

Question 1

- 1.1 catalyst
- 1.2 cathode/positive electrode
- 1.3 functional group
- 1.4 alkynes
- 1.5 dynamic equilibrium

Question 2

- 2.1 C
- 2.2 C
- 2.3 C
- 2.4 B
- 2.5 A
- 2.6 A
- 2.7 B
- 2.8 C
- 2.9 A
- 2.10 B

Question 3

3.1 7✓

3.2.1

3.2.2

3.3 In Cl_2 the electrons are shared and the 2 chlorine atoms are bonded covalently. ✓ In MgCl_2 the electrons are transferred from the chlorine ions to the Mg ions and ionic bonding takes place ✓

3.4.1 +1 ✓✓

3.4.2 +7 ✓✓

[11]

Question 4

4.1 The measure of the ability of an atom in a molecule to attract bonding electrons to itself ✓✓

4.2 a) Non-polar ✓

4.3 a) linear ✓

b) pyramidal ✓

c) linear ✓

[6]

Question 5

5.1 $M(\text{C}_4\text{H}_{10}) = 58 \text{g} \cdot \text{mol}^{-1}$ ✓

$$\% \text{ C} = \frac{48}{58} \times 100 = 82,76\% \checkmark$$

$$\% \text{ H} = \frac{10}{58} \times 100 = 17,24\% \checkmark$$

(3)

5.2 $2 \text{C}_4\text{H}_{10} + 13 \text{O}_2 \qquad \qquad \qquad 8 \text{CO}_2 + 10 \text{H}_2\text{O}$

$$n = \frac{m}{M} \quad (= \frac{116}{58} (= 2 \text{ mol}))$$

Thus $2 \text{ mol} \times 4 = 8 \text{ mol}$ ✓

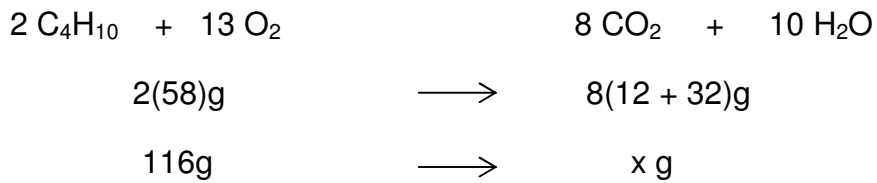
$$V = n \times V_0 \checkmark$$

$$= 8 \times 22,4 \checkmark$$

$$= 179,2 \text{ dm}^3 \checkmark$$

(6)

Or



$x = 352\text{g}$ ✓ of CO_2 produced

$$n = \frac{m}{M} = \frac{352}{44} (= 8 \text{ mol})$$

$$V = n \times 22,4 \text{ ✓} = 8 \times 22,4 \text{ ✓} = 179,2 \text{ dm}^3 \text{ ✓}$$

5.3.1 2 mol butane reacts with 13 mol O_2 ✓

$$\text{Mass O}_2 \text{ needed} = n \cdot M \text{ ✓} = 13 \times 32 = 416\text{g} \text{ ✓}$$

But you have been given 420 g of O_2 , therefore butane is the limiting reagent ✓

Or

No. of moles of O_2 given:

$$n = \frac{m}{M} (= \frac{420}{32}) = 13,13 \text{ moles}$$

Thus since the C_4H_{10} and O_2 are in a ratio 2:13, but there is 13,13 moles of O_2 ✓

O_2 is in excess and C_4H_{10} is the limiting reagent ✓ (4)

5.3.2 Mass of O_2 in excess = $420 - 416 = 4 \text{ g}$ ✓

$$n = \frac{m}{M} = \frac{4}{32} (= 0,125 \text{ mol}) \text{ ✓}$$

or moles in excess = $13,13 - 13$ ✓

$$= 0,13$$

$$m = n \times M$$

$$= 0,13 \times 32 \text{ ✓}$$

$$= 4,16 \text{ g} \text{ ✓}$$

(3)

Question 6

6.1.

