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GRADE 12: PHYSICAL SCIENCES

MARKING GUIDELINES

CHEMISTRY PRELIM P2

QUESTION 1

- 1.1 B
- 1.2 B
- 1.3 A
- 1.4 C
- 1.5 B
- 1.6 D
- 1.7 B
- 1.8 A
- 1.9 B
- 1.10 C

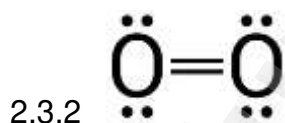
QUESTION 2

- 2.1.1 A
- 2.1.2 F
- 2.1.3 D or H
- 2.1.4 E
- 2.1.5 D

2.2.1  $(\text{CH}_3\text{COO})_2\text{Be}$

2.2.2 Magnesium dichromate

2.3.1  $1\text{S}^2 2\text{S}^2 2\text{P}^2$  Core electrons: 2 Valence electrons: 4

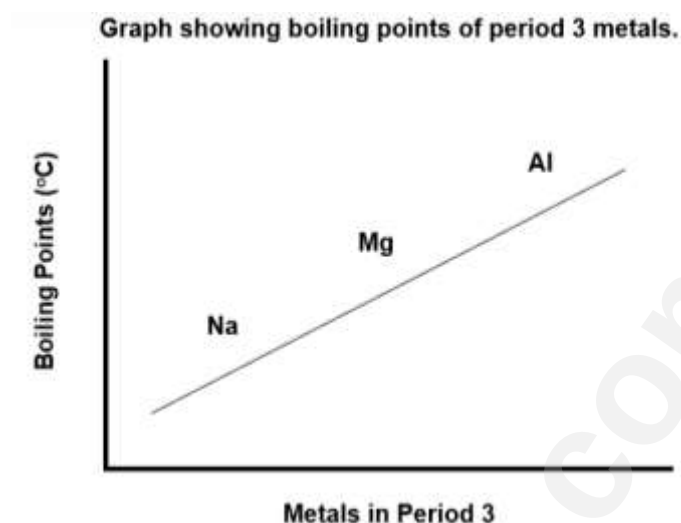


2.4 **Compound C** is an **ionic crystal** with **many ionic bonds**; it contains **strong electrostatic** forces between its ions.

**Compound F** forms **TWO hydrogen bonds** between its molecules.

Both ionic bonds and hydrogen bonds require **more energy to break and/ overcome**.

2.5.2



2.5.2

The boiling point increases from left to right across the period. Boiling points increase with increasing metallic bond strength. This means boiling point increases with increasing valence electrons, and smaller atomic radius and/or a more positive kernel. As you move from left to right in the period the number of valence electrons increase with decreasing atomic radius.

### QUESTION 3

3.1 The change in the concentration per unit time or either reactant or product.

3.2  $n = cV = (0,5)(0,1) = 0,05 \text{ mol}$

$$n = \frac{m}{M} = \frac{2-0,25}{100} = 0.0175 \text{ mol}$$

2:1

CaCO<sub>3</sub> is the limiting reagent.

3.3  $\text{Rate} = \frac{0,0175}{30} = 5,83 \times 10^{-4} \text{ mol. s}^{-1}$

3.4.1 Surface area

3.4.2 Reaction rate

3.4.3 Concentration of acid/volume of acid/mass of calcium carbonate.

3.5 When increasing the surface area more particles are exposed.

There will be more collisions per unit time.

More effective collision per unit time.

The reaction rate increases.

3.6.1 B

3.6.2 a) Steeper gradient with graph lining up with B at the end.

b) Less steep gradient with graph lining up with B at the end.

3.7.1 The concentration of the acid decreases

*For a lower concentration the curve shows fewer particles with enough kinetic energy to react per unit time.*

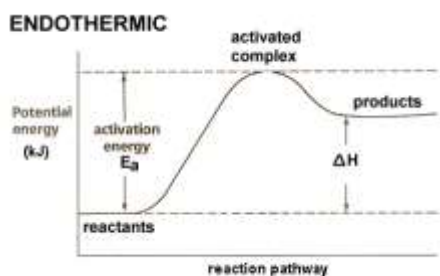
There will be fewer effective collisions per unit time.

The reaction rate decreases.

## QUESTION 4

4.1 Exothermic

4.2 Hydroxyl group



4.3

4.4 When an external stress is applied to a system in dynamic equilibrium the equilibrium point will change in such a way as to counteract the stress.

