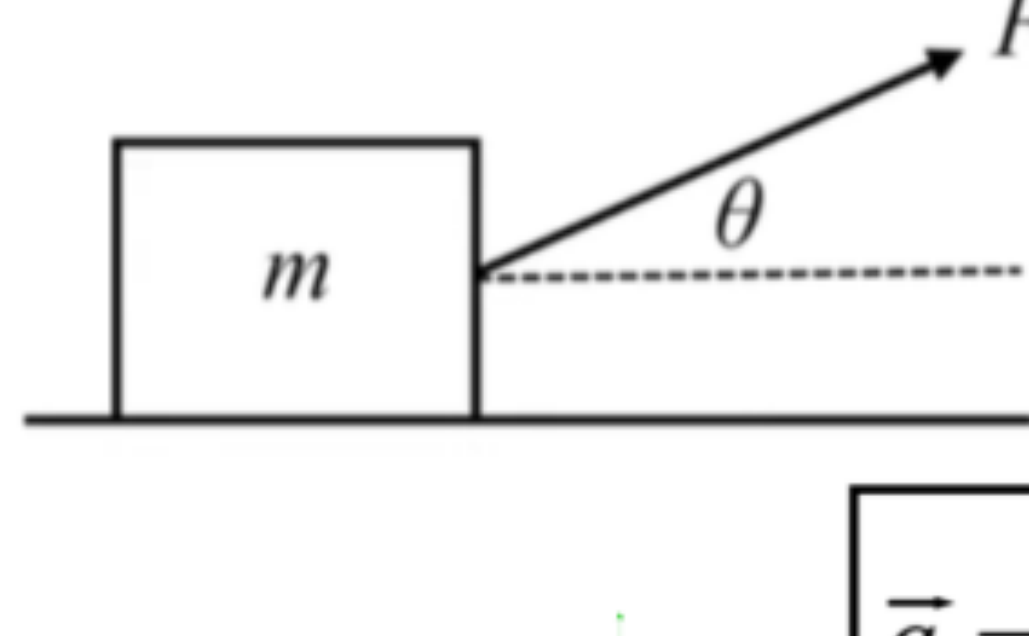
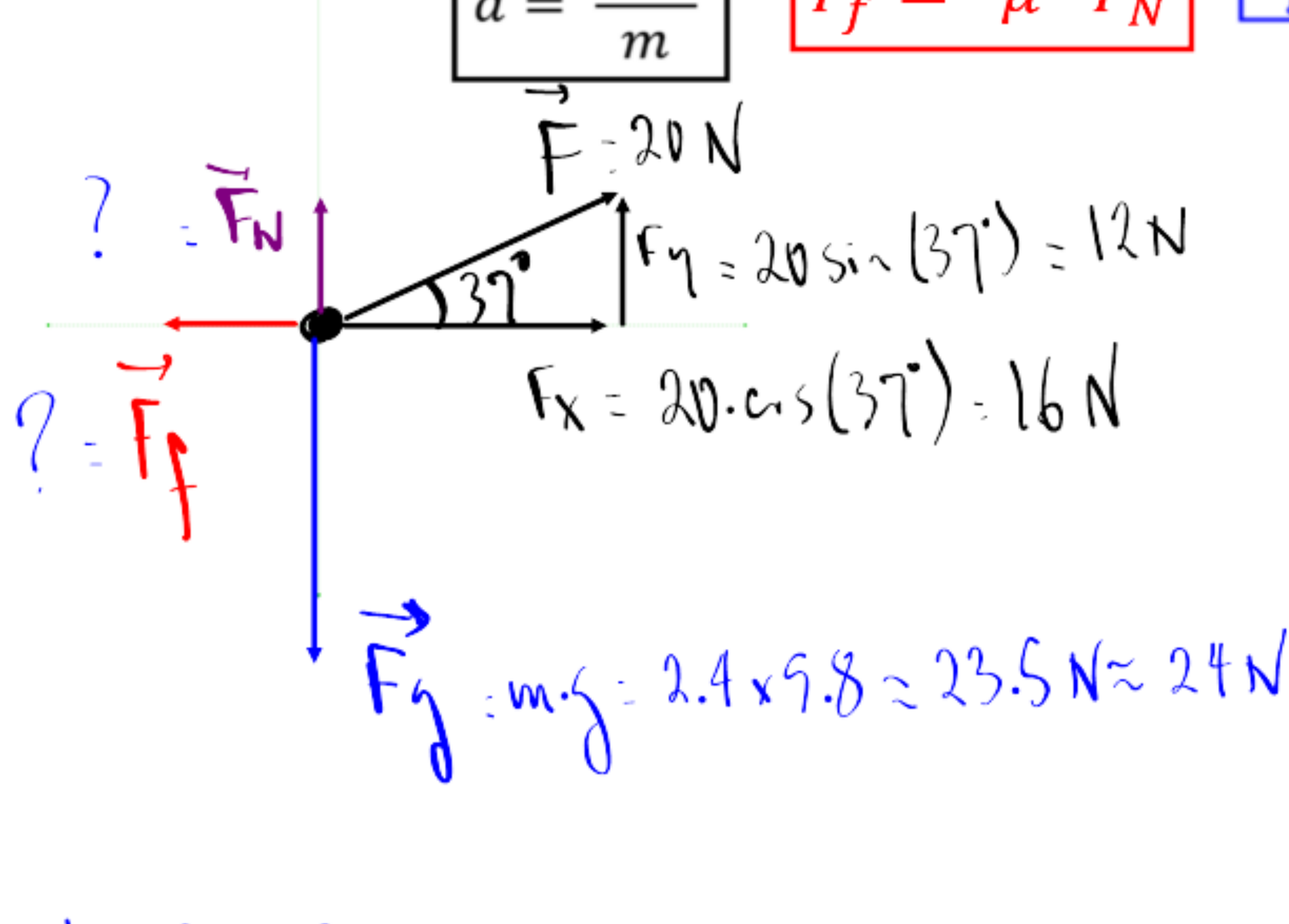


