2.4 Acids and Alkalis: 30-minute Pack

Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 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)

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)

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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)

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5 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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6 What is the pH value of a neutral solution such as pure water at room temperature?

(1)

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7 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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8 State what an acid is in terms of the ions it produces in water.

(1)

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9 A student carries out a titration and obtains these titres: 9.40 cm^3, 9.85 cm^3, 9.48 cm^3. One of these is an anomaly. Identify the anomalous titre and calculate the best estimate of the titre to use (to 2 decimal places). Include units.

(3)

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10 A teacher asks which indicator to use for a titration between a strong acid and a strong alkali. Name a suitable indicator and explain why this indicator is appropriate for a strong acid versus strong alkali titration.

(4)

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Mark scheme · 2.4 Acids and Alkalis: 30-minute Pack

Question 1

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	M1
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	A1

Answer: **pH will decrease (move from 10 towards 7) because dilution lowers the concentration of hydroxide ions so the solution becomes less alkaline.**

Question 2

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

Answer: **hydroxide ions (OH^-)**

Question 3

identify litmus as the indicator	M1
litmus cao	A1

Answer: **Litmus**

Question 4

Liquid B acidic	B1
Liquid A neutral	B1
Liquid C alkaline	B1

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

Question 5

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)	M1
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)	A1

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 6

7 cao	B1

Answer: **7**

Question 7

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

Answer: **0.25 g**

Question 8

produces hydrogen ions (H^+) in water, cao	B1

Answer: **Produces hydrogen ions (H^+) in water.**

Question 9

identify 9.85 cm^3 as the anomalous value (it differs more from the other two)	M1
calculate mean of the two concordant titres 9.40 and 9.48: (9.40 + 9.48)/2	M1
give final answer 9.44 cm^3 cao	A1

Answer: **9.44 cm^3**

Question 10

name a suitable indicator, e.g. phenolphthalein or universal indicator	B1
state that the indicator has a sharp colour change around pH 7 for strong acid/strong alkali titrations (or that colour change occurs quickly at the equivalence)	M1
link to titration: endpoint occurs near neutral so indicator change will be clear and small volume change gives accurate titre	A1
if phenolphthalein named, state it changes from colourless to pink around pH 8-10 and is suitable for strong acid vs strong alkali, oe	A1

Answer: **Phenolphthalein (or universal indicator). Phenolphthalein gives a sharp colour change near the end point for a strong acid versus strong alkali titration so the endpoint is easy to see.**

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