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 (cm^3)

allow a tolerance of ± ½ a small square
allow volume from drawn curve

1

(rate =) $\dfrac{45}{60}$

allow correct use of incorrectly determined volume at 60
seconds

1

= 0.75

1

cm^3/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/dm^3 sulfuric acid) is less steep

  allow converse statements about 0.10 mol/dm^3 sulfuric acid

  ignore produces less gas

- (0.05 mol/dm^3 sulfuric acid) produces less gas in a fixed time

  *do **not** accept produces less gas in total*

- the reaction (using 0.05 mol/dm^3 sulfuric acid) takes longer to finish

1

(d)   tangent drawn at 80 s on 0.05 mol/dm^3 curve

1

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

  allow a tolerance of ± ½ a small square

1

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

  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)   Cu^{2+}

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 ± ½ 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 ± ½ 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 × 7.1 × 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/dm^3 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

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

allow a tolerance of ± ½ 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 $\left(\dfrac{\text{volume of hydrochloric acid}}{\text{volume of Na}_2\text{S}_2\text{O}_3 \text{ solution}} =\right) 4$

allow correct use of incorrectly determined volumes

1

1 : 4

1

[17]