# UNIT 2 — NOVEMBER EXAM

# CHEMISTRY

## Written test 2

## ANSWER BOOK

## Structure of book

| Section | Number of questions | Number of questions to be answered | Number of marks | Suggested times (minutes) |
|---|---|---|---|---|
| A | 20 | 20 | 20 | 20 |
| B | 10 | 10 | 64 | 70 |
| | | | **Total 84** | **90** |

## Section A

| | | | | |
|---|---|---|---|---|
| **1.** B | **5.** C | **9.** B | **13.** D | **17.** A |
| **2.** A | **6.** A | **10.** A | **14.** B | **18.** C |
| **3.** A | **7.** B | **11.** B | **15.** B | **19.** C |
| **4.** D | **8.** C | **12.** A | **16.** C | **20.** D |

## Section B

**Question 1.**

**a.** $Mg^{2+}(aq) + 2OH^{-}(aq) \longrightarrow Mg(OH)_2(s)$

**b.** $Ca^{2+}(aq) + CO_3^{2-}(aq) \longrightarrow CaCO_3(s)$

**c.** $Cl_2(g) + 2e^{-} \longrightarrow 2Cl^{-}(aq)$

$Cl_2(g) + 2H_2O(l) \longrightarrow 2HClO(aq) + 2e^{-} + 2H^{+}(aq)$

**d.** $2Cl_2(g) + 2H_2O(l) \longrightarrow 2HClO(aq) + 2Cl^{-}(aq) + 2H^{+}(aq)$

**e.** $Cl_2(g)$

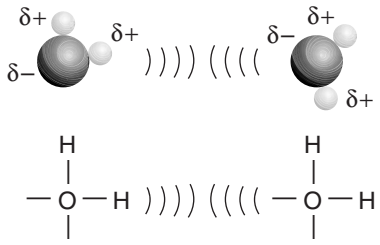
**6 marks**

**Question 2.**

**a.** Covalent bonding, hydrogen bonding and dispersion forces

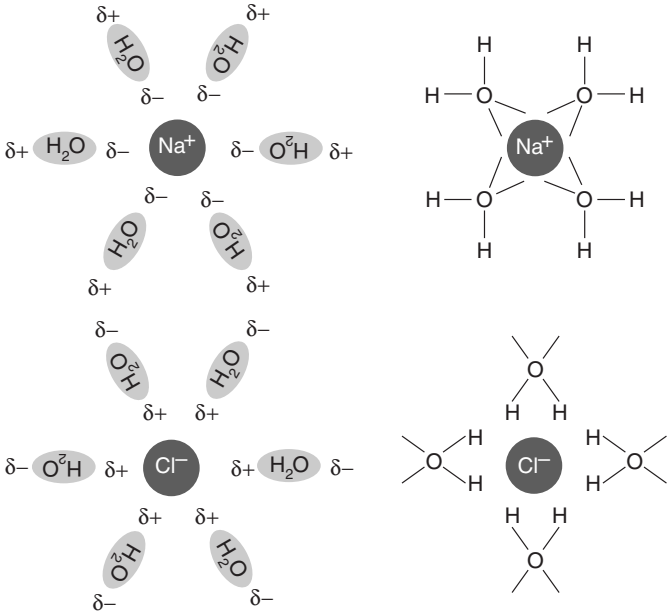
**b.** These molecules do not show hydrogen bonding. As the molar mass increases, the strength of the dispersion forces between the molecules increases.

**c.** Two possible representations:




**d.** **i.** $NaCl(s) \xrightarrow{H_2O} Na^+(aq) + Cl^-(aq)$

**ii.**




**e.** Only water is volatile; sodium chloride remains as an ionic salt after evaporation

**7 marks**

**Question 3.**

**a.** $Mg(OH)_2(aq) + H_2SO_4(aq) \longrightarrow MgSO_4(aq) + 2H_2O(l)$

**b.** $Li_2CO_3(aq) + 2HCl(aq) \longrightarrow 2LiCl(aq) + CO_2(g) + H_2O(l)$

**c.** $SO_3^{2-}(aq) + H_2O(l) \longrightarrow HSO_3^-(aq) + OH^-(aq)$

**d.** $HPO_4^{2-}(aq) + H_2O(l) \longrightarrow H_2PO_4^-(aq) + OH^-(aq)$

$HPO_4^{2-}(aq) + H_2O(l) \longrightarrow PO_4^{3-}(aq) + H_3O^+(aq)$

**e.** $H_2PO_4^- + H_2O(l) \longrightarrow 2H_3O^+(aq) + PO_4^{3-}(aq)$

**6 marks**

**Question 4.**

**a.** $2\,NaOH(aq) + CO_2(g) \longrightarrow Na_2CO_3(aq) + H_2O(l)$

**2 marks**

**b.**
$$\begin{aligned} n(NaOH) &= 5.23 \times 10^{-3} \times 0.1 \text{ mol} \quad (n = cV) \\ &= 5.23 \times 10^{-4} \text{ mol} \\ n(CO_2) &= \frac{1}{2} n(NaOH) \\ &= \frac{1}{2} \times 5.23 \times 10^{-4} \text{ mol} \\ m &= \frac{1}{2} \times 5.23 \times 10^{-4} \text{ g} \quad (m = nMr) \\ \%CO_2 &= 2.62 \times 10^{-4} \times 100/0.500 \\ &= 0.0523\% \end{aligned}$$

