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**GCSE Combined Science**

**Student Revision Booklet**

**Chemical changes**

**Contents:**

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

**Student Checklist and RAG Sheet**

**Chemical Changes**

**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)**

**GCSE Chemistry**

**Reactivity of metals**

|  |  |  |  |
| --- | --- | --- | --- |
| **Checklist statement:**  | **R** | **A** | **G** |
| Describe how metals react with oxygen and state the compound they form, define oxidation and reduction |  |  |  |
|  Describe the arrangement of metals in the reactivity series, including carbon and hydrogen, and use the reactivity series to predict the outcome of displacement reactions |  |  |  |
|  Recall and describe the reactions, if any, of potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper with water or dilute acids |  |  |  |
|  Relate the reactivity of metals to its tendency to form positive ions and be able to deduce an order of reactivity of metals based on experimental results |  |  |  |
|  Recall what native metals are and explain how metals can be extracted from the compounds in which they are found in nature by reduction with carbon |  |  |  |
|  Evaluate specific metal extraction processes when given appropriate information and identify which species are oxidised or reduced |  |  |  |

**Reactions of acids**

|  |  |  |  |
| --- | --- | --- | --- |
| **Checklist statement:**  | **R** | **A** | **G** |
|  **HT ONLY: Describe oxidation and reduction in terms of loss and gain of electrons** |  |  |  |
|  **HT ONLY: Write ionic equations for displacement reactions, and identify which species are oxidised and reduced from a symbol or half equation** |  |  |  |
|  **HT ONLY: Explain in terms of gain or loss of electrons that the reactions between acids and some metals are redox reactions, and identify which species are oxidised and which are reduced (Mg,Zn, Fe + HCl & H2SO4)** |  |  |  |
|  Explain that acids can be neutralised by alkalis, bases and metal carbonates and list the products of each of these reactions |  |  |  |
|  Predict the salt produced in a neutralisation reaction based on the acid used and the positive ions in the base, alkali or carbonate and use the formulae of common ions to deduce the formulae of the salt |  |  |  |
|  Describe how soluble salts can be made from acids and how pure, dry samples of salts can be obtained |  |  |  |
|  ***Required practical 8:*** *preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution* |  |  |  |
|  Recall what the pH scale measures and describe the scale used to identify acidic, neutral or alkaline solutions |  |  |  |
|  Define the terms acid and alkali in terms of production of hydrogen ions or hydroxide ions (in solution), defiine the term base |  |  |  |
|  Describe the use of universal indicator to measure the approximate pH of a solution and use the pH scale to identify acidic or alkaline solutions |  |  |  |
|  **HT ONLY: Use and explain the terms dilute and concentrated (in terms of amount of substance) and weak and strong (in terms of the degree of ionisation) in relation to acids** |  |  |  |
|  **HT ONLY: Explain how the concentration of an aqueous solution and the strength of an acid affects the pH of the solution and how pH is related to the hydrogen ion concentration of a solution** |  |  |  |

**Electrolysis**

|  |  |  |  |
| --- | --- | --- | --- |
| **Checklist statement:**  | **R** | **A** | **G** |
|  Describe how ionic compounds can conduct electricity when dissolved in water and describe these solutions as electrolytes |  |  |  |
|  Describe the process of electrolysis |  |  |  |
|  Describe the electrolysis of molten ionic compounds and predict the products at each electrode of the electrolysis of binary ionic compounds |  |  |  |
|  Explain how metals are extracted from molten compounds using electrolysis and use the reactivity series to explain why some metals are extracted with electrolysis instead of carbon |  |  |  |
|  Describe the electrolysis of aqueous solutions and predict the products of the electrolysis of aqueous solutions containing single ionic compounds |  |  |  |
|  ***Required practical 9:*** *investigate what happens when aqueous solutions are electrolysed using inert electrodes* |  |  |  |
|  **HT ONLY: Describe the reactions at the electrodes during electrolysis as oxidation and reduction reactions and write balanced half equations for these reactions** |  |  |  |

**Pre-Revision Multiple Choice Questions**

**Multiple Choice Questions**

**GCSE Combined Science – Chemical changes**

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| **INSTRUCTIONS Score: /20** |