Ex. A box of mass $m = 2.4 \text{ kg}$ is pulled across a rough surface by an applied force of 20 N at an angle of 37° above the horizontal as shown below. The coefficient of kinetic friction between the surface and the box is 0.4 . What is the acceleration of the box?



- Draw a force diagram for the block.
- What is the block's vertical acceleration?
- What is the normal force acting on the block?
- What is the acceleration of the box?



$$F_f = \mu \cdot F_N$$

$$F_g = m \cdot g = W$$

b) $a_y = 0$

c) $F_N = ?$

$$\vec{F}_{net,y} = m \cdot \vec{a}_y$$

$$F_N + F_y - F_g = 0$$

$$F_N = F_g - F_y = 24 - 12 = 12 \text{ N}$$

d) $a = ?$

$$\vec{F}_{net,x} = m \cdot \vec{a}_x$$

$$F_x - F_f = m \cdot a$$

$$16 - 4.8 = 2.4 \times a$$

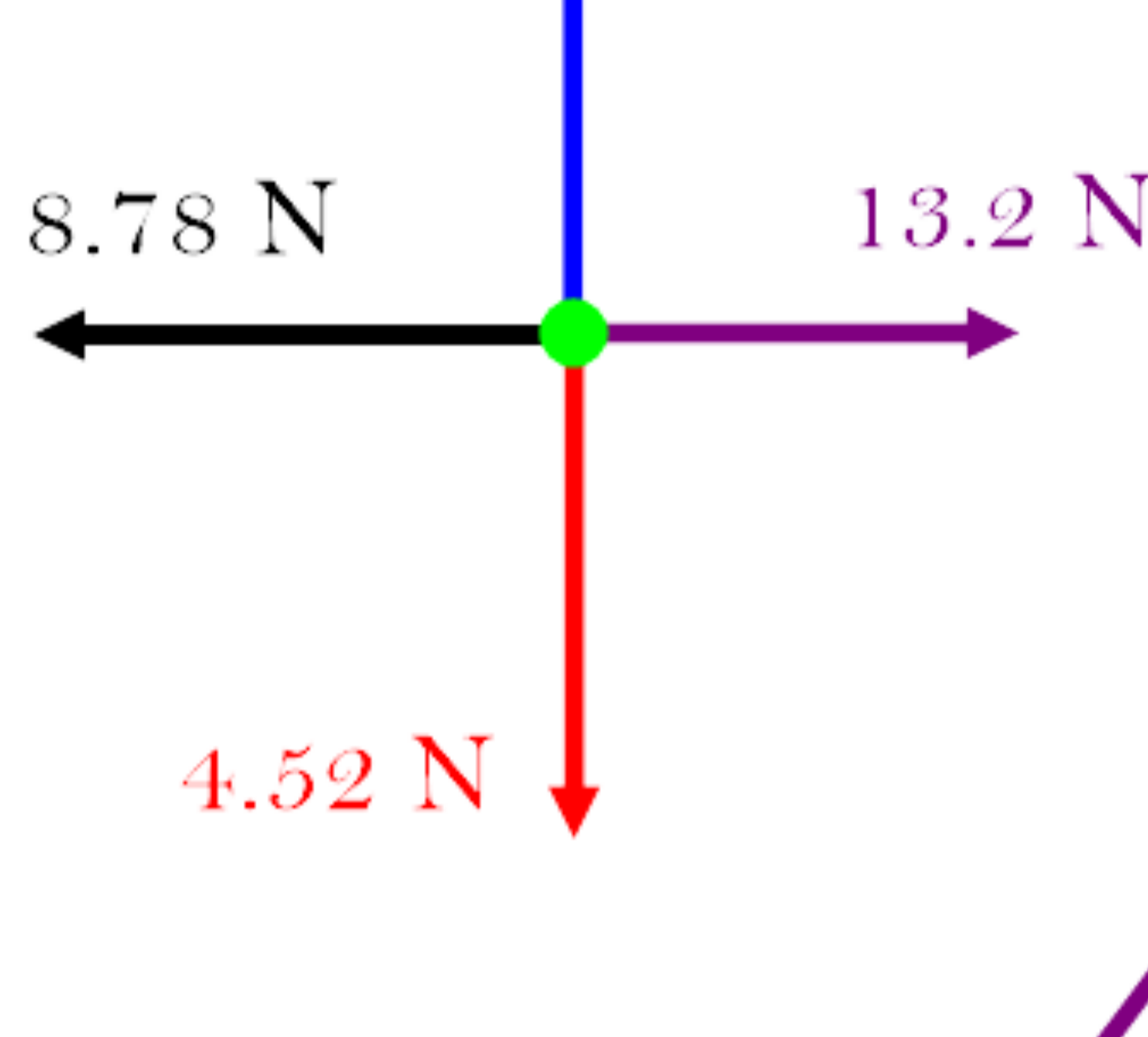
$$\frac{11.2}{2.4} = a = 4.7 \frac{\text{m}}{\text{s}^2}$$

