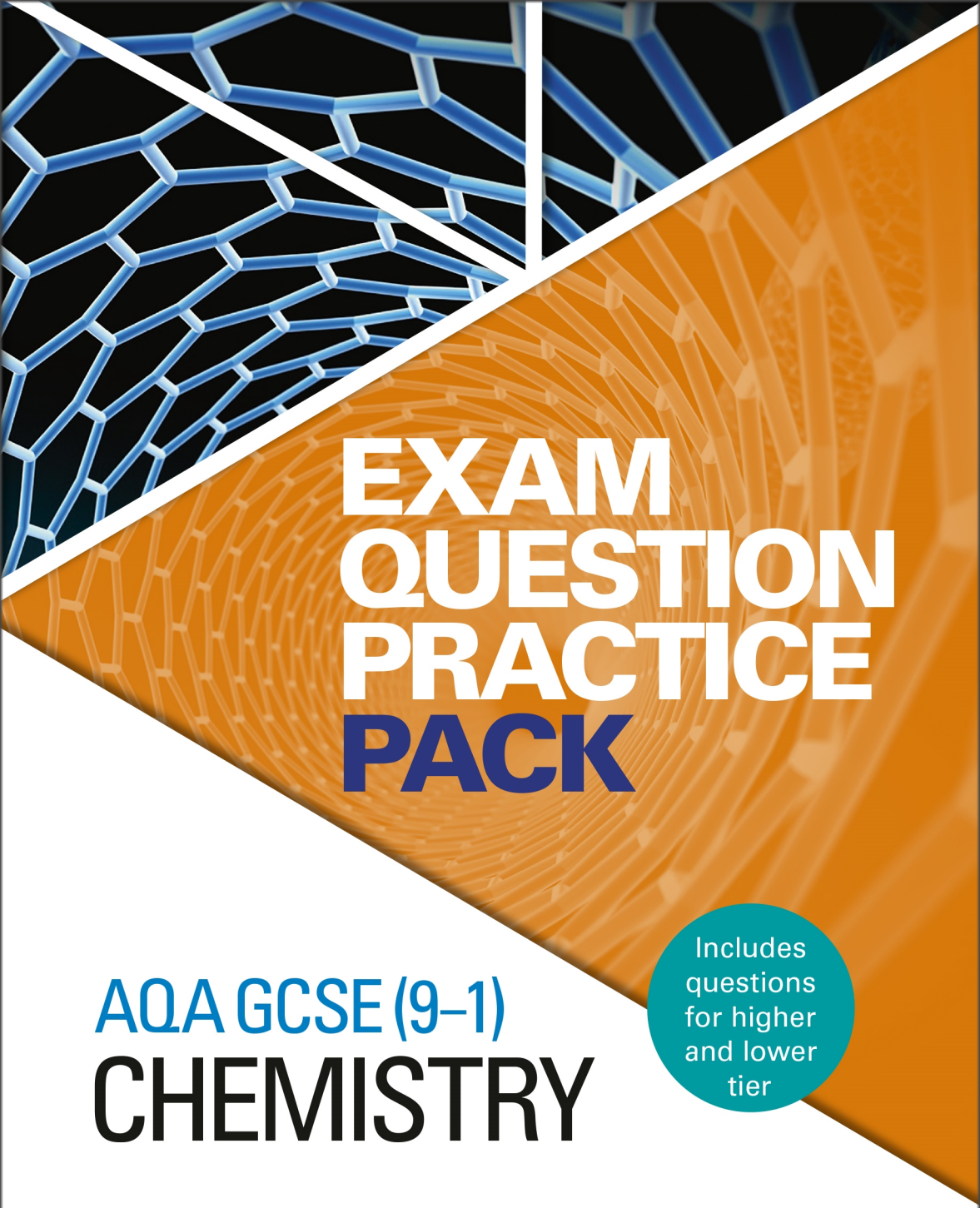

# EXAM QUESTION PRACTICE PACK

## AQA GCSE (9–1)
# CHEMISTRY

Includes questions for higher and lower tier

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# CONTENTS





# Paper 2

## The rate and extent of chemical change

(F) **1** **(a)** A student wants to investigate the rate of decomposition of hydrogen peroxide:

