AJC H2 Chemistry Prelim 2008 - Paper 2 Suggested Answers

1 (a) (i) $M\ \mathbf{(g)} \rightarrow M^{+}\ \mathbf{(g)} + e$

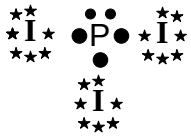
(ii) Iodine has a **higher nuclear charge and exerts a higher screening effect**

Hence, the valence electrons in iodine experiences the **similar effective**

nuclear charge as that for the valence electron in phosphorus.

(b) (i) $P_4 + 6I_2 \rightarrow 4PI_3$

(ii)

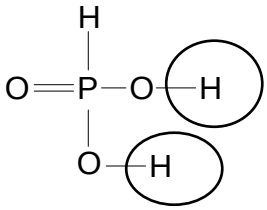


Shape of molecule trigonal pyramidal

(iii) **Energetically unfavorable** to arrange five iodine atoms around small central P

Atom, **OR Steric hindrance** prevents five iodine atoms to be bonded to P atom

(c) (i)



(ii) $K_{a\ (1)}$ $\mathbf{H_3PO_3 \Leftrightarrow H_2PO_3^{-} + H^{+}}$

$K_{a\ (2)}$ $\mathbf{H_2PO_3^{-} \Leftrightarrow HPO_3^{2-} + H^{+}}$

(iii) More **difficult** to dissociate another $\mathbf{H^{+}}$ from a **negatively** charged ion**.**

(iv) P-H bond is **non-polar**, hence $\mathbf{H^{+}}$ **cannot be formed easily**.

2 **(a)** **(i)** **$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$**

(ii) HI is **more reducing** than HCl, hence it is **oxidized to I_2** by conc H_2SO_4

(b) **(i)** 0.0500 mol min^{-1}

(ii) 0.0250 mol

(iii) 0.0750 mol

(iv) 25%

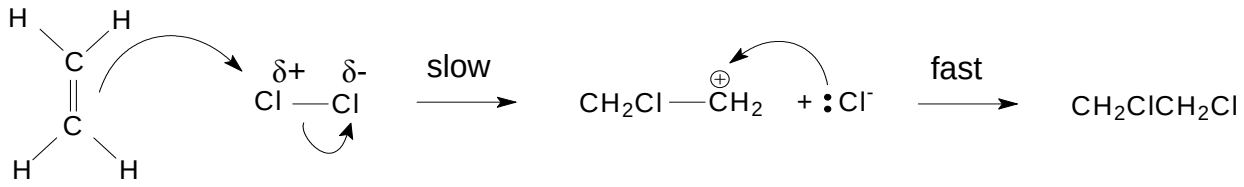
(v) Any **one** of the following:

- All the HCl that emerged from chamber was absorbed by NaOH
- C_2H_4 does not undergo combustion inside the chamber

(c) **(i)** reagent(s) **Cl_2**

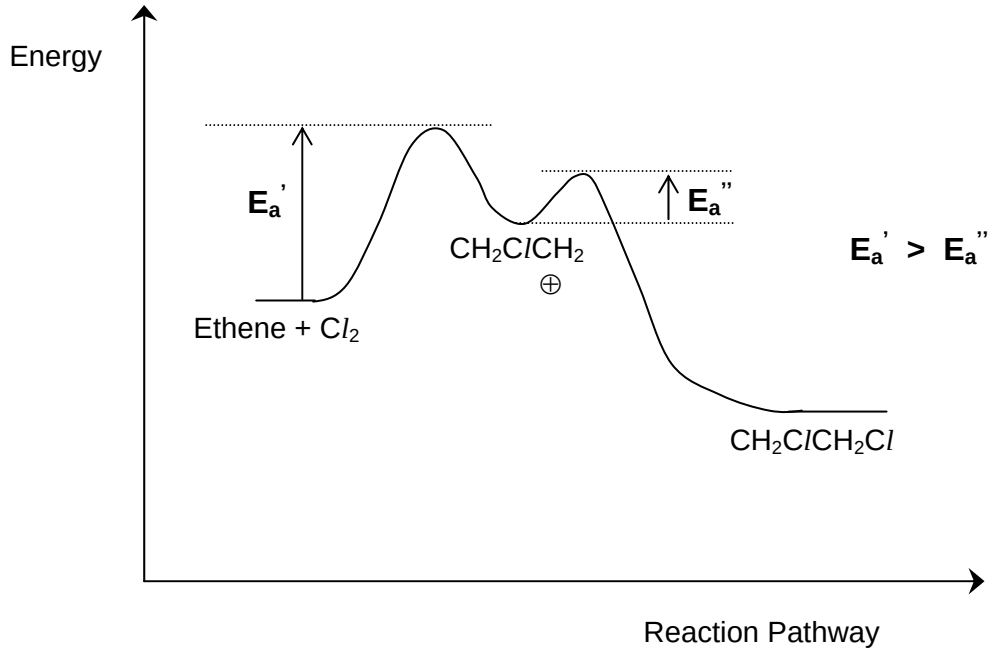
condition(s) **Room temperature**

(ii)



