

**2009 A-LEVEL H1 CHEMISTRY (8872)**  
**PAPER 1: MCQ SUGGESTED ANSWERS**

Q	Ans	Q	Ans	Q	Ans
1	B	11	D	21	D
2	D	12	C	22	B
3	A	13	B	23	C
4	C	14	A	24	B
5	C	15	B	25	C
6	D	16	B	26	A
7	B	17	B	27	B
8	C	18	C	28	B
9	D	19	A	29	C
10	A	20	D	30	B

**Section A**

1 Mr of  $C_6H_{12}O_6 = 6 \times 12.0 + 12 \times 1.0 + 6 \times 16.0$   
 $= 180.0$

$$n_{C_6H_{12}O_6} = \frac{18}{180.0} = 0.100 \text{ mol}$$

$$n_C = 0.100 \times 6 = 0.600 \text{ mol}$$

$$\text{No. of atoms of C} = 0.600 \times 6.02 \times 10^{23}$$

$$= \underline{3.6 \times 10^{23} \text{ atoms}}$$

**Ans: B**

2 There is a big jump in IE from 4<sup>th</sup> e<sup>-</sup> to 5<sup>th</sup> e<sup>-</sup>  
 $\rightarrow$  4e<sup>-</sup> in outermost shell.

$\therefore$  M is in Group IV  $\rightarrow$  M is Silicon.

Note: There is a small jump in IE from 2<sup>nd</sup> e<sup>-</sup> to 3<sup>rd</sup> e<sup>-</sup>  $\rightarrow ns^2np^2$ .

**Ans: D**

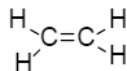
3 O.N. of La in  $La_2O_3$  is +3.

$$\text{No. of e}^- \text{ in } {}^{139}_{57}\text{La} = 57$$

$$\text{No. of e}^- \text{ in } {}^{139}_{57}\text{La}^{3+} = \underline{54}$$

**Ans: A**

4 There are 4 single bonds ( $4\sigma$ ) and 1 double bond ( $1\sigma + 1\pi$ ). Each covalent bond is made up of  $2e^-$ .



$\therefore \sigma$  ( $10e^-$ ) and  $\pi$  ( $2e^-$ )

**Ans: C**

5 Angle P is  $109^\circ$  as it is tetrahedral abt C. (4bp, 0lp)

Angle Q is  $105^\circ$  as it is bent abt O. (2bp, 2lp)

**Ans: C**

6 **A** Graphite has weak dispersion forces between its layers,  $\therefore$  they can slide easily  $\rightarrow$  not as strong as diamond

**C** Graphite has strong covalent bonds within each layer  $\rightarrow$  not easily deformed

**B & D** Only  $3e^-$  are used per C for bonding, hence each C contributes  $1e^-$ . These  $e^-$ s are delocalised along the plane of C atoms and act as mobile charge carriers to conduct electricity.

**Ans: D**

7 A simple molecule would have a low m.p., hence Options **C & D** are eliminated. To be a solid at r.t., the m.p. must be higher than  $25^\circ\text{C}$ , hence Option **A** is eliminated. In addition, solid at r.t. means that it is likely to have a large Mr and no. of e<sup>-</sup>,  $\therefore$  molecules are generally held by strong dispersion forces.  $\rightarrow$  high solubility in non-polar solvents, like  $CCl_4$  and low solubility in polar solvents, like  $H_2O$ .

**Ans: B**

8 Lattice Energy  $\propto \left| \frac{q^+ \cdot q^-}{r_+ + r_-} \right|$

Since ions in both LiI and LiF have the same charges and  $r_{I^-} > r_{F^-}$ ,  $|LE(LiI)| < |LE(LiF)|$ .

Since ions in both  $MgF_2$  and  $SrF_2$  have the same charges and  $r_{Sr^{2+}} > r_{Mg^{2+}}$ ,  $|LE(SrF_2)| < |LE(MgF_2)|$ .

Since charge is the predominant factor,  $MgF_2$  and  $SrF_2$  have numerically larger  $|LE|$  than LiI and LiF as the product of their charges is larger ( $2 \times 1 = 2$ ).

Increasing  $|LE|$ : **LiI, LiF, SrF<sub>2</sub>, MgF<sub>2</sub>**

**Ans: C**

9 Since there is no change in O.N. of Cu, Cu in  $CuFeS_2$  has O.N. +2. Fe in  $CuFeS_2$  is oxidised from +2 to +3 in  $Fe^{3+}$ .  $\therefore$  O.N. of S in  $CuFeS_2 = -2$ . O.N. of S in  $SO_4^{2-} = +6$ .  $\rightarrow \Delta O.N.(Fe) = +1$ ,  $\Delta O.N.(S) = +8$ .

