SECTION A (46 Marks)

Answer all questions from this section A

1. (a) Write:

(i) equation for ionization of methanoic acid in water. (1 ½ marks)

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(ii) the expression for the acid constant Ka, for methanoic acid. (½ mark)

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(b) The molar conductivity of 0.1M methanoic acid solution at 25°C is 16.2scm^2 mol^{-1}. Calculate the:

(i) Degree of ionisation of methanoic acid at 25°C (molar conductivity of methanoic acid at infinite dilution at 25°C is 40 scm^2 mol^{-1}) (1 ½ marks)

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(ii) Ionization constant, Ka for methanoic acid at 25°C. (1 ½ marks)

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2. Write equations for the reaction of the following oxides with sodium hydroxide. (1 ½ marks each)

(a) Chromium (III) oxide.

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(b) Beryllium oxide

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(c) Lead (II) oxide

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3. Complete the following reaction equations and write the accepted mechanism.

a) $CH_3C \equiv CH \xrightarrow[Hg^{2+}, 60^{\circ}C]{H_2O/H^+}$ (3marks)

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b) $CH_3CH = CH_2 + HCl \longrightarrow$ (2marks)

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4. (a) State what is meant by the term **diagonal relationship?**. (1mark)

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(b) State three reasons why lithium and magnesium resemble. (1 ½ marks)

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(c) Mention three properties to show the diagonal relationship between lithium and magnesium. (3marks)

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5. 20cm^3 of a gaseous hydrocarbon, X was exploded with 100cm^3 of oxygen. After explosion, the volume and cooling of the residual gas was found to be 90cm^3. On addition of concentrated potassium hydroxide, the volume reduced to 50cm^3.

(a) Determine the molecular formula of X. (2marks)

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(b) X reacts with ammoniacal copper (I) chloride solution.

(i) State what is observed (1mark)

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(ii) Write equation for the reaction that takes place. (1mark)

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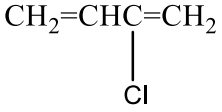
6. (a) Synthetic rubber (Z) was made from monomers with structure.



(i) State the conditions for the reaction. (1mark)

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(ii) Write the equation leading the formation of Z (1mark)

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(iii) Name the type of reaction in a(ii) (½ mark)

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(b) A solution containing 5.0g of Z in 200cm^3 of benzene is found to have an osmotic pressure of 34KPa at 17°C. Calculate

(i) the molar mass of Z (2 ½ marks)

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(ii) the number of monomers (n) (1 ½ marks)

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7. (a) State **Raoult's law** of relative lowering of vapour pressure. (1marks)

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(b)(i) Calculate the vapour pressure of a solution containing 18g of glucose ($C_6H_{12}O_6$) in 50g of water at 60°C is 150mmHg. (2 ½ marks)

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(ii) State any three assumptions made in b(i) (1 ½ marks)

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8. Sodium propanoate undergoes hydrolysis when dissolved in water.

a) Write equation for the hydrolysis of sodium propanoate (1mark)

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b) Write the expression for the hydrogen constant, Kh (1mark)

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c) The hydrolysis constant, K_h for sodium propaonate is 5.9×10^{-10} moldm^{-3} at 25°C. What is the concentration of hydrogen ions in solution at equilibrium for a 0.1M sodium propanoate? (2marks)

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9. (a) One of the properties of transition metals is complex ion formation

(i) Define the term **complex ion** (1mark)

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(ii) Explain why transition metals form may complexes (1 ½ marks)

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(b) Complete the table below. (2marks)

Complex ion	Oxidation state of metal ion	Name of complex ion
(i) $Fe(CN)_6^{3-}$		
(ii) $CuCl_4^{2-}$		

SECTION B (54 MARKS)

Answer six questions from this section

10. a) When red lead oxide, Pb_3O_4 was heated with dilute nitric acid, a solid was formed. Write equation for the reaction. (2marks)

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(b)The mixture from (a) was filtered and the residue warmed with concentrated hydrochloric acid.

