ATTEMPT ALL QUESTIONS IN THIS SECTION.

1. Complete the following **equations for nuclear reactions**.

   a. $^{239}_{94}Pu + ^{4}_{2}He \longrightarrow$ .... $+ ^{27}_{13}Al$ (01 mark)

   b. ... ... $\longrightarrow$ $^{234}_{90}Th$ $+ \alpha$ (01 mark)

   c. $^{214}_{83}Bi \longrightarrow$ $^{206}_{82}Pb +$ ... . $+ 3^{4}_{2}He$ (01 mark)

   d. $^{250}_{98}Cf +$ .... $\longrightarrow$ $^{257}_{103}Lw + 4^{1}_{0}n$ (01 mark)
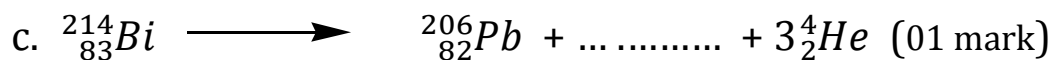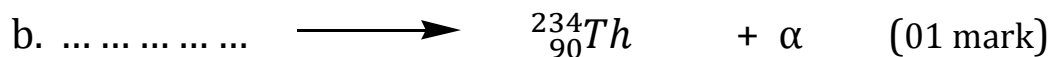
2. The **first three** successive ionisation energies of element **T** are **549, 1064** and **4226KJ/mol**.

   a. Explain the **trend in the variation energy** of **T**. (03 marks)

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   b. State the **group in the periodic table** to which **T belongs** to. (01 mark)

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3. **10.0cm³** of a hydrocarbon **P (C_xH_y)** was exploded in **90.0cm³** of oxygen gas. On cooling to room temperature, the residual gases occupied **70.0cm³**, when the residual gases were passed through potassium hydroxide solution, the volume reduced to **40.0cm³**.

   a. (i). Write the **equation** for the reaction between hydrocarbon **P** and **oxygen gas**. (01 mark)

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   (ii). Determine the **molecular formula** of hydrocarbon P.

   (03 marks)

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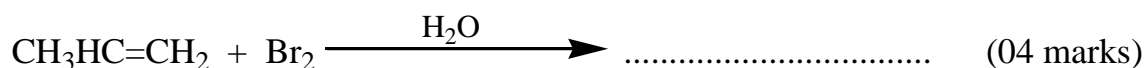
   b. Write equations to show how hydrocarbon **P** can be prepared from **propan-2-ol**. (02 marks)

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4. Complete the **equation** below and write the **suggested mechanism** for the reaction.

$$CH_3HC=CH_2 \ + \ Br_2 \xrightarrow{\text{H}_2\text{O}} \ \text{................................} \qquad \text{(04 marks)}$$

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5. Thermo energy data for some processes are shown in the table below.

Processes	Energy (KJ/mol)
✓ Atomization of calcium	+178
✓ First ionization energy of calcium	+590
✓ Second ionization energy of calcium	+1146
✓ Formation of calcium fluorine	-1220
✓ Electron affinity of fluorine	-328
✓ Bond dissociation of fluorine	+242.7

a. (i). Calculate the **lattice energy** of calcium fluoride crystal.

(02 marks)

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(ii).Determine the enthalpy of solution of calcium fluoride crystal.
[Enthalpies of Ca^{2+} and F^- ions are -1587 and -515KJ/mol]

(02½ marks)

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b. (i).State the **effect of temperature** of the solution of calcium fluoride. (01 mark)

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(ii).Give **a reason** for your answer in b (i). (0½ mark)

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6. Methane reacts with steam according to the following equation:

$$CH_{4(g)} + 2H_2O_{(l)} \longrightarrow CO_{2(g)} + 4H_{2(g)} \quad H_r = ?$$
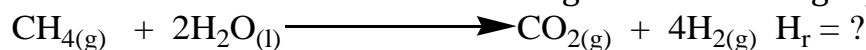
The enthalpy of formation of methane, water & carbon dioxide gas are $^-$76, $^-$242 & $^-$394KJ/mol.

