AP PHYSICS - CH 10

Q3: SINCE KELVIN IS °C MINUS 273 THE TWO TEMPERATURES 1.5×10^7 K AND 1.5×10^7 °C ARE ALMOST EXACTLY THE SAME !

Q12: THE TAPE IS LONGER SO THE MEASUREMENTS WILL USE LESS OF THE TAPE AND BE SMALLER NUMBERS.

① $-273.15\ °C \rightarrow °F$ $\qquad T_F = \frac{9}{5} T_C + 32$

$\frac{9}{5}(-273.15) + 32 = -459.67°F$

$98.6°F \rightarrow °C$

$T_C = \frac{5}{9}(T_F - 32) = \frac{5}{9}(98.6 - 32) = 37°C$

$100\ K \rightarrow °F$

$100K = -173.15°C \qquad T_F = \frac{9}{5} T_C + 32 = -279°F$

④ $134°F \qquad T_C = \frac{5}{9}(T_F - 32) = 56.7°C$

$-79.8°F \qquad T_C = -62.1°C$

1) $\Delta L = L_0 \alpha \Delta T$

$(518m)(11 \times 10^{-6}\ C^{-1})(55°C) = .313\ m$ OR $31.3\ cm$

2) $\Delta L = L_0 \alpha \Delta T = 1.3(19 \times 10^{-6})(20) = 4.94 \times 10^{-4}\ m$

SO ~~1.3004~~ $1.3000 \rightarrow 1.2995\ m$ ← INSIGNIFICANT CHANGE

IF $T = 2\pi\sqrt{\frac{L}{g}}$ AND $L\downarrow$ $T\downarrow$ SO THE CLOCK WILL RUN FAST (MORE TICKS EVERY REAL MINUTE)

(17) $R = 2.168\text{ cm}$

$\Delta R = R_0 \alpha \Delta T = 2.168(1.42\times10^{-5}\,C^{-1})(85) = .0026\text{ cm}$

So $R' = 2.1706\text{ cm}$

(21) $\Delta V_{ol} = V_{ol}\cdot\beta\cdot\Delta T = (45L)(9.6\times10^{-4}\,C^{-1})(25°C) = 1.08L$

SO WE LOSE ABOUT 1.1 L!

(27)

1 MOLE, 6.00 ATM, 27.0°C → 1 MOLE, 18 ATM, ? °C

$PV = nRT$ MOVE CHANGING THINGS TO LEFT UNCHANGING TO RIGHT...

$\frac{P}{T} = \frac{nR}{V}$

SO $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ OR $T_2 = \frac{P_2}{P_1}T_1$

$T_2 = \frac{18}{6}\,27°C$ ← NO! MUST USE K!

$T_2 = (3)(300\,K)$

$= 900\,K$

$= 627°C$

(29) $1.0\text{ cm}^3 = 1\times10^{-6}\text{ m}^3$

$20°C = 293\,K$

$1\text{ ATM} = 1\times10^5\text{ Pa}$

$PV = NkT$

$N = \frac{PV}{kT} = \frac{10^5(10^{-6})}{1.38\times10^{-23}(293)} = 2.5\times10^{19}$ MOLECULES

$\frac{P_1}{N_1} = \frac{P_2}{N_2}$ SO $N_2 = \frac{P_2}{P_1}N_1 = \frac{10^{-11}}{10^5}(2.5\times10^{19}) = 2500$ MOLECULES

(31)

$T = 27°C = 300\,K$
$V = 1.5\,m^3$
$P = .2 \times 10^5\,Pa$

$\longrightarrow$

$T = ?$
$V = .700\,m^3$
$P = .8 \times 10^5\,Pa$

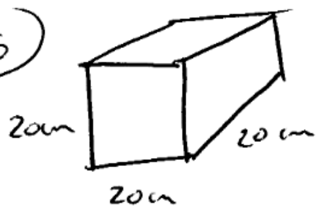
$PV = NkT$ so

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \longrightarrow T_2 = \frac{P_2V_2}{P_1V_1}T_1 =$$

$$\frac{.8(.7)}{.2(1.5)}(300) = 560\,K$$

$$= 287\,°C$$

(36)



