

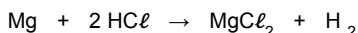


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Basic Multiple Choice Questions (Level 1 and Level 2 Learners)

MULTIPLE CHOICE

1.

Which one will not increase the rate of formation of H_2 ?

- (A) An increase in temperature.
 (B) Using powdered magnesium.
 (C) Adding a suitable catalyst.
 (D) Adding more of the same HCl .

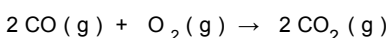
2.

Compound XY represents a higher potential energy situation than the individual atoms X and Y .

The reaction is

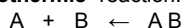
- (A) endothermic (B) exothermic
 (C) spontaneous (D) homogeneous.

3.

If $\Delta H < 0$, the rate of the forward reaction can be increased by

- (A) decreasing the temperature.
 (B) removing carbon dioxide as it is formed.
 (C) adding a suitable catalyst.
 (D) decreasing the pressure.

4.

is an **exothermic** reaction. The reverse reaction

- is (A) endothermic (B) exothermic
 (C) spontaneous (D) homogenous.

5.

An increase in temperature increases the rate of

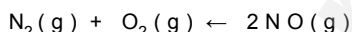
- (A) exothermic reactions only.
 (B) endothermic reactions only.
 (C) decomposition reactions only.
 (D) all chemical reactions.

6.

During an endothermic reaction, the potential energy of the products relative to the potential energy of the reactants will

- (A) increase (B) decrease
 (C) remain constant (D) oscillate.

7.

If $\Delta H > 0$ for the forward reaction, the rate of the reverse reaction can be increased by

- (A) decreasing the temperature.
 (B) increasing the volume of the container.
 (C) adding a suitable catalyst.
 (D) decreasing the pressure.

8.

The effect of a catalyst on a reversible reaction is to

- (A) reduce the activation energy.
 (B) add energy to the reaction.
 (C) decrease the rate of the reverse reaction.
 (D) increase the heat of reaction.

9.

The reaction rate between combining gases is likely to be greatest under conditions of

- (A) high pressure, high temperature.
 (B) high pressure, low temperature.
 (C) low pressure, high temperature.
 (D) low pressure, low temperature.

10.

Test tube A contains 10 g zinc covered in 20 ml of $0,1 \text{ mol} \cdot \text{dm}^{-3}$ sulfuric acid. Test tube B contains 9 g zinc covered in 30 ml of $0,8 \text{ mol} \cdot \text{dm}^{-3}$ hydrochloric acid.

B has a much faster reaction rate because it has

- (A) a greater volume of Zn .
 (B) a greater surface area of zinc.
 (C) more acid.
 (D) acid of a higher concentration.

11.

Zinc granules react even faster with sulfuric acid if a little copper(II) sulfate is added.

The reason for this is, that

- (A) the copper(II) ions act as a catalyst.
 (B) the increase in concentration of the sulfate ions.
 (C) the Zn reacts with the Cu^{2+} ions in a redox reaction.
 (D) the sulfate ion is a common ion.

12.

A solid and a liquid react with each other in a sealed flask.

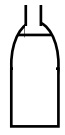
The products that are formed remain in solution.

Which of the following changes will have least effect upon the reaction rate?

- (A) Changing the pressure.
 (B) Changing the concentration of the liquid.
 (C) Powdering the solid.
 (D) Adding a suitable catalyst.

13.

Consider the 4 samples shown:

P	Q	R	S
			
12 g zinc powder	12 g zinc pellets	1 dm ³ 1 mol · dm ⁻³ HCl	0,3 dm ³ 2 mol · dm ⁻³ HCl

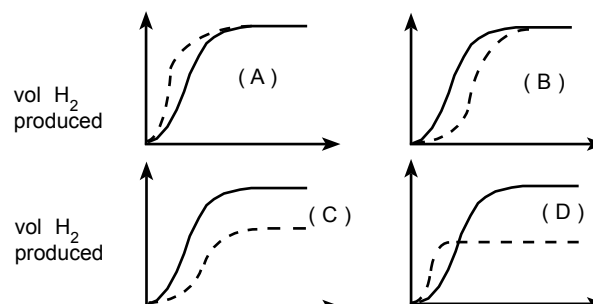
You wish to inflate a small balloon with hydrogen gas by attaching it to the top of one of the bottles into which you have added zinc. The balloon must inflate as quickly as possible. Which combination is best?

- (A) P and R (B) P and S
 (C) Q and R (D) Q and S.

14.

The volume of hydrogen produced against time for the reaction between 1 mole of powdered zinc and excess

$2 \text{ mol} \cdot \text{dm}^{-3}$ hydrochloric acid is given by the **SOLID** line in the graphs. Which **DASHED** line represents the volume of hydrogen produced if the experiment was repeated with the **zinc** being replaced by 1 mole of powdered **magnesium**?



Difficult Multiple Choice Questions (Level 5 - 7 Learners)

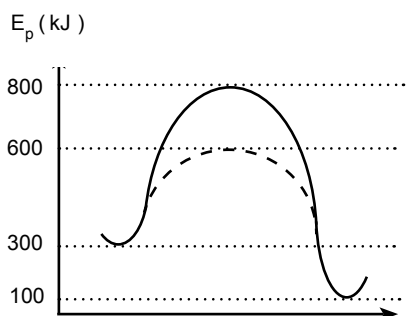
1. Which reaction is **endothermic** ?
 (A) The combustion of an alkane.
 (B) The dehydration of cane sugar.
 (C) Thermal decomposition of potassium chlorate.
 (D) Adding concentrated sulfuric acid to water.

2. In the chemical reaction,

$$A + B \rightleftharpoons AB$$

 the addition of a catalyst will increase the
 (A) temperature of the reaction.
 (B) rate of the reverse reaction.
 (C) amount of product formed.
 (D) yield of the reaction.

Questions 3 to 10 all use the following energy diagram.
 (All answers are given in kJ)



3. What is the heat of reaction for the forward reaction ?
 (A) 200 (B) -200 (C) 500 (D) 700
4. What is the change in enthalpy for the reverse reaction ?
 (A) 200 (B) -200 (C) 500 (D) 700
5. What is the energy of the activated complex for the uncatalysed forward reaction ?
 (A) 800 (B) 300 (C) 500 (D) 700
6. What is the activation energy for the catalysed forward reaction ?
 (A) 800 (B) 300 (C) 500 (D) 700
7. What is the activation energy for the uncatalysed reverse reaction ?
 (A) 200 (B) 300 (C) 500 (D) 700
8. What is the activation energy for the catalysed reverse reaction ?
 (A) 600 (B) 300 (C) 500 (D) 700
9. What is the energy of the activated complex for the catalysed reverse reaction ?
 (A) 600 (B) 300 (C) 500 (D) 700
10. What is the minimum energy of the reactants for the forward reaction?
 (A) 600 (B) 300 (C) 500 (D) 100

11.
$$N_2 + 3H_2 \rightarrow 2NH_3$$

 This is the balanced equation to make ammonia.
 How will the rate of the reaction be influenced if the concentration of the hydrogen is doubled ?
 (A) The rate of the reaction is doubled.
 (B) The rate of the reaction increases three times.
 (C) The rate of the reaction increases six times.
 (D) The influence of the rate cannot be predicted from the balanced chemical equation alone.

12. Reaction X : $A + B \rightarrow AB$ $\Delta H < 0$
 Reaction Y : $C + D \rightarrow CD$ $\Delta H > 0$
 (A) Reaction X occurs rapidly.
 (B) Reaction Y occurs slowly.
 (C) Reaction X is always faster than reaction Y.
 (D) Reaction Y may be faster than reaction X.

13. When sodium thiosulfate is added to HCl , a milky suspension begins to form after a while.

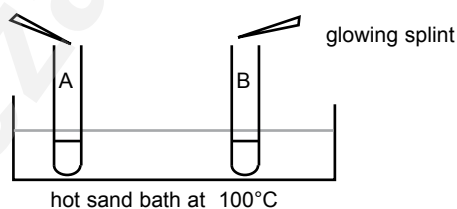
$$Na_2S_2O_3 + 2HCl \rightarrow 2NaCl + S + SO_2 + H_2O$$

 If the temperature remains constant, how does the rate of the reaction change as the reaction proceeds.
 (A) The rate of the reaction is constant with time.
 (B) The rate of the reaction increases with time.
 (C) The rate of the reaction decreases with time.
 (D) The rate of the reaction is instantaneous.

14.
$$N_2 + 3H_2 \rightarrow 2NH_3$$

 This is the balanced exothermic equation to make ammonia.
 Increasing the temperature of the system
 (A) increases the rate of the forward reaction only.
 (B) increases the rate of the reverse reaction only.
 (C) increases the rate of both forward and reverse reactions.
 (D) decreases the rate of the reverse reaction since the reverse reaction is endothermic.

15. Test tube A contains 20 g potassium chlorate and 5 g of the catalyst MnO_2 . Test tube B contains 20 g potassium chlorate. They are kept at the same temperature ($100^\circ C$) in a hot sand bath. The oxygen that is given off ignites glowing splinters of wood.

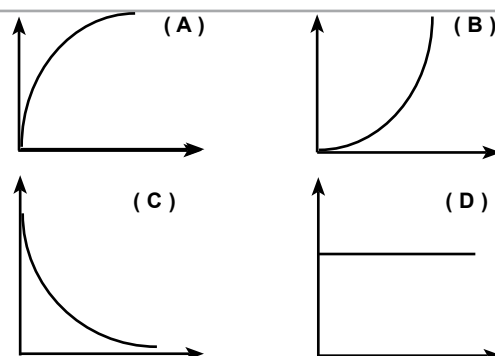


The catalysed reaction happens fastest but the uncatalysed reaction lasts longest.

