

MARK SCHEME

GCSE

CHEMISTRY

AQA - COMBINED SCIENCE

C6 - TEST 4

RATE OF REACTION

Intermediate

Mark schemes

1.

(a) particles move faster

accept molecules / atoms / ions instead of particles

or

particles have more energy

ignore move / vibrate more

1

so they collide more often / frequently

allow particles collide harder / with more force

ignore collide quicker

or

more of the collisions are successful / have the activation energy

ignore collide more / more collisions

1

(b) any **one** from:

- increase surface area (of the rock)

accept crush / powder the rock

- increase the concentration (of the acid)

ignore increase the pressure / temperature

- add a catalyst

- stir / mix the mixture

1

[3]

2.

(a) (i) 0.2

correct answer gains 2 marks with or without working

accept answer in table

if answer incorrect 5/25 gains 1 mark

2

(ii) any **one** from:

- wider range of temperatures (owtte)
- (repeat at the same temperature) to improve accuracy / reliability
allow to make it reliable / accurate
- reveal anomalous results (owtte)
allow to eliminate random / human errors / to check results owtte
- so you can get an average / better average
ignore to make it a fair test / to get better results
ignore precision and validity

1

(b) any **two** from:

allow atoms / molecules / they instead of particles throughout

- particles gain energy / have more energy
ignore increases particles activation energy
- particles move faster
ignore move more / vibrate more
- particles collide more
- more of the particles have the activation energy **or** more of the collisions are successful (owtte)
ignore increases / decreases activation energy

or

particles collide with more force / harder / more energy

allow more successful collisions

alone for 1 mark

2

[5]

3.

(a) (i) $\text{Na}_2\text{S}_2\text{O}_3(\text{aq}) + 2 \text{HCl}(\text{aq}) \rightarrow 2\text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{S}(\text{s}) + \text{SO}_2(\text{g})$

1

(ii) (formation of) sulphur

*accept precipitate **or** solid produced*

*do **not** accept goes cloudy **or** milky*

1

(b) (i) heat \equiv temperature increased temperature increases (the rate of reaction)
or decreased temperature decreases rate of reaction

may be gained in part (ii) if stated and not implied

1

(ii) (these ideas may be given in (i))

particles have more kinetic energy
accept particles move faster

1

more collisions (so more reactions)
*more energetic collisions **two** marks*

1

[5]

4.

(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]

5.

(a) any **two** from:

- effervescence / bubbles / fizzing
allow gas / hydrogen is given off
allow volume of gas
allow magnesium floats
- magnesium disappears / dissolves
allow change in mass of magnesium
- heat given off / exothermic
allow temperature change
*do **not** accept temperature decreases*
- change in pH
*do **not** accept pH decreases*

2

(b) 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 refer to the information in the [Marking guidance](#).

0 marks

No relevant content.

Level 1 (1-2 marks)

A simple plan without reference to changing any variable but should include an attempt at measuring rate **or** an attempt at fair testing

Level 2 (3-4 marks)

A plan including change of concentration / 'volume' of acid **and** should include an attempt at measuring rate **and / or** an attempt at fair testing

Level 3 (5-6 marks)

A workable plan including change of concentration **and** measurement of rate **and** fair testing

Examples of chemistry points made in the response could include:

Plan:

- add magnesium to acid
- time reaction / 'count bubbles' / measure volume of gas
- change concentration / 'volume' of acid

Control Variables:

- amount / mass / length / same 'size' of magnesium
- volume / amount of acid

6

[8]

- 6.** (a) time from when the heating is started until 1
the limewater turns cloudy / milky 1
- (b) (i) the temperature was not high enough
accept the copper carbonate had not started to decompose / react
accept it takes time to heat up the copper carbonate 1
- the bubbles of gas were air
accept no carbon dioxide produced 1
- (ii) the copper carbonate was decomposing / reacting
accept the temperature was high enough to cause decomposition /
a reaction 1
- so carbon dioxide was produced
allow correct word / symbol equation 1
- (iii) copper oxide was produced
allow correct word / symbol equation 1
- because the copper carbonate had completely decomposed / reacted
ignore all of the carbon dioxide had been given off 1
- [8]**
- 7.** (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]

- 8.** (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
- (b) (i) Concentration of acid
 Mass of marble chips 2
- (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
- [8]**

- 9.** (a) (i) accurate plotting of points ($\pm \frac{1}{2}$ square)
2 marks for all points
1 mark for 3 or 4 points 2
- sensible smooth curve
reasonable attempt
 do **not** accept double lines **or** dot to dot 1

- (ii) accurately read from their graph to $\pm \frac{1}{2}$ square 1
- (b) (i) (as temperature increases) rate increases
accept speeds up, gets faster, gets quicker
accept higher speed
*do **not** accept gets bigger / higher unqualified*
*do **not** accept answers about time on its own* 1
- (ii) **Quality of Written Communication**
The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.
maximum 2 marks if ideas not expressed well
- any **three** from:
for converse maximum 2 marks
- particles have more energy
higher kinetic energy
- particles move faster
*do **not** accept move more or vibrate more* 3
- more collisions
accept greater rate of collisions
- more energetic / successful / harder collisions
more particles have activation energy
- (c) concentration (of solutions) **or** volume (of solutions)
accept 'how much of'
accept references to intensity of colour
accept same endpoint
accept rate of stirring / shaking
*do **not** accept reference to solids **or** catalysts etc*
ignore containers
*do **not** accept pH* 1

[9]

10.

(a) (i) **must be chemical symbol**

Ca

1

C

$\text{CaCO}_3 = 2$ marks

1

O not O_2

1

(ii) carbon dioxide

must be name

1

(b) (i) *points all correct 2 marks*
one point incorrect 1 mark
two points incorrect 0 marks

2

suitable line -narrow neat single curve

not dot to dot

1

(ii) reaction with X forms less gas

must include X or Y

do **not** penalise for H_2/O_2 if (a) (ii) already penalised

do **not** accept is finished in less time **or** slower/faster reaction **or** lower on graph

1

(iii) any two from:

- concentration (of acid) decreases/less reacting particles/molecules
not acid/ CaCO_3 runs out/is used up
- surface area of calcium carbonate decreases
not strength of acid decreases
- less collisions between reacting particles
not smaller (amount of) CaCO_3

2

[10]