2.4 Acids and Alkalis: Test Pack

Calculator allowed · about 40 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Give the name for a substance that has a pH less than 7.

(1)

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2 Design a fair test to compare how quickly two different antacid liquids neutralise stomach acid. You will use 10 cm^3 of simulated stomach acid (dilute hydrochloric acid, same concentration for both tests) and add 10 cm^3 of antacid A or 10 cm^3 of antacid B.

(a) Suggest one dependent variable to measure. **(1)**

(b) Give two control variables to keep the same. **(2)**

(c) Suggest one practical improvement to reduce random error. **(1)**

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3 A chemist measures how the pH of a solution changes as 0.1 mol/dm^3 sodium hydroxide is added to 15.0 cm^3 of 0.1 mol/dm^3 hydrochloric acid. The chemist records the following data for volume of sodium hydroxide added and pH.
Volume NaOH added (cm3): 0, 5, 10, 15, 20, 25, 30
pH: 1.0, 1.5, 2.8, 7.0, 11.2, 12.0, 13.0

(a) A student plots pH against volume of sodium hydroxide added and draws a smooth curve. Describe what happens to the pH as the sodium hydroxide is added from 0 to 30 cm^3. **(3)**

(b) Estimate the volume of sodium hydroxide at the equivalence point (where acid is neutralised). Explain how you decided. **(2)**

(c) Give one possible reason for why the pH changes rapidly between two particular points on the table and name the pair of volumes between which this rapid change happens. **(3)**

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4 Write a simple word equation for the reaction between hydrochloric acid and magnesium ribbon.

(2)

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5 In a titration, 20.0 cm^3 of a dilute hydrochloric acid exactly neutralises 25.0 cm^3 of a dilute sodium hydroxide solution (so the ratio needed for exact neutralisation is 20.0 cm^3 acid : 25.0 cm^3 alkali). A student instead mixes 30.0 cm^3 of the same hydrochloric acid with 30.0 cm^3 of the same sodium hydroxide solution.

(a) Show that this mixture is not exactly neutralised. State whether it contains excess acid or excess alkali, giving your reasoning. **(3)**

(b) Calculate the extra volume of the sodium hydroxide solution that must be added to exactly neutralise the mixture, and explain why this works. **(3)**

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6 On the pH scale from 0 to 14, which region is acidic and which region is alkaline?

(1)

7 Name one piece of personal protective equipment (PPE) you should wear when handling concentrated acid in the laboratory.

(1)

8 Which of these pH values shows the most strongly alkaline solution?

- ☐ A) 1
- ☐ B) 6
- ☐ C) 8
- ☐ D) 13

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9 A technician dissolves 6 g of sodium hydroxide in 3 dm3 of water to make a cleaning solution. Calculate the concentration of the solution in g/dm3.

(2)

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10 Nadia adds a short piece of magnesium ribbon to a test tube of dilute hydrochloric acid. Bubbles of gas form immediately and the magnesium disappears over a few minutes.

(a) Complete the word equation for this reaction: magnesium + hydrochloric acid -> ____ + ____ **(2)**

(b) Describe a test Nadia could use to confirm the identity of the gas produced, including the result she would see. **(1)**

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11 Complete each word equation below by naming the salt formed in the neutralisation reaction.

(a) hydrochloric acid + sodium hydroxide -> ____ + water **(2)**

(b) sulfuric acid + potassium hydroxide -> ____ + water **(2)**

(c) nitric acid + calcium hydroxide -> ____ + water **(2)**

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Mark scheme · 2.4 Acids and Alkalis: Test Pack

Question 1

acid cao — **B1**

Answer: **Acid**

Question 2

(a) time taken to reach pH 7 (or time to reach a chosen pH) cao — **B1**

(a) Answer: **Time taken to reach pH 7**

(b) same volume of simulated stomach acid (10 cm³) cao — **B1**

(b) same concentration of the acid or same volume of antacid used cao — **B1**

(b) Answer: **Keep same volume of acid (10 cm³) and same concentration of acid (and same volume of antacid).**

