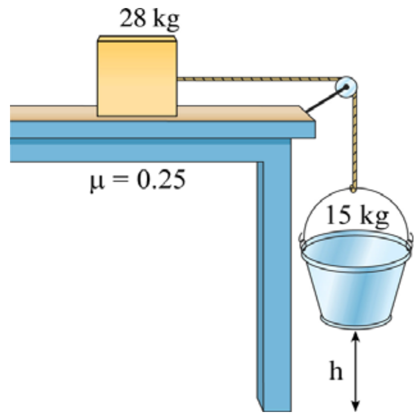
Phyx 135-1, Spring 2016, Quiz 2 **Name** ______________________________

1) (10 points) A pail with water in it has a total mass of 15 kg. It is connected by a frictionless pulley to a 28-kg block on a table. There is a coefficient of kinetic friction of 0.25 between the block and the table. If the pail is allowed drop a height h = 1 meter to the floor, how fast will it be moving when it hits the floor?



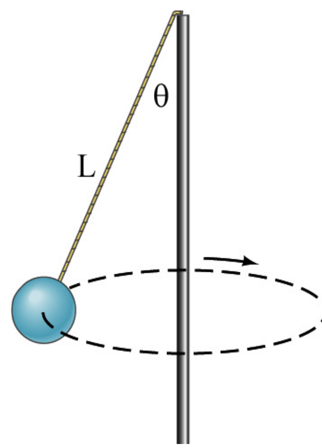
Solution

We can use conservation of energy to solve this. The only source of energy in the problem is the gravitational potential of the falling pail: that is $E = mgh = (15\text{ kg})(9.8\text{ m/s}^2)(1\text{ m}) = 147\text{ J}$.

Friction will dissipate some of this energy as heat. We have $W = F_N d = \mu\, mg\, d = (0.25)(28\text{ kg})(9.8\text{ m/s}^2)(1\text{ m}) = 68.6\text{ J}$.

The remaining energy (147 J – 68.6 J = 78.4 J) will appear as kinetic energy. We have $E_k = \frac{1}{2} mv^2$, or $78.4 = \frac{1}{2}(28 + 15)v^2$, or v = 1.91 m/s.

2) (10 points) A ball with a mass of 100 g is at the end of a cord of length one meter. The cord is attached to the top end of a vertical rod, and the ball is rotating around the rod as shown. If θ = 30°, what is the velocity of the ball?



Solution

The force pulling down on the ball is mg, and the only thing holding it up is the tension in the cord. So, it must be that $T\cos\theta = mg$, which means that $T = (0.1\text{ kg})(9.8\text{ m/s}^2) / \cos(30°) = 1.13\text{ N}$.

Thus, the horizontal force acting on the ball must be $T\sin\theta$. This in turn must equal mv^2/r. We know that $r = L\sin\theta = (1\text{ m})\sin(30°) = 0.5\text{ m}$, so we have: $(1.13\text{ N})\sin(30°) = (0.1\text{ kg})v^2 / 0.5\text{ m}$, or v = 1.68 m/s.