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**GCSE Combined Science**

**(and Chemistry)**

**Student Revision Booklet**

**Rate and extent of chemical change**

**Contents:**

1. Student checklist and RAG sheet
2. Pre-revision Multiple Choice Quiz
3. Key Questions, 5 sentences, 5 words
4. Exam Question Practice
5. Progress checkpoint - Post-revision Multiple Choice Quiz
6. Student checklist and RAG sheet

**Student Checklist and RAG Sheet**

**Read each statement below and colour the box that best describes your current understanding.**

**(R – red: low understanding, A – amber: some understanding, G - green: good understanding)**

**Combined and Separate Chemistry**

|  |  |  |  |
| --- | --- | --- | --- |
| **Checklist statement** | **R** | **A** | **G** |
| Calculate the rate of a chemical reaction over time, using either the quantity of reactant used or the quantity of product formed, measured in g/s, cm3/s or mol/s |  |  |  |
| Draw and interpret graphs showing the quantity of product formed or reactant used up against time and use the tangent to the graph as a measure of the rate of reaction |  |  |  |
| **HT ONLY: Calculate the gradient of a tangent to the curve on the graph of the quantity of product formed or reactant used against time and use this as a measure of the rate of reaction**  |  |  |  |
| Describe how different factors affect the rate of a chemical reaction, including the concentration, pressure, surface area, temperature and presence of catalysts |  |  |  |
| ***Required practical 5 (Chemistry only) or 11(Combined Science):*** *investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced, change in colour or turbidity* |  |  |  |
| Use collision theory to explain changes in the rate of reaction, including discussing activation energy |  |  |  |
| Describe the role of a catalyst in a chemical reaction and state that enzymes are catalysts in biological systems |  |  |  |
| Draw and interpret reaction profiles for catalysed reactions |  |  |  |
| Explain what a reversible reaction is, including how the direction can be changed and represent it using symbols: A + B ⇌ C + D |  |  |  |
|  Explain that, for reversible reactions, if a reaction is endothermic in one direction, it is exothermic in the other direction |  |  |  |
|  Describe the State of dynamic equilibrium of a reaction as the point when the forward and reverse reactions occur at exactly the same rate |  |  |  |
|  **HT ONLY: Explain that the position of equilibrium depends on the conditions of the reaction and the equilibrium will change to counteract any changes to conditions** |  |  |  |
| **HT ONLY: Explain and predict the effect of a change in concentration of reactants or products, temperature, or pressure of gases on the equilibrium position of a reaction** |  |  |  |

**Pre-Revision**

**Multiple Choice Questions**

**Rate and extent of chemical change**

|  |
| --- |
| **INSTRUCTIONS Score: /20** |

* **Read the question carefully.**
* **Circle the correct letter.**
* **Combined science – Answer Q1 – 10 ONLY**
* **Separate Chemistry - Answer all questions.**

