In-Class Assessment NAME: MARKING GUIDE. /20

Molar Volume of Hydrogen Gas and Percentage Purity of Magnesium Ribbon

1. Construct a balanced chemical equation showing the nature of all species for the reaction between Magnesium metal and Hydrochloric Acid. (3 marks)

$$Mg_{(s)} + 2HCl_{(aq)} \rightarrow H_{2(g)} + MgCl_{2(aq)}$$

Symbols/formulae ✓ Stoich. ✓ species ✓

Edit → procedure

2. Record one safety rule specific to this experiment, indicating at which step it should be observed. (2 marks)

Gloves for handling/pouring 3M(Conc.) HCl.
Safety glasses for " " " "

Rule ✓ Rel. to Step. ✓

3. A group of Year 11 students carried out the experiment as you did. This is their results.

Mass of Mg Reacted (+/- 0.001g)	Volume of H_2 Produced (+/- 0.05mL)
0.041	40.6

Room Temp: 18.5°C

Atmospheric Pressure: 99.2 kPa

i. Compare the conditions for their experiment with STP. (2 marks)

Temp: 18.5° above Std. Temp (0°C). ✓
Pressure: 0.8 kPa below Std. Pressure (100 kPa) ✓

ii. How many moles of Magnesium metal have been reacted in this experiment. (Assume the metal to be 100% Mg) (2 marks)

$m_{Mg} = 0.041\,g$

$M_{Mg} = 24.31\,g\,mol^{-1}$

$n = \frac{m}{M} = \frac{0.041}{24.31} = 1.69 \times 10^{-3}$ moles ✓

iii. Determine the Molar Volume of Hydrogen from these results. (Assume the metal to be 100% Mg) (2 marks)

Edit → at 18.5°C and 99.2 kPa

$0.041\,g \longrightarrow 40.6\,mL\ (4.06 \times 10^{-2}\,L)$

i.e. $1.69 \times 10^{-3}\,mol \longrightarrow 4.06 \times 10^{-2}\,L$ ✓½

Stoich: $1\,mol\ Mg \longrightarrow 1\,mol\ H_2$ ½

$\therefore 1.69 \times 10^{-3}\,mol \longrightarrow 1.69 \times 10^{-3}\,mol$ occupies $4.06 \times 10^{-2}\,L$ ½

$\therefore 1\,mol$ occupies $\frac{1.00}{1.69 \times 10^{-3}} \times 4.06 \times 10^{-2} = 24.02\,L$ ✓

$\frac{24.31}{0.041} \times 0.0406 \downarrow 24.07\,L$

4. Another group of Year 11 students carried out the experiment as you did.
This is their results.

Mass of Mg Reacted (+/- 0.001g)	Volume of H_2 Produced (+/- 0.05mL)
0.048	42.6

Room Temp: 18.5°C

Atmospheric Pressure: 99.2 kPa

i. How many moles of Hydrogen gas have been collected in this experiment.
(Assume the Gas was collected at STP) (2 marks)

$n_{gas} = \frac{V_{@STP}}{22.71}$ $V_{@STP} = 42.6 \times 10^{-3} L$

$\therefore n_{H_2} = \frac{42.6 \times 10^{-3}}{22.71} = 1.876 \times 10^{-3}$ moles.

ii. What mass of magnesium does the amount of gas collected suggest has been reacted? (2 marks)

$n_{Mg} = n_{H_2} = 1.876 \times 10^{-3}$ $\therefore m = n \times M$

$M_{Mg} = ?$ $= 1.876 \times 10^{-3} \times 24.31$

$M_{Mg} = 24.31$ g mol^{-1} $= 0.046$ g

iii. Determine the Percentage purity of the Magnesium metal used in the experiment. (2 marks)

$\%Mg = \frac{M_{Mg\ in\ sample}}{M_{sample}} \cdot \frac{100}{1}$

$= \frac{0.046}{0.048} \cdot \frac{100}{1} = 95\%$

5. Two groups of students compared their results. One group (Group A) found their Magnesium to be more than 100% pure and the other (Group B) to be less than 100% pure. Taking into account the experimental conditions and the procedure they followed (identical to yours) - which group do you believe has carried out the experiment more accurately?
Justify your answer with an explanation. (3 marks)

Edit → Assumptions made

proficiently.

Gp A : >100% pure

- Gas collected @ 18.5° (>0°C)
∴ Volume exaggerated.
- Gas collected at 99.2 kPa (<100kPa)
∴ Volume exaggerated.
- Water vapour contribution not included
∴ Volume exaggerated.

Gp B < 100%

- Trapped Bubbles not measured in Vol_{H_2}.
- H_2 soluble in H_2O (?)
∴ diminished Vols.
- Gas bubble in tube prior to reaction commencement
∴ Volume exaggerated.