(c) repeat each test several times and use the mean cao — **B1**

(c) Answer: **Repeat each test several times and use the mean of the results.**

Question 3

(a) pH starts very acidic (around 1) and rises slowly at first — **M1**

(a) pH then rises rapidly through the neutral region — **M1**

(a) after equivalence it becomes strongly alkaline reaching about 13 at 30 cm³ cao — **A1**

(a) Answer: **pH starts very acidic and rises slowly, then increases rapidly around the equivalence point and becomes strongly alkaline after that, reaching about pH 13 by 30 cm³.**

(b) identify that equivalence point is where pH changes rapidly / middle of the steep section — **M1**

(b) estimate 15 cm³ cao with explanation referencing steep change around 10-20 cm³ — **A1**

(b) Answer: **Approximately 15 cm³; this is the middle of the steep rise in pH between about 10 cm³ and 20 cm³ where the pH moves through neutral.**

(c) reason: the acid is being neutralised so a small addition of alkali causes large change in H^+ concentration — **M1**

(c) identify the pair of volumes: between 10 cm³ and 20 cm³ (steep change) — **M1**

(c) link: around the equivalence point buffering is low so pH changes quickly cao — **A1**

(c) Answer: **Because the acid is being neutralised so a small addition of alkali causes a large change in hydrogen ion concentration; this rapid change happens between about 10 cm³ and 20 cm³ (steepest section).**

Question 4

word equation including acid, metal and product salt and hydrogen — **M1**

hydrochloric acid + magnesium -> magnesium chloride + hydrogen cao — **A1**

Answer: **hydrochloric acid + magnesium -> magnesium chloride + hydrogen**

Question 5

(a) calculate the volume of NaOH that would exactly neutralise 30.0 cm³ of the acid, using the ratio 20.0:25.0 — **M1**

(a) 30.0 x (25.0/20.0) = 37.5 cm³ required, compared with the 30.0 cm³ actually added — **M1**

(a) since 30.0 cm³ is less than the 37.5 cm³ needed, there is not enough alkali to neutralise all the acid, so the mixture contains excess (unreacted) acid — **A1**

(a) Answer: **Excess acid - 37.5 cm³ of the alkali would be needed to neutralise 30.0 cm³ of the acid, but only 30.0 cm³ was added, so acid is left unreacted**

(b) extra volume = volume required - volume already added — **M1**

(b) 37.5 - 30.0 = 7.5 cm³ cao — **A1**

(b) explains that adding 7.5 cm³ more brings the total alkali added to 37.5 cm³, matching the volume needed to exactly neutralise the 30.0 cm³ of acid, oe — **B1**

(b) Answer: **7.5 cm³**

Question 6

pH less than 7 is acidic, pH greater than 7 is alkaline; pH 7 is neutral, cao — **B1**

Answer: **pH less than 7 is acidic; pH greater than 7 is alkaline.**

Question 7

e.g. safety goggles (or acid-resistant gloves, lab coat), accept one, oe — **B1**

Answer: **Safety goggles.**

Question 8

D cao — **B1**

Answer: **D) 13**

Question 9

concentration = mass / volume = 6 / 3 — **M1**

2 g/dm3 cao — **A1**

Answer: **2 g/dm3**

Question 10

(a) magnesium chloride — **B1**

(a) hydrogen — **B1**

(a) Answer: **magnesium + hydrochloric acid -> magnesium chloride + hydrogen**

(b) hold a lit/burning splint at the mouth of the test tube; gas burns with a squeaky pop, confirming hydrogen — **B1**

(b) Answer: **Hold a lit splint at the mouth of the test tube. If the gas is hydrogen it burns rapidly with a squeaky pop.**

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Question 11

(a) sodium chloride cao **B1**

(a) equation correctly completed with + water **B1**

(a) Answer: **sodium chloride (+ water)**

(b) potassium sulfate cao **B1**

(b) equation correctly completed with + water **B1**

(b) Answer: **potassium sulfate (+ water)**

(c) calcium nitrate cao **B1**

(c) equation correctly completed with + water **B1**

(c) Answer: **calcium nitrate (+ water)**

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