|  |  |
| --- | --- |
| 1. | The rate of a reaction can be measured by: |
|  | a. | Measuring the mass of the reactants or the volume of the gas produced.  |
|  | b. | Measuring the mass of the products. |
|  | c. | Measuring the volume of the reactants. |
|  | d. | Measuring the volume of the reactants and the mass of the products. |
| 2. | The factors affecting the rate of a reaction are: |
|  | a. | Temperature, concentration, surface area and using a catalyst.  |
|  | b. | Temperature, volume used, surface area and concentration. |
|  | c. | Concentration, mass, volume and surface area.  |
|  | d. | Surface area, temperature and using a catalyst.  |
| 3. | Increasing the temperature of the reaction: |
|  | a. | Has no effect.  |
|  | b. | Increases the amount of product formed. |
|  | c. | Increases the rate of the reaction.  |
|  | d. | Decreases the rate of the reaction.  |
| 4. | Increasing the volume of the reactant: |
|  | a. | Has no effect.  |
|  | b. | Increases the amount of product formed. |
|  | c. | Increases the rate of the reaction.  |
|  | d. | Decreases the rate of the reaction.  |
| 5. | Increasing the concentration of the reaction: |
|  | a. | Has no effect.  |
|  | b. | Increases the amount of product formed. |
|  | c. | Increases the rate of the reaction.  |
|  | d. | Decreases the rate of the reaction.  |
| 6. | Increasing the surface area of the reaction means: |
|  | a. | Using a large lump rather than a powder.  |
|  | b. | Using a powder rather than a large lump.  |
|  | c. | Using small chips rather than powder. |
|  | d. | That all particles come into contact with the reactant at the same time. |
| 7. | Increasing the surface area of the reaction: |
|  | a. | Has no effect.  |
|  | b. | Increases the amount of product formed. |
|  | c. | Increases the rate of the reaction.  |
|  | d. | Decreases the rate of the reaction.  |
| 8.  | Using a catalyst for a reaction: |
|  | 1. Has no effect.
 |
|  | 1. Increases the amount of the product formed.
 |
|  | 1. Decreases the rate of the reaction.
 |
|  | 1. Increases the rate of the reaction.
 |
|  |  |
| 9. | Using a catalyst: |
|  | a. | Provides an alternative pathway with a higher activation energy requirement.  |
|  | b. | Provides an alternative pathway with less reactants.  |
|  | c. | Provides an alternative pathway with a lower activation energy requirement. |
|  | d. | Provides an alternative pathway with more products.  |
|  |  |
| 10. | Increasing the surface area gives: |
|  | a. | A smaller surface area to volume ratio. |
|  | b. | A larger volume for the particles to react with. |
|  | c. | No real difference in the volume. |
|  | d. | A larger surface area to volume ratio. |
|  |  |  |
| 11. | In order for a reaction to occur: |
|  | a. | Particles must collide. |
|  | b. | Particles must collide with the correct activation energy. |
|  | c. | Particles need to have the correct activation energy. |
|  | d. | Particle must collide with more than the activation energy. |
|  |  |
| 12. | The catalyst for the decomposition of hydrogen peroxide is: |
|  | a. | Copper oxide. |
|  | b. | Magnesium oxide. |
|  | c. | Manganese oxide. |
|  | d. | Kidney. |
|  |  |
| 13. | Increasing the temperature affects the rate of the reaction because: |
|  | a. | Particles have more energy and collide more. |
|  | b. | Particles have more energy and move faster. |
|  | c. | Particles have more energy and have more successful collisions. |
|  | d. | Particles have more energy and move quicker to escape the solution. |
|  |  |
| 14. | Increasing the pressure affects the rate of the reaction because: |
|  | a. | The particles are closer together so collide more successfully. |
|  | b. | The particles have more energy so collide more successfully.  |
|  | c. | The particles move more quickly so collide more successfully.  |
|  | d. | The particles collide more with the surface of the container. |
|  |  |
| 15. | A dynamic equilibrium is: |
|  | a. | When there is a forward and a backward reaction in the same container.  |
|  | b. | When the rate of the forward and the backward reactions are equal. |
|  | c. | When the products are removed to ensure the forward reaction is the quickest.  |
|  | d. | When the backward reaction is endothermic.  |
|  |  |
| 16. | In a dynamic equilibrium, when the forward reaction is exothermic, increasing the temperature will: |
|  | a. | Increase the rate the products are made.  |
|  | b. | Decrease the rate that the products are made.  |
|  | c. | Have no effect.  |
|  | d. | Increase the amount of product made. |
|  |  |
| 17. | In a dynamic equilibrium, increasing the pressure will favour: |
|  | a. | The reaction with more products. |
|  | b. | Neither side of the reaction. |
|  | c. | The reaction with fewer products. |
|  | d. | The quicker rate. |
|  |  |
| 18. | In making ammonia, the forward reaction is exothermic, so 450°C used because: |
|  | a. | It is a high temperature so the reaction will occur quicker. |
|  | b. | It is compromise as the forward reaction prefers a low temperature. |
|  | c. | It is a compromise as the forward reaction prefers a high temperature. |
|  | d. | It is easy to maintain.  |
|  |  |
| 19. | Using a higher pressure favours the forward reaction but only 200atm is used because: |
|  | a. | It is high enough for the reaction to occur.  |
|  | b. | It is a safe pressure to maintain.  |
|  | c. | It is too labour intensive at higher pressures.  |
|  | d. | It is 2x the natural atmospheric pressure. |
|  |  |
| 20. | A biological catalyst is known as: |
|  | a. | An enzyme. |
|  | b. | A protein. |
|  | c. | A type pf washing powder. |
|  | d. | Mitochondria.  |
|  |  |

