

PHYSICS 1030

Homework #4

(Due Nov. 1, 2023, 6:00 pm)

1. Suppose one wishes to establish a space platform or satellite moving in a circle in the Earth's equatorial plane and at such a height above the Earth's surface that it remains always above the same point. Find the height of the space platform.
2. A block weighing 16 lb is pushed 20 ft along a horizontal frictionless surface by a horizontal force of 8 lb. The block starts from rest. (a) How much work is done? (b) Check your answer by computing the acceleration of the block, its final velocity, and its kinetic energy.
3. A block weighing 2 lb is forced against a horizontal spring of negligible mass, compressing the spring an amount $x_1 = 6$ inches. Upon releasing the block, it moves on a horizontal table top a distance $x_2 = 2$ ft before coming to rest. The spring constant k is 8 lb/ft. What is the coefficient of friction μ between the block and the table?
4. (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.
5. (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 (Fig. P9.11 in the text). 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 systems original elastic potential energy, taking $m = 0.350$ kg.
6. (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, as shown in Figure P9.29 of the text. (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?

7. (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?

8. (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?

9. A ball is dropped from rest onto a fixed horizontal surface and rebounds to a height which is 64% of its original height. (a) What is the coefficient of restitution? (b) With what vertical velocity must the ball strike the surface to rebound to a height of 25 ft?

10. A bullet of mass 20 g is fired into a ballistic pendulum of mass 5 kg. The center of gravity of the pendulum rises 10 cm after being struck. Find the initial velocity of the bullet.