

Questions

Q1.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

This question is about acids and bases.

Bromothymol blue, methyl orange and phenolphthalein are indicators used in titrations.

Which, if any, of these indicators could be used for a titration of ammonia, $\text{NH}_3(\text{aq})$, with ethanoic acid, $\text{CH}_3\text{COOH}(\text{aq})$?

(1)

- A bromothymol blue
- B methyl orange
- C phenolphthalein
- D none of these three indicators

(Total for question = 1 mark)

Q2.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

This is a question about buffer solutions.

A buffer solution always

(1)

- A keeps the pH less than 7.
- B contains equimolar amounts of acid and its conjugate base.
- C keeps the pH constant if small quantities of acid or base are added.
- D resists changes in pH if small quantities of acid or base are added.

(Total for question = 1 mark)

Q3.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

This question is about acids and bases.

Which of these mixtures would form a buffer solution with a pH **below** 7?

(1)

- A NaOH(aq) and excess HCl(aq)
- B NaOH(aq) and excess CH₃COOH(aq)
- C excess NaOH(aq) and HCl(aq)
- D excess NaOH(aq) and CH₃COOH(aq)

(Total for question = 1 mark)

Q4.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

This question is about acids and bases.

What is the order of **decreasing** pH for 0.100 mol dm⁻³ solutions of these three acids?

(1)

- A CH₃COOH > CH₂ClCOOH > HCl
- B HCl > CH₃COOH > CH₂ClCOOH
- C CH₂ClCOOH > CH₃COOH > HCl
- D HCl > CH₂ClCOOH > CH₃COOH

(Total for question = 1 mark)

Q5.

This question is about acids and bases.

The pH of two salt solutions, **J** and **K**, are

solution **J** pH = 5

solution **K** pH = 9

The solutions are equimolar.

Which acids and bases could form the salts in solutions **J** and **K**?

(1)

	Acid and base forming the salt in solution J	Acid and base forming the salt in solution K
<input type="checkbox"/> A	HCl(aq) and NH ₃ (aq)	CH ₃ COOH(aq) and NaOH(aq)
<input type="checkbox"/> B	HCl(aq) and NaOH(aq)	CH ₃ COOH(aq) and NH ₃ (aq)
<input type="checkbox"/> C	CH ₃ COOH(aq) and NaOH(aq)	HCl(aq) and NaOH(aq)
<input type="checkbox"/> D	CH ₃ COOH(aq) and NH ₃ (aq)	HCl(aq) and NH ₃ (aq)

(Total for question = 1 mark)

Q6.

Boric acid, H₃BO₃, is a weak acid with antiseptic properties.

Boric acid can undergo further dissociation.

Which is the conjugate acid of the HBO₃²⁻ ion?

(1)

- A** BO₃³⁻
- B** H₂BO₃⁻
- C** H₃BO₃
- D** H₃O⁺

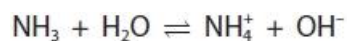
(Total for question = 1 mark)

Q7.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

This question is about acids and buffer solutions.

The reaction of ammonia with water can be represented by



Which is the acid-conjugate base pair?

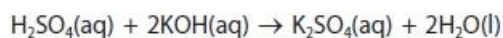
(1)

	Acid	Conjugate base
<input type="checkbox"/> A	NH_3	OH^-
<input checked="" type="checkbox"/> B	NH_3	NH_4^+
<input type="checkbox"/> C	H_2O	OH^-
<input type="checkbox"/> D	H_2O	NH_4^+

(Total for question = 1 mark)

Q8.

The reaction of sulfuric acid with potassium hydroxide is a neutralisation. The equation for this reaction is



A titration was carried out using the following method.

- Potassium hydroxide solution of unknown concentration was placed in a burette and the initial reading was recorded.
- 25.0 cm³ of sulfuric acid solution, concentration 0.0800 mol dm⁻³, was transferred to a conical flask.
- Three drops of phenolphthalein indicator were added to the sulfuric acid.
- Potassium hydroxide was added from the burette until the solution just changed colour and then the burette reading was recorded.
- Repeat titrations were carried out until concordant titres were obtained.

What is the colour of the solution when neutralisation has just occurred?

(1)

- A colourless
- B orange
- C pale pink
- D red

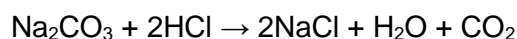
(Total for question = 1 mark)

Q9.

Hydrochloric acid is prepared by dissolving hydrogen chloride gas in water. It is difficult to dissolve a known amount of hydrogen chloride, so the exact concentration of such solutions is uncertain. A solution of hydrochloric acid of concentration between $0.095 \text{ mol dm}^{-3}$ and $0.105 \text{ mol dm}^{-3}$ was prepared.

Before a class attempted a practical using this solution, a technician standardised the hydrochloric acid with sodium carbonate solution. The technician dissolved 1.30 g of anhydrous sodium carbonate in water and made up the solution to 100 cm^3 .

The equation for the reaction which occurs is shown.



A 10.0 cm^3 portion of the sodium carbonate solution was transferred to a conical flask. Three drops of methyl orange indicator were added and the solution titrated with hydrochloric acid. The results for the experiment are shown.

Titration	1	2	3	4	5
Final burette reading / cm^3	26.00	34.00	36.10	24.15	48.20
Initial burette reading / cm^3	0.00	10.00	11.00	0.05	24.15
Titre / cm^3					
Concordant results (✓)					

The colour change at the end-point when methyl orange is used as an indicator for this titration is from

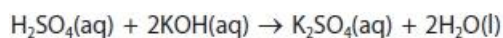
(1)

- A orange to yellow
- B red to orange
- C yellow to orange
- D yellow to red

(Total for question = 1 mark)

Q10.