* **Read the question carefully.**
* **Circle the correct letter.**
* **Answer all questions.**

|  |  |
| --- | --- |
| 1. | The element lithium has the chemical symbol: |
|  | a. | L |
|  | b. | LI |
|  | c. | Li |
|  | d. | Lu |
| 2. | Methane has one carbon atom and four hydrogen atoms, so the chemical formula is:  |
|  | a. | CH4 |
|  | b. | C4H |
|  | c. | CH |
|  | d. | C4H4 |
| 3. | The balanced symbol equation for sodium reacting with chlorine is:  |
|  | a. | 2Na + Cl2 →2NaCl2 |
|  | b. | Na + Cl2 →NaCl2 |
|  | c. | 2Na + Cl2 →NaCl2 |
|  | d. | 2Na + Cl2 →2NaCl |
| 4. | When oxygen reacts the half equation is: |
|  | a. | O2 →2O2- + 2e- |
|  | b. | O2 →2O2- + 4e- |
|  | c. | O2 →O2- + 4e- |
|  | d. | O2 → O2- + 2e- |
| 5. | The chemical formula for magnesium chloride is, as the ions are Mg2+ and Cl-: |
|  | a. | MgCl2 |
|  | b. | Mg2Cl |
|  | c. | MgCl |
|  | d. | Mg2Cl2 |
| 6. | The test for hydrogen gas is: |
|  | a. | Limewater goes cloudy.  |
|  | b. | Relights a glowing splint.  |
|  | c. | Bleaches litmus paper. |
|  | d. | Squeaky pop test. |
| 7. | The test for carbon dioxide is: |
|  | a. | Limewater goes cloudy.  |
|  | b. | Relights a glowing splint.  |
|  | c. | Bleaches litmus paper. |
|  | d. | Squeaky pop test. |
| 8.  | Copper carbonate reacts with hydrochloric acid to produce: |
|  | 1. Copper chloride and carbon dioxide.
 |
|  | 1. Copper carbonate and carbon dioxide.
 |
|  | 1. Copper chloride and hydrogen.
 |
|  | 1. Copper carbonate and hydrogen.
 |
|  |  |
| 9. | Acids dissolve in water to produce: |
|  | a. | OH- |
|  | b. | H+ |
|  | c. | H- |
|  | d. | OH+ |
|  |  |
| 10. | Alkalis dissolve in water to produce: |
|  | a. | OH- |
|  | b. | H+ |
|  | c. | H- |
|  | d. | OH+ |
|  |  |  |
| 11. | The general neutralisation equation is: |
|  | a. | Acid + Alkali → Salt + Hydrogen  |
|  | b. | Acid + Alkali → Salt + Water |
|  | c. | Acid + Alkali → Hydroxide + Water |
|  | d. | Acid + Alkali → Hydroxide + Hydrogen |
|  |  |
| 12. | The general ionic equation for neutralisation is: |
|  | a. | H + OH →H2O |
|  | b. | H- + OH- →H2O |
|  | c. | H+ + OH- →H2O |
|  | d. | H+ + OH- →2H2O |
|  |  |
| 13. | When a metal reacts it forms: |
|  | a. | A positive ion. |
|  | b. | An atom. |
|  | c. | A negative ion. |
|  | d. | A covalent bond. |
|  |  |
| 14. | A concentrated solution of acid contains: |
|  | a. | Fully ionised hydrogen ions.  |
|  | b. | Partially ionised ions.  |
|  | c. | Fully ionised hydroxide ions.  |
|  | d. | Partially ionised hydroxide ions. |
|  |  |
| 15. | When molten lead bromide undergoes electrolysis the products are:  |
|  | a. | Lead and bromide.  |
|  | b. | Lead and oxygen. |
|  | c. | Lead and bromine.  |
|  | d. | Lead and water.  |
|  |  |
| 16. | Reduction reactions are: |
|  | a. | The losing of electrons.  |
|  | b. | The gaining of oxygen.  |
|  | c. | The gaining of electrons.  |
|  | d. | The losing of ions. |
|  |  |
| 17. | The opposite reaction of reduction is: |
|  | a. | Oxidation. |
|  | b. | Oxygenation.  |
|  | c. | Gaining.  |
|  | d. | neutralisation.  |
|  |  |
| 18. | In Fe2O3 the iron is: |
|  | a. | Oxidised. |
|  | b. | Reduced.  |
|  | c. | Neutralised.  |
|  | d. | Combusted.  |
|  |  |
| 19. | During electrolysis, non-metals go to the: |
|  | a. | Cathode.  |
|  | b. | Electrolyte.  |
|  | c. | Solution.  |
|  | d. | Anode. |
|  |  |
| 20. | Non-metals go to this electrode as they are: |
|  | a. | Positively charged.  |
|  | b. | Neutral. |
|  | c. | Negatively charged. |
|  | d. | Larger.  |
|  |  |

