

Answer Key: SCH4U: Practice Exam

Answers: Multiple Choice

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

Answers: Problems

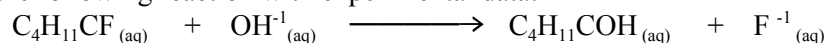
1. For the reaction: $2 \text{N}_2\text{O}_5(\text{g}) \rightarrow 4 \text{NO}_2(\text{g}) + \text{O}_2(\text{g})$ $\Delta H^\circ = +126.4 \text{ kJ}$
- a. Use Table of Standard enthalpies of formation to determine the enthalpy of formation of N_2O_5 .
[$\Delta H^\circ_f(\text{NO}_2) = +33.2 \text{ kJ/mol}$]
- b. State the sign of ΔS and ΔG that you would expect for this reaction.

ANSWER

- a. ΔH°_f , enthalpy of formation of $\text{N}_2\text{O}_5 = +3.2 \text{ kJ mol}^{-1}$
- b. $\Delta S = +$, increasing

$\Delta G =$ spontaneous only at high temperatures, since $\Delta H_{\text{rxn}} = +126.4 \text{ kJ}$ and ΔS is +.

2. Given the following reaction with experimental data:

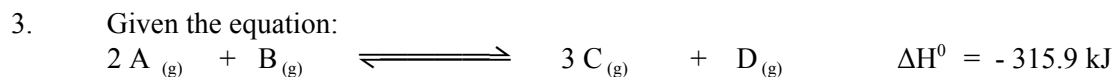


Trial	Initial [C ₄ H ₁₁ CF] (mol/L)	Initial [OH ⁻] (mol/L)	Initial Rate of Formation of F ⁻ (mol/L/s)
1	0.10	0.20	5.5 x 10 ⁻⁴
2	0.20	0.20	1.1 x 10 ⁻³
3	0.10	0.40	5.5 x 10 ⁻⁴

- Determine the order of the reaction with respect to C₄H₁₁CF
- Determine the order of the reaction with respect to OH⁻
- What is the overall order of the reaction ?
- Write the rate law expression for the reaction.
- Determine the value of the rate law constant for the reaction.
- State the molecularity of the reaction.
- State the effect of doubling the concentration of C₄H₁₁CF and the concentration of the OH⁻ on the rate of the reaction.

ANSWER

- Order with respect to C₄H₁₁CF_(aq) = 1
- Order with respect to OH⁻_(aq) = 0
- overall order of the reaction = 1
- rate law expression for the reaction is: $\text{Rate} = k [\text{C}_4\text{H}_{11}\text{CF}_{(\text{aq})}]^1$
- value of the rate law constant, k, for the reaction = 5.0 x 10⁻³ s⁻¹
- molecularity of the reaction = unimolecular
- Rate will double when the concentration of C₄H₁₁CF and the concentration of the OH⁻, since $\text{Rate} = k [\text{C}_4\text{H}_{11}\text{CF}_{(\text{aq})}]^1$, only the concentration of C₄H₁₁CF will have any effect and since it is first order with respect to C₄H₁₁CF, thus the rate will double.



a) Write the equilibrium law expression (K_c) for the above reaction.

b) When equal volumes of A and B are combined in a 3.5 L flask, their initial concentrations were each 1.75 mol/L. Once equilibrium is reached, the equilibrium concentration of C, is $[C] = 0.65 \text{ mol/L}$. Determine the K_c for this reaction.

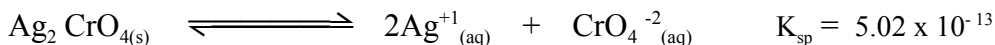
ANSWER

a.
$$K_c = \frac{[C]^3 [D]}{[A]^2 [B]}$$

b.
$$K_c = 0.022$$

4. The solubility product constant (K_{sp}) of $Ag_2CrO_4(s)$, in water is 5.02×10^{-13} at $25^{\circ}C$. What is the solubility of silver chromate (in g/L) at 298 K?

ANSWER



solubility of silver chromate, $Ag_2 CrO_{4(s)} = 1.66 \times 10^{-3} \text{ g/L}$

5. Hypobromous acid, $HOBr_{(aq)}$, has a $K_a = 3.75 \times 10^{-8}$ at a given temperature. Calculate the pH of a 0.225 M solution of hypobromous acid. State clearly any assumptions you have made at arriving your answer.

ANSWER

The pH of a 0.225 M solution of hypobromous acid, $HOBr_{(aq)} = 4.04$

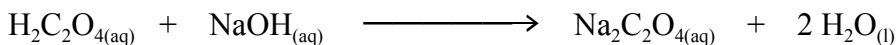
6. A new drug obtained from the seeds of a strange Colombian plant was found to be a weak organic base. A solution of this weak base has a concentration of 0.0100 mol /L, and a pH of 10.8. Determine the K_b for the drug.

