

- 1 **C** In diamond, all the bonding electrons are localised in C-C bonds.  
 Not **A**. The six  $\pi$  electrons in the benzene ring are delocalised.  
 Not **B**. Metallic bonding in copper consists of cations in a delocalised sea of electrons.  
 Not **D**. The two  $\pi$  electrons in the  $\text{CO}_2^-$  group are delocalised over  $\text{sp}^2$  hybridised C, O, O.



- 2 **B**  $n(\text{H}^+) = \dots = 2.46 \times 10^{-3} \text{ mol}$   
 $n(\text{Cl}^-) = \dots = 4.92 \times 10^{-3} \text{ mol}$   
 $\therefore \frac{n(\text{H}^+)}{n(\text{Cl}^-)} = \frac{1}{2} \Rightarrow \text{HCl}_2^-$

- 3 **C**

X: Group II  $\Rightarrow X^{2+}$

Y: Group V  $\Rightarrow Y^{5-}$

So formula of compound is  $X_3Y_2$ .

- 4 **D** Intermolecular H bonds are broken in this question. Since vaporisation involves breaking of intermolecular bonds, a more endothermic  $\Delta H_{\text{vap}}$  shows stronger H bonding.

- 5 **A** Average K.E.  $\propto T$ . Same  $T \Rightarrow$  same average K.E.

- 6 **D** At X, reduction at cathode:  $2\text{H}_2\text{O} + 2e^- \rightarrow \text{H}_2 + 2\text{OH}^-$  (turns litmus blue)  
 At Y, solution remains neutral (litmus purple)

At Z, oxidation at anode:  $\text{H}_2\text{O} \rightarrow \text{O}_2$ ; after a few min, oxidation of  $\text{Cl}^- \rightarrow \text{Cl}_2$  (bleaches litmus)

- 7 **B** Forward reaction is endothermic, so  $p_{\text{eq}}$  shifts right when  $T$  increases. There is net increase in number of gas particles  $\Rightarrow V$  increases.  
 But ideal gas equation ( $V \propto T$ ) tells us that  $V$  can also increase when  $T$  increase, i.e. thermal expansion.  
 Hence both effects lead to increase in  $V$ .

- 8 **A** If the weak acid  $\text{CH}_3\text{CO}_2\text{H}$  is partially neutralised, the resulting solution will consist of a large reservoir of the weak acid  $\text{CH}_3\text{CO}_2\text{H}$  together with the salt  $\text{CH}_3\text{CO}_2^- \text{Na}^+$ . This constitutes a buffer.  
**B** and **C** are strong acids.  
**D** is a very dilute solution of  $\text{H}_2\text{S}$  and will not give a sufficiently large reservoir of a weak acid and its conjugate base.

- 9 **C**  $K_{\text{sp}} = [\text{Cd}^{2+}][\text{OH}^-]^2 = (1.0 \times 10^{-5})(2 \times 1.0 \times 10^{-5})^2 = 4.0 \times 10^{-15}$

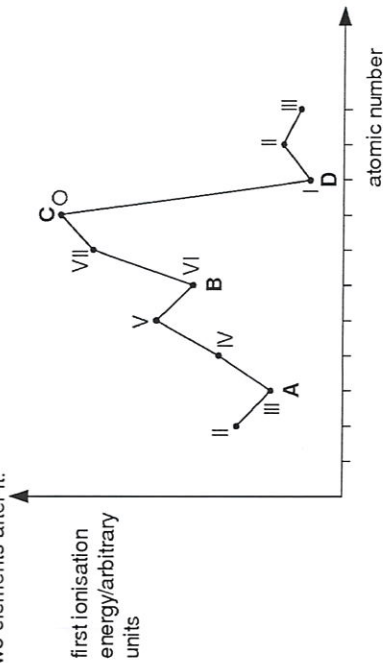
- 10 **A** Refer to notes.

- 11 **C** The slow step in the mechanism involves only one RBr molecule. So this agrees with the fact that the reaction is first order with respect to RBr.  
 Not **A** and **B**. Slow step involves  $\text{OH}^-$  ion which contradicts the fact that the reaction is zero order with respect to  $\text{OH}^-$ .

