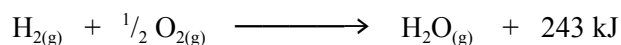


# SCH4U: EXAM · REVIEW

SCH4U\_08 - 09

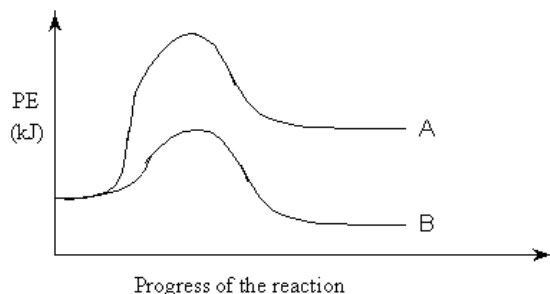
- The heat of a reaction is equal to:
  - enthalpy (products) + enthalpy (reactants)
  - enthalpy (reactants) – enthalpy (products)
  - enthalpy (products) – enthalpy (reactants)
  - sum of all internal molecular energies
- Which of the following has a standard enthalpy of formation of 0 kJ mol<sup>-1</sup> at 25°C and 1.00 atm?
 

(a) C<sub>(g)</sub>                      (b) O<sub>(g)</sub>                      (c) Fe<sub>(l)</sub>                      (d) H<sub>2(g)</sub>                      (e) Ne<sub>(l)</sub>
- Consider the following equation for the combustion of hydrogen:



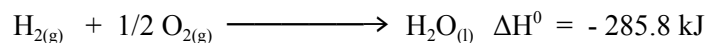
In order to produce 1215 kJ of heat, how many grams of H<sub>2</sub> must burn?

- 12.0 g
  - 0.100 g
  - 10.0 g
  - 0.250 g
  - 8.00 g
- Consider the following potential energy diagram that represents two different reaction



Which of the following statements is correct?

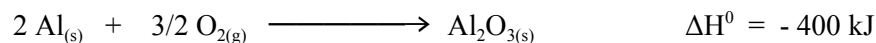
- Reactions A and B are both exothermic.
  - Reactions A and B are both endothermic.
  - Reactions A is exothermic and reaction B is endothermic.
  - Reactions A is endothermic and reaction B is exothermic.
- Given the following thermochemical equation:



How much heat is evolved when 100.0 g of H<sub>2</sub>O<sub>(l)</sub> are formed from the combustion of hydrogen gas and oxygen gas?

- 51.44
- 285 kJ
- 1587 kJ
- 2297 kJ

6. Given the following thermochemical equation:



- a. + 200 kJ                      b. + 400 kJ                      c. - 400 kJ                      d. + 800 kJ
7. Which one of the following equation represents the **standard enthalpy of formation** of nickel (II) carbonate,  $\text{NiCO}_3$ :
- a.  $\text{Ni}_{(s)} + \text{C}_{(g)} + 3/2 \text{O}_{2(g)} \longrightarrow \text{NiCO}_{3(s)}$   
 b.  $\text{Ni}_{(s)} + \text{C}_{(s)} + 3/2 \text{O}_{2(g)} \longrightarrow \text{NiCO}_{3(s)}$   
 c.  $2 \text{Ni}_{(s)} + 2\text{C}_{(s)} + 3\text{O}_{2(g)} \longrightarrow 2 \text{NiCO}_{3(s)}$   
 d.  $\text{Ni}_{(s)} + \text{CO}_3^{-2}{}_{(aq)} \longrightarrow \text{NiCO}_{3(s)}$
8. The heats of formation of  $\text{NO}_2$  and  $\text{N}_2\text{O}_4$  are +33.2 and +9.2  $\text{kJ mol}^{-1}$  respectively. Calculate the enthalpy change for the reaction:



