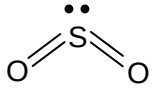
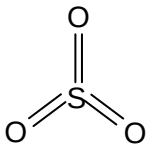
H2 Chemistry 9746/2
JJ 2009 Preliminary Examination Paper 2 (Suggested Answers)

1. (a) (i)



[1]



[1]

Bent/ angular/ v-shape [1]

trigonal planar [1]

(ii)

P/ kPa	V/ m^3	PV/ kPa m^3
6.0	0.375	2.3
12.0	0.188	2.3
18.0	0.125	2.3

[1] for 3 correct values to 1 d.p

(iii) Since **PV** is **constant**, SO_2 behaves **ideally**. [1]

(iv) At **low pressure**, the **volume of** (SO_2) **molecules become negligible compared to the volume of gas/container.** [1]

OR

At **low pressure**, **molecules** are **well spaced-out**, resulting in **negligible intermolecular attraction**. [1]

(b) (i)

$2SO_2\ (g) + O_2\ (g) = 2SO_3\ (g)$

Initial p.p	10	5	-
Eqm p.p	10-2x	5-x	2x

At eqm, **10 – 2x + 5 – x + 2x = 11** [1]

x = 4

P_{SO2} = 10 - 2(4) = **2 atm** (✓)

P_{O2} = 5 - 4 = **1 atm** (✓)

P_{SO3} = 2(4) = **8 atm** (✓)

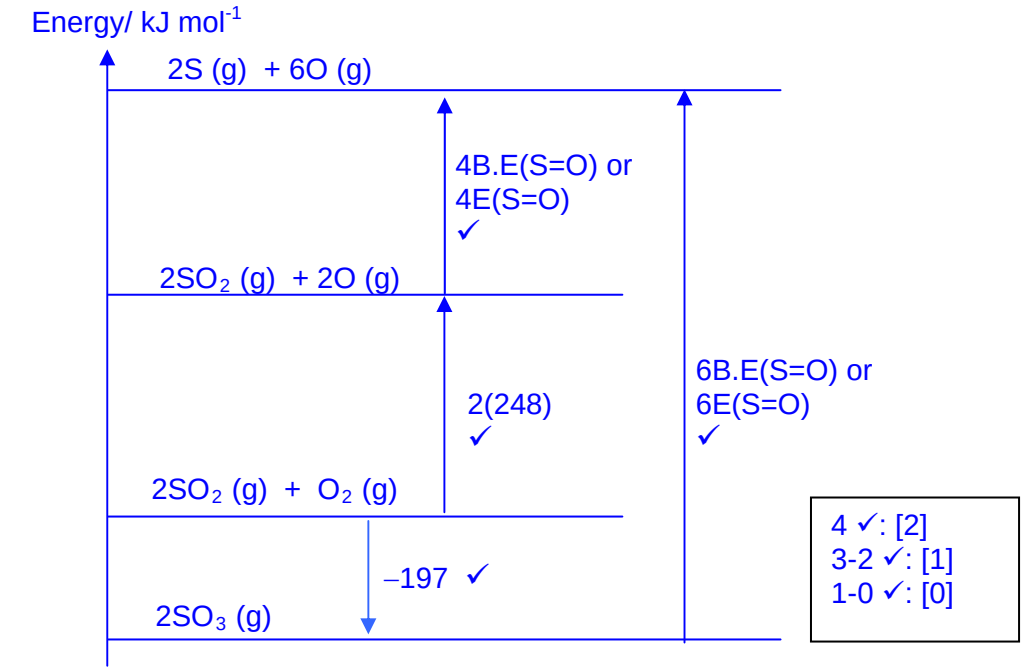
3(✓): [2] 1-2(✓): [1]

(ii) $K_p = \frac{8^2}{2^2(1)} = 16\ \text{atm}^{-1}$ [1] with correct units; ecf from (b)(i)