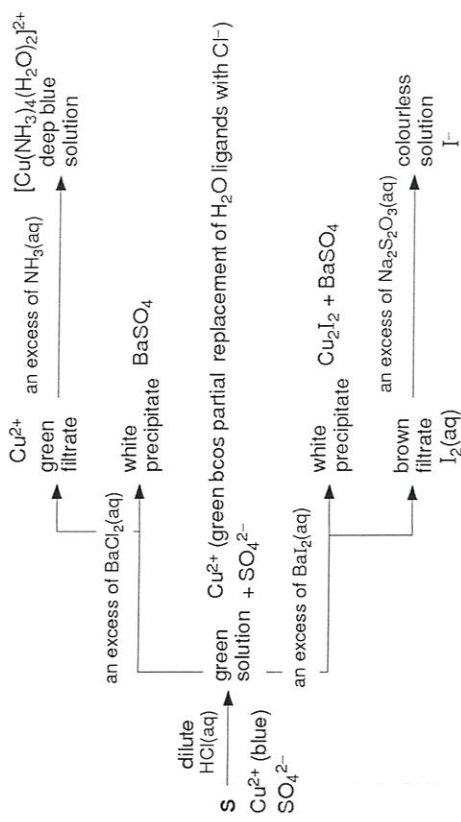
Not **D**. From the slow step, rate =  $k'[\text{RBrOH}^-]$  but  $\text{RBrOH}^-$  is formed from RBr and  $\text{OH}^-$  in the previous fast step. So rate =  $k[\text{RBr}][\text{OH}^-]$ .

- 12 **C**  $\Delta H_f(\text{CO})$  refers 1 mol of  $\text{CO}(\text{g})$  formed ... so not **D**.  
 ... from its constituent elements in their standard states (i.e. C(graphite) and  $\text{O}_2(\text{g})$ ).

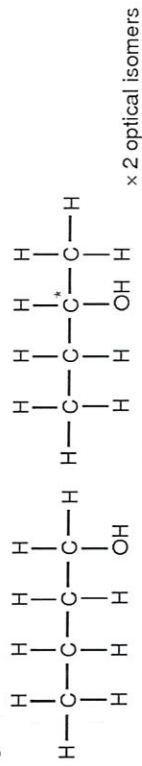
- 13 **D** There is a sharp drop in first IE from **C** to **D**. This suggests that elements **C** and **D** are in different Periods, i.e. **C** is in Group 0 and in the same Period as the elements before it while **D** is in Group 1 (alkali metal) of the next Period together with the next two elements after it.



- 14 **D** Not **A** because across Period, atomic radius decreases.  
Not **B** and **C** because down Group, atomic radius increase.
- 15 **A** Only Be in Group II shows +2 oxidation state in all of its compounds. Group V (N) and Group VII (Cl, Br) elements have variable o.s. in their compounds.
- 16 **D** Always remember two gases are evolved when Group II nitrates are heated strongly.
- 17 **D** Aluminium hydroxide behaves in a similar way to aluminium oxide. It is an amphoteric hydroxide.  
Sodium aluminate is soluble in water, not a ppt.
- 18 **C**  $\text{NH}_3$  is produced from heating  $\text{NH}_4^+$  salt with aq NaOH.  
 $\text{NH}_4^+ + \text{OH}^- \rightarrow \text{NH}_3 + \text{H}_2\text{O}$   
 1 mol  $\text{NH}_4\text{Cl} \equiv 1 \text{ mol NH}_4^+ \equiv 1 \text{ mol NH}_3$   
 1 mol  $\text{CH}_3\text{CO}_2\text{NH}_4 \equiv 1 \text{ mol NH}_4^+ \equiv 1 \text{ mol NH}_3$   
 1 mol  $(\text{NH}_4)_2\text{SO}_4 \equiv 2 \text{ mol NH}_4^+ \equiv 2 \text{ mol NH}_3$   
 So **C** gives total 3 mol of  $\text{NH}_4^+$ . So 3 mol of  $\text{NH}_3$  produced.  
**A** and **B**: 1 mol  $\text{NH}_3$ ; **D**: 2 mol  $\text{NH}_3$   
 Note: **A**  $\text{C}_6\text{H}_5\text{NH}_2 \rightarrow$  no rxn; **B**  $\text{C}_6\text{H}_5\text{NH}_3^+ + \text{OH}^- \rightarrow \text{C}_6\text{H}_5\text{NH}_2 + \text{H}_2\text{O}$
- 19 **B** Electronegativity decreases down the Group.  
Not **A**. Both molecules are bent.  
Not **C**. Both are polar.  
Not **D**. O–O bonds do exist, e.g. in  $\text{H}_2\text{O}_2$ .
- 20 **B** Cathode (reduction):  $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$   
 Anode (oxidation):  $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$   
 Overall:  $2\text{H}_2\text{O} + 2\text{Cl}^- \rightarrow \text{H}_2 + 2\text{OH}^- + \text{Cl}_2$  or  
 $2\text{H}_2\text{O} + 2\text{NaCl} \rightarrow \text{H}_2 + 2\text{NaOH} + \text{Cl}_2$

21 **D**

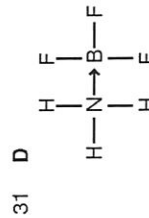
- 22 **B** Not **A**. Counterexample:  $\text{AlCl}_3$ .  
 Not **C**. Counterexample: Pb show +2 and +4 o.s. e.g.  $\text{PbO}$ ,  $\text{PbO}_2$ .  
 Not **D**. Counterexample: Ca, Sr, Ba

23 **C**

- 24 **B** Benzene undergoes ES in this reaction. A H atom in the benzene ring has been substituted with an  $\text{SO}_3\text{H}$  group.