**Key questions, 5 sentences, 5 words**

|  |
| --- |
| **INSTRUCTIONS** |

* **For each statement, use either the suggested website or your own text book to write a 5-point summary. In examinations, answers frequently require more than 1 key word for the mark, so aim to include a few key words.**
* **It is important to stick to 5 sentences. It is the process of selecting the most relevant information and summarizing it that will help you remember it.**
* **Write concisely and do not elaborate unnecessarily, it is harder to remember and revise facts from a big long paragraph.**
* **Finally, identify 5 key words that you may have difficulty remembering and include a brief definition. You might like to include a clip art style picture to help you remember it.**

**Example:**

|  |  |
| --- | --- |
| **QUESTION:** | **Explain how to measure the rate of a reaction and to interpret the data.** |
| **Sources:** | **Website –** 1. [http://www.bbc.co.uk/schools/gcsebitesize/science/add\_ocr\_gateway/chemical\_economics/reaction1rev1.shtmltml](http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_gateway/chemical_economics/reaction1rev4.shtml)
2. <http://www.s-cool.co.uk/a-level/chemistry/reaction-kinetics/revise-it/measuring-rates-of-reaction>
 |
| 1. **Measure how much product is formed over a specific period.**
2. **E.g. the mass of the substance or the volume of gas given off.**
3. **Plot the data on a graph, the steeper the gradient the quicker the reaction.**
4. **Both reactions should plateau at the same volume/mass.**
5. **However, the faster rate should stop first.**
 |
| **plateau** | **time** | **volume** | **mass** | **gradient** |

|  |  |
| --- | --- |
| **QUESTION 1:** | **Explain the effect of increasing the concentration on the rate of the reaction.** |
| **Sources:** | **Website –** 1. <http://chemguide.co.uk/physical/basicrates/concentration.html>
2. [http://www.chem4kids.com/files/react\_rates.html](http://www.sciencemadesimple.co.uk/curriculum-blogs/chemistry-blogs/exothermic-and-endothermic-reactions)
 |
|  |
| **High concentration** | **Low concentration** | **Frequency of collisions** | **Energy of collisions** |  |

|  |  |
| --- | --- |
| **QUESTION 2:** | **Explain how increasing the temperature affects the reaction rate.** |
| **Sources:** | **Website –** 1. [http://www.bbc.co.uk/schools/gcsebitesize/science/edexcel\_pre\_2011/chemicalreactions/preparinggasesrev4.shtmlhttp://www.bbc.co.uk/schools/gcsebitesize/science/add\_ocr\_gateway/chemical\_economics/reaction2rev2.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/edexcel_pre_2011/chemicalreactions/preparinggasesrev4.shtmlhttp%3A//www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_gateway/chemical_economics/reaction2rev2.shtml)
2. <http://www.docbrown.info/page03/3_31rates3d.htm>

  |
|  |
| **High temperature** | **Low temperature** | **Frequency of collisions** | **Energy of collisions** |  |

|  |  |
| --- | --- |
| **QUESTION 3:** | **Describe the term ‘dynamic equilibrium’ and how we can change it to produce more product.** |
| **Sources:** | **Website –** 1. <http://www.bbc.co.uk/bitesize/higher/chemistry/reactions/equilibrium/revision/1/>
2. <https://socratic.org/chemistry/phases-of-matter/dynamic-equilibrium-of-phase-changes>
 |
|  |
| **Dynamic equilibria** | **Forward reaction** | **Reverse reaction** | **Le Chatelier’s Principle** |  |

|  |  |
| --- | --- |
| **QUESTION 4:** | **Describe how catalysts can be used to speed up the rate of a reaction.** |
| **Sources:** | **Website –** 1. <http://chemguide.co.uk/physical/basicrates/catalyst.html>
2. <https://www.youtube.com/watch?v=pwLQGeKQuKU>
 |
|  |
| **Catalyst** | **Activation energy** | **Collision theory** | **Biological catalyst** | **Rate of reaction** |

|  |  |
| --- | --- |
| **QUESTION 5:** | **Describe how increasing the surface area increases the rate of the reaction.** |
| **Sources:** | **Website –** 1. <http://chemguide.co.uk/physical/basicrates/surfacearea.html>
2. <https://www.youtube.com/watch?v=FJtwkum_QAY>
 |
|  |
| **Large surface area** | **Small surface area** | **Collisions of particles** | **Calculating mean rate of reaction** |  |

**Rate and extent of chemical change**

**Exam Practice**

**This question is about measuring rates of reaction:**

A student investigated the rate of reaction between marble chips and hydrochloric acid.