$$F_f = \mu \cdot F_N$$

$$F_f = 0.4 \times 12 = 4.8 \text{ N}$$

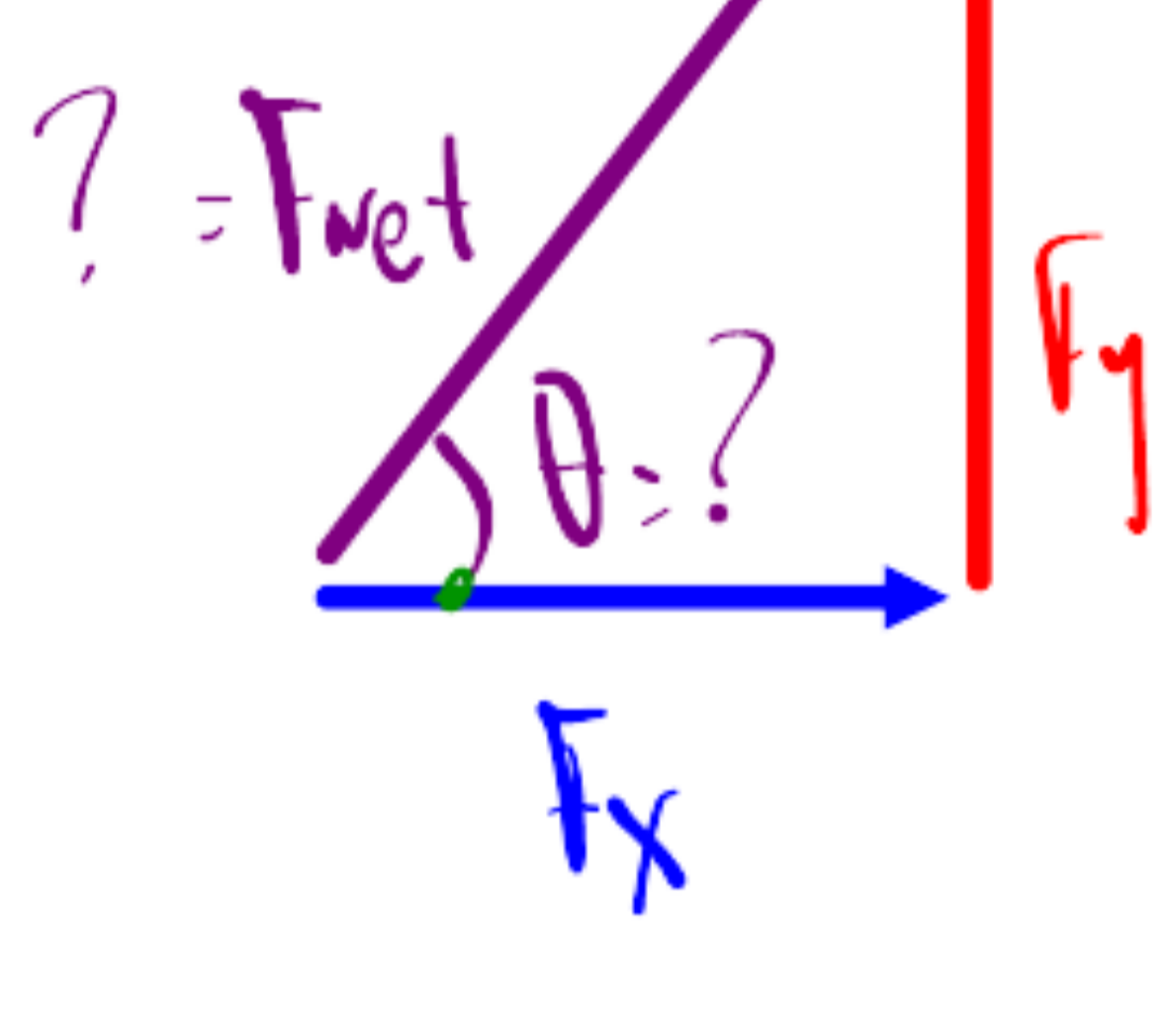
Force (Magnitude) = ?

Direction (Angle) = ?



