Assignment Set 2 - Read Unit 1 Ch. 3 thru Ch.5 Due *9/05/17* Name______________

Basic IBM† Physics

1. Many are surprised by a little “explosion” that occurs when a *90gm* superball is dropped with a *10gm* pen on top.
(a) Under ideal† conditions the pen is fired upward with a speed that is ______ †† times the speed with which the two hit the floor and rises ______†† times the height from which they were dropped.
(They usually don’t notice that the ball rises only ______†† times that drop height.)

† *“Ideal” means negligible internal friction and air drag and valid Independent Bang Model (IBM).*

†† *Use geometry or algebra to give factors to 2-figure precision.*

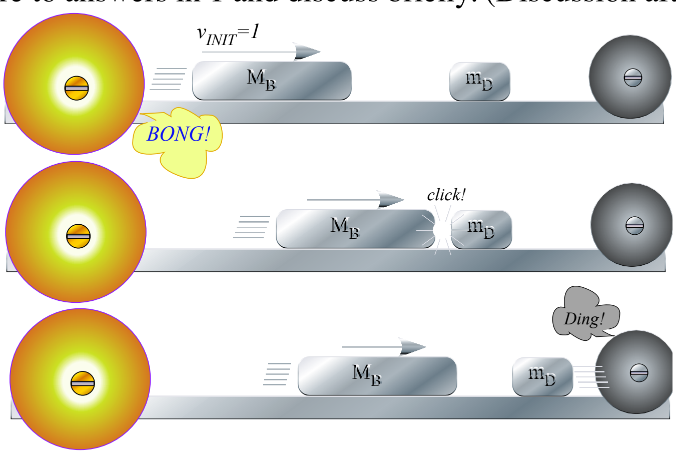
(b) Under less ideal conditions an evil student might spoil the professor’s demo toy by putting a drop of *Sticky-Stuff*© between the ball and pen. Assuming that drop wastes as much energy as possible, derive the final speed and height factors that may result.

V_{BALL}=______$\cdot v_{INIT}$ V_{PEN}=______$\cdot v_{INIT}$ h_{BALL}=______$\cdot h_{INIT}$ h_{PEN}=______$\cdot h_{INIT}$

Discuss briefly why the approximate IBM† works so well in “superball theory.”

Random Banging Around

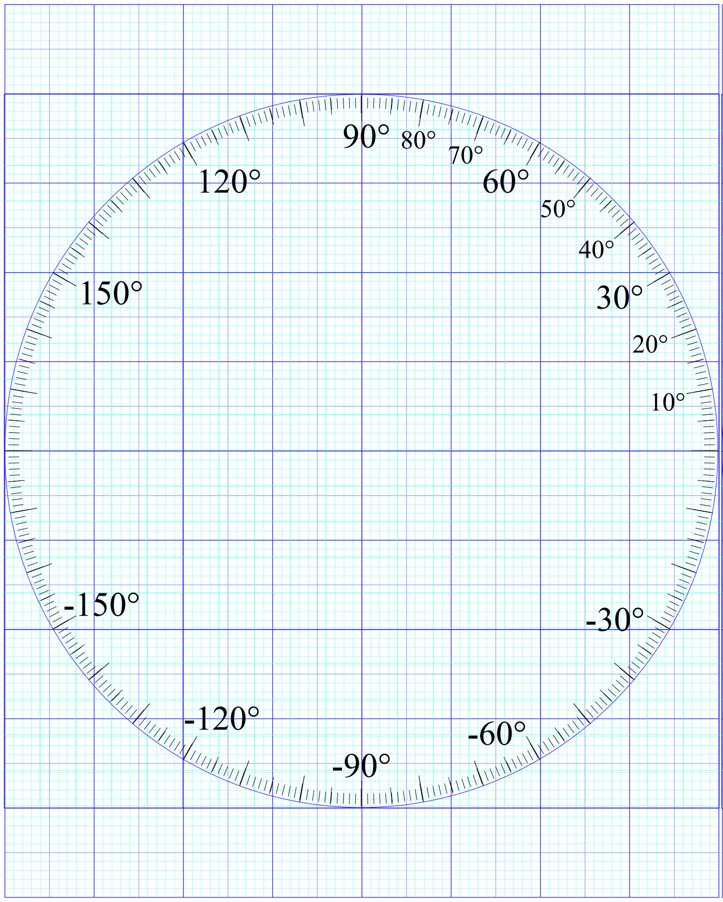
2. These same people might not be so surprised by what goes on in a low-temperature high-vacuum atomic vapor chamber that has a mixture of Hydrogen (atomic weight 1.0) and Beryllium (atomic weight 9.0). On the average the H atoms have a speed that is _______ times that of the Be atoms. If the chamber is opened to a large enclosing ultra-high vacuum chamber, then H atoms could rise ______ times as high as the Be atoms, on the average. Compare to answers in 1 and discuss briefly. (Discussion after Fig. 5.2(d-e) is important here.)



