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Questions 11 and 12 relate to the following experiment.

A chemistry class was given the task of distinguishing between two white powders, sodium hydroxide (NaOH) and sodium sulfate (Na_2SO_4). The students began by dissolving each of the powders into separate beakers of water.

11. Which of the solutions below would **not** be useful in distinguishing between the NaOH and Na_2SO_4 solutions, when a small amount was added to each?

    a. $Zn(NO_3)_2(aq)$
    b. $BaCl_2(aq)$
    c. $Pb(NO_3)_2(aq)$
    d. $MgCl_2(aq)$

Question 26 **(9 marks)**

Write **ionic** equations for any reactions that occur in the following procedures. If no reaction occurs write 'no reaction'. In each case **describe in full what you would observe**, including any colours, odours, precipitates (give the colour) and gases evolved (give the colour or describe as colourless). Give structural formulae for any organic substances involved.

2 – ionic equation (1 reactants, 1 products, -1 unbalanced, -1 no states)
1 – observation (½ reactants, ½ products)

a) Bromine liquid is introduced to a container of propane gas in the presence of ultraviolet light. The reaction does not go to completion. (3 marks)

Equation : _____

Observation: _____

_____

b) A solution of phosphoric acid is added to barium hydroxide solution. (3 marks)

Equation : _____

Observation: _____

_____

c) Ammonium ethanoate solution is added to sodium hydroxide solution. (3 marks)

Equation : _____

Observation: _____

_____

Question 36 **(15 marks)**

A chemist was preparing for his next experiment by organising and labelling all his bottles of solutions. He had five bottles to go when the fire alarm went off for a practice safety drill. When he got back to his bench later he found five bottles, each containing a clear colourless liquid. Next to these bottles were the remaining five labels;

Barium hydroxide $Ba(OH)_2$ 0.25 mol L^{-1}	Sodium chloride NaCl 0.25 mol L^{-1}	Ethanoic acid CH_3COOH 0.25 mol L^{-1}
Hydrochloric acid HCl 0.25 mol L^{-1}	Sodium hydroxide NaOH 0.25 mol L^{-1}	

He set about identifying each solution so that he could finish labelling them. He began by adding a few drops of sulfuric acid to a small sample of each. This test allowed him to identify the $Ba(OH)_2$ solution straight away.

(a) What observation would he have made to allow this identification? Write the ionic equation for the reaction that could have taken place in the test tube containing $Ba(OH)_2$. (3 marks)

He then added some powdered ammonium chloride (NH_4Cl) to a new sample of the remaining four unidentified solutions. Bubbles were observed to form with **one** of the unknown solutions and an unpleasant, pungent smelling gas was produced.

(b) Identify this solution and write the ionic equation for the reaction that was occurring. (3 marks)

The gas produced by the reaction in part (b) was collected and dissolved in a sample of distilled water.

(c) Describe the expected observations if litmus indicator was added to the water sample once the gas had dissolved and write an equation that supports these observations. (3 marks)

Universal indicator was then added to new samples of the remaining three unidentified solutions.

(d) Which substance would be identified in this step? (1 mark)

A piece of zinc metal was added to the final two solutions. In one solution, a fast reaction was seen, with much effervescence (bubbles). The other test tube also showed some effervescence but at a much slower rate.

(e) Explain in detail why a difference in reaction rate was observed between these two solutions and how this observation allowed the chemist to identify and distinguish these two solutions from one another. (5 marks)