

- 1 **A** zero mass => electron.
- 2 **D** $\text{CH}_2\text{O} + 2[\text{O}] \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
30 g CH_2O give 44 g CO_2
 $m(\text{CO}_2) = \frac{44}{30} \times 1.80 \text{ kg} = 2.64 \text{ kg}$
- 3 **D** Acidic: $\text{MnO}_4^- (\text{Y}) + 5\text{Fe}^{2+} (\text{X}) + \dots \rightarrow \text{Mn}^{2+} + 5\text{Fe}^{3+} + \dots$
 $\frac{c_Y \times 20}{c_X \times 25} = \frac{1}{5} \dots \dots \dots (1)$
Neutral: $\text{MnO}_4^- (\text{Y}) + 3\text{Fe}^{2+} (\text{X}) + \dots \rightarrow \text{MnO}_2 + 3\text{Fe}^{3+} + \dots$
 $\frac{c_Y \times V_Y}{c_X \times 25} = \frac{1}{3} \dots \dots \dots (2)$

Dividing (2) by (1)

$$V_Y = \frac{5}{3} \times 20 \text{ cm}^3$$

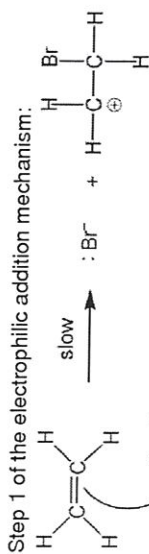
- 4 **B** A molecule is polar because the individual bond dipoles do not cancel out. The bond dipole results from a difference in the electronegativities of the two bonded atoms.
- 5 **A**
- 6 **A** $p_1 V_1 = p_2 V_2$ (constant T)
 $p(\text{He}) \times 3 = 2 \times 1 \Rightarrow p(\text{He}) = \frac{2}{3} \text{ kPa}$
 $p(\text{Ne}) \times 3 = 1 \times 2 \Rightarrow p(\text{Ne}) = \frac{2}{3} \text{ kPa}$
 $p(\text{total}) = \frac{2}{3} + \frac{2}{3} = 1 \frac{1}{3} \text{ kPa}$
- 7 **D** The key word here is *readily*. The solid iodine must have a simple molecular structure with weak dispersion forces between molecules. These can be overcome easily for the vapour to form readily. Strong covalent bonds between iodine atoms are not broken so that the molecules still exist in the vapour state.
- 8 **A** $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$

- 9 **B** $\text{N}_2\text{H}_4(\text{g}) \rightarrow 2\text{N}(\text{g}) + 4\text{H}(\text{g})$
 $\Delta H = E(\text{N-N}) + 4 \times E(\text{N-H}) = 160 + 4(390) = 1720 \text{ kJ mol}^{-1}$
- 10 **B** $K_c = \frac{[\text{CH}_3\text{CO}_2\text{CH}_3(\text{l})][\text{H}_2\text{O}(\text{l})]}{[\text{CH}_3\text{OH}(\text{l})][\text{CH}_3\text{CO}_2\text{H}(\text{l})]}$
- 11 **C**
- 12 **B** Since H^+ is the catalyst in this reaction, its concentration is constant during the reaction. The method of initial rates is used with different initial concentrations of H^+ .
- 13 **A** All are isoelectronic species with 18 e^- s. This means shielding effect is the same in each case, so the species with the largest radius is the one with the smallest nuclear charge.
- 14 **C** **A** +7 in ClO_4^- and +6 in SO_4^{2-}
B +7 in MnO_4^- and +6 in MnO_4^{2-}
C +6 in CrO_4^{2-} and +6 in $\text{Cr}_2\text{O}_7^{2-}$
D +4 in SO_3^{2-} and +6 in SO_4^{2-}
- 15 **A**
- 16 **D** Two gases are produced during the thermal decomposition of Group II nitrates.
- 17 **B** $n(\text{Ag}) = \dots = 0.01 \text{ mol}$
 $\text{Ag}^+ + e^- \rightarrow \text{Ag}$
 $n(e^-) = 0.01 \text{ mol} = 0.01 \text{ L } e^-$ s
- 18 **D** $\text{Mg}(\text{OH})_2$ is a base. NH_4^+ is a Bronsted acid.
- 19 **C** One H in $\text{CF}_3\text{CH}_2\text{Cl}$ has been replaced with a Br atom to form CF_3CHBrCl . FRS.
- 20 **D**

