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civil engineering

lab Chemistry 108

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① Exp. 6 Molar Mass of Volatile liquid.

* Avogadro's Principle: **Equal Volume of gases under the same temp. & pressure contain an equal number of Molecules.**

* We will use Ideal Gas law in our calculations.

$$* \text{ } PV = nRT \Rightarrow PV = \frac{m}{M.m} RT$$

$$\Rightarrow M.m = \frac{m RT}{P V} \Rightarrow M.m = \frac{D RT}{P}$$

- ②
- * V : Volume of Vapor (L): $1 \text{ L} = 1000 \text{ mL}$
 - * R : Gas Constant = $0.0821 [\text{atm L/K mol}]$
 - * T : Temperature (K): $K^\circ = C^\circ + 273$
of Boiling water
 - * n : number of Moles = $\frac{\text{mass (g) of vapor}}{\text{M.m (g/mol) of vol. liq.}}$
 - * D : Density (g/L)
 - * P : Atmospheric pressure (atm):
 $1 \text{ atm} = 760 \text{ mmHg} = 760 \text{ torr} = 101325 \text{ Pa}$
 - * $1 \text{ L} = 1000 \text{ mL} = 1000 \text{ cm}^3 = 1 \text{ dm}^3$

③ ex A flask weighs 40.1305 g when clean, dry, evacuated, 138.241 g when filled with water ($D = 0.997 \text{ g/ml}$) & 40.2487 g when filled with a gaseous substance at 470.4 torr & 96°C. What's the Molar Mass (g/mol) of the gas? [$R = 0.0821 \text{ L atm/mol K}$]

sol * $P = \frac{470.4}{760} = 0.62$

* mass water = $138.241 - 40.1305 = 98.1105 \text{ g}$

* $V_{\text{water}} = \frac{m_w}{D_w} = \frac{98.1105}{0.997} = 98.4057 \text{ mL}$
 $= \underline{0.0984057 \text{ L}}$

$$\text{sol}^{\text{④}} * \text{mass}_{\text{gas}} = 40.2487 - 40.1305 = 0.1182 \text{ g}$$

$$* T = 96 + 273 = \underline{\underline{369 \text{ K}}}$$

$$* M.m = \frac{m R T}{P V}$$

$$M.m = \frac{(0.1182)(0.0821)(369)}{(0.0984057)(0.62)} = 58.7 \text{ g/mol}$$

⑤ Q] For which of the following compounds can we determine its M.m using the Method described in This exp. ? Give reasons . Benzene (B.P. 78°C)
Glycerol (B.P. 180°C)
B.P. water = 100°C

* ملاحظة مهمة : يختار الي درجة غليانه أقل من الماء

Benzene because its B.P lower than B.P of water

⑥ Q] A cylinder contains compressed hydrogen gas & the mass of the hydrogen is 20 g, what Mass of Oxygen would be contained in an Identical Cylinder at the same Temperature & Pressure? $V_H = V_O \Rightarrow n_O = n_H$

$$n_H = \frac{m_H}{M.m_H} = \frac{20}{1} = \boxed{20 \text{ mol} = n_O}$$

$$n_O = \frac{m_O}{M.m_O} \Rightarrow m_O = 20 * 16 = \underline{\underline{320 \text{ g}}}$$

Q) Why should The Erlommyer flask be dry?
To Avoid Changing the Mass of the substance.

Q) Why we should Make a small hole through
The Aluminum foils? To Avoid The ^{انفجار} explosion of the flask.

Q) Does it effect If we change the quantity
of The water? NO, M.m is independent on
The quantity of the water.

Q) Why we are putting a few boiling stones (chips) in the liquid? To decrease the bubbles of the Boiling, So we can avoid explosion.

Q) Why should we heat the Beaker slowly?

To avoid fast evaporation

Q) Why should we ~~heat~~ dry the outside of The Aluminum foil Completely, After finish heating?

To have an accurate reading of the Mass.

Q) What's the Mass of Vapor Volatile liquid
(M.m = 85 g/mol) which completely fill a 184 mL
flask at 94°C & 675.05 torr? $R = 0.0821$
a) 0.211 g b) 0.632 g ☒ c) 0.461 g d) 0.344 g

sol * $P = \frac{675.05}{760} = 0.888 \text{ atm}$

* $T = 94 + 273 = 367 \text{ K}$

* $V = \frac{184}{1000} = 0.184 \text{ L}$

* $\text{mass} = \frac{PVM.m}{RT} = \frac{0.888 * 0.184 * 85}{0.0821 * 367} = \underline{\underline{0.461 \text{ g}}}$

Q) Describe the effect on the calculated Molar Mass of the Volatile liquid [increase, decrease, no effect]

1) If flask isn't dried completely from outside before weighing? $m \uparrow \therefore M.m \uparrow$ inc.

2) If The density of the volatile liquid was Mistakenly greater than the true value? inc.

3) If The Temp. of the boiling water was Mistakenly less than the true Value? dec

4) If Balance reads lower than the true value? No effect

⑤ If the volume of the flask is bigger than the recorded volume? **inc**

V أقل
المحسوبة

⑥ If amount of ~~volatile~~ liquid isn't enough in the flask $\Rightarrow$ But V will be considered as filled
 $\Rightarrow$ But Mass of vapor will be lower
 $\Rightarrow \therefore$ **Mass lower $\Rightarrow$ dec**

⑦ If 50 mL rather than 20 mL of vol. liquid is used in exp. ? **NO effect**
 $\Rightarrow$ due to mass of Vapor not vol. liq. is considered
- Yatan