$N = 3(6.022 \times 10^{23})$

$$P = \frac{2}{3}\left(\frac{N}{V}\right)\left(\frac{1}{2}mv^2\right) = \frac{2}{3}\left(\frac{N}{V}\right)\left(\frac{3}{2}kT\right) = \frac{N}{V}kT$$

OK .. IDEAL GAS LAW

$$P = \frac{NkT}{V} \quad \text{and} \quad F = P \cdot A = \frac{NkT}{V} \cdot A = NkTd$$

$$F = 3(6.022 \times 10^{23})(1.38 \times 10^{-23})(293)(.20)$$

$$F = 1460\,N$$ ← wow!

(37) $\overline{KE} = \frac{3}{2}kT$ ← EQUIPARTITION THEOREM

$$\overline{KE} = \frac{3}{2}(1.38 \times 10^{-23})(300) = 6.2 \times 10^{-21}\,J$$

(AND WE DON'T EVEN CARE THAT IT IS O_2)

(40) a) $\overline{KE} = \frac{3}{2} kT$

$\frac{1}{2} m v_{rms}^2 = \frac{3}{2} kT$ so $v_{rms} = \sqrt{\frac{3kT}{m}}$

H_2 is 2 g/mole

$2 \text{ g/mol} \left(\frac{1 \text{ kg}}{1000 \text{ g}}\right)\left(\frac{6 \times 10^{23} \text{ mol}}{1 \text{ mol}}\right)$

H_2 is 3.3×10^{-27} kg

$$V_{rms} = \sqrt{\frac{3(1.38 \times 10^{-23})(240)}{3.3 \times 10^{-27}}} = 1735 \text{ m/s}$$

YIKES!

b) CO_2 is $12 + 16 + 16 = 44$ g/mole $= 7.3 \times 10^{-26}$ kg

$$V_{rms} = \sqrt{\frac{3(1.38 \times 10^{-23})(240)}{7.3 \times 10^{-26}}} = 369 \text{ m/s}$$

c) $V_{esc} = 10{,}300$ m/s $\quad \frac{1}{6} V_{esc} = 1716$ m/s so H_2 is GONE BUT CO_2 REMAINS

(50) THE PRESSURE FROM BELOW WILL BALANCE THE WEIGHT

$$F_g = F_{gas} = P \cdot A$$

$$mg = \frac{2}{3} \frac{N}{V}\left(\frac{3}{2} kT\right) \cdot A = NkT \cdot h$$

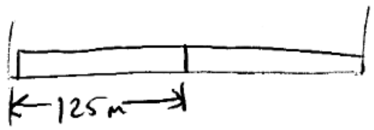
$$\text{so } h = \frac{mg}{NkT} = \frac{(5.0 \text{ kg})(9.80 \text{ m/s}^2)}{3(6.022 \times 10^{23})(1.38 \times 10^{-23})(500)}$$

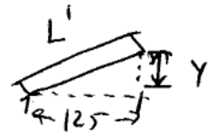
$$h = .004 \text{ m} = .4 \text{ cm}$$

OH CRAP! I FORGOT P_{ATM}!

$$\text{so } h = \frac{mg + P_{ATM} A}{NkT} = \frac{5(9.8) + 10^5(.050)}{3(8.21)(500)} \Rightarrow h = 41 \text{ cm}$$

(55)





$$L' = L_o + \Delta L = L_o + L_o \alpha \Delta T$$

$$125 + 125(12\times10^{-6})(20)$$

$$L' = 125.03$$

SO, BY PYTHAG...

$$125^2 + y^2 = 125.03^2$$

$$y^2 = 125.03^2 - 125^2$$

$$y = 2.7\ m$$! HOLY MOLY!