Physics 1114 - General Physics I

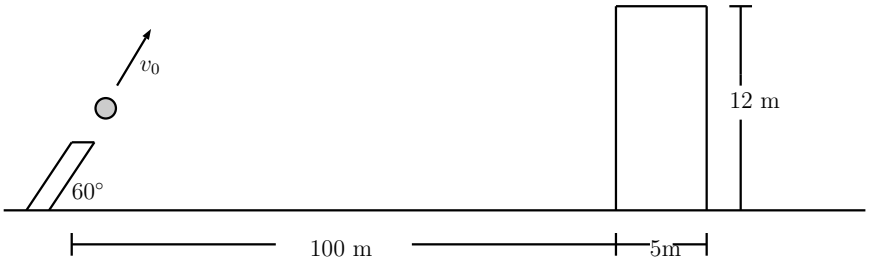
Final Exam - 2014.12.08

Name: _____

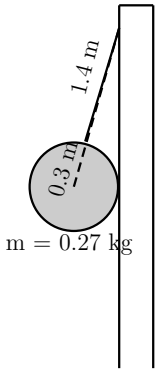
Instructions: Please show all work on each problem, and give full explanations where needed. No points will be awarded for a correct answer, points are awarded on the work shown for each problem. When you are finished, please attach your cheat sheet to this final exam.

problem	points	score
1	10	
2 (a)	4	
2 (b)	3	
2 (c)	3	
3	10	
4	10	
5 (a)	8	
5 (b)	2	
6 (a)	4	
6 (b)	4	
6 (c)	2	
7 (a)	2	
7 (b)	3	
7 (c)	3	
7 (d)	2	
8	10	
9	10	
10 (a)	6	
10 (b)	4	
11 (a)	3	
11 (b)	3	
11 (c)	4	
12	10	
Total	120	

1. A tennis ball launcher is used to launch a tennis ball from the ground, at an angle of 60° from the horizontal. You want to hit the top of the wall a distance of 100 meters away, which has height of 12 m, and thickness of 5 m (see the figure below). What range of initial velocities can you use to ensure that you hit the top of the wall?



2. A ball rests against a smooth, frictionless post to which it is attached. The string is attached through the center of the ball, passing through the surface and is attached to the top of the post. The radius of the ball is 0.3 meters and the length of measurable string outside of the ball is 1.4 meters.

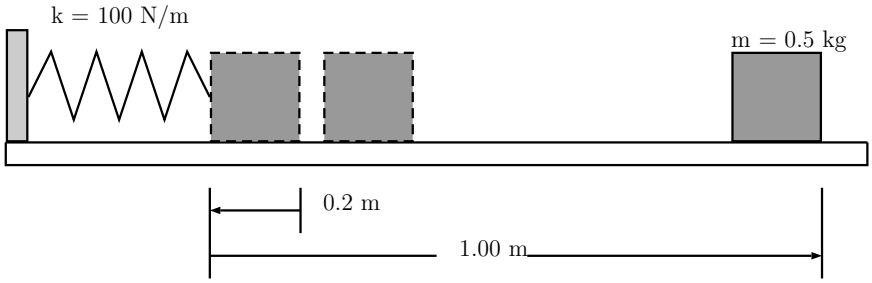


(a) Make a free-body diagram of the ball.

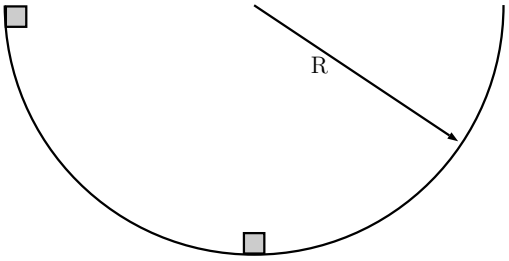
(b) What is the tension in the rope?

(c) What is the force the pole exerts on the ball?

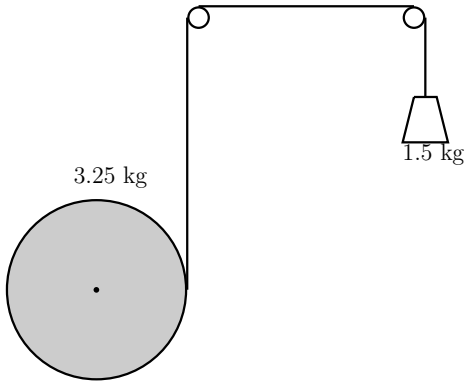
3. A block with mass 0.50 kg is forced against a spring of negligible mass, compressing the spring a distance of 0.20 m, as shown in the figure below. When released, the block moves on a horizontal table top for 1.00 m before coming to rest. The spring constant k is 100 N/m. What is the coefficient of kinetic friction μ_k between the block and the table top?



4. Two identical masses are released from rest in a smooth hemispherical bowl of radius R, from the positions shown from in the figure below. You can ignore the friction between the masses and the surface of the bowl. If they stick together when they collide, how high above the bottom of the bowl will the masses go?



