phys 225 Homework due Oct 23

3.14

^{12}C atom has mass 12 u exactly

the nucleus = atom − 6 (electrons)

mass of 6 electrons = 6 (0.549×10^{-3} u)

= 3.294 × 10^{-3} u

so mass of ^{12}C nucleus = 12.000 − 0.003

= 11.997 u

3.23 1 pound mass = 454 grams

12 grams = 1 mole of ^{12}C

1 mole of 12C = $(N_A)(12)$ u

so $N_A u$ = 1 gram

part b) 6.022×10^{23} u = 1 gram

a.) mult. by 454: 2.73×10^{26} u = 1 pound mass

3.32 $\lambda = \frac{1}{n\sigma}$; $PV = NkT$

$P = \frac{N}{V} kT = nkT$

so $\lambda = \frac{kT}{P\sigma} = d$ for Knudsen regime

$P = \frac{kT}{d\sigma}$ if we use S.I. units

$P = \frac{1.38\times10^{-23}(293)}{(20\times10^{-2})(\pi)(0.15\times10^{-9})^2} = 0.29$ pascal

One Atm ≈ 10^5 pascal

so $P = 0.29 \times 10^{-5} = 2.9 \times 10^{-6}$ atm

3.37 – eq 3.36 → $D_{rms} = \left(\frac{kT}{3\pi\eta a}\right)^{1/2} t^{1/2}$

the only thing changed is a

3.37 - cont'd

Since mass does not appear here

Q is doubled, so D_{rms} is multiplied by $\frac{1}{\sqrt{2}} \rightarrow D_{rms} = 71\ \mu m$

3.38 here we are asked how far it goes if $t \rightarrow 10 \times t$.

Since D_{rms} is proportional to $\sqrt{t}$

D_{rms} will be multiplied by $\sqrt{10}$

$= 10 \times \sqrt{10}\ \mu m = 32\ \mu m$

3.40

$\vec{\Delta p} = \vec{F} \Delta t \qquad \vec{P_0} = m v \hat{x}$

$\vec{F} = -eE\hat{y}$

$\Delta t = l/v$

$\tan\theta = -P_y/P_x$

$P_y = \Delta p$ since $\vec{F}$ is in $\hat{y}$ direction and P_y started at 0

$P_x = P_0$ since $F_x = 0$

So $\tan\theta = \dfrac{eEl/v}{mv} = \dfrac{eEl}{mv^2}$

and $\tan\theta \approx \theta$ for small θ.