

# PHYSICS 1030

## Homework #5

(Due Nov. 7, 2022)

1. (Serway 9-2) An object has a kinetic energy of 275 J and a momentum of magnitude 25.0 kg m/s. Find the speed and mass of the object.
2. (Serway 9-11) Two blocks of masses  $m$  and  $3m$  are placed on a frictionless, horizontal surface. A light spring is attached to the more massive block, and the blocks are pushed together with the spring between them. A cord initially holding the blocks together is burned; after that happens, the block of mass  $3m$  moves to the right with a speed of 2.00 m/s. (a) What is the velocity of the block of mass  $m$ ? (b) Find the system's original elastic potential energy, taking  $m = 0.350$  kg.
3. (Serway 9-26) Four railroad cars, each of mass  $2.50 \times 10^4$  kg, are coupled together and coasting along horizontal tracks at speed  $v_i$  toward the south. A very strong but foolish movie actor, riding on the second car, uncouples the front car and gives it a big push, increasing its speed to 4.00 m/s southward. The remaining three cars continue moving south, now at 2.00 m/s. (a) Find the initial speed of the four cars. (b) How much work did the actor do?
4. (Serway 9-29) A tennis ball of mass 57.0 g is held just above a basketball of mass 590 g. With their centers vertically aligned, both are released from rest at the same time, to fall through a distance of 1.20 m. (a) Find the magnitude of the downward velocity with which the basketball reaches the ground. (b) Assume that an elastic collision with the ground instantaneously reverses the velocity of the basketball while the tennis ball is still moving down. Next, the two balls meet in an elastic collision. To what height does the tennis ball rebound?
5. (Serway 9-31) A 12.0-g wad of sticky clay is hurled horizontally at a 100-g wooden block initially at rest on a horizontal surface. The clay sticks to the block. After impact, the block slides 7.50 m before coming to rest. If the coefficient of friction between the block and the surface is 0.650, what was the speed of the clay immediately before impact?

6. (Serway 9-45) Four objects are situated along the  $y$  axis as follows: a 2.00-kg object is at +3.00 m, a 3.00-kg object is at +2.50 m, a 2.50-kg object is at the origin, and a 4.00-kg object is at  $-0.500$  m. Where is the center of mass of these objects?

7. A rod has its left end at the origin of the  $x$ -axis and its right end at  $x = 3$  m. Its linear mass density varies as  $\lambda(x) = (3x^4 - 2x^2 + 1)$  kg/m, where  $x$  is in meters. Find the  $x$  coordinate of the rod's center of mass.