Pearson Edexcel

Additional Assessment Materials Summer 2021

Pearson Edexcel GCSE in Chemistry (1CH0) Foundation

Resource Set Topic K: Rates of reaction and energy changes

Questions

(Public release version)

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

1 Students are investigating exothermic and endothermic reactions.
They are finding the temperature change in 50 cm^3 water when a solid dissolves in it.
The apparatus is shown in Figure 1.

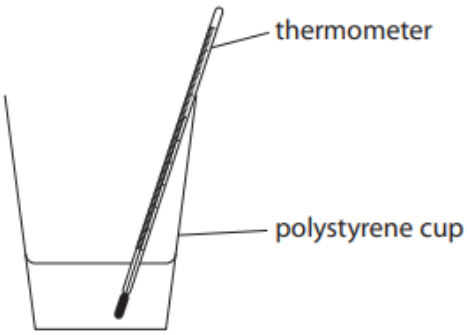


Figure 1

(a) The steps needed to carry out this experiment are **P**, **Q**, **R**, **S** and **T**.
They are shown below.

They are not in the correct order.

P pour the 50 cm^3 water into the polystyrene cup
Q add the solid to the water and stir
R measure 50 cm^3 water using a beaker
S measure the initial temperature of the water
T measure the final temperature of the solution when all the solid has dissolved

Write the steps in the correct order, from left to right.

(2)

R | P | S | Q | T

(b) The dissolving of this solid in water is an exothermic change.
The experiment is repeated a number of times.
Compared with the initial temperature of the water, the final temperature of the solution is

(1)

☒ **A** always higher

☒ **B** always lower

☒ **C** sometimes higher and sometimes lower

☒ **D** always unchanged

(c) State how step **R** could be changed to measure the volume of water more accurately.

(1)

measure using a pipette

(d) Figure 2 shows a cold pack.

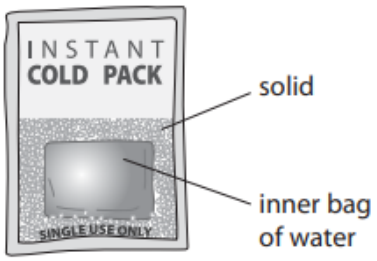


Figure 2

When the pack is squeezed hard the inner bag bursts.
Then the pack goes cold.

(i) Explain why the pack goes cold.

(2)

The solid reacts with the water. This is an endothermic reaction so temperature decreases.

(ii) Give the reason why the pack can be used only once.

(1)

The reactants will be used up and reaction cannot take place again.

3 Hydrogen peroxide decomposes to form water and oxygen.

The rate of this reaction can be found by measuring the volume of oxygen formed after different time intervals.

Hydrogen peroxide solution is placed in a conical flask.
The apparatus is set up as shown in Figure 5.

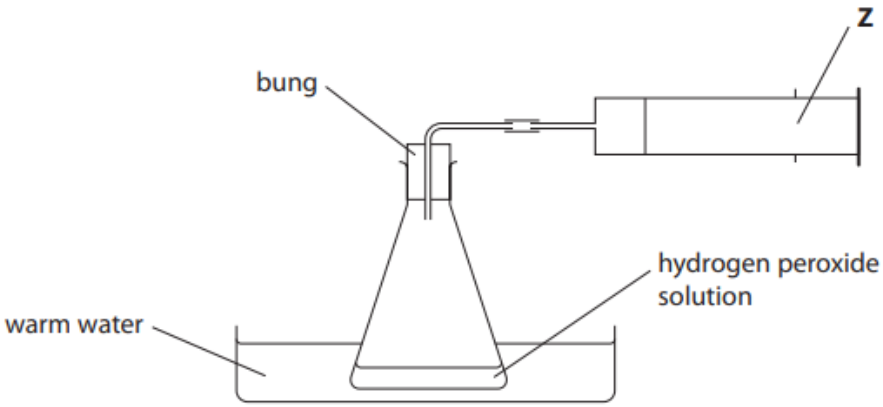


Figure 5

(a) State the name of the piece of apparatus labelled **Z** in Figure 5.

(1)

gas syringe

(b) At the end of the reaction the bung is removed from the conical flask.
A glowing splint is put into the gas in the flask.

State what you would **see**.

(1)

glowing splint relights

(c) A solid catalyst can be used for this reaction.

(i) The experiment is repeated under identical conditions but with the catalyst added.

(1)

In the experiment **with** the catalyst added

☒ **A** the rate of reaction is the same as when no catalyst is present

☒ **B** water and oxygen are the only products of the reaction

☒ **C** some of the catalyst is used up

☒ **D** the volume of oxygen produced when all the hydrogen peroxide is decomposed is larger than when no catalyst is present

(ii) At the end of the experiment with the catalyst added, the mass of the catalyst remaining is found.

