2.14 Reactivity, Acids and Salts: Test Pack

AQA 8464 · Calculator allowed · about 35 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 This question checks three key terms used throughout this topic.

(a) Define an 'acid', in terms of the ions it produces in aqueous solution. **(1)**

(b) Define an 'alkali', in terms of the ions it produces in aqueous solution. **(1)**

(c) Define a 'salt'. **(1)**

(Total for Question 1 is 3 marks)

2 An iron nail is placed into a test tube of blue copper sulfate solution and left for several minutes.

(a) Describe two observations you would expect to make. **(2)**

(b) Write the balanced symbol equation for the reaction taking place. **(2)**

(c) State, in terms of electrons, what happens to (i) the iron atoms and (ii) the copper ions during this reaction. **(2)**

(Total for Question 2 is 6 marks)

© Revision Library | revisionlibrary.co.uk

3 When magnesium is heated with copper oxide, a reaction occurs: Mg + CuO -> MgO + Cu.

(a) State, in terms of oxygen, which substance is oxidised and which is reduced in this reaction. **(2)**

(b) Write the balanced half equation for the oxidation of magnesium in this reaction. **(2)**

(Total for Question 3 is 4 marks)

---

4 Sulfuric acid is exactly neutralised by sodium hydroxide according to the equation: H_2SO_4 + 2NaOH -> Na_2SO_4 + $2H_2O$. Relative formula masses: H_2SO_4 = 98, NaOH = 40. 4.9 g of sulfuric acid is used.

(a) Calculate the number of moles of sulfuric acid in 4.9 g. **(1)**

.....

(b) Use the balanced equation and your answer to (a) to calculate the mass of sodium hydroxide needed to exactly neutralise this sulfuric acid. **(3)**

.....

(Total for Question 4 is 4 marks)

© Revision Library | revisionlibrary.co.uk

5 The table shows the pH of five solutions.

Solution 1: pH 1
Solution 2: pH 4
Solution 3: pH 7
Solution 4: pH 10
Solution 5: pH 13

For every whole pH unit decrease, the hydrogen ion concentration increases by a factor of 10.

(a) Higher tier only. Calculate how many times greater the hydrogen ion concentration of Solution 1 (pH 1) is compared with Solution 2 (pH 4). **(2)**

.....

(b) State whether Solution 5 (pH 13) is acidic, neutral or alkaline, and name the ion that is in excess in this solution. **(2)**

(Total for Question 5 is 4 marks)

---

6 Nitric acid and methanoic acid are both acids, at the same concentration (0.50 mol/dm3). Nitric acid is a strong acid; methanoic acid is a weak acid. Equal volumes of each acid are reacted separately with excess powdered calcium carbonate, and the volume of carbon dioxide gas produced in the first 15 seconds is measured.

(a) Higher tier only. Predict which acid would produce the greater volume of gas in the first 15 seconds, and explain your answer in terms of ion concentration. **(3)**

.....

.....

.....

(b) State whether the total volume of gas produced, once both reactions are fully complete, would be the same or different for the two acids, assuming equal moles of acid are used in each case. **(1)**

(Total for Question 6 is 4 marks)

© Revision Library | revisionlibrary.co.uk

Mark scheme · 2.14 Reactivity, Acids and Salts: Test Pack

Question 1

(a) a substance that releases (forms) hydrogen ions, H^+, when dissolved in water, oe **B1**

(a) Answer: A substance that releases hydrogen ions, H^+, when dissolved in water.

(b) a soluble base that releases (forms) hydroxide ions, OH^-, when dissolved in water, oe **B1**

(b) Answer: A soluble base that releases hydroxide ions, OH^-, when dissolved in water.

(c) a compound formed when the hydrogen ion(s) of an acid are replaced by a metal ion (or ammonium ion), oe **B1**

(c) Answer: A compound formed when the hydrogen ions of an acid are replaced by a metal (or ammonium) ion.

Question 2

(a) the blue colour of the solution fades (becomes paler), oe **B1**

(a) an orange-brown (pinkish-brown) coating of copper forms on the surface of the iron nail, oe **B1**

(a) Answer: The blue solution fades in colour, and an orange-brown coating of copper forms on the nail.

(b) correct formulae: $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$ **M1**

(b) equation is already balanced (1 Fe, 1 Cu, 1 S, 4 O on each side) cao **A1**

(b) Answer: $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

(c) iron atoms lose electrons (are oxidised) to form Fe^{2+} ions, oe **B1**

(c) copper ions gain electrons (are reduced) to form copper atoms, oe **B1**

(c) Answer: Iron atoms lose electrons and are oxidised to Fe^{2+} ions; copper ions gain electrons and are reduced to copper atoms.

Question 3

(a) magnesium is oxidised, because it gains oxygen to form magnesium oxide, oe **B1**

(a) copper oxide is reduced, because it loses oxygen to form copper, oe **B1**

(a) Answer: Magnesium is oxidised (gains oxygen to form MgO); copper oxide is reduced (loses oxygen to form copper).

(b) correct species: $Mg \rightarrow Mg^{2+}$ **M1**

(b) correctly balanced with electrons: $Mg \rightarrow Mg^{2+} + 2e^-$ cao **A1**

(b) Answer: $Mg \rightarrow Mg^{2+} + 2e^-$

Question 4

(a) 0.05 mol (4.9 / 98) cao **B1**

(a) Answer: 0.05 mol

(b) uses the 1:2 mole ratio: moles NaOH = 0.05 x 2 = 0.1 mol, ecf from (a) **M1**

(b) substitutes: mass = 0.1 x 40 **M1**

(b) 4.0 g cao **A1**

(b) Answer: 4.0 g

Question 5

(a) identifies the difference in pH as 3 units **B1**

(a) 1000 times greater (10 x 10 x 10), cao **B1**

(a) Answer: 1000 times greater

(b) alkaline **B1**

(b) hydroxide ions, OH^-, cao **B1**

(b) Answer: Alkaline; hydroxide ions (OH^-) are in excess.

Question 6

(a) predicts nitric acid produces more gas in the first 15 seconds (a faster initial rate), oe **M1**

(a) explains that nitric acid, as a strong acid, fully ionises (dissociates) in water, producing a higher concentration of H^+ ions than the same concentration of the weak methanoic acid, which only partially ionises, oe **M1**

(a) the higher concentration of H^+ ions in the nitric acid causes more frequent successful collisions with the calcium carbonate per second, increasing the initial rate of reaction, oe **A1**

(a) Answer: Nitric acid produces more gas in the first 15 seconds, because as a strong acid it fully ionises, giving a higher H^+ ion concentration than the partially-ionised methanoic acid, so collisions with the calcium carbonate are more frequent.

(b) the same total volume, because the total amount of gas produced depends on the total number of moles of acid (H^+ ions) available overall, not on how quickly the acid ionises, oe **B1**

(b) Answer: The same total volume, because the total gas produced depends on the total moles of acid available, not on how fast it ionises.

© Revision Library | revisionlibrary.co.uk