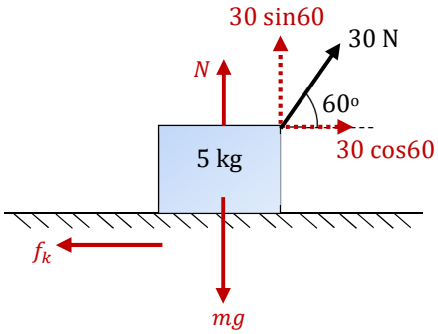
Physics-145 Summer 2019

Quiz No. 2

Q1) A 5 kg block is dragged over a horizontal frictionless surface by a constant force of 30 N acting at an angle of 60° above the horizontal as shown. If the coefficient of kinetic friction is equal to 0.2, then:



a) Calculate the magnitude of the frictional force.

$$f_k = \mu_k N$$

To find the normal force N, analyze the forces along the direction normal to the surface (i.e. the y-axis):

$$F_{net} = ma \quad (y\text{-axis})$$

$$N + 30\sin 60 - mg = 0$$

$$\Rightarrow N = mg - 30\sin 60$$

$$= (5)(9.8) - 26 = 23 \text{ N}$$

$$\therefore f_k = 0.2 \times 23 = 4.6 \text{ N}$$

b) Calculate the acceleration of the block.

To find the acceleration of the system a, analyze the forces along the direction of motion (i.e. the x-axis):

$$F_{net} = ma \quad (x\text{-axis})$$

$$30\cos 60 - f_k = ma$$

$$15 - 4.6 = 5a$$

$$\Rightarrow a = 2.08 \text{ m/s}^2$$

c) If the block started the movement under the 30 N force from rest, what will be the speed of the block after a displacement of 5 m?

From Chapter 1 (equations of motion with a constant acceleration) we have:

$$2\,a\,\Delta x = v^2 - v_0^2$$

$$2(2.08)(5) = v^2 - 0$$

$$v^2 = 20.8\ m/s$$

$$\Rightarrow v = 4.56\ m/s$$