

[illegible]

SECTION A (46 MARKS)

Answer all questions in this section

1. (a) Aluminium chloride is covalent and rapidly undergoes hydrolysis in moist air.

(i) State **three** other properties to show that aluminium chloride is covalent. (1½ marks)

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(ii) Write an equation for the hydrolysis of aluminium chloride in moist air. (01 mark)

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(b) (i) State how anhydrous aluminium chloride can be prepared in the laboratory. (01 mark)

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(ii) Write equation for the reaction in b(i) above. (01 mark)

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2. (a) Complete the following nuclear reactions;

(i) ${}^9_4\text{Be} + \gamma \longrightarrow {}^8_4\text{Be} + \dots\dots\dots$ (01 mark)

(ii) ${}^{19}_9\text{F} + {}^1_0\text{n} \longrightarrow \dots\dots\dots + {}^4_2\text{He}$ (01 mark)

(b) It takes 5 days for 0.025g of Bismuth-214 to disintegrate into 0.0125mg of Bismuth-210. Calculate the time required for 0.016mg of Bismuth-214 to change into 0.001mg of Bismuth-210. (03 marks)

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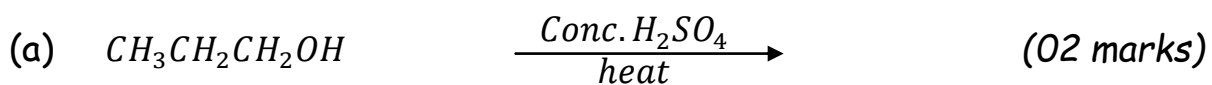
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3. Complete the following equations and in each case outline the mechanism for the reaction.



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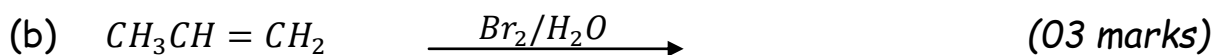
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4. (a) Define the term **nuclear stability**.

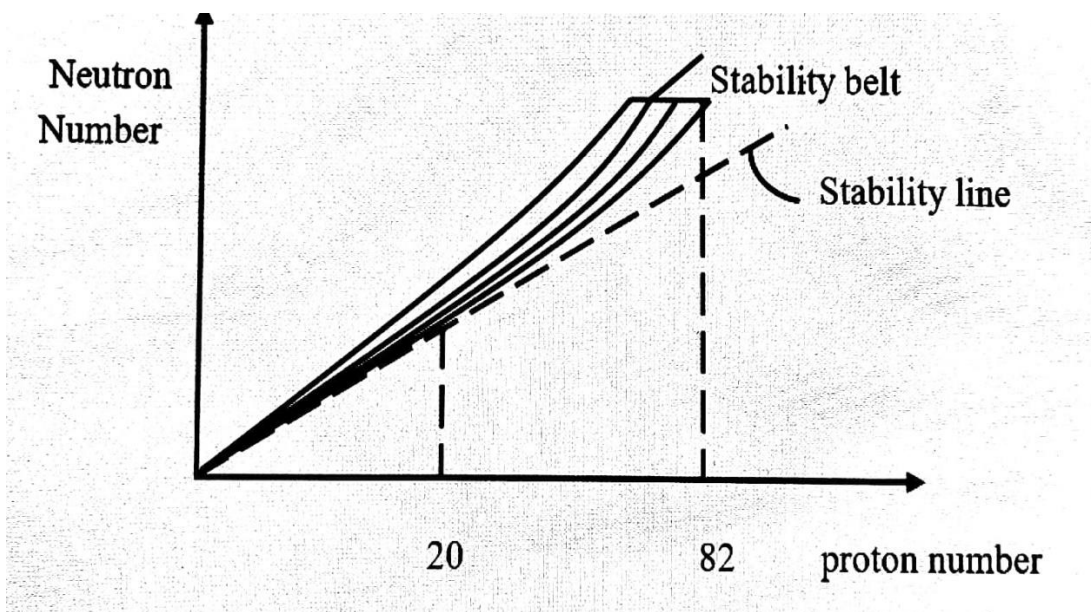
(01 mark)

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(b) (i) The graph below shows the variation of number of neutrons in an atom with proton numbers.