The reaction of sulfuric acid with potassium hydroxide is a neutralisation. The equation for this reaction is



A titration was carried out using the following method.

- Potassium hydroxide solution of unknown concentration was placed in a burette and the initial reading was recorded.
- 25.0 cm³ of sulfuric acid solution, concentration 0.0800 mol dm⁻³, was transferred to a conical flask.
- Three drops of phenolphthalein indicator were added to the sulfuric acid.
- Potassium hydroxide was added from the burette until the solution just changed colour and then the burette reading was recorded.
- Repeat titrations were carried out until concordant titres were obtained.

Select the most appropriate piece of apparatus to measure the 25.0 cm³ of sulfuric acid.

(1)

- A burette
- B measuring cylinder
- C pipette
- D volumetric flask

(Total for question = 1 mark)

Mark Scheme

Q1.

Question Number	Answer	Mark
	<p>The only correct answer is D (none of these three indicators)</p> <p><i>A is incorrect because both acid and base are weak so pH range at equivalence is too narrow for bromothymol blue to change colour</i></p> <p><i>B is incorrect because both acid and base are weak so pH range at equivalence is too narrow for methyl orange to change colour</i></p> <p><i>C is incorrect because both acid and base are weak so pH range at equivalence is too narrow for phenolphthalein to change colour</i></p>	(1)

Q2.

Question Number	Answer	Mark
	<p>The only correct answer is D (resists changes in pH if small quantities of acid or base are added)</p> <p><i>A is not correct because buffer solutions can be alkaline or acidic</i></p> <p><i>B is not correct because buffers do not always contain equal numbers of moles of the acid and its conjugate base</i></p> <p><i>C is not correct because a buffer does not prevent any change in pH</i></p>	(1)

Q3.

Question Number	Answer	Mark
	<p>The only correct answer is B (NaOH(aq) and excess CH₃COOH(aq))</p> <p><i>A is incorrect because the solutions would not form a buffer</i></p> <p><i>C is incorrect because the solutions would not form a buffer</i></p> <p><i>D is incorrect because the solutions would not form a buffer</i></p>	(1)

Q4.

Question Number	Answer	Mark
	<p>The only correct answer is A ($\text{CH}_3\text{COOH} > \text{CH}_2\text{ClCOOH} > \text{HCl}$)</p> <p><i>B is incorrect because HCl is the only strong acid, so would have the lowest pH</i> <i>C is incorrect because CH_2ClCOOH is stronger than CH_3COOH as the Cl atom stabilises the anion</i> <i>D is incorrect because the stronger the acid the lower the pH, hence these are in reverse order</i></p>	(1)

Q5.

Question number	Answer	Mark
	<p>The only correct answer is A (solution J: $\text{HCl}(\text{aq})$ and $\text{NH}_3(\text{aq})$, solution K: $\text{CH}_3\text{COOH}(\text{aq})$ and $\text{NaOH}(\text{aq})$)</p> <p><i>B is incorrect because the salt formed from a strong acid (HCl) and a strong base (NaOH) will have pH 7 while that formed from a weak acid (CH_3COOH) and a weak base (NH_3) will have pH close to 7</i></p> <p><i>C is incorrect because the salt formed from a weak acid and a strong base will have a pH of about 9 while that formed from a strong acid and a strong base will have pH 7</i></p> <p><i>D is incorrect because the salt formed from a weak acid and a weak base will have a pH of about 7 while that formed from a strong acid and a weak base will have pH of about 5</i></p>	(1)

Q6.

Question Number	Answer	Mark
	<p>The only correct answer is B</p> <p><i>A is not correct because it is the conjugate base not acid</i> <i>C is not correct because it is not the conjugate acid</i> <i>D is not correct because it is not the conjugate acid</i></p>	(1)

Q7.

Question Number	Answer	Mark
	<p>The only correct answer is C (H_2O and OH^-)</p> <p><i>A is not correct because ammonia is acting as a base and not an acid</i></p> <p><i>B is not correct because this is the base – conjugate acid pair</i></p> <p><i>D is not correct because water and the ammonium ion are not an acid-conjugate base pair</i></p>	(1)

Q8.

Question Number	Acceptable Answer	Mark
	<p>The only correct answer is C</p> <p><i>A is not correct because this is the appearance of the solution before the potassium hydroxide is added</i></p> <p><i>B is not correct because this is the colour that methyl orange would be in neutral solution</i></p> <p><i>D is not correct because this is a colour sometimes given for the end-point which is incorrect, and it is the colour of phenolphthalein in acidic solution</i></p>	(1)

Q9.

Question Number	Answer	Mark
	<p>The only correct answer is C</p> <p><i>A is not correct because this is the reverse of the correct colour change</i></p> <p><i>B is not correct because this is doing the reverse titration (acid in flask and carbonate in burette)</i></p> <p><i>D is not correct because this is going beyond the endpoint to an acidic solution</i></p>	(1)

Q10.

Question Number	Acceptable Answer	Mark
	<p>The only correct answer is C</p> <p><i>A is not correct because a burette is used to measure varied volumes</i></p> <p><i>B is not correct because a measuring cylinder is less precise</i></p> <p><i>D is not correct because a volumetric flask is less precise</i></p>	(1)