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

**GCSE Combined Science – Chemical changes**

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| **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 conservation of mass, including a balanced symbol equation.** |
| **Sources:** | **Website –** 1. <https://www.youtube.com/watch?v=0IIJ4IglmK8>
2. [http://www.bbc.co.uk/schools/gcsebitesize/science/edexcel/materials\_from\_earth/conservation\_of\_massrev1.shtmlistryrev1.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_gateway/chemical_economics/nanochemistryrev1.shtml)
 |
| 1. **The elements reacting need to be represented in the products.**
2. **The mass of the reactants equals the mass of the products.**
3. **2Zn + 2HCl →ZnCl2 + H2.**
4. **During a reaction no elements are created or destroyed.**
5. **The products have different properties to the reactants.**
 |
| **mass** | **equal** | **created** | **destroyed** | **atoms** |

|  |  |
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| **QUESTION 1:** | **Explain the electrolysis of lead bromide.**  |
| **Sources:** | **Website –** 1. <http://www.gcsescience.com/ex5.htm>
2. <https://www.youtube.com/watch?v=4x2ZCSr23Z8>
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| **QUESTION 2:** | **Identify the common tests for chlorine, oxygen, carbon dioxide and hydrogen.**  |
| **Sources:** | **Website –** 1. <http://www.bbc.co.uk/schools/gcsebitesize/science/edexcel_pre_2011/chemicalreactions/preparinggasesrev4.shtml>
2. <https://www.youtube.com/watch?v=LiAvDpl5aJA>
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| **QUESTION 3:** | **Describe the neutralization of sodium hydroxide and hydrochloric acid, include a balanced symbol equation.** |
| **Sources:** | **Website –** 1. <http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_21c/chemical_synthesis/whychemicalsrev10.shtml>
2. <http://www.gcsescience.com/aa27.htm>
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| **QUESTION 4:** | **Explain redox reactions.** |
| **Sources:** | **Website –** 1. <http://www.bbc.co.uk/bitesize/higher/chemistry/reactions/redox/revision/1/>

 1. <http://www.s-cool.co.uk/a-level/chemistry/electrochemistry/revise-it/redox-reactions>
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| **QUESTION 5:** | **Describe how the pH is used to measure the acidity of substances and what makes them acidic.** |
| **Sources:** | **Website –** 1. [http://www.bbc.co.uk/schools/gcsebitesize/science/add\_ocr\_pre\_2011/chemical\_synthesis/acidsalkalisrev2.shtml](https://www.thoughtco.com/metals-versus-nonmetals-608809)
2. <https://www.sciencebuddies.org/science-fair-projects/references/acids-bases-the-ph-scale>
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| **QUESTION 6:** | Describe the arrangement of metals in the reactivity series, including carbon and hydrogen, and explain how the reactivity series is used to predict the outcome of displacement reactions |
| **Sources:** | **Website –** 1. [https://www.google.co.uk/search?q=reactivity+series+of+metals&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiCpt\_W18TaAhVRGsAKHduXC\_AQ\_AUICigB&biw=1366&bih=673#imgrc=4kWu8vBLJOmZFM:&spf=1524084395711](https://www.google.co.uk/search?q=reactivity+series+of+metals&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiCpt_W18TaAhVRGsAKHduXC_AQ_AUICigB&biw=1366&bih=673%23imgrc=4kWu8vBLJOmZFM:&spf=1524084395711%20)
2. <http://www.bbc.co.uk/bitesize/standard/chemistry/metals/reactivity/revision/5/>
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| **QUESTION 7:** | **Required practical 8:** describe how to prepare a dry sample of the salt copper chloride, include a balanced symbol equation to show the reactants and all products formed |
| **Sources:** | **Website –** 1. <https://www.bbc.com/education/guides/zptrd2p/revision/3>
2. <https://www.youtube.com/watch?v=9GH95172Js8>
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| **QUESTION 8:** | **Describe how you would predict the products of electrolysis for a molten ionic compound and a solution containing an ionic compound (a summary table may help)** |
| **Sources:** | **Website –** 1. <http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/ions/electrolysisrev2.shtml>
2. <https://www.bbc.com/education/guides/zk96fg8/revision/2>
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**Chemical Changes**

**Exam Practice**

**Question 1:**

A student investigated displacement reactions of metals.

