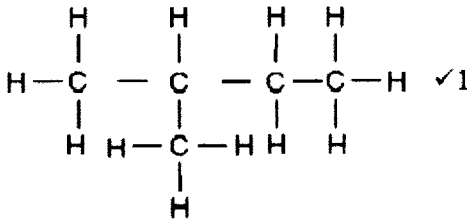
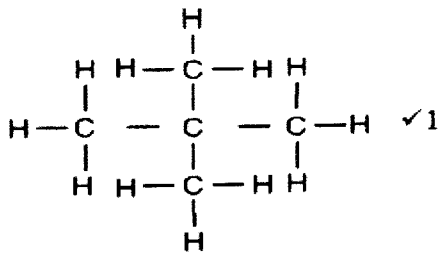
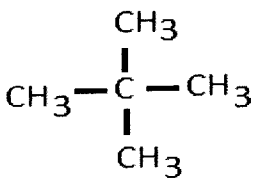
4.7.2 Chemistry Paper 2 (233/2)

1.	(a) Molecular formula $= C_nH_{2n+2}$, n = 11 $= C_{11}H_{11\times2+2}$ $= C_{11}H_{24}$ ✓ 1	(1 mark)
	(b) (i) Cracking ✓ 1	(1 mark)
	(ii) Catalyst ✓ ½ High temperature /heating/400°C-700°C✓ ½	(1 mark)
	(iii) **B** – Hexene/Hex-1-ene ✓1	(1 mark)
	(c)  ✓1 2-methylbutane ✓1 OR $CH_3CHCH_2CH_3$ (CH₃ branch) **OR** $CH_3CH_2CH_2CH_2CH_3$ Pentane	(2 marks)
	 ✓1 2,2-dimethylpropane ✓1 **OR** 	(2 marks)

	(d) $C_5H_{12}(g) + 3O_2(g) \rightarrow 5C(s) + 6H_2O(l)$ OR ✓ 1 $C_5H_{12}(g) + \frac{11}{2}O_2(g) \rightarrow 5CO(g) + 6H_2O(l)$	(1 mark)
	(e) - Decomposition / breakdown of organic matter✓ 1 in the absence of oxygen. ✓ 1	(2 marks)
	(f) -Heat a mixture of sodium ethanoate and sodalime✓ 1 - methane gas is produced and collected over water/ in a syringe/upward delivery✓ 1	(2 marks)
		13 marks
2.	(a) (i) - Dynamic equilibrium refers to a state of balance/reaction in which forward and backward/reverse reactions are taking place at the same rate. ✓ 1	(1 mark)
	(ii) - The intensity of the orange colour increases. ✓ 1 Addition of H^+ ions, sulphuric(VI) acid removes OH^- ions from the equilibrium mixture hence equilibrium shifts to the left. ✓ 1	(2 marks)
	(b) (i) Nitrous acid / HNO_2/ Nitric(III) acid	(1 mark)

(ii) I. Decrease in temperature favours forward (exothermic) reaction ✓ 1 hence equilibrium shifts to the right. ✓ 1 (2 marks)

II. Increase in pressure causes more of the products to the combine ✓ 1 hence equilibrium shifts to the left ✓ 1 where we have fewer number of moles. (2 marks)

(III) No effect/ Catalyst does not affect the position of the equilibrium but affects the rate at which the equilibrium is attained. ✓ 1 (1 mark)

(c) Rate of the reaction decreases ✓ 1 because the molecules are moving slowly due to decrease ✓ 1 in the kinetic energy of the molecules hence less effective collisions. (2 marks)

(d) No. of moles of $NH_3 = \frac{100}{17} = 5.88$ ✓ 1

68kg (4x17) of NH_3 produces 120kg (4x30) of NO

100kg of NH_3 should produce $\frac{100}{68} \times 120 = 176.5$ kg of NO✓ 1.

No. of moles of $NO = 5.88$ but the expected mass is

$176.5g \rightarrow 5.88$ moles.