As time elapses, the rate of evolution of oxygen

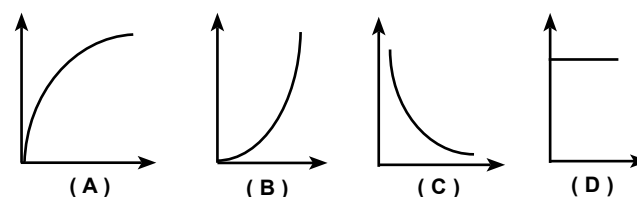
- (A) decreases in both test tubes.
 (B) increases in test tube A and decreases in test tube B.
 (C) increases in test tube A and remains constant in test tube B.
 (D) decreases in test tube A and increases in test tube B.

16. Consider the following graphs of rate vs time.

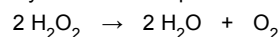


Which graph shows the rate of product formation against elapsed time as the reaction proceeds.

17. Consider the following graphs of the amount of oxygen formed vs time.



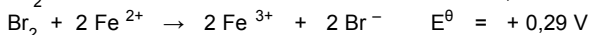
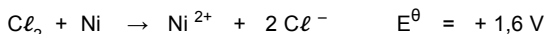
MnO_2 catalyses the decomposition of H_2O_2 .



From which graph can we determine the amount of oxygen which is liberated ?

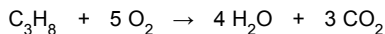
Difficult Multiple Choice Questions (Level 5 - 7 Learners)

18.

From a comprehensive $E^\ominus$ table we read that

- (A) The faster reaction cannot be predicted.
 (B) Cl_2 reacts faster as its $E^\ominus$ value is bigger.
 (C) Cl_2 reacts faster as it is a stronger oxidising agent.
 (D) Br_2 reacts faster as there is more Fe^{2+} than Ni.

19.



Increasing the temperature increases the reaction rate of this combustion reaction because

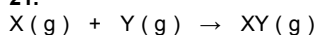
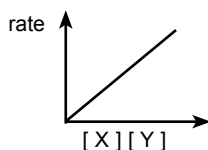
- (A) the reaction is strongly exothermic.
 (B) the gaseous reactants expand on heating.
 (C) The activation energy is lowered.
 (D) The percentage of effective collisions increases.

20.

Which of the following reactions is **endothermic** ?

- (A) Combustion of an alkane.
 (B) Dehydration of cane sugar.
 (C) Thermal decomposition of potassium chlorate.
 (D) Addition of concentrated sulfuric acid to water.

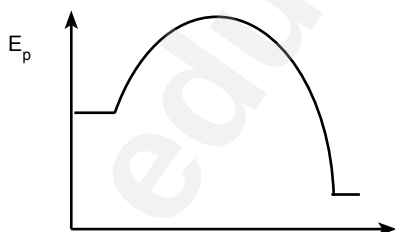
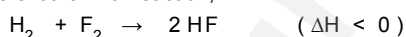
21.

A graph of rate vs product of reactants, is shown for this reaction. The **gradient** of the graph can be **changed** by changing the ..

- (A) concentration of X or Y.
 (B) concentration of X and Y.
 (C) pressures of the gases.
 (D) temperature of the gases.

22.

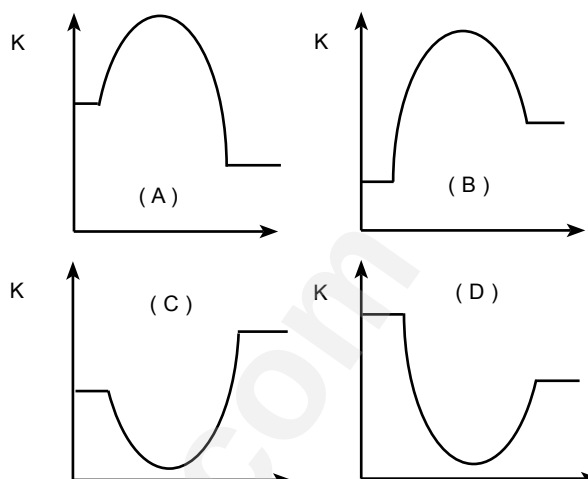
The diagram shows the potential energy changes that occur during the exothermic reaction,



The reaction proceeds with the formation of an activated complex as an intermediate step.



The corresponding kinetic energy changes experienced by the reactant and product molecules is



23.

When nitrogen dioxide (NO_2) vapours are cooled down, they become

- A colourless nitric acid (HNO_3) liquid.
 B brown nitrogen dioxide (NO_2) liquid.
 C colourless nitrogen monoxide (NO) vapours.
 D colourless dinitrogen tetroxide (N_2O_4) vapour.

24.

The reaction rate between two gases is likely to be the greatest under conditions of

- A high pressure and high temperature.
 B high pressure and low temperature.
 C low pressure and high temperature.
 D low pressure and low temperature.

25.

A small piece of Mg ribbon is added to a solution of HCl . Which of the following changes will NOT affect the rate at which H_2 gas is produced?

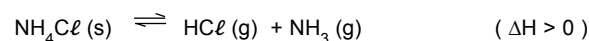
- A Using a larger piece of magnesium ribbon.
 B Increasing the volume of the HCl solution used.
 C Decreasing the concentration of the HCl solution used.
 D Increasing the temperature of the HCl solution.

26.

By raising the temperature of a reaction at equilibrium, the rate of the forward reaction will be

- A increased.
 B increased in endothermic reactions only.
 C decreased in endothermic reactions only.
 D decreased in exothermic reactions only.

27. Consider the following reaction, which occurs in an open container :



The rate of the reaction can be increased by

- (A) increasing the temperature.
 (B) decreasing the temperature.
 (C) adding more HCl .
 (D) removing the NH_3 as it is formed.

Basic Activities (Level 1 and Level 2 Learners)

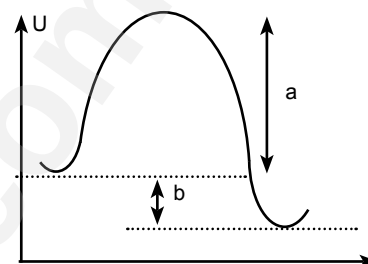
- 1.
- 1.1 What is meant by reaction rate?
- 1.2 List three factors that can influence the reaction rate of any reaction.
- 1.3 What factor can influence the reaction rate of a solid reactant?
- 1.4 What factor can influence the reaction rate of a solution?
- 1.5 What factor can influence the reaction rate of a gas?
- 2.
- What is meant by the following
- 2.1 F (g)
- 2.2 Br (l)
- 2.3 K (s)
- 2.4 Na⁺ (aq)
- 3.
- 3.1 Where is chemical potential energy stored up?
- 3.2 Mention two factors that affect the chemical potential energy of particles.
- 3.3 What happens to the particles of a reactant when their kinetic energy increases?
- 3.4 What happens to the particles of a reactant when their potential energy increases?
- 4.
- 4.1 What are two essential requirements to ensure that the collisions between particles are effective in the production of new products.
- 4.2 What two effects does moving faster have on the collisions between particles?
- 4.3 How do we get particles of a substance to move faster?
- 4.4 What energy barrier must be overcome to produce successful collisions that will form new products?
- 4.5 What is the activation energy of a reaction?
- 5.1 What is meant by the word "reactants"?
- 5.2 What formula can be used to calculate the change in enthalpy?
- 5.3 What is meant by the "change in enthalpy"?
- 5.4 What is meant by the "heat of reaction"?
- 5.5 The products formed by an exothermic reaction are (low energy stable products / high energy unstable products).
- 5.6 Is ΔH positive or negative for an exothermic reaction?
- 5.7 All reactions have an input of kinetic energy from their moving reactants. This kinetic energy is then manifest as potential energy which moves the atoms further apart until their bonds snap to form (separate / combined) atoms.
- 5.8 When the separated atoms rearrange themselves to form new bonds, they (absorb / release) thermal energy.
- 5.9 An exothermic reaction releases (more / less) energy than what it absorbs.
- 6.
- 6.1 The products formed by an endothermic reaction are (low energy stable products / high energy unstable products).
- 6.2 Is ΔH positive or negative for an endothermic reaction?
- 6.3 Energy is (absorbed / released) to snap the bonds between reacting atoms.
- 6.4 When the separated atoms rearrange themselves to form new bonds, they (absorb / release) thermal energy.
- 6.5 An endothermic reaction releases (more / less) energy than what it absorbs.

- 7.
- 7.1 For an exothermic reaction the surroundings get (hotter / colder).
- 7.2 For an endothermic reaction the surroundings get (hotter / colder).
- 7.3 Endothermic and exothermic reactions both need to be heated to get started. How can you then tell the difference between an exothermic and an endothermic reaction?
- 7.4 Explain why cooking is an endothermic reaction.
- 7.5 Explain why dynamite can produce an exothermic reaction.
- 8.1
- 8.1 (All / some) of the reactants are used up in an open system.
- 8.2 (All / some) of the reactants are used up in a closed system.
- 8.3 Why does all the water in a cup evaporate after a long enough time?
- 8.4 Why does water in a sealed container not evaporate completely away?
- 9.
- Which substances react faster?
- 9.1 (Concentrated / dilute) acid.
- 9.2 (Powdered / lumpy) zinc pieces.
- 9.3 (Hot / cold) acid.
- 9.4 (Catalysed / uncatalysed) solutions.
- 9.5 (Pressurised / unpressurised) gases.
- 9.6 (Reactants that have positive and negative ions to attract each other as in an acid-base reaction / reactants that are formed from neutral molecules)
- 10.
- Using collision theory explain how a reaction rate is speeded up by
- 10.1 heating the reactants
- 10.2 powdering a solid
- 10.3 pressurising a gas
- 10.4 making a solution more concentrated
- 10.5 adding a suitable catalyst
- 11.
- 11.1 In a water treatment plant the water is sprayed up into the air. Why is this an effective method for treating water.
- 11.2 What is a variable?
- 11.3 What is a fair test?
- 11.4 What is an independent variable?
- 11.5 What is a dependent variable?
- 11.6 What is a controlled variable?
- 11.7 When is an experiment judged to be successful?
- 12.
- 12.1 In an open container a reaction (can / cannot) go to completion when one or more of the (reactants / products) is used up.
- 12.2 If the product can escape then the reaction (will / will not) go to completion.
- 13.
- Sketch the potential energy curve for an exothermic reaction. Clearly show the
- 13.1 energy of the reactants.
- 13.2 energy of the products.
- 13.3 activation energy of forward reaction
- 13.4 heat of reaction.
- 13.5 change in enthalpy.

