

Final Exam

December 12, 2005

This is a closed book examination. There is extra scratch paper available. Explain all answers completely – show your thoughts and work!

- 1) [10 pts] You have a spring with a small mass attached that has an oscillation frequency, f , when it is bounced vertically. If you cut your spring in 3 equal parts and use one of these shorter springs with the same mass the new oscillation frequency is
 - a) Less, $\frac{1}{\sqrt{3}}f$.
 - b) Less, $\frac{1}{3}f$.
 - c) The same, f .
 - d) Greater, $\sqrt{3}f$.
 - e) Greater, $3f$.

- 2) [10 pts] You throw a light ball into the air at an angle of θ to the horizontal. After the ball leaves your hand it travels a vertical distance y . You toss another ball that has 9 times the mass of the first ball into the air again exactly as you did before except you throw this ball with 3 times the initial velocity. The resulting vertical distance is
 - a) Less, $\frac{1}{3}y$
 - b) Less, $\frac{1}{9}y$
 - c) The same, y
 - d) Greater, $3y$
 - e) Greater, $9y$

- 3) [10 pts] You have a ring and a solid disk that both have the same radius. However, the disk has four times the mass of the ring. If these objects were to roll without slipping down a 7° ramp which one would reach the bottom first?
 - a) The ring
 - b) The disk
 - c) They would reach the bottom at the same time
 - d) They would not reach the bottom, the ramp needs to be steeper

- 4) [10 pts] You are pushing a box horizontally across the floor at a constant velocity of 2 m/s. You get tired and start pushing with half the original force. If the box travels 2 meters after you get tired, what is the kinetic coefficient of friction?

- 5) [10 pts] What is the escape velocity for a 3.14×10^4 kg rocket launched from earth?

- 6) [10 pts] An amusement park is testing the failure modes of their new roller coaster. They release an empty 3-car chain from the top of a 50 m tall ramp. At the bottom of the ramp is a horizontal section of track 10 m long. In the middle of this section is a 2-car chain. Following the flat section is a ramp that carries the cars to the top of a 20 m tall hill. If the first 3 empty cars were to stick to the bottom cars would the resulting 5-car chain make it over the second ramp? Assume negligible friction.

- 7) [10 pts] If $\Sigma F = 0$ on an object, can it stop spinning? If $\Sigma \tau = 0$ on an object, can it accelerate? Can an object be moving if $\Sigma F = 0$ and $\Sigma \tau = 0$? Explain.