- A. -57.2 kJ                      B. -24.0 kJ                      C. 41.4 kJ                      D. 75.6 kJ
9. Which equation represents the bond enthalpy for the H-F bond?
- a)  $\text{HF}_{(g)} \longrightarrow \text{H}_{(g)} + \text{F}_{(g)}$   
 b)  $\text{HF}_{(g)} \longrightarrow \frac{1}{2} \text{H}_{2(g)} + \frac{1}{2} \text{F}_{2(g)}$   
 c)  $\text{HF}_{(aq)} \longrightarrow \text{H}_{(aq)}^{+1} + \text{F}_{(aq)}^{-1}$   
 d)  $\text{HF}_{(g)} \longrightarrow \text{H}_{(g)}^{+1} + \text{F}_{(g)}^{-1}$
10. Which of the following species has the highest entropy,  $S^\circ$  at 25  $^\circ\text{C}$  ?
- A.  $\text{C}_3\text{H}_{8(g)}$                       B.  $\text{C}_2\text{H}_{4(g)}$                       C.  $\text{Zn}_{(s)}$                       D.  $\text{SiF}_{4(g)}$
11. Which one of the following processes would be expected to have a value of  $\Delta S^\circ$  closest to zero?
- A.  $\text{H}_{2(g)} + \text{F}_{2(g)} \longrightarrow 2\text{HF}_{(g)}$                       B.  $\text{C}_2\text{H}_{4(g)} + \text{HBr}_{(g)} \longrightarrow \text{C}_2\text{H}_5\text{Br}_{(g)}$   
 C.  $\text{CO}_{2(g)} \longrightarrow \text{CO}_{(g)} + 1/2 \text{O}_{2(g)}$                       D.  $2\text{NO}_{2(g)} \longrightarrow 2\text{NO}_{(g)} + \text{O}_{2(g)}$
12. What is true about the signs of  $\Delta H$  and  $\Delta S$  for a reaction that is spontaneous at low temperatures but becomes non-spontaneous at higher temperatures?

	$\Delta H$	$\Delta S$
A.	-	-
B.	-	+
C.	+	+
D.	+	-

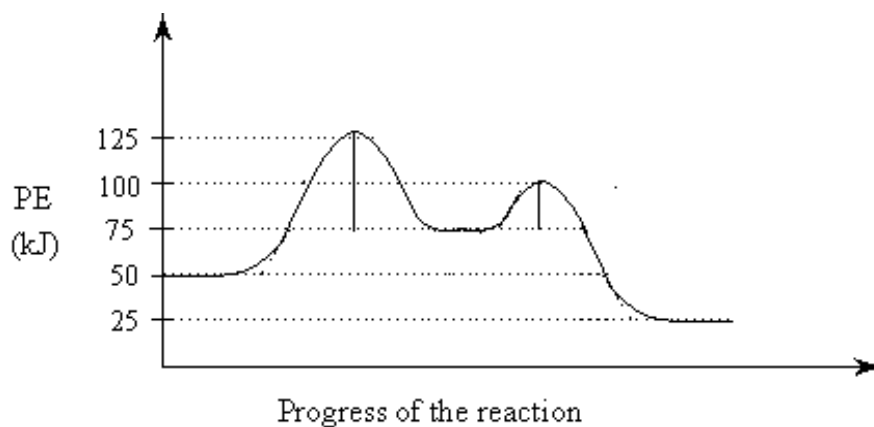
13. Which of the following combinations of enthalpy change,  $\Delta H$ , entropy change,  $\Delta S$ , and Gibbs Free energy change,  $\Delta G$  would **always** give a spontaneous reaction?

	$\Delta H$	$\Delta S$	$\Delta G$
A.	increased	increased	+
B.	increased	decreased	-
C.	decreased	decreased	+
D.	decreased	increased	-

14. In which of the following does the entropy decrease ?

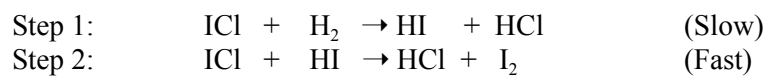
- A.  $\text{NaCl(s)} \rightarrow \text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq})$   
 B.  $4 \text{NO(g)} + 6 \text{H}_2\text{O(g)} \rightarrow 4 \text{NH}_3(\text{g}) + 5 \text{O}_2(\text{g})$   
 C.  $2 \text{NaHCO}_3(\text{s}) \rightarrow \text{Na}_2\text{CO}_3(\text{s}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O(g)}$   
 D.  $\text{CaCO}_3(\text{s}) + 2 \text{HCl(aq)} \rightarrow \text{CaCl}_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O(l)}$