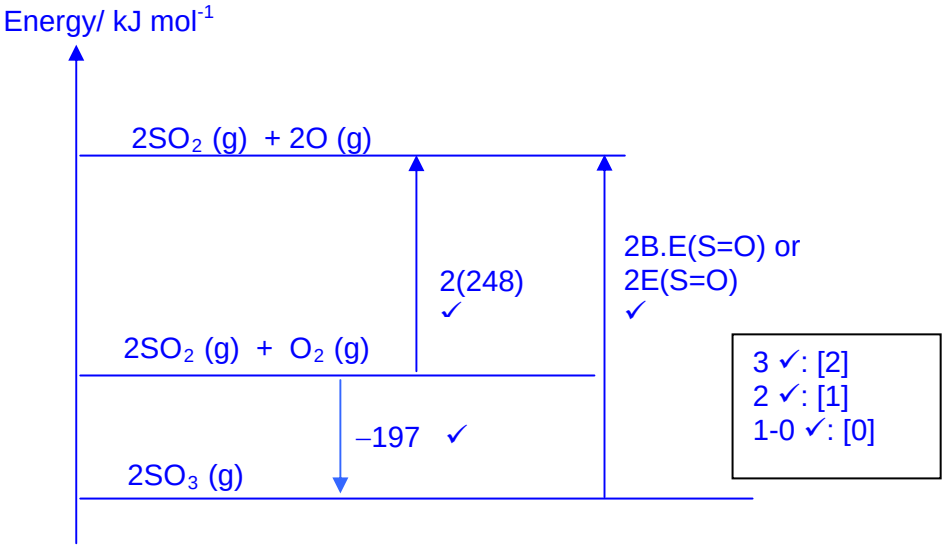
(iii) When pressure is lowered, **eqm position is shifted to the left** to **increase the number of gaseous molecules**. [1]

Yield/ amount of SO_3 **decreases**. [1]

1. **(c)** **(i)**



OR



(ii) 6E(S=O) = 4E(S=O) + 2(248) – (-197) or 2E(S=O) = 2(248) – (-197)

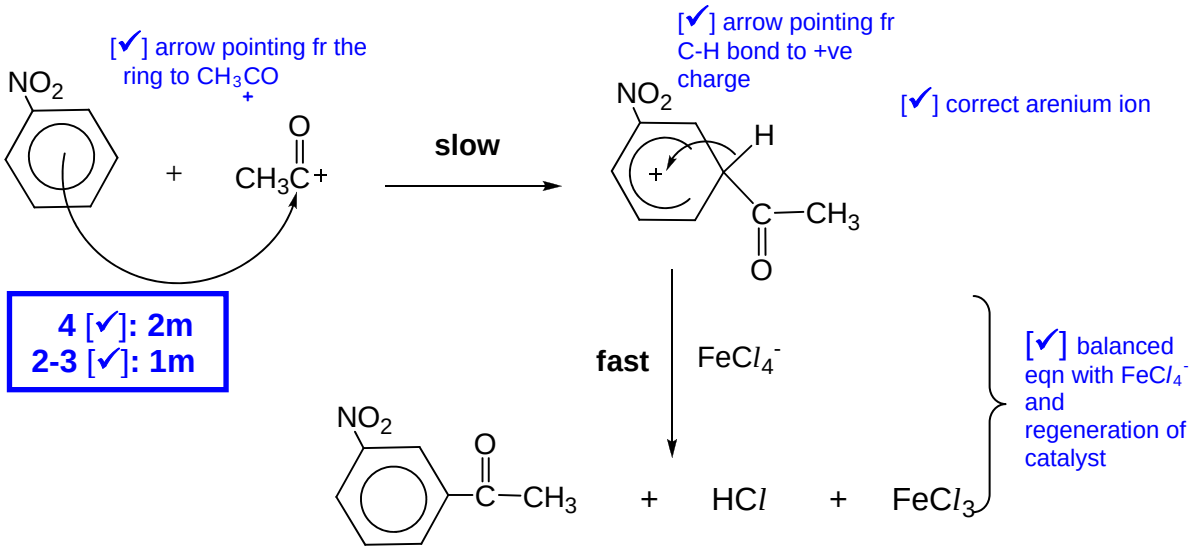
E(S=O) = 346.5 kJ mol^{-1} or 347 kJ mol^{-1} [1]

2. **(a)** **$Fe(H_2O)_6^{3+} = Fe(H_2O)_5(OH)^{2+} + H^+$** [1]

(b) **(i)** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$ [1]

(ii) **Colourless** [1]
because **Cu^+ does not have unfilled/ partially filled d-orbital** [1]

2. (c)



4 [✓]: 2m
2-3 [✓]: 1m

3. (a) Concentration of vanillin may be followed by **measuring the colour intensity** of vanillin [1]

(b) Using the graph [HCN] = 5.00 mol dm^{-3},

$(t_{1/2})_1 = (t_{1/2})_2 = 0.095$ min [1]

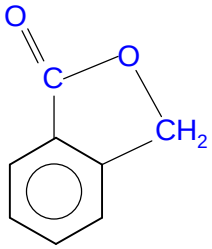
Since **half-lives is constant**, it is **1st order w.r.t vanillin**. [1]

(c) When the **concentration of HCN increased by 50 times** (from 0.1 mol dm^{-3} to 5.00 mol dm^{-3}), **half life decreased by 50 times.** [1]

Order of reaction with respect to HCN is one. [1]

(d) Type of reaction: **esterification/ ester formation** [1]

Structure of **R**



[1]

4. (a) (i)

