

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

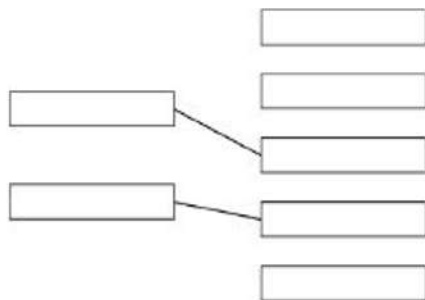
1

= 36 (%)

1

an answer of 36 (%) scores 2 marks

(f)



copper sulfate – CuSO₄

water – H₂O

1

1

[8]

2.

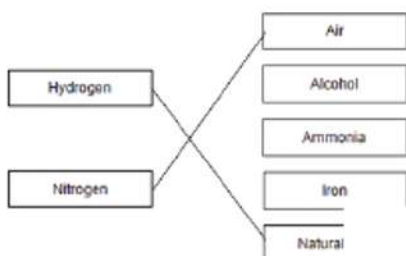
(a) 4

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.

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

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1

(iii) ammonium chloride

allow NH_4Cl

1



ignore an incorrect formula

- (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
allow reversible

1



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 H₂O **or** 5H₂O*

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) 2.0×10^3 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]