(i) State what was observed. (1mark)

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(ii) Write equation for the reaction (1 ½ marks)

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(c) The filtrate from (b) was divided into two portions.

(i) To the first portion was added aqueous potassium iodide. State what was observed and write equation for the reaction. (2marks)

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(ii) The second portion evaporated to dryness and then heated strongly. State what was observed and write equation for the reaction. (2 ½ marks)

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11. Name reagent(s) that can be used to distinguish between the following pairs of compounds and in each case state what is observed. (3marks)

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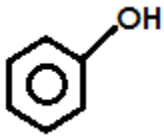

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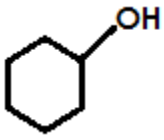

Reagent

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Observations

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(b) Ethanoic acid and chloroethanoic acid

Reagent

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Observations.

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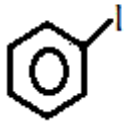
(c)



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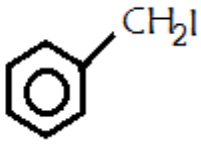

Reagent

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Observations

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12. (a) State three properties in which manganese differs from magnesium. (1 ½ marks)

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(b) Write equation to show the reduction of manganate (VII) ion in

(i) Acidic medium (1 ½ marks)

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(ii) Alkaline medium (1 ½ marks)

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(c) State what is observed when drops of acidified potassium manganate (VII) solution are added to each of the following solutions. In each case, write the equation of reaction.

(i) Hydrogen peroxide (2marks)

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(ii) Hot sodium oxalate solution. (2marks)

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(d) State one reason why potassium manganate (VII) is not a good primary standard in volumetric analysis ($\frac{1}{2}$ mark)

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13. (a) State three characteristics of a **chemical equilibrium**. (1 $\frac{1}{2}$ marks)

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(b) Dinitrogentetraoxide dissociates at 40°C and 1 atm according to the following equation.

$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$ $\Delta H = +57\ KJmol^{-1}$

(i) Write an expression for the equilibrium constant, Kp ($\frac{1}{2}$ mark)

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(ii) Draw a labelled energy level diagram for the reaction in (b) (2marks)

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(c) The reaction mixture in (b) was found to contain 60% by volume of nitrogen dioxide. Calculate the equilibrium constant Kp at 60°C for the reaction. (3marks)

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(e) Explain the effect of increasing pressure on the position of the above equilibrium. (2marks)

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14. Write equations to show how the following compounds can be synthesized and in each case indicate the conditions of reaction.

(a) $CH_2 = CH_2$ from CH_3CH_2COOH (3marks)

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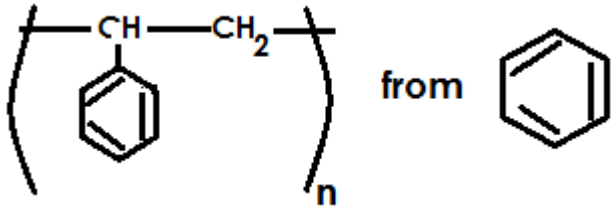
(b) (3marks)



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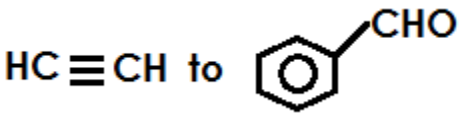
(c) (3marks)