$$C_{(s)} + 2H_{2(g)} \longrightarrow CH_{4(g)} \quad \Delta H_f \quad ^-76KJ/mol$$
$$H_{2(g)} + \tfrac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)} \quad \Delta H_f \quad ^-242KJ/mol$$
$$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)} \quad \Delta H_f \quad ^-394KJ/mol$$

a. Calculate the **enthalpy of reaction**. (03 marks)

$$CH_{4(g)} + 2H_2O_{(l)} \longrightarrow CO_{2(g)} + 4H_{2(g)}$$

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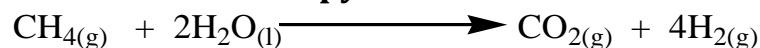
b. State whether the reaction above is **feasible**, give a **reason** for your answer. (01 mark)

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7. **2.0g** of phosphorus raises the boiling point of **37.4g** of carbondisulphide by **1.003°C**, whereas **4.65g** of sulphur raises the boiling point of **100g** of carbondisulphide by **0.42°C**.

   a. (i). Calculate the **boiling point constant** for carbondisulphide. (Molar mass of sulphur is **256**) (03 marks)

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   (ii). **Molar mass** of phosphorus in carbondisulpide. (03 marks)

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   b. Determine **the molecular formula** of phosphorus. (02 marks)

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8. (a). (i). State the **conditions for the reaction** between Benzene and sulphuric acid. (01 mark)

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(ii). Outline the **mechanism for the reaction** in **(a). (i)**. (02 marks)

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(b).Write **equation (s)** to show the product in **(a) (ii)** can be converted to hydroxybenzene. (02 marks)
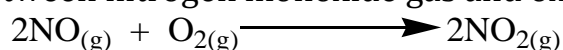
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9. (a). Define the **order of reaction**. (01 mark)

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(b).The experimental results in the table were obtained for the reaction between nitrogen monoxide gas and oxygen gas.

$$2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$$

Initial concentrations (mol/dm^3)		Rate of reaction (mol/dm^3/s)
NO	O$_2$	
0.03	0.03	2.7 X 10^{-5}
0.03	0.06	5.5 X 10^{-5}
0.06	0.03	10.8 X 10^{-5}

(i). Determine the **order of reaction** with respect to:
Nitrogen monoxide. (01 mark)

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   Oxygen. (01 mark)

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      (ii).Write the **rate equation** for the reaction. (0½ mark)

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(c).Calculate the:
      (i). **Overall order of reaction**. (0½ mark)

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      (ii).**Rate constant** for the reaction and **state it's S.I unit**.

(0½ mark)

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SECTION B–54 MARKS
ATTEMPT <u>ANY</u> SIX QUESTIONS IN THIS SECTION.

10.(a). Define the term **radioactivity**. (01 mark)

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(b).The table below shows how the mass of radioactive protactinium, $^{234}_{91}Pa$ varies with time.

