



**GCSE Chemistry**  
**Reversible Reactions and**  
**Dynamic Equilibrium**  
**Mark Scheme**

**Time available: 65 minutes**  
**Marks available: 62 marks**

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Mark schemes

**1.**

(a) reactant

1

(b) reversible

1

(c) blue

*allow shades of blue, e.g. pale blue*

1

(d) 1.6 (g)

1

(e)  $\frac{0.9}{2.5} \times 100$

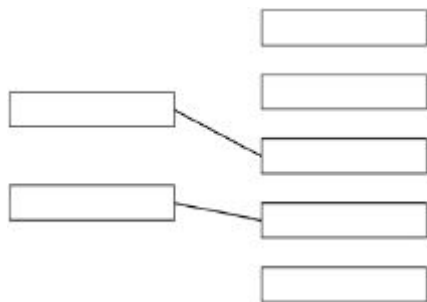
1

= 36 (%)

1

*an answer of 36 (%) scores 2 marks*

(f)



*copper sulfate – CuSO<sub>4</sub>*

1

*water – H<sub>2</sub>O*

1

**[8]**

**2.**

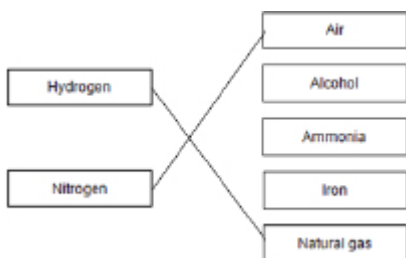
(a) 4

1

(b) reversible (reaction)

1

(c)



1

1

(d)  $-40\text{ }^{\circ}\text{C}$

1

(e) recycled to the reactor

1

(f) ionic

1

(g) nitrogen

1

phosphorus

1

(h)  $0.24 \times 50 \times 5$

*allow £87.50*

1

= £60

1

*an answer of £60 scores 2 marks*

(i) may need to use nitrogen, phosphorus and potassium

*allow neither fertiliser has all the elements / nutrients needed.*

[12]

3.

(a) endothermic

1

(b) 82 (%)

*correct answer with working gains 3 marks*

*if 17 or 34 not shown in working max 2 marks*

*accept 82.4*

*accept 82.35 to full calculator display (82.35294...) correctly rounded to at least 2 sf*

*if no answer or incorrect answer, then*

*( $M_r$  =) 17 gains 1 mark or*

*14/17 gains 2 marks*

**OR**

*( $2M_r$  =) 34 gains 1 mark or*

*28/34 gains 2 marks*

**OR**

*14/their  $M_r$  shown gains 1 mark or*

*correct calculation of 14/their  $M_r$  gains 2 marks*

3

(c) (i) 7 / seven

1

(ii)  $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$

1

(iii) ammonium chloride

*allow  $NH_4Cl$*

*ignore an incorrect formula*

1

- (d) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

**Level 3 (5 – 6 marks):**

Suggestion with reasons from all three graphs, and linking of ideas which may explain a compromise.

**Level 2 (3 – 4 marks):**

Suggestion with reasons referring to more than one graph.

**Level 1 (1 – 2 marks):**

Suggestion with a reference to a graph.

**0 marks:**

No relevant content.

**Examples of chemistry points made in response:**

A reasonable suggested amount of fertiliser would be in the region of 200 kg (per ha).  
Accept any suggestion from about 180 kg (per ha) to 500 kg (per ha).

**Yield:**

- Using fertiliser improves yield.
- Yield improved most up to about 200 kg (per ha) of fertiliser.
- Yield only increased slightly above about 200 kg (per ha).

**Profit:**

- About 200 kg of fertiliser gives the most profit.
- Above about 200 kg (per ha) of fertiliser profit declines.

**Run off:**

- Run off is at low levels until about 300 kg (per ha) of fertiliser.
- Above about 300 kg (per ha) of fertiliser, run off increases.

**Examples of linking of ideas:**

- Overall 200 kg gives high crop yield and most profit.
- In conclusion 200 kg gives high crop yield and low run off.
- 200 kg gives most profit and low run off.

**Examples of compromise:**

- Profits go down after about 200 kg (per ha) of fertiliser because cost of fertiliser is not covered by increased yield.
- 200 kg gives the highest profit although it is not the highest yield.
- 500 kg gives the best yield but has the most runoff.

6

[13]

4. (a) the forward and backward reactions occur 1  
*allow reversible*
- at (exactly) the same rate 1
- in a closed system  
*allow therefore the concentrations / amounts of the reactants and products remain the same* 1
- (b) (i) increasing the temperature would lower the yield of ethanol **or** the (position of equilibrium moves to the left  
*if student has stated that increasing the temperature increases the yield then award 0 marks* 1
- since the backwards reaction is endothermic **or** the forward reaction is exothermic 1
- (ii) increasing the pressure would increase the yield of ethanol **or** the (position of equilibrium moves to the right  
*if student has stated that increasing the pressure decreases the yield then award 0 marks* 1
- because the position (of equilibrium) moves in the direction of the lower number of moles (of gas)  
*2 (moles / molecules / volumes / particles) on lhs / 1 (mole / molecule / volume / particle) on rhs* 1
- (c) (a catalyst) provides an alternative pathway 1
- with lower activation energy
- or**
- (a catalyst) lowers the activation energy (1)
- so less energy is needed to react **or** more particles react (1) 1
- [9]**
5. (a) water  
*accept H<sub>2</sub>O or 5H<sub>2</sub>O*
- 2 must be below halfway 1

- (b) the cold water / ice / cubes (owtte)  
*accept 'cooled down' or references to cold* 1
- (c) reversible reaction 1
- (d) (i) 0.87g 1
- (ii) the student made errors in weighing during the experiments 1
- the student did not heat the copper sulfate for long enough in one of the experiments 1
- (e) white 1
- blue  
*allow 1 mark for blue to white* 1

[8]

6.

- (a) enzyme 1
- (b)  $2.0 \times 10^3$  moles 1
- (c) smaller yield  
*allow less methanol is produced* 1
- (because) favours endothermic reaction  
*allow (because) favours reverse reaction*  
*allow equilibrium / reaction shifts to the left*  
*allow equilibrium / reaction shifts to reduce the temperature*  
*ignore reference to forward reaction is exothermic*  
*ignore references to rate* 1

(d) (yield)  
equilibrium position moves to the product side  
*allow equilibrium / reaction moves to the right*  
*allow equilibrium / reaction shifts to reduce the pressure*

1

(because) fewer molecules / moles / particles on product side  
*allow (because) fewer molecules / moles / particles on the right*  
*allow (because) smaller volume on product side*

1

(rate)  
more collisions per unit time  
*allow increases collision frequency / rate*  
*ignore more collisions alone*  
*ignore faster collisions*  
*do **not** accept any indication of more energetic / forceful collisions*

1

(because) more molecules / particles per unit volume  
*allow (gas) molecules / particles closer together*  
*ignore more molecules / particles alone*  
  
*allow converse arguments*

1

(e) provides different reaction pathway  
*allow provides a different mechanism / route*

1

(which has a) lower activation energy  
  
*ignore references to collisions*

1

(f) less energy is needed  
*allow reduces the temperature required*  
*allow reduces costs*  
*ignore references to pressure*  
*ignore references to rate or time*

1

(g) no effect / change

1

[12]