hydrogen peroxide → water + oxygen

$2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$

The student has researched that there are two possible catalysts for the reaction: manganese(IV) oxide ($MnO_2$) and copper(II) oxide (CuO). They plan to add 2 g of catalyst for each experiment and to monitor the volume of gas collected every 30 s (Figure 1). Their results are shown in Figure 2.

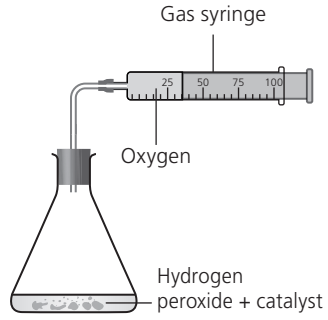



**Figure 1**

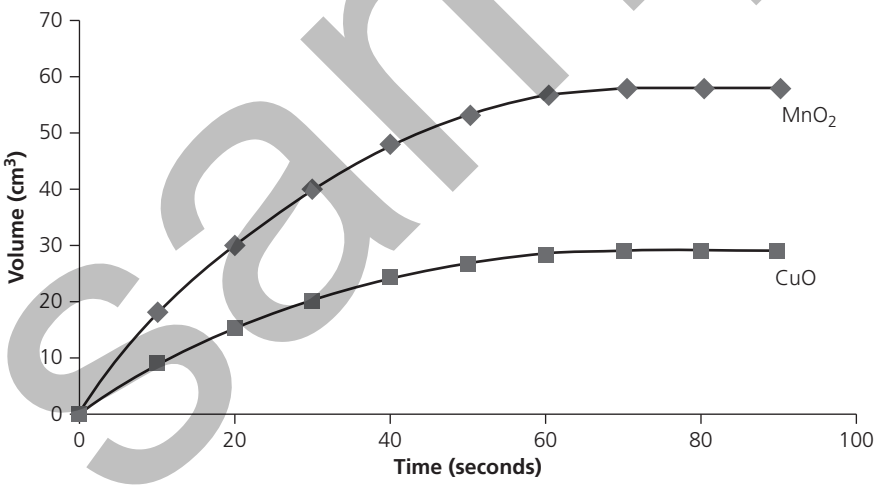



**Figure 2**

**(i)** What does a catalyst do? **(1 mark)**

.....

**(ii)** The student has planned to keep the mass of catalyst the same each time. What other variable must they keep the same to ensure a valid test? **(1 mark)**

.....



**(iii)** Explain which catalyst is most effective. **(1 mark)**

.....

**(b) (i)** For $MnO_2$, draw a tangent at time 20 s. For $MnO_2$, draw a tangent at time 40 s. **(2 marks)**

**(ii)** Using the tangents you have drawn, describe how the rate of reaction changes from 20 s to 40 s. **(2 marks)**

.....

.....

**Total: 7 marks**

**(Example student responses and mark scheme on p. XXX)**

(F) **2** **(a)** This question is based on the following reactions.

**A** calcium carbonate + sulfuric acid → calcium chloride + carbon dioxide + water

$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$

**B** nitrogen + hydrogen ⇌ ammonia

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

**C** Sodium thiosulfate + hydrochloric acid → sodium chloride + sulfur + sulfur dioxide + water

$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + S(s) + SO_2(g) + H_2O(l)$

Identify one of the reactions that would be suitable for each of the following statements. **(7 marks)**

| Statement | Reaction letter |
|---|---|
| Investigating the effects of surface area on rate of reaction | |
| Investigating the effects of pressure on rate of reaction | |
| Investigating the effects of concentration on rate of reaction | |
| Investigating the effects of temperature on rate of reaction | |
| Using gas collection to monitor rate of reaction | |
| Using loss of mass due to gas release to monitor rate of reaction | |
| Using the cloudiness of a solution to monitor rate of reaction | |