**Figure 1** shows the apparatus the student used.

**Figure 1**



(a)     What is **A**?

|  |  |  |
| --- | --- | --- |
|  | Tick **one** box. |   |
|   | cotton wool | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F09_files/img02.png  |
|   | limestone | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F09_files/img02.png  |
|   | poly(ethene) | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F09_files/img02.png  |
|   | rubber bung | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F09_files/img02.png  |

**(1)**

(b)     **Table 1** shows the student’s results for one investigation.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Table 1  | **Time****in s** | **Mass lost****in g** |
|   |   | 0 | 0.0 |
|   |   | 20 | 1.6 |
|   |   | 40 | 2.6 |
|   |   | 60 | 2.9 |
|   |   | 80 | 3.7 |
|   |   | 100 | 4.0 |
|   |   | 120 | 4.0 |

On **Figure 2**:

•        Plot these results on the grid.

•        Draw a line of best fit.

**Figure 2**



**(3)**

(c)     Use **Figure 2** to complete **Table 2**.

                                      **Table 2**

|  |  |  |
| --- | --- | --- |
|  | Mass lost after 0.5 minutes | ............ g |
|   | Time taken to complete the reaction | ............ s |

**(2)**

(d)     The equation for the reaction is:

2HCl(aq)    +   CaCO3(s)   →   CaCl2(aq)   +   H2O(l)   +   CO2(g)

Explain why there is a loss in mass in this investigation.

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**(2)**

(e)     Another student investigated the rate of a different reaction.

**Table 3** shows the results from the different reaction.

                                      **Table 3**

|  |  |  |
| --- | --- | --- |
|  | Mass lost when the reaction was complete | 9.85 g |
|   | Time taken to complete the reaction | 2 minutes 30seconds |

Calculate the mean rate of the reaction using **Table 3** and the equation:

                        mean rate of reaction = 

Give your answer to two decimal places.

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    Mean rate of reaction = .......................................... g / s

**(2)**

(f)     The student measured the change in mass of the reactants.

Describe another method, other than measuring the change in mass of the reactions, that the student could have used to find the rate of the reaction between marble chips and hydrochloric acid.

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**(2)**

(g)     Another student planned to investigate the effect of temperature on the rate of reaction.

The student predicted that the rate of reaction would increase as the temperature was increased.

Give **two** reasons why the student’s prediction is correct.

|  |  |  |
| --- | --- | --- |
|  | Tick **two** boxes. |   |
|   | The particles are more concentrated. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F09_files/img02.png  |
|   | The particles have a greater mass. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F09_files/img02.png  |
|   | The particles have a larger surface area. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F09_files/img02.png  |
|   | The particles have more energy. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F09_files/img02.png  |
|   | The particles move faster. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F09_files/img02.png  |

**(2)**

**(Total 14 marks)**

**This question is about temperature and rates:**

A student investigated the effect of temperature on the rate of a reaction.

**Figure 1** shows an experiment.

**Figure 1**

The student:

•        put 50 cm3 sodium thiosulfate solution into a conical flask

•        heated the sodium thiosulfate solution to the required temperature

•        put the flask on a cross drawn on a piece of paper

•        added 5 cm3 dilute hydrochloric acid and started a stopclock

•        stopped the stopclock when the cross could no longer be seen

•        repeated the experiment at different temperatures.

The equation for the reaction is:



(a)     Which product is a gas?.. ......................................................................

**(1)**

(b)     **Figure 2** shows the results of this experiment at five different temperatures.

The circled result point is anomalous.

**Figure 2**



(i)      Draw a line of best fit on **Figure 2** to show how the reaction time varied with reaction temperature.

**(1)**

(ii)     Give a possible reason for the anomalous result at 40 °C.

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**(1)**

(iii)    The reaction at 20 °C produced 0.32 g of sulfur in 64 seconds.

Calculate the rate of the reaction at 20 °C using the equation:



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Rate of reaction = .................................... grams per second

**(2)**

(iv)    Give **two** reasons why the rate of the reaction increases as the temperature increases.

|  |  |  |
| --- | --- | --- |
|  | Tick (✔) **two** boxes. |   |
|   | The particles move faster. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q16S2F04_files/img05.png |
|   | The particles collide less often. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q16S2F04_files/img05.png |
|   | All the particles have the same energy. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q16S2F04_files/img05.png |
|   | The particles collide with more energy. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q16S2F04_files/img05.png |
|   | The number of particles increases. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q16S2F04_files/img05.png |

**(2)**

(v)     Use the correct answer from the box to complete the sentence.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **activation** | **collision** | **exothermic** |

The minimum amount of energy particles must have to react is called the ................................................... energy.