Explain why the band of nuclear stability (stability belt) deviates from $n/p = 1$ (stability line) after atomic number 20. (02 marks)

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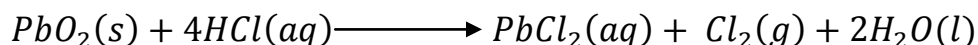
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(ii) Determine the number of alpha and beta particles that must be emitted for ${}^{232}_{90}\text{Th}$ to transform to ${}^{208}_{82}\text{Pb}$ (02 marks)

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5. (a) Lead(IV) oxide reacts with hydrochloric acid according to the redox reaction below:



(i) State the condition(s) for the above reaction. (01 mark)

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(ii) Write the half reduction and oxidation reactions from the overall redox reaction above. (02 marks)

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(b) Lead(IV) oxide was added to an acidified solution of potassium iodide and the mixture heated.

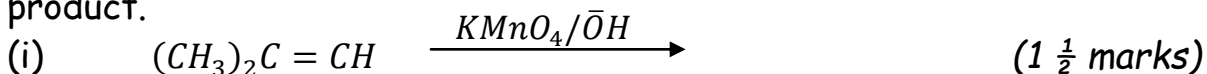
(i) State what was observed. (01 mark)

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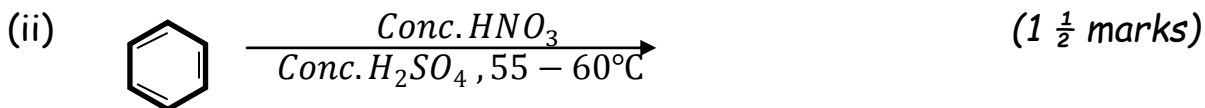
(ii) Write equation for the reaction that took place. (1 $\frac{1}{2}$ marks)

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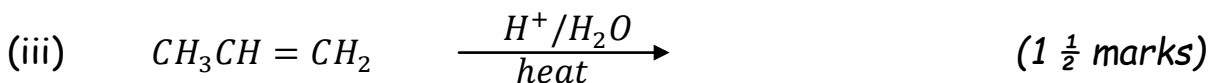
6. Complete each of the following equations and name the main organic product.



Name of main product;



Name of main product;.....



Name of main product;.....

7. (a) Potassium manganate (VII) is a commonly used reagent in volumetric analysis and yet it is not a primary standard.

(i) What is meant by the term 'primary standard'? (01 mark)

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(ii) State **two** reasons why potassium manganate (VII) is not a primary standard (01 mark)

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(b) Explain why hydrochloric acid is not used to acidify a solution of potassium manganate(VII) solution in volumetric analysis. (03 marks)

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8. State what would be observed and write equation(s) for the reaction(s) that take place when:

- (i) hydrogen sulphide is bubbled through an aqueous solution of acidified potassium dichromate(VI).

Observation

(1 $\frac{1}{2}$ marks)

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Equation

(1 $\frac{1}{2}$ marks)

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- (ii) An aqueous solution of sodium thiosulphate is left standing in air.

Observation

(1 $\frac{1}{2}$ marks)

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Equation

(1 $\frac{1}{2}$ marks)

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9. Write equation(s) to show how the following conversions can be effected. In each case indicate the necessary reagents and conditions.

- (a) $CH_3CH_2C \equiv CH$ to $CH_3CH_2\underset{\text{Cl}}{\text{CH}}CH_3$ (02 marks)

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(b) Benzene from ethanol.

(04 marks)

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SECTION B: (54 MARKS)

Answer any six questions from this section.

10. (a) (i) Define the term **enthalpy of a reaction**.

(01 mark)

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(ii) State **four** factors affecting the quantity of an enthalpy change of a reaction.

(02 marks)

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(b) The standard heat of formation of ethanol, carbon dioxide and water are -227.0, -393.5 and -285.5 kJmol⁻¹ respectively.