4.5.1 No effect    4.5.2 Decrease    4.5.3 Increase

4.6 **Stress:** Decrease in pressure

**Response:** The reverse reaction is favoured as the concentration of methanol decreases and the concentration of carbon monoxide and hydrogen increases.

**Reason:** The reverse reaction produces more moles (this increases pressure) to counteract the stress of a decrease in pressure.

4.7

| Ratio       | 1   | 2   | 1  |
|-------------|-----|-----|----|
| Initial     | x   | 18  | 0  |
| Change      | -8  | -16 | +8 |
| Equilibrium | x-8 | 2   | 8  |

$$K_c = \frac{[CH_3OH]}{[H_2]^2[CO]} \quad 4,3 = \frac{8}{4(x-8)} \quad 4x - 32 = \frac{8}{4,3} \quad x = 8,465 \text{ mol} \cdot d^{-3}$$

$$m = cMV = (8,465)(28)(3) = 711,06 \text{ g} = 0,77106 \text{ kg}$$

4.8.1 Reverse reaction    4.8.2 Temperature increases    4.8.3 Forward reaction.

4.8.4 Both graphs spike (not to the same level) showing that the reaction rates of both forward and reverse reaction increase when temperature increases.

The kinetic energy of all the particles in the reaction mixture is increases.

The forward reaction graph spikes more because the forward reaction is favoured. A new dynamic equilibrium is achieved at a higher rate because an increase in temperature increases the rate of the reaction.

**QUESTION 5**

5.1 The reaction of a molecular substance with water to produce ions.

5.2 Carbon dioxide gas

5.3 A: Burette B: Retort stand

5.4 A proton donor

5.5 **Incorrect!** It is an impure substance. The correct molar mass of the substance is unknown. This makes it impossible for learners to get an accurate mass required to make standard solution and therefore, accurate concentration.

5.6  $n = cV = (0,1)(0,25) = 0,025 \text{ mol}$   $m = nM = (0,025)(100) = 2,5 \text{ g}$

$$\frac{2,5}{5} \times 100 = 50\%$$

5.7 Reaction of an ion (from a salt) with water.

5.8 EQUAL/NEUTRAL

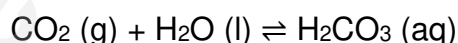
5.9  $\text{H}_3\text{O}^+$

5.10

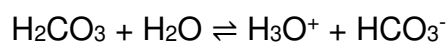
| Base 1 | Acid 2 | Acid 1 | Base 2 |
|--------|--------|--------|--------|
|--------|--------|--------|--------|

5.11  $n = \frac{V}{V_m}$   $V = 0.025(22,4) = 0,56 \text{ dm}^3$

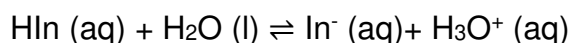
5.12 When carbon dioxide gas is pumped into water carbonic acid is formed:



This is a very unstable combine so some of it decomposes into carbon dioxide and water while some of it autoionizes producing hydronium ions:



The production of hydronium ions disturbs the indicator equilibrium.



**RED**

**YELLOW**

Increases the concentration of the hydronium ions favours the reverses reaction which produces HIn. The solution turns red.

## QUESTION 6

6.1.1 Cathode

6.1.2 Electrical to chemical energy

6.1.3  $\text{AgNO}_3$

6.1.4  $Q = It = 5 \times 3600 \times 3 = 54000 \text{ C}$

$$n = \frac{Q}{F} = \frac{54000}{96500} = 0,5595 \text{ mol of electrons} \quad 1:1$$

$$m = nM = (0,5595)(108) = 60,44 \text{ g}$$

6.2.1  $\text{Zn}^{2+}$ ,  $\text{Cu}^{2+}$  and  $\text{CO}_3^{3+}$

6.2.2  $\text{CO}_3^{3+}$  and  $\text{Zn}^{2+}$  remain because copper(II) ions are stronger oxidising agents and therefore are preferentially discharged at the cathode.

6.2.3 Sludge

6.2.4 Decreases

6.2.5 For every one copper (II) ion that is oxidised at the anode, three are reduced at the cathode. There are six electrons available at the cathode to reduce copper (II) ions in the solution. Once all the copper from the blister has been oxidised the copper (II) ions in the solution will not be replenished hence all the copper (II) in the solution will be reduced over time causing the intensity of the blue colour to decrease. Therefore, the concentration of copper (II) ions decreases.