15. Consider the following potential energy diagram.



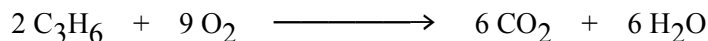
The activation energy for the **forward** reaction is:

- A. 25 kJ                      B. 50 kJ                      C. 75 kJ                      D. 125 kJ
16. Consider the following reaction mechanism:



The species HCl is a:

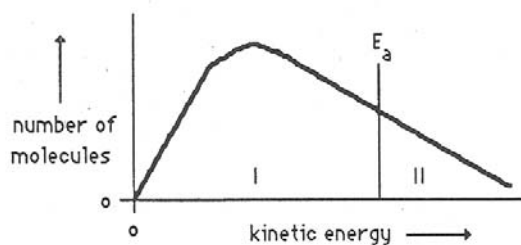
- A. Product                      B. Catalyst                      C. Reactant                      D. Reaction intermediate
17. Consider the reaction:



If the rate of appearance of  $\text{CO}_2$  is 0.40 mol/L/s, the rate of disappearance of  $\text{O}_2$  is:

- a. 0.10 mol/L/s                      b. 0.90 mol/L/s  
 c. 0.60 mol/L/s                      d. 0.30 mol/L/s

18. Consider the following graph of the kinetic energy distribution among molecules at temperature T.



If the temperature were increased how would the resulting graph differ from the one above?

- a. both areas I and II would increase                      b. both areas I and II would decrease  
c. area I would increase and area II would decrease    d. area I would decrease and area II would increase

19. The rate of reaction increases with increasing temperature primarily because:

- a. the activation energy is lowered as the temperature is increased  
b. changing the temperature usually alters the mechanism  
c. the heat of reaction is increased  
d. a greater fraction of the molecules possess the activation energy

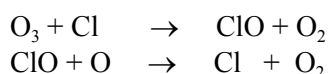
20. A catalyst speeds up a reaction by:

- a. lowering the  $\Delta H$  for the reaction                      b. lowering the activation energy for the reaction  
c. lowering the enthalpy of the reactants                d. raising the enthalpy of the reactants

21. The rate-determining step of a reaction is:

- a. always the slowest step                                      b. always the fastest step  
c. always the first step in a reaction mechanism  
d. always the step with the lowest activation energy

22. Which species might be behaving as a catalyst based on the equations below?



- A.  $\text{O}_2$                       B. Cl                      C. ClO                      D. O

23. Which of the following can be used to determine the order of a reaction?

- I. Studies of reaction rate as a function of reactant concentration  
II. Consideration of the balanced equation for the reaction  
III. Knowledge of the activation energy for the reaction

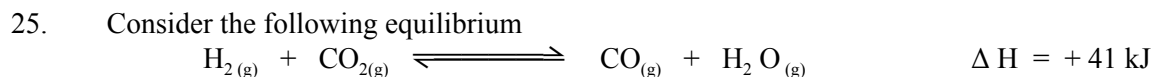
- A. I only                      B. II only                      C. Either I or II                      D. I, II or III

24. The rate equation for the reaction between  $\text{O}_2$  and NO is:  $\text{O}_2$

$$\text{Rate} = k [\text{O}_2] [\text{NO}]^2$$

By what factor would the rate of this reaction increase if the concentrations of  $\text{O}_2$  and NO are both doubled?

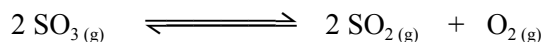
- A. 1/8                      B. 3                      C. 4                      D. 8



The temperature of the above equilibrium system is increased while kept at a constant volume. A new state of equilibrium is established in which there is:

- An increase in [CO] and a decrease in  $K_{\text{eq}}$
- An increase in [CO] and a increase in  $K_{\text{eq}}$
- An increase in [CO<sub>2</sub>] and a decrease in  $K_{\text{eq}}$
- An increase in [CO<sub>2</sub>] and a increase in  $K_{\text{eq}}$

26. Consider the following equilibrium:



The volume of the system is decreased at a constant temperature. A new state of equilibrium is established by a shift of the original equilibrium to the:

- Left and [SO<sub>3</sub>] increases.
- Right and [SO<sub>3</sub>] decreases.
- Left and [SO<sub>3</sub>] remains unchanged.
- Right and [SO<sub>3</sub>] remains unchanged.

