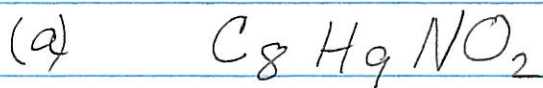


CHAPTER 14

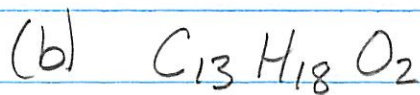
14-2



$$\begin{aligned}\text{Molecular mass}^* &= 8(12.011 \text{ g/mol}) + 9(1.00794) + 14.0067 \\ &\quad + 2(15.999) \\ &= 151 \text{ g/mol}\end{aligned}$$

So 325 mg contains: $\frac{0.325 \text{ g}}{151 \text{ g/mol}} \times 6.02 \times 10^{23} \text{ atoms/mol}$

$$= \underline{1.3 \times 10^{21} \text{ molecules}}$$

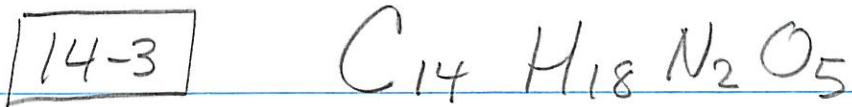


$$\text{Molecular mass}^* = 13(12) + 18(1) + 2(16) = 206 \text{ g/mol}$$

So 200 mg contains: $\frac{0.2}{206} \times 6.02 \times 10^{23}$

$$= \underline{5.8 \times 10^{20} \text{ molecules}}$$

* the atomic masses are listed on the periodic table on the back page of the textbook.



(a) molecular mass in amu

$$14(12) + 18(1) + 2(14) + 5(16) = \underline{294 \text{ u}}$$

$$(b) \quad m = 294 \text{ u} \times 1.6605 \times 10^{-27} \text{ kg/u} \\ = \underline{4.88 \times 10^{-25} \text{ kg}}$$

14-4

$$(a) \quad m = \frac{196.967 \text{ g}}{\text{mole}} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ atoms}}$$

$$= 3.27 \times 10^{-22} \text{ g} = \underline{3.27 \times 10^{-25} \text{ kg}}$$

$$(b) \quad m = 285 \text{ g} \times \frac{1 \text{ mol}}{196.967 \text{ g}} = \underline{1.45 \text{ mol}}$$

14-7 (a) $m_w = 0.71 \times \frac{580}{9.8} = 42 \text{ kg}$

$$1 \text{ mol of } H_2O = 2(1) + 16 = 18 \text{ g/mol.}$$

$$\# \text{ moles} = 42000 \text{ g} \times \frac{1 \text{ mol}}{18} = \underline{2333 \text{ mol}}$$

$$(b) \quad \# \text{ molecules} = 2333 \times 6.02 \times 10^{23} = \underline{1.4 \times 10^{27}}$$

14-9

$$\rho = 1000 \text{ kg/m}^3$$

$$V = \pi R^2 h = \pi (0.045 \text{ m})^2 \times 0.12 \text{ m} \\ = 7.6 \times 10^{-4} \text{ m}^3$$

$$m = \rho V = 0.76 \text{ kg}$$

$$\text{H}_2\text{O} : 2(1) + 16 = 18 \text{ g/mol}$$

also # molecules = $\left(\frac{760 \text{ g}}{18 \text{ g/mol}} \right) \times 6.02 \times 10^{23} = 2.5 \times 10^{25}$

\rightarrow # moles = $\frac{760}{18} = \underline{42 \text{ moles}}$

14-11

$$0.16 \text{ g He} = \frac{0.16 \text{ g}}{4 \text{ g/mol}} = 0.04 \text{ moles}$$

at same $P, T,$ and V we need 25 moles of N_2 to fill the balloon

$$\text{N}_2 \text{ has } 2(14) = 28 \text{ g/mol}$$

$$\text{so } m_{\text{N}_2} = 28 \text{ g/mol} \times 0.04 \text{ mol} \\ = 1.1 \text{ g}$$

14-13

$$(a) PV = nRT$$

$$T = 15,5 + 273 \approx 289 \text{ K}$$

$$n = \frac{PV}{RT} = \frac{1,72 \times 10^5 \times 2,81 \text{ m}^3}{8,31 \times 289}$$

$$= 201 \text{ moles}$$

$$(b) P = \frac{nRT}{V} = \frac{201 (8,31) (273 + 28,2)}{4,16}$$
$$= 1,21 \times 10^5 \text{ Pa}$$