- 14.1
- Do all collisions between molecules of reacting substances result in a reaction? Explain.

- 14.2
- State 3 factors which can influence the rate of chemical reactions.

- 15.
- The graph represents the changes in potential energy during a chemical reaction.

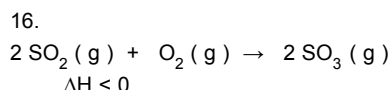


What energy is represented by

- 15.1 a
- 15.2 b?

On the graph draw in the

- 15.3 energy absorbed by the forward reaction.
- 15.4 energy given out by the forward reaction.
- 15.5 Is this forward reaction endothermic or exothermic?
- 15.6 Is $\Delta H > 0$ or is $\Delta H < 0$ for the forward reaction?

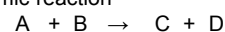


How is the rate at which SO_3 is formed influenced by

- 16.1 an increase in temperature?
- 16.2 the addition of a catalyst?
- 16.3 decreasing the concentration of the reactants?

- 17.
- 17.1 Explain the concept of enthalpy and its relationship to the heat of reaction.
- 17.2 An endothermic process is when bonds (form / break).
- 17.3 An exothermic process is when bonds (form / break).

18. Draw a potential energy graph for the endothermic reaction



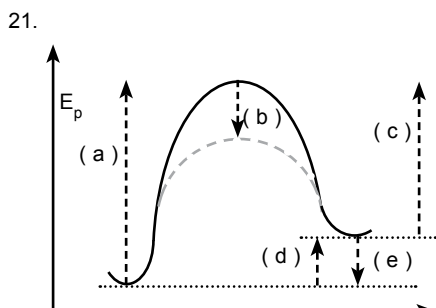
On the graph indicate

- 18.1 the activation energy for the reverse reaction.
- 18.2 the potential energy of the activated complex.
- 18.3 What would happen to the rate of the forward reaction if the temperature were increased?

Basic Activities (Level 1 - 2 Learners)

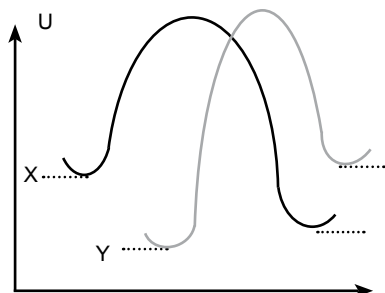
19. Define exothermic and endothermic reactions.

20. Define activation energy.
20.1 Define activation energy.
20.2 State the role of a catalyst



Describe the energy changes represented by each of the arrows.

22. The graphs of two reactions X and Y are shown on the same axes.



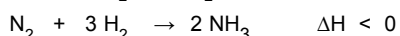
Which of the two reactions has

- 22.1 a positive change in enthalpy ?
22.2 the greatest activation energy ?
22.3 the greatest change in enthalpy ?
How will heating affect the reaction rate of
22.4 X ?
22.5 Y ?

23.1 How does a catalyst affect a reaction's rate and its yield or amount of products ?

23.2 How does a catalyst affect the equilibrium of a reaction ? (Which is the stage the reaction reaches when no further changes are seen to happen).

24. This equation represents the reaction between N_2 and H_2 to make ammonia.



24.1 Draw a graph to show how the potential energy of the system changes during the course of the reaction.

Use arrows to indicate the

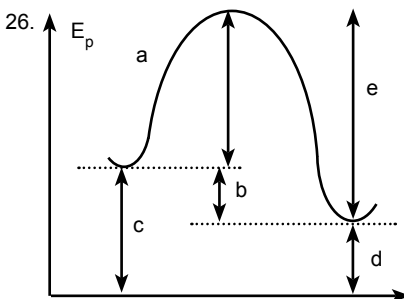
- 24.2 activation energy of the forward reaction.
24.3 the change in enthalpy.

Difficult Activities

(Level 5 - 7 Learners)

25.1 Which chemical reactions are speeded up by an increase in temperature ?

25.2 State two reasons why the exhaust pipe of a motor car is very prone to rust.



Which arrow represents the

- 26.1 activation energy for the reverse reaction ?
26.2 energy absorbed by the forward reaction ?
26.3 energy given out by the forward reaction ?
26.4 total energy released by the forward reaction which heats up the surroundings?
26.5 Which energies are altered by the use of a catalyst ?
26.6 Is the reverse reaction endothermic or exothermic ?

27.

Phosphine (PH_3) reacts far more quickly with O_2 than NH_3 reacts with O_2 . Which reaction has the lower activation energy ?

28.

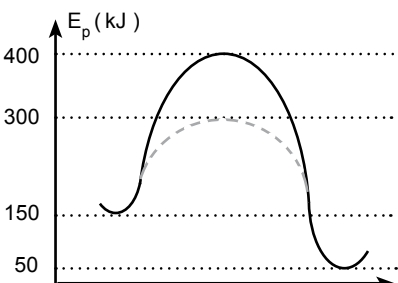
Clean, filtered air mixes with ammonia vapour and passes into a tube that contains some platinised ceramic. Heat the platinised ceramic until red hot.

Remove the flame. The red glow of the platinum continues as the two gases react.

Is this reaction endothermic or exothermic ? Explain.

Question 29

(There is one mole of each reactant)
(One mole of product forms)



- 29.1 What is the heat of reaction for the forward reaction ?
29.2 What is the heat of reaction for the reverse reaction ?
29.3 The energy of the activated complex for the uncatalysed forward reaction is....?

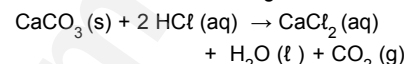
29.4 What is the activation energy for the catalysed forward reaction ?

29.5 What is the activation energy for the uncatalysed reverse reaction ?

29.6 What is the activation energy for the catalysed reverse reaction ?

29.7 The energy of the activated complex for the catalysed reverse reaction is... ?

30. Consider the following reaction :



The reaction rate of calcium carbonate with an excess of hydrochloric acid is determined by measuring the loss of mass of the reaction components in an open container. The following results were obtained :

Time (min)	1	2	3	4	5	6	7	8
mass loss (g)	0,5	1,0	1,5	1,8	2,0	2,0	2,0	2,0

- 30.1 Write down a suitable investigative question for this experiment.
30.2 Write down a suitable hypothesis for this investigation.
30.3 Identify the independent variable.
30.4 How could you ensure that these results are reliable?
30.5 What controls are kept constant during the investigation?
Why are they kept constant ?
30.6 What does the loss of mass represent ?
30.7 Mention a reason why the loss of mass remains constant after 5 minutes.
30.8 How will the rate of gas production be affected if the temperature of the hydrochloric acid is raised?
30.9 Has the reaction reached equilibrium? Explain.

31.

If a reaction has to be heated continually (eg. cooking) is it exothermic or endothermic ?

32.

If a reaction needs a bit of energy to get going (eg. light the fuse of dynamite) and then it sustains itself after that, is it exothermic or endothermic ?

33

- 33.1 What is the difference between a dependant variable and an independent variable ?
33.2 What is meant by a control ?
33.3 What is a hypothesis ?
33.4 How can we confirm if a hypothesis is correct ?
33.5 What is the basic problem with every hypothesis ?

34.

A colorimeter can measure the loss of brown colour of liquid Br_2 during its reaction with a pure ketone solvent. The experiment is repeated four times using different concentrations of the initial amount of Br_2 (l) in the pure ketone solvent, to determine the effect on the reaction rate of changing the dibromine concentration. The light transmitted through the clear solvent is regarded as 100%. This reading drops to about 2% when each sample of the Br_2 (l) is added to the ketone.

When the light transmitted through the colorimeter reaches 75% of the amount of light transmitted through the clear solvent, the time is recorded.

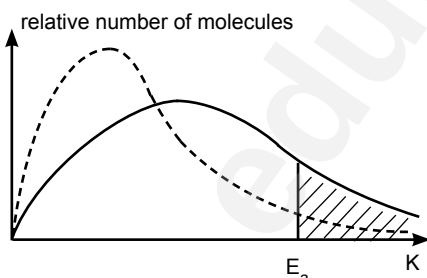
Initial [Br_2] ($\text{mol} \cdot \text{dm}^{-3}$)	Time (s) for 75% of light to be transmitted	Reaction rate $\frac{-\Delta[\text{Br}_2]}{\Delta t}$
0,01	100	
0,02	91	
0,03	75	
0,04	50	

- 34.1 Write down a suitable investigative question for these results.
 34.2 Why must temperature be controlled?
 34.3 What other variable must be kept constant?
 34.4 Calculate each reaction rate.
 (Ignore the units)
 34.5 Describe the relationship between reaction rate and concentration of Br_2
 34.6 Explain this trend in terms of the behaviour of the reacting molecules.

35.

An experiment initially produced the dotted line.

- 35.1 What variable was changed to produce the solid line?
 35.2 Explain the solid curve in terms of collision theory.



