Mark scheme

Rates of reaction

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

Total marks

89

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	10	Total
6	7	8	9	10	12	8	8	10	11	**89**

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 [7]

2 **(a)** fizzing/bubbles stopped/no more gas produced (1) [1]

(b) **(i)** W little/no effect/slight increase (1)
X no effect/(slight) decrease (1)
Y speeds up reaction (1) [3]
note: The question is about rate, if candidates quote three different time differences, penalise first then allow the 'correct' answers (–11 s, +2 s, –199 s).
It must be clear that the increase in rate is less for W than Y for these 2 marks.

(ii) Y (1) [1]

(c) repeat experiments (1) take average/compare results/see if there is a difference (1) [2]

[Total: 7]

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Question 3 [8]

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

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

Question 4 [9]

4 (a) (i) D [1]

(ii) C [1]

(iii) A [1]

(b) (i) loss of carbon dioxide / loss of gas [1]

(ii) accept values from 360–380 [1]
ALLOW: 6 min to 6 min 20 s / 6 ⅓ min

(iii) 0.5 (g) [1]

(iv) (initial) gradient greater / slope greater and starts at 0, 0; [1]
same final volume [1]

(v) (rate) increases [1]
IGNORE: more carbon dioxide per second
ALLOW : (rate) faster

[Total: 9]

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Question 5 [10]

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

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

(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]

Question 6 [12]

6(a)(i)	measure volume of gas / measure amount of gas; gas collected in the measuring cylinder; at different times / use of stopclock to measure time;	**1** **1** **1**
6(a)(ii)	faster reaction / rate increases;	**1**
6(b)(i)	same concentration of acid; same mass of iron; same size of iron pieces;	**1** **1** **1**
6(b)(ii)	rate increases with increase in temperature rate increases with temperature = [1]	**2**
6(c)	any three from: • filter (off the iron); • evaporate water / heat gently; • to crystallisation point / leave to cool (after heating); • filter off / pick out crystals; • dry crystal between filter papers;	**3**

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Question 7 [8]

7 **(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 8 [8]

8(a)	1 $Na_2S_2O_3$ 2 H_2O 3 HCl **OR** 1 HCl 2 H_2O 3 $Na_2S_2O_3$ **OR** 1 H_2O 2 $Na_2S_2O_3$ 3 HCl **OR** 1 H_2O 2 HCl 3 $Na_2S_2O_3$;	**1**
8(b)(i)	**M1** volumes 40 : 10 : 10; **M2** time = 14;	**2** 1 1
8(b)(ii)	**M1** more particles per unit volume/particles are closer together; **M2** increases the rate of collisions/there are more collisions per unit time;	**2** 1 1
8(c)	**M1** particles gain more energy **and** move fast**er**; **M2** increasing rate of collisions/more collisions per unit time; **M3** higher proportion of particles have sufficient energy to react/collisions have sufficient energy to react/are above the activation energy;	**3** 1 1 1

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Question 9 [10]

9(a)	**M1** (a substance that) speeds up a reaction / increases the rate of a reaction (1) **M2** unchanged chemically at the end (1)	**2**
9(b)(i)	oxygen gas escapes	**1**
9(b)(ii)	**M1** rate decreases **OR** rate / reaction is fastest at the start (1) **M2** reaction stops **or** rate = zero (1)	**2**
9(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**
9(c)(ii)	**M1** steeper gradient from start (1) **M2** levels off **at the same mass** (1)	**2**

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Question 10 **[11]**

10 **(a)** volume given off (in that 20 s interval) [1]
divided by 20 [1]
accept 48/20 for [2]
Answer to 3 (a) may appear twice, both in 3 (a) and 3 (b). Please ignore in 3 (b).

(b) 0.6 (cm^3/s) [1]

(c) concentration [1]
of hydrogen peroxide decreases [1]

for hydrogen peroxide used up ONLY [1]
not reagent / reactant

(d) rate increases / doubles [1]
catalyst has bigger surface area / more catalyst particles exposed [1]
more collisions [1]
not more catalyst / higher concentration of catalyst / more molecules of catalyst

OR

volume of oxygen the same [1]
oxygen from hydrogen peroxide (not catalyst) [1]
amount / number of moles the same [1]

OR

amount/mass/volume/number of moles of hydrogen peroxide the same [2]

catalyst chemically unchanged ONLY [1]
reactants have not changed (only the catalyst) [1]
accept catalyst does not react [1]

[Total: 11]

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