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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016**

COURSE NAME : CHEMISTRY
COURSE CODE : DAS 12203
PROGRAMME CODE : 1 DAA / 3 DAM
EXAMINATION DATE : JUNE/JULY 2016
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : SECTION A) ANSWER ALL QUESTIONS
SECTION B) ANSWER TWO (2)
QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF SEVEN (7) PAGES

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Q2 (a) Given NO_3^- , HSO_4^- and CH_3COOH , select the species that behave as

- (i) Brønsted-Lowry acid
- (ii) Brønsted-Lowry base
- (iii) Both Brønsted-Lowry acid and base.

(3 marks)

(b) (i) Define the term pH.

(1 mark)

(ii) Find the pH at 25 °C of 2.00×10^{-3} M HCl.

(2 marks)

(iii) Calculate the $[\text{OH}^-]$, $[\text{H}^+]$, pH and pOH of 2.50×10^{-2} M NaOH at 25 °C.
($K_w = 1.0 \times 10^{-14}$)

(8 marks)

(c) A voltaic cell utilizes the following redox reaction:



(i) Identify the anode and cathode and write the half-cell reaction at the anode and cathode.

(4 marks)

(ii) Write the cell diagram for the voltaic cell.

(2 marks)

(iii) Calculate the standard cell potential, E°_{cell} , for this electrochemical cell.

$$(E^\circ_{\text{Bi}^{3+}/\text{Bi}} = 0.308 \text{ V}, E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.771 \text{ V})$$

(3 marks)

(iv) State whether the reaction is spontaneous or non-spontaneous and give your reasons.

(2 marks)

SECTION B

- Q3** (a) Mandelic acid is an organic acid composed of carbon (63.15 %), hydrogen (5.30%) and oxygen (31.55 %). Determine the
- empirical formula of mandelic acid (4 marks)
 - molecular formula given its molar mass is 152.0 g/mol.
(Relative atomic mass : H = 1, C = 12, O = 16) (4 marks)
- (b) Find the mass of solute present in 113.0 mL of 1.43 M Na₂CO₃.
(Relative atomic mass : C = 12, O = 16, Na = 23) (4 marks)
- (c) 2.00 L of a gas is collected at 25.0 °C and 745.0 mmHg. Determine the volume at STP. (5 marks)
- (d) 1.40 g of sodium bicarbonate (NaHCO₃) was allowed to react with HCl as shown in the equation :



- Find the number of moles of NaHCO₃.
(Relative atomic mass : H = 1, C = 12, O = 16, Na = 23, Cl = 35.5) (3 marks)
 - Calculate the volume of CO₂ produced at 0.95 atm and 17 °C.
(R = 0.0821 L.atm/mol.K) (5 marks)
- Q4** (a) Determine the number of orbitals that correspond to the following designations.
- $n = 5$
 - $2s$
 - $3p$
 - $5d$
 - $6f$
- (5 marks)
- (b) (i) Write the full and abbreviated electron configuration for silicon, Si (Z = 14). (2 marks);
- (ii) Give the set of 4 quantum numbers (n, ℓ, m_ℓ, m_s) for the valence electrons in Si. (5 marks)

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- (c) Given the elements Be, N and Na.
- (i) Determine their respective group and period.
(Atomic number, Z : Be = 4, N = 7, Na = 11) (6 marks)
 - (ii) Arrange the elements in order of increasing radius. (2 marks)
 - (iii) Identify the element that has the lowest ionization energy. Explain your answer. (3 marks)
 - (iv) State the element that is most electronegative. (2 marks)

Q5 (a) Define :

- (i) An ionic bond (2 marks)
- (ii) A covalent bond (2 marks)

(b) Using suitable combinations of the elements H, Li and F, use Lewis dot symbols to show the formation of

- (i) An ionic bond (3 marks)
- (ii) A covalent bond (3 marks)

(Atomic number, Z : H = 1, Li = 3, F = 9)

(c) Draw the Lewis structure of OSCl_2 (where S is the central atom) and calculate formal charges.

(Atomic number, Z : O = 8, S = 16, Cl = 17)

(5 marks)

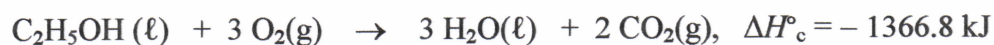
- (d) (i) The thermochemical equation for the combustion of nitrogen is



Find the heat absorbed when 5 moles of NO is produced during a lab test.

(2 marks)

- (ii) Determine the heat of formation of ethanol, $\text{C}_2\text{H}_5\text{OH}$ from the following information.

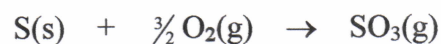


$$\Delta H^\circ_f(\text{H}_2\text{O}(\ell)) = -285.8 \text{ kJ/mol}, \quad \Delta H^\circ_f(\text{O}_2) = 0 \text{ kJ/mol},$$

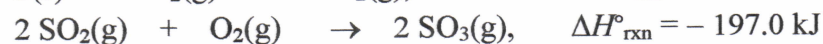
$$\Delta H^\circ_f(\text{CO}_2(\text{g})) = -393.5 \text{ kJ/mol}$$

(4 marks)

- (iii) Calculate the heat of reaction for the formation of sulfur trioxide, SO_3 .



Given the following thermochemical equations



(4 marks)

- Q6** (a) The reaction $\text{A} \rightarrow 2\text{B} + \text{C}$ is found to be second order with respect to the reactant, A.

- (i) Write the rate law.

(1 mark)

- (ii) Find the value of the rate constant when the concentration of A is 0.01M and the rate is $1.0 \times 10^{-2} \text{ M/min}$.

(3 marks)

- (iii) Calculate the new rate when the concentration of A is increased to 0.05M.

(2 marks)

- (b) For the reaction $2\text{NO}(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{N}_2\text{O}(\text{g}) + \text{H}_2\text{O}(\text{g})$, the following rate data were collected:

Experiment	Initial [NO]/M	Initial [H ₂]/M	Initial rate/Ms ⁻¹
1	0.60	0.37	3.0×10^{-3}
2	1.20	0.37	1.2×10^{-2}
3	1.20	0.74	1.2×10^{-2}

- (i) Determine the order of [NO] and [H₂]. (7 marks)
- (ii) Write the rate law equation. (1 mark)
- (iii) Determine the value of the rate constant, k (complete with units). (4 marks)
- (c) The reaction, $\text{A} \rightarrow \text{B}$, is first order with a half-life of 2.75 days.
- (i) Find the rate constant, k . (2 marks)
- (ii) Determine the time to reduce the concentration of A from 1.0 M to 0.03 M. (5 marks)

- END OF QUESTION -

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