27. Consider the following equilibrium:



At equilibrium, [H<sub>2</sub>S] = 0.50 mol/L, [H<sub>2</sub>] = 0.10 mol/L and [S<sub>2</sub>] = 0.40 mol/L. The value of  $K_{\text{eq}}$  is calculated using the ratio:

A.  $\frac{(0.10)(0.40)}{(0.50)}$

B.  $\frac{(0.10)^2(0.40)}{(0.50)^2}$

C.  $\frac{(0.50)}{(0.10)(0.40)}$

D.  $\frac{(0.50)^2}{(0.10)^2(0.40)}$

28. Consider the following equilibrium



The equilibrium constant expression for the above system is:

A.  $K_{eq} = [\text{H}^+][\text{I}^-]$

B.  $K_{eq} = [\text{H}^+][\text{I}^-][\text{HOI}]$

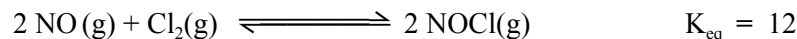
C.  $K_{eq} = \frac{[\text{H}^+][\text{I}^-][\text{HOI}]}{[\text{I}_2][\text{H}_2\text{O}]}$

D.  $K_{eq} = \frac{[\text{H}^+][\text{I}^-][\text{HOI}]}{[\text{H}_2\text{O}]}$

29. In an exothermic equilibrium reaction involving only gases, the value of  $K_{eq}$  can be **decreased** by

- A. adding some reactant gas.
- B. Removing some reactant gas.
- C. increasing the temperature.
- D. decreasing the temperature.

30. Consider the following equilibrium:



At equilibrium,  $[\text{NOCl}] = 1.60 \text{ mol/L}$  and  $[\text{NO}] = 0.80 \text{ mol/L}$ . The  $[\text{Cl}_2]$  is:

- A. 0.17 mol/L      B. 0.27 mol/L      C. 0.33 mol/L      D. 3.0 mol/L

31. The equation represents the equilibrium in a saturated solution of  $\text{Fe}_2(\text{SO}_4)_3$  is:

- A.  $\text{Fe}_2(\text{SO}_4)_3(\text{s}) \rightleftharpoons 3 \text{Fe}^{2+}(\text{aq}) + 2 \text{SO}_4^{3-}(\text{aq})$
- B.  $\text{Fe}_2(\text{SO}_4)_3(\text{s}) \rightleftharpoons 2 \text{Fe}^{2+}(\text{aq}) + 3 \text{SO}_4^{3-}(\text{aq})$
- C.  $\text{Fe}_2(\text{SO}_4)_3(\text{s}) \rightleftharpoons 3 \text{Fe}^{3+}(\text{aq}) + 2 \text{SO}_4^{2-}(\text{aq})$
- D.  $\text{Fe}_2(\text{SO}_4)_3(\text{s}) \rightleftharpoons 2 \text{Fe}^{3+}(\text{aq}) + 3 \text{SO}_4^{2-}(\text{aq})$

32. The solubility of  $\text{SrSO}_4$  at room temperature is  $8.0 \times 10^{-4} \text{ mol/L}$ . The calculated  $K_{sp}$  for  $\text{SrSO}_4$  is

- A.  $6.4 \times 10^{-9}$       B.  $1.6 \times 10^{-7}$       C.  $6.4 \times 10^{-7}$       D.  $4.2 \times 10^{-5}$       E.  $4.0 \times 10^{-4}$

33. The solubility product constant for  $\text{HgS}$  is  $1.0 \times 10^{-20}$ . How many grams of  $\text{HgS}$  will dissolve in 1.0 L at  $25^\circ\text{C}$  :

- A.  $1.0 \times 10^{-10}$       B.  $2.4 \times 10^{-8}$       C.  $2.4 \times 10^{-10}$       D.  $2.4 \times 10^{-12}$

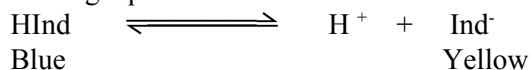
34. The conjugate base of  $\text{H}_2\text{BO}_3^-$  is :

- A.  $\text{BO}_3^{3-}$                       B.  $\text{H}_3\text{BO}_3$                       C.  $\text{HBO}_3^{2-}$                       D.  $\text{H}_3\text{BO}_3^-$

35. Which of the following is the **weakest** acid ?

- A.  $\text{HClO}$                       B.  $\text{HClO}_2$                       C.  $\text{HClO}_3$                       D.  $\text{HClO}_4$

36. Consider the following equilibrium for the indicator bromthymol blue,  $\text{HInd}$  :



A solution of bromthymol blue is yellow. What should a student do to change the colour of the solution to blue?

