PS.121 – 2021 Spring Foltz Quiz 3 name FOLTZ (KEY)

$\rho_m = \frac{m}{Vol}$; specific $E = \frac{E}{m}$; 0°C= 32°F= 273 K ; 1 C°=1.8 F° ; 1 cal = 4.18 J ; 1 atm= 101 $\frac{kN}{m^2}$ = 760 TORR

ΔE : $\mathcal{P}\cdot\Delta t$, $mc\Delta T$, mL , $P\Delta V$; $PV = nRT$; $R = 1.99\ ^{cal}/_{mol\cdot K} = .0821\ ^{L\cdot atm}/_{mol\cdot K}$; $P = \rho g d$; $g = 9.8\ \frac{N}{kg}$

mass densities: $gN_2 = 1.25\ ^{g}/_{L}$ $gCO_2 = 1.964\ ^{g}/_{L}$; $\ell N_2 = 0.808\ ^{g}/_{mL}$ $\ell H_2O = 1.000\ ^{g}/_{mL}$ $sCO_2 = 1.56\ ^{g}/_{mL}$

water: c(solid) = .50 $^{cal}/_{gC°}$; L(melt) = 80 $^{cal}/_{g}$; c(liq) = 1.0 $^{cal}/_{gC°}$; L(vap) = 540 $^{cal}/_{g}$; c(gas) = .47 $^{cal}/_{gC°}$

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1. A sealed bicycle pump holds 200 mL atmospheric pressure air at 20°C . *Always Show Steps!*

a) About what mass of air does the pump hold?

5 mass = $\rho_m V \approx 1.25 \frac{g}{L} \cdot (200 mL) = 0.25 g$

b) if it is slowly compressed to 50 mL, its pressure will be { 16 | 4 | 2 | 1 | ½ | ¼ | 1/16 } atm.

$P_{200}V_{200} = P_{50}V_{50} \Rightarrow P_{50} = 1 atm \frac{200mL}{50mL} = 4 atm$

so hit piston 4× as often

c) this occurs because the air molecules move { faster | farther | not as far | slower } to the piston.

d) if the air is compressed to 50 mL fast, its pressure will be { more | less | the same } than b) above.

3 e) explain your answer to d) briefly, using Energy vocabulary:

You did Work to gas, transfered Energy from you to gas, which stays if fast; with more energy the gas molecules move faster, @ higher Temperature

if slow, heat leaks out thru pump wall.

2. A suction cup "dart gun" dart can stick to a window

a) because it becomes { frozen | pulled by suction | pulled by glass | pushed by air } .

3 b) a good (2.5cm dia.) suction cup's holding force is about { 500 kN | 5 kN | 50 N | 0.5 N | 50 mN } .

Force = $P \cdot A = 101 \frac{kN}{m^2} \cdot (\frac{\pi}{4} \cdot .025m \times .025m) = .05 kN$

3. With power returned, the furnace heats air in the house from 5°C to 20°C .

a) which change(s) occur? Air volume ___ contracts X expands

Air pressure ___ decreases ___ increases ← remains atm pressure inside house

5 b) the value in a) changes to what percent of the original (cold) value?

$PV \sim T(kelvin)$: $\frac{T_{warm}}{T_{cold}} = \frac{273K+20K}{273+5K} = 1.054 (\Rightarrow \Delta V = 5.4\%)$ = 105.4%

c) the air molecules do : ___ get larger ___ more of them X move faster ___ move slower

X space farther apart ___ closer together X spin faster ___ weigh more ___ weigh less

4. Explain why (briefly!) why mountains are often "snow-capped":

5 Less Pressure @ mountaintop, so rising air expands, doing Work. Losing Energy while rising lowers its Temperature, until water vapor deposits into snow.

$\frac{6.24 \pm 1.8}{21}$ $\frac{7 \times .5}{6½ \times 1}$ $\frac{5.9 \pm 1.4}{10}$