$$F_x = 13.2 - 8.78 = 4.42 \text{ N}$$

$$F_y = 10.5 - 4.52 = 5.98 \text{ N} (\uparrow)$$



$$F_{net}^2 = F_x^2 + F_y^2$$

$$F_{net} = \sqrt{4.42^2 + 5.98^2}$$

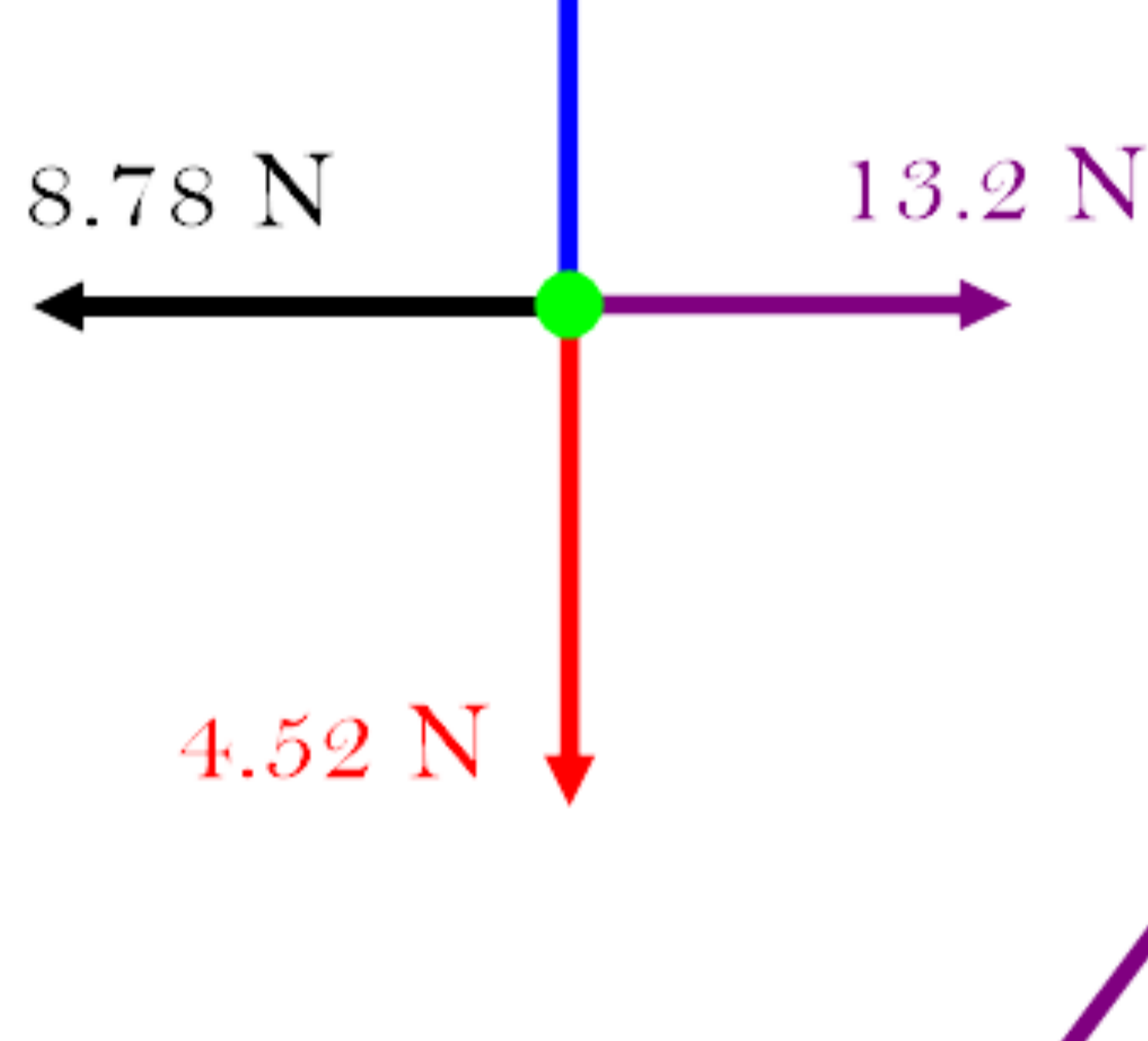