**Ans: D**

10  $K_w = [H^+][OH^-] = 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$   
 ( $[H_2O]$  is excluded from the expression as  $H_2O$  is in large excess.)

**Ans: A**

11 To increase the proportion of products means to favour the forward reaction.

When  $P \downarrow$ , the system tries to  $\uparrow P$  by favouring the side with more moles of gases (Option **B & D**).

When  $T \uparrow$ , the system tries to absorb excess heat by favouring the endothermic reaction (Option **A & D**).

**Ans: D**

12 **A**  $\text{H}_2\text{NSO}_3\text{H}$  and  $\text{H}_2\text{NSO}_3^-$  is a conjugate acid-base

pair as they differ by one  $\text{H}^+$ .

**B** acid + carbonate  $\rightarrow$  salt(aq) +  $\text{H}_2\text{O}(l)$  +  $\text{CO}_2(g)$

**C** For strong acids,  $[\text{H}^+]$  is relatively high.

$\uparrow K_a = \frac{[\text{H}_2\text{NSO}_3^-][\text{H}^+]}{[\text{H}_2\text{NSO}_3\text{H}]}$  will be relatively

large.

**D**  $[\text{H}_2\text{NSO}_3^-] = [\text{H}^+] = 10^{-1} \text{ mol dm}^{-3}$

$\text{pH} = -\lg(10^{-1}) = 1$

**Ans: C**

13 Rate =  $k[\text{H}_2][\text{NO}]^2$

Unit of rate =  $\text{mol dm}^{-3} \text{ s}^{-1}$

Unit for  $k = \frac{\text{mol dm}^{-3} \text{ s}^{-1}}{(\text{mol dm}^{-3})^3} = \text{mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$

**Ans : B**

14 First order w.r.t  $\text{N}_2\text{O}_5 \rightarrow$  Rate =  $k[\text{N}_2\text{O}_5]$ ; constant  $t_{1/2}$

Fraction of  $\text{N}_2\text{O}_5$  left after 34 min

$$= \frac{0.025}{0.10} = \frac{1}{4}$$

$\therefore t_{1/2} = 17 \text{ min}$

**A** At the end of the rxn, 0.20 mol of  $\text{NO}_2$  is formed.

Fraction of  $\text{NO}_2$  formed in 17 min (one

$t_{1/2}$ ) =  $\frac{1}{2} \times 0.20 = 0.10 \text{ mol} \rightarrow$  True

**B** Fraction of  $\text{N}_2\text{O}_5$  left after 17 min (one

$t_{1/2}$ ) =  $\frac{1}{2} \times 0.10 = 0.05 \neq 0.0625 \rightarrow$  False

**C** Fraction of  $\text{N}_2\text{O}_5$  left =  $\frac{0.0125}{0.10} = \frac{1}{8}$ . This

requires 3  $t_{1/2} = 3 \times 17 = 51 \text{ min} \rightarrow$  False

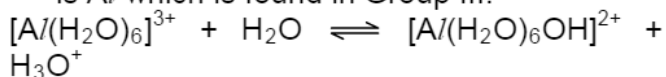
**D** At the end of the rxn, 0.20 mol of  $\text{NO}_2$  is formed. After 34 min ( $2 t_{1/2}$ ), 0.15 mol of  $\text{NO}_2$  is formed.

Fraction of  $\text{NO}_2$  formed is  $\frac{0.15}{0.20} = \frac{3}{4}$  of the

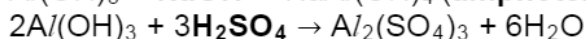
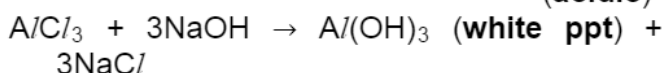
final amount of  $\text{NO}_2$  formed.  $\rightarrow$  False

**Ans: A**

15 Acidic chlorides are usually covalent chlorides. The white ppt is an insoluble hydroxide which is amphoteric.  $\therefore$  Element **X** is **Al** which is found in Group III.



(acidic)



**Ans: B**

16  $\text{Na}_2\text{O}$  is made up of a metal and non-metal, hence it has ionic bonding, confirmed by the high m.p.