- A. Add a base to shift the equilibrium left.                      B. Add an acid to shift the equilibrium left.  
C. Add a base to shift the equilibrium right.                      D. Add an acid to shift the equilibrium right.

37. Which of the following is amphiprotic in water?

- A.  $\text{SO}_2$                       B.  $\text{SO}_3^{2-}$                       C.  $\text{HSO}_3^-$                       D.  $\text{H}_2\text{SO}_3$

38. The  $[\text{OH}^-]$  in 0.050 M  $\text{HNO}_3$  at  $25^\circ\text{C}$  is:

- A.  $5.0 \times 10^{-16}$  M                      B.  $1.0 \times 10^{-14}$  M                      C.  $2.0 \times 10^{-13}$  M                      D.  $5.0 \times 10^{-2}$  M

39. Consider the following equilibrium constant expression:

$$K = \frac{[\text{H}_2\text{S}][\text{OH}^-]}{[\text{HS}^-]}$$

- A.  $K_b$  for  $\text{H}_2\text{S}$                       B.  $K_a$  for  $\text{H}_2\text{S}$                       C.  $K_b$  for  $\text{HS}^-$                       D.  $K_a$  for  $\text{HS}^-$

40. Which of the following 0.10 M solutions will be acidic?

- A.  $\text{AlCl}_3$                       B.  $\text{LiCl}$                       C.  $\text{K}_2\text{CO}_3$                       D.  $\text{Na}_3\text{PO}_4$

41. Consider the following data:

Solution	Initial pH	Final pH
1	1.0	4.0
2	2.0	6.0
3	6.0	3.0
4	9.0	3.0

In which solution has the  $[\text{H}_3\text{O}^+]$  increased 1000 times?

- A. 1                      B. 2                      C. 3                      D. 4

42. The pOH of an aqueous solution is equal to:

- A.  $14 + \text{pH}$                       B.  $\text{p}K_w - \text{pH}$                       C.  $-\log \text{p}K_w$                       D.  $-\log [\text{H}_3\text{O}^+]$

43. The reaction of a strong acid with a strong base produces:

- A. A salt and water.                      B. A base and an acid.  
C. A metallic oxide and water.                      D. A non-metallic oxide and water.

44. The stoichiometric point of a titration is reached when 35.50 mL 0.40 M HBr is added to a 25.00 mL sample of LiOH. The original [LiOH] is:

- A. 0.014 M                      B. 0.0224 M                      C. 0.28 M                      D. 0.57 M

45. What is the pH of a solution prepared by adding 0.50 mol KOH to 1.0 L of 0.30 M  $\text{HNO}_3$ ?

- A. 0.20                      B. 0.07                      C. 13.30                      D. 13.80

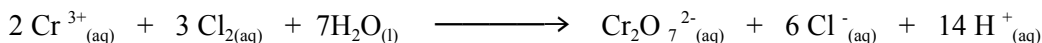
46. A **basic** buffer solution can be prepared by mixing equal numbers of moles of:

- A.  $\text{NH}_4\text{Cl}$  and  $\text{NH}_3$                       B.  $\text{NaCl}$  and  $\text{NaOH}$   
C.  $\text{Na}_2\text{CO}_3$  and  $\text{NaHCO}_3$                       D.  $\text{NaCH}_3\text{COO}$  and  $\text{CH}_3\text{COOH}$

47. The pH range of 'acid rain' is often:

- A. 3 to 6                      B. 6 to 8                      C. 7 to 9                      D. 10 to 12

48. Consider the following redox reaction:



The species which loses electrons is:

- A.  $\text{Cl}_2$                       B.  $\text{Cr}^{3+}$                       C.  $\text{H}_2\text{O}$                       D.  $\text{Cr}_2\text{O}_7^{2-}$

49. The species which gains electrons in a redox reaction:

- A. Loses mass.                      B. Is oxidized.  
C. Is the oxidizing agent.                      D. Increases in oxidation number.