# Paper 2

## The rate and extent of chemical change

# Question 1 example responses

### Student A

**(a) (i)** A catalyst gives the chemicals a different way to react. By doing this the rate of reaction increase.

*e* **The student identifies that a catalyst speeds up the reaction by offering an alternative reaction pathway but a reference to activation energy is necessary. No marks**

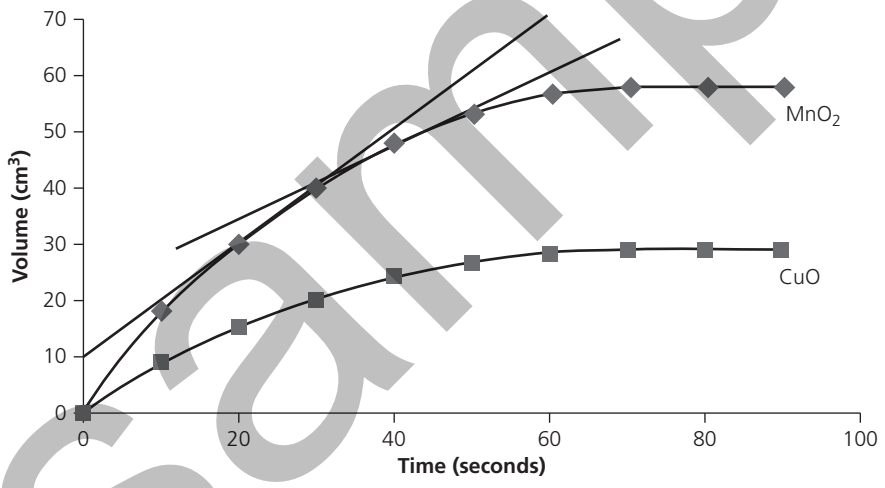
**(ii)** How much of the chemical is put in at the start.

*e* **The student indirectly references the amount of hydrogen peroxide because they write 'at the start', and 'how much' is a suitable substitute for volume. 1 mark**

**(iii)** Manganese oxide is the more effective catalyst as the line is steeper.

*e* **The student correctly links the gradient of the graph to an increase in rate. They clearly identify the catalyst by name. 1 mark**

**(b) (i)**




*e* **The student correctly draws the tangents for both 20 s and 40 s. 2 marks**

**(ii)** My tangent at 20 s is much steeper than at 40 s — this means the reaction is going faster at the time of the reaction.

*e* **The student correctly links the steeper tangent at 20 s to a faster rate of reaction. They do not state how the rate changes (i.e. slows down from 20 s to 40 s). 1 mark**



## Student B

**(a) (i)** It speeds up a reaction without getting used up.

*e* **The student identifies that a catalyst speeds up the reaction but a reference to the alternative pathway at a lower activation energy is necessary. No marks**

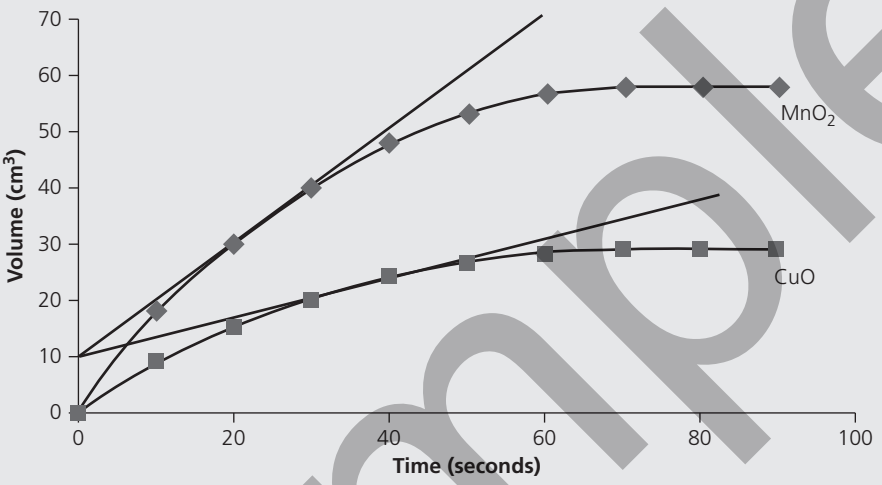
**(ii)** The size of the flask where the reaction is taking place.