### QUESTION 7

7.1 Loss of electrons

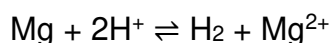
7.2  $1 \text{ mol.dm}^{-3}$ ,  $25^\circ\text{C}$  and  $1 \text{ atm}$ .

7.3 Negative

7.4  $\text{H}_2\text{SO}_4 (\text{aq}) \rightarrow 2\text{H}^+ + \text{SO}_4^{2-}$

Sulphuric acid is a strong diprotic acid that ionises completely in water.

The concentration of the hydrogen ions is  $2 \text{ mol.dm}^{-3}$ .



A higher concentration of hydrogen ions will favour the forward reaction which would **increase the initial emf of the cell**.

7.5  $\text{Pt(s)} \mid \text{H}_2 (\text{g}) \mid 2\text{H}^+ (\text{aq}) \parallel \text{Mg}^{2+} (\text{aq}) \mid \text{Mg (s)}$

7.6  $\text{H}^+$

7.7  $\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$

7.8 It is inert.

7.9 There is a build-up of positive charge in the anode half-cell. ( $\text{Mg}^{2+}$  increases).

The salt bridge pumps its negative ions to balance the build up of charge.

7.10 Remain the same.

7.11 Remain the same.

7.12 Increases.

7.13 hydrogen is a stronger reducing agent than copper. Therefore hydrogen will undergo oxidation. Electrons will therefore flow from the hydrogen half-cell to the copper half-cell.

## QUESTION 8

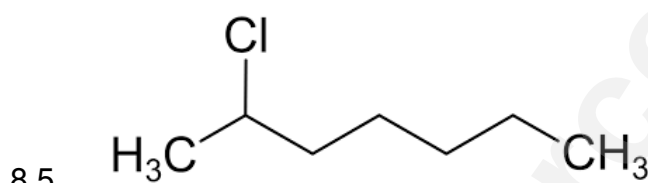
8.1.1 A compound containing carbon and hydrogen atoms, in which all bonds between carbon atoms are single bonds.

8.1.2 An atom or group of atoms that form the centre of chemical activity within the molecule.

8.2 B: Pent-2-ene (accept if FG site is different) C: Heptane

8.3 Both B and C form London forces between their molecules.  
C has a larger interacting surface area, more electrons, forms stronger temporary dipoles and therefore stronger London forces.  
More energy is required to overcome stronger IMF.  
Therefore, C has a larger boiling point.

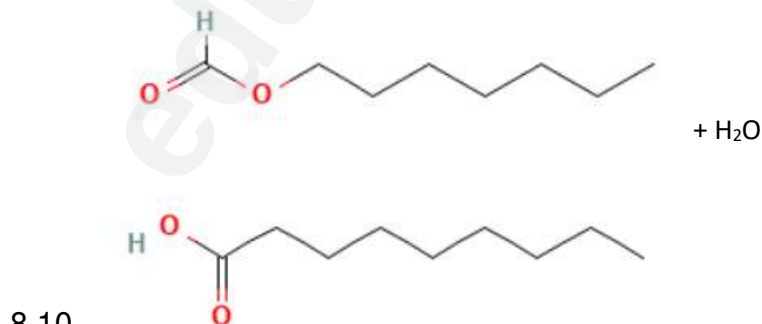
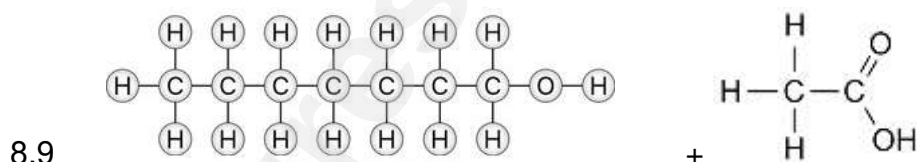
8.4  $\text{CH}_3\text{CH}_2\text{CHBrCHBrCH}_3$



8.6 Heptan-3-ol Accept if FG site is different.

8.7  $\text{H}_2\text{SO}_4$

8.8 Catalyst and dehydrating agent



8.11  $2\text{C}_7\text{H}_{14} + 21\text{O}_2 \rightarrow 14\text{CO}_2 + 14\text{H}_2\text{O}$