**(1)**

**(Total 8 marks)**

**This question is about extent of chemical change in the Haber process:**

Ammonia is made using the Haber process.

(a)     How is ammonia separated from unreacted nitrogen and hydrogen in the separator?

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**(2)**

(b)     The equation shows the reaction which takes place in the reactor:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N2(g) | + | 3H2(g) | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q12SY2H05_files/9_img02.png | 2NH3(g) |

(i)      Why does the yield of ammonia at equilibrium increase as the temperature is decreased?

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 **(1)**

(ii)     A temperature of 450 °C is used in the reactor to make the reaction take place quickly.

Explain, in terms of particles, why increasing the temperature makes a reaction go faster.

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 **(2)**

(iii)    Why does the yield of ammonia at equilibrium increase as the pressure is increased?

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 **(1)**

(iv)     The pressure used in the reactor is 200 atmospheres.
Suggest why a much higher pressure is **not** used.

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 **(1)**

(c)     Use the equation for the reaction in the reactor to help you to answer these questions.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N2(g) | + | 3H2(g) | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q12SY2H05_files/9_img02.png | 2NH3(g) |

(i)      It is important to mix the correct amounts of hydrogen and nitrogen in the reactor.

20 m3 of nitrogen is reacted with hydrogen.

What volume of hydrogen (measured at the same temperature and pressure as the nitrogen) is needed to have the correct number of molecules to react with the nitrogen?

 Volume of hydrogen needed = .......................... m3 **(1)**

(ii)     Calculate the maximum mass of ammonia that can be made from 2 g of nitrogen.

Relative atomic masses: H = 1; N = 14.

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                             Maximum mass of ammonia = ............................ g

**(3)**

(d)     The expected maximum mass of ammonia produced by the Haber process can be calculated.

(i)      In one process, the maximum mass of ammonia should be 80 kg.

The actual mass of ammonia obtained was 12 kg.

Calculate the percentage yield of ammonia in this process.

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                              Percentage yield of ammonia = ......................... %

**(1)**

(ii)     Give **two** reasons why it does **not** matter that the percentage yield of ammonia is low.
Use the flow diagram at the start of this question to help you.

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 **(2)**

**(Total 14 marks)**

**This question is about concentration and rates:**

A student investigated the rate of reaction of magnesium and hydrochloric acid.

Mg(s) + 2HCl(aq)    MgCl2(aq)  +  H2(g)

The student studied the effect of changing the concentration of the hydrochloric acid.

She measured the time for the magnesium to stop reacting.



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Concentration of hydrochloric acid in moles per dm3 | 0.5 | 1.0 | 1.5 | 2.0 |

(a)     The student changed the concentration of the hydrochloric acid.

Give **two** variables that the student should control.

1 ....................................................................................................................

2 ....................................................................................................................

**(2)**

(b)     (i)      The rate of reaction increased as the concentration of hydrochloric acid increased.

Explain why.

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 **(2)**

(ii)     Explain why increasing the temperature would increase the rate of reaction.

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 **(3)**

**(Total 7 marks)**

**This question is about pressure and rates:**

(a)     The figure below represents the reaction of sulfur dioxide with oxygen.

Oxygen
Sulfur dioxide Sulfur trioxide

(i)      Complete the word equation for the reaction of sulfur dioxide with oxygen.

sulfur dioxide    +    ...................................        ...................................

**(1)**

(ii)     Draw a ring around the correct answer to complete the sentence.

|  |  |  |
| --- | --- | --- |
|  | Sulfur dioxide (SO2) is | a compound.an element.a mixture. |

**(1)**

(b)     The reactants are gases.

When the pressure of the gases is increased, the reaction gets faster.

Complete the sentence.

When the pressure of the gases is increased, the frequency of the collisions ...................................................................... .

**(1)**

(c)     The particles need energy to react.

Complete the sentence.

The minimum amount of energy that particles need to react is called

the ...................................................................... energy.

**(1)**

(d)     Give **one** way of increasing the rate of the reaction other than changing the pressure.

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**(1)**

**(Total 5 marks)**

**This question is about surface area and rates:**

Calcium carbonate reacts with nitric acid to produce carbon dioxide.