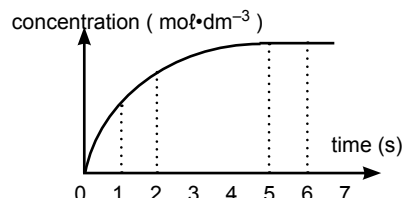
- 35.3 Why is the graph of the number of the molecules skewed to the right and is not symmetrical around the centre of the curve?
 35.4 The experiment is repeated by adding a catalyst. Indicate on the graph what changes when a catalyst is added?
 35.5 Explain in terms of collision theory why a catalyst speeds up the reaction rate.
 35.6 Robert Scott left food buried in the ice near the South Pole in 1912. It was discovered decades later. Was the food safe to eat?

36.

Why can we dissolve more salt in hot water than what we can dissolve in an equal volume of cold water?

37.

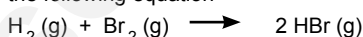
Calcium carbonate decomposes in a hot oven to form carbon dioxide gas. The following graph indicates the concentration of the gas that forms as the gas pressure increases.



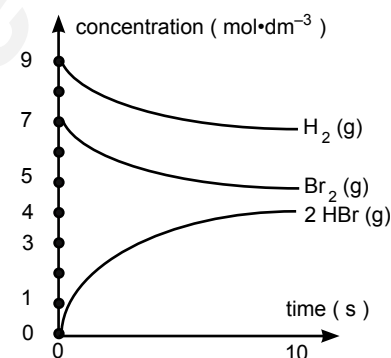
- 37.1 How do we determine the rate of the reaction at $t = 1$ s and $t = 2$ s for the forward reaction?
 37.2 How does the reaction rate change between $t = 1$ s and $t = 2$ s for the forward reaction?
 37.3 Why is the graph horizontal between $t = 5$ s and $t = 6$ s?
 37.4 How does the rate of the reverse reaction change between $t = 0$ s and $t = 5$ s?
 37.5 Draw a graph to show how the mass of calcium carbonate changes during this reaction.
 37.6 Draw a graph to represent both the forward and reverse reaction rates versus time.

38.

Express the average rate of reaction of the following equation

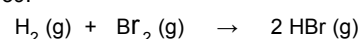


represented by the following graph



- 38.1 in terms of $\text{H}_2(\text{g})$
 38.2 in terms of $\text{Br}_2(\text{g})$
 38.3 in terms of $\text{HBr}(\text{g})$
 38.4 How do these values for the average reaction rate compare?

39.



This reaction is endothermic.

39.1 Write down a balanced equation for the forward reaction.

39.2 Write down a balanced equation for the reverse reaction.

39.3 Draw an energy diagram to represent

39.3.1 the forward reaction.

On the diagram represent the energy of the reactants, the activation energy E_a , the energy given out by the formation of the products, the energy of the products and a possible atomic representation of the activated complex.

39.3.2 the reverse reaction.

40.

Describe the activated complex.

41.

Define the activation energy of a reaction

42.

42.1 What is meant by the term "rate"?

42.2 What is meant by the term "yield"?

42.3 The **forward reaction** enables (reactants / products) to make (reactants / products).

42.4 The **reverse reaction** enables (reactants / products) to make (reactants / products).

42.5 H_2 and F_2 combine to make HF .

42.5.1 Write down the forward reaction.

42.5.2 Write down the reverse reaction.

43

43.1 What is meant by a "reversible reaction"?

43.2 Write down the equation for the reversible reaction between dihydrogen and difluorine.

43.3 What do the double arrows signify?

43.4 What is meant by "dynamic equilibrium" in a chemical reaction?

43.5 What is a "closed system"?

43.6 How long a time is "unit time"?

43.7 Describe chemical dynamic equilibrium from a

43.7.1 microscopic point of view

43.7.2 macroscopic point of view.

43.8 At equilibrium, reactants form products and products form reactants at the same

44.

Place only reactant gases into a sealed reaction chamber.

44.1 Initially there are only (reactants / products) present.

44.2 The forward reaction produces (reactants / products).

44.3 As the amount of products increases the rate of the forward reaction gets (faster / slower) as more of the reactants get used up.

44.4 As the amount of products increases the rate of the reverse reaction gets (faster / slower).

Past Matric Papers

1. When the enthalpy of a chemical reaction increases, ...

- A ΔH is negative.
- B the reaction is endothermic.
- C the temperature in the reaction vessel will increase.
- D the reaction cannot take place spontaneously.

2.

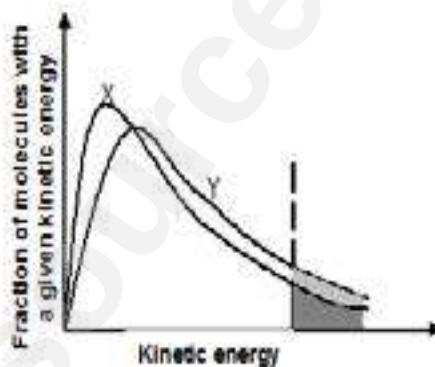
Kano tries to light a fire next to the road on a cold winter morning while waiting for the school bus. He finds that the fire burns better when he blows on it.

- 2.1 Explain, using the collision theory, why the fire burns better when he blows on it. (2)
- 2.2 Give ONE other method that Kano can use to make his fire burn faster, and explain why this method will have the desired effect. (2)
- 2.3 Briefly explain why the reason mentioned in QUESTION 7.1 makes it very dangerous for Kano to leave the fire when the bus arrives without putting it out thoroughly. (2)
- 2.4 Kano uses a match to light the fire. What is the energy that is supplied by the match called? (1)

3.

A learner investigates a way to increase the rate at which hydrogen gas develops in the reaction between zinc and hydrochloric acid.

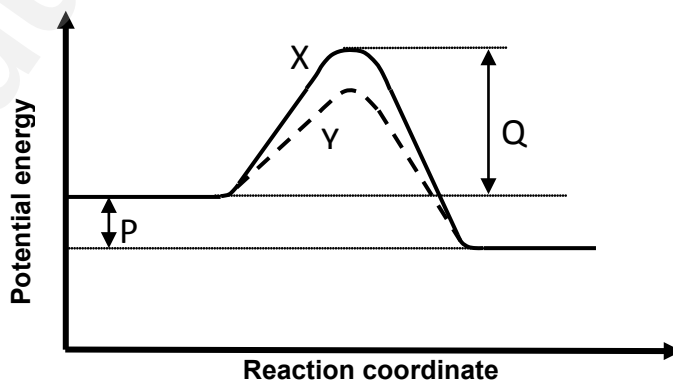
- 3.1 By changing one reaction condition she obtains the graph below, in which:
 - Curve X denotes the initial condition
 - Curve Y denotes the changed condition that produced a higher reaction rate



- 3.1.1 Which reaction condition did the learner change? (2)
- 3.1.2 Apply the collision theory and explain why the changed condition results in a higher reaction rate. (3)

3.2 She then changes another condition in which the effect is represented by the graph below. Once again:

- Curve X denotes the initial condition
- Curve Y denotes the changed condition that resulted in a higher reaction rate



- 3.2.1 Which reaction condition did the learner change? (2)
- 3.2.2 What is the name of the energy value denoted by the following:

- (a) P (1)
- (b) Q (1)

Past Matric Papers

4.

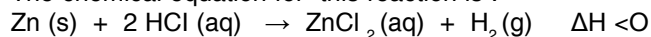
The reaction rate between two gases is likely to be the greatest under conditions of

- A high pressure and high temperature.
- B high pressure and low temperature.
- C low pressure and high temperature.
- D low pressure and low temperature.

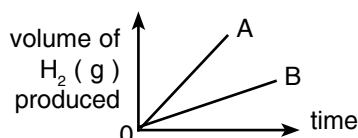
5.

Hydrogen gas may be prepared by the reaction of granulated zinc with dilute hydrochloric acid.

The chemical equation for this reaction is :



Two students using the same mass of zinc and the same volume of hydrochloric acid, plotted graphs showing the volume of hydrogen formed against time for their specific reactions.



With reference to the above reaction give THREE possible reasons why graph A has a greater gradient than B. (6)

6.

A small piece of Mg ribbon is added to a solution of HCl. Which of the following changes will NOT affect the rate at which H_2 gas is produced?

- A Using a larger piece of magnesium ribbon.
- B Increasing the volume of the HCl solution used.
- C Decreasing the concentration of the HCl solution used.
- D Increasing the temperature of the HCl solution.

7.

By raising the temperature of a reaction at equilibrium, the rate of the forward reaction will be

- A increased.
- B increased in endothermic reactions only.
- C decreased in endothermic reactions only.
- D decreased in exothermic reactions only.

8.

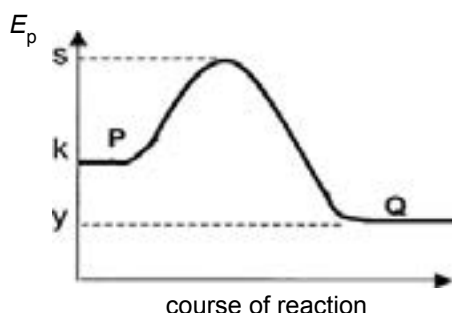
Consider the following reaction, which occurs in an open container :



The rate of the reaction can be increased by

- (A) increasing the temperature.
- (B) decreasing the temperature.
- (C) adding more HCl.
- (D) removing the NH_3 as it is formed.

9. The sketch graph below represents the change in potential energy for the chemical reaction P → Q in a closed container.



