2.16 Rates of Reaction: Test Pack

AQA 8464 · Calculator allowed · about 45 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Define the term 'rate of reaction' as used in chemistry.

(Total for Question 1 is 1 mark)

2 State two ways, other than changing the concentration, that the rate of a chemical reaction can be increased.

(Total for Question 2 is 2 marks)

3 A student plots concentration against time and obtains a curve that levels off as time increases. What does the curve indicate about the reaction progress and why does the curve level off?

(Total for Question 3 is 2 marks)

4 Collision theory explains why temperature affects reaction rate. Give the two key ideas of collision theory needed to explain this effect.

(Total for Question 4 is 2 marks)

© Revision Library | revisionlibrary.co.uk

5 In the required practical for investigating how concentration affects rate, a student measures the time for a mark to disappear when sodium thiosulfate reacts with dilute hydrochloric acid. Name one control variable that must be kept constant and state why it must be controlled.

(Total for Question 5 is 3 marks)

---

6 The initial rate of a reaction is measured as 0.020 mol/dm3 s. After 30 s the concentration of product is 0.60 mol/dm3. Using initial rate as an approximation, estimate the concentration of product after 60 s. Show your working.

(Total for Question 6 is 2 marks)

---

7 A student mixes 25.0 cm^3 of 0.200 mol/dm3 hydrochloric acid with magnesium ribbon. Use the idea of moles to calculate how many mol of HCl are present in the 25.0 cm^3 sample. Show your working.

(Total for Question 7 is 3 marks)

---

8 Explain how you would alter the method for the sodium thiosulfate required practical to reduce random error in timing when measuring the time for the cross to disappear.

(Total for Question 8 is 4 marks)

© Revision Library | revisionlibrary.co.uk

9 Explain briefly how a catalyst increases the rate of a reaction, using collision theory and activation energy in your answer.

(Total for Question 9 is 3 marks)

10 The table shows the concentration of hydrochloric acid used and the time taken for a fixed volume of gas (10 cm^3) to be collected when the acid reacts with excess magnesium ribbon.

Concentration / mol/dm3: 0.50, time taken / s: 40
Concentration / mol/dm3: 1.00, time taken / s: 20
Concentration / mol/dm3: 2.00, time taken / s: 10

Describe the relationship between concentration and rate shown by this data, then explain, using collision theory, why increasing the concentration of hydrochloric acid increases the rate of reaction.

(Total for Question 10 is 4 marks)

© Revision Library | revisionlibrary.co.uk

11 A student compares two methods for measuring the rate of reaction between excess marble chips and dilute hydrochloric acid, which produces carbon dioxide gas: Method A, measuring the loss in mass of the flask and its contents on a balance; Method B, collecting the gas in a gas syringe. The student's mass-loss results for Method A are shown below.

Time / s: 0, 20, 40, 60, 80, 100
Mass loss / g: 0.00, 0.28, 0.48, 0.60, 0.66, 0.68

Calculate the mean rate of reaction, in g/s, between 0 and 60 s, showing your working. Then evaluate which of the two methods (A or B) is likely to give the more precise results, and explain one limitation of Method A.

Time (s)	Mass loss (g)
0	0.00
20	0.28
40	0.48
60	0.60
80	0.66
100	0.68

(Total for Question 11 is 6 marks)

© Revision Library | revisionlibrary.co.uk

Mark scheme · 2.16 Rates of Reaction: Test Pack

Question 1

the change in amount of reactant or product per unit time, oe	**B1**

Answer: Change in amount of reactant or product per unit time.

Question 2

increase the temperature, oe	**B1**
use a catalyst or increase surface area, or increase pressure for gases, any two distinct answers allowed	**B1**

Answer: Increase the temperature; use a catalyst. (Other valid answers: increase surface area, increase pressure for gases.)

