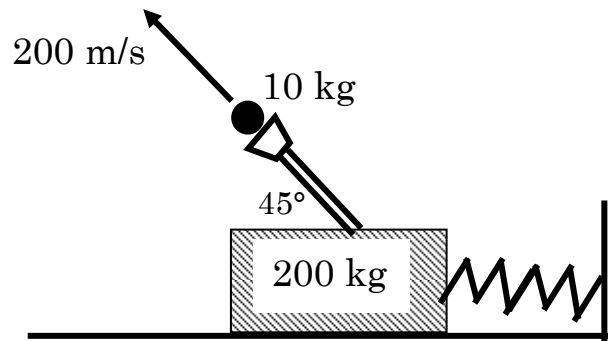


Momentum: Gun Cushion (solutions)

A cannon fires a 10 kg projectile with a velocity of 200 m/s at an angle of 45° with respect to horizontal. The cannon, which has a mass of 200kg, is cushioned by a relaxed, horizontal spring that is designed to absorb the recoil. Assume that the gun stands on a frictionless surface. Compute the minimum spring constant required so that the spring compresses by less than 20 centimeters.



The cannon and projectile can be treated as an explosion where momentum is conserved. This means that you can use the momentum in the horizontal direction of the projectile to find the recoiling momentum of the cannon. Since you know the mass of the cannon, you can find the recoiling speed and then the kinetic energy of the cannon as it recoils. The kinetic energy of the cannon becomes spring potential energy as the spring is compressed and the motion of the cannon is stopped. Setting up an equation for the conservation of energy, you can solve for the spring constant using the given mass and maximum compression as well as the velocity you found from the conservation of momentum. You should obtain a spring constant of 250000 N/m.