Supplemental Midterm Examination Physics 100

November 7, 2011

Name/Student #:

Instructions: Formulas at the back (you can rip that sheet off). Questions are on both sides. Calculator permitted. Put your name and student number at the top of the question sheet and complete all questions on the question sheet. Point values are shown with the questions. Complete the questions in any order. Total exam is worth 60 points.

For multiple choice questions clearly circle the correct answer or the letter/symbol immediately in front of the correct answer. You do not need to show your work for multiple choice questions and I will not include the work of multiple choice questions for credit.

1. A driver wants to test the brakes on his car. Draw a motion diagram for a car that starts from a stop, accelerates to drive east at speed of 20 m/s over a distance to 80 m. After 2 s the driver slams on the brakes to rapidly stop in about 20 m. Use 0.5 s time intervals but don't worry about the length scales being perfectly correct. (8 points)

2. A child is moving on a merry go-round that is speeding up. At one instant the velocity of the child is 2.00 m/s to the right. 0.500 s later the speed has increased to 3.00 m/s and the direction of $\vec{v}$ is now 10.0 degrees counter-clockwise compared to the original $\vec{v}$. (The merry go-round is rotating counter-clockwise if that helps you with directions.)

   (a) Draw $\vec{v}_i$, $\vec{v}_f$, and $\Delta\vec{v}$ keeping the scales and angles at least roughly correct. (5 points)

(b) The magnitude of the acceleration is (5 points)

i. 4.48 m/s^2

ii. 4.35 m/s^2

iii. 2.16 m/s^2

iv. 2.00 m/s^2

v. Can't give an answer from the given information.

3. You step off a platform diving board and 2 s later you land in the water. One second after that your speed is reduced to one-half of what it was one second later you have come to rest below the surface of the water. Give $y(t)$, $v_y(t)$, and $a_y(t)$ graphs for the time interval from when you step off until you come to rest. (6 points) How can we find the $v_y(t)$ graph from the $a_y(t)$ graph? (2 points) Use this fact to demonstrate how two important "features" of the $a_y(t)$ compare if v_y is zero at the beginning and at the end. (2 points) A child with half of your mass also steps off of the board. Will their $y(t)$, $v_y(t)$, and $a_y(t)$ graphs before hitting the water look the same or different? Explain why with Newton's 2nd law. (4 points)

4. A ball rolls off a high shelf with a speed of 0.60 m/s and it lands 0.40 m away from the edge of the shelf. How high is the shelf from the floor? (8 points)

   (a) 1.1 m
   (b) 2.2 m
   (c) 3.3 m
   (d) 4.4 m
   (e) Need to know $(v_y)_i$ and it isn't given.

5. It is your option whether or not you want to draw a free-body diagram to assist you with this question. A 400 g block sits on a plane inclined at an angle of 25°. The coefficient of static friction is 0.5 and the coefficient of kinetic friction is 0.4. A force F_a is applied to the block in the direction parallel to and "up" the plane. The motion of the block is best described as (10 points)

   (a) Constant acceleration with $a_y = -g$.
   (b) Impossible to say since we can't say anything definite about the normal force.
   (c) If the block is moving then we could say that $a_{xR} = \left(F_a - mg\sin\theta - \mu_k mg\cos\theta\right)/m$ with positive x_R being "up" the ramp.
   (d) The above statement even applies if the block is not moving.
   (e) Statement '(c)' applies but the expression for the acceleration should be $a_{xR} = \left[F_a - mg\sin\theta - \mu_k(mg - F_a)\cos\theta\right]/m$.

6. In class I demonstrated showed you a glider on an air track. We had it set up so there was no force of friction. I did two experiments: one I started the glider moving and it just kept moving. In the 2nd I moved the entire air track but the glider just stayed in place relative to the class room. These experiments point to one of Newton's Law. Which one and how does it support the law? (10 points)

———Space for extra notes———