2.7 Rate and Extent of Chemical Change: 30-minute Pack

Total Marks

AQA 8462 · Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Surface area can affect rates when one reactant is a solid.

(a) Mixing powdered calcium carbonate reacts faster with acid than mixing whole marble chips. Give one reason why. **(1)**

(b) A student compares 10 g of marble chips with 10 g of powdered carbonate. Which will react faster and why? One sentence. **(2)**

(Total for Question 1 is 3 marks)

2 Rate of reaction may be measured by volume of gas produced.

(a) A reaction produces 48 cm^3 of gas in 2 minutes. Calculate the average rate in cm3 per minute. **(2)**

(Total for Question 2 is 2 marks)

3 Enzymes and catalysts are used to speed up reactions in industry and in the body.

(a) Name the type of biological catalyst that speeds up reactions in the human body. **(1)**

(b) State one industrial process that uses a catalyst. **(1)**

(Total for Question 3 is 2 marks)

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4 Le Chatelier's principle describes how an equilibrium responds to a change.

(a) Predict what happens to the position of equilibrium if the concentration of a reactant is increased. **(1)**

(b) Predict qualitatively what happens to the amount of product if the pressure is increased for a reaction where there are more gas molecules on the reactant side than the product side. **(1)**

(Total for Question 4 is 2 marks)

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5 A student follows a practical method to investigate the effect of concentration on rate by measuring how long it takes for effervescence to start when magnesium reacts with acid. Suggest one improvement to make the timing more accurate.

(a) Suggest one improvement to reduce random timing error and explain briefly how it helps. **(2)**

(Total for Question 5 is 2 marks)

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6 Catalysts increase reaction rates without being used up.

(a) Explain how a catalyst increases the rate of a reaction. **(3)**

(Total for Question 6 is 3 marks)

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7 During a reaction the initial rate is faster than later because reactant concentration falls.

(a) Explain why the rate of a reaction decreases as the reaction proceeds in terms of collisions. **(3)**

(Total for Question 7 is 3 marks)

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8 A reversible reaction can reach dynamic equilibrium in a closed container.

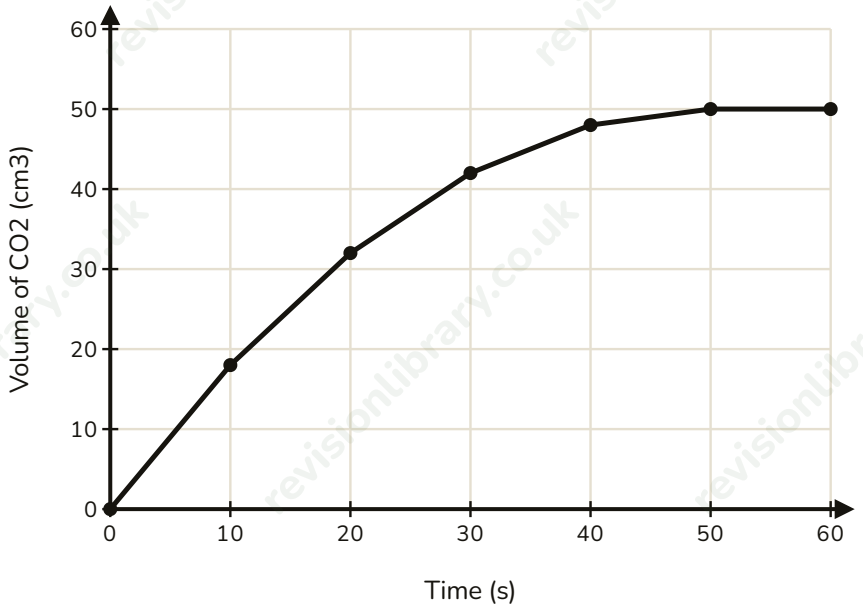
(a) State what is meant by dynamic equilibrium in a closed system. **(1)**

(b) Name one condition that is necessary for dynamic equilibrium to be established. **(1)**

(Total for Question 8 is 2 marks)

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9 Figure 1 shows data from a student's investigation into the effect of hydrochloric acid concentration on the rate of reaction with excess marble chips (calcium carbonate). The volume of carbon dioxide gas produced was measured using a gas syringe at 10-second intervals.



