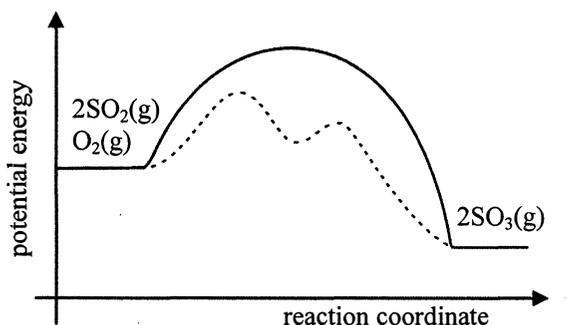


Paper 2

Marks

1. (a) (i) (1) $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ 1
 (2) The reaction mixture is cooled to condense ammonia to liquid. 1
 (ii) The order of reaction with respect to A is zero. 1
 From the graph, rate of change of [A] is independent from [A]. 1
 (iii) flammable 1
 (b) (i) 3



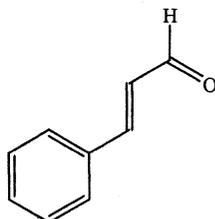
- (ii) (1) Impurities in the reaction mixture may poison the catalyst. 1
 (2) (I) Lowering the temperature makes the reaction proceed at a slower rate. 1
 (II) The percentage conversion is already very high. Increasing the pressure can only lead to a small increase in the percentage conversion but very high cost is needed. 1
 (3) Oxygen is used in a slight excess because oxygen is more readily available. 1
 (c) (i) $\text{CH}_4 + \text{H}_2\text{O} \rightarrow \text{CO} + 3\text{H}_2$ 1
 (ii) (1) $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ 1
 (2) $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$ 1
 (3) Mercury is poisonous. 1
 (iii) Let $\text{rate} = k[\text{CO}]^m[\text{Cl}_2]^n$ 2
 From doubling [CO] while keeping [Cl₂] unchanged,
 $2.83 = 2^m$
 $m = 1.5$
 (iv) (1) The atom economy of the reaction is 100%. / No solvent is required in the reaction. 1
 (2) The reactants are poisonous. 1

Marks

2. (a) (i) Cross-linkages / covalent bonds / disulphur linkages are formed between polymer chains. With cross-linkages, the polymer chains cannot slip easily over each other. 1
1
- (ii) The structure of HDPE is less branched than that of LDPE. 1
- (iii) A exhibits liquid crystal behaviour. A molecule of A has a rigid central part, a polar group / ester group and a long alkyl chain. 2
- (b) (i) (1) coordination number = 12 1
(2) number of Cu atoms = $12 \times (1/4) + 1 = 4$ 1
- (ii) (1) hexagonal close-packed 1
(2) Similarity: coordination number (12) / close-packed structures 1
(3) Difference: 1
• Cu : A-B-C type packing 1
• Zn : A-B type packing 1
- (iii) brass 1
- (c) (i) $\text{CH}_2=\text{C}(\text{CH}_3)\text{CO}_2\text{CH}_3$ 1
petroleum / crude oil 1
- (ii) contact lens 1
- (iii) (1) Thermoplastic is a type of plastic that becomes soft when heated; becomes hard when cooled. 1
(2) • Production: Raw material is biomass. 1
• Disposal: PHB is biodegradable. 1
- (iv) (1) Small molecules (e.g. H_2O) would be eliminated in the reaction. 1
(2) Disposal: PHB undergoes hydrolysis in the presence of acids / alkalis. 1

Marks

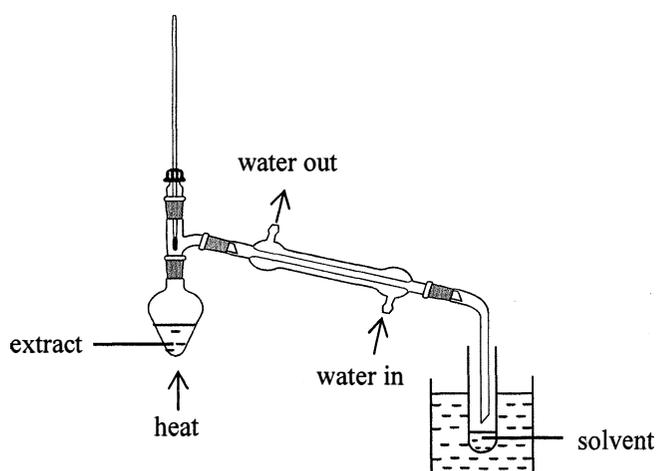
3. (a) (i) Flame tests are carried out. 1
Sodium ions give an intense golden yellow flame while potassium ions give a lilac flame. 1
- (ii) Add a piece of filter paper which is soaked with acidified $K_2Cr_2O_7(aq)$ to the gas. 1
The filter paper turns from orange to green. 1
- (iii) 1



- (b) (i) From pale yellow to pale pink 1
- (ii) (1) $(37.62+37.58+37.60) \div 3 = 37.60 \text{ cm}^3$ 1
- (2) Number of moles of $Fe^{2+}(aq)$ ions formed in Step (1) 3
 $= 0.0282 \times 37.60 \times 10^{-3} \times 5 \times 10 = 0.0530$
 Number of moles of $Fe^{3+}(aq)$ ions reacted in Step (1) = 0.0530
 Number of moles of $HONH_2(aq)$ reacted = $0.875 \div 33.0 = 0.0265$
 Mole ratio of $HONH_2(aq) : Fe^{3+}(aq) = 1 : 2$
- (3) The oxidation number of iron changes from +3 to +2 and the oxidation number of N 2
 in $HONH_2(aq)$ is -1.
 Since the mole ratio of $HONH_2(aq) : Fe^{3+}(aq) = 1 : 2$, the oxidation number of N in
 this oxide = $-1+2 = +1$

(iii) N_2O 1

- (c) (i) (1) The solvent will not lose during heating. 1
- (2) 2



- (3) column chromatography 1
- (ii) **W** 1
 It has $>C=O$ group: It has a strong absorption peak at around 1700 cm^{-1} in its IR spectrum. 1
 It has no $-COOH$ group: It does not react with $NaHCO_3(aq)$. 1