Revision for the topic test – Calculations Unit 2

Question 1 (3 marks)

A pure sample of potassium bromide (KBr) was weighed on an electronic balance and dissolved in 500 mL of distilled water. The mass of KBr was 15.0 g.

a) Calculate the concentration of the solution in mol/L. 1 mark

b) Calculate the concentration of the solution in %(m/v). 1 mark

c) c) Calculate the concentration of the solution in ppm. 1 mark

Question 2 (8 marks)

A lake is heavily contaminated with calcium chloride. To purify the water, chloride ions must be removed through precipitation.

a) Choose **one** salt solution from the following list that could be added to remove the chloride ions. Circle your choice. 1 mark

Na_2CO_3 (aq) $AgNO_3$ (aq) Na_3PO_4 (aq)

b) Write the balanced chemical equation (with states) for the precipitation reaction.

_____ 2 marks

c) Write the net ionic equation for this precipitation reaction.

_____1 mark

d) In a different precipitation, lead(II) nitrate ($Pb(NO_3)_2$) is used to remove iodide ions (I^-) from a 25.0 mL water sample contaminated after an industrial spill. The reaction is shown below.

$$Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$

A mass of 6.60 g of PbI_2 (molar mass = 461.0 g/mol) was collected.

i. Calculate the moles of PbI_2 precipitated. 2 marks

ii. Calculate the concentration of KI in the original water sample. 2 marks

Question 3 (13 marks)

Nitrogen gas reacts with hydrogen gas to produce ammonia gas as per the balanced equation:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

a) 50.0 L of hydrogen gas is mixed with 20.0 L of nitrogen gas at Standard Laboratory Conditions (SLC).

i. Calculate the number of moles of each gas initially present. 2 marks

ii. Identify the limiting reagent and calculate the moles of excess gas remaining after the reaction is complete. 3 marks

iii. Calculate the volume of ammonia gas formed at SLC. 2 marks

b) A 40.0 L sealed container at 25°C and 2000 kPa contains an unknown alkane weighing 3.6 kg.

i. Calculate the number of moles of gas in the container. 2 marks

ii. Calculate the molar mass of the gas and identify the hydrocarbon. 2 marks

c) Propane combusts in oxygen according to the equation below.

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$$

If 5.00×10^3 L of propane burns in excess oxygen at SLC, calculate the total volume of greenhouse gases produced. 2 marks

Question 4 (11 marks)

A 0.200 M sulfuric acid (H_2SO_4) and a 0.200 M carbonic acid (H_2CO_3) are compared in their acid strength and reactions.

a) Write the balanced chemical equation including states for the ionisation of sulfuric acid in water. Assume H_2SO_4 acts as a diprotic acid and fully ionises.

_____ 2 marks

b) Write the balanced chemical equation for the neutralisation reaction between carbonic acid and NaOH. (states not required)

_____2 marks

c) Explain the difference between a strong acid and a weak acid using sulfuric acid and carbonic acid as examples.

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_____ 2 marks

d) 50.0 mL of 0.200 M H_2SO_4 is diluted to 200 mL with distilled water.

i. Calculate the concentration of H_2SO_4 after dilution. 2 marks

ii. Calculate the pH of the diluted solution, assuming H_2SO_4 acts as a diprotic acid and completely ionises. 3 marks

Question 5 (5 marks)

Magnesium ribbon reacts rapidly with oxygen gas to form magnesium oxide. The initial mass of magnesium used was 5.40 g and the final mass after reaction was 8.99 g.

a) Calculate the amount in moles of magnesium originally used. 1 mark

b) Calculate the moles of oxygen atoms that combined with magnesium. 2 marks

c) Determine the empirical formula of the magnesium oxide formed. 2 marks