**4 marks**

**c.**
$$\begin{aligned} c &= \frac{n}{V} \\ &= \frac{2.62}{500} \\ &= 5.23 \times 10^{-3} \text{ mol L}^{-1} \end{aligned}$$

**1 mark**

**Question 5.**

**a.** $2O_3(g) \longrightarrow 3O_2(g)$

**b.** $Fe_2O_3(s) + 2Al(s) \longrightarrow Al_2O_3(s) + 2Fe(s)$

**c.** $Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$

$HNO_3(aq) + H^+(aq) + e^- \longrightarrow NO_2(g) + H_2O(aq)$

**4 marks**

**Question 6.**

**a.** $N_2$

**b.** $O_2$

**c.** $2NO_2(g) + H_2O(l) \longrightarrow HNO_2(aq) + HNO_3(aq)$

**d.** $2HNO_3(aq) + CaCO_3(s) \longrightarrow Ca(NO_3)_2(aq) + H_2O(l) + CO_2(g)$

**e.** $PV = nRT$

$$\begin{aligned} 124.8 \times 3.15 &= n \times 8.31 \times 300 \\ n &= 0.158 \\ M &= \frac{10.10}{0.158} = 63.9 \end{aligned}$$

**f.** $SO_2$; $SO_2(g) + H_2O(l) \longrightarrow H_2SO_3(aq)$

**8 marks**

**Question 7.**

**a.** $2C_8H_{18}(g) + 25O_2(g) \longrightarrow 16CO_2(g) + 18H_2O(g)$
$C_6H_{12}O_6(aq) + 6O_2(g) \longrightarrow 6CO_2(g) + 6H_2O(l)$

**b.** Thistle funnel, conical flask, stopper, gas tube, pneumatic trough, gas jar

**c.** $2HCl(aq) + CaCO_3(s) \longrightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$

**d.** Dry ice, fire extinguishers, preservative

**e.** Photosynthesis:
$6CO_2(g) + 6H_2O(l) \longrightarrow C_6H_{12}O_6(aq) + 6O_2(g)$

**8 marks**

**Question 8.**

**a.** $V_{SO_2} = V_{SO_3} = 2.50$ L

**b.** $SO_3(g) + H_2O(l) \longrightarrow H_2SO_4(aq)$

$$n(H_2SO_4) = (nSO_3)$$

$$n = \frac{2.5}{24.5} = 0.102$$

$$c = \frac{0.102}{0.025} = 4.08 \text{ mol L}^{-1}$$

$$[H^+] = 2 \times 4.08$$

$$= 8.16 \text{ mol L}^{-1}$$

$$pH = -\log(8.16)$$

$$= -0.91$$

**c.** $[H^+] = \frac{10^{-14}}{[OH^-]}$

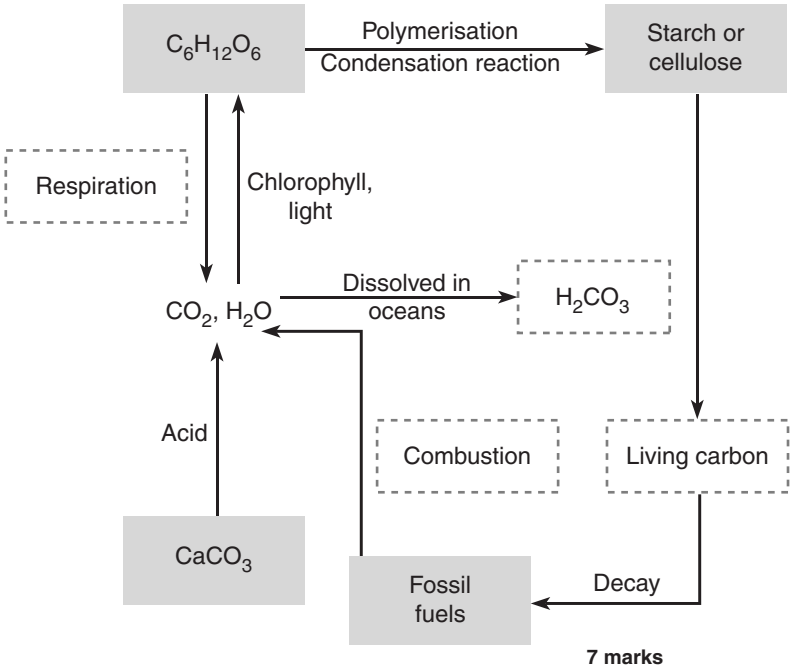
$$[H^+] = \frac{10^{-14}}{0.001 \text{ mol L}^{-1}}$$

$$pH = -\log(10^{-11})$$

$$pH = 11$$

**7 marks**

**Question 9.**




**7 marks**

**Question 10.**

**a.** Nitrogen

**b.** Noble gases

**c.** $CO_2$

**d.** $O_3$

**4 marks**

**End of Section B**