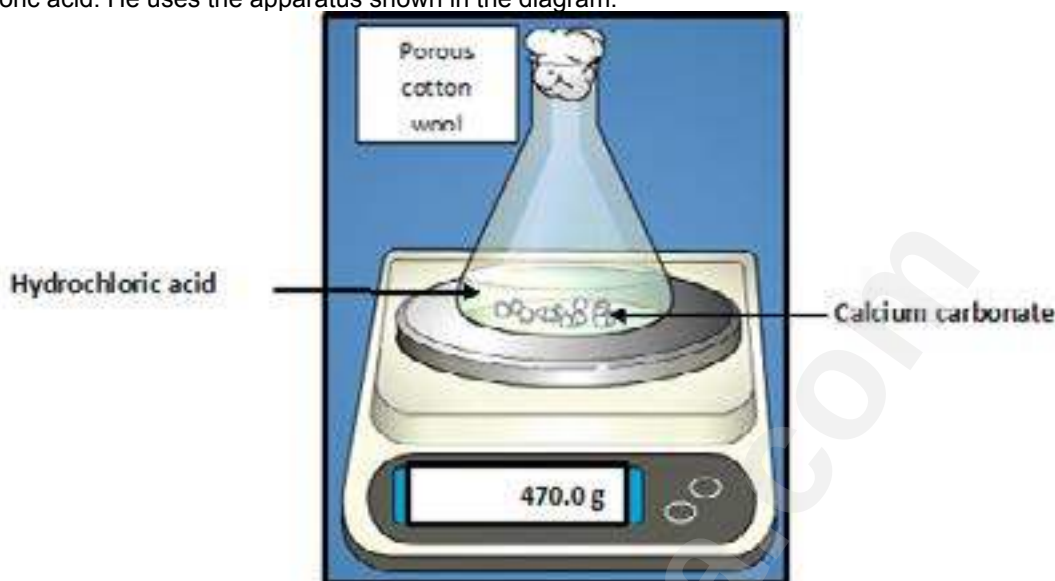
ΔH for the forward reaction is given by:

- A. $k - y$
- B. $s - k$
- C. $y - k$
- D. $y - s$

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10.

Petros conducts an investigation to determine the effect of temperature on the rate of reaction between calcium carbonate and hydrochloric acid. He uses the apparatus shown in the diagram.



He follows the method given below.

Place 20 g of CaCO_3 powder in a conical flask on top of a digital balance.

Add 300 cm^3 of HCl of concentration $2 \text{ mol} \cdot \text{dm}^{-3}$ at a temperature of 20°C to the flask.

Place porous cotton wool in the neck of the flask to prevent any dust falling into the flask.

Record the mass on the balance and start timing with a stop watch.

Stop timing after 50 s and record the mass.

Repeat using HCl at a temperature of 30°C , 40°C , 50°C and 60°C .

He jots down his results as indicated.

Table to show loss in mass of flask at different temperatures.

Temperature ($^\circ\text{C}$)	Final mass (g)	Loss in mass (g)
20	467,8	2,2
30	465,6	4,4
40	461,2	8,8
50	452,4	17,6
60	452,4	17,6

10.1 What was the independent variable in this experiment? (1)

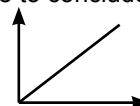
10.2 State TWO relevant controlled (fixed) variables in this experiment. (2)

10.3 Why was there a loss in mass from the flask contents? (2)

10.4 Give a reason why the final mass at 50°C and 60°C was the same. (2)

10.5 Analyse the results of this experiment and hence explain whether it is accurate to conclude that the loss in mass from the flask contents is directly proportional to the temperature.

Hint : directly proportional means the graph is a straight line through the origin.



This means doubling the x-value (independent variable) will also double the y-value (dependent variable) (3)

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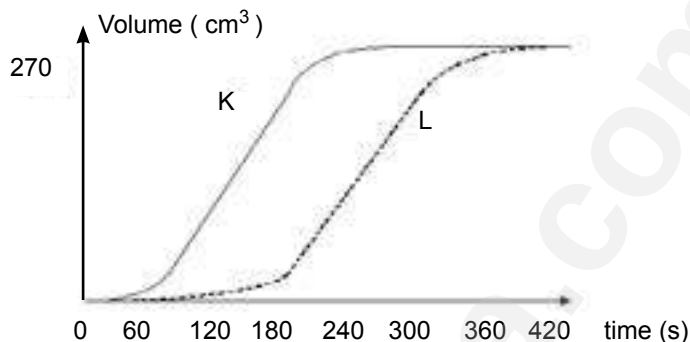
11.

Learners investigate one of the factors that influence the rate of a chemical reaction.

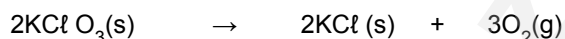
The arrangement for the experiment is given below.

Test tube	Contents of test tube
A	1 g potassium chlorate (KClO_3) + 5 g manganese(IV) oxide (MnO_2)
B	1 g potassium chlorate (KClO_3)
C	5 g manganese(IV) oxide (Mn^{4+})

The test tubes were set up in a sand bath and then evenly heated. The oxygen produced was measured at 60-second intervals. No reading was obtained for test tube C. The graph shows the results obtained during the experiment.



The equation for the production of oxygen using potassium chlorate is :



11.1 Which factor was being investigated? (2)

11.2 Which graph line, K or L, was obtained for the reaction in test tube B? (1)

11.3 Give a reason for your answer to QUESTION 11.2. (2)

If the mass of MnO_2 in test tube A was increased, how will each of the following change?

Choose from: INCREASES, DECREASES or NO CHANGE.

11.4 The volume of oxygen produced (2)

11.5 The rate of the reaction. (2)

12.

12.1 Name the amount of heat energy absorbed or released during a particular chemical reaction.

12.2 Name the type of substance that provides an alternative reaction path for a reaction

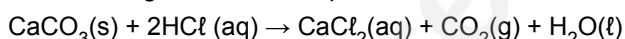
12.3 If the concentration of reactants increases, the total number of collisions also increases.

Is this statement true or false?

13.

A learner uses an excess of calcium carbonate chunks and dilute hydrochloric acid during a practical investigation.

The following reaction takes place between the two reagents:



The learner provides the following information as part of her laboratory report:

- Set up the apparatus as shown in the diagram below.

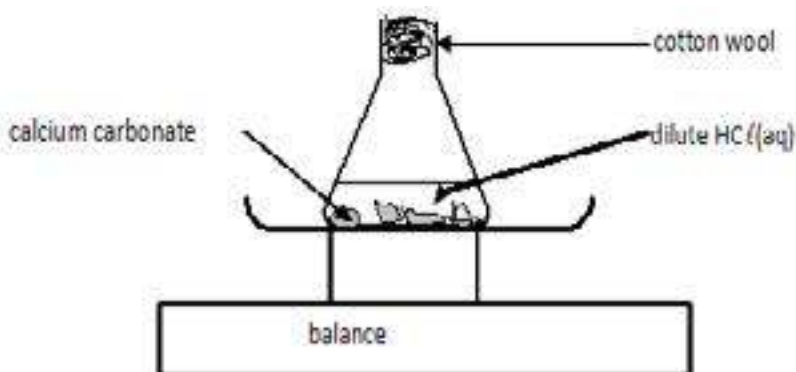
- Place 20 g of the calcium carbonate into an Erlenmeyer flask and cover it with 50 cm^3 dilute hydrochloric acid.

- Record the mass of the flask and contents at 30 second time intervals.

- Repeat the experiment another two times.

Use the same amount of calcium carbonate, but change the size of the calcium carbonate pieces each time by breaking the chunks into smaller particles.

Keep the amount and concentration of the hydrochloric acid constant.



13.1 Write down the investigative question for this investigation. (2)

13.2 Apart from the initial mass of the calcium carbonate and the volume of acid, what initial measurement must the learner make? (1)

13.3 Why does the learner use the same amounts of calcium carbonate and hydrochloric acid during each experiment? (1)

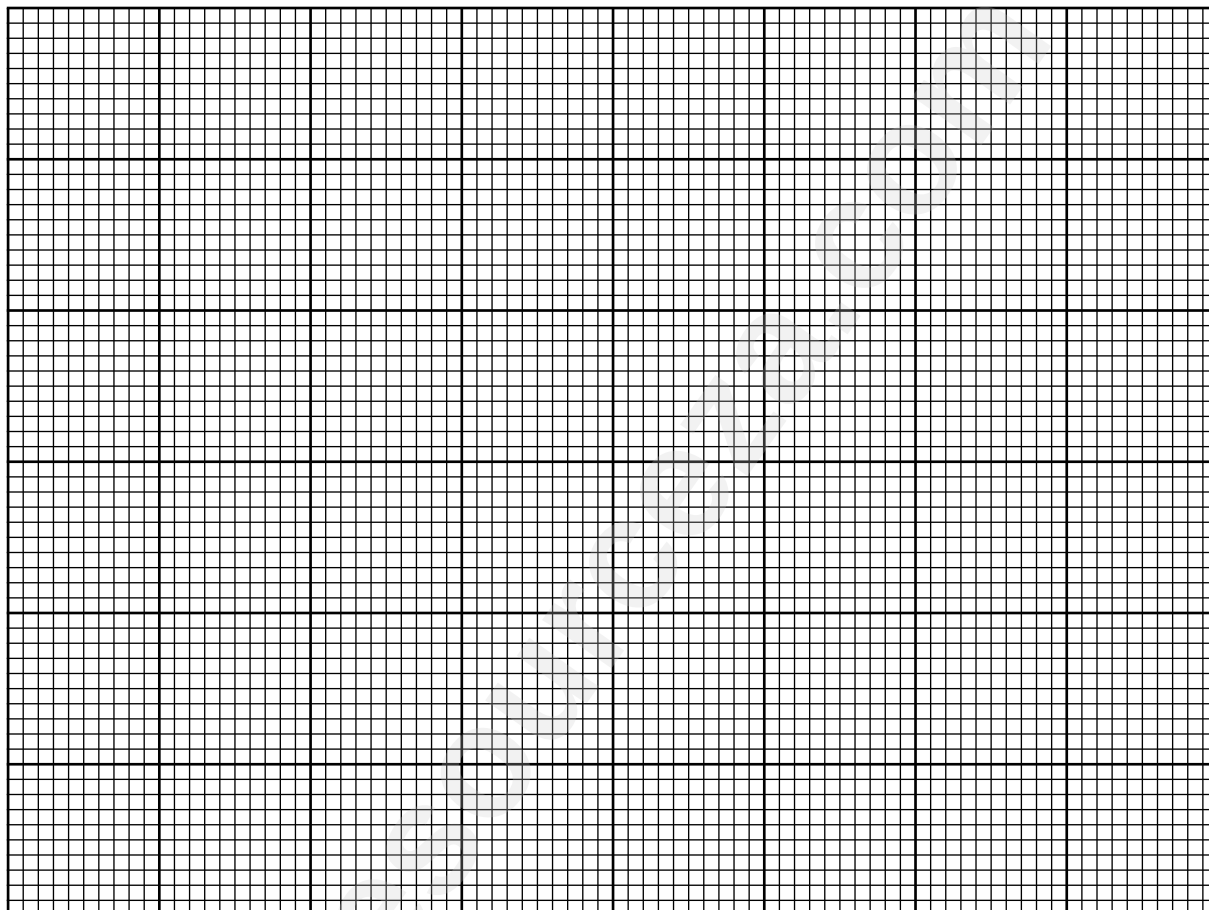
13.4 In recording the time, what important precaution should the learner take? (1)

One set of readings obtained by the learner is shown below.