$\text{SiO}_2$ ,  $\text{P}_4\text{O}_{10}$  and  $\text{SO}_3$  are made up of non-metals, hence they have covalent bonding. Since m.p. is very high for  $\text{SiO}_2$ , it has a giant molecular structure.

Since m.p. of  $\text{P}_4\text{O}_{10}$  and  $\text{SO}_3$  are low, they have simple molecular structures.

**Ans: B**

17 **A**  $\text{SiCl}_4$  has a simple molecular structure, hence  $\text{GeCl}_4$  cannot be an ionic compound.

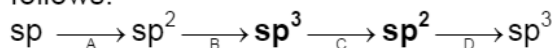
**B** Covalent chlorides react with water to form an acidic solution.  $\text{SiCl}_4 + \text{H}_2\text{O} \rightarrow \text{Si}(\text{OH})_4 + 4\text{HCl}$

**C** There are no mobile charge carriers in simple molecules  $\text{SiCl}_4$  to conduct electricity.

**D** There are 4 bp and 0 lp in  $\text{SiCl}_4$   
 $\rightarrow$  Tetrahedral; bond angle =  $109.5^\circ$

**Ans: B**

18 Hybridisation of C atoms changes as follows:



**Ans: C**

19 All three C=C have two similar groups directly attached to the same doubly bonded C, hence none of them can exhibit geometric isomerism.

Ans: A

20  $2\text{Fe} + 3\text{Br}_2 \rightarrow 2\text{FeBr}_3$  → acts as Lewis acid catalyst for ring substitution rxn

No *uv* light/heat → No substitution at the side chain

Only Option D does not have side chain substitution of Br and since CH<sub>3</sub> is an o,p-director, Option D is correct as the Br is directed to the ortho and para positions respectively in the 2 main products.

Ans: D

21 A No rxn, as benzene is rather unreactive. Ring substitution requires a Lewis acid catalyst.

B Ring substitution requires a Lewis acid catalyst, while side chain substitution requires *uv* light/ heat.

C Substitution of OH can occur with PBr<sub>3</sub>, reflux, instead of Br<sub>2</sub>.

D Addition of Br<sub>2</sub> across the C=C is the fastest as it can occur at r.t. in an organic solvent, like CCl<sub>4</sub>.

Ans: D

22 From the Data Booklet,

BE(C-C) = 350 kJ mol<sup>-1</sup>

BE(C-C<sub>l</sub>) = 340 kJ mol<sup>-1</sup>

BE(C-H) = 410 kJ mol<sup>-1</sup>

BE(C-F) is not given, however, C-F bond is a strong bond as C and F are from the same period, there is good 2p-orbital overlap. Moreover, F being highly electronegative causes additional attraction b/w the partial charges δ<sup>+</sup> and δ<sup>-</sup> on C and F respectively.

Ans: B

23 C<sub>4</sub>H<sub>6</sub>O<sub>2</sub> reacts with HCN & NaCN(aq) to undergo addition reaction on C=O to form cyanohydrin. Since there is an increase of 2C, 2N and 2H in the pdt, C<sub>6</sub>H<sub>8</sub>N<sub>2</sub>O<sub>2</sub> → two C=O groups are present in X, ∴ Options A & B are eliminated.

No brick red ppt with Fehling's solution → absence of aliphatic aldehyde, ∴ Option D is eliminated.

Reduction of C<sub>4</sub>H<sub>6</sub>O<sub>2</sub> results in the addition of 4H in C<sub>4</sub>H<sub>10</sub>O<sub>2</sub> → presence of two oxidising groups. In Option C, both ketone functional groups can be reduced to 2° alcohols by addition of 4H.

Ans: C

24 Presence of  $\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_3\text{C}-\text{C}- \\ | \\ \text{H}_3\text{C} \end{array}$  or  $\begin{array}{c} \text{OH} \\ | \\ \text{H}_3\text{C}-\text{C}- \\ | \\ \text{H} \end{array}$  gives yellow ppt, CHI<sub>3</sub> when warmed with I<sub>2</sub>/OH<sup>-</sup>(aq). ∴ To distinguish b/w the pair, one must give a +ve iodoform test, while the other -ve.

Ans: B

25  $\text{CH}_3\text{CH}_2\text{COOH} + \begin{array}{c} \text{conc. H}_2\text{SO}_4 \\ \text{warm} \\ \text{CH}_3\text{CH}_2\text{OH} \end{array}$   
 $\xrightarrow{\hspace{1.5cm}}$   
 $\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_3 + \text{H}_2\text{O}$   
 ethyl propanoate

The procedure failed as he did not use c.H<sub>2</sub>SO<sub>4</sub> catalyst but used a little c.NaOH.