$\therefore$ % yield $= \frac{160}{176.5} \times 100\%$ (3 marks)

= 90.65%✓ 1

OR

Mole ratio for $NH_3 : NO$

1 : 1 ✓ ½

$17g \rightarrow 30g$

$100g \rightarrow ?$

$\frac{100}{17} \times 30 = 176.5g$ ✓ 1

% yield $= \frac{160}{176.5} \times 100\%$ ✓ ½

= 90.65% ✓ 1 (3 marks)

(14 marks)

3.

	Name	Formula	
(a) (i)	Siderite ✓ ½	$FeCO_3$ ✓ ½	(2 marks)
(ii)	Magnetite ✓ ½	Fe_3O_4 ✓ ½	
	Iron pyrites	FeS_2	

(Any two correct)

(b) (i) Temperature in region I is lower than that in region II (700°C) ✓ ½ because the raw materials are not pre-heated. ✓ ½ (1 mark)

OR

Reaction in region I is endothermic while in region II is exothermic. (1 mark)

(ii) I. $C(s) + O_2(g) \rightarrow CO_2(g)$ ✓ 1 (1 mark)

OR

$3CO(g) + Fe_2O_3(s) \longrightarrow 3CO_2(g) + 2Fe(l)$

(2 marks)

II. $CaCO_3(g) \underline{Heat}\ CaO(s) + CO_2(g)$ ✓ 1 (1 mark)

(iii) Accept any value between 1535°C and 3000°C ✓ 1.
The temperature keeps the iron in molten state ✓ 1. (2 marks)

(iv) Calcium silicate / $CaSiO_3$ ✓ 1 (1 mark)

(v) It forms a protective layer over the iron so that the iron does not react with the hot air. ✓ 1 (1 mark)

(vi) I. - Carbon ✓ 1

II. - Making manhole covers; ✓ 1
- Bunsen burner bases;
- Electric poles;
- Fire grills.
- Iron boxes
- Manufacture of steel
- Electric arch furnaces
- Iron pipes (2 marks)

(Any one correct)

(vii) - The waste gases ✓ 1 should be used to preheat the air blast ✓ 1.

- Carbon(IV) oxide is reduced to carbon(II) oxide which acts as a reducing agent. (2 marks)
- Carbon(II) oxide is used as a reducing agent

13 marks

4.	(a) (i) Na_2O ✓ ½ Na_2O_2 ✓ ½	(1 mark)
	(ii) Cl_2O ✓ ½ Cl_2O_7 ✓ ½	(1 mark)
	(b) $2P(s)+3Cl_2(g) \rightarrow 2PCl_3(l)$ ✓ 1 $P_{10}(s) + 5Cl_2(g) \longrightarrow 10PCl_3(g)$ (Accept (g) or (l) for PCl_3	(1 mark)
	(c) Al✓ 1 – It has the highest number of outermost electrons /valency /delocalized electrons per atom. ✓ 1	(2marks)
	✓ 1 (d) React each of the metals with water. Reactivity increases Na > Mg > Al. Sodium reacts vigorously with cold water ✓ 1, magnesium reacts slowly with cold water ✓ ½ while aluminium does not react with water. ✓ ½	(3 marks)
	(e) (i) The melting point of chlorine is greater than that of argon.✓ 1 Molecular size of chlorine is greater than that of argon ✓ ½ hence chlorine has stronger Van der Waals forces. ✓ ½ **OR** Chlorine is a diatomic molecule with stronger Van der Waals forces compared to argon which is monoatomic.	(2 marks)
	(ii) Melting point of magnesium oxide is greater than that of silicon(IV)oxide✓2	(2 marks)
		12 marks

