1 **C**

$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$

$n(CO_2) = n(CaCO_3) = \ldots = 5 \times 10^{-4}$ mol

$V(CO_2) = \ldots \times 24 = 0.012\ dm^3$

$\%\ CO_2 = \dfrac{0.012}{10} \times 100 = 0.12\%$

2 **B**

$CH_3CHO + \frac{5}{2}O_2$; $CH_3CH_2OH + 3O_2$; $CH_3CH_3 + \frac{7}{2}O_2$; $CH_3CO_2H + 2O_2$

3 **D**

S: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$; S^{2-}: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

4 **B**

Definition of IE: ... remove 1 mol of e⁻s from 1 mol of gaseous atoms (i.e. Br(g)) to form 1 mol of singly charged gaseous cations (i.e. $Br^+(g)$)

5 **D**

Mass of HgI_2 ppt increases as KI is added in reaction 1 and reaches a maximum when all the $HgCl_2$ is used up. Further addition of KI results in decrease in mass of HgI_2 ppt because the ppt reacts with the KI in the second reaction to form a complex.

6 **C**

$6C(s) + 3H_2(g) \xrightarrow{\Delta H_f} C_6H_6(l)$

$6(-400)$; $3(-306)$; -3350

$6CO_2 + 3H_2O$

$\Delta H_f = 6(-400) + 3(-300) - (-3350) = +50\ kJ\ mol^{-1}$

7 **D**

Refer to Chemical Bonding notes. Structure of sodium chloride. p. 68.

8 **C**

pV = constant.

9 **A**

$2O^{2-} \rightarrow O_2 + 4e^-$

$Q = It = 8 \times 100 \times 60 = 48\,000$ C

$n(e^-) = \dfrac{48000}{96500}$ mol

$n(O_2) = \dfrac{1}{4} \times \dfrac{48000}{96500}$ mol

$V(O_2) = \dfrac{1}{4} \times \dfrac{48000}{96500} \times 22.4 = 2.8\ dm^3$

10 **D**

"increase in the proportion of products" => poe shifts right

(i) p decrease, results in poe shifting to right => RHS has more moles of gas => **B** or **D**.

(ii) T increase, results in poe shifting to right => forward rxn is endothermic => **A** or **D**.

Only **D** satisfies both (i) and (ii).

11 **C**

Let s be ∈ solubility for each option.

A RS: $Ksp = [R][S]$, $Ksp = s^2$, $s = \sqrt{Ksp}$

B T_2U: $Ksp = [T]^2[U]$, $Ksp = 4s^2$, $s = \sqrt{Ksp/4}$

(C) VW_3: $Ksp = [V][W]^3$, $Ksp = (s)(3s)^3 = 27s^4$, smallest → $s = (Ksp/27)^{1/4}$

D X_2Y_2: $Ksp = [X]^2[Y]^2$, $Ksp = (2s)^2(2s)^2 = 16s^4$, $s = (Ksp/16)^{1/4}$

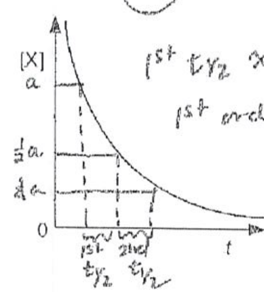
12 **C**

Not **A**. Units of k: mol dm^{-3} s^{-1} / (mol dm^{-3})^2 = mol^{-1} dm^3 s^{-1}

Not **B**. Value of k depends on temperature.

13 **D**

(D)



1st $t_{1/2}$ ≈ 2nd $t_{1/2}$

1st order wrt X

14 **B**
Na_2O, MgO: basic
Al_2O_3: amphoteric
SiO_2, P_4O_{10}, SO_3: acidic

15 **A**
$|\Delta H_{hyd}| \propto \frac{|z_+|}{r_+}$
A 30.7; **B** 10.5; **C** 14.8; **D** 5.9

16 **C**
$2Al + 6H_2O \rightarrow 2Al(OH)_3 + 3H_2$

17 **D**
Si has the highest bp.