The method used to find the mass of the catalyst remaining is
filter the mixture of products and catalyst
determine the mass of the filter paper and solid catalyst
subtract the mass of a filter paper from the mass of filter paper and solid catalyst.

This method would not give the accurate mass of catalyst remaining.

Which of the following needs to be done to give a more accurate mass?

(1)

☒ **A** dry the filter paper and catalyst before finding their mass

☐ **B** scrape the catalyst off the filter paper and find the mass of the catalyst

☐ **C** find the mass of the filtrate and not the filter paper and catalyst

☐ **D** repeat the experiment

(iii) A given mass of catalyst is more effective if it has a large surface area.

State how you could increase the surface area of some lumps of solid catalyst.

(1)

break it down into smaller pieces or powder

(d) The experiment is repeated three times
once using a more dilute solution of hydrogen peroxide
once using a lower temperature
once using a larger flask

In each case, all other conditions are kept the same.

Circle the word that shows the change in the rate of decomposition in each case.

(2)

	change in rate		
hydrogen peroxide solution is more dilute	faster	slower	unchanged
the temperature used is lower	faster	slower	unchanged
the reaction is carried out in a larger flask	faster	slower	unchanged

(e) Complete the balanced equation for the reaction and fill in the two missing state symbols.

(2)

2 H_2O_2(aq) → 2H_2O(l) + O_2(g)

4 A student poured 50 cm^3 water into a beaker and measured the water's temperature.

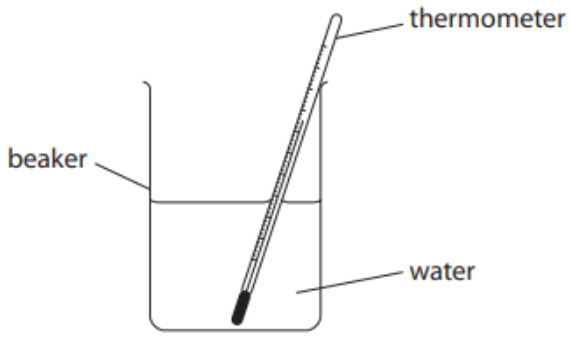


Figure 7

The student added 1.00 g calcium chloride to the water, stirred the mixture and then recorded the temperature.

(a) Give the name of the apparatus that could be used to measure 1.00 g of calcium chloride.

(1)

electronic balance

(b) The student's results were

temperature of water at start	= 21 °C
temperature of mixture after stirring	= 32 °C

Explain, using these results, the type of heat energy change that occurs when calcium chloride dissolves in water.

(2)

Temperature of mixture has increase so it is an exothermic reaction. Energy has been released during the reaction.

(c) Calcium chloride is hazardous to health.

(i) Which hazard symbol would be expected to be seen on a container of calcium chloride?

(1)

☐ **A**

☐ **B**

☒ **C**

☐ **D**

(ii) Give a safety precaution that the student should take during the experiment.

(1)

wear gloves and goggles

(d) State **one** way in which the apparatus could be changed to reduce the amount of heat energy lost during the experiment.

(1)

use a polysterene cup instead of a beaker.

6 The word equation for the reaction between magnesium and dilute hydrochloric acid is

magnesium + hydrochloric acid → magnesium chloride + hydrogen

The reaction was carried out using the apparatus shown in Figure 11.

