Physics 1114 - General Physics I

Final Exam

Name: _____

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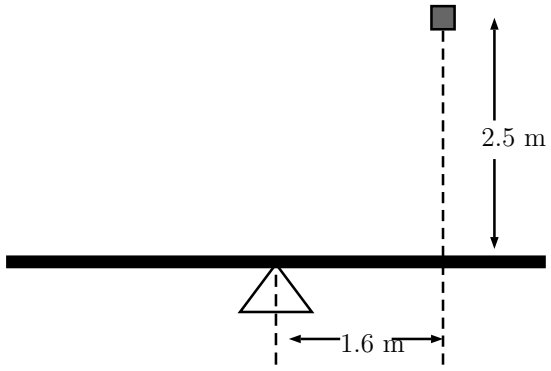
1. A small 4.0 kg brick is released from rest 2.5 m above a horizontal seesaw on a fulcrum at its center. (a) Find the angular momentum of this brick about a horizontal axis through the fulcrum and perpendicular to the plane of the figure below the instant it hits the seesaw. (b) Secondly, find the torque that the brick exerts on the system the instant it hits the seesaw.



2. You are watching an object that is moving in simple harmonic motion. When the object is displaced 0.600 m to the right of its equilibrium position, it has a velocity of 2.20 m/s to the right and an acceleration of 8.40 m/s^2 to the left. How much farther from this point will the object move before it stops momentarily and then starts to move back to the left?

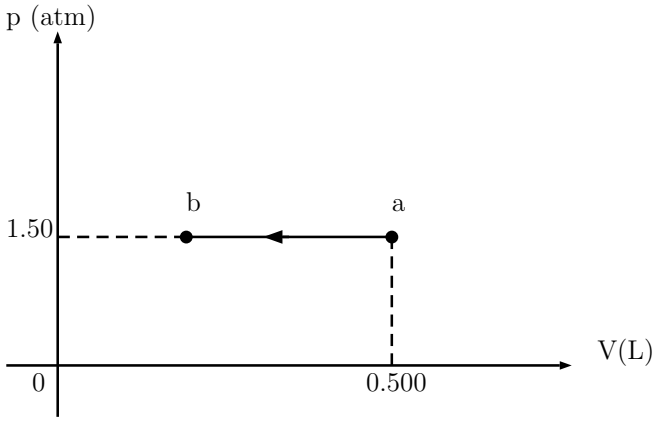
3. A stationary car's alarm is emitting sound waves of frequency 520 Hz. You are on a motorcycle, traveling directly away from the car. How fast must you be traveling if you detect a frequency of 490 Hz? You may assume the speed of sound in air to be 344 m/s.

4. A small circular hole 6.00 mm in diameter is cut in the side of a large water tank, 14.0 m below the water level in the tank. The top of the tank is open to the air. Find the speed at which the water shoots out of the tank.

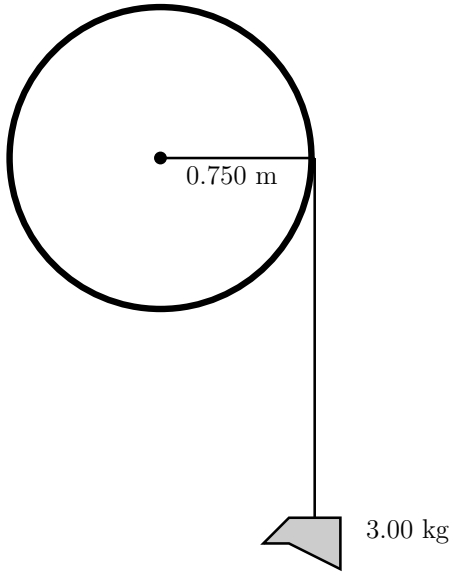
5. A hunk of aluminum is completely covered with a gold shell to form an ingot of weight 45.0 N. When you suspend the ingot from a spring balance and submerge the ingot in water, the balance reads 39.0 N. What is the weight of the gold in the shell? The density of gold is $19.3 \times 10^3 \text{kg/m}^3$, and aluminum is $2.7 \times 10^3 \text{kg/m}^3$. The density of water is 1000 kg/m^3.

6. Molten lead of mass 1.250 kg at a temperature of 327.3°C is poured into 0.5000 kg of water at a temperature of 70.00°C in an insulated bucket of negligible mass. Assuming no heat loss to the surroundings, calculate the mass of lead and water remaining in the bucket when the materials have reached thermal equilibrium. Here, $L_{\mathrm{f,l}} = 24.5 \times 10^3\,\mathrm{J/kg}$, $c_{\mathrm{l}} = 130\,\mathrm{J/kg \cdot K}$, and the melting point of lead is 327.3°C. For water, $c_{\mathrm{w}} = 4190\,\mathrm{J/kg \cdot K}$ and $L_{\mathrm{v,w}} = 2256 \times 10^3\,\mathrm{J/kg}$.

7. A pV diagram for an ideal gas is depicted below. The absolute temperature at b is one-fourth the absolute temperature at a. (a) What volume does this gas occupy at point b? (b) How many joules of work was done by or on the gas in the process? Was it done by or on the gas? (c) Did the internal energy of the gas increase or decrease from a to b? How do you know? (d) Did heat enter or leave the gas from a to b? How do you know? Note that $1\ \text{L} = 10^{-3}\ \text{m}^3$ and $1\ \text{atm} = 1.013 \times 10^5\ \text{Pa}$.



8. A light string is wrapped around the outer rim of a solid uniform cylinder of diameter 0.750 m that can rotate without friction against an axle through its center. A 3.00 kg stone is tied to the free end of the string. When the system is released from rest, you determine that the stone reaches a speed of 3.50 m/s after having fallen 2.50 m. What is the mass of the cylinder? For the cylinder, $I = \frac{1}{2}MR^2$, where M is its mass and R its radius.



9. Three identical boxcars are coupled together and are moving at a constant speed of 20.0 m/s on a level track. They collide with another identical boxcar that is initially at rest and couple to it, so that the four cars roll on as a unit. Friction is small enough to be neglected. (a) What is the speed of the four cars? (b) What percentage of the kinetic energy of the boxcars is dissipated in the collision?

10. Draw a picture of a cute animal.