

Limiting reagent question(two masses on reactants)

- (f) Sodium reacts with sulphur to form sodium sulphide.

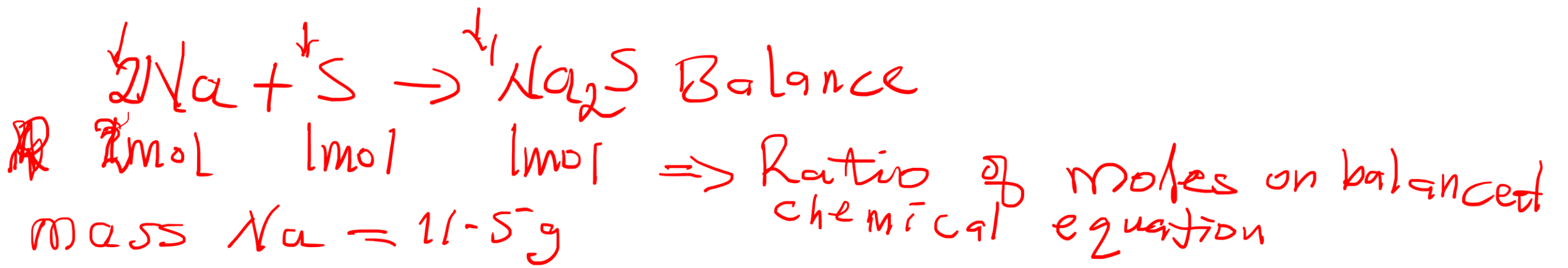


An 11.5 g sample of sodium is reacted with 10 g of sulphur. All of the sodium reacted but there was an excess of sulphur.

Calculate the mass of sulphur left unreacted.

→ (i) Number of moles of sodium atoms reacted =
[2 moles of Na react with 1 mole of S]

→ (ii) Number of moles of sulphur atoms that reacted =



$$\text{mass Na} = 11.5 \text{ g}$$

$$\text{mass S} = 10 \text{ g}$$

Determine the limiting reagent b/w Na and S

$$n = \frac{m}{\text{MM}_{\text{Na}}} = \frac{11.5 \text{ g}}{23 \text{ g/mol}} = 0.5 \text{ moles of Na}$$

$$n = \frac{m}{\text{MM}_{\text{S}}} = \frac{10 \text{ g}}{32 \text{ g/mol}} = 0.3125 \text{ moles of S}$$

$$R_{\text{Na}} = \frac{n}{\text{coefficient of Na}} = \frac{0.5}{2} = \frac{0.5}{2} \text{ moles} = 0.25 \text{ moles}$$

$$R_{\text{S}} = \frac{n}{\text{coefficient of S}} = \frac{0.3125}{1} = 0.3125 \text{ mole} = 0.3125 \text{ mole}$$

Determine R_{Na} and R_S of smaller value.

→ R_{Na} is the smallest = 0.25 mole hence
 Na is the limiting reagent.

(i) number of Na reacted (n) = $\frac{m}{M_{Na}} = \frac{11.5g}{23g/mol} = 0.5 \text{ moles of } Na$

(ii) ~~the~~ number of mole of sulphur that reacted



$$2 \times 2L = 0.5$$

$$\Rightarrow 2L = \frac{0.5}{2} = 0.25 \text{ mole of } S \text{ reacted}$$

- 6 (a) The following method is used to make crystals of hydrated nickel sulphate.

An excess of nickel carbonate, 12.0 g, was added to 40 cm³ of sulphuric acid, 2.0 mol/dm³. The unreacted nickel carbonate was filtered off and the filtrate evaporated to obtain the crystals.



Mass of one mole of NiSO₄·7H₂O = 281 g

Mass of one mole of NiCO₃ = 119 g

- (i) Calculate the mass of unreacted nickel carbonate.

Number of moles of H₂SO₄ in 40 cm³ of 2.0 mol/dm³ acid = 0.08

Number of moles of NiCO₃ reacted =

Mass of nickel carbonate reacted = g

Mass of unreacted nickel carbonate = g [3]

- (ii) The experiment produced 10.4 g of hydrated nickel sulphate. Calculate the percentage yield.

The maximum number of moles of NiSO₄·7H₂O that could be formed =

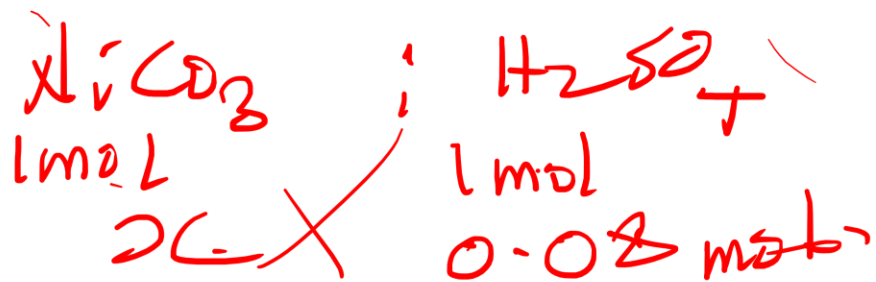
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The maximum mass of NiSO₄·7H₂O that could be formed = g