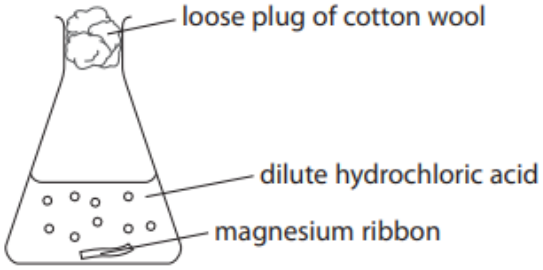
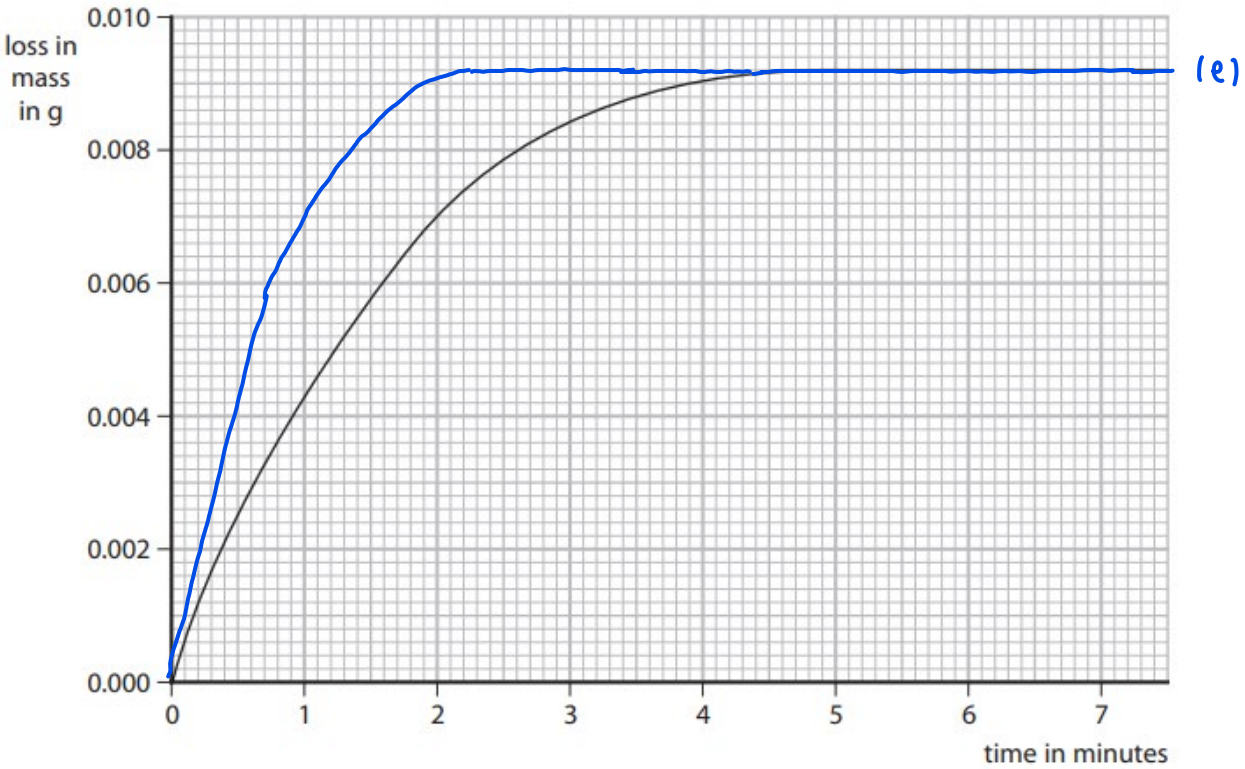


Figure 11

A strip of magnesium ribbon was placed in the conical flask.
100 cm^3 of dilute hydrochloric acid was added to the conical flask.

The mass of the flask and contents was measured at regular intervals.
The loss in mass was calculated.
Figure 12 shows a graph of the results.



(e)

Figure 12

(a) Name the apparatus that could be used to measure out 100 cm^3 of dilute hydrochloric acid.

(1)

measuring cylinder

(b) Explain why there is a loss in mass of the flask and contents.

(2)

hydrogen is one of the products formed and has escaped from the flash.

(c) The graph shows that the rate of reaction slows as the reaction takes place.

Explain, in terms of particles, why the rate of reaction between magnesium ribbon and dilute hydrochloric acid slows as the reaction takes place.

(3)

As reaction takes place, there are less reactants available so they collide less frequently. There are less successful collision so rate of reaction decreases.

(d) The experiment was repeated using the acid at a higher temperature.
All other conditions were kept the same.

State the effect of the higher temperature on the mass loss after two minutes.

(1)

increase

(e) The original experiment was repeated using the same mass of magnesium powder instead of the magnesium ribbon.
All other conditions were kept the same.

Sketch, on the graph in Figure 12, the line you would expect for this experiment.

(2)

(f) Some reactions are affected by the presence of a catalyst.

(i) State the effect of a catalyst on a reaction.

(1)

increases rate of reaction

(ii) Devise a simple experiment to find out what happens to the mass of a solid catalyst during a reaction.

(3)

Measure the mass of solid catalyst before the reaction. After the reaction is complete, filter the mixture. Dry the filter paper and the solid catalyst with tissue paper and weigh using an electronic balance. Minus the mass of the filter paper from this mass. Check whether it is the same as the mass before the reaction.

3bi-ii-iii-iv

(b) In another experiment, a student investigated the temperature decrease when different amounts of ammonium nitrate crystals were dissolved in 100 cm^3 of water.

The apparatus used is shown in Figure 5.

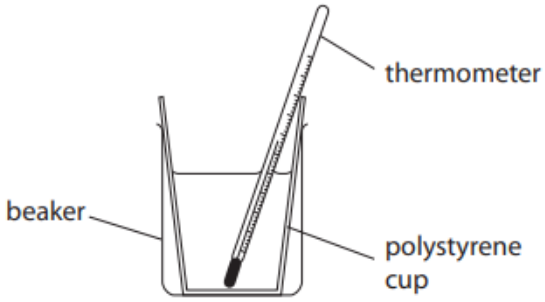


Figure 5

The student used the following method.

step 1 pour 100 cm^3 of water into the polystyrene cup

step 2 add one spatula of ammonium nitrate crystals to the water

step 3 stir the mixture

step 4 use the thermometer to record the lowest temperature reached by the mixture

step 5 repeat steps 1 to 4 using different amounts of ammonium nitrate

(i) Name a piece of apparatus that should be used to measure the 100 cm^3 of water in **step 1**.