The student added different metals to copper sulfate solution and measured the temperature change.

The more reactive the metal is compared with copper, the bigger the temperature change.

The apparatus the student used is shown in **Figure 1**.

**Figure 1**



(a)     State **three** variables that the student must control to make his investigation a fair test.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

(b)     **Figure 2** shows the thermometer in one experiment before and after the student added a metal to the copper sulfate solution.

**Figure 2**

|  |  |
| --- | --- |
| **Before adding metal** | **After adding metal** |



Use **Figure 2** to complete **Table 1**.

**Table 1**

|  |  |
| --- | --- |
| Temperature before adding metal in °C | \_\_\_\_\_\_\_\_ |
| Temperature after adding metal in °C | \_\_\_\_\_\_\_\_ |
| Change in temperature in °C | \_\_\_\_\_\_\_\_ |

**(3)**

(c)     The student repeated the experiment three times with each metal.

**Table 2** shows the mean temperature change for each metal.

**Table 2**

|  |  |
| --- | --- |
| **Metal** | **Mean temperature change in °C** |
| Cobalt | 4.5 |
| Gold | 0.0 |
| Magnesium | 10.0 |
| Nickel | 3.0 |
| Silver | 0.0 |
| Tin | 1.5 |

(i)      On **Figure 3**, draw a bar chart to show the results.

**Figure 3**

 **(3)**

(ii)     Why is a line graph **not** a suitable way of showing the results?

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**(1)**

(iii)    Use the results to work out which metal is the most reactive.

Give a reason for your answer.

Most reactive metal \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Reason \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

(iv)    Explain why there was no temperature change when silver metal was added to the copper sulfate solution.

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**(2)**

(v)     It is **not** possible to put all six metals in order of reactivity using these results.

Suggest how you could change the experiment to be able to put all six metals into order of reactivity.

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**(2)**

**(Total 16 marks)**

Question 2:

A student investigated the reactions of copper carbonate and copper oxide with dilute hydrochloric acid.

In both reactions one of the products is copper chloride.

(a)     Describe how a sample of copper chloride crystals could be made from copper carbonate and dilute hydrochloric acid.

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(4)

Question 3:

Sodium hydroxide neutralises sulfuric acid.

The equation for the reaction is:

                 2NaOH + H2SO4  →  Na2SO4 + 2H2O

(a)     Sulfuric acid is a strong acid.

What is meant by a strong acid?

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(2)

(b)     Write the ionic equation for this neutralisation reaction. Include state symbols.

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(2)

Question 4:

 Magnesium chloride can be electrolysed.

The diagram below shows two experiments for electrolysing magnesium chloride.



(i)      Explain why magnesium chloride must be molten or dissolved in water to be electrolysed.

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(2)

(ii)     Explain how magnesium is produced at the negative electrode in **Experiment 1**.

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(3)

(iii)    In **Experiment 2** a gas is produced at the negative electrode.

Name the gas produced at the negative electrode.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(1)

(iv)    Suggest why magnesium is **not** produced at the negative electrode in **Experiment 2**.

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(1)

(v)     Complete and balance the half equation for the reaction at the positive electrode.

\_\_\_\_\_ Cl⁻       →       Cl2       +       \_\_\_\_\_

(1)

Question 5:

Sodium hydroxide neutralises sulfuric acid.

The equation for the reaction is:

                 2NaOH + H2SO4  →  Na2SO4 + 2H2O

(a)     Sulfuric acid is a strong acid.

What is meant by a strong acid?

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**(2)**

(b)     Write the ionic equation for this neutralisation reaction. Include state symbols.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