*e* **The student refers to equipment usage, which is not a significant variable. No marks**

**(iii)** The top line is the more effective catalyst as its job is to make the reaction faster and this line is steeper.

*e* **The student correctly links the gradient of the graph to an increase in rate. Although they have not quoted the name of the catalyst, they make it clear which line they are referring to and this is sufficient for the mark to be awarded. 1 mark**

**(b) (i)**




*e* **The student correctly draws the tangents for 20 s, but then draw the tangent for copper oxide at 40 s. Even though it is drawn correctly, it does not answer the question. 1 mark**

**(ii)** My tangent at 20 s is a bit steeper so this reaction is going faster at this time.

*e* **The student correctly matches steeper gradient to faster rate. They make no attempt to describe how the rate changes. 1 mark**

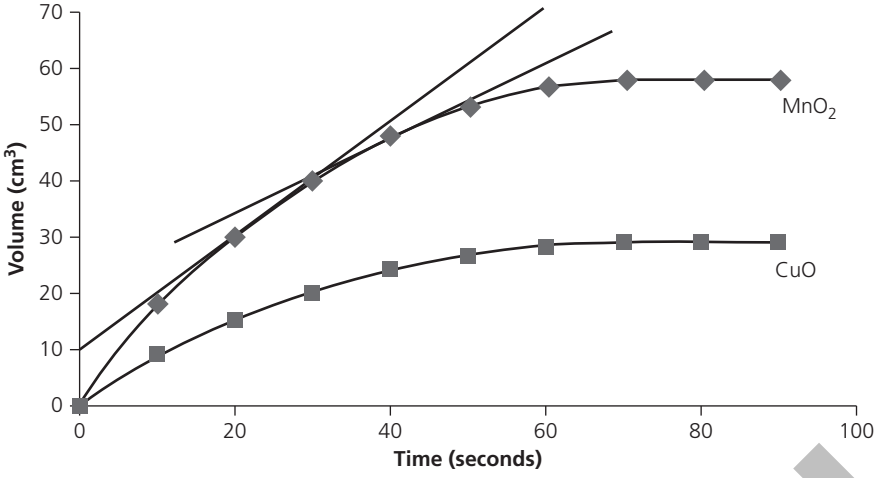
# Question 1 mark scheme

**(a) (i)** Catalysts speed up reactions by providing an alternative pathway with a lower activation energy.

**(ii)** Volume of $H_2O_2$. (Or start temperature, surface area of catalyst or concentration of $H_2O_2$.)

**(iii)** $MnO_2$ is more effective because the rate of reaction is greatest with this catalyst.

**(b) (i)** 1 mark for each of the following correctly plotted:
- Correct tangent at 20 s.
- Correct tangent at 40 s




(ii) 1 mark for each of the following points:
- The tangent at 20 s is steeper than the tangent at 40 s, so the rate is faster at 20 s compared with 40 s.
- The reaction slows down as it progresses.

