

Rate of Reaction

Mark Scheme 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.6 Rate + Extent Chemical Change
Sub-Topic	Rate of Reaction
Difficulty Level	Standard Level
Booklet	Mark Scheme 1

Time Allowed: 58 minutes

Score: /54

Percentage: /100

Grade Boundaries:

M1.(a) Level 3 (5–6 marks):

A coherent method is described with relevant detail, which demonstrates a broad understanding of the relevant scientific techniques and procedures. The steps in the method are logically ordered with the dependent and control variables correctly identified. The method would lead to the production of valid results.

Level 2 (3–4 marks):

The bulk of a method is described with mostly relevant detail, which demonstrates a reasonable understanding of the relevant scientific techniques and procedures. The method may not be in a completely logical sequence and may be missing some detail.

Level 1 (1–2 marks):

Simple statements are made which demonstrate some understanding of some of the relevant scientific techniques and procedures. The response may lack a logical structure and would not lead to the production of valid results.

0 marks:

No relevant content

Indicative content

- remove bung and add magnesium
- start stopclock / timer
- measure volume of gas at fixed time intervals
- repeat with different concentrations of acid
- control volume of acid
- control initial temperature of acid
- control amount / mass / length / particle size of magnesium

6

(b) 6.5 cm^3

1

(c) all points plotted correctly

allow 1 mark for 4 points plotted correctly

2

best fit straight line drawn

1

(d) when the concentration of acid increased the rate of reaction increased or vice versa

answer must use the terms 'rate of reaction' linked to

'concentration'

1
[11]

M2.(a) products below reactants

1

correct energy profile

1

activation energy correctly labelled

1

energy given out correctly labelled

1

(b) 31 (%)

1

(c) the products would be above the reactants

1

(d) catalysts increase rate of reaction
1 mark for each property

1 mark for each explanation

so products formed in less time

or

catalysts lower activation energy

explanation must be linked correctly to the property to gain the mark

so lowers energy requirements

or

catalysts not used up in the reaction

so only an initial outlay needed

or

only a small amount of catalyst needed

so small initial cost

max. 4

(e) Protein

1

(f) high temperatures

1

extremes of pH

1

(g) lactase acts as the lock, lactose is the key (substrate)

1

lactase has an active site which will only fit lactose molecules

1

so lactase will not work with other molecules

1

[16]

M3.(a) (as concentration increases)

*answers **must** refer to data from graph to gain full marks*

relationship identified from the graph

*eg the same volume of gas is collected in a shorter time **or**
more gas is collected in the same time **or** reaction reaches
completion in a shorter time*

1

reference to relevant data to evidence relationship

eg 20 ml collected in 10 seconds at 0.5 mol / dm³ in 6.5 s at 1.0 mol / dm³ and in 4 s at 2.0 mol / dm³

or

at 10 seconds volume collected is 20 cm³ with 0.5 mol / dm³, 30 cm³ with 1.0 mol / dm³, 50 cm³ with 2.0 mol / dm³

or

total volume collected reaches maximum of 100ml in 20 seconds at 2.0 mol / dm³ but takes twice as long at 1.0 mol / dm³ and at 0.5 mol / dm³

1

(b) reactions occur when particles collide

1

increasing concentration means there are more particles in the same volume

1

so there are more collisions

1

(c) leave for longer

1

if gas continues to be produced student A is right

1

or

repeat with more acid (1)

if more gas is produced student B is right (1)

[7]

- M4.(a)** 6.1 circled on table (15 °C, test 1) 1
- (b) 1.8
do not allow 1.83 1
- (c) 16 (minutes)
correct number extrapolated from curve 1
- (d) 4.0 min – blue / black / purple 1
- 7.0 min – yellow / orange / brown 1
- (e) The amylase solution had been prepared with water at 95 °C 1
- 1
- (f) **Level 3 (5–6 marks):**
A clear and coherent method is described using logical steps and demonstrating a good understanding of how to improve the validity of the method. The method would lead to the production of valid results that would give rise to a more valid conclusion.
- Level 2 (3–4 marks):**
The substantive content of a method is present and demonstrates reasonable understanding of how to improve the validity but may be missing some detail. The plan may not be in a completely logical sequence but leads towards the measurement of rate of the reaction.
- Level 1 (1–2 marks):**
Simple relevant statements made, which demonstrate limited understanding of how to improve the experimental method. The response lacks logical structure and would not lead to the production of valid results or a more precise optimum temperature.

0 marks:

No relevant content

Indicative content

- conduct at a greater range of temperatures
- use temperatures both above and below 40 °C
- use smaller temperature intervals to get a more accurate optimum (eg go up in 2 °C increments)
- take samples at smaller time intervals to get a more accurate result for 'time taken'
- control the volume of starch used (eg 5 cm³)
- control the volume of the amylase solution (eg 1 cm³)
- control the temperature (eg using a water bath)
- heat the two solutions separately before mixing
- control the concentration of the starch solution
- control the concentration of the amylase solution

6

[13]

M5.(a) sulfur / sulphur / S / S(s)

1

(b) as the temperature increases, the rate of reaction increases

allow two correct values for rate quoted (from graph) at different temperatures

1

the rate of increase increases **or** there is an exponential relationship

accept the rate of reaction increases slowly (from 20 °C to 50 °C) then increases more rapidly for 2 marks

answer MUST be based on rate / speed of reaction

1

(c) (i) any **two** from:

- temperature (of the reactants)
- concentration of hydrochloric acid
- volume of hydrochloric acid
- volume of sodium thiosulfate
- the (size / darkness / thickness of the) cross
- total volume of solution.

if no other marks gained, allow 1 mark for:

rate of stirring

OR

amount of hydrochloric acid / sodium thiosulfate

OR

volume of solution

2

- (ii) (because as the concentration increases) the number of particles per unit volume increases **or** particles are closer together.

idea of more particles in a given space is required for the first mark.

ignore references to area.

1

(therefore) the frequency of (successful) collisions increases

allow increased chance / probability of collisions

number of collisions increases is insufficient here.

must mention per unit time or frequency.

ignore speed of collisions.

if reference to space and time missing from M1 and M2 but they are otherwise correct, then award 1 mark.

1

so the number of particles (per unit volume) doubles **or** (the frequency of) collisions doubles.

students can score 2 marks for a qualitative explanation; the third mark is for a quantitative explanation.

1

[8]