

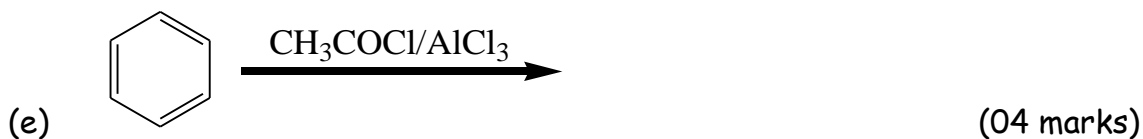
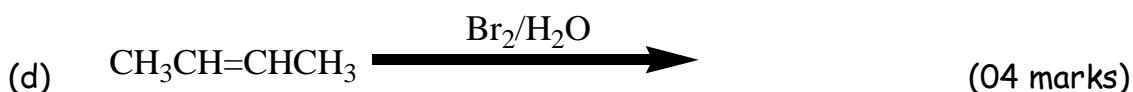
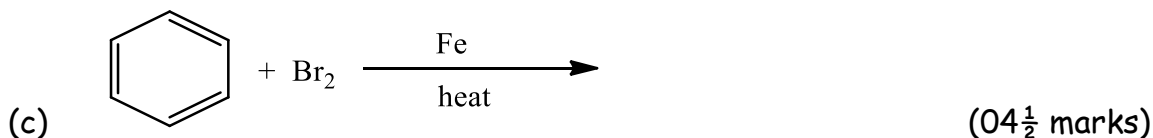
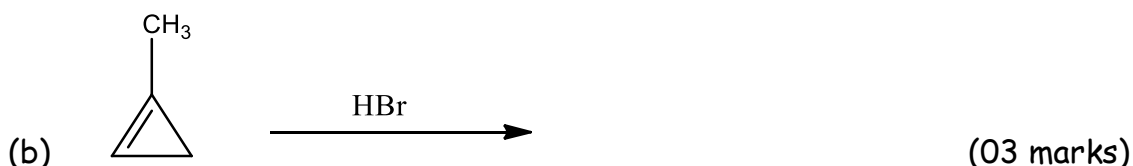
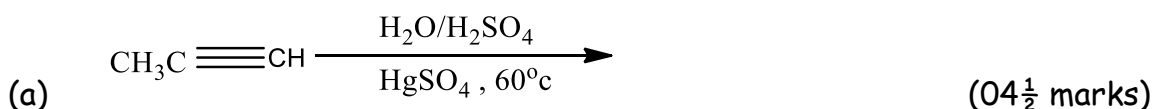
SECTION A (60 Marks)

Answer only **three** questions from this section.

1. The mass spectrometer can be used to determine the relative atomic mass of elements consisting of various isotopes.
- a) What is meant by the following terms: (@01 mark)
- (i) Relative atomic mass.
 - (ii) Relative abundance.
 - (iii) Relative intensities.
- b) Briefly describe how the relative atomic mass of magnesium metal which consists of three isotopes can be determined using a mass spectrometer.
[Diagram NOT required] (06 marks)
- c) The relative atomic mass of magnesium with isotopes $^{24}_{12}\text{Mg}$, $^{25}_{12}\text{Mg}$ and $^{26}_{12}\text{Mg}$ is 24.3, If the percentage of abundance of $^{25}_{12}\text{Mg}$ and $^{26}_{12}\text{Mg}$ is equal.
- (i) Calculate the percentage abundance of each isotope of magnesium. (01½ marks)
 - (ii) Sketch the mass spectrum of magnesium. (02 marks)
- d) The table below shows the results of radioactive decay of a radioactive isotope of magnesium $^{26}_{12}\text{Mg}$. Use the data below to plot a graph of $\log(\text{mass})$ against time. (04 marks)
- | | | | | | | |
|---|------|------|------|-------|-------|-------|
| Mass of $^{26}_{12}\text{Mg}(\text{g})$ | 18.7 | 14.6 | 11.3 | 8.8 | 6.9 | 5.4 |
| Time (s) | 300 | 600 | 900 | 1,200 | 1,500 | 1,800 |
- e) Using the graph plotted in (d) above determine the:
- (i) Order of radioactive decay of $^{26}_{12}\text{Mg}$. (01 mark)
 - (ii) Rate constant and hence half-life of $^{26}_{12}\text{Mg}$. (01½ marks)
 - (iii) Original mass of $^{26}_{12}\text{Mg}$. (01 mark)
2. Tin and lead are members of group (IV) of the periodic table.
- (a) Write:
- (i) The outer most electronic configuration of the elements (1 mark)
 - (ii) The formulae of the common oxides of lead (1 ½ marks)

- (b) Write equations of reactions to show the oxides of lead in (a) (ii) are formed (4 $\frac{1}{2}$ marks)
- (c) Describe the reactions of tin and lead with:
- (i) Sulphuric acid
 - (ii) Sodium hydroxide (8 marks)
- (d) Name one reagent that can be used to distinguish between the following pairs ions. In each case state what would be observed and write equation(s) for the reaction(s).
- (i) Pb^{2+} and Sn^{2+}
 - (ii) Sn^{2+} and Sn^{4+} (5 marks)

3. Complete the following equations and in each suggest a mechanism for the reaction.



4. (a) Define the terms:

- (i) Freezing point depression constant (1 mark)
- (ii) Osmotic Pressure (1 mark)

- (b) Describe how the relative molecular mass of camphor can be determined by freezing point depression method using naphthalene as a solvent.
(Diagram not required) (6 marks)

(c) State the:

(i) Law of osmotic pressure (1 mark)

(ii) Conditions under which the law is invalid. (1 mark)

(d) The osmotic pressure of a **2.1%** solution of neoprene rubber is **0.45mmHg** at **23°C**. Determine the number of monomer units in neoprene rubber. (4 marks)

(e) The freezing points of solution of various concentration of naphthalene in cyclohexane at **760mmHg** are shown in the table below.

