Phys 221 Exam 2 Date: October 13, 2017

Name: _____

Please answer the following questions in the space provided. In the case of multiple choice questions, please circle your answer clearly. Show *all* your work, *even on multiple choice problems* for a chance at partial credit! Please refrain from using any Chapter 6 material (energy or work) on this test. Good luck!

Useful Constants and Identities
$G = 6.67 \times 10^{-11}\,\mathrm{Nm^2/kg^2}$
$\epsilon_0 = 8.85 \times 10^{-12}\,\mathrm{A^2s^4/kgm^3}$
$M_{earth} = 5.97 \times 10^{24}\,\mathrm{kg}$
$R_{earth} = 6371\,\mathrm{km}$
$\cos(90+\theta) = -\sin(\theta)$
$\cos(90-\theta) = \sin(\theta)$
$\tan(\theta) = \frac{\sin(\theta)}{\cos(\theta)}$
Circumference $= 2\pi r$
Area of Circle $= \pi r^2$

Happy Friday the 13th!

(2) 1. Jason hurls a 5 kg axe at his hapless target. The terrified target (65 kg) is running in the negative z-direction at 8 m/s. If the axe strikes the target moving at 20 m/s in the positive x-direction and sticks in the target, at what speed is the target/axe system moving immediately after the collision?

A. 7.4 m/s

B. 7.56 m/s

C. 12.31 m/s

D. 21.5 m/s

(2) 2. Seeking to dispose of the body, Jason retrieves his axe and drags the body down to the lake. The now 60 kg body has a volume of 0.0664 m^3, and the lake water has a density of 1000 kg/m^3. Obsessed with being efficient, Jason wants to add the minimum mass needed to the body (rocks stuffed into pockets) to ensure it will sink to the bottom of the lake. How much mass should he add?

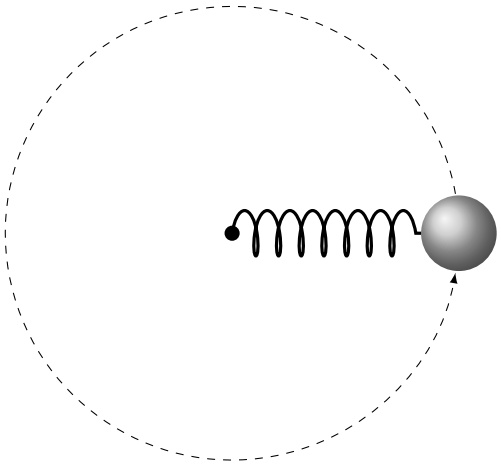
A. 3.23 kg

B. 6.41 kg

C. 7.38 kg

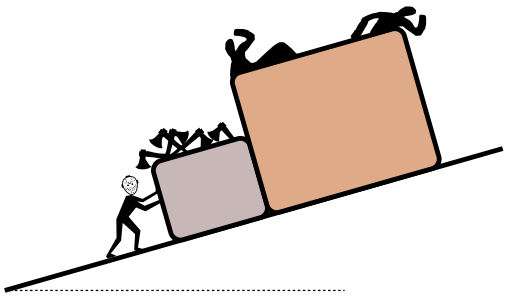
D. No extra mass is needed, the body will sink on its own

(5) 3. Climbing back up the hill to the Camp Crystal Lake Lodge, Jason notices a peculiar device spinning on the ground. A 5 kg mass is attached to a 400 N/m strong spring and is spinning in a circle of radius 2 m centered on the other end of the spring. Jason has been needing a strong spring for a special project, but he needs to know the relaxed length of the spring. Observing the setup for a bit, he notices that the mass completes one revolution every 1.25 s. What is the relaxed length of the spring?



Topdown View

4. Jason wants to head up a hill (angle with horizontal = 20°) with a box of axes (30 kg) and a box of bodies (500 kg). Both boxes experience a coefficient of static friction of 0.82 and a coefficient of kinetic friction of 0.74.



(2) (a) Sketch Free Body Diagrams for both boxes, labeling all forces and indicating relevant angles.

(3) (b) How hard should Jason push to start the boxes moving?

(4) 5. Resurrected (yet again) sometime in the distance future, Jason (85 kg) finds himself aboard a space station circling 400 km above the surface of the Earth. Striving to get to a higher portion of the station, he leaps straight up from the ground with an initial velocity of 10 m/s. How high above the space station floor does he travel?

(6) 6. In order to trip unfortunate passerby's and make an easier target for his machete, Jason tightens a trip wire across a 1 m wide door-frame. The wire has a cross-section of 3 mm^2 and is made of titanium ($Y = 116\,\text{GPa}, 47.87\,\text{g/mol}, 4.507\,\text{g/cm}^3$). If the wire stretches 1 cm as Jason tightens it, what is the final tension in the wire?

(2 (bonus)) 7. Returning to the surface of the Earth, suppose Jason wears shoes with a total charge of 5 mC and the floor of the lab has a charge of 3.129 mC. How high above the floor would Jason levitate?

If I didn't pay this source material the respect you thought it deserved, I apologize but I've never actually seen any of these movies! (Wikipedia for the win!) Hope you have an accident free and healthiest of days and weekends!!