Midterm Examination Physics 100

October 24, 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. Draw a motion diagram for a car that is driving west through a parking lot at 2 m/s, then slows down to 1 m/s, and then turns right into a parking space and stops. Don't need to include any velocity vectors unless you think they help explain your solution. You don't need absolute scales. (8 points)

2. A baseball is moving at 30 m/s to the right in the horizontal direction. 0.05 s later it has been fouled back and its velocity is now 20 m/s, upward, 25 degrees to the right of vertical. For this problem ignore the effects of gravity and drag; just take the initial and final velocities as stated.

   (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. 28 m/s^2

ii. 200 m/s^2

iii. 850 m/s^2

iv. 560 m/s^2

v. There is no such thing as "magnitude" of acceleration. It is always a vector.

3. You throw a ball straight up into the air and catch it when it comes back. Assume there is no drag force. Give $y(t)$, $v_y(t)$, and $a_y(t)$ graphs for the time interval when the ball is not in your hand. (6 points) How can we find the $v_y(t)$ graph from the $y(t)$ graph? (2 points) Compare points on the $y(t)$ graph at $t = 0$, when the ball is part way up and when the ball has reached its maximum height to show how this matches the $v_y(t)$ graph. (4 points)

4. You are at a cottage and jumping off a 3.0 m high boat house deck into deep water. One of your friends takes a slight run before jumping off (horizontally, $\theta = 0$) and lands 3.0 m away from the deck. How fast was she running? (10 points)

   (a) 0 m/s

   (b) 3.8 m/s

   (c) 4.9 m/s

   (d) 6.5 m/s

   (e) This motion isn't possible (square root of a negative number).

5. It is your option whether or not you want to draw a free-body diagram to assist you with this question. A 300 g block sits on a plane inclined at an angle of 20^{o}. The coefficient of static friction is 0.5 and the coefficient of kinetic friction is 0.4. You increase the angle until the block just begins to slip then the angle θ stays unchanged. The motion of the block is best described as (10 points)

   (a) Constant velocity since $mg\sin\theta > f_k$.

   (b) It will slip but just for a bit. n will increase as the block slides down the plane increasing the friction.

   (c) As the block accelerates there is a change in the normal force but it *reduces* the friction, causing the acceleration to keep increasing.

   (d) There is a constant acceleration in the direction parallel and down the plane given by $g\left[\tan\theta - (\mu_s - \mu_k)\cos\theta\right]$.

   (e) There is a constant acceleration in the direction parallel and down the plane given by $g(\sin\theta - \mu_k\cos\theta)$.

6. In class I showed you a top that would float above a base due to some magnetic forces. I also showed you that when the top "floated" the base became "heavier" as measured by a scale. Essentially the scale measures the normal force on the base (it reads a mass but that mass is equal to the normal force divided by g). Explain what is happening with details. (A good diagram is worth many words!) (10 points)

———Space for extra notes———