Concentration [g/1,000g of cyclohexane]	10	20	30	40	50	60
Freezing point [°C]	4.93	3.36	1.79	0.22	-1.35	-2.92

(i) Plot a graph of freezing point against concentration. (03 marks)

(ii) Use the graph to determine the freezing point of cyclohexane. (01 mark)

(iii) Determine the slope of the graph and use it to determine the relative molecular mass of naphthalene. [$K_f = 20.1^\circ\text{C}/\text{mol}/1,000\text{g}$] (02 marks)

SECTION B (40 Marks)

Answer only **two** questions from this section.

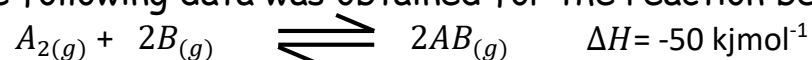
5. (a) Explain what is meant by the following terms: (@01 mark)

(i) Order of reaction

(ii) Molecularity of a reaction

(iii) Elementary reaction

(b) The following data was obtained for the reaction below;



Experiment	$[A](molL^{-1})$	$[B](molL^{-1})$	Initial rate $(molL^{-1}s^{-1})$
1	0.03	0.03	0.3×10^{-4}
2	0.06	0.06	1.2×10^{-4}
3	0.06	0.09	2.7×10^{-4}

- (i) State the order of reaction with respect to A_2 and **B**. Give reasons for your answer. (02 marks)
- (ii) Write the rate equation for the reaction. (01 mark)
- (iii) Calculate the rate constant and its units. (02 marks)
- c) (i) Draw a labeled energy diagram for the reaction in (b) above (activation energy $E_a = +250 \text{ kJmol}^{-1}$, enthalpy change) (03 marks)
- (ii) Calculate the activation energy for the backward reaction. (1 mark)
- (d) Explain the effect of increasing temperature for the above reaction on:
- (i) Equilibrium constant
 - (ii) Position of equilibrium
 - (iii) Rate of reaction
- (f) Draw a sketch graph to show the change in concentration of **AB** with time at a given temperature. (02 marks)
6. (a) Explain the term **melting point**. (01 mark)
- (b) State the **factors** which **affect the melting point**: (@03 marks)
- i. **Metals**.
 - ii. **Molecular substances**.
- (c) Explain the trend in melting points of the elements in **group (II)** and **group (VII)** of the periodic table. (05 marks)
- (d) The table below shows melting points of some compounds.

Compounds	Melting point/K
Aluminium oxide	2290
Aluminium chloride	451
Calcium oxide	2850
Calcium chloride	1051

Explain why:

- The melting point of aluminium chloride is abnormally low compared to that of aluminium oxide. (02 marks)
- The melting point of calcium oxide is much higher than that of calcium chloride. (03 marks)

(e) Explain why a solution of aluminium nitrate turns blue litmus paper red. (03 marks)

7. Steam distillation is one of the methods used in purification of substances below their boiling points.

- State three requirements for purifying a substance by steam distillation. (01½ marks)
 - Explain the principle of purifying a substance by steam distillation method. (03 marks)
- Cyclohexane distils on steam at 98°C and standard atmospheric pressure of 760mmHg. Calculate the percentage of cyclohexane in the distillate. [The vapour pressure of water at 98°C is 655mmHg, C = 12, H = 1, O = 16]. (03 marks)
- Nitric acid and water form a non-ideal solution that deviates from Raoult's law. The table below shows the composition of nitric acid in liquid and vapour phases at different temperatures are given below.

Temperature (°C)	Percentage of Nitric acid	
	Liquid	Vapour
90	93	98
96	85	96
101	09	01
103	18	03
104	78	90
106	30	08
110	43	20
113	71	81
116	59	40
119	66	53
120	67	58
121	68	68

- (i) Plot a well-labelled boiling point composition diagram for the nitric acid - water system. [The boiling points of nitric acid and water are 86°C and 100°C respectively. (05 marks)
- (ii) Explain why the mixture of nitric acid and water shows the type of deviation in the diagram above. (04 marks)
- (iii) Describe what happens when a liquid mixture containing 40% of nitric acid is fractionally distilled. (03½ marks)

8. 6.20g of a bromoalkane **W**, $C_nH_{2n+1}Br$ contains 65.04 % by mass bromine.

- (a) Determine the molecular formula of **W**. (03½ marks)
- (b) Write the structural formulae and IUPAC names of all possible isomers of **W** (02 marks)
- (c) When **W** is refluxed with aqueous potassium hydroxide, compound **Q** is formed. Identify:
- (i) **W** (01 mark)
- (ii) **Q** (01 mark)
- (d) Write equation and suggest a mechanism for the reaction between:

- (i) **W** and hot alcoholic potassium hydroxide solution. (02 marks)
- (ii) **W** and potassium cyanide in presence of ethanol and heat.
(03 marks)
- (e) Using equations only, show how **W** from propene and write the mechanism. (04 marks)
- (f) State what would be observed and write equation for the reaction between **W** and hot sodium hydroxide solution, dilute nitric acid and silver nitrate solution. (03½ marks)

♥ ===END===

WELCOME TO SENIOR SIX, YEAR 2018
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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