

# PHYSICS 1030

## Homework #4

(Due Oct. 17, 2022)

1. (Serway 5-1) A 3.00-kg object undergoes an acceleration given by  $\mathbf{a} = (2.00\mathbf{i} + 5.00\mathbf{j}) \text{ m/s}^2$ . Find (a) the resultant force acting on the object and (b) the magnitude of the resultant force.
2. (Serway 5-12) A force  $\mathbf{F}$  applied to an object of mass  $m_1$  produces an acceleration of  $3.00 \text{ m/s}^2$ . The same force applied to a second object of mass  $m_2$  produces an acceleration of  $1.00 \text{ m/s}^2$ . (a) What is the value of the ratio  $m_1/m_2$ ? (b) If  $m_1$  and  $m_2$  are combined into one object, find its acceleration under the action of the force  $\mathbf{F}$ .
3. (Serway 5-21) A block slides down a frictionless plane having an inclination of  $\theta = 15.0^\circ$ . The block starts from rest at the top, and the length of the incline is 2.00 m. (a) Draw a free-body diagram of the block. Find (b) the acceleration of the block and (c) its speed when it reaches the bottom of the incline.
4. (Serway 5-39) A 25.0-kg block is initially at rest on a horizontal surface. A horizontal force of 75.0 N is required to set the block in motion, after which a horizontal force of 60.0 N is required to keep the block moving with a constant speed. Find (a) the coefficient of static friction and (b) the coefficient of kinetic friction between the block and the surface.
5. (Serway 5-43) A 3.00-kg block starts from rest at the top of a  $30.0^\circ$  incline and slides a distance of 2.00 m down the incline in 1.50 s. Find (a) the magnitude of the acceleration of the block, (b) the coefficient of kinetic friction between block and plane, (c) the friction force acting on the block, and (d) the speed of the block after it has slid 2.00 m.
6. A motorboat of mass  $m$  is acted on by a resisting force  $R$  which varies directly with the square of the velocity:  
$$R = kv^2. \tag{1}$$

Suppose the power is cut off when the motorboat has a velocity  $v_0$ . (a) Find the expression for the acceleration of the motorboat,  $dv/dt$ , in terms of  $m$ ,  $k$ , and  $v$ . (b) Is the acceleration constant? (c) What is the initial acceleration? (d) Find by integration the velocity at any time  $t$ . (e) If the initial velocity  $v_0$  is 10 m/s, and if the velocity decreases to 5 m/s in 10 sec, find the resisting force  $R$  at a velocity of 10 m/s. The mass  $m$  of the motorboat is 1600 kg.