ANSWER

K_b for the Colombian drug, a weak base = 3.98×10^{-5}

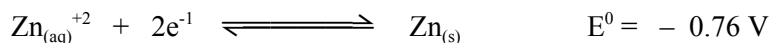
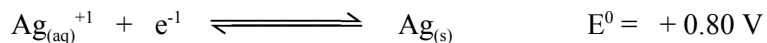
7. Oxalic acid is a diprotic acid. 0.200 g of oxalic acid, $H_2C_2O_4$ was neutralized with 35.5 mL of $NaOH_{(aq)}$. Determine the concentration of the $NaOH_{(aq)}$.

ANSWER



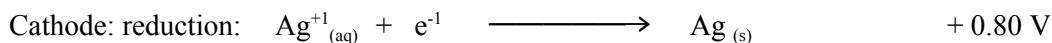
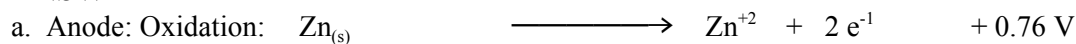
Concentration of the $NaOH_{(aq)} = 0.0313 \text{ mol L}^{-1}$

8. An electrochemical cell consists of a compartment with a zinc electrode in contact with 1.0 mol/L $\text{Zn}(\text{NO}_3)_2$ (aq), and a compartment with a silver electrode in contact with 1.0 mol/L $\text{Ag}(\text{NO}_3)$ (aq). Ammonium nitrate, NH_4NO_3 (aq), is placed in the salt-bridge. The standard reduction potentials are:



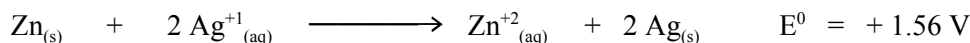
- For the above cell, write the two half-reactions that will occur at each electrode.
- State which of the two metals silver or zinc is acting as the anode and which the cathode and state the polarity of each electrode.
- Write the overall reaction for the cell and calculate the standard cell potential.
- State the direction of the electron flow.
- State the direction of the ion flow in the salt-bridge.
- State the oxidizing agent and state what is oxidized.
- Write the standard cell notation for the spontaneous reaction occurring in the cell.

ANSWER



- b. Anode (negative): Zinc Cathode (positive): Silver

- c. Overall reaction for the cell and the standard cell potential:



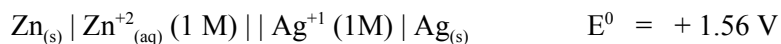
- d. Electron will flow from zinc to silver: $\text{Zn} \longrightarrow \text{Ag}$

- e. Direction of the ion flow in the salt-bridge:

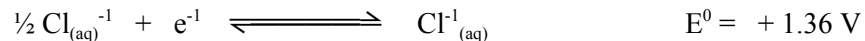
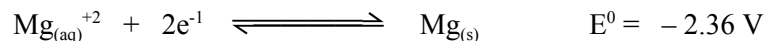
NH_4^{+1} to the cathode, NO_3^{-1} to the anode

- f. Oxidizing agent: Ag^{+1} oxidized: Zn

- g. Standard cell notation for the spontaneous reaction occurring in the cell:

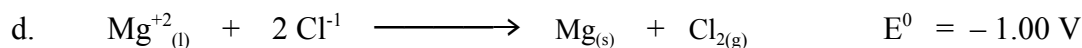
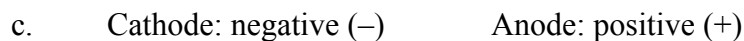
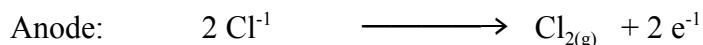
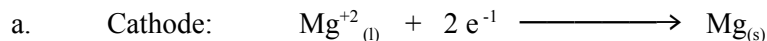


9. Molten magnesium chloride is electrolysed. Use the following standard reduction potentials to answer the following questions:



- Write the two half-reactions that will occur at each electrode.
- State the products at each electrode
- State the polarity of each electrode.
- Write the overall reaction for the cell and calculate the standard cell potential.
- Is the reaction spontaneous or non-spontaneous.
- State the sign of ΔG^0 .
- If **dilute** aqueous magnesium chloride is electrolysed, a different product is obtained at each electrode. Identify the product formed at each electrode, the overall E^0 value and write an overall equation, showing the formation of the product at each electrode.

ANSWER



e. Reaction is Non-spontaneous, since E^0 is negative

f. ΔG^0 will be positive (+), since non-spontaneous reaction.

g. If **dilute** aqueous magnesium chloride is electrolysed:

Cathode: reduction of water will preferentially take place to produce $\text{H}_{2(\text{g})}$

Anode: oxidation of water will take place to produce oxygen gas, $\text{O}_{2(\text{g})}$.

