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525/2
S6 CHEMISTRY

Exam 13

PAPER 2

DURATION: 2 HOUR 30 MINUTES

INSTRUCTIONS

- Answer five questions including three from section A and two from section B
- Where necessary use C = 12, O = 16, H = 1, S = 32, 1F = 96500C

SECTION A

Attempt three questions from this section

- (a) Define the term isotopes (01 mark)
(b) One of the factors that affect the stability of the isotopes is neutron to proton ratio
(i) State the other factor (01 mark)
(ii) Sketch a graph of number of neutrons versus number of protons and on it indicate
 - The line in which $n/p = 1$
 - The stability region
 - Three points in the unstability region (3½ marks)
- (c) Describe briefly how the isotopes in the unstability region in the three points indicated in (b) can gain stability (04marks)
- (d) Gallium has two isotopes of mass number 69 and 71 in the ratio x:y. If the relative atomic mass of gallium is 69.8, determine the values of x and y. (03marks)
- (e) The table below shows the results of the radioactive decay of ${}^{234}_{91}\text{Pa}$

Time (seconds)	20	40	60	80	100	120
Mass of ${}^{234}_{91}\text{Pa}$ (g)	48.2	38.5	31.5	26.0	21.0	17.2

Plot a graph of $\log_{10}(\text{mass})$ against time and use it to determine the

- Initial mass of ${}^{234}_{91}\text{Pa}$ (01mark)
- Decay constant of ${}^{234}_{91}\text{Pa}$ (02marks)
- Half-life of ${}^{234}_{91}\text{Pa}$ (02marks)

2. (a) Define the terms
- Electrolytic conductivity (01 mark)
 - Molar conductivity (01mark)
- (b) Conductivity measurement is one of the methods of determining solubility product of a sparingly soluble salt.
- Describe how the method is carried out (05marks)
 - The electrolytic conductivity of a saturated solution of calcium phosphate at 25°C is $3.1219 \times 10^{-5} \Omega^{-1} \text{cm}^{-1}$. The molar ionic conductivities of calcium ions at infinity dilution at 25°C are $119.0 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$ and $240.0 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$ respectively. Calculate the solubility product of calcium phosphate at 25°C and state its units (05 marks)
- (c) Explain each of the following observations
- In the conductimetric titration of copper (II) sulphate solution against ammonia solution, the electrolytic conductivity of the mixture decreases to minimum value and then increases gradually and finally almost levels off with excess ammonia (04marks)
 - The molar conductivity decrease with increase in concentration for both ethanoic acid and sodium chloride (04 marks)
3. An organic compound P on complete combustion yielded 8.8g of carbon dioxide and 1.8g of water. 0.1g of P vaporized at 273°C and 734mmHg occupied a volume of $4.46 \times 10^{-2} \text{dm}^3$
- Calculate
 - the empirical formula of P (02marks)
 - molecular formula of P (04marks)
 - Write the structure and IUPAC name of P (01 mark)
 - Discuss the reactions of P with
 - Sulphuric acid
 - Bromine (08marks)
 - Using equations only show conditions for synthesis of P from benzoic acid (05marks)
4. (a) Write the outermost electronic configuration of group (IV) elements. (01 marks)
- (b) Describe the reaction of:
- Carbon, silicon, tin and lead with water (6½ marks)
 - Lead with ethanoic acid (2½ marks)
 - Chlorides of lead with sodium hydroxide solution (04marks)
 - Silicon with acids (03 marks)
- (c) Carbon does not react with chlorine but reacts readily with fluorine. Explain this observation. (03 marks)

SECTION B

Answer two questions from this section

5. (a) Describe an experiment that can be used to determine the enthalpy of displacement reaction between zinc and copper sulphate (09marks)
- (b) State what would be observed and write equation for the reaction when
- Copper metal is added to silver nitrate solution (03marks)
 - Aluminium metal is added to iron (III) sulphate solution (2 ½ marks)
- (c) Calculate the Gibbs free energy in (b)(ii) above given that the standard reduction potential of aluminium half cell is -1.66V and that of iron (III) half cell is +0.77V. (03marks)
- (d) Write the cell notation for the cell formed by combining the half cells in (b) above (1 ½ marks)
6. Using equations only show the following compounds can be synthesized
- Phenylethanoate from aminobenzene (04marks)

- (b) 2,2-dichloropropane from propan-1-ol (04marks)
 - (c) 1,3,5-tribromobenzene from benzene diazonium chloride (04marks)
 - (d) $\text{CH}_3\text{CH}=\text{NOH}$ from but-2-ene (04marks)
 - (e) Ethylamine from propanoic acid (04marks)
7. Explain the following observations
- (a) When potassium iodide solution was added to copper (II) sulphate solution; white precipitate and brown solution were formed, however, when potassium bromide solution was used there was no observable change (05marks)
 - (b) When concentrated hydrogen peroxide solution was added to lead (II) sulphide, the black solid turned to white solid (03marks)
 - (c) When concentrated ammonia solution was added to cobalt (II) chloride solution, blue precipitate was formed which dissolved in excess ammonia solution to form a pale brown solution (05marks)
 - (d) When 60g of urea, $(\text{NH}_2)_2\text{CO}$ and 128g of naphthalene (C_{10}H_8) were separately added to ethanol, both solutions boil at the same temperature and pressure (04marks)
 - (e) A solution of hydrogen chloride gas in methylbenzene has no effect on litmus papers however an aqueous solution of hydrogen chloride turns blue litmus paper red. (03marks)
8. (a) Discuss the chemical properties of aluminium and iron showing
- (i) Similarity
 - (ii) Differences (12marks)
- (b) Explain the following observations
- (i) the melting points of aluminium and iron are 66°C and 1537°C respectively (04marks)
 - (ii) Hydrogen chloride gas cannot be used to prepare anhydrous iron (III) chloride, however, hydrogen chloride gas is suitable for preparation of anhydrous aluminium chloride (04marks)

END