Mark schemes

Q1.

(a) (some) hydrogen / gas escapes (from the flask)

1

(because the reaction starts) before the stopper is put in

allow (because) stopper cannot be inserted instantly

*allow for **1** mark some air (from the conical flask) is collected*

or

allow some hydrogen remains in the conical flask

or

allow some hydrogen remains in the delivery tube

1

(b) (volume = 39 − 25 =) 14 (cm^3)

1

($14\ cm^3$ =) 0.014 (dm^3)

allow correct use of an incorrectly determined volume

1

(moles of hydrogen =)

$$\frac{0.014}{24}$$

allow correct use of an incorrectly determined volume

allow correct use of an incorrect / no conversion of volume

1

= 5.8×10^{-4} (mol)

allow 5.833333×10^{-4} correctly rounded to at least 2 significant figures

allow 0.00058 (mol)

1

alternative approach 1:

($24\ dm^3$ =) 24 000 (cm^3) (1)

(volume = 39 − 25 =)
14 (cm^3) (1)

(moles of hydrogen =)

$$\frac{14}{24000}$$ (1)

allow correct use of an incorrectly determined volume

allow correct use of an incorrect / no conversion of volume

= 5.8×10^{-4} (mol) (1)

allow 5.833333×10^{-4} correctly rounded to at least 2 significant figures

allow 0.00058 (mol)

alternative approach 2:

(24 dm^3 =) 24 000 (cm^3) (1)

(moles of hydrogen at 100 s =

$\frac{39}{24000}$ =) 0.001625

allow correct use of an incorrect / no conversion of volume

and

(moles of hydrogen at 40 s =

$\frac{25}{24000}$ =) 0.00104 (1)

(moles 100 s – moles 40 s =)
0.001625 – 0.00104 (1)

allow correct use of an incorrectly determined number of moles

= 5.8 x 10^{-4} (mol) (1)

allow 5.833333 x 10^{-4} correctly rounded to at least 2 significant figures

allow 0.00058 (mol)

alternative approach 3:

(39 cm^3 =) 0.039 (dm^3)
and
(25 cm^3 =) 0.025 (dm^3) (1)

(moles of hydrogen at 100 s =
$\frac{0.039}{24}$ =) 0.001625

allow correct use of an incorrect / no conversion of volume

and

(moles of hydrogen at 40 s =
$\frac{0.025}{24}$ =) 0.00104 (1)

(moles 100 s – moles 40 s =)
0.001625 – 0.00104 (1)

allow correct use of an incorrectly determined number of moles

= 5.8 x 10^{-4} (mol) (1)

allow 5.833333 x 10^{-4} correctly rounded to at least 2 significant figures

allow 0.00058 (mol)

(c) tangent drawn at 45 s

1

correct values for *y* step **and** *x* step from tangent

allow correct use of an incorrectly drawn tangent

allow a tolerance of ± ½ a small square for each coordinate

1

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

allow correct use of incorrectly determined value(s) from the tangent for y step and/or x step

1

correct calculation of rate (mol/s)

1

rate given in standard form (mol/s)

allow a correctly calculated answer in standard form from an incorrect attempt at rate determination

1

(d) line starting at 0,0.000 and less steep than existing line

1

becomes level at 0.0084 mol

allow a tolerance of ± ½ a small square

1

(e) (increasing the temperature) increases the rate of reaction

1

(because) particles have more energy

allow (because) particles move faster

1

(so) the frequency of collisions increases

allow (so) a greater proportion of collisions have enough energy to react

ignore successful

1

[16]

Q2.

(a) (a catalyst) provides a different pathway for the reaction

1

(which has a) lower activation energy

1

(b) (oxygen is) a gas

1

(which) escaped from the flask

1

(c) correct value for *x* step **and** *y* step from tangent

1

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

allow correct use of incorrectly determined x and/or y step

1

correct calculation of rate

1

answer to 2 significant figures

allow an answer correctly rounded to 2 significant figures from an incorrect calculation which uses values determined from the graph.

1

(d) line starting at 0,0 which is less steep than existing line

1

which becomes level at 0.80 g

allow a tolerance of ± ½ a small square

1

[10]

Q3.

(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

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

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

(i) **View with Figure 4**

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

$$\left(\frac{\text{volume of } Na_2S_2O_3 \text{ solution}}{\text{volume of hydrochloric acid}} =\right) 0.25$$

allow $\left(\frac{\text{volume of hydrochloric acid}}{\text{volume of } Na_2S_2O_3 \text{ solution}} =\right)$ *4*

allow correct use of incorrectly determined volumes

1

1 : 4

1

[17]