Type of reaction mechanism Electrophilic addition

(iii)



(iv) By-product, **CH_2ClCH_2OH,** can be formed because **H_2O is a nucleophile** and will react with the $CH_2\overset{\oplus}{C}lCH_2$ **carbocation**.

3 (a) (i) **Mg** reacts with **slowly** with **hot water**,

effervescence observed and a **white ppt** is formed.

Ba reacts **rapidly** with **cold water**

effervescence observed and a **colourless solution** is formed.

(ii) **$M(NO_3)_2 \rightarrow MO + 2NO_2 + ½O_2$**

(iii) **$Mg(NO_3)_2$** decomposes at the lower temperature

Mg^{2+} is **smaller** than Ba^{2+}, hence possesses **higher charge density / higher polarizing power**

Electron cloud of NO_3^- is **distorted more easily**

N-O bond in NO_3^- **breaks more easily / is more weakened** in $Mg(NO_3)_2$

(b) **(i)** $K_{sp} = [Mg^{2+}][F^-]^2$

(ii) 2.10×10^{-3} mol dm^{-3}

(iii) $[F^-]$ in fluoridated drinking water $= 5.26 \times 10^{-5}$ mol dm^{-3}
Good source.

(iv) 7.40×10^{-4} mol dm^{-3}

4 **(a)** **(i)** $K_p = \dfrac{P_{NO_2}{}^2}{P_{NO}{}^2 . P_{O_2}}$

(ii) 300K

K is the largest at 300K,

(iii) 0.1

(b) From the K_p values, **the formation of NO is endothermic** which is favoured by the **high temperature** in car engines.

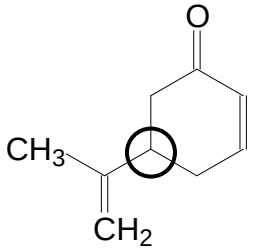
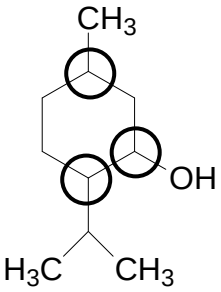
The **formation of NO_2 is exothermic** which is favoured by the **lower temperature outside**.

(c) **Time** is needed for the NO emitted from the car engine to **cool down** to 300K

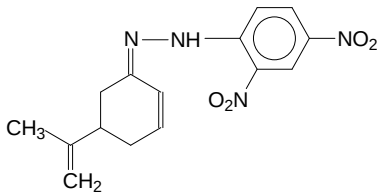
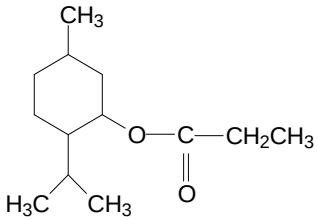
(d) Lowering the pressure will **not reduce** the formation of NO

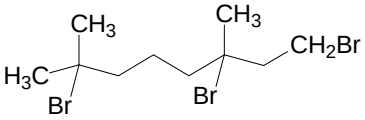
Pressure has **no effect on the position** of equilibrium between N_2, O_2 and NO as there is **no change in the number of gas molecules**.

5 (a)

	structural formula	no. of stereoisomers
Carvone		**2**
Menthol		**8**

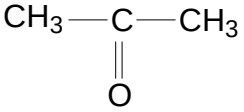
(b)

terpenoid	reagent and condition	structural formula of the product
Carvone	2,4-dinitrophenylhydrazine, room temperature	
Menthol	CH_3CH_2COCl, room temperature	

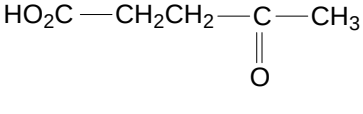


(c) (i) $\underline{\mathbf{H_2C_2O_4}}$ + [O] → $2CO_2$ + H_2O

(ii)



compound **B**



compound **C**

(iii)

test Na test / Na_2CO_3 test / PC*l* or SOCl_2 test

observations For **C**: H_2 / CO_2 / HCl fumes produced

For **B**: **No** H_2 / CO_2 / HCl fumes produced