K9D Acids and Alkalis: Exam Drill

AQA AQA KS3 Science - Chemistry · Calculator allowed · about 75 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)

2 Complete the sentence. An alkali is a base that dissolves in water to produce _____ ions.

(3)

3 Name the indicator that turns red in acid and blue in alkali.

(2)

4 A student tests three liquids with universal indicator and records the colour and inferred pH range. Liquid A: green, pH about 7. Liquid B: orange, pH about 3. Liquid C: purple, pH about 11. State which liquid is acidic, which is neutral, and which is alkaline.

(3)

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

(2)

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6 A teacher asks a class to investigate how pH changes when lemon juice is diluted with water. The teacher gives 10 cm3 of lemon juice to each group and asks them to add different volumes of water. Group 1 adds 0 cm3 water, Group 2 adds 10 cm3 water, Group 3 adds 30 cm3 water, Group 4 adds 90 cm3 water. The students measure pH with a pH meter and get the following mean pH values: Group 1 pH 2.1, Group 2 pH 2.7, Group 3 pH 3.2, Group 4 pH 3.8. Explain whether this is a fair test and suggest one improvement to make it fairer.

(4)

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7 What is the pH value of a neutral solution such as pure water at room temperature?

(1)

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8 A student adds a small amount of sodium hydroxide solution to beaker X containing universal indicator. The indicator colour changes from yellow to green. What does this change tell you about the pH of the solution in beaker X after the addition? Explain briefly.

(3)

9 Magnesium hydroxide is often used as an antacid to neutralise excess stomach acid. A tablet contains 250 mg magnesium hydroxide. Calculate the mass in grams of magnesium hydroxide in one tablet.

(3)

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10 A student performs a titration to find how much 0.1 mol/dm^3 hydrochloric acid is neutralised by sodium hydroxide. They add sodium hydroxide from a burette to 25.0 cm3 of acid with methyl orange indicator and find that the end point occurs after adding 24.5 cm3 of 0.1 mol/dm^3 sodium hydroxide. Using the idea of neutralisation (acid + alkali -> salt + water), evaluate whether the student could improve the accuracy of the titre value and give two suggestions. (This is a levels-of-response question.)

(6)

11 The table below shows universal indicator colours with typical pH values for some common liquids. Use the table and the pH descriptions to answer the questions.
- Lemon juice: pH 2 (red-orange).
- Tomato juice: pH 4 (orange).
- Pure water: pH 7 (green).
- Milk of magnesia (dilute): pH 9 (blue-green).

(a) Which of these is the strongest acid? (b) Which two are alkaline or near alkaline? (c) Suggest why milk of magnesia can be used to treat heartburn. (3 parts, total 4 marks)

(a) Which of these is the strongest acid? **(1)**

(b) Which two are alkaline or near alkaline? **(1)**

(c) Suggest why milk of magnesia can be used to treat heartburn. **(2)**

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12 Design a fair test to compare how quickly two different antacid liquids neutralise stomach acid. You will use 10 cm3 of simulated stomach acid (dilute hydrochloric acid, same concentration for both tests) and add 10 cm3 of antacid A or 10 cm3 of antacid B. Suggest one dependent variable to measure, two control variables to keep the same, and one practical improvement to reduce random error. (4 marks)

(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)**

13 A student adds 5 cm3 of 1.0 mol/dm^3 sodium hydroxide solution to 45 cm3 of universal indicator solution in a beaker and records the pH as 10. They then dilute the mixture by adding 450 cm3 of water and record the pH again. Explain qualitatively whether you expect the pH to increase, decrease or stay the same after dilution and why. (4 marks)

(4)

14 A chemist measures how the pH of a solution changes as 0.1 mol/dm^3 sodium hydroxide is added to 15.0 cm3 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, 5.0, 9.5, 12.0, 13.0

(a) On the grid (not provided here) the student would plot pH against volume added and draw a curve. Describe what happens to the pH as the sodium hydroxide is added from 0 to 30 cm3. (3 marks)

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

(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 marks)

(a) Describe what happens to the pH as the sodium hydroxide is added from 0 to 30 cm3. **(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)**

Mark scheme · K9D Acids and Alkalis: Exam Drill

Question 1

- **B1** acid cao
- Answer: **Acid**

Question 2

- **M1** identify that alkalis produce hydroxide ions or OH-
- **A1** hydroxide ions (OH-) cao
- **B1** accept answer written as OH minus or OH-
- Answer: **hydroxide ions (OH-)**

Question 3

- **M1** identify litmus as the indicator
- **A1** litmus cao
- Answer: **Litmus**

Question 4

- **B1** Liquid B acidic
- **B1** Liquid A neutral
- **B1** Liquid C alkaline
- Answer: **Liquid B acidic; Liquid A neutral; Liquid C alkaline**