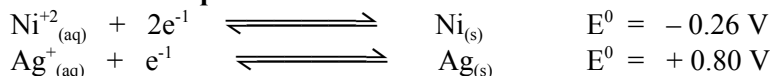
50. The oxidation number of carbon in  $\text{CaC}_2\text{O}_4$  is:

- A. +2                      B. +3                      C. +4                      D. +6

51. When  $\text{MnO}_4^-$  reacts to form  $\text{Mn}^{2+}$ , the manganese in  $\text{MnO}_4^-$  is:

- A. Reduced as its oxidation number increases.                      B. Reduced as its oxidation number decreases.  
C. Oxidized as its oxidation number increases.                      D. Oxidized as its oxidation number decreases.

Use the following data to answer questions 52 to 54:



52. The balanced equation for the overall reaction is

- A.  $\text{Ni}^{+}_{(\text{aq})} + \text{Ag}_{(\text{s})} \rightarrow \text{Ag}^{+}_{(\text{aq})} + \text{Ni}_{(\text{s})}$                       B.  $\text{Ni}_{(\text{s})} + \text{Ag}^{+}_{(\text{aq})} \rightarrow \text{Ag}_{(\text{s})} + \text{Ni}^{+}_{(\text{aq})}$   
C.  $\text{Ni}^{2+}_{(\text{aq})} + 2 \text{Ag}_{(\text{s})} \rightarrow 2 \text{Ag}^{+}_{(\text{aq})} + \text{Ni}_{(\text{s})}$                       D.  $\text{Ni}_{(\text{s})} + 2 \text{Ag}^{+}_{(\text{aq})} \rightarrow 2 \text{Ag}_{(\text{s})} + \text{Ni}^{2+}_{(\text{aq})}$

53. This redox reaction occurs because:

- A.  $\text{Ag}_{(\text{s})}$  is a stronger oxidizing agent than  $\text{Ni}_{(\text{s})}$                       B.  $\text{Ag}_{(\text{s})}$  is a weaker reducing agent than  $\text{Ni}_{(\text{s})}$   
C.  $\text{Ag}^{+}_{(\text{aq})}$  is a stronger reducing agent than  $\text{Ni}^{2+}_{(\text{aq})}$                       D.  $\text{Ag}^{+}_{(\text{aq})}$  is a weaker oxidizing agent than  $\text{Ni}^{2+}_{(\text{aq})}$

54. The initial cell voltage at 25 °C is:

- A. - 1.06 V                      B. - 0.54 V                      C. + 0.54 V                      D. + 1.06 V

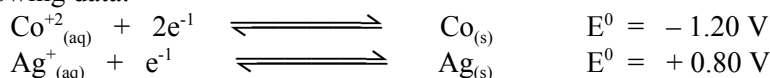
55. In the electrolysis of molten zinc chloride, the half-reaction at the anode is:

- A.  $\text{Cl}_2 + 2 \text{e}^- \rightarrow 2 \text{Cl}^-$                       B.  $2 \text{Cl}^- \rightarrow \text{Cl}_2 + 2 \text{e}^-$   
C.  $\text{Zn}^{2+} + 2 \text{e}^- \rightarrow \text{Zn}$                       D.  $\text{Zn} \rightarrow \text{Zn}^{2+} + 2 \text{e}^-$

56. To plate a nickel coin with copper:

- A. The nickel coin must be the cathode.                      B. The cathode must be made of copper.  
C. The electrons must flow to the anode.                      D. The solution must contain nickel ions.