14-15

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

1 → TANK

2 → ROOM

$$V_2 = \frac{P_1}{P_2} \frac{T_2}{T_1} = \frac{65}{1} \cdot \frac{297}{288} = 67 \text{ m}^3$$

14-19

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$T_2 = \frac{P_2}{P_1} \frac{V_2}{V_1} T_1 = 48,5 \cdot \frac{1}{16} (305 \text{ K})$$

$$\underline{T_2 = 925 \text{ K}}$$

14-23

$$(a) \quad Q_1 = Q_2$$

let n_1 be # moles in 1 and n_2 # moles in 2

C_{Ne} is the Heat capacity per mole

$$n_1 \cancel{C_{Ne}} \Delta T_1 = n_2 \cancel{C_{Ne}} \Delta T_2$$

$$\Delta T_1 = T_f - T_1, \quad \Delta T_2 = (T_2 - T_f)$$

$$n_1 = \frac{P_1 V_1}{RT_1} = 542 \text{ mol} \quad n_2 = \frac{P_2 V_2}{RT_2} = 241 \text{ mol}$$

$$\frac{P_1 V_1}{RT_1} (T_f - T_1) = \frac{P_2 V_2}{RT_2} (T_2 - T_f)$$

$$\frac{5 \cdot 10^5 \cdot 2 \text{ m}^3}{220} (T_f - 220) = \frac{2 \cdot 10^5 \cdot 5.8}{580} (T_2 - T_f)$$

$$4.55 \cdot 10^{-2} (T_f - 220) = 2 \cdot 10^{-2} (580 - T_f)$$

$$T_f - 220 = 0.44 (580 - T_f) = 255 - 0.44 T_f$$

$$1.84 T_f = 475 \Rightarrow \underline{T_f = 330 \text{ K}}$$

$$(b) \quad P = \frac{n_f R T_f}{V_f} = \frac{(542 + 241) 8.31 (330)}{2 + 5.8}$$

$$= \underline{2.8 \times 10^5 \text{ Pa}}$$

14-35

$$U = \frac{3}{2} n R T$$

$$n = \frac{P_1 V_1}{R T_1}$$

$$U = \frac{3}{2} \frac{P_1 V_1}{R T_1} R T$$

$$\Delta U = \frac{3}{2} \frac{1.01 \times 10^5 \cdot 680 \text{ m}^3}{293,2} (1.10 \text{ K}) = \underline{3.9 \times 10^5 \text{ J}}$$

14-37

$PV = nRT$, if PV is constant and n is doubled
then $T' = T/2$

$$v_{\text{rms}}^2 \propto T$$

$$\frac{v'_{\text{rms}}}{v_{\text{rms}}} = \sqrt{\frac{T'}{T}} = \sqrt{\frac{1}{2}}$$

$$v'_{\text{rms}} = 463 / \sqrt{2} = \underline{327 \text{ m/s}}$$

14-39

$$v_{rms} = \sqrt{\frac{3kT}{m}}$$

$$v_{rms}^2 = \frac{3kT}{m} \Rightarrow m = \frac{3kT}{v_{rms}^2}$$

$$m = \frac{3 \times 1.38 \times 10^{-23} \times 301 \text{ K}}{(2.8 \times 10^{-3} \text{ m/s})^2} = \underline{1.59 \times 10^{-15} \text{ kg}}$$

14-41

$$PV = nRT \Rightarrow T = \frac{PV}{nR}$$

$$T = \frac{2.12 \times 10^4 \text{ Pa} \times 50 \text{ m}^3}{421 \text{ mol} \times 8.31} = \underline{303 \text{ K}}$$

$$\text{SO}_2 : 32 + 32 = 64 \text{ amu}$$

$$M_{\text{SO}_2} = 64 \times 1.66 \times 10^{-27} \text{ kg/amu} = 1.06 \times 10^{-25} \text{ kg}$$

$$v_{rms} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3 \times 1.38 \times 10^{-23} \times 303}{1.06 \times 10^{-25} \text{ kg}}}$$

$$= \underline{344 \text{ m/s}}$$