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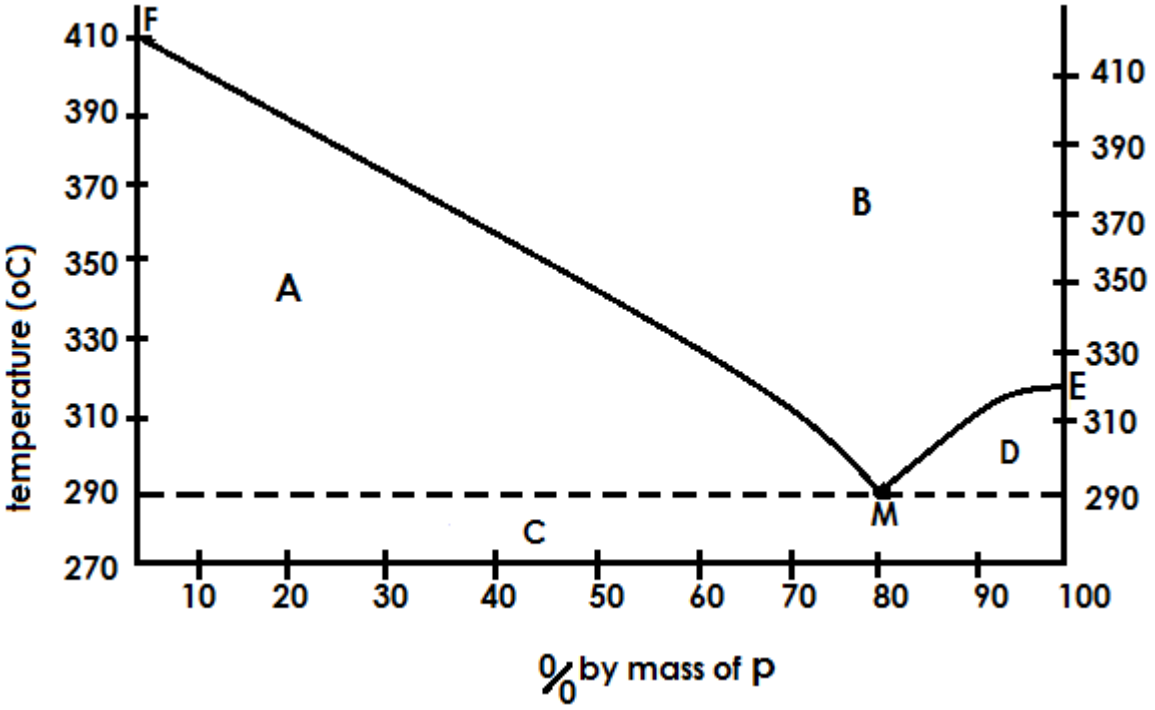
15. The phase diagram for a mixture of metals **P** and **Q** is shown below.



(a) Identify the regions A, B, C and D (2marks)

(i) A ……

(ii) B ……

(iii) C ……

(iv) D ……

(b) State what point M represents. (1mark)

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(c) Using the diagram, estimate the melting point of; (1mark)

(i) P ……

(ii) Q ……

(d) Describe what would happen if a mixture containing 50% by mass of P and Q is cooled from 410°C to 270°C. (3marks)

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(e) State one difference and one similarity between the substance at point M and a pure compound

(i) difference (1mark)

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(ii) similarity (1mark)

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16. (a) Compound Y contains by mass 22.86% oxygen, 8.57% hydrogen and the rest carbon.

(i) Calculate the empirical formula of Y (2 ½ marks)

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(ii) When 0.30g of Y is vapourised at 80°C and 700mmHg pressure, it occupied a volume of 134.77cm^3. Determine the molecular formula of Y. (3 ½ marks)

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(b) Y forms a yellow precipitate with 2,4-dinitrophenyl hydrazine and does not react with Tollen's reagent. Identify Y

Identify Y. (1mark)

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(c) Write equation for the formation of the yellow precipitate in (b) above.(2marks)

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17. Explain the following observations

(a) phenylamine is a weaker base than ethyl amine (3marks)

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(b) The PH of a 0.1M phenol is 6.5 while that of cyclohexanol is 7 (3marks)

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(c) Hydrofluoric acid is a weaker acid than hydrobromic acid. (3marks)

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THE PERIODIC TABLE

1	2											3	4	5	6	7	8
1.0 H 1																1.0 H 1	4.0 He 2
6.9 Li 3	9.0 Be 4											10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12											27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 TI 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103

♥ ===END===

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