	Mn	O
Mass	63.8	36.2
A_r	54.9	16.0
Mole	1.16	2.26
Ratio	1	2

Empirical Formula: **MnO_2** [1]

(ii) Identity of **Z**: **MnO_4^-** [1]

Type of reaction **Disproportionation** [1]

Equation **$3MnO_4^{2-} + 2H_2O \rightarrow 2MnO_4^- + MnO_2 + 4OH^-$** [1]

(b) (i) Anode **$Zn \rightarrow Zn^{2+} + 2e$** [1]

Cathode **$2MnO_2 + 2H^+ + 2e \rightarrow Mn_2O_3 + H_2O$** [1]

(ii) $E^{\ominus}_{cell} = E^{\ominus}(MnO_2/ Mn_2O_3) - (-0.76) = 1.5$

$E^{\ominus}(MnO_2/ Mn_2O_3)$ = **0.74 V** [1]

5. (a) (i) **X** is **Na/ Mg** [1]

W is **Si** [1]

(ii) **$SiCl_4 + 2H_2O \rightarrow SiO_2 + 4HCl$** [1]

(b) To 2 separate samples of the powder, **add in dilute HCl** and **dilute NaOH** [1] respectively.

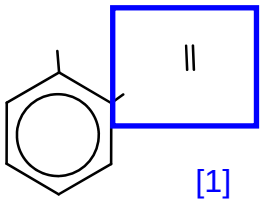
If the **powder dissolves in both dilute HCl and dilute NaOH** to **form colourless solution**, it is **Al_2O_3**. [1]

If the **powder dissolves only in dilute HCl to form colourless solution,** it is **MgO**. [1]

If the **powder does not dissolve in both dilute HCl and dilute NaOH**, it is **SiO_2**. [1]

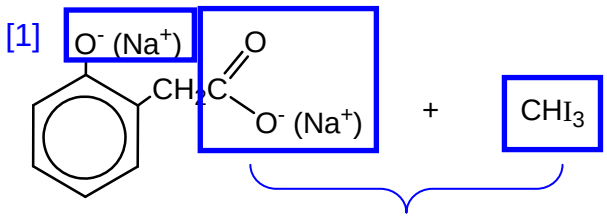
6. **(a)** **Phenol and secondary alcohol** [1]

(b) **(i)**



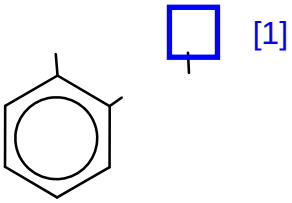
[1]

(ii)



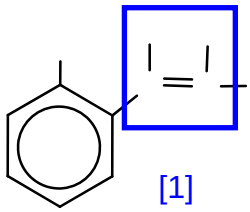
[1]

(iii) $SOCl_2$



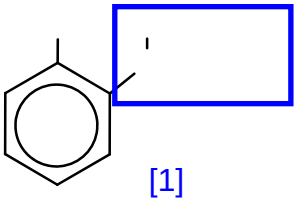
[1]

(c) **(i)**



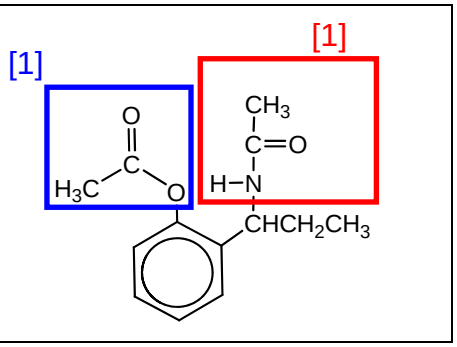
[1]

B



[1]

C



E

6. **(c)** **(ii)** **Excess NH_3, heat** under reflux **in ethanol**. [1]

(d) **F**, an aromatic amine, is a **weaker base** than D, an aliphatic amine. [1]

The **lone pair of electrons on N atom of F is delocalised into the benzene ring**, and hence is **less available for protonation** as compared to that of D. [1]

7. **(a)** **Ile-His-Cys-Pro-Gly-Val-Leu-Pro-Val-Lys-Val** [1]

(b) At low pH, **–N / –NH becomes $–NH^+$ / $–NH_2^+$**. This **disrupts** the **hydrogen bonds** in the tertiary structure, and hence lead to denaturation. [1]

(c) **(i)** **Glu** forms a **peptide bond** to cysteine, through the **–COOH group of its side chain** rather than its main carboxylic acid group [1]

(ii) Zn^{2+} ions bind tightly to the –SH group of the cysteine residues. This **disrupts the disulphide bridges** in the tertiary structure, [1]

This disruption results in the **shape of the cartiliage protein being altered/ causes cartiliage protein to fold differently** and hence, leads to denaturation of cartiliage protein. [1]