

200 points
6 Pages + Cover and Equation Sheet
1 hour, 48 minutes

Student Name: _____

Recitation Instructor (circle one): Moe Larry Curly Groucho Harpo Chico

- **Write your name and circle the name of your recitation instructor on every page.** The pages of this exam will be separated and each page graded by a different instructor. You must have your name on each sheet to receive a grade.
- **Show your work and justify your answers to guarantee full credit.**
- **Force, acceleration, velocity, etc. are vectors.** Answer accordingly.
- **Neglect the effect of air resistance and friction and the mass of ropes, pulleys and springs unless instructed or clearly implied otherwise.**
- **Good luck!**

Page 1 _____ Page 5 _____

Page 2 _____ Page 6 _____

Page 3 _____

Page 4 _____

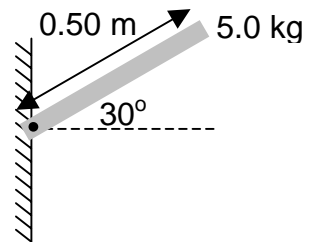
Total _____

Recitation Instructor (circle one): Moe Larry Curly Groucho Harpo Chico

Problem 1. Short Exercises.

- (a) A ball, launched from the ground, lands 15 m away after 2.0 s. What was the launch angle as measured with respect to the horizontal?
- (b) A 10 N box, initially sliding at 3.0 m/s, comes to a halt in 5.0 m. What is the coefficient of friction between the box and floor?
- (c) A 7.0 kg mass hangs at rest from a spring attached to the ceiling. The spring is stretched 8.0 cm beyond its relaxed length. What is the spring constant?

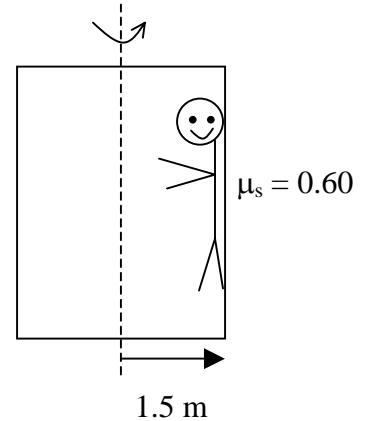
- (d) What is the angular acceleration at the moment shown?



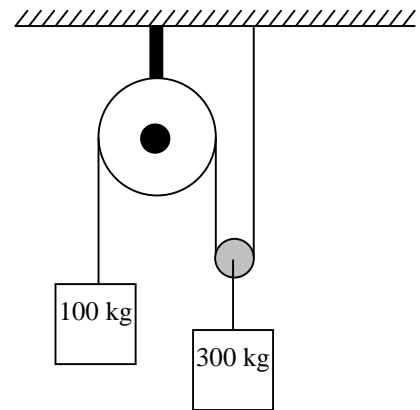
Recitation Instructor (circle one): Moe Larry Curly Groucho Harpo Chico

Problem 2. Short Exercises.

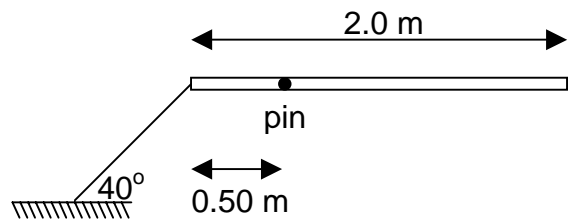
- (a) A popular amusement ride consists of a spinning cylinder with a floor that lowers leaving the riders stuck on the inside wall of the cylinder. For the situation shown, what is the minimum angular velocity that will keep the rider from sliding down the wall?



- (b) What's the acceleration of the 100 kg mass?



- (c) A 10 kg rod is free to rotate about a pin as shown, but is motionless. What is the tension in the string connected to the left side of the rod?

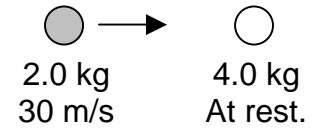


Recitation Instructor (circle one): Moe Larry Curly Groucho Harpo Chico

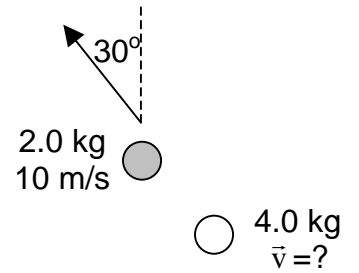
Problem 3. Two masses sliding on a frictionless table collide as shown. Before the collision. Assume they do not spin.

