S4S coaching

Year 12- Chemistry

The Acidic Environment

Acidic environment exam 1 – Questions

1. **(4 marks)**

You have carried out a first-hand investigation to prepare and test a natural indicator.

(a) Outline the procedure used to prepare and test the natural indicator.   2 marks

(b) Draw a table to show the results obtained in testing this indicator.   2 marks

2. **(6 marks)**

Assess the evidence which indicates that the atmospheric concentrations of oxides of sulfur and nitrogen have been increasing.   6 marks

3. **(5 marks)**

Rain has been recorded in Sydney with a pH as low as 4.5, however 80 kilometres to the west, in the Blue Mountains, the pH of the rain is always between 5.5 and 6.5.

(a) How do you account for the fact that rain in the Blue Mountains is always slightly acidic?   1 mark

(b) Explain with the help of a chemical equation, why Sydney rain is usually more acidic than rain in the Blue Mountains.   3 marks

(c) A student tested some rain water with four different indicators. The indicators used are shown in the table below as well as the colours he obtained while testing the rainwater.

Indicator	Colour change	pH range	RESULTING COLOURS
Cresol Red	Red to yellow	3.2-4.4	YELLOW
Methyl orange	Red to yellow	3.1-4.4	YELLOW
Bromocresol green	Yellow to blue	3.8-5.4	BLUE
Bromothymol blue	Yellow to blue	6.0-7.6	YELLOW

Estimate the pH of the water.   1 mark

4. **(4 marks)**

You performed a first-hand investigation to prepare an ester by reflux.

(a) Identify the products formed when propanoic acid and butanol are refluxed with acid catalyst.   1 mark

(b) Draw a fully labelled diagram of the equipment assembled for use   2 marks

(c) Outline the advantages of using reflux to prepare the ester.   2 marks

5. **(4 marks)**

A sample of lignite, a high sulfur content coal, was analysed and found to contain 4.32% sulfur.

(a) Calculate the volume of sulfur dioxide, at 25°C and 100kPa that would be produced by burning 1.0 kg of lignite coal.   3 marks

(b) Assess the impact, on the environment, of using lignite as a fuel, writing equations where appropriate.   3 marks

6. **(4 marks)**

An equilibrium mixture of hydrogen, hydrogen iodide and iodine gas was subjected to a change at time T. The result of this change is shown in the diagram below:
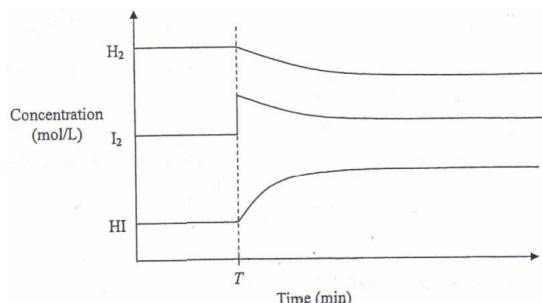
(a) What is the change made at time T?   1 mark

(b) Explain why the curve beyond time T have the shapes drawn in the diagram. 3 marks

7. **(7 marks)**

To prepare a standard solution of sodium hydroxide a student first dissolved 1.0 g of solid sodium hydroxide in 250 mL of distilled water. By titration, 25.0 mL of this solution required 23.2 mL of standard 0.100 mol/L hydrochloric acid for neutralization.

(a) Why is titration necessary to standardise the sodium hydroxide solution? 1 mark

(b) Calculate the concentration of the standardised sodium hydroxide solution. 2 marks

(c) Describe the titration procedure for this standardisation.   4 marks

8. **(5 marks)**

An antacid tablet is known to contain calcium carbonate ($CaCO_3$). To determine the mass

of calcium carbonate in the tablet, the following procedure was used.

- The tablet was crushed and then placed in a beaker.
- A pipette was used to add 25.0 mL of 0.600 mol L hydrochloric acid to the crushed - 1 tablet in the beaker.
- Once the reaction between the calcium carbonate and hydrochloric acid had stopped, phenolphthalein indicator was added to the reaction mixture.
- A Teflon-coated burette was then used to add O.lOOmollT1 sodium hydroxide to the beaker to neutralise the excess hydrochloric acid.
- The phenolphthalein changed from colourless to pink after 14.2 mL of the sodium hydroxide solution had been added.

(a) Write a balanced chemical equation for the reaction that occurred between the calcium carbonate in the tablet and the hydrochloric acid.   1 mark

(b) How many moles of hydrochloric acid were added to the tablet? 1 mark

(c) Calculate the mass of calcium carbonate in the original antacid tablet. 3 marks

9. **(7 marks)**

A solution of vinegar was titrated against 0.22 mol/L NaOH to determine its concentration. The 50.00 mL sample of vinegar was diluted to 500.0mL and 20.00mL aliquots of the diluted solution were titrated with phenolphthalein as the indicator. The results of the titration are shown:

Run	Rough	1	2	3
Volume of NaOH used (mL)	23.50	23.10	23.00	22.90

(a) Justify the use of phenolphthalein as the indicator.   2 marks

(b) Calculate the concentration of the vinegar.   3 marks

**(c)** Describe an alternative method of determining the equivalent point of this titration. 2 marks

10. **(8 marks)**

Different theories of acids and bases were developed by Lavoisier, Davy, Arrhenius and Bronsted- Lowry. Sulfuric acid, H2 SO4, was classified as an acid by all of these scientists. Explain how each of their theories predict that H2 SO4 is an acid. Support your answer by using equations where appropriate.

11. **(8 marks)**

Hydrogen sulfide gas is extremely toxic if inhaled, has an unpleasant smell (rotten eggs) and is highly flammable. Stringent precautions are required when handling it.

(a) Explain why hydrogen sulfide is classified as a WEAK acid.   1 mark

(b) Explain (with the aid of a chemical equation) why H_2S is considered a Bronsted-Lowry acid.   2 marks

(c) Identify ONE conjugate acid-base pair involved in the equation you have written in (b) above.   1 mark

(d) Hydrogen sulfide *(g)* is formed when hydrochloric acid reacts with zinc sulfide.

$$ZnS_{(s)} + 2HCl_{(aq)} \Rightarrow ZnCl_{2(aq)} + H_2S_{(g)}$$
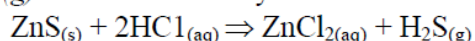
In an experiment performed in a fume cupboard 50.0 mL of O.IOMHC1 was added to 0.11 g of solid zinc sulfide.

(i) Which reagent is in excess? Show Your Working.   2 marks

(ii) What volume of hydrogen sulfide *(g)* is produced at 298K and 100 kPa in this experiment   2 marks