Magnesium Reaction To Ammonia Calculation

https://gemini.google.com/app/51ebcf53de5a36c9

Response: Here is the step-by-step solution to solve the problem:

1. Identify the Chemical Reactions

- **Reaction 1:** Magnesium reacts with excess nitrogen to form magnesium nitride ($\mathrm{Mg_3N_2}$):

$$3\mathrm{Mg} + \mathrm{N_2} \rightarrow \mathrm{Mg_3N_2}$$

- **Reaction 2:** Magnesium nitride reacts with water to yield magnesium hydroxide and ammonia gas ($\mathrm{NH_3}$):

$$\mathrm{Mg_3N_2} + 6\mathrm{H_2O} \rightarrow 3\mathrm{Mg(OH)_2} + 2\mathrm{NH_3}$$

2. Determine Stoichiometric Relations

From the balanced equations:

- $3 \text{ mol of } \mathrm{Mg} \rightarrow 1 \text{ mol of } \mathrm{Mg_3N_2}$
- $1 \text{ mol of } \mathrm{Mg_3N_2} \rightarrow 2 \text{ mol of } \mathrm{NH_3}$

Therefore, the relationship between Mg and the evolved gas $\mathrm{NH_3}$ is:

$$3 \text{ mol of } \mathrm{Mg} \equiv 2 \text{ mol of } \mathrm{NH_3}$$

3. Calculate the Moles of Evolved Gas ($\mathrm{NH_3}$)

Given:

- Volume of $\mathrm{NH_3} = 672 \text{ cm}^3 = 0.672 \text{ dm}^3$
- Molar volume at STP $= 22.4 \text{ dm}^3/\text{mol}$

$$\text{Moles of } \mathrm{NH_3} = \frac{0.672 \text{ dm}^3}{22.4 \text{ dm}^3/\text{mol}} = 0.03 \text{ mol}$$

4. Calculate the Mass of Mg

Using the mole ratio:

$$\text{Moles of } \mathrm{Mg} = \text{Moles of } \mathrm{NH_3} \times \frac{3}{2} = 0.03 \text{ mol} \times 1.5 = 0.045 \text{ mol}$$

Now, convert moles of Mg to mass using its relative atomic mass ($24\ \mathrm{g/mol}$):

$$\text{Mass of Mg} = 0.045\ \text{mol} \times 24\ \text{g/mol} = \mathbf{1.08}\ \text{g}$$

Conclusion

- The correct option is **(4) 1.08 g**.