Question 3

curve shows concentration of reactant/product changing over time and approaching completion or equilibrium	**B1**
levels off because reactant is used up or the reaction reaches equilibrium so net change is zero, oe	**B1**

Answer: The reaction progresses and approaches completion; the curve levels off because reactant is used up or the system reaches equilibrium so there is no further net change in concentration.

Question 4

particles must collide for a reaction to occur, oe	**B1**
higher temperature increases frequency of collisions and proportion of collisions with energy greater than the activation energy, oe	**B1**

Answer: Particles must collide; higher temperature increases collision frequency and the proportion with enough energy to react.

Question 5

temperature	**B1**
because temperature affects rate so differences would change the time measured, oe	**B1**
or: volume of reactants or total volume, because changing volumes changes collision frequency and concentrations, oe	**B1**

Answer: Temperature; it must be kept constant because temperature changes the rate of reaction.

Question 6

uses rate x time to find increase in concentration for next 30 s: 0.020 x 30 = 0.60	**M1**
1.20 mol/dm3 cao	**A1**

Answer: 1.20 mol/dm3

Question 7

uses formula: moles = concentration x volume (in dm3) and substitutes: 0.200 x 0.025	**M1**
0.00500 mol cao	**A1**
explicitly shows unit mol or states 'mol' with the numerical answer	**B1**

Answer: 0.00500 mol

Question 8

use multiple repeats and take the mean	**B1**
use a more precise timing method such as a video recording or a light sensor and timer	**B1**
use a consistent volume and mixing method and start timing at a defined point (e.g. when reactants are fully mixed), oe	**B1**
explain that these reduce random error by averaging out variability and improving timing resolution, oe	**B1**

Answer: Repeat each measurement and take an average; use a more precise timing method such as video or a light sensor; ensure consistent mixing and start timing at a defined moment to reduce random error.

Question 9

a catalyst provides an alternative reaction pathway, oe	**B1**
this alternative pathway has a lower activation energy, oe	**B1**
so a greater proportion of collisions have enough energy to react, increasing rate, oe	**B1**

Answer: A catalyst provides an alternative pathway with lower activation energy, so a greater proportion of collisions have enough energy to react and the rate increases.

Question 10

as concentration doubles, the time taken halves, oe	**B1**
so the rate of reaction doubles each time the concentration doubles, i.e. rate is directly proportional to concentration, oe	**B1**
increasing concentration increases the number of acid particles in a given volume	**B1**
this increases the frequency of collisions between acid and magnesium particles per unit time, increasing the rate of reaction, oe	**B1**

Answer: As concentration doubles, the time taken halves, so the rate doubles (rate is directly proportional to concentration). This is because a higher concentration means more acid particles in a given volume, increasing the frequency of collisions with the magnesium and so increasing the rate of reaction.

© Revision Library | revisionlibrary.co.uk

Question 11

Level 3 Correct calculation of the mean rate with correct units and a clear, justified evaluation of both methods, including a valid limitation of Method A and sound reasoning for which method is more precise. **5-6**

Level 2 Correct or nearly correct calculation of the mean rate, with some evaluation of the two methods but with limited justification or one omission. **3-4**

Level 1 Attempts the calculation with errors, or gives an unsupported statement about which method is better without valid reasoning. **1-2**

Indicative content:

- Mean rate between 0 and 60 s = change in mass / change in time = 0.60 / 60 = 0.010 g/s (accept 0.01 g/s).
- Method B (gas syringe) is likely to give the more precise results because it measures the volume of gas produced directly, and is not affected by loss of water vapour or acid spray as gas escapes.
- One limitation of Method A: some of the mass lost may be due to evaporation of water or acid spray carried out with the gas, not only carbon dioxide escaping, which can make the measured rate appear larger than the true rate.
- A further limitation of Method A: if the total mass loss is small, the balance may not measure the change precisely, whereas a gas syringe can measure small gas volumes accurately.
- A valid conclusion justifies the choice of method using precision or accuracy of measurement, not simply personal preference.

© Revision Library | revisionlibrary.co.uk