12 g of C in 44 g of CO₂

$$n = \frac{m}{M} \checkmark = \frac{1,77}{44} \checkmark = 0,04 \text{ moles}$$

$$m = n \times M$$

$$= 0,04 \times 12 \checkmark = 0,48\text{g} \checkmark$$

2 g H in 18 g H₂O

$$n = \frac{m}{M} = \frac{1,08}{18} \checkmark = 0,06 \text{ moles}$$

$$m = n \times M$$

$$= 0,06 \times 2 \checkmark = 0,12\text{g} \checkmark$$

(6)

6.2. Mole ratio

$$\text{C}:n = m/M = \frac{0,48}{12} \checkmark = 0,04 \text{ } (\div 0,04) \checkmark = 1$$

$$\text{H}:n = m/M = \frac{0,12}{1} \checkmark = 0,12 \text{ } (\div 0,04) = 3$$

$$= 1 : 3$$

Empirical formula CH₃ ✓

(4)

$$6.3. \quad \frac{30}{15} = 2 \text{ therefore true formula is C}_2\text{H}_6$$

(2)

6.4. Ethane ✓

6.5.1. Exothermic ✓✓

Question 7

7.1 exothermic ✓

7.2.1 100 kJ.mol⁻¹ ✓

7.2.2 -100 kJ.mol⁻¹ ✓

7.2.3 200 kJ.mol⁻¹ ✓

7.2.4 100 kJ.mol⁻¹ ✓

[5]

Question 8

8.1 $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$ ✓✓ (2)

8.2 $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ ✓✓ (2)

8.3 Cu^{+2} ✓✓ (2)

[6]

Question 9

9.1 Chemical (energy) to electrical (energy) ✓ (1)

9.2 Completes the circuit. ✓
OR Maintains electrical neutrality. / Transports ions. ✓ (1)

9.3 $\text{Pb} \rightarrow \text{Pb}^{2+} + 2\text{e}^-$ ✓✓ (2)

9.4 Pb to Cu ✓ (1)

9.5 $\text{Pb} + \text{Cu}^{2+} \rightarrow \text{Pb}^{2+} + \text{Cu}$ ✓ Bal. ✓ (3)

9.6 Exothermic ✓ (1)

9.7 **Option 1**
 $E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}}$ ✓
 $= 0,34 - (-0,13)$ ✓
 $E^\theta_{\text{cell}} = 0,47 \text{ V}$ ✓

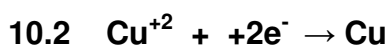
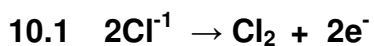
Option 2
 $\text{Pb} \rightarrow \text{Pb}^{2+} + 2\text{e}^- \quad E^\theta = +0,13 \text{ V}$ ✓
 $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu} \quad E^\theta = 0,34 \text{ V}$ ✓
 $E^\theta = 0,47 \text{ V}$ ✓ (4)

9.8 Measurements not done at:
Temperature of 25 °C / 298 K ✓✓
Concentration of 1 mol·dm⁻³ ✓✓

OR / OF
Concentration > or < 1 mol·dm⁻³ ✓✓
Temperature > or < 25 °C / 298 K ✓✓ (4)

[17]

Question 10



10.3 anode - P

Cathode - Q

10.4 Q

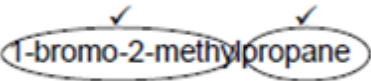
10.5 $E^{\circ}\text{cell} = E^{\circ}\text{cathode} - E^{\circ}\text{anode}$

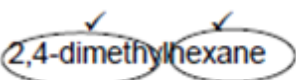
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Question 11

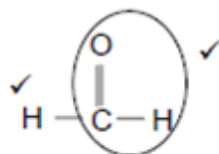
11.1 11.1.1 A ✓
Accept: but-1-ene ; 1-butene ; correct redrawn structure [12.2.3] (1)

11.1.2 D ✓
Accept: Methanal; correct drawn structure [12.2.3] (1)


11.2 11.2.1  If hyphens omitted: Max. 1/2 [12.2.3] (2)

11.2.2  If hyphens omitted: Max. 1/2 [12.2.3] (2)

11.3



Functional group encircled ✓
Molecule correct ✓

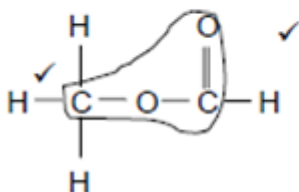
Molecular formula: CH ₂ O	0/2
Condensed or semi-structural formula: HCHO ; 	Max. 1/2

[12.2.3] (2)

11.4 Ethanoic (acid) ✓✓
Accept: Acetic (acid)

[12.2.1] (2)

11.5

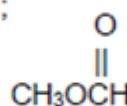


Functional group encircled ✓
Molecule correct ✓

Molecular formula: $C_2H_4O_2$

0/2

Condensed or semi-structural formula: CH_3COOH ;



Max. 1/2

[12.2.3]

(2)
[12]

Question 12

12.1.1 State of division (of solid) / Reaction surface ✓

[12.1.1] (1)

12.1.2



Criteria for investigative question	Mark
The <u>dependent</u> and <u>independent</u> variables are stated.	✓
Asks a question about the relationship between the dependent and independent variables.	✓

Example:

How will the state of division/ reaction surface / surface area influence the rate of the reaction?