The percentage yield = % [3]

$$M = \frac{\text{moles}}{\text{Volume}}$$

$$\begin{aligned} \text{moles of } H_2SO_4 &= M \times \text{Volume} \quad \nearrow 40 \text{ cm}^3 \\ &= 2 \text{ Mole/dm}^3 \times \frac{40 \text{ dm}^3}{1000} \\ &= 0.08 \text{ mol} \end{aligned}$$



$$20 = 0.08 \text{ moles } NiCO_3$$

$$m = n \times M_r = 0.08 \times 119 \text{ g/mol} = \underline{\underline{9.52 \text{ g } NiCO_3}}$$

$$n = \frac{m}{M_r} = \frac{12 \text{ g}}{119 \text{ g/mol}} = 0.100840336 \text{ moles } NiCO_3$$

$$\text{Unreacted moles} = 12 \text{ g} - 9.52 \text{ g} = 2.48 \text{ g of } NiCO_3$$

$$12g - 9.52g = \underline{2.48g}$$



1 mol

1 mol

0.08 mol

0.08 moles

$$m = n \times M_r = 0.08 \text{ moles} \times 281 \text{ g/mol}$$

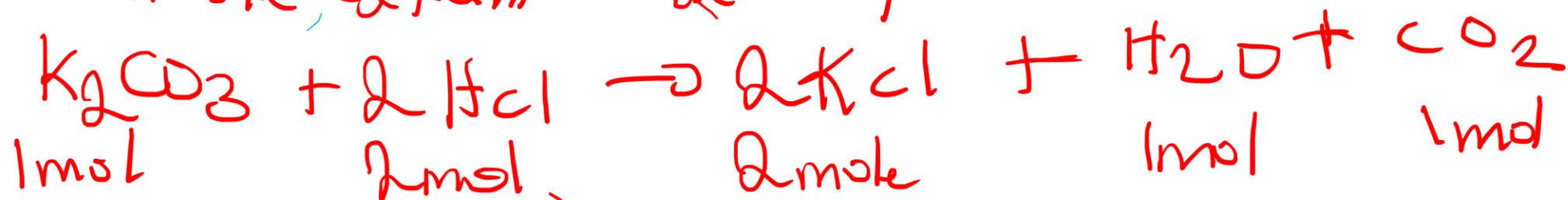
$$= 22.48g \text{ } NiSO_4 \cdot 7H_2O$$

$$\text{Percentage yield} = \frac{10.4g}{22.48g} \times 100 = 46.3\%$$



You react 6.9g of K_2CO_3 with HCl
 calculate the volume of CO_2 produced
 at rtp (room temperature and pressure)

1 mole $\rightarrow$ 24 dm³ at rtp



$$\text{mole}(K_2CO_3) \rightarrow \frac{m(K_2CO_3)}{M_r(K_2CO_3)} = \frac{6.9 \text{ g}}{39 \times 2 + 16 \times 3} = \frac{6.9 \text{ g}}{126 \text{ g/mol}} = 0.055 \text{ mol } K_2CO_3$$

K_2CO_3
1 mole
0.05 moles

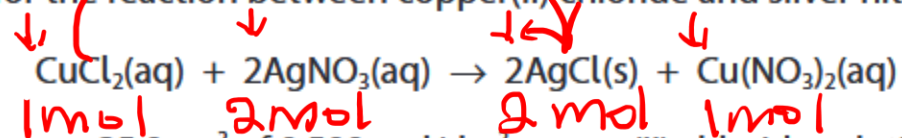
∴ CO_2
1 mole
0.05 moles

~~1 mole~~

1 mole → 24 dm³ (volume CO_2)
0.05 mole →

$$V = 0.05 \times 24 = 1.2 \text{ dm}^3 = 1.2 \times 1000 = 1200 \text{ cm}^3 \text{ of } CO_2$$

(c) The equation for the reaction between copper(II) chloride and silver nitrate is



Balanced eqn
mole ratio

A student measures 25.0 cm^3 of 0.500 mol/dm^3 copper(II) chloride solution and reacts it with silver nitrate solution.

(i) Name a piece of apparatus suitable for measuring 25.0 cm^3 of copper(II) chloride solution.

(1)

burette

(ii) Calculate the maximum mass, in grams, of silver chloride that could be produced.

$[M_r \text{ of AgCl} = 143.5]$...

(3)

$$M = \frac{\text{moles}}{V}$$

$$\text{moles} = M \times V = 0.5 \text{ mol/dm}^3 \times \frac{25}{1000} \text{ dm}^3 = 0.0125 \text{ moles of CuCl}_2$$

CuCl_2 1 mol 0.0125 moles	$\times$	AgCl 2 moles 70
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$$2 \times 1 = 0.0125 \times 2 = 0.025 \text{ moles AgCl}$$

$$\text{moles} = \frac{\text{mass}}{M_r} = \frac{m}{M_r(M_r)}$$

$$m = \text{moles} \times M_r(M_r)$$

$$= 0.025 \text{ moles} \times 143.5 \text{ g/mol}$$

$$\text{mass} = 3.59 \text{ g} \quad \text{to } 3 \text{ s.f.}$$
