This practice exam does not include questions with material that was covered on the first two exams; however, the actual final exam will cover material from the first two exams. I recommend studying the first two practice and actual exams. The actual final will integrate concepts from the whole class, so the problems on the final may have a somewhat different form than these questions.

Physics 161 - General Physics Final Exam - Pratice Block 5

To get credit for the problems on this test, you must start with a basic equation. You must solve algebraically for the quantity you're interested in finding before plugging in numbers. Then you must write down the equations with the numbers plugged in before you write down the answer. Justify any steps that are not just algebra.

Short answers

1. A 20 m long bungee cord stretches to 24 m when a 60 kg person hangs on it. What is the spring constant of the bungee cord? If a friend sets her into oscillation, what will her period of oscillation be?

2. When you are spinning on a merry-go-round, why does it feel like there is a force pulling you directly out from its center? What is really happening?

3. An object is accelerating at a rate of $a(t)=bt^2$. Find expressions for v(t) and x(t).

4. A satellite makes a circular orbit around the earth's equator in geosynchronous orbit (one orbit every 24 hours). How far away from the center of the earth must the satellite be and how fast must it be going?

Long Problems.

1. As you are riding in a 1450 kg car, you approach a hairpin curve in the road whose radius is 60 m. The roadbed is banked inward at an angle of 12°. Suppose the road is dry and that the static friction coefficient between the tires and the asphalt road is 0.6. What is the maximum speed at which you can go around the curve without slipping? (Ignore air drag.) To get full credit for answering the question, you must draw a free body diagram, a net force diagram, and identify the acceleration for the car. You must also state (in words) the principles that apply and write down the master equation(s) which reflect those principles.

2. A 0.5 kg ball is thrown at an angle 25° above the horizon at a speed of 10 m/s and an initial height of 12 m above the ground. Use the following two different methods to find the speed of the ball when it hits the ground.
   a) Use conservation of energy (you do not need to justify the use of conservation of energy).
   b) Use projectile motion equations.
   c) Use a trajectory diagram with a time step of 0.2 s and a scale factor of 2 cm = 1 m to determine the maximum height of the ball. Check the value by calculating the maximum height of the ball.

3. Your spaceship is orbiting a planet of mass 6.4×10^{23} kg in a circular orbit at a distance of R= 40,000 km from the center of the planet. You'd like to put your spaceship into a Hohmann transfer orbit which brings you to a distance of 3,500 km from the center of the planet at its closest point (100 km above the surface of the planet). When you reach this close point, you will re-establish a circular orbit at 3,500 km from the center of the planet. Calculate the changes needed in orbital speed for transfers both from the initial circular orbit to the elliptical orbit and from the elliptical orbit to the final circular orbit.

4. Draw a motion diagram, a free body diagram, and a net force diagram for a suitcase left in the aisle of an airplane as the airplane accelerates forward for take-off. The suitcase accelerates forward, but not as fast as the airplane.

5. A pickup truck (m=1800 kg) carries a box (m=45 kg) up a road that is inclined at an angle θ=5.7°. Ignore drag. To get full credit for answering this question, you must

a) Identify all of the forces that are acting on the truck and (separately) all the forces acting on the box.

b) Write down Newton's Second Law in column vector form separately for the truck and for the box.

c) If the coefficient of static friction between the box and the bed of the truck is μ_s=0.45, what is the largest acceleration the truck can have while preventing the box from sliding in the truck bed?

d) What force must the tires exert on the road to accelerate the truck this amount?