(a) What is the final velocity of the 4.0 kg mass?

(b) If the collision lasted 1.5 ms, what was the average force exerted on the 4.0 kg mass?



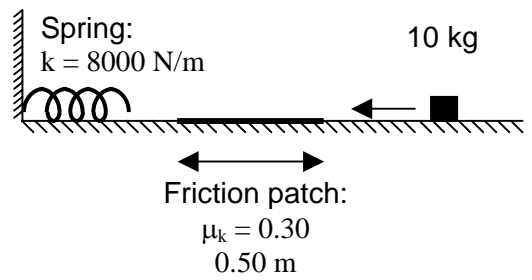
After the collision.



Recitation Instructor (circle one): Moe Larry Curly Groucho Harpo Chico

Problem 4. A mass, moving to the left, passes over a friction patch and compresses a spring 4.0 cm before momentarily stopping.

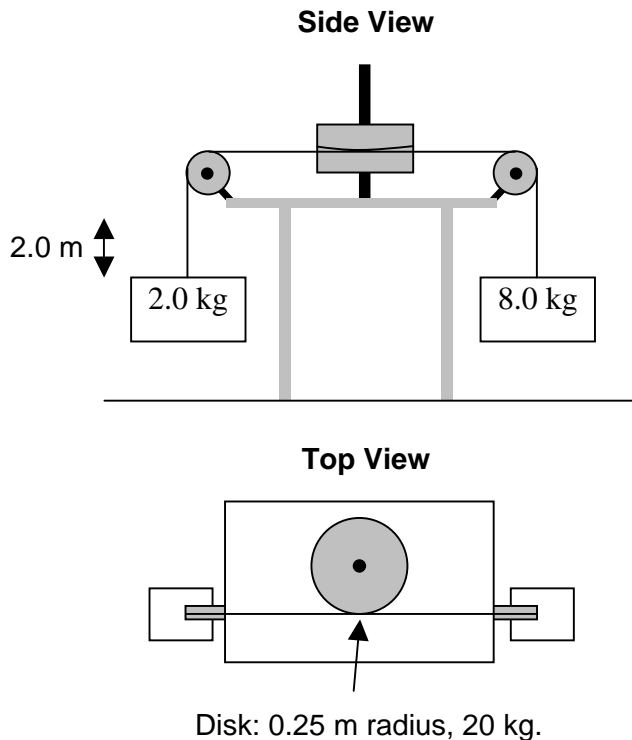
What was the initial speed of the mass?



Recitation Instructor (circle one): Moe Larry Curly Groucho Harpo Chico

Problem 5. A string wraps around a solid cylindrical disk and is connected on both ends to masses over massless pulleys. The system is initially at rest. As the masses move, the string does not slip on the disk.

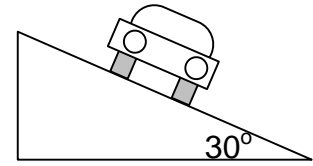
What is the speed of the 2.0 kg mass after it has raised 2.0 m?



Recitation Instructor (circle one): Moe Larry Curly Groucho Harpo Chico

Problem 6. A car is going around a circular track. The road is banked as shown in the figure. The coefficient of friction between the car's tires and the road is 0.40. The maximum speed the car can go without slipping is 200 km/h.

What is the radius of the track?



Car on a banked road.
The car is traveling
out of the page at the
moment shown.

Recitation Instructor (circle one): Moe Larry Curly Groucho Harpo Chico

Here are some extra questions, covering different subjects than those on the previous pages. If you using this exam for timing, don't include these problems.

(a) A 40 kg box is pulled up by a rope and winch at 3.0 m/s. What power must be expended by the winch to do this?

(b) A 100 kg astronaut in a rocket ship one earth radius above the earth's surface has an apparent weight of 1200 N. The rocket ship is accelerating directly away from the earth. What is the magnitude of its acceleration?

(c) The 10 kg block is moving up at constant velocity. The kinetic coefficient of friction between the block and the wall is 0.40. What is the magnitude of force F , applied to the block at an angle of 30° as shown?