Ans: C

### Section B

26 3  $\Delta H_{\text{rxn}1} = \sum \Delta H_f(\text{pdt}) - \sum \Delta H_f(\text{rxt})$   
 $= [82 + 2(-286)] - [-366]$   
 $= \underline{-124 \text{ kJ mol}^{-1}}$  → Rxn 1 is exothermic.

2  $\Delta H_{\text{rxn}2} = \sum \Delta H_f(\text{pdt}) - \sum \Delta H_f(\text{rxt})$   
 $= [2(-286)] - [-366] = \underline{-206 \text{ kJ mol}^{-1}}$

1  $\Delta H_{\text{rxn}2} - \Delta H_{\text{rxn}1} = -206 - (-124)$   
 $= \underline{-82 \text{ kJ mol}^{-1}}$   
 → Rxn 2 gives off 82 kJ mol<sup>-1</sup> > En than Rxn 1

Ans: A (1, 2 and 3)

27 1 Initially, there is no R and it is only formed **slowly** by the 1<sup>st</sup> step. ∴ If there is addition of R at the start, then rate of formation of S in the 2<sup>nd</sup> step will increase.

2 By conservation of mass,

$$R = P + Q \text{ ----(1)}$$

$$R + P = 2S \text{ ----(2)}$$

$$\text{Rearranging (2): } S = \frac{1}{2}(P + R)$$

$$\text{Substitute (1) into (2): } = \frac{1}{2}(2P + Q)$$

$$= P + \frac{1}{2}Q$$

→ Mr(S) is always > Mr(P)

- 3 1 mole of R reacts to give 2 moles of S. Moreover, the 2<sup>nd</sup> step is a faster step, leading to a faster formation of S than the production of R. ∴ [S] is always > [R].

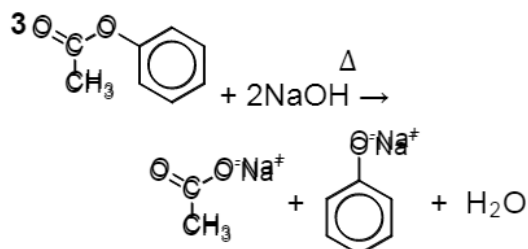
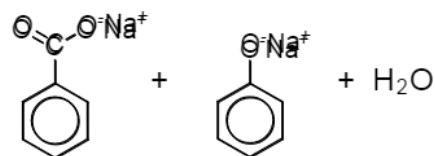
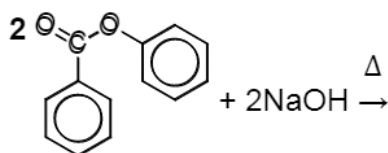
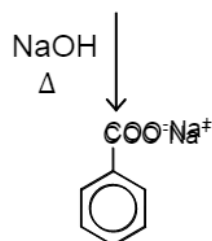
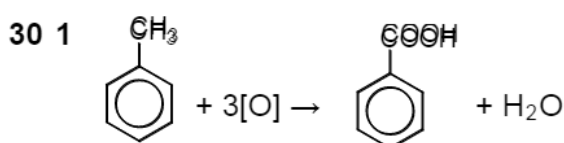
**Ans: B (1 and 2)**

- 28 1 Ne has less inner shell e<sup>-</sup>s, hence the valence e<sup>-</sup>s are less well-shielded than those of Xe. ∴ the valence e<sup>-</sup>s are held more tightly to the nucleus, leading to the unreactive nature of Ne.
- 2 Down the group, the nuclear charge ↑, shielding effect ↑. Since shielding effect is the predominant factor, effective nuclear charge down the group ↓, leading to larger atomic size and lower IE. Less energy is required to remove an e<sup>-</sup> from Xe than Ne, hence Ne is less reactive than Xe.
- 3 True statement, however it does not explain why Ne is less reactive than Xe.

**Ans: B (1 and 2)**

- 29 Aldehyde can be oxidised to carboxylic acid with mild O.A. Aldehyde cannot form esters or react with sodium. Both carboxylic acids and 3<sup>o</sup> alcohols cannot be oxidised further with mild O.A. Carboxylic acids can react with 3<sup>o</sup> alcohols to form esters. Both carboxylic acids and 3<sup>o</sup> alcohols react with Na to form a salt via acid-metal rxn.

**Ans: C (2 and 3)**



**Ans: B (1 and 2)**