mass of protactinium (g)	60.0	38.5	26.0	17.2	11.1
Time (s)	0	40	80	120	160

(i).Plot a **graph of mass** of protactinium against **time**.   (03 marks)
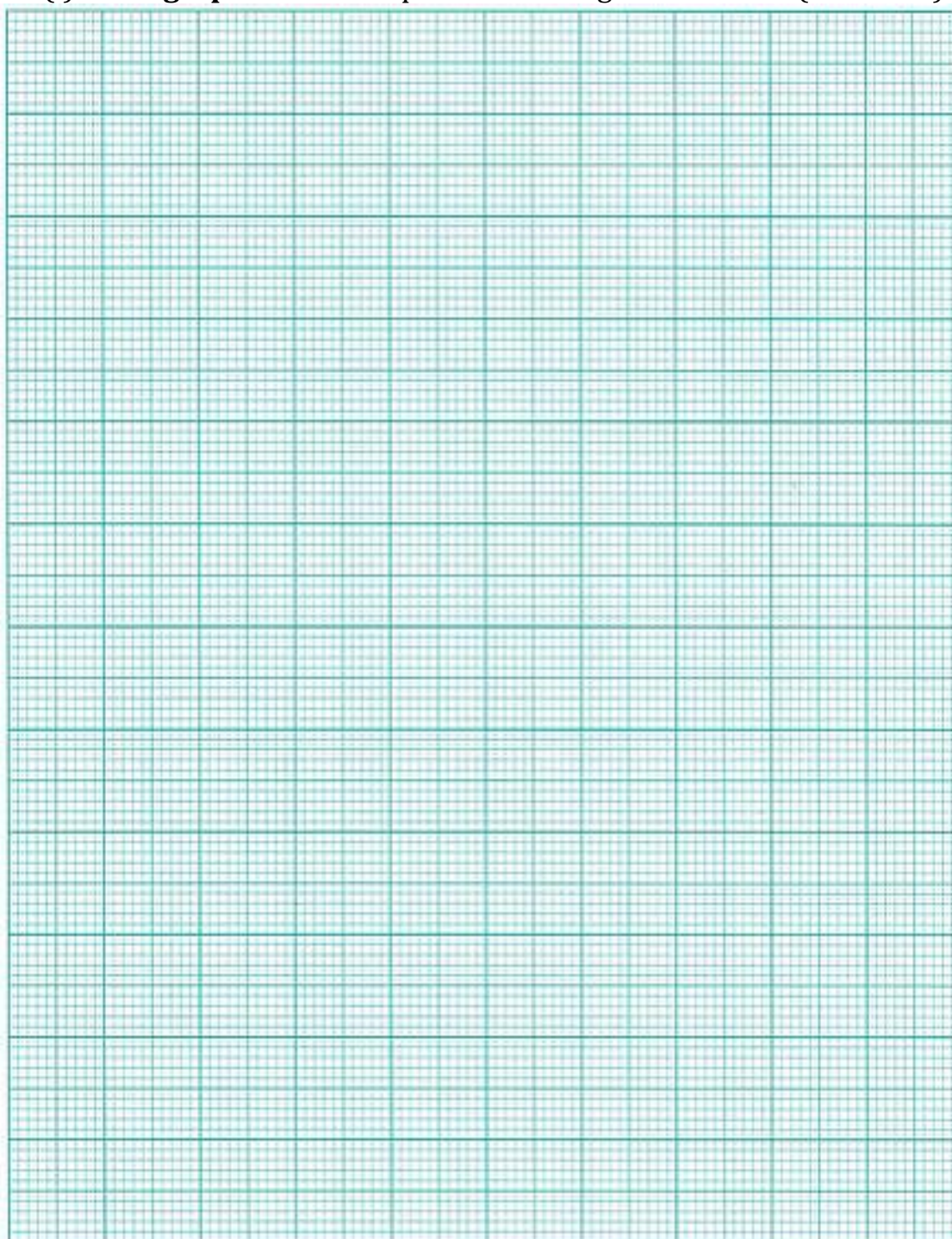
(ii).Use your graph to determine the **half-life** of protactinium.

(01 mark)

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(iii).Calculate the **radioactive decay** of protactinium.   (02 marks)

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11.Name one reagent that can be used to distinguish between the following pairs of compounds. In each case state what would be observed if each member of the pair is treated with the named reagent.

a. But-2-yne and But-1-yne

Reagent.   (01 mark)
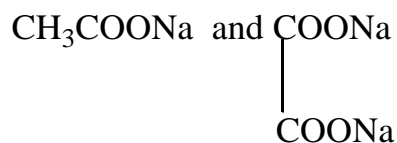
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Observations.   (02 marks)

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b. CO_2^{3-} and HCO_3^-

Reagent.   (01 mark)

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Observations. (02 marks)

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CH$_3$COONa and COONa
                     |
                   COONa

c.
Reagent. (01 mark)

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Observations. (02 marks)

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12. The vapour pressure of a solution containing **108.2g** of a substance **Y** in **1000g** of water at **20°C** was reduced by **0.186mmHg**.
(The vapour pressure of water at **20°C** is **17.54mmHg**)
   a. Calculate the **molecular mass** of substance **Y**. (04 marks)

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b. State **three assumption made** in (a). (03 marks)