- 25 **A** All the C atoms in  $C_7H_{13}N$  are  $sp^3$  hybridised  $\Rightarrow$  tetrahedral just like  $CH_4$ . The N is like  $NH_3$  and  $CH_3CH_2NH_2 \Rightarrow$  trigonal pyramidal.  
**Not B.** The dipole moments in  $C_7H_{13}N$  do not cancel out.  
**Not C.** The H atoms in  $C_7H_{13}N$  are not attached to N, O, F.  
**Not D.**  $C_7H_{13}N$  is a tertiary amine. Its aqueous solution should be basic.
- 26 **D**  $C_6H_5CH_3 + aq \text{ alkaline } MnO_4^- \rightarrow C_6H_5CO_2^-$  (side chain oxidation)  
 $C_6H_5CO_2^- + H^+ \rightarrow C_6H_5CO_2H$
- 27 **D** Diol formation:  $CH_3CH=CH_2 + [O] + H_2O \rightarrow CH_3CH(OH)CH_2OH$
- 28 **B** Ester hydrolysis.  $CH_3CH_2CO_2CH_3 + OH^- \rightarrow CH_3CH_2CO_2^- + CH_3OH$   
**Not A.**  $(CH_3CO)_2O$  is an acid anhydride.  

$$\begin{array}{c} O & O \\ || & || \\ CH_3-C-O-C-CH_3 \end{array} \rightarrow CH_3CO_2^-$$
  
**Not C.** Amide.  $CH_3CONH_2 + OH^- \rightarrow CH_3CH_2CO_2^- + NH_3$   
**Not D.** Alkene. No reaction.
- 29 **C** Orange ppt with 2,4-DNPH  $\Rightarrow$  aldehyde or ketone. Either **B** (aldehyde) or **C** (ketone).  
**A** is 2° alcohol. **D** is ester.  
 Yellow ppt with alkaline aqueous iodine (triiodomethane test)  $\Rightarrow$  if aldehyde, only ethanal; if ketone, only methyl ketones,  $CH_3COR$ .  
 Note that while **A** (a 2° methyl alcohol) gives a positive triiodomethane test, it will not give an orange ppt with 2,4-DNPH.
- 30 **A** Methanoic acid,  $HCOOH$ , can react with  $H^+ / MnO_4^-$  to form  $CO_2 + H_2O$ .  
 Note: The other special carboxylic acid that can react in a similar manner is ethanedioic acid.  
**Not D.** This is a 3° alcohol, resistant to oxidation.



- 32 **D** Both compounds have simple molecular structure with weak dispersion forces between molecules. Pentane is a straight chain molecule with a large surface area while 2,2-dimethylpropane is branched and more spherical in shape, less surface area. Dispersion forces stronger in pentane.
- 33 **D** If the gas behaves ideally,  $p_1 V_1 = p_2 V_2$   
 $15 \times 76 = 60 \times V_2 \Rightarrow V_2 = 19 \text{ cm}^3$ . But volume is not  $19 \text{ cm}^3$ . So gas is not ideal.
- 34 **D**  $T$  increase favour forward endo rxn.  
 Option 2 is wrong. Assuming gaseous phase, equal number of moles of gas on both left and right side of the equation. So pressure has no effect on the equilibrium.  
 Option 3 is wrong. Catalyst increases the rates of both forward and reverse reactions to the same extent. So no effect on  $p_{oe}$ .
- 35 **B** Option 3 is wrong. Reaction should be exothermic.
- 36 **D** Option 2 is wrong, e.g. Group IV contains non-metals (C) and metals (lead).  
 Option 3 is wrong. Group I metals show a decrease in the melting points as the metallic bonding becomes weaker down the Group.
- 37 **A** Option 1 is correct. White ppt is  $Al(OH)_3$ . Ppt dissolves to form  $Al(OH)_4^-$  complex.  
 Option 2 is correct. Refer to Chemical Bonding for diagram.  
 Option 3 is correct. Refer to Periodicity notes for equations.
- 38 **D** Option 2 is wrong.  $NH_4^+$  is a proton donor  $\Rightarrow$  Bronsted acid.  
 Option 3 is wrong. Not a redox reaction; no change in oxidation numbers.
- 39 **C**  
 (2)  $CH_3C^+H(OH)CO_2H$   
 (3)  $CH_3C^+H(NH_2)CO_2H$
- 40 **A** Refer to notes.