# Question 2 example responses

## Student A

**(a)**

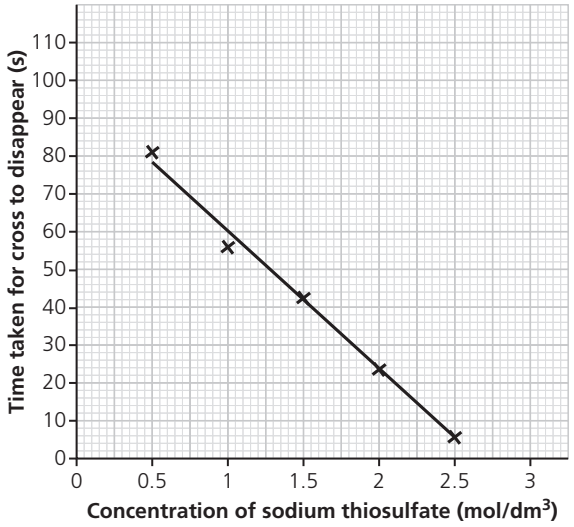
| Statement | Reaction letter |
|---|---|
| Investigating the effects of surface area on rate of reaction | A |
| Investigating the effects of pressure on rate of reaction | B |
| Investigating the effects of concentration on rate of reaction | C |
| Investigating the effects of temperature on rate of reaction | C |
| Using gas collection to monitor rate of reaction | A |
| Using loss of mass due to gas release to monitor rate of reaction | B |
| Using the cloudiness of a solution to monitor rate of reaction | C |

**e** **1st row: the student correctly identifies the only reaction with a solid reactant. 2nd row: the student correctly identifies a reaction where the reactants are gases. 3rd row: the student correctly identifies a reaction with a solution as a reactant. They could also have chosen reaction A. 4th row: the student correctly identifies a suitable reaction. 5th row: the student correctly identifies a reaction with a gaseous product. 6th row: the student incorrectly identifies a reaction where all substances involved are gases making it unsuitable to monitor mass lost due to gas production. 7th row: the student correctly identifies the reaction that produces a solid and therefore will cloud as the reaction occurs. 6 marks**



(b) (i)




*e* **The student accurately plots all the data points and draws a correct line of best fit. 3 marks**

(ii) They are wrong because they have said it is a fast rate when the cross takes a long time but this shows the reaction is going really slowly. A shorter time would be a fast rate.

*e* **The student outlines the relationship between shorter time and faster rate. 1 mark**

(iii) There are more reactant particles when the concentration is higher. As there are more particles they will collide more often.

*e* **The student links the increased number of particles to increased frequency of collision. 2 marks**

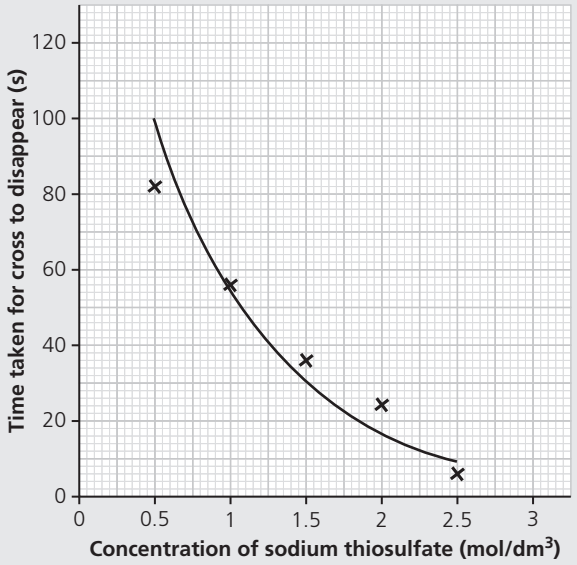
## Student B

(a)

| Statement | Reaction letter |
|---|---|
| Investigating the effects of surface area on rate of reaction | C |
| Investigating the effects of pressure on rate of reaction | A |
| Investigating the effects of concentration on rate of reaction | C |
| Investigating the effects of temperature on rate of reaction | A |
| Using gas collection to monitor rate of reaction | A |
| Using loss of mass due to gas release to monitor rate of reaction | A |
| Using the cloudiness of a solution to monitor rate of reaction | A |