(1)

measuring cylinder

(ii) The student cannot work out the temperature decrease using the method described.

State what the student must do before **step 2** to be able to work out the temperature decrease.

(1)

record the initial temperature of the water

(iii) State why a polystyrene cup is used in this experiment.

(1)

To reduce transfer of heat between water and the surroundings.

(iv) Figure 6 shows the reaction profile for this reaction.

Use the words from the box to complete the labels on Figure 6.

activation energy	products	reactants

(2)

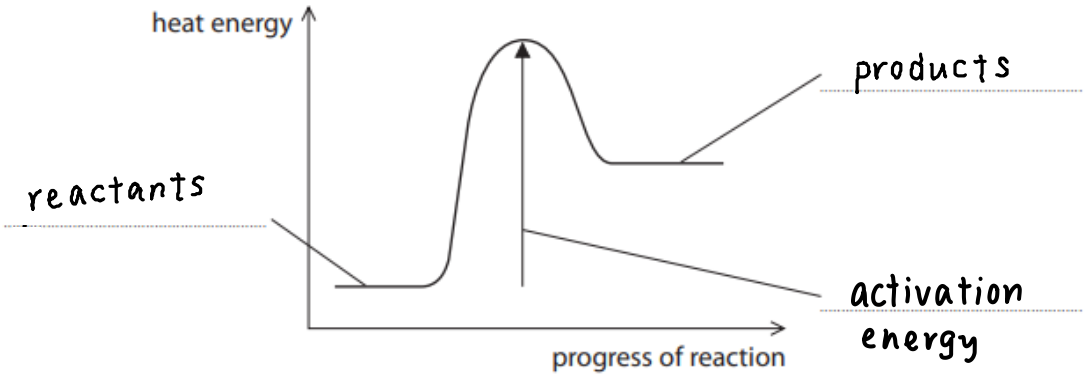


Figure 6

9 (a) Calcium carbonate reacts with dilute hydrochloric acid to produce carbon dioxide gas.

The rate of reaction between calcium carbonate and dilute hydrochloric acid at room temperature was investigated.

(i) The investigation was carried out with different sized calcium carbonate pieces.

The mass of calcium carbonate and all other conditions were kept the same.

The results are shown in Figure 15.

size of calcium carbonate pieces used	volume of carbon dioxide gas produced in five minutes in cm^3
large	16
small	48
powder	90

Figure 15

State, using the information in Figure 15, the effect of the surface area of the calcium carbonate on the rate of this reaction.

(1)

Rate of reaction increases as size of calcium carbonate pieces decreases.

(ii) The calcium carbonate powder produced 90 cm^3 of carbon dioxide in five minutes.

Calculate the average rate of reaction in $cm^3 s^{-1}$.

(3)

$\frac{90}{5(60)} = 0.08 cm^3 s^{-1}$

average rate of reaction = 0.08 $cm^3 s^{-1}$

(iii) The experiments were repeated at a higher temperature.
The rate of reaction for each experiment increased.

Explain, in terms of particles, why the rate of reaction increased when the temperature was increased.

(3)

when temperature increases, particles move faster as they gain kinetic energy. They collide more frequently so there are more successful collisions which have reached the activation energy.

*(b) Zinc metal reacts with dilute hydrochloric acid to produce hydrogen gas.

zinc + hydrochloric acid → zinc chloride + hydrogen

A student investigated the effect of doubling the concentration of the hydrochloric acid on this reaction.

The student made the following prediction.

> When the concentration of the hydrochloric acid is doubled the rate of reaction will double and the reaction will be more exothermic.

Devise a plan, including the apparatus you would use, to test the student's prediction.

You are provided with pieces of zinc and two bottles of dilute hydrochloric acid. One bottle of hydrochloric acid is double the concentration of the other.

(6)

Measure equal volumes of HCl of different concentrations and place them into 2 different conical flasks. Add equal mass of zinc pieces with the same surface area into the beakers and measure the volume of hydrogen gas produced at 1 minute intervals using a gas syringe. Plot a graph of volume of hydrogen produced against time. The rate of reaction can be found by drawing a line of best fit and finding its gradient.

To determine whether the reaction is more exothermic, repeat the experiment using polysterene cups instead of conical flasks. Measure the initial temperature of the hydrochloric acid. After adding zinc, measure the temperature of the mixture at regular intervals and find the highest temperature reached. Substract the initial temperature from the highest temperature to find the temperature change.

TOTAL FOR PAPER IS 53 MARKS