

Answers

- 1 (a) Mass of F^- in 1000 cm^3 of fluorinated reservoir water = $10 \times 0.16 = 1.6\text{ mg}$

Optional working:

Mass of F^- in 100 cm^3 of diluted solution = $0.1 \times 0.16 = 0.016\text{ mg}$

Mass of F^- in 10.0 cm^3 of fluorinated reservoir water = 0.016 mg

Mass of F^- in 1000 cm^3 of fluorinated reservoir water = $100 \times 0.016 = 1.60\text{ mg}$

- (b) Amount of F^- in fluorinated reservoir water = $\frac{1.6 \times 10^{-3}}{19.0} = 8.421 \times 10^{-5}\text{ mol}$

Amount of H_2SiF_6 required = $\frac{1}{6} \times 8.421 \times 10^{-5} = 1.404 \times 10^{-5}\text{ mol}$

Mass of H_2SiF_6 required = $(1.404 \times 10^{-5})(144.1) = 2.02 \times 10^{-3}\text{ g} = 2.02\text{ mg}$

(Note: answer can be given in grams or milligrams, since the question did not specify.)

- 2 Concentration of $M_2CO_3 = \frac{5.30}{500 \times 10^{-3}} = 10.6\text{ g dm}^{-3}$



Amount of $HCl = \frac{26.0}{1000} \times 0.192 = 4.992 \times 10^{-3}\text{ mol}$

Amount of $M_2CO_3 = \frac{1}{2} \times 4.992 \times 10^{-3} = 2.496 \times 10^{-3}\text{ mol}$

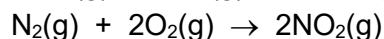
Concentration of $M_2CO_3 = \frac{2.496 \times 10^{-3}}{25.0 \times 10^{-3}} = 0.09984\text{ mol dm}^{-3}$

Let the relative atomic mass of M be x .

$$0.09984(2x + 12.0 + 3 \times 16.0) = 10.6$$

$$x = \underline{23.1}$$

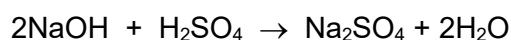
- 3 (a) $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$



- (b) Applying Avogadro's law, V is proportional to n ,

$$\begin{aligned}\text{Volume of } CO_2 \text{ formed} &= 10 \times 3 \\ &= 30\text{ cm}^3\end{aligned}$$

- (c) Amount of $NaOH$ present initially = $\frac{50}{1000} \times 0.50 = 0.025\text{ mol}$



Amount of H_2SO_4 used = $\frac{24.40}{1000} \times 0.35 = 8.54 \times 10^{-3}\text{ mol}$

Amount of $NaOH$ reacted with $H_2SO_4 = 2 \times 8.54 \times 10^{-3} = 0.01708\text{ mol}$

Amount of $NaOH$ reacted with gaseous products = $0.025 - 0.01708 = \underline{7.92 \times 10^{-3}\text{ mol}}$

- (d) $CO_2(g) + 2NaOH(aq) \rightarrow Na_2CO_3(aq) + H_2O(l)$

At room temperature and pressure,

$$\text{Amount of NaOH reacted with CO}_2 = 2 \times \frac{30 \times 10^{-3}}{24} = 2.50 \times 10^{-3} \text{ mol}$$

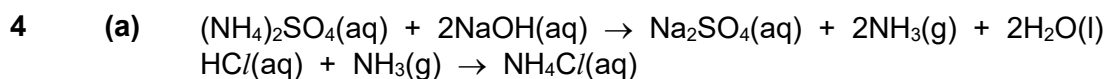
$$\text{Amount of NaOH reacted with NO}_2 = 7.92 \times 10^{-3} - 2.50 \times 10^{-3} = 5.42 \times 10^{-3} \text{ mol}$$

Since mole ratio of NO₂ to NaOH is 1:1 (as given in the equation),

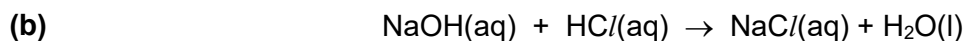
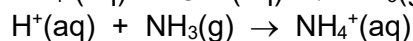
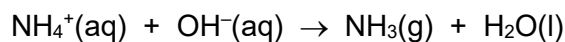
$$\text{Amount of NO}_2 = 5.42 \times 10^{-3} \text{ mol}$$

$$\frac{2z \times 10^{-3}}{24} = 5.42 \times 10^{-3}$$

$$z = \underline{65.0}$$



Or



Amount of unreacted HCl (step III) = Amount of NaOH used

$$= \frac{20.0}{1000} \times 0.100 = 2.00 \times 10^{-3} \text{ mol}$$

$$\text{Amount of HCl (step II)} = \frac{50.0}{1000} \times 0.100 = 5.00 \times 10^{-3} \text{ mol}$$

Amount of NH₃ = Amount of HCl reacted with liberated NH₃

$$= 5.00 \times 10^{-3} - 2.00 \times 10^{-3}$$

$$= 3.00 \times 10^{-3} \text{ mol} = \text{Amount of N present in 1.00 g of a foodstuff}$$

$$\text{Mass of N} = 3.00 \times 10^{-3} \times 14.0 = 0.0420 \text{ g}$$

$$\% \text{ by mass of N in the foodstuff} = \frac{0.0420}{1.00} \times 100\% = \underline{4.20\%}$$