57. Given the following data:



Predict if the following redox reaction will be:



- A. Spontaneous and  $E^{\circ}$  is positive.                      B. Spontaneous and  $E^{\circ}$  is negative.  
C. Non-spontaneous and  $E^{\circ}$  is positive                      D. Non-spontaneous and  $E^{\circ}$  is negative

58. Which one of the following cations can be easily reduced from an aqueous solution of its salt during electrolysis ?

- A.  $\text{Ba}^{2+}$                       B.  $\text{Al}^{3+}$                       C.  $\text{Sn}^{2+}$                       D.  $\text{Na}^{+}$

59. Which of the following statements about galvanic cells is **incorrect**?

- A. electrons always flow from the anode to the cathode  
B. negative ions within the cell migrate towards the anode  
C. oxidation always occurs at the anode  
D. salt bridges are used to maintain electrical neutrality within the half cells  
E. the  $E^{\circ}$  value of an operating electrochemical cell is negative

60. The half-reaction that occurs at the cathode during electrolysis of aqueous sodium iodide solution is:

- a.  $\text{Na}^{+1} + \text{e}^{-1} \longrightarrow \text{Na}$                       b.  $\text{Na} \longrightarrow \text{Na}^{+1} + \text{e}^{-1}$   
c.  $\text{I}_2 + 2\text{e}^{-1} \longrightarrow 2\text{I}^{-1}$                       d.  $2 \text{H}_2\text{O} + 2\text{e}^{-1} \longrightarrow \text{H}_2 + 2\text{OH}^{-1}$

**This is the end of the multiple-choice section.**  
**Answer the remaining questions in Section B, directly in the spaces provided.**

## PART B: WRITTEN-RESPONSE

**INSTRUCTIONS:** You will be expected to communicate your knowledge and understanding of chemical principles in a clear and logical manners.

- Your steps and assumptions leading to a solution must be written in the spaces below the questions.
- Answers must include units where appropriate and be given to the correct number of significant figures.
- **For questions involving calculation, full marks will NOT be given for providing only an answer.**

**Value : 65 marks**

**Suggested Time: minutes**

1. a) On the graph below, draw the potential energy diagram for a reaction in which the activation energy for the forward reaction is  $155 \text{ kJ mol}^{-1}$  and the activation energy for the reverse reaction is  $195 \text{ kJ mol}^{-1}$ . Is this reaction endothermic or exothermic? Show on the graph the effect of adding a catalyst to this reaction. **(6 mark)**

- b) Define the term *enthalpy of formation*. **(1 mark)**

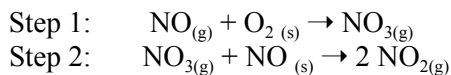
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Score for  
Question 1:  
1. \_\_\_\_\_  
(7)

2. Consider the following reaction mechanism:



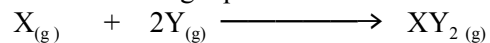
- a) Identify a reaction intermediate. **(1 mark)**

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- b) Write the equation for the overall reaction. **(1 mark)**

Score for  
Question 2:  
2. \_\_\_\_\_  
(2)

3. Two gases react according to the following equation:



Experiments were performed at 500 K in order to determine the order of the reaction, the following results were obtained:

Experiment Number	Initial Concentration of X (mol dm <sup>-3</sup> )	Initial Concentration of Y (mol dm <sup>-3</sup> )	Initial Rate of Formation of XY <sub>2</sub> (mol dm <sup>-3</sup> s <sup>-1</sup> )
1	0.10	0.10	0.0001
2	0.10	0.20	0.0004
3	0.10	0.30	0.0009
4	0.20	0.10	0.0001
5	0.30	0.10	0.0001

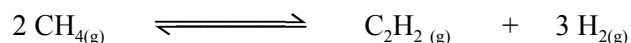
- a. Determine the order of the reaction with respect to X and Y and justify your answer: 2
- (i) X
- (i) Y
- b. Write a rate equation for the reaction between X and Y. 1
- c. Determine the numerical value for the rate constant and determine its units. 3
- d. Using the rate equation predict a possible mechanism for this reaction. 2

**Score for Question 3:**

**3.**

            
**(8)**

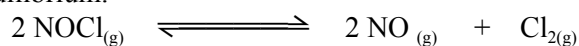
4. Consider the following equilibrium:



A 0.180 mol sample of  $\text{CH}_4$  is added to an empty 1.00 L container at  $800^\circ\text{C}$ . At equilibrium, the  $[\text{C}_2\text{H}_2]$  is 0.0800 mol/L. Calculate the numerical value for the equilibrium constant. **4**

Score for Question 4: 4. _____ (4)
---

5. Consider the following equilibrium:



A chemist places 2.00 mol  $\text{NOCl}$  in a 1.0 L container. Describe the changes **graphically** in  $[\text{NOCl}]$ ,  $[\text{Cl}_2]$  and  $[\text{NO}]$  when the volume of the system is decreased until the system approaches a new equilibrium. **(3 mark)**

Score for Question 5: 5. _____ (3)
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6. A saturated solution of  $\text{BaSO}_4$  is given to patients needing digestive tract x-rays.