MASS OF CO ₂ PRODUCED (g)	0	0,46	0,70	0,82	0,90	0,96	1,0	1,0
t (s)	0	60	120	180	240	300	360	420

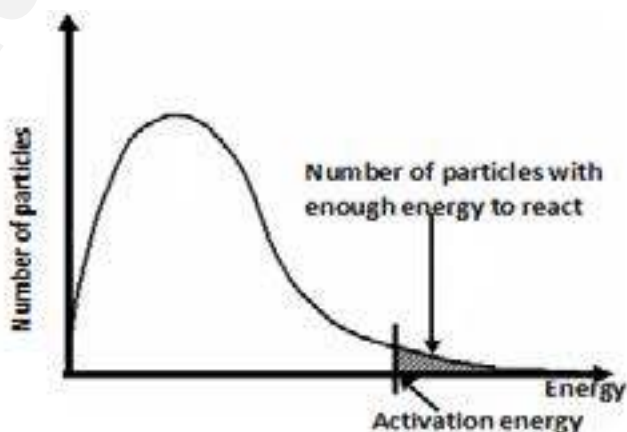
13.5 Represent the above results on a graph. Use the attached GRAPH PAPER. (6)

13.6 What conclusion can be drawn from the graph? (2)



14. A catalyst speeds up the rate of a reaction. This behaviour of a catalyst can be explained in terms of the activation energy and the collision theory.

14.1 The diagram below shows the Maxwell-Boltzmann distribution curve for a certain reaction.



14.1.1 Explain in terms of the collision theory and activation energy, how a catalyst influences the rate of a reaction. (4)

14.1.2 Redraw the above distribution curve into the answer book and show the new activation energy when a catalyst is added to the reaction mixture on the diagram. (2)

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14.2 When milk is left at room temperature, it spoils rapidly. However, in a refrigerator, it stays fresh for a longer time. Use the collision theory to explain this observation.

15.

15.1 Name the unstable intermediate compound formed during a chemical reaction.

15.2 What type of substance offers an alternative lower activation energy path for a reaction?

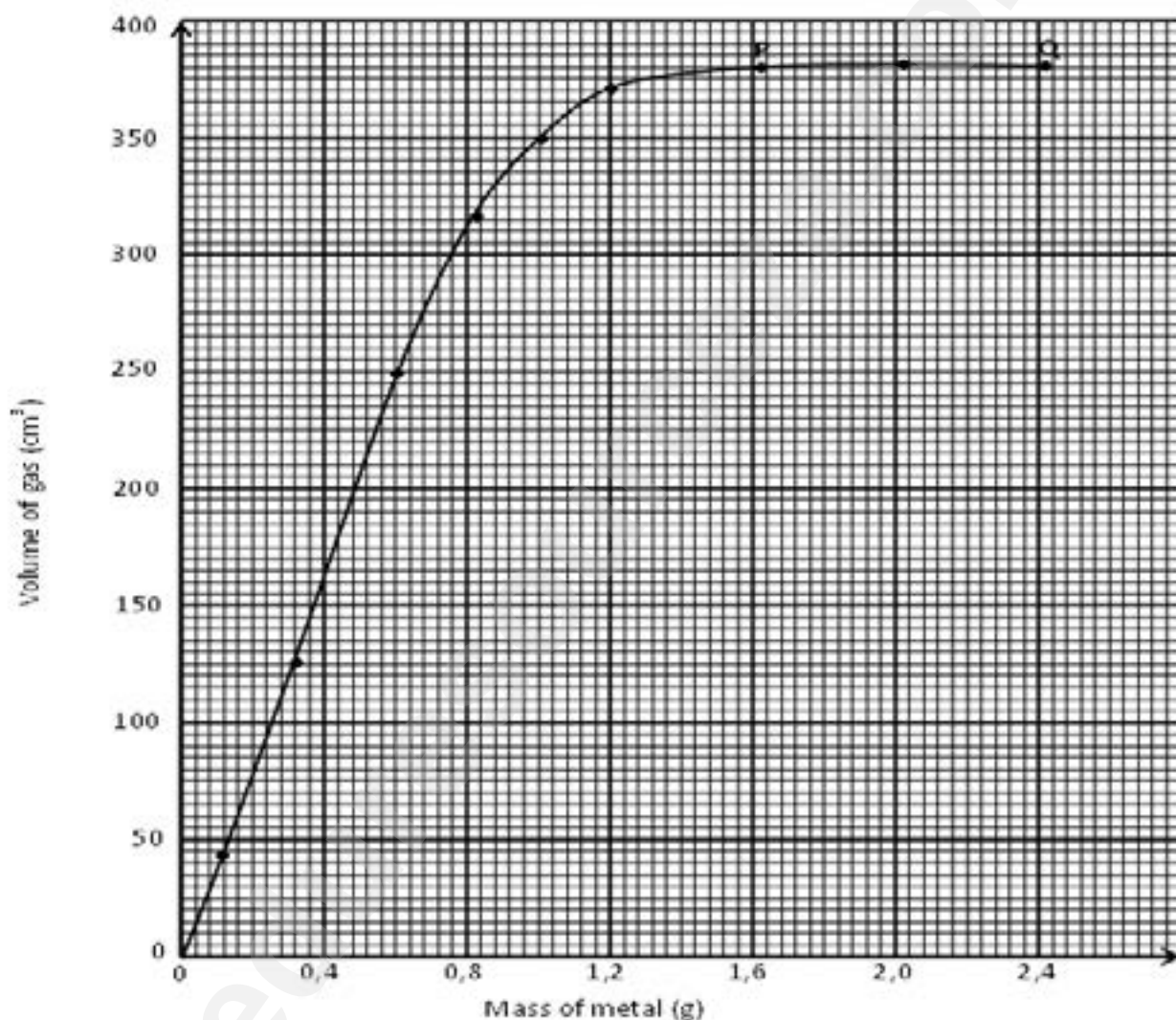
16.

A learner investigates the relationship between the mass of a metal and the volume of the gas produced when the metal reacts with dilute hydrochloric acid.

16.1 State a possible hypothesis for this investigation?

(2)

The learner plotted the graph shown below after conducting the investigation.



16.2 Mention TWO variables that must be controlled during this investigation?

(4)

16.3 What conclusion can be drawn from the section PQ on the graph?

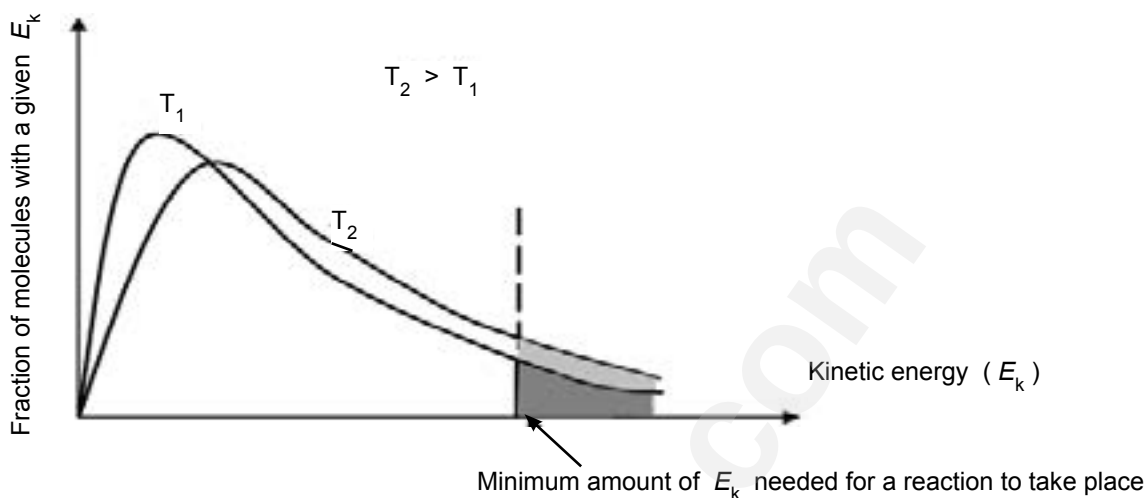
(2)

16.4 Use the graph to predict the volume of gas that will be produced when 0,4 g of the metal has reacted with the acid.

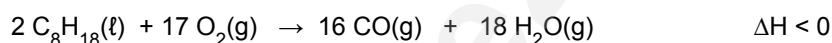
(2)