(a) Identify the independent variable and the dependent variable in this investigation. **(2)**

(b) Calculate the mean rate of reaction between 0 and 30 seconds, in cm3/s. **(2)**

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(c) Explain, in terms of collision theory, why the rate of reaction decreases as the reaction proceeds. **(3)**

(d) State how the graph in Figure 1 shows that the reaction has finished. **(1)**

(Total for Question 9 is 8 marks)

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Mark scheme · 2.7 Rate and Extent of Chemical Change: 30-minute Pack

Question 1

(a) powder has a larger total surface area so more particles are exposed to the acid, increasing collision frequency, oe **B1**

(a) Answer: Powder has a larger surface area so more particles are exposed to the acid.

(b) identifies powder reacts faster because of greater surface area **M1**

(b) adds that greater surface area means more collisions per second so rate is higher, oe **A1**

(b) Answer: The powdered carbonate reacts faster because it has a greater surface area so there are more collisions per second.

Question 2

(a) divides volume by time: 48 / 2 **M1**

(a) 24 cm^3 per minute cao **A1**

(a) Answer: 24 cm^3 per minute

Question 3

(a) enzyme **B1**

(a) Answer: Enzyme

(b) the Haber process (iron catalyst) oe (accept catalytic converters, or any correctly named industrial catalytic process) **B1**

(b) Answer: The Haber process, which uses an iron catalyst.

Question 4

(a) equilibrium shifts to make more product (shifts to the right) to reduce the added reactant, oe **B1**

(a) Answer: The equilibrium shifts to make more product (shifts to the right).

(b) equilibrium shifts to the side with fewer gas molecules (products), so amount of product increases, oe **B1**

(b) Answer: The equilibrium shifts to the side with fewer gas molecules, so the amount of product increases.

Question 5

(a) suggests an improvement, e.g. use a video camera or use a gas syringe or start timing from mixing using a clamp and release or use more repeats **M1**

(a) explains how it reduces error, e.g. video allows accurate replay to see first bubble or gas syringe gives measurable volume rather than subjective observation, oe **A1**

(a) Answer: Use a camera to record the reaction so you can replay and see exactly when effervescence starts, reducing timing error.

Question 6

(a) states that a catalyst provides an alternative reaction pathway with lower activation energy or equivalent **M1**

(a) states that more collisions have enough energy to react, increasing the rate, oe **A1**

(a) mentions that the catalyst is not used up at the end of the reaction, oe **A1**

(a) Answer: A catalyst provides an alternative pathway with lower activation energy so more collisions have enough energy to react, increasing the rate; the catalyst is not used up.

Question 7

(a) states that concentration of reactants decreases over time **M1**

(a) states that fewer particles per unit volume mean fewer collisions per second **A1**

(a) concludes that therefore the rate decreases, oe **A1**

(a) Answer: As reactants are used up their concentration falls so there are fewer particles per unit volume and fewer collisions per second; this reduces the rate.

Question 8

(a) forward and backward reactions occur at the same rate and concentrations of reactants and products remain constant, oe **B1**

(a) Answer: Forward and backward reactions occur at the same rate and concentrations stay constant.

(b) system must be closed so no substances enter or leave **B1**

(b) Answer: The system must be closed (no substances can enter or leave).

Question 9

(a) independent variable: concentration of hydrochloric acid **B1**

(a) dependent variable: volume of carbon dioxide gas produced (in a given time) **B1**

(a) Answer: Independent variable: concentration of hydrochloric acid. Dependent variable: volume of CO_2 gas produced.

(b) 42 / 30 **M1**

(b) 1.4 cm^3/s cao **A1**

(b) Answer: 1.4 cm^3/s

(c) as the reaction proceeds, hydrochloric acid (a reactant) is used up, so its concentration decreases oe **M1**

(c) this means there are fewer acid particles in a given volume, so collisions between reacting particles are less frequent oe **M1**

(c) fewer successful collisions occur per second, so the rate of reaction decreases **A1**

(c) Answer: As the reaction proceeds, the acid is used up so its concentration falls, meaning there are fewer acid particles per unit volume; collisions between reacting particles happen less often, so fewer are successful each second and the rate decreases.

(d) the volume of gas produced stops changing/becomes constant (the line becomes flat/horizontal) between 50 s and 60 s **B1**

(d) Answer: The volume of gas stays constant at 50 cm^3 between 50 s and 60 s, showing the reaction has stopped.

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