Physics 201 MWF 9:10 Fall 2008 (Ford)

Name (printed)_____

Name (signature as on ID)_____

Section_____

Final Exam Chapts. 1–16 in Young/Geller

Show all your work. Partial credit will be given if earned. Write your answers in the blanks provided.

(8 pts) 1. When a rock is suspended from a string in air, the tension in the string is 49.0 N. When the rock is lowered into water until it is totally submerged, the tension in the string is 38.0 N. The density of water is 1000 kg/m^3.

a) What is the magnitude of the buoyant force that the water exerts on the rock when it is fully submerged?

Ans. 11 N

b) What is the volume of the rock?

Ans. 1.12×10^{-3} m^3

c) What is the density of the rock?

Ans. 4.45×10^{3} kg/m^3

d) Is the density of the rock larger or smaller than the density of water?

Ans. larger

(12 pts) 2. The ground surrounding a building is level. A small rock is thrown from the roof of the building with a speed of 20.0 m/s at an angle of 37° above the horizontal. The rock strikes the ground 3.5 s after it is thrown. Air resistance can be neglected.

a) What is the horizontal distance from the base of the building to the point where the rock strikes the ground?

Ans. 56 m

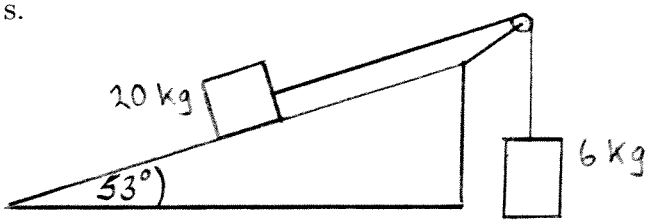
b) What is the height of the building?

Ans. 18 m

c) What is the magnitude of the resultant velocity of the rock (the rock's speed) just before it strikes the ground?

Ans. 27.4 m/s

(12 pts) 3. A block with mass 20.0 kg rests on a ramp that is inclined at 53° above the horizontal. A light rope passes over a light frictionless pulley and connects the 20.0 kg block to a 6.0 kg block that hangs vertically in the air. When the system is released from rest, the 6.0 kg block moves upward 0.26 m in 0.50 s.



a) What is the magnitude of the acceleration of the 20.0 kg block as it slides down the ramp?

Ans. 2.08 m/s²

b) While the blocks are moving, what is the tension in the rope?

Ans. 71.3 N

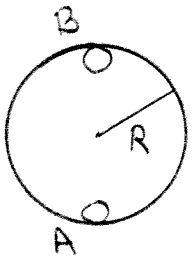
c) What is the magnitude of the friction force that the ramp exerts on the 20.0 kg block?

Ans. 43.6 N

d) What is the coefficient of kinetic friction μ_k between the block and the surface of the ramp?

Ans. 0.369

(12 pts) 4. A small rock with mass 0.20 kg slides without friction inside a horizontal steel pipe that has inside radius $R = 0.80$ m. The path of the rock is a vertical circle.



a) At the lowest point in its circular path (point A), the upward normal force that the pipe exerts on the rock is 17.0 N. What is the speed of the rock when it is at point A?

Ans. 7.76 m/s

b) What is the speed of the rock when it is at point B?

Ans. 5.37 m/s

c) What is the magnitude of the downward normal force that the pipe exerts on the rock when it is at point B?

Ans. 5.25 N

(8 pts) 5. A block with mass 0.40 kg is attached to a horizontal spring that has force constant 500 N/m. The block moves with simple harmonic motion on a horizontal frictionless surface. When the block is at $x = -0.20$ m (0.20 m to the left of its equilibrium position) its speed is 6.0 m/s.

a) What is the amplitude of the motion, the magnitude of the maximum displacement of the block from its equilibrium position?

Ans. 0.262 m

b) What is the maximum speed of the block during its motion?

Ans. 9.27 m/s

(8 pts) 6. A uniform disk with radius 0.20 m is pivoted at its center about a horizontal frictionless axle. The moment of inertia of the disk about an axis at the axle is 40 kg·m^2. The disk is initially at rest and then a constant force of $F = 80$ N is applied tangent to the rim of the disk.

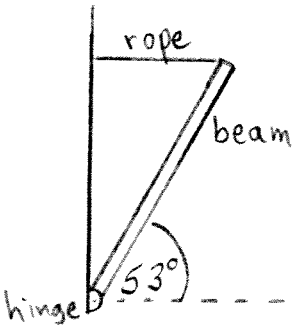
a) What is the magnitude of the angular acceleration of the disk?

Ans. 0.4 rad/s^2

b) What is the magnitude v of the tangential velocity of a point on the rim of the disk 5.0 s after the force starts to be applied?

Ans. 0.4 m/s

(10 pts) 7. A uniform beam is 12.0 m long and weighs 700 N. The lower end of the beam is attached to a vertical wall by a frictionless hinge. A light horizontal rope is attached to the upper end of the beam and holds the beam at an angle of 53° above the horizontal.



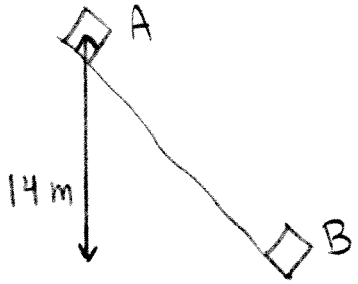
a) For an axis at the hinge, what is the magnitude of the torque produced by the weight of the beam?

Ans. 2527 N·m

b) What is the tension in the rope?

Ans. 264 N

(10 pts) 8. A brick with mass 2.0 kg slides down a grassy slope. At the top of the slope (point A) the speed of the brick is zero. After the brick has descended a vertical distance of 14.0 m, to point B, its speed is 7.0 m/s. How much work does friction do on the block as it moves from point A to point B?



Ans. -225 J

(8 pts) 9. In a container of negligible mass, a 1.5 kg piece of metal with an initial temperature of 220°C is placed on a 0.20 kg block of ice that has an initial temperature of −40.0°C. If no heat is lost to the surroundings and the final temperature of the system is 12°C, what is the specific heat capacity c of the metal? (For ice, $c = 2010$ J/(kg·K). For water $c = 4190$ J/(kg·K), $L_f = 3.34 \times 10^5$ J/kg and $L_v = 2.26 \times 10^6$ J/kg.)

Ans. 298 J/(kg.C°)

(12 pts) 10. In a process, 600 J of heat flows into 2.0 moles of a monatomic ideal gas that has $C_V = 3R/2$.

a) If this process is carried out at constant temperature, what is the work W for the process? Does the volume of the gas increase or decrease?

Ans. $W =$ +600 J

volume increases or decreases? increases

b) If this process is carried out at constant volume, what is the change in internal energy of the gas?

Ans. +600 J

c) If this process is carried out at constant pressure, what is the work W for this process?

Ans. +240J