CaCO3  +  2HNO3   →   Ca(NO3)2  +  H2O  +  CO2

          A 10 g lump of calcium carbonate was reacted with 20 cm3of dilute nitric acid. When the reaction was finished, some of the calcium carbonate was left unreacted. The graph shows the volume of carbon dioxide made in each minute for sixteen minutes.



(a)     The volume of carbon dioxide made in each minute decreases until it remains steady
at 83 cm3.
Explain why.

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**(2)**

(b)     Draw a graph line, on the axes above, for an experiment where 20 cm3 of the same dilute nitric acid was reacted with 10 g of **powdered** calcium carbonate.

**(2)**

(c)     Give **one** way of changing the rate of this reaction (other than using powdered calcium carbonate).

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**(1)**

**(Total 5 marks)**

|  |  |  |
| --- | --- | --- |
|  |  |  |

**Post-Revision**

**Multiple Choice Questions**

**Rate and extent of chemical change**

|  |
| --- |
| **INSTRUCTIONS Score: /20** |

* **Read the question carefully.**
* **Circle the correct letter.**
* **Combined science – Answer Q1 – 10 ONLY**
* **Separate Chemistry - Answer all questions.**

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| 1. | The rate of a reaction can be measured by: |
|  | a. | Measuring the mass of the reactants or the volume of the gas produced.  |
|  | b. | Measuring the mass of the products. |
|  | c. | Measuring the volume of the reactants. |
|  | d. | Measuring the volume of the reactants and the mass of the products. |
| 2. | The factors affecting the rate of a reaction are: |
|  | a. | Temperature, concentration, surface area and using a catalyst.  |
|  | b. | Temperature, volume used, surface area and concentration. |
|  | c. | Concentration, mass, volume and surface area.  |
|  | d. | Surface area, temperature and using a catalyst.  |
| 3. | Increasing the temperature of the reaction: |
|  | a. | Has no effect.  |
|  | b. | Increases the amount of product formed. |
|  | c. | Increases the rate of the reaction.  |
|  | d. | Decreases the rate of the reaction.  |
| 4. | Increasing the volume of the reactant: |
|  | a. | Has no effect.  |
|  | b. | Increases the amount of product formed. |
|  | c. | Increases the rate of the reaction.  |
|  | d. | Decreases the rate of the reaction.  |
| 5. | Increasing the concentration of the reaction: |
|  | a. | Has no effect.  |
|  | b. | Increases the amount of product formed. |
|  | c. | Increases the rate of the reaction.  |
|  | d. | Decreases the rate of the reaction.  |
| 6. | Increasing the surface area of the reaction means: |
|  | a. | Using a large lump rather than a powder.  |
|  | b. | Using a powder rather than a large lump.  |
|  | c. | Using small chips rather than powder. |
|  | d. | That all particles come into contact with the reactant at the same time. |
| 7. | Increasing the surface area of the reaction: |
|  | a. | Has no effect.  |
|  | b. | Increases the amount of product formed. |
|  | c. | Increases the rate of the reaction.  |
|  | d. | Decreases the rate of the reaction.  |
| 8.  | Using a catalyst for a reaction: |
|  | 1. Has no effect.
 |
|  | 1. Increases the amount of the product formed.
 |
|  | 1. Decreases the rate of the reaction.
 |
|  | 1. Increases the rate of the reaction.
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| 9. | Using a catalyst: |
|  | a. | Provides an alternative pathway with a higher activation energy requirement.  |
|  | b. | Provides an alternative pathway with less reactants.  |
|  | c. | Provides an alternative pathway with a lower activation energy requirement. |
|  | d. | Provides an alternative pathway with more products.  |
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| 10. | Increasing the surface area gives: |
|  | a. | A smaller surface area to volume ratio. |
|  | b. | A larger volume for the particles to react with. |
|  | c. | No real difference in the volume. |
|  | d. | A larger surface area to volume ratio. |
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| 11. | In order for a reaction to occur: |
|  | a. | Particles must collide. |
|  | b. | Particles must collide with the correct activation energy. |
|  | c. | Particles need to have the correct activation energy. |
|  | d. | Particle must collide with more than the activation energy. |
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| 12. | The catalyst for the decomposition of hydrogen peroxide is: |
|  | a. | Copper oxide. |
|  | b. | Magnesium oxide. |
|  | c. | Manganese oxide. |
|  | d. | Kidney. |
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| 13. | Increasing the temperature affects the rate of the reaction because: |
|  | a. | Particles have more energy and collide more. |
|  | b. | Particles have more energy and move faster. |
|  | c. | Particles have more energy and have more successful collisions. |
|  | d. | Particles have more energy and move quicker to escape the solution. |
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| 14. | Increasing the pressure affects the rate of the reaction because: |
|  | a. | The particles are closer together so collide more successfully. |
|  | b. | The particles have more energy so collide more successfully.  |
|  | c. | The particles move more quickly so collide more successfully.  |
|  | d. | The particles collide more with the surface of the container. |
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| 15. | A dynamic equilibrium is: |
|  | a. | When there is a forward and a backward reaction in the same container.  |
|  | b. | When the rate of the forward and the backward reactions are equal. |
|  | c. | When the products are removed to ensure the forward reaction is the quickest.  |
|  | d. | When the backward reaction is endothermic.  |
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| 16. | In a dynamic equilibrium, when the forward reaction is exothermic, increasing the temperature will: |
|  | a. | Increase the rate the products are made.  |
|  | b. | Decrease the rate that the products are made.  |
|  | c. | Have no effect.  |
|  | d. | Increase the amount of product made. |
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| 17. | In a dynamic equilibrium, increasing the pressure will favour: |
|  | a. | The reaction with more products. |
|  | b. | Neither side of the reaction. |
|  | c. | The reaction with fewer products. |
|  | d. | The quicker rate. |
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| 18. | In making ammonia, the forward reaction is exothermic, so 450°C used because: |
|  | a. | It is a high temperature so the reaction will occur quicker. |
|  | b. | It is compromise as the forward reaction prefers a low temperature. |
|  | c. | It is a compromise as the forward reaction prefers a high temperature. |
|  | d. | It is easy to maintain.  |
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| 19. | Using a higher pressure favours the forward reaction but only 200atm is used because: |
|  | a. | It is high enough for the reaction to occur.  |
|  | b. | It is a safe pressure to maintain.  |
|  | c. | It is too labour intensive at higher pressures.  |
|  | d. | It is 2x the natural atmospheric pressure. |
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| 20. | A biological catalyst is known as: |
|  | a. | An enzyme. |
|  | b. | A protein. |
|  | c. | A type pf washing powder. |
|  | d. | Mitochondria.  |