18 **D**
The key word is *immediately*.

19 **C**
Blue soln => Cu^{2+}; brown gas => NO_2.
$Cu \rightarrow Cu^{2+}$; $0 \rightarrow +2$
$HNO_3 \rightarrow NO_2$; $+5 \rightarrow +4$

20 **D**
Group VII. NaBr and below all react with hot conc H_2SO_4 to give X_2.

21 **B**
A +6; B +2; C +6; D +7
B contains two $CH_3CO_2^-$ ions; So Mn^{2+}. +2.

22 **A**
$Cu^{2+} \rightarrow$ blue ppt $Cu(OH)_2 \rightarrow$ dark blue complex $[Cu(NH_3)_4]^{2+}$ or $[Cu(NH_3)_4(H_2O)_2]^{2+}$

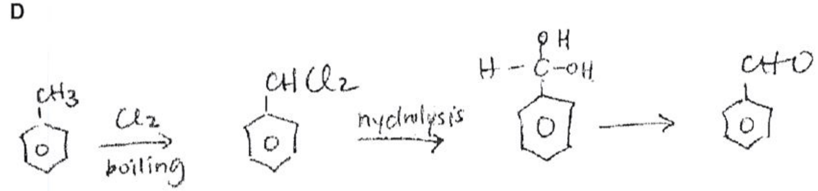
23 **C**
Must have two different groups attached to each C of the alkene double bond.

24 **A**

25 **A**

26 **D**
$CH_3CH_2CH_2OH \rightarrow CH_3CH_2CO_2H$ (oxidation to carboxylic acid)
$CH_3CH_2CH_2OH + CH_3CH_2CO_2H \rightarrow$ ester

27 **D**



Y gives ppt with 2,4-DNPH => aldehyde or ketone. Either **C** or **D**.
When two OH groups are attached to the same C atom, the molecule can undergo an elimination reaction (dehydration).

28 **D**
Acyl chloride is most easily hydrolysed. Aryl chlorides are resistant to hydrolysis.

29 **B**
The carboxylic acid group can react with a base.
Not **A**. Both are small molecules and can form H bonds with water molecules => soluble

30 **D**
Phenol itself cannot react with sodium carbonate. Since the phenol group in **X** reacts with sodium carbonate, it must mean that it must be a sufficiently strong acid. (The three electron withdrawing NO_2 groups attached to the benzene ring cause the phenol group to be very acidic.)

31 **C**
VSEPR. Option 1 is wrong because it is not repulsion between H *atoms* that explains the different bonds angles.

32 **A**
Refer to notes.

33 **C**
A small highly charged cation can polarise a large anion, imparting covalent character to ionic bonding.

34 **B**
Common ion effect. Option 1: common ion is OH^-. Option 2: common ion is Ca^{2+}.

35 **A**
Option 1 is correct. Lone pair of electrons on O in $C_2H_5O^-$ forms bond to Si.

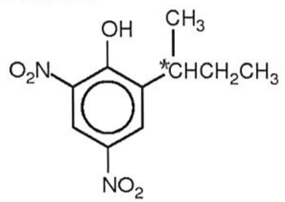
36 **B**
Option 3 is wrong. N_2 and H_2 reaction is not explosive.

37 **D**
K_c depends only on temperature.

38 **C**
MF shows only one double bond. (If saturated compound, then MF is $C_nH_{2n+2}O_2$.)
Option 1 is wrong since two carbonyl groups will introduce two double bonds.

39 **A**
Option 1 is correct. Similar to NH_3.

40 **D**
Option 1 is correct. Phenol group is weakly acidic.
Option 2 is wrong. There is a chiral C.



Option 3 is wrong. Phenol cannot form ester with an alcohol; need an acyl chloride.