

MARK SCHEME

GCSE

CHEMISTRY

AQA - TRIPLE SCIENCE

C6 - TEST 3

RATE OF REACTION

Intermediate

Mark schemes

1.

(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]

2.

(a) because sulfur / S forms

1

which is insoluble / a solid / a precipitate

1

(b) (i) 32

correct answer with or without working gains 2 marks

accept evidence of 31 + 33 / 2 for 1 mark

allow 35 for 1 mark

2

(ii) reaction rate increases

if incorrect reference to energy = max 2

1

because of more particles (per unit volume)

allow because particles are closer together

1

and because there is an increase in frequency of collisions

accept because particles are more likely to collide or higher chance of collision

ignore more (successful) collisions

1

[7]

3.

(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]

4.

(a) gives out energy **or** heat

1

(b) (i) *accept qualified answers in terms of volume of gas related to time*

fast initially

1

slows down

1

reaction stops

accept reaction is now very slow

1

(b) (ii) 21 1

(iii) 84
correct answer with or without working = 2 marks
allow ecf from (b)(ii) correctly calculated for 2 marks
allow evidence of 21/25 or (b)(ii)/25 for 1 mark 2

(c) because they / particles have more energy / move faster
ignore particles move more / vibrate 1

(and so) particles collide more often / more frequently **or** particles more likely to collide
ignore collide faster
ignore more collisions 1

(and) more of the collisions are successful **or** particles collide with more energy / harder **or**
more of the particles have the activation energy
accept more successful collisions 1

[10]

5.

(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]

6.

(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]

7.

- (a) O_2 in correct space

1

correct balancing

accept multiples

1

- (b) (i) rate increases

incorrect reference to energy = max 2

ignore references to equilibrium

1

because particles are closer together

accept because there are more particles (per unit volume)

allow particles have less space / room to move around

1

so frequency of collisions increases

accept particles are more likely to collide

ignore more collisions

ignore more successful collisions

1

- (ii) has a greater surface area

1

so the reaction is faster

accept so more frequent collisions

1

- (c) the (minimum) amount of energy (particles must have) to react **or** to start a reaction
accept the energy needed to break bonds
ignore references to heat 1
- (d) (i) (potassium is) too / very reactive
ignore potassium is a Group 1 / alkali metal 1
- so dangerous / violent reaction
accept hydrogen produced rapidly 1
- (ii) ZnSO_4
accept products in either order
ignore names of substances 1
- H_2
*do **not** accept brackets or charges in the formulae* 1
- (iii) any **one** from:
 - increase concentration (of sulfuric acid)
 - increase temperature **or** heat it
 - increase surface area of zinc 1
- [13]**
- 8.** (a) (i) precipitation 1
- (ii) (aq) on left hand side 1
- (s) on right hand side 1
- (iii) potassium iodide 1
- potassium nitrate 1
- (iv) filtration 1
- (b) (i) diffusion 1
- (ii) iodide ions move / diffuse faster than lead ions **or** travel further in the same time
Must be a comparison
Accept converse 1

because the lead iodide forms much closer to the lead nitrate (or **X**) than the potassium iodide (or **Y**).

*allow because iodide ions are smaller than lead ions
allow references to potassium iodide and lead nitrate*

1

(iii) the particles / ions move / diffuse faster

ignore which particles / ions the student refers to

1

because they have more energy **or** will collide / meet sooner

ignore reference to frequency of collisions

1

[11]

9.

(a) (i) a continuous straight line missing anomalous point

allow a line which does not start at zero / origin

1

(ii) any **two** sensible errors eg

*ignore systematic / zero error / weighing error **or** error unqualified*

- timing errors and / or example
- measurement errors and / or example
- apparatus errors and / or example
- human / experimental / reading / random error and / or example or 'did not do it right'
*could be two from **same** category
eg two timing errors – watch not started at the same time plus difficulty in deciding when the cross has disappeared.*
- temperature fluctuation
- anomalous point
accept outlier / wrong result
- results not recorded correctly
- plotting error
- rate calculated incorrectly
ignore 'not repeated'

2

(b) (i) straight line
*allow as concentration increases the rate goes up **or** converse*
allow numerical example
allow positive correlation
allow same gradient
ignore 'most points near / on line of best fit'

1

(ii) because of an increase in frequency of collisions
*max 1 if incorrect reference to energy **or** if subatomic particle specified*
accept because particles are more likely to collide or higher chance of collision
ignore more (successful) collisions

1

because there are more particles (per unit volume)
allow because particles are closer together

1

[6]

10.

(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]