Name: _____ Key _____   Id#: _____   Sect.#: _____

Suppose $A = B^n/C^m$, where A has dimensions LT, B has dimensions L^2T^{-1}, and C has dimensions LT^2. Find the values of the exponents n and m.

$$LT = \frac{\left(L^2 T^{-1}\right)^n}{\left(L T^2\right)^m} = \frac{L^{2n} \, T^{-n}}{L^m \, T^{2m}}$$

$$L^1 T^1 = L^{2n-m} \, T^{-n-2m}$$

$$\Rightarrow \quad 2n - m = 1$$

$$-n - 2m = 1 \quad \Rightarrow \quad 2n = \boxed{-2 - 4m}$$

$$-2 - 4m - m = 1 \quad \Rightarrow \quad -5m = 3$$

$$\Rightarrow \boxed{m = -\frac{3}{5}}$$

$$2n = -2 - 4\left(-\frac{3}{5}\right) \Rightarrow n = -1 + \frac{6}{5}$$

$$\Rightarrow \boxed{n = \frac{1}{5}}$$

Name: **Key**   Id#:   Sect.#:

(a) Pressure, P, inside a fluid is given by $P = \rho\, g\, h$, where ρ is the density, g is the acceleration due to gravity and h is the depth inside the fluid (distance). Find the dimensions of P.

$$[P] = \frac{M}{L^3}\,\frac{L}{T^2}\,L \qquad\qquad [\rho] = \frac{M}{L^3}$$

$$\boxed{[P] = \frac{M}{LT^2}} \qquad\qquad [g] = \frac{L}{T^2}$$

$$[h] = L$$

(b) The speed of sound is 340 m/s. Express this in millimeters per nanosecond [1 ns = 10^{-9} s]. Write the answer in **3 significant figures**.

$$340\ \frac{m}{s}\left(\frac{1000\ mm}{1\ m}\right)\left(\frac{10^{-9}\ s}{1\ ns}\right) = \boxed{3.40 \times 10^{-4}\ \frac{mm}{ns}}$$

$$or = 0.000340\ \frac{mm}{ns}$$

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The average radius of a nucleus is R = 1.2 fm (femto-meter). Calculate the density in (kg/m³) of the nucleus which has a mass of 1.1u (atomic mass unit) [1 fm = 10^{-15} m, 1 u = 1.66 x 10^{-27}kg]. Write the answer **3 significant figures**.

$$\rho = \frac{mass}{volume} = \frac{mass}{\frac{4}{3}\pi R^3}$$

$$m = 1.1\, u = 1.1\, u \left(\frac{1.66\times10^{-27}\, kg}{1\, u}\right) = 1.826\times10^{-27}\, kg$$

$$R = 1.2\, fm = 1.2\, fm \left(\frac{10^{-15}\, m}{1\, fm}\right) = 1.2\times10^{-15}\, m$$

$$\rho = \frac{1.826\times10^{-27}}{\frac{4}{3}\pi\,(1.2\times10^{-15})^3} = \boxed{2.52\times10^{17}\, \frac{kg}{m^3}}$$