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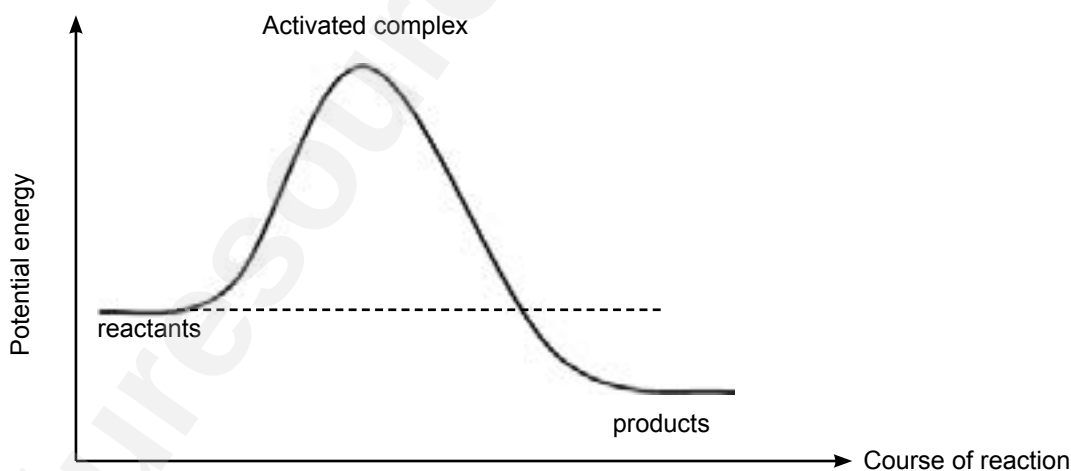
17. In general a teaspoonful of sugar dissolves much quicker in hot water than in the same amount of cold water. Use the graph below and your knowledge of the collision theory to explain this observation. (5)



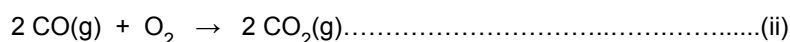
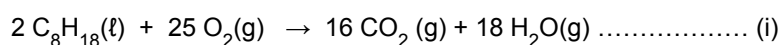
18. In a limited supply of oxygen, such as in a car which is not tuned properly, octane burns incompletely to produce carbon monoxide as shown in the following equation:



The reaction can be represented by the potential energy graph below



- 18.1 By comparing the activation energies of the forward and reverse reactions, explain whether it will be easier to form products from reactants or reactants from products. (2)
- 18.2 Use the chemical equation above THE GRAPH to explain why vehicles with incorrectly tuned engines are a health hazard. (2)
- 18.3 Part of the action of catalytic converters is to speed up the complete oxidation of carbon monoxide (CO) and petrol (C_8H_{18}) from incorrectly tuned engines according to the equations below.



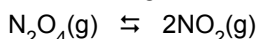
Why should people support legislation that makes catalytic converters a necessary component of exhaust systems of automobiles (or cars)? (2)

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- 19.
- 19.1 Name the type of reaction in which the temperature of the mixture decreases.
- 19.2 Name a unit in which reaction rate is measured
- 19.3 During the catalytic oxidation of ammonia the platinum ensures a high concentration of products. Correct this statement.
- 19.4 Which ONE of the following statements about the rate of reaction is INCORRECT?
- A. Meat decays quicker in a warm environment than in a fridge.
- B. Most industrial processes are cheaper to run when a catalyst is used.
- C. Zinc reacts faster with excess dilute hydrochloric acid than with concentrated hydrochloric acid that is not in excess.
- D. Potatoes cook faster when sliced than when cooked whole.
- 20.
- 20.1 The collision theory can be used to explain how different factors affect the rate of a chemical reaction.
- 20.1.1 Name TWO conditions that determine whether a collision between two molecules, A and B, will lead to a chemical reaction. (2)
- 20.1.2 In terms of the collision theory, explain why the rate of a chemical reaction increases with increasing temperature. (2)
- 20.2 The reaction between nitrogen dioxide and carbon monoxide is represented below.
- $$\text{NO}_2(\text{g}) + \text{CO}(\text{g}) \rightarrow \text{NO}(\text{g}) + \text{CO}_2(\text{g}) \quad \Delta H = -226 \text{ kJ}$$
- The activation energy for the reaction, E_a , is 132 kJ.
- 20.2.1 Sketch a potential energy versus reaction coordinate graph for this reaction. Label the axes and indicate the following on your graph: (4)
- $$\Delta H = -226 \text{ kJ} \quad E_a = 132 \text{ kJ}$$
- 20.2.2 Use a broken line on your graph to show the effect a catalyst would have on the potential energy as the reaction proceeds. (1)
- 21.
- 21.1 What name is given to the minimum energy required to start a chemical reaction?
- 21.2 What do we call the change in concentration of reactants per unit time?
- 21.3 Some catalysts can speed up a chemical reaction by providing a new, lower energy pathway. Is this statement true or false?
- 22.

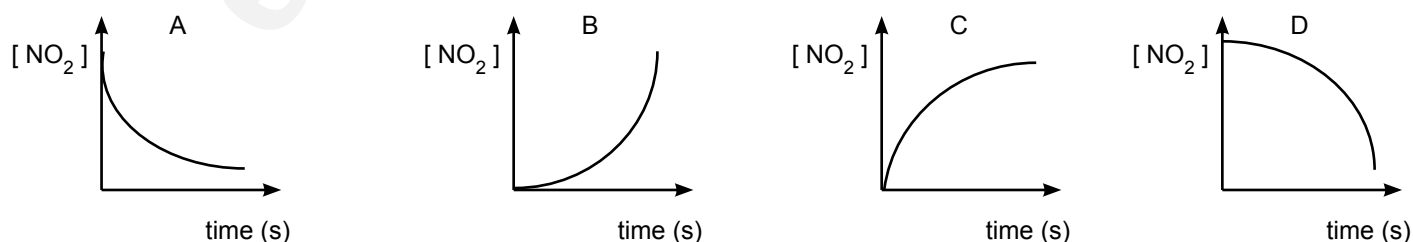
$\text{N}_2\text{O}_4(\text{g})$ is placed in an evacuated, sealed container.

The following reaction takes place in the container at constant temperature:



The concentration of the product is measured over time.

Which ONE of the following graphs correctly illustrates the relationship between the nitrogen dioxide (NO_2) concentration and time?



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23.

Antacids are used to relieve indigestion. Indigestion is the condition when the stomach produces too much acid resulting in an uncomfortable and painful feeling. A certain antacid tablet dissolves in water and reacts with the acid in the stomach to release carbon dioxide gas.

23.1 Name the type of chemical reaction that explains why antacids bring relief from indigestion. (1)

23.2 A group of learners wants to investigate the effect of temperature on the rate of dissolution of this antacid tablet in water.

Design an investigation that the group of learners can conduct by answering the questions below.

23.2.1 State an investigative question. (2)

23.2.2 State a hypothesis for this investigation. (2)

23.2.3 Write down a procedure that can be followed in this investigation to test your hypothesis using some or all of the apparatus/chemicals listed below:

- Thermometer
 - Stopwatch
 - Hot plate
 - Beaker
 - Measuring cylinder
 - Spatula/Teaspoon
 - Water
 - Antacid tablet
- (4)

23.2.4 Draw a table that can be used to record the results. Indicate the relevant headings of the rows and columns in the table. No values (numerical data) are required. (4)

23.3 Is it better to take the antacid tablet with warm water or with cold water? Give a reason for your answer. (2)

24.

Smog refers to a very unpleasant condition of pollution in certain urban environments. It is produced largely by the action of sunlight on car exhaust gases. Two groups of compounds emitted from car exhausts, that contribute to the formation of smog, are nitrogen oxides and unburned hydrocarbons.

Nitric oxide (NO(g)) forms in internal combustion engines by the direct combination of nitrogen and oxygen according to the following reversible reaction:



In air, nitric oxide is rapidly oxidised to nitrogen dioxide (NO₂(g)) that initiates the reactions responsible for the formation of smog. Nitrogen dioxide acts as catalyst for the formation of ozone, a key component of smog.

Although an essential UV screen in the upper atmosphere, ozone is an undesirable pollutant in the lower atmosphere. It is extremely reactive and toxic, and breathing air containing appreciable amounts of ozone can be dangerous for asthma sufferers, sports people and the elderly.

24.1 Before the Olympic Games in Beijing, authorities were extremely concerned about the levels of smog in the city. Explain why high smog levels are especially dangerous for sports people. (2)

24.2 Suggest TWO ways of reducing NO(g) in urban areas. (2)

24.3 Draw the potential energy diagram for the above reaction. Indicate the heat of reaction and the activation energy for the catalysed reaction on the diagram. (5)

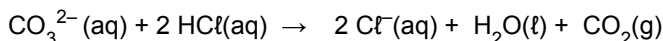
25. A catalyst increases the rate of a reaction by lowering the heat of the reaction. Correct this statement.

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26.

The active ingredient in a certain antacid tablet is the carbonate ion ($\text{CO}_3^{2-}(\text{aq})$).