(i) Calculate the standard heat of combustion of ethanol using the information above.

(3 $\frac{1}{2}$ marks)

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(ii) From your calculation in above and energy changes in *b(i)* above, what can be the ideal use of ethanol in chemistry? Give a reason for your answer. (1 $\frac{1}{2}$ marks)

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11. Show how the following conversions can be effected. In each case, indicate the reagents and conditions for the reaction

(a) Ethanol to propan-2-ol (03 marks)

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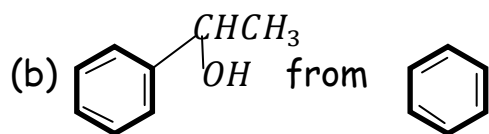
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(03 marks)

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(c) Butane from $\text{CH}_3\text{CH}_2\text{OH}$

(03 marks)

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12. (a) A compound **R** contains carbon, hydrogen and oxygen only.
 0.463g of **R** on combustion gave 1.1g of carbon dioxide and 0.563g of water. Determine the empirical formula of **R**. (03 marks)

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(b) When 0.1g of **R** was vapourised at 208°C and 98.3kPa, it occupied a volume of 54.5cm^3 . Determine the molecular formula of **R**.

(02 marks)

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(c) **R** reacts with sodium metal with evolution of a gas. Write the structural formulae of all possible isomers of **R**.
(02 marks)

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(d) **R** reacts with anhydrous zinc chloride and concentrated hydrochloric acid to form a cloudy solution in about 5 minutes.

(i) Identify **R** (01 mark)

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(ii) Write equation(s) to show how can be synthesized from but-2-ene (01 mark)

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13. Explain the following observations.

(a) When refluxed with aqueous potassium hydroxide followed by acidified silver nitrate solution. Chloroethane forms a white precipitate while chlorobenzene gives no observable change. (03 marks)

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(b) Iron(III) chloride and tin(II) chloride cannot exist together in
aqueous solution. (03 marks)

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(c) The mass spectrum of dichloromethane(CH_2Cl_2) shows three peaks
at mass to charge ratios of 84, 86 and 88 in a ratio 9:6:1. (03 marks)

14.(a) Write equation for the reaction between water and the chloride of:

(i) Aluminium (1 $\frac{1}{2}$ marks)

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(ii) Sulphur (1 $\frac{1}{2}$ marks)

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(iii) Phosphorus (1 $\frac{1}{2}$ marks)

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(b) Write an equation for the reaction between concentrated sodium hydroxide and :

(i) Aluminium (1 $\frac{1}{2}$ marks)

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(ii) Chlorine (1 $\frac{1}{2}$ marks)

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(iii) Aluminium oxide (1 $\frac{1}{2}$ marks)

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15.(a) An organic compound X has a molecular formula C_4H_9Br

(i) Name the functional group in X. (01 mark)

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(ii) Write the structural formulae and names of all possible isomers of X. (04 marks)

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(iii) Identify **two** isomers in a(ii) that when reacted with hot ethanolic potassium hydroxide solution give the same product. (01 mark)

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(iv) Write the structural formula and name of the product in a(iii) (01 mark)

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(b) Outline the mechanism for the reaction between the product in a(iii) and benzene in presence of an acid. (02 marks)

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16.(a) Write an equation between water and the oxide of :

(i) Sodium (1 $\frac{1}{2}$ marks)

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(ii) Magnesium (1 $\frac{1}{2}$ marks)

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(iii) Phosphorus (1 $\frac{1}{2}$ marks)

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(b) Write equation for the reaction between concentrated sulphuric acid and:

(i) magnesium (1 $\frac{1}{2}$ marks)

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(ii) aluminium (1 $\frac{1}{2}$ marks)

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(iii) phosphorus (1 $\frac{1}{2}$ marks)

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17. Write a mechanism for the reaction that occurs between a mixture of:

(a) ethanol and concentrated sulphuric acid at 140°C. (2 $\frac{1}{2}$ marks)

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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 Tl 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.