Question 5

- **M1** word equation including acid, metal and product salt and hydrogen
- **A1** hydrochloric acid + magnesium -> magnesium chloride + hydrogen cao
- Answer: **hydrochloric acid + magnesium -> magnesium chloride + hydrogen**

Question 6

- **M1** identify something kept same or not kept same (example: same initial lemon juice volume was kept)
- **M1** identify a variable that was not controlled that affects pH reading (example: temperature, different pH meter calibration, contamination)
- **A1** suggest improvement such as use same pH meter calibrated before use or repeat each dilution and take mean
- **A1** brief reason why improvement makes test fairer (reduces systematic or random error)
- Answer: **Not fully fair: initial lemon volume is controlled but temperature and instrument calibration are not; improvement example: calibrate the pH meter and repeat each dilution to take an average, so readings are more reliable**

Question 7

- **B1** 7 cao
- Answer: **7**

Question 8

- **M1** state that green indicates pH about 7 or slightly alkaline
- **A1** pH is around 7 to 8 cao
- **B1** explain that sodium hydroxide is alkaline so it raised the pH from acidic/yellow towards neutral/green
- Answer: **pH about 7 to 8; the sodium hydroxide raised the pH from acidic (yellow) towards neutral so the indicator turned green**

Question 9

- **M1** convert mg to g using 1000 mg = 1 g
- **A1** 0.25 g cao
- **B1** correct unit g stated
- Answer: **0.25 g**

Question 10

- **Level 3** (5-6): Clear evaluation with two appropriate improvements and reasons; uses accurate chemistry idea of end point and repeats to give reliable mean; links suggestions to how accuracy increases.
- **Level 2** (3-4): Some valid suggestions with brief reasons; mentions repeat readings or better indicators but limited explanation of how accuracy improves.
- **Level 1** (1-2): Simple statements about possible improvements with little or no explanation (for example, 'do it again' or 'use a burette carefully').
- **Indicative content:**
  - Repeat titration several times and use the mean of concordant titres to reduce random error.
  - Use a more suitable indicator if methyl orange range is not ideal for the expected pH change, or use a pH meter to detect the equivalence point precisely.
  - Ensure the burette and pipette are rinsed with the solutions before use and the meniscus is read at eye level to reduce systematic error.
  - Carry out a rough titration first to estimate the end point and then perform accurate titres.
  - Record volumes to correct decimal places and ensure consistent technique when swirling and adding near the end point.

Question 11

- (a) **B1** lemon juice cao
- (a) Answer: **Lemon juice**
- (b) **B1** milk of magnesia and pure water (accept milk of magnesia and water as near alkaline)
- (b) Answer: **Milk of magnesia and pure water**
- (c) **M1** state that it is alkaline so neutralises excess stomach acid
- (c) **A1** neutralises acid so reduces acidity and relieves heartburn cao
- (c) Answer: **Because it is alkaline and neutralises excess stomach acid, reducing acidity and so relieving heartburn.**

Question 12

- (a) **B1** time taken to reach pH 7 (or time to reach a chosen pH) cao
- (a) Answer: **Time taken to reach pH 7**
- (b) **B1** same volume of simulated stomach acid (10 cm3) cao
- (b) **B1** same concentration of the acid or same volume of antacid used cao
- (b) Answer: **Keep same volume of acid (10 cm3) and same concentration of acid (and same volume of antacid).**
- (c) **B1** repeat each test several times and use the mean cao
- (c) Answer: **Repeat each test several times and use the mean of the results.**

Question 13

- **M1** state that dilution reduces concentration of hydroxide ions
- **M1** state that pH is related to concentration of H+ or OH- so pH will move towards neutral
- **A1** state direction: pH will decrease towards 7 if solution is alkaline (i.e. pH falls from 10 towards 7) cao
- **A1** brief reason: adding water lowers OH- concentration so solution becomes less alkaline and pH moves closer to 7
- Answer: **pH will decrease (move from 10 towards 7) because dilution lowers the concentration of hydroxide ions so the solution becomes less alkaline.**

Question 14

- (a) **M1** pH starts very acidic (around 1) and rises slowly at first
- (a) **M1** pH then rises rapidly through the neutral region
- (a) **A1** after equivalence it becomes strongly alkaline reaching about 13 at 30 cm3 cao
- (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) **M1** identify that equivalence point is where pH changes rapidly / middle of the steep section
- (b) **A1** estimate 15 cm3 cao with explanation referencing steep change around 10-20 cm3
- (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) **M1** reason: the acid is being neutralised so a small addition of alkali causes large change in H+ concentration
- (c) **M1** identify the pair of volumes: between 10 cm3 and 20 cm3 (steep change)
- (c) **A1** link: around the equivalence point buffering is low so pH changes quickly cao
- (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).**