OR

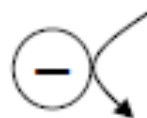
What is the relationship between state of division/ reaction surface / surface area and reaction rate?

[12.1.1] (2)

12.2.1 Concentration (of HCl) ✓

[12.1.1] (1)

12.2.2



Criteria for hypothesis:	Mark
The <u>dependent</u> and <u>independent</u> variables are stated.	✓
Makes prediction about about the relationship between the <u>dependent</u> and <u>independent</u> variables.	✓

Example:

The higher the concentration (of the reactant / acid), the higher the rate of the reaction.

OR

The higher the concentration, the lower the rate of the reaction.

OR

Reaction rate increases with decrease in concentration.

OR

Reaction rate increases with increase in concentration.

OR

Reaction rate is proportional/directly proportional/inversely proportional to concentration.

[12.1.1] (2)

12.2.3 Yes✓
All other variables that affect the reaction rate are constant.✓

OR

The volume of the acid will not affect the rate of the reaction. ✓

OR

There is only one independent variable

OR

Concentration is the only variable that changes

OR

Concentration is the only independent variable

[12.1.1] (2)

12.2.4 Equal to✓ (any equivalent correct answer)
CaCO₃ is the limiting reactant. ✓

OR

equal to ✓

The same amount/number of moles/mass of CaCO₃ reacts in both experiments✓.

[12.1.1] (2)

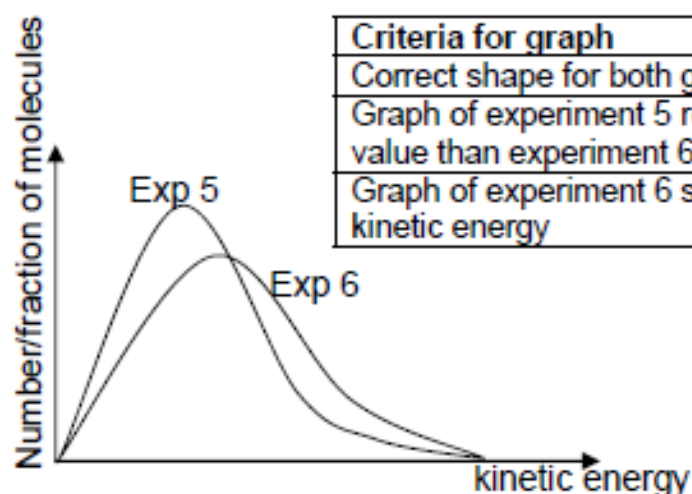
12.3.1 Lower than✓ (any equivalent correct answer)

OR

Larger than in experiment 6.

[12.1.2] (1)

12.3.2



Criteria for graph	Mark
Correct shape for both graphs	✓
Graph of experiment 5 reaches a higher maximum/peak value than experiment 6.	✓
Graph of experiment 6 shows more molecules of higher kinetic energy	✓

[12.1.2] (3)

Question 13

13.1 A (propane) ✓

IF: it is between propane and pentane. $\frac{1}{2}$

It has four carbon atoms. $\frac{1}{2}$

[12.2.1] (1)

13.2 13.2.1 Compounds with the same molecular formula, ✓ but different structural formulae. ✓

[12.2.1] (2)

13.2.2 Compound C / 2-methylbutane is more branched/more compact/more spherical/has a shorter chain/has a smaller surface area. ✓

Weaker intermolecular forces/ Van der Waals forces/dispersion forces/London forces. ✓

Less energy needed to overcome intermolecular forces. ✓

OR

Compound B / Pentane is less branched/has a longer chain/less compact/less spherical/has a larger surface area. ✓

Stronger intermolecular forces / Van der Waals forces. ✓

More energy needed to overcome intermolecular forces. ✓

[12.1.4] (3)

13.3 The Van der Waals forces in B (pentane) ✓ are weaker ✓ than the hydrogen bonds in D (pentan-1-ol) ✓ and requires less energy ✓ to break.

[12.1.4] (4)

[10]