
- B. $\Delta G = -69.1 \text{ kJ}$, spontaneous
- C. $\Delta G = 97.5 \text{ kJ}$, spontaneous
- D. $\Delta G = 40.6 \text{ kJ}$, nonspontaneous
- E. $\Delta G = -97.5 \text{ kJ}$, nonspontaneous

67. A certain electrochemical cell has for its cell reaction:



Which is the half-reaction occurring at the anode?

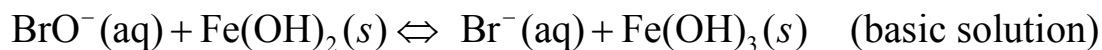
- A. $\text{Hg}^{2+} + 2e^{-} \rightarrow \text{Hg(l)}$
B. $\text{Zn}^{2+} + 2e^{-} \rightarrow \text{Zn(s)}$
C. $\text{Zn(s)} \rightarrow \text{Zn}^{2+} + 2e^{-}$
D. $\text{Hg(l)} \rightarrow \text{Hg}^{2+} + 2e^{-}$
68. Calculate the value of E°_{cell} for the following reaction:



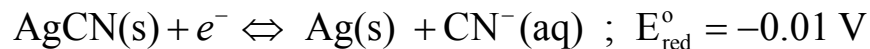
- A. -4.37 V B. -1.37 V C. -11.6 V D. 1.37 V E. 4.37 V
69. Which of the following reactions will occur spontaneously?
- A. $\text{Mg}^{2+}(\text{aq}) + \text{Ca(s)} \rightarrow \text{Mg(s)} + \text{Ca}^{2+}(\text{aq})$
B. $\text{Au(s)} + 3\text{K}^{+}(\text{aq}) \rightarrow \text{Au}^{3+}(\text{aq}) + 3\text{K(s)}$
C. $2\text{Al}^{3+}(\text{aq}) + 3\text{Fe(s)} \rightarrow 2\text{Al(s)} + 3\text{Fe}^{2+}(\text{aq})$
D. $\text{Cu(s)} + 2\text{H}^{+}(\text{aq}) \rightarrow \text{Cu}^{2+}(\text{aq}) + \text{H}_2(\text{g})$
70. Which of the following reagents is the strongest reducing agent?

- A. Cr^{3+} B. Cr C. Mn^{2+} D. Co E. MnO_4^{-}

71. Which one of the following reagents is capable of transforming Cu^{2+} to $\text{Cu}(s)$?
- A. $\text{I}^{-}(\text{aq})$ B. $\text{Ni}(s)$ C. $\text{Al}^{3+}(\text{aq})$ D. $\text{F}^{-}(\text{aq})$ E. $\text{Ag}(s)$
72. Which of the following species is the strongest oxidizing agent under standard state conditions?
- A. $\text{Ag}^{+}(\text{aq})$ B. $\text{H}_2(\text{g})$ C. $\text{H}^{+}(\text{aq})$ D. $\text{Cl}_2(\text{g})$ E. $\text{Al}^{3+}(\text{aq})$
73. What is the coefficient of the bromide ion when the following redox equation is balanced?



- A. 5
B. 3
C. 1
D. 2
E. 4
74. Given the following standard reduction potentials



Calculate the solubility product (K_{sp}) of $\text{AgCN}(s)$ at 25°C .

- A. 4.3×10^{-14}
B. 2.3×10^{13}
C. 2.0×10^{-14}
D. 5.1×10^{13}
E. None of the above.

75. The measured voltage of a cell in which the following reaction occurs is 0.96 V.



Calculate the pH of the $\text{H}^+(\text{aq})$ solution.

A. 1.4

B. 2.7

C. 5.4

D. 7.1

E. 14.9