



GCSE Chemistry

Rate Experiments

Mark Scheme

Time available: 60 minutes

Marks available: 57 marks

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Mark schemes

- 1.** (a) (diagram)
gas syringe
or
inverted measuring cylinder over water 1
- (b) (error)
(delivery) tube is in (sulfuric) acid 1
- (problem)
(sulfuric) acid will travel up tube
or
no hydrogen / gas will be collected 1
- (c) line of best fit
must include 0, 0 1
- (d) (volume of gas =) 45 (cm³)
allow a tolerance of $\pm \frac{1}{2}$ a small square
allow volume from drawn curve 1
- (rate =) $\frac{45}{60}$
allow correct use of incorrectly determined volume at 60 seconds 1
- = 0.75 1
- cm³/s 1
- (e) the line of best fit for higher concentration would have a steeper slope 1
- [9]**
- 2.** (a) (delivery) tube is in (sulfuric) acid 1
- (b) reaction has stopped
allow no more gas produced 1
- (because a) reactant is used up
allow named reactants 1

- (c) any **one** from:
- the line (for 0.05 mol/dm³ sulfuric acid) is less steep
allow converse statements about 0.10 mol/dm³ sulfuric acid
ignore produces less gas
 - (0.05 mol/dm³ sulfuric acid) produces less gas in a fixed time
*do **not** accept produces less gas in total*
 - the reaction (using 0.05 mol/dm³ sulfuric acid) takes longer to finish

1

- (d) tangent drawn at 80 s on 0.05 mol/dm³ curve

1

(from tangent)
value for x-step
and
value for y-step

allow a tolerance of $\pm \frac{1}{2}$ a small square

1

(rate =) $\frac{\text{value for y-step}}{\text{value for x-step}}$

allow correct use of incorrectly determined values from tangent for x-step and/or y-step

1

calculation of rate

1

answer to 2 significant figures

allow an answer correctly calculated to 2 significant figures from an incorrect calculation of rate

1

- (e) Cu²⁺

1

[10]

3.

- (a) glowing splint
*do **not** accept burning splint*

1

(which) relights

dependent on correct test in MP1
ignore with a pop

1

- (b) place the conical flask in a water bath at constant temperature.

1

use a mass of 1 g manganese dioxide each time.

1

(c)

an answer of 0.092 (cm³/s) scores 3 marks

allow an answer of 0.091666 (cm³/s) correctly rounded to at least 2 significant figures for 2 marks

allow an answer of 0.033 (cm³/s) for 2 marks

allow an answer of 0.033333 (cm³/s) for 1 mark

11 (cm³) **and** 120 (seconds)

1

(mean rate of reaction = $\frac{11}{120}$)

= 0.09167

allow a correct calculation using incorrectly determined value(s) for difference in volume and / or time

1

= 0.092 (cm³/s)

allow a correctly calculated answer given to 2 significant figures from an incorrect attempt at the rate equation

1

(d) line starts at origin **and** less steep than solid line

1

line levelling off at 40 (cm³)

allow a tolerance of $\pm \frac{1}{2}$ a small square

1

(e) (because) surface area (of fine manganese dioxide powder) greater

allow converse for coarse lumps

1

(so) more collisions (with hydrogen peroxide molecules / particles) per unit time

*do **not** accept references to changes in kinetic energy or speed (of molecules / particles)*

ignore references to activation energy.

1

[11]

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) (sulfur is a) precipitate / solid
or
 (sulfur is an) insoluble substance 1
- (b) **View with Figure 1**
- correctly drawn tangent at 30 s 1
- correct values for x step **and** y step from tangent
allow correct use of an incorrectly drawn tangent
allow a tolerance of $\pm \frac{1}{2}$ a small square for each coordinate 1
- (ratio =) $\frac{\text{value for y step}}{\text{value for x step}}$
allow correct use of incorrectly determined values from tangent for x step and/or y step 1
- correct calculation of ratio 1
- (conversion rate = ratio $\times 7.1 \times 10^{-5}$)
 correct evaluation of rate (mol/s)
allow correct use of an incorrectly calculated ratio 1

- (c) rate decreases
allow the collision frequency decreases 1
- (because) concentration of reactants decreases 1
- alternative approach:**
- greatest rate at start (1)
allow the collision frequency is highest at the start
- (because) greatest concentration of reactants at start (1)
- (d) (hydrochloric) acid is used up
allow (hydrochloric) acid is the limiting reactant
ignore reactants used up 1
- (e) **View with Figure 3**
- decreasing curve starting at 0,95 **and** steeper initially than curve for 0.10 mol/dm³ sodium thiosulfate solution 1
- levelling at 24% 1
- (f) stop light from other sources reaching the light sensor 1
- (g) repeatable 1
- (h) $V \propto m$ 1

(i) **View with Figure 4**

volume of sodium thiosulfate solution **and** volume of hydrochloric acid at any fixed mass

allow a tolerance of $\pm \frac{1}{2}$ a small square for volume readings

1

$$\left(\frac{\text{volume of Na}_2\text{S}_2\text{O}_3 \text{ solution}}{\text{volume of hydrochloric acid}} = \right) 0.25$$

allow $\left(\frac{\text{volume of hydrochloric acid}}{\text{volume of Na}_2\text{S}_2\text{O}_3 \text{ solution}} = \right) 4$

allow correct use of incorrectly determined volumes

1

1 : 4

1

[17]