Woo-Pig and Click-Ding-a-ling

3. Physics has decided to spend another $10,000 to design a … *BONG!, Click-Ding, Click-Ding, …(some number N of Click-Dings)…Click-BONG!-…(repeat)* toy to add to our contraption that currently greets visitors. The idea (as silly as it sounds) is to have exactly *N Click-Dings* (M_B hits m_D=*1gm* with a *click* and m_D hits right bell with a *Ding!*) after a first *BONG!* is heard when mass M_B initially bounces off the huge left bell with velocity v_{INIT} = *10m/s* toward the initially stationary little mass m_D that makes *N* trips between M_B(*Click!*) and right bell (*Ding!*). Finally, M_B returns with final velocity $v_{FIN}=-v_{INIT}$ after a final M_B-m_D *Click!* and a *Bong!* to start over.

Can you save the department a high design fee? What mass M_B will give exactly *N-Click-Ding-Click* trips?
Is this possible for *N=4*? ... for *N=3*? ... for *N=2*? ... for *N=1*?... for *N=0*? *(Hint: start with lower N.)*
Plot (v_B,v_D) velocity-velocity diagrams in Lagrangian and/or l’Etrangian form for each allowed *N* and give M_B.
Plot corresponding (x_B,x_D) position-position diagrams for *N=2* case.
Within each allowed *N*-sequence plot&write peak speed v_{Dmax} of *Ding-ing* mass m_D.
Within each allowed *N*-sequence plot&write minimum speed v_{Bmin} of *Bong-ing* mass M_B.
Give a convenient general formula for allowed $M_B(N)$.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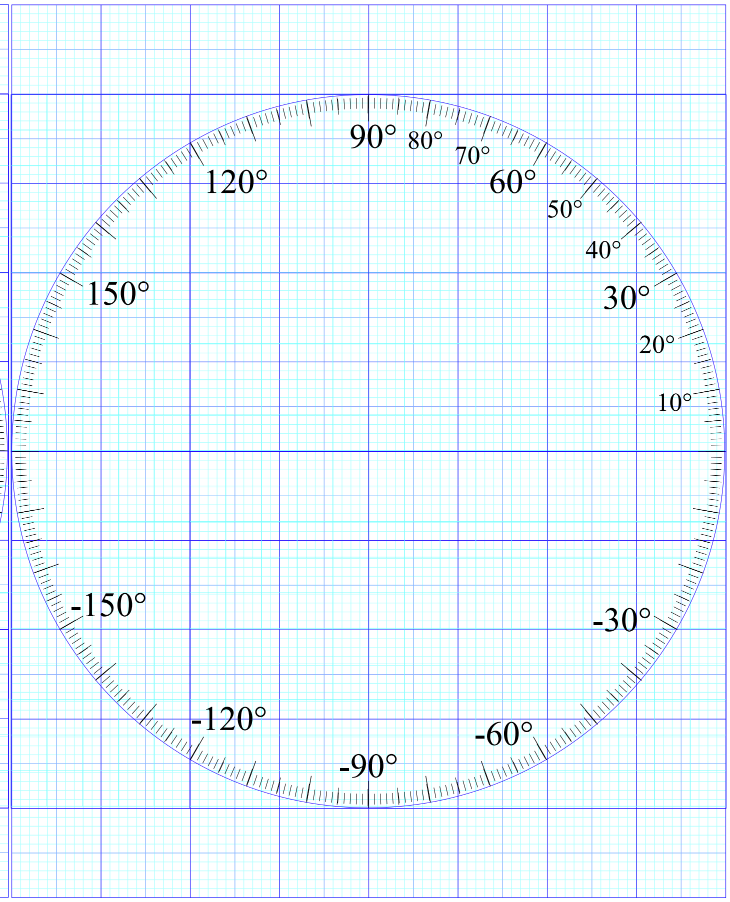
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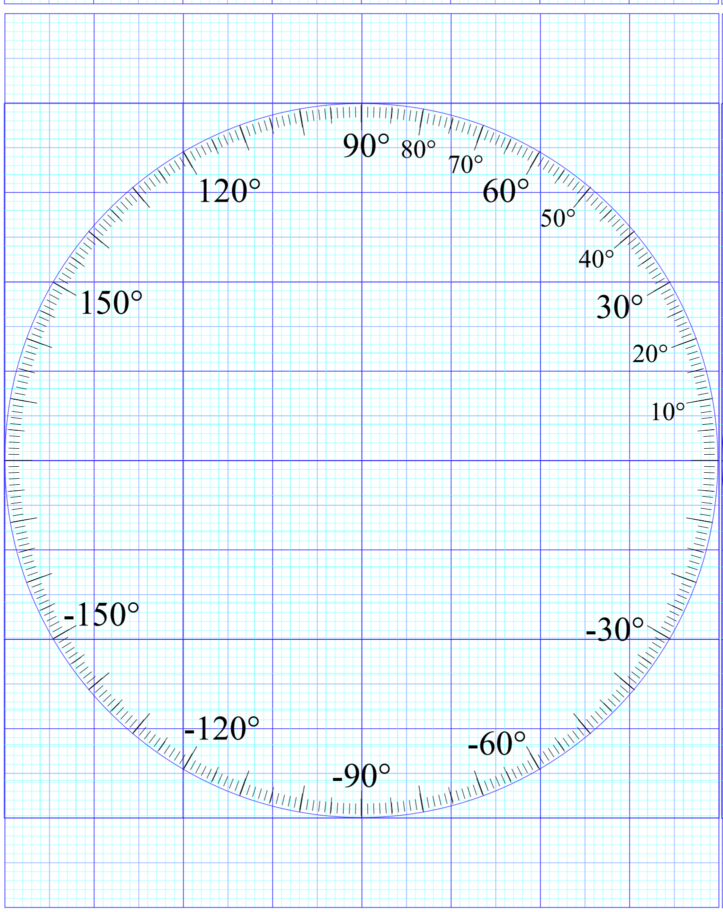
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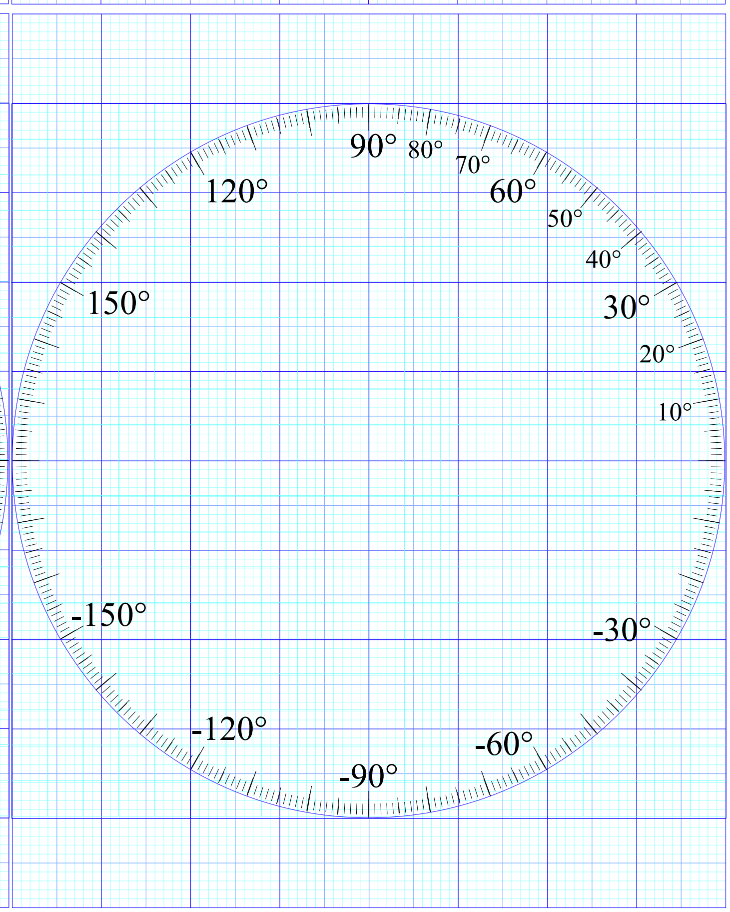
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