AQA Chemistry GCSE

Required Practical 5 - Rate of Reaction
Mark Scheme

Q1 (a) $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$ (2)

Allow 1 mark for correct formulae

(b) Sensible scales, using at least half the grid for the points

(1)

All points correct ± ½ small square
Allow 1 mark if 8 or 9 of the points are correct (2)

Best fit line (1)

(c) steeper line to left of original

(1)

line finishes at same overall volume of gas collected

(1)

(d) mass lost of 2.2 (g) (1)

time taken of 270 s
allow values in range 265 − 270

(1)

$$\frac{2.2}{270} = 0.00814814$$

allow ecf for values given for mass and time

(1)

0.00815 (g / s) or 8.15 × 10^-3

Allow 1 mark for correct calculation of value to 3 sig figs
accept 0.00815 or 8.15 × 10^−3
with no working shown for 4 marks

(1)

(e) correct tangent

(1)

eg 0.35 / 50

(1)

0.007
allow values in range of 0.0065 − 0.0075

(1)

7 × 10−3

(1)

accept 7 × 10^{-3} with no working shown for 4 marks

Q2 .(a) (delivery) tube sticks into the acid (1)

the acid would go into the water or the acid would leave the flask or go up the delivery tube ignore no gas collected (1)

(b) any one from:
- bung not put in firmly / properly
- gas lost before bung put in
- leak from tube (1)

(c) all of the acid has reacted (1)

(d) take more readings in range 0.34 g to 0.54 g 1
take more readings is insufficient
ignore repeat

(e) 95 / 24000
1 0.00396 **or** 3.96 × 10−3 (1)
*accept 0.00396 or 3.96 × 10−3 with no working shown for **2** marks*

(f) use a pipette / burette to measure the acid (1)
because it is more accurate volume than a measuring cylinder
or
greater precision than a measuring cylinder
or
use a gas syringe to collect the gas so it will not dissolve in water
or
use a flask with a divider accept description of tube suspended inside flask so no gas escapes when bung removed (1)

(g) they should be collected because carbon dioxide is left in flask at end 1 and it has the same volume as the air collected / displaced (1)

Q3(a) cotton wool

(1)

(b) all points correct

± ½ *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

Q4

..(a) 36 cm^3 **1**

(b) all points correct
± ½ small square **2**

*allow **1** mark if 6 or 7 of the points are correct*

2 best fit lines drawn
must not deviate towards anomalous point **2**

*allow **1** mark if 1 line correct*

(c) The bung was not pushed in firmly enough. **1**

The measuring cylinder was not completely over the delivery tube. **1**

(d) as mass of lithium carbonate increases volume of gas produced increases **1**

linear / (directly) proportional **1**

Q5.

.(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.

Q6.

.(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

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Q7

.

(a) (s) (aq) (aq) (g)

must be in this order

***2** marks if all four correct*

***1** mark if 2 or 3 correct*

2

(b) (i) 55

ignore units

1

(ii) 54

*allow ecf from **(b)(i)***

1

(iii) 0.92

*correct answer with or without working gains **2** marks*

*ecf from volume in **(b)(i)***

accept 2 d.p. up to calculator value

*if answer incorrect, allow rate = (b)(i) / 60 for **1** mark*

2

(c) (i) circle round point at (48,22)

1

(ii) problem (1) and explanation (1)

*explanation **must** give lower volume of gas or slower reaction*

ignore human error unless qualified

problem with bung

e.g. bung not placed in firmly / quickly enough

so gas lost

or

problem with reagent

e.g. acid was diluted **or** acid not replaced

so reaction slower

or

problem with temperature

e.g. temperature was lower than recorded temperature

so reaction slower

or

problem with measurement

e.g. length of magnesium less than 8 cm **or** timed for less than a minute

so less gas produced

2

(d) repeat the experiment (several times)

1

because anomalous results could be excluded

1

and then the mean can be determined / calculated

*accept suggestion of alteration to method, which is explained as to why it would reduce the error, for **3** marks (e.g. place the magnesium in a container within the flask (1) so it can be tipped into the acid once the bung is in place (1). This will prevent anomalous results or gas loss (1))*

ignore idea of more accurate gas syringe
ignore shorter time intervals

1

(e) (i) use clean magnesium **or** use magnesium without oxide coating

1

compare results

1

(ii) **either**

measure the temperature of the acid before (adding magnesium)

1

and after adding magnesium

or

place the conical flask in a water bath (at 40 °C) (1)

compare results (1)

1

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Q8.

(a) (i) H_2O_2 reactant correct

ignore any state symbols

1

$H_2O + O_2$ products correct

1

$2H_2O_2 \rightarrow 2H_2O + O_2$ balanced

accept correct multiple

1

(ii) glowing splint

1

relights

accept 'bursts into flame'

*do **not** accept a lighted splint burns brighter **or** faster*

1

(b) unchanged

*accept **not** used up **or** left (behind)*

1

(c) (i) gas syringe **or** measuring cylinder **either** with scale drawn **or** labelled

1

the apparatus as drawn would work

1

(ii) correct plotting of points

***one** mark to be deducted for each error*

2

best fit graph line drawn (single line drawn)

1

(iii) concentration of hydrogen peroxide decreases

accept less particles of hydrogen peroxide to collide

*do **not** accept hydrogen peroxide gets used up*

1

rate of reaction decreases

accept reaction gets slower

1

(iv) any two from:

- temperature
- pressure
- division of catalyst **or** manganese oxide

*do **not** accept any other factors*

2

[15]