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c. Explain why the vapour pressure of a solution containing a non-volatile solute is **less** than the vapour pressure of the pure solvent. (03 marks)

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13.(a).Draw the structure and name the shape of the following oxy anions of nitrogen gas. (03 marks)

Oxy anions	Structure	Shape
NO_2^-		
NO_3^-		

(b)(i).Name the reagent (s) that can be used to distinguish between the oxyanions in (a) above. (01½ marks)

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(ii). State what would be observed if the solution of each oxy anion is separately treated with the reagent (s) you have named in b (i) above. (02 marks)

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(iii). Write three equation (s) if any reaction (s) that would take place when a solution of each oxy anion is treated separately with the reagent (s) you have named in b (i).

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14. The table shows the atomic radius and first ionization energy of some elements in period 3 of the periodic table.

Elements	Na	Mg	Al	Si	P	S	Cl
Atomic radius	0.186	0.160	0.143	0.117	0.110	0.104	0.099
1st I.E(KJ/mol)	496	738	577	787	1060	1000	1251

a. (i). State how **atomic radius** of the elements **varies across** the period. (01 mark)

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(ii). Explain your answer in a (i). (03 marks)

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b. (i).Explain how atomic radius affects the ionization energy.

(02 marks)

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(ii).Why the first ionization energy of aluminium is lower than that of magnesium.   (03 marks)

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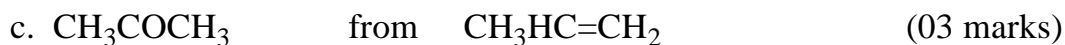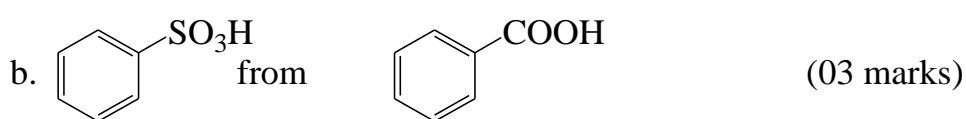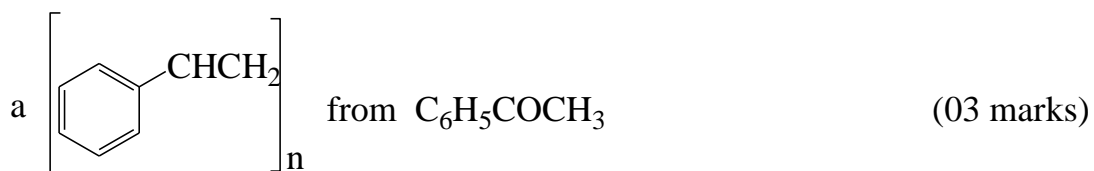...

15.Write equations to show how the following compounds can be synthesized and in each case state the conditions for the reaction.

a $\left[\begin{array}{c} \text{C}_6\text{H}_5\text{—CHCH}_2 \end{array}\right]_n$ from $C_6H_5COCH_3$ (03 marks)

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b. $C_6H_5\text{—}SO_3H$ from $C_6H_5\text{—}COOH$ (03 marks)

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c. CH_3COCH_3 from $CH_3HC=CH_2$ (03 marks)

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16. Write an equation for dissolution of each of the following compounds in water. State whether the resultant solution is **neutral, acidic** or **basic**.
   a)   Sodium Sulphide.   (02 marks)

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b)   Ammonium Methanoate.   (02 marks)

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c)   Phenyl Ammonium Chloride.   (03 marks)

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d)   Sodium Benzoate.   (02 marks)

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17. Complete the following equations and in each case outline a suitable **mechanism** for the reaction.

a. $CH_3CH_2C \equiv CH \xrightarrow{\quad 2HBr \quad}$ ....   (03 marks)

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b.   + Conc.H_2SO_4 $\xrightarrow{\text{Conc.HNO}_3}$ .... (02 ½ marks)

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c. $C(CH_3)_3Br$ $\xrightarrow[\text{Heat}]{\text{NaOH}_{(aq)}/CH_3CH_2OH}$ .... (03½ 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===

WELCOME TO SENIOR SIX, YEAR 2019

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