



GCSE Chemistry

Rates of Reaction

Mark Scheme

Time available: 60 minutes

Marks available: 58 marks

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Mark schemes

1. (a) 83 (cm³)
allow 83.0 / 83.00
1
- (b) mass of magnesium powder
1
temperature of hydrochloric acid
1
- (c) $\frac{(46 + 47 + 49)}{3}$
allow 47.3(333) (cm³) for 1 mark
1

= 47 (cm³) (2 sf)
an answer of 43 (cm³) scores 1 mark
1
an answer of 47 (cm³) scores 2 marks
- (d) all points plotted correctly
(inc 0,0)
allow a tolerance of $\pm\frac{1}{2}$ a square
allow ecf from question (c)
ignore line
allow 1 mark for four points plotted correctly
2
- (e) $\frac{80}{50}$
allow 80 ± 2
1

= 1.6 (cm³/s)
allow 1.60 ± 0.04
1
an answer of 1.6 (cm³/s) scores 2 marks
- (f) rate is greatest at start
allow rate is faster at start
1

(then) rate decreases
allow (then) rate slows down
1

reaction stops
1

1

(g) there are more particle collisions each second

there are more particles in the same volume

1

(h) (gas is) not carbon dioxide

ignore does not react with limewater

1

(i) hydrogen

allow H₂

1

pop sound

1

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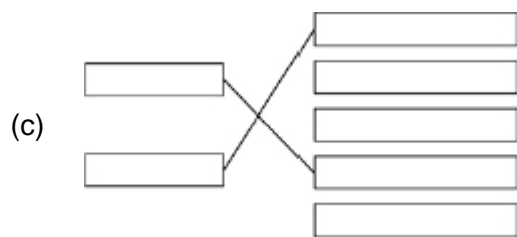
2.

(a) S(s)

1

(b) measuring cylinder

1



1

allow for 1 mark an answer of dependent variable --- concentration of sodium thiosulfate solution and independent variable --- time for cross to become no longer visible

1

(d) cross might be darker or paler

allow cross may not be the same size / shape

1

(e)
$$\frac{43 + 41}{2}$$

an answer of 42 (s) scores 2 marks

1

= 42 (s)

an answer of 54 (s) scores 1 mark

1

(f) smooth curve through all points

must touch all crosses

*do **not** allow straight lines between points*

ignore attempt to plot X

1

1

(g) reproducible

1

(h) particles collide more frequently

there are more particles in a fixed volume

1

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3.

(a) cotton wool

1

(b) all points correct

$\pm \frac{1}{2}$ small square

2

allow 1 mark if 5 or 6 of the points are correct

best fit line

must not deviate towards anomalous point

1

(c) (mass)

2.1 (g)

allow ecf from drawn best fit line

1

(time)

100 (s)

1

(d) a gas is produced

1

which escapes from the flask

1

(e) $\frac{9.85}{150} = 0.0656$

1

0.07 (g / s)

allow ecf answer correctly calculated to 2 decimal places

1

(f) collect the gas in a gas syringe

1

measured the volume of gas

allow carbon dioxide for gas

1

allow for 1 mark

collected gas

or

counted bubbles

(g) The particles have more energy

1

The particles move faster

1

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4.

(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]

5.

- (a) (i) the higher the temperature, the greater the rate
or
at 40 °C rate is faster than at 20 °C

accept the higher the temperature, the faster the reaction

1

- (ii) 40 °C curve is steeper

accept the 40 °C line becomes horizontal sooner

accept at higher temperatures the reaction finishes sooner

accept reaction finishes sooner at 40 °C

accept at higher temperatures the gas is produced faster

or

correct comparison of data from the graph

1

- (iii) 2

1

2

- (b) (i) Concentration of acid
Mass of marble chips

- (ii) increases rate

incorrect reference to energy = max 1

1

(because of) more frequent collisions (between particles)

accept particles are more likely to collide

ignore more collisions

ignore more successful collisions

1

- (c) any **one** from:

- increases rate of reaction
- reduces energy required
- lower temperature can be used
- catalyst is not used up.

1

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