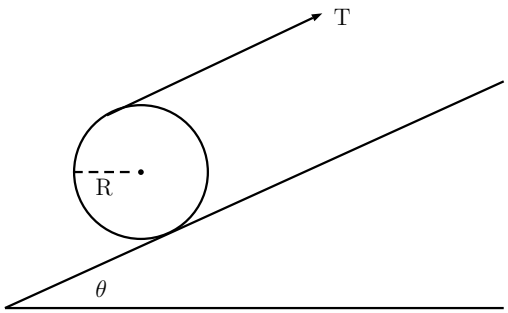
5. A solid uniform 3.25 kg cylinder 0.65 m in diameter is connected to a 1.5 kg weight over two massless frictionless pulleys as shows in the figure below. The cylinder is free to rotate about an axle through its center perpendicular to its circular faces, and the system is released from rest.



(a) How far must the 1.50 kg weight fall before it reaches a speed of 2.50 m/s?

(b) How fast is the cylinder turning at this instant?

6. A uniform solid cylinder of mass M is supported on a rough surfaced ramp that rises at an angle θ above the horizontal by a wire that is wrapped around its rim and pulls on it tangentially parallel to the ramp as depicted in the figure below.



(a) Construct a free-body diagram of the system, be sure to include torques.

(b) Find the required tension in the wire for the system to be in equilibrium.

(c) Is it possible for the system to be in equilibrium if the ramp is frictionless? Please explain your answer fully.

7. The sound source of a ship's sonar system operates at a frequency of 22.0 kHz. The speed of sound in water is 1482 m/s.

(a) What is the wavelength of the waves emitted by the sonar system?

(b) Compute the frequency of the sound a happy whale receives from the sonar system on the stationary ship if the whale is traveling straight towards the stationary ship at 4.95 m/s.

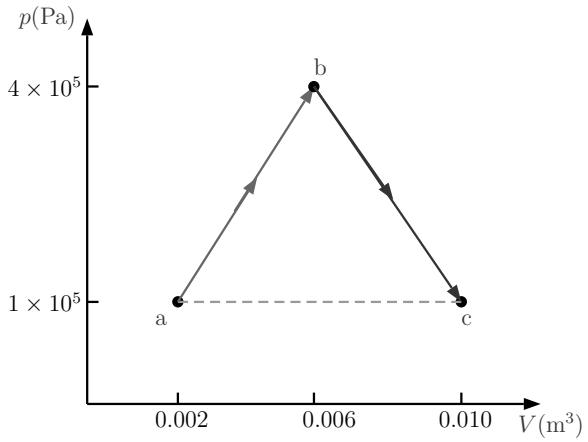
(c) The sonar waves bounce off the whale and radiate back towards the ship. Compute the frequency of the waves received back by the ship if the whale is traveling straight towards the stationary ship at 4.95 m/s.

(d) What is the difference in frequency between the directly radiated waves and the waves reflected from the whale.

8. An ore sample weighs 17.50 N in air. When the sample is suspended by a light chord and totally immersed in water, the tension in the chord is 11.20 N. Find the total volume and density of the sample. Remember that the density of water is 1.00×10^3 kg/m^3.

9. An insulated beaker with negligible mass contains 0.250 kg of water at a temperature of 75°C. How many kilograms of ice at a temperature of −20.0°C must be dropped in the water so that the final temperature of the system will be 30.0°C? The specific heat capacity of ice is $c_i = 2.01 \times 10^3$ J/kg·K, for water is $c_w = 4.19 \times 10^3$ J/kg·K, the latent heat of fusion for water is $L_f = 3.34 \times 10^5$ J/kg and the latent heat of vaporization for water is $L_v = 2256 \times 10^5$ J/kg.

10. One-third of a mole of an ideal gas in a cylinder is taken along the path $a \to b \to c$ shown as the solid line in the figure below.



(a) How much work is done by the system during this process?

(b) How much work is done by the system if the process follows the path from part (a) and then follows dashed line from point c to point a.

11. A flat (unbanked) curve on a highway has a radius of 220 m. A car rounds the curve at a speed of 25.0 m/s.

(a) Make a free body diagram of the car as it round the curve.

(b) What is the minimum coefficient of friction that will prevent sliding?

(c) If the curve was to be rebuilt, at what angle (from horizontal) should it be banked so that the car would not need any friction to round it at 25.0 m/s?

12. A pendulum with a block of mass 2.0 kg is oscillating at the end of a massless rigid rod of length 4.5 m. The mass is moving counterclockwise at 7.0 m/s. You throw a blob of putty weighing 0.35 kg horizontally at the 2.0 kg block opposite the direction of motion of the block and they collide and stick together when the pendulum is at its bottom most point. What must the initial velocity of your putty be so that it causes the block and putty together to swing back around clockwise so that the pendulum (now with block and putty at the end) stops directly above the pivot. Refer to the diagram below.