$$F_{net} = 7.44 \text{ N}$$

$$\theta = \tan^{-1} \frac{F_y}{F_x}$$

$$\theta = \tan^{-1} \left(\frac{5.98}{4.42} \right) = 53.5^\circ \text{ N of E}$$

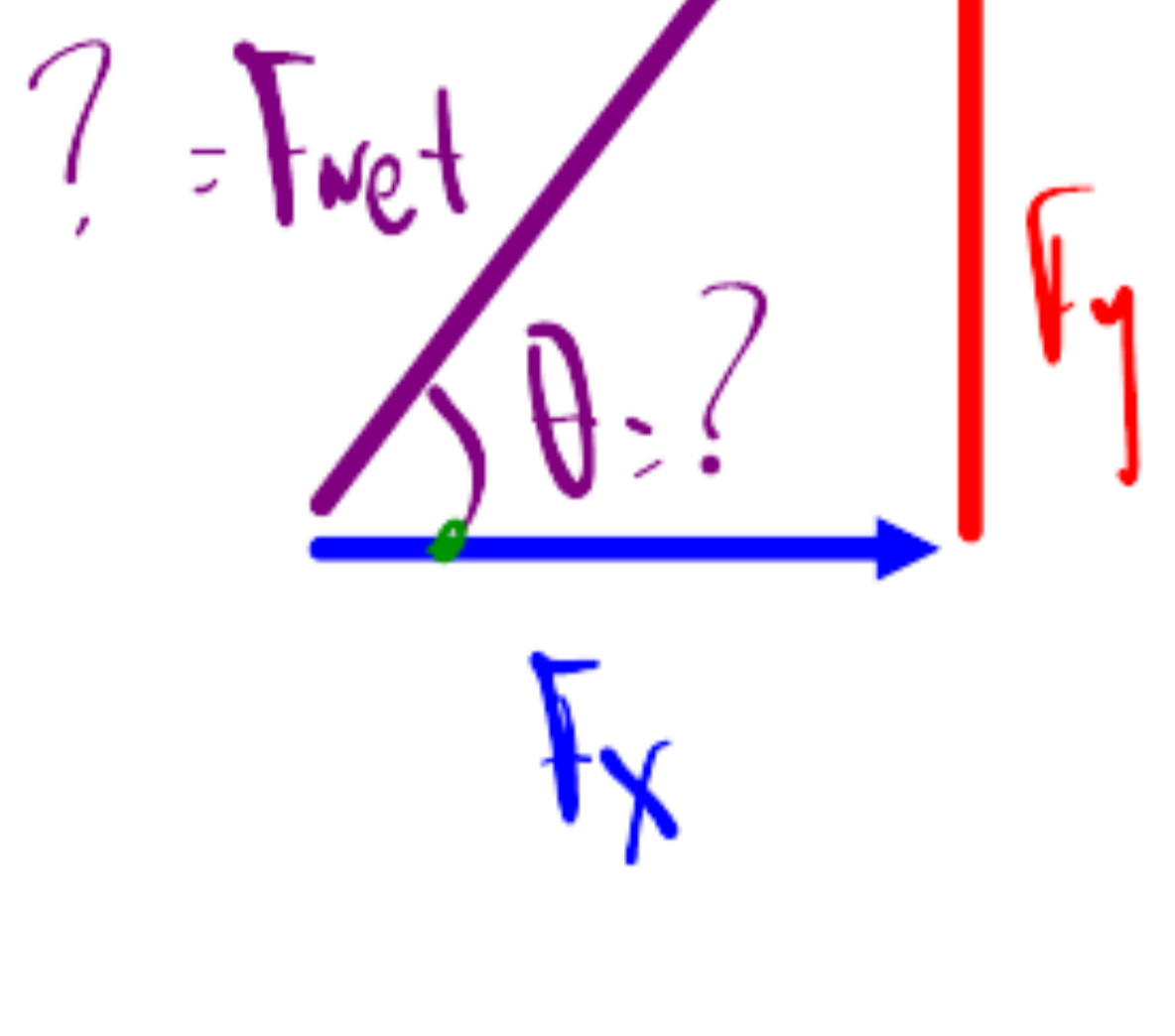
Force (Magnitude) = ?