 **(Total 4 marks)**

**Post-Revision Multiple Choice Questions**

**Multiple Choice Questions**

**GCSE Combined Science – Chemical changes**

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

* **Read the question carefully.**
* **Circle the correct letter.**
* **Answer all questions.**

|  |  |
| --- | --- |
| 1. | The element lithium has the chemical symbol: |
|  | a. | L |
|  | b. | LI |
|  | c. | Li |
|  | d. | Lu |
| 2. | Methane has one carbon atom and four hydrogen atoms, so the chemical formula is:  |
|  | a. | CH4 |
|  | b. | C4H |
|  | c. | CH |
|  | d. | C4H4 |
| 3. | The balanced symbol equation for sodium reacting with chlorine is:  |
|  | a. | 2Na + Cl2 →2NaCl2 |
|  | b. | Na + Cl2 →NaCl2 |
|  | c. | 2Na + Cl2 →NaCl2 |
|  | d. | 2Na + Cl2 →2NaCl |
| 4. | When oxygen reacts the half equation is: |
|  | a. | O2 →2O2- + 2e- |
|  | b. | O2 →2O2- + 4e- |
|  | c. | O2 →O2- + 4e- |
|  | d. | O2 → O2- + 2e- |
| 5. | The chemical formula for magnesium chloride is, as the ions are Mg2+ and Cl-: |
|  | a. | MgCl2 |
|  | b. | Mg2Cl |
|  | c. | MgCl |
|  | d. | Mg2Cl2 |
| 6. | The test for hydrogen gas is: |
|  | a. | Limewater goes cloudy.  |
|  | b. | Relights a glowing splint.  |
|  | c. | Bleaches litmus paper. |
|  | d. | Squeaky pop test. |
| 7. | The test for carbon dioxide is: |
|  | a. | Limewater goes cloudy.  |
|  | b. | Relights a glowing splint.  |
|  | c. | Bleaches litmus paper. |
|  | d. | Squeaky pop test. |
| 8.  | Copper carbonate reacts with hydrochloric acid to produce: |
|  | 1. Copper chloride and carbon dioxide.
 |
|  | 1. Copper carbonate and carbon dioxide.
 |
|  | 1. Copper chloride and hydrogen.
 |
|  | 1. Copper carbonate and hydrogen.
 |
|  |  |
| 9. | Acids dissolve in water to produce: |
|  | a. | OH- |
|  | b. | H+ |
|  | c. | H- |
|  | d. | OH+ |
|  |  |
| 10. | Alkalis dissolve in water to produce: |
|  | a. | OH- |
|  | b. | H+ |
|  | c. | H- |
|  | d. | OH+ |
|  |  |  |
| 11. | The general neutralisation equation is: |
|  | a. | Acid + Alkali → Salt + Hydrogen  |
|  | b. | Acid + Alkali → Salt + Water |
|  | c. | Acid + Alkali → Hydroxide + Water |
|  | d. | Acid + Alkali → Hydroxide + Hydrogen |
|  |  |
| 12. | The general ionic equation for neutralisation is: |
|  | a. | H + OH →H2O |
|  | b. | H- + OH- →H2O |
|  | c. | H+ + OH- →H2O |
|  | d. | H+ + OH- →2H2O |
|  |  |
| 13. | When a metal reacts it forms: |
|  | a. | A positive ion. |
|  | b. | An atom. |
|  | c. | A negative ion. |
|  | d. | A covalent bond. |
|  |  |
| 14. | A concentrated solution of acid contains: |
|  | a. | Fully ionised hydrogen ions.  |
|  | b. | Partially ionised ions.  |
|  | c. | Fully ionised hydroxide ions.  |
|  | d. | Partially ionised hydroxide ions. |
|  |  |
| 15. | When molten lead bromide undergoes electrolysis the products are:  |
|  | a. | Lead and bromide.  |
|  | b. | Lead and oxygen. |
|  | c. | Lead and bromine.  |
|  | d. | Lead and water.  |
|  |  |
| 16. | Reduction reactions are: |
|  | a. | The losing of electrons.  |
|  | b. | The gaining of oxygen.  |
|  | c. | The gaining of electrons.  |
|  | d. | The losing of ions. |
|  |  |
| 17. | The opposite reaction of reduction is: |
|  | a. | Oxidation. |
|  | b. | Oxygenation.  |
|  | c. | Gaining.  |
|  | d. | neutralisation.  |
|  |  |
| 18. | In Fe2O3 the iron is: |
|  | a. | Oxidised. |
|  | b. | Reduced.  |
|  | c. | Neutralised.  |
|  | d. | Combusted.  |
|  |  |
| 19. | During electrolysis, non-metals go to the: |
|  | a. | Cathode.  |
|  | b. | Electrolyte.  |
|  | c. | Solution.  |
|  | d. | Anode. |
|  |  |
| 20. | Non-metals go to this electrode as they are: |
|  | a. | Positively charged.  |
|  | b. | Neutral. |
|  | c. | Negatively charged. |
|  | d. | Larger.  |