Mark scheme

Rate of reaction graphs

Chemistry 0620 · Questions from Paper 3, Paper 4 and Paper 6

Total marks

85

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	10	Total
6	6	7	7	8	8	10	10	10	13	**85**

Question 1 [6]

1(a)	179.3 (g)	1
1(b)	A (1) the gradient / slope is the steep(est) (1)	2
1(c)	360 (cm^3)	1
1(d)	decreases rate / reaction slower (1) increases rate / reaction faster (1)	2

Question 2 [6]

2(a)	the reaction is complete / the reaction has finished	1
2(b)	any value between and including 37 (cm^3) to 38 (cm^3)	1
2(c)	line starts from 0 cm^3 **AND** initial gradient less steep	1
	final volume levels off between 24–30 cm^3 **OR** line below 27 cm^3 **AND** gradient becoming less steep at a later point	1
2(d)	zinc chloride	1
2(e)	pH 1	1

Question 3 [7]

3(a)	magnesium chloride	1
3(b)(i)	decreases as reaction proceeds (1) gradient of graph decreases as time increases / gradient of graph is steep at first and less steep later (1)	2
3(b)(ii)	34 s	1
3(b)(iii)	line steeper than original and starting from 0 (1) line ends up at same final volume **AND** levels off at or before 100 s (1)	2
3(b)(iv)	9.6 (g)	1

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Question 4 [7]

4 **(a)** Any two of: [2]
temperature
mass / amount of manganese(IV) oxide / volume of manganese(IV) oxide
size of manganese dioxide particles
allow: pressure
ignore: concentration

(b) **(i)** the greater the concentration the greater the speed / rate increases with concentration [1]
ignore: concentration increases speed / more oxygen the grater the concentration

(ii) less hydrogen peroxide present (in B) / more hydrogen peroxide (in A) [1]
allow: hydrogen peroxide less concentrated (in B)

(iii) time taken → 27 (s) [1]
allow: 26 (s)
volume → 37 (cm^3) [1]

(c) magnesium → copper → manganese → lead [1]
ignore: oxide / oxidation numbers

[Total: 7]

Question 5 [8]

5(a)(i)	39 (cm^3)	1
5(a)(ii)	29 (cm^3)	1

5(b)	steeper initial gradient starting at 0-0 point (1) final volume of oxygen higher than 39 cm^3 (1)	2
5(c)	(rate) decreases / slower (1) (rate) decreases / slower (1)	2
5(d)(i)	lead(IV) oxide > manganese(IV) oxide > iron(III) oxide	1
5(d)(ii)	decreased / slower (rate with larger pieces)	1

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Question 6 [8]

6 **(a)** smooth curve missing anomalous point (1) [1]

(b) **composition of mixture**
double volume / 100 cm^3 of hydrogen peroxide (1)
more than 1 g of manganese(IV) oxide / powdered (1) [2]
ignore: references to water
note: double the concentration is valid for (2)

explanation
double volume of gas (1)
faster reaction (1) [2]

(c) catalyst / increase the rate of the reaction (1) [1]

(d) sketch graph less steep than original for Experiment 1 (1)
to same level (1) [2]

Question 7 [10]

7(a)(i)	Gradient gets less	**1**
7(a)(ii)	Concentration of HC*l* is decreasing	**1**
7(a)(iii)	120 seconds	**1**
7(b)	M1 New line steeper than printed line and starts at origin M2 New line reaches same final volume as printed line	**2**

7(c)	M1 **Time** taken is less M2 (particles) have more energy M3 (particles) move faster M4 More collisions (of particles) occur per second / per unit time M5 More (of the) particles / collisions have energy greater than activation energy **or** More (of the) particles / collisions have sufficient energy to react **or** A greater percentage / proportion / fraction of collisions (of particles) are successful	**5**

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Question 8 [10]

8(a)	**M1** (a substance that) speeds up a reaction / increases the rate of a reaction (1) **M2** unchanged chemically at the end (1)	**2**
8(b)(i)	oxygen gas escapes	**1**
8(b)(ii)	**M1** rate decreases **OR** rate / reaction is fastest at the start (1) **M2** reaction stops **or** rate = zero (1)	**2**
8(c)(i)	**M1** (particles) have more kinetic energy / particles move fast**er**(1) **M2 more** collisions per unit time (1) **M3 more** particles have energy greater than or equal to activation energy **OR** **more** particles have sufficient energy to react **OR** A greater percentage or greater proportion or greater fraction of collisions have sufficient energy to react **OR** A greater percentage or greater proportion or greater fraction of collisions have energy greater than or equal to activation energy **OR** A greater percentage or greater proportion or greater fraction of collisions are successful (1)	**3**
8(c)(ii)	**M1** steeper gradient from start (1) **M2** levels off **at the same mass** (1)	**2**

Question 9 [10]

9 **(a)** all points plotted correctly (2), –1 each incorrect
straight line (1) [3]

(b) gas / carbon dioxide given off
not hydrogen gas given off [1]

(c) prevent loss of acid / liquid [1]

(d) **(i)** Experiment 1 [1]

(ii) (in Experiment 2) the temperature of the acid was lower / converse [1]

(e) 18.5 minutes ±1/2 small square (1) extrapolation on grid (1) [2]

(f) sketched line to the left of Experiment 1 line [1]

[Total: 10]

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Question 10 [13]

10(a)(i)	any 4 from: slowed down acid became less concentrated **OR** fewer particles per unit volume fewer collisions per second **OR** lower collision rate (then the reaction) stopped all the hydrochloric acid reacted	**4**
10(a)(ii)	any 4 from: faster (reaction) (powder has) larger surface area more collisions per second **OR** higher collision rate same volume of gas amount / moles hydrochloric acid is not changed	**4**
10(b)	any 5 from: temperature increased particles have more energy (particles) move faster more collisions per second **OR** higher collision rate more particles have sufficient energy to react / activation energy more of the collisions are successful	**5**

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