**Student Checklist and RAG Sheet**

**Rate and extent of chemical change**

**Read each statement below and colour the box that best describes your current understanding.**

**(R – red: low understanding, A – amber: some understanding, G - green: good understanding)**

**Combined and Separate Chemistry**

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| **Checklist statement** | **R** | **A** | **G** |
|  Calculate the rate of a chemical reaction over time, using either the quantity of reactant used or the quantity of product formed, measured in g/s, cm3/s or mol/s |  |  |  |
|  Draw and interpret graphs showing the quantity of product formed or reactant used up against time and use the tangent to the graph as a measure of the rate of reaction |  |  |  |
|  **HT ONLY: Calculate the gradient of a tangent to the curve on the graph of the quantity of product formed or reactant used against time and use this as a measure of the rate of reaction**  |  |  |  |
|  Describe how different factors affect the rate of a chemical reaction, including the concentration, pressure, surface area, temperature and presence of catalysts |  |  |  |
|  ***Required practical 5 (Chemistry only) or 11(Combined Science):*** *investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced, change in colour or turbidity* |  |  |  |
|  Use collision theory to explain changes in the rate of reaction, including discussing activation energy |  |  |  |
|  Describe the role of a catalyst in a chemical reaction and state that enzymes are catalysts in biological systems |  |  |  |
|  Draw and interpret reaction profiles for catalysed reactions |  |  |  |
|  Explain what a reversible reaction is, including how the direction can be changed and represent it using symbols: A + B ⇌ C + D |  |  |  |
|  Explain that, for reversible reactions, if a reaction is endothermic in one direction, it is exothermic in the other direction |  |  |  |
|  Describe the State of dynamic equilibrium of a reaction as the point when the forward and reverse reactions occur at exactly the same rate |  |  |  |
|  **HT ONLY: Explain that the position of equilibrium depends on the conditions of the reaction and the equilibrium will change to counteract any changes to conditions** |  |  |  |
| **HT ONLY: Explain and predict the effect of a change in concentration of reactants or products, temperature, or pressure of gases on the equilibrium position of a reaction** |  |  |  |