5.	(a) Concentration - 1.0M solutions; Pressure - 1 atmosphere; Temperature - 25°C/298 K or room temperature. **(All the 3 correct for 2 marks)** **(Any 2 correct for 1 mark)** **(1 correct for 0 mark)**	(2 marks)
	(b) (i) A_1 – Pb/ lead electrode A_2 – 1.0M Pb^{2+} ions / aqueous lead(II) nitrate A_3 – Ag / Silver electrode A_4 – 1.0M Ag^+ ions / aqueous silver nitrate	(2 marks)
	(ii) $Pb(s) + 2Ag^+(aq) \rightarrow Pb^{2+}(aq) + 2Ag(s)$ ✓ 1 e.m.f. = $E^{\theta}_{\text{Reduced cell}}$ - $E^{\theta}_{\text{oxidised cell}}$ = $+0.8 - {}^{-}0.13$ ✓ ½ = +0.93V ✓ ½	(2 marks)
	(iii) Chloride ions from the salt bridge move into the lead half-cell to balance the charges while the potassium ions move the silver half-cell. Formation of insoluble lead(II) chloride reduces the concentration of the electrolyte in the lead half-cell hence reduces the efficiency of the salt bridge. ✓ 1	(1 mark)
	(c) - The potassium electrode will react vigorously with water. ✓ 1	(1 mark)
	(d) - Brown colour changes to green ✓ ½ and a grey/black precipitate formed. ✓ ½ The E^{θ} value for the reaction $Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$ is + 0.23V ✓	(2 marks

	(e) (i) $KMnO_4$ acts as its own indicator changing from purple to colourless. ✓ 1	(1 mark)
	(ii) Moles of $Cr_2O_7^{2-} = \frac{18\times0.15}{1000}$ ✓ ½ $= 0.0027$ Moles of Fe^{2+} in $25.0cm^3 = 6\times0.0027$ ✓ ½ $= 0.0162$ Moles of Fe^{2+} in $250cm^3 = 0.0162\times10$ ✓ ½ $= 0.162$ ✓ ½ Mass of iron $= 0.162\times56$ ✓ ½ $= 9.072g$ ✓ ½	(3 marks)
		14 marks
6.	(a) (i) When it rains carbon(IV) oxide in air dissolves in the water to form acid rain. $CO_2 + H_2O \rightarrow H_2CO_3$ ✓½ The acid rain reacts with carbonate rocks of magnesium and calcium to form soluble magnesium hydrogen carbonate and calcium hydrogen carbonate. ✓½	(1 mark)
	(ii) At high temperatures calcium hydrogen carbonate decomposes ✓1 to form scales (insoluble calcium carbonate) in boilers that causes poor thermal conductivity✓1.	(2 marks)
	(b) (i) Permanent hardness. ✓ 1	(1 mark)
	(ii) Aqueous sodium carbonate is added to the water✓ 1. Carbonate ions (CO_3^{2-}) precipitates calcium ions (Ca^{2+}) to form insoluble calcium carbonate which is then filtered off ✓ 1	(2 marks)

	(iii) I. $RNH_3^+OH^-(s) + Cl^-(aq) \rightarrow RNH_3Cl(s) + OH^-(aq)$	(1 mark)
	$2RNH_3^+OH^-(s) + NO_3^-(aq) \longrightarrow RNH_3NO_3(s) + OH^-(aq)$	(1 mark)
	II. $RSO_3^-H^+$ ✓ 1/$RCOO^-H^+$	
	Any correct 1 mark	
	III. Resins do not remove micro- organisms/bacteria/ pathogens/germs, ✓ 1 boiling of water kills ✓ 1 micro-organisms that might be present in water.	(2 marks)
	(c) (i) $CH_3(CH_2)_{13}CH_2\overset{O}{\overset{\|\|}{C}}-O^-K^+$	(1 mark)
	$C_{15}H_{31}COOK$✓ 1	
	(ii) Potassium soaps are soft/mild while sodium soaps are hard. ✓ 1	(1 mark)
	(d) Hydrophobic – $CH_3(CH2)_{13}CH_2$- ✓ 1	(1 mark)
	Hydrophilic - -$OSO3^-Na^+$ ✓ 1	(1 mark)
		14 marks