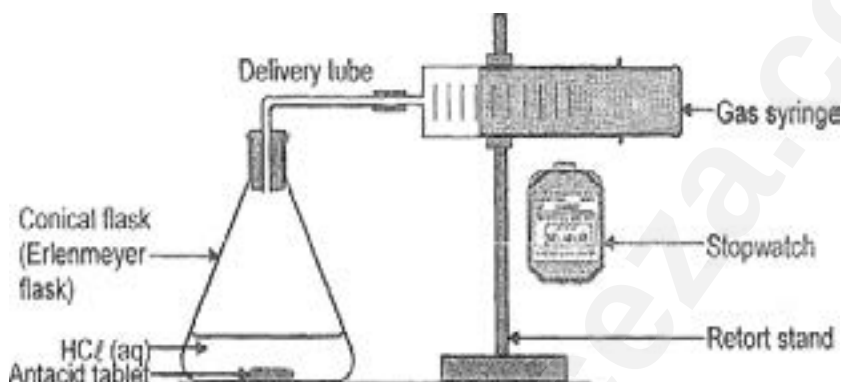
This ion reacts with the hydrochloric acid in your stomach according to the following reaction:



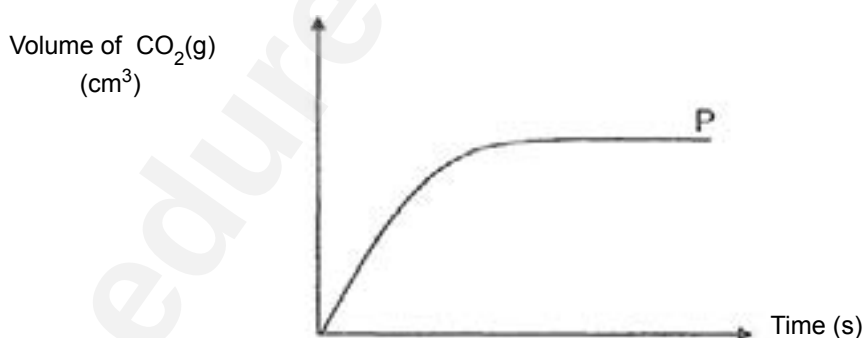
The formation of CO_2 gas is an indication that some of the acid has been neutralised and this brings relief from indigestion. A group of learners use two of these antacid tablets to investigate one of the factors that influence the reaction rate. They follow the method and use the apparatus given below, to conduct the investigation.

Method:

1. Place one antacid tablet in a conical (Erlenmeyer) flask and add $20 \text{ cm}^3 \text{ HCl}(\text{aq})$.
2. Simultaneously start the stopwatch and close the flask with the rubber stopper that is at the end of the delivery tube attached to the gas syringe.
3. Measure the volume of the CO_2 gas formed in intervals of 30 seconds.
4. Repeat 1 to 3 above, but grind the second antacid tablet to a fine powder prior to the reaction.



- 26.1 Define the term reaction rate. (2)
- 26.2 Write down an investigative question for this investigation. (2)
- 26.3 State THREE variables that must be controlled during this investigation. (3)
- 26.4 Apart from the apparatus illustrated on the previous page, the learners need at least TWO other pieces of apparatus to conduct the investigation. Write down the NAMES of the two pieces of apparatus, as well as the PURPOSE of each. (4)
- 26.5 The learners measure the volume of CO_2 gas formed at 30-second intervals in Step 3 of the method. Write down the NAME of the apparatus that they used for measuring the volume of the CO_2 . (1)
- 26.6 Consider the sketch graph below for the reaction of hydrochloric acid with the SOLID antacid tablet.



Redraw the above sketch graph in your ANSWER BOOK. On the same set of axes, sketch the curve Q that was obtained for the reaction of the POWDERED antacid tablet with hydrochloric acid.

Clearly label the curves P and Q on the re-drawn sketch graph. (3)

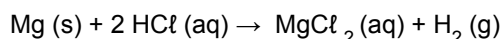
- 26.7 The instruction on an antacid packet recommends that antacid tablets must be chewed for faster relief. Explain how chewing the tablets bring about faster relief. (2)

27.1

Name the theory that explains why an increase in temperature results in an increase in reaction rate.

- 27.2 Name the minimum energy needed for a reaction to take place.
 27.3 A catalyst increases the yield or amount of products in a chemical reaction.
 28. Correct this statement.

A group of learners use the reaction between hydrochloric acid and magnesium powder to investigate one of the factors that influence the rate of a chemical reaction. The reaction that takes place is:



The learners use the apparatus and follow the method shown below to conduct the investigation.

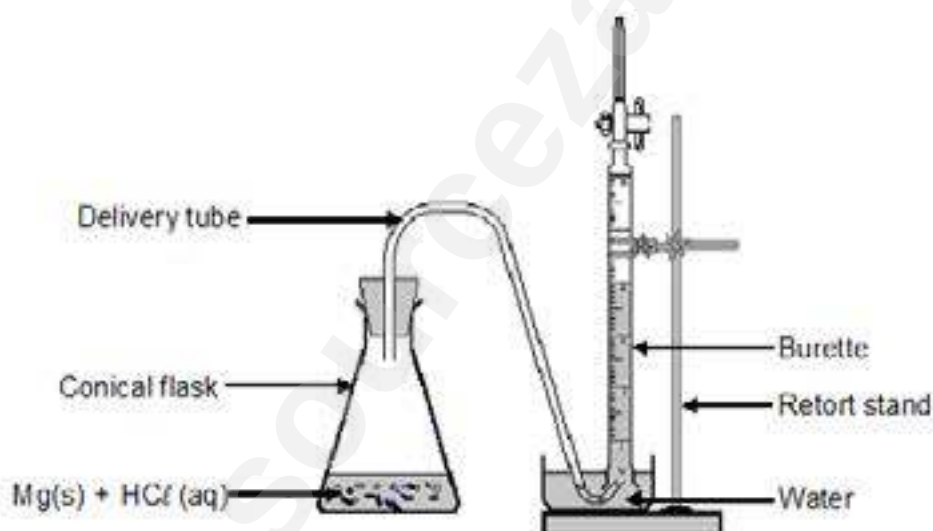
Method – Experiment 1:

- Step 1: Place a spatula of magnesium powder in a conical flask and add 50 cm³ HCl (aq) of known concentration.
 Step 2: Simultaneously start the stopwatch and close the flask with the rubber stopper containing the delivery tube.
 Step 3: Measure the volume of the H₂(g) formed in time intervals of 20 seconds.

Method – Experiment 2:

Repeat steps 1 to 3 above, but use only 25 cm³ of the same HCl (aq) diluted to 50 cm³ with distilled water.

Apparatus:



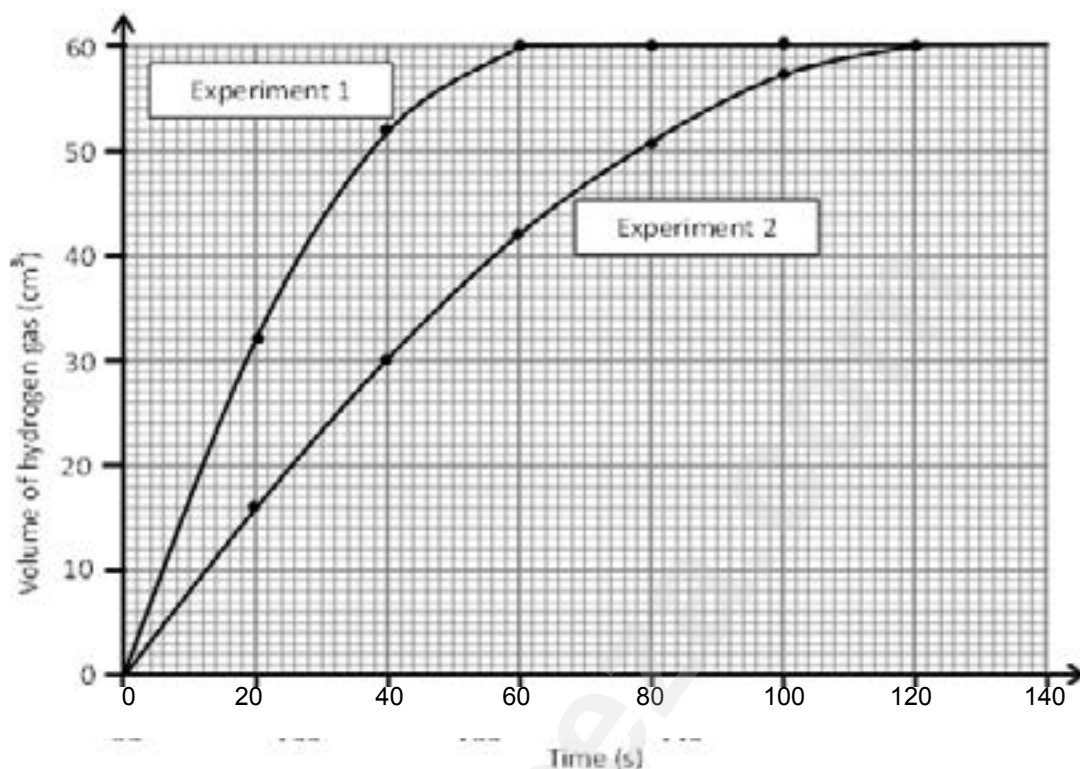
- 28.1 How does the concentration of the acid used in Experiment 2 differ from the concentration of the acid used in Experiment 1? Write down only GREATER THAN, SMALLER THAN or EQUAL TO. (1)
 28.2 Write down a hypothesis for this investigation. (2)
 28.3 Why should the learners ensure that equal amounts of magnesium powder are used in each of the two experiments? (2)
 28.4 The learners use an excess of (aq) for the two experiments. Give a reason why the excess (aq) will not influence the results. (2)

After completing the investigation, the learners represent the results obtained during each experiment on the graph which is drawn on the next page.

Past Matric Papers

28.

Graph of volume of hydrogen gas versus time



28.5 Write down the volume of hydrogen gas formed during the first minute in:

28.5.1 Experiment 1

(1)

28.5.2 Experiment 2

(1)

28.6 Which one of the experiments (Experiment 1 or Experiment 2) took place at the faster rate? Refer to the shape of the curves to motivate your answer.

(2)

28.7 Write down a reason why the final volume of gas produced is the same in both experiments.

(1)

28.8 What conclusion can the learners draw from the results obtained?

(2)

28.9 How will an increase in the temperature influence the following:

28.9.1 Final volume of gas obtained in each experiment
(Write down only INCREASES, DECREASES or REMAINS THE SAME.)

(1)

28.9.2 Volume of gas obtained in each experiment after 40 s
(Write down only INCREASES, DECREASES or REMAINS THE SAME.)

(1)

29.

29.1 Name the minimum energy needed for a reaction to take place.

29.2 Name the type of reaction in which all reactants and products are in the same phase.