

Chemistry

Section I – Part B (continued)

Marks

Question 19 (7 marks)

Name ONE type of cell, other than the dry cell or lead–acid cell, you have studied. Evaluate it in comparison with either the dry cell or lead–acid cell, in terms of chemistry and the impact on society. Include relevant chemical equations in your answer.

7

The mercury button cell was one cell studied. In terms of impact on society, while dry cells were the first portable source of reliable energy, \therefore therefore had huge impact, enabling the use of low-drainage appliances such as torches, the Mercury button cell was the first reliable, steady source of power made so compact, \therefore allowed the invention of such things as the hearing aid. This is today taken for granted, but without a power source, would not have been possible. In this way, mercury cells have had a big impact on today's society as well.

The mercury button cell has a powdered zinc anode & a Hg/MnO_2 cathode. The cathode's incorporation into the ~~outer~~ casing helps enable the small size. The Dry cell on the other hand, has a graphite anode, which must be surrounded by the electrolyte of moist ammonium chloride. ~~This~~ The chemistry of this cell, therefore contributes to its bulky size comparatively.

Question 20 (4 marks)

A 0.1 mol L^{-1} solution of hydrochloric acid has a pH of 1.0, whereas a 0.1 mol L^{-1} solution of citric acid has a pH of 1.6.

- (a) State ONE way in which pH can be measured.

1

Through an indicator, such as the universal indicator.

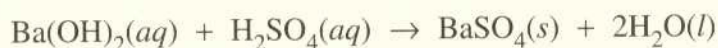
- (b) Explain why the two solutions have different pH values.

3

pH is a measure of the concentration of hydronium ions — a low pH indicating higher concentrations. HCl acid, a strong acid, ionises completely in water $\text{HCl}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_3\text{O}^+(\text{aq}) + \text{Cl}^-$. Citric acid, however, only ionises partially to produce some hydronium ions. Hence so solutions of HCl and citric acid with equal concentrations will have different concentrations of hydronium ions, and hence different pH values. HCl, the stronger acid, will have a higher concentration of hydronium ions and thus a lower pH.

Question 21 (4 marks)

Barium hydroxide and sulfuric acid react according to the following equation:



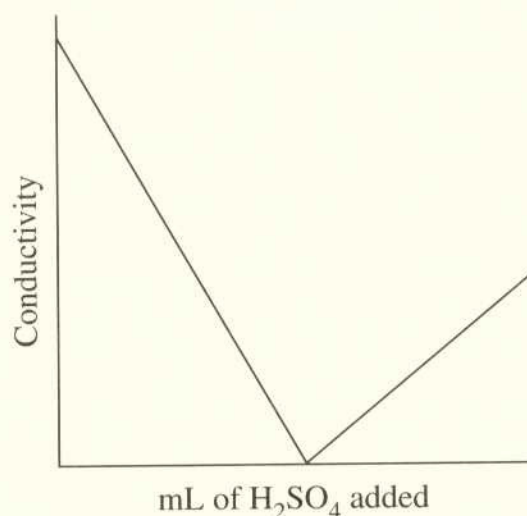
- (a) Name this type of chemical reaction.

1

A neutralisation reaction.

- (b) A 20 mL sample of barium hydroxide was titrated with 0.12 mol L^{-1} sulfuric acid. The conductivity of the solution was measured throughout the titration and the results graphed, as shown.

3



Explain the changes in conductivity shown by the graph.

Originally the solution contains both Ba^{2+} and OH^- ions which conduct electricity. As H_2SO_4 is added $\text{Ba}^{2+} + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4(\text{s})$ and $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}(\text{l})$. Hence the concentration of ions drops and so does conductivity. At the equivalence point Ba(OH)_2 is just completely neutralised and so there are very few ions - virtually zero - conductivity is at its lowest. As H_2SO_4 continues to be added H^+ and SO_4^{2-} ions begin to accumulate and conductivity begins to rise again.