- 21 **C**
 $n = 1 \Rightarrow 1$ (Cl at 1)
 $n = 2 \Rightarrow 2$ (Cl at 1, 1 or 1, 2)
 $n = 3 \Rightarrow 2$ (Cl at 1, 1 or 1, 1, 2)
 $n = 4 \Rightarrow 2$ (Cl at 1, 1, 1, 2 or 1, 1, 2, 2)
 $n = 5 \Rightarrow 1$ (only 1 H left)
 $n = 6 \Rightarrow 1$ (completely substituted with Cl)
- 22 **A**
 Only the H atom of the alcohol group is ionisable.
 $\text{C}_6\text{H}_5\text{CH}_2\text{OH} + \text{H}_2\text{O} \rightleftharpoons \text{C}_6\text{H}_5\text{CH}_2\text{O}^- + \text{H}_3\text{O}^+$
- 23 **B**
 $3\text{C RX} \rightarrow 4\text{C}$ carboxylic acid; use CN^- route to increase carbon skeleton.
- 24 **A**
- 25 **D**
 Not ethane; it is a gas.
 Not ethanoic acid; it mixes completely with water.
 Not ethanol; it mixes completely with water and can be oxidised by $\text{H}^+ / \text{MnO}_4^-$.
- 26 **A**
 Reaction of a carbonyl compound RCOR' with HCN gives $\text{RC(OH)(CN)R}'$. So for the product to be chiral, $\text{R} \neq \text{R}'$.
- 27 **B**
A butane and **D** ethanoic acid do not decolorise both reagents. **C** ethene decolorises both reagents.
- 28 **C**
A is ketone; **B** is ester; **C** contains ketone and 1° alcohol groups; **D** is carboxylic acid. neutral \Rightarrow **A**, **B** and **C**.
 orange ppt with 2,4-DNPH \Rightarrow **A** and **C**.
 HCl with $\text{PCl}_5 \Rightarrow$ **C** and **D**.
- 29 **D**
 Hydrolysis of ester.
- 30 **D**
 Main difference in structures: MCPA contains carboxylic acid group and 2,4-D contains 1° alcohol group.
A and **B**: no reaction for both compounds.
C: both compounds react to give H_2 .
D: carboxylic acid group in MCPA $\rightarrow \text{CO}_2$; 2,4-D \rightarrow no reaction.

- 31 **C**
Option 1 ethane, C_2H_6 and ethene, C_2H_4
Option 2 ethene, C_2H_4 and cyclohexane, C_6H_{12}
Option 3 cyclohexane, C_6H_{12} and oct-1-ene, $\text{C}_{10}\text{H}_{20}$
- 32 **D**
- | | | | |
|----------|----------------------|---------------|---------------|
| 1 | H_2O | NH_3 | CH_4 |
| | 105° | 107° | 109° |
| 2 | H_2O | SF_6 | BF_3 |
| | 105° | 90° | 120° |
| 3 | CH_4 | CO_2 | SF_6 |
| | 109° | 180° | 90° |
- 33 **C**
 $\text{H}-\text{I}$ bond length is greater because of the larger atomic radius of I atom.
 $\text{H}-\text{I}$ bond is less polar because the difference in electronegativities of H and I atoms is less.
- 34 **C**
Option 1 is wrong. Graph shows k_p increases as T increases \Rightarrow forward reaction is endothermic.
Option 2 is correct. High pressures cause p_{oe} to shift right because there are fewer gas particles on the right hand side of the equilibria.
Option 3 is correct. T increases \Rightarrow p_{oe} shifts right since forward reaction is endothermic.
- 35 **B**
 Only **1** and **2** react with acids.
- 36 **C**
Option 1 is wrong. Strontium and other Group II metals burn in oxygen.
- 37 **C**
 All three salts give a white ppt with aqueous AgNO_3 but silver chloride is soluble in excess aq NH_3 . So option 1 is wrong.
- 38 **A**
 Reaction pathway diagram for $\text{S}_{\text{N}}2$.

39 C



The intermediate has a Br; so the product must also have a Br attached to a C. Hence option 1 is wrong.

The carbocation formed can now react with Br^- or Cl^- or H_2O .

Reaction with $\text{Br}^- \rightarrow \text{CH}_2\text{BrCH}_2\text{Br}$ (option 3).

Reaction with $\text{Cl}^- \rightarrow \text{CH}_2\text{BrCH}_2\text{Cl}$ (option 2).

40 B

Product is a carboxylic acid. So alcohol must be 1° (options 1 and 2).