*e* **1st row: the student incorrectly identifies a reaction between two solutions. Only reaction A involves a solid reactant and so is the only choice. 2nd row: The student incorrectly identifies a reaction where a gas is a product. To investigate pressure they would need to select reaction B, where the reactants are gases. 3rd row: the student correctly identifies a reaction with a solution as a reactant. They could also have chosen reaction A. 4th row: the student correctly identifies that any of the reactions could be used. 5th row: the student correctly identifies a reaction with a gaseous product. 6th row: the student correctly identifies a reaction where gas is lost as a product. 7th row: the student incorrectly identifies a reaction that does not produce a solid and therefore will not cloud as the reaction occurs. 4 marks**

**(b) (i)**




*e* **1 mark for three plots correct. The student incorrectly plots the data point for 1.5. The line of best fit is incorrect both in the context of the correct data and also for these data because a straight line is more appropriate.**

**(ii)** They are wrong because if it takes a long time to react it means the reaction rate is slow.

*e* **The student outlines the relationship between longer time and slower rate. 1 mark**

**(iii)** There are more particles, so they react more often and so react faster.

*e* **The student indicates that more particles leads to increased collisions but does not link the increased number of particles to an increase in concentration. 1 mark**

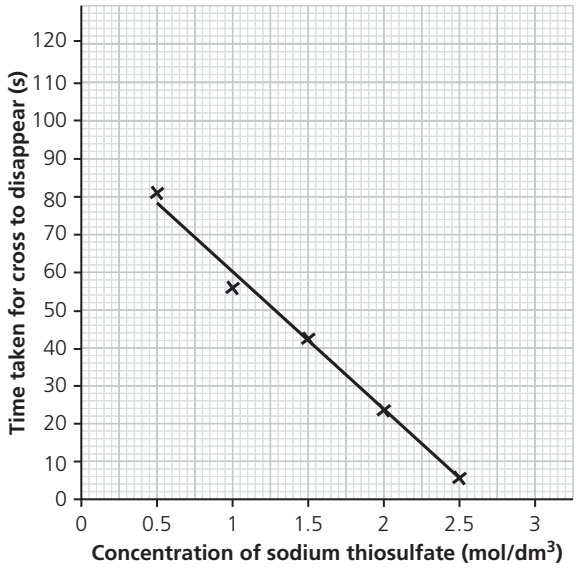
# Question 2 mark scheme

**(a)** 1 mark for each correct answer.

| Statement | Reaction letter |
|---|---|
| Investigating the effects of surface area on rate of reaction | A only |
| Investigating the effects of pressure on rate of reaction | B only |
| Investigating the effects of concentration on rate of reaction | A or C |
| Investigating the effects of temperature on rate of reaction | A, B or C |
| Using gas collection to monitor rate of reaction | A or C |
| Using loss of mass due to gas release to monitor rate of reaction | A or C |
| Using the cloudiness of a solution to monitor rate of reaction | C only |

**(b) (i)** 1 mark for each of the following points:

- Correctly plots three of five points.
- Correctly plots all five points.
- Correctly draws line of best fit.




**(ii)** Inverse relationship between time and rate — the longer the time, the lower the rate (or vice versa).

**(iii)** The higher the concentration, the greater the number of reactant particles (1). The greater number of particles leads to an increase in the frequency of collisions (1).

# Question 3 example responses

## Student A

**(a)**

| Type of $CaCO_3$ | Concentration of HCl (mol/dm$^3$) | Reaction |
|---|---|---|
| Powder | 0.5 | E |
| Powder | 1.0 | B |
| Powder | 2.0 | A |
| Small chips | 1.0 | C |
| Large chips | 1.0 | D |

**e** **The student correctly matches all four remaining reactions.** **2 marks**

**(b)** Reaction A because the line is the steepest.

**e** **The student correctly identifies reaction A as the fastest.** **1 mark**