1. Write an equation that represents the solubility equilibrium. **1**

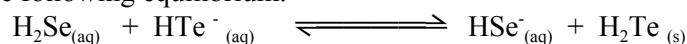
2. Calculate the  $[\text{Ba}^{2+}]$  present in the saturated solution given the  $K_{\text{sp}}$  for  $\text{BaSO}_4$  at  $25^\circ\text{C}$  is  $1.4 \times 10^{-12}$ . **3**

Score for Question 6: 6. _____ 4
---

7. Will a precipitate form when 90.0 mL of  $1.00 \times 10^{-2}$  M  $\text{Cu}(\text{NO}_3)_2$  and 10.0 mL of  $1.00 \times 10^{-2}$  M  $\text{NaIO}_3$  are mixed? Explain using appropriate calculations. ( $K_{\text{sp}} \text{Cu}(\text{IO}_3)_2 = 1.23 \times 10^{-8}$ . 3

Score for Question 7: 7. _____ (3)
---

8. Consider the following equilibrium:



The reactants are favoured in this equilibrium.

1. Identify the stronger acid. \_\_\_\_\_ (1 mark)
2. Identify the weaker base. \_\_\_\_\_ (1 mark)

Score for Question 8: 8. _____ (2)
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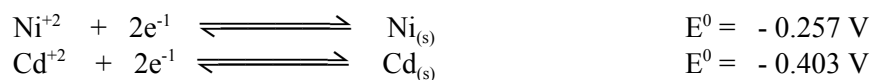
9. The hydrogen carbonate ion,  $\text{HCO}_3^-$ , can act as a weak base. Use calculations to determine the  $K_b$  of a solution containing 0.125 M hydrogen carbonate ion, if it has a pH 4.25.

4

10. (a) Calculate the pH of a 0.212 M solution of vitamin C, ascorbic acid, (use the abbreviation, HAsc), a weak monoprotic acid with a  $K_a = 7.91 \times 10^{-1}$  at  $25^\circ\text{C}$ .

- (b) What is the  $K_b$  for a 0.155 M solution of codeine, weak base which has a pH of 8.25. 4

11. The half cells  $\text{Ni}_{(s)} | \text{Ni}^{2+}_{(aq)}$  and  $\text{Cd}_{(s)} | \text{Cd}^{2+}_{(aq)}$  are assembled into a battery. The reduction potential for the cells are:



- a. Write a balanced equation for the reaction occurring in the cell. 2
- b. What is oxidized and what is reduced? What is the oxidizing agent and what is the reducing agent? 2
- c. Which is the anode and which is the cathode? What is the polarity of the Cd electrode, explain why? 2
- d. What is the  $E^{\circ}$  for the cell? 2
- e. What is the direction of the electron flow in the external wire? 1
- f. If the salt bridge contains  $\text{KNO}_3_{(aq)}$ , towards which compartment will the  $\text{NO}_3^{-1}$  ions migrate? 1
- g. What is the function of the salt bridge? 1
- h. If a piece of Cd metal was placed in a solution of nickel (II) nitrate, what would be observed, justify your answer. 2
- i. What is the cell notation for the Ni and Cd battery? 1

# ANSWER KEY

## Multiple Choice Answers

1	2	3	4	5	6	7	8	9	10
C	D	C	D	C	D	B	A	A	D
11	12	13	14	15	16	17	18	19	20
A	A	D	B	C	A	C	D	D	B
21	22	23	24	25	26	27	28	29	30
A	B	A	D	B	A	B	B	C	C
31	32	33	34	35	36	37	38	39	40
D	C	B	C	A	B	C	C	C	A
41	42	43	44	45	46	47	48	49	50
C	A	A	D	C	A	A	B	C	B
51	52	53	54	55	56	57	58	59	60
B	D	A	D	B	A	D	C	E	D