Direction (Angle) = ?



$$F_x = 13.2 - 8.78 = 4.42 \text{ N}$$

$$F_y = 10.5 - 4.52 = 5.98 \text{ N} (\uparrow)$$



$$F_{net}^2 = F_x^2 + F_y^2$$

$$F_{net} = \sqrt{4.42^2 + 5.98^2}$$

$$F_{net} = 7.44 \text{ N}$$

$$\theta = \tan^{-1} \frac{F_y}{F_x}$$

$$\theta = \tan^{-1} \left(\frac{5.98}{4.42} \right) = 53.5^\circ \text{ N of E}$$

1. A race car has a mass of 710 kg . It starts from rest and travels 40.0 m in 3.0 s . The car is uniformly accelerated during the entire time. How big is the net force acting on the car?

1. Given

$$\begin{aligned} m &= 710 \text{ kg} \\ v_0 &= 0 \\ \Delta x &= 40 \text{ m} \\ t &= 3 \text{ sec.} \end{aligned}$$

$$F = ?$$

$$F_{net} = m \cdot a$$

$$a = ?$$

$$F_{net} = 710 \times 8.9$$

$$F_{net} = 6311 \text{ N}$$

$$\vec{a} = \frac{\vec{F}_{net}}{m}$$

$$v_x = v_{x0} + a_x t$$

$$x = x_0 + v_{x0} t + \frac{1}{2} a_x t^2$$

$$v_x^2 = v_{x0}^2 + 2 a_x (x - x_0)$$

$$x - x_0 = 0.3 + \frac{1}{2} \cdot 9 \cdot 3^2$$

$$40 = 4.5 \cdot a$$

$$\frac{40}{4.5} = a = 8.9 \frac{\text{m}}{\text{s}^2}$$

2. Suppose that a 1000 kg car is traveling at 25 m/s (55 mph). Its brakes can apply a force of 5000 N . What is the minimum distance required for the car to stop?

2. Given

$$\begin{aligned} m &= 1000 \text{ kg} \\ v_0 &= 25 \frac{\text{m}}{\text{s}} \\ F_{nd} &= 5000 \text{ N} \\ v &= 0 \end{aligned}$$

$$\Delta x = ?$$

$$a = \frac{F_{net}}{m}$$

$$a = \frac{-5000 \text{ N}}{1000 \text{ kg}}$$

$$a = -5 \frac{\text{m}}{\text{s}^2}$$

$$v^2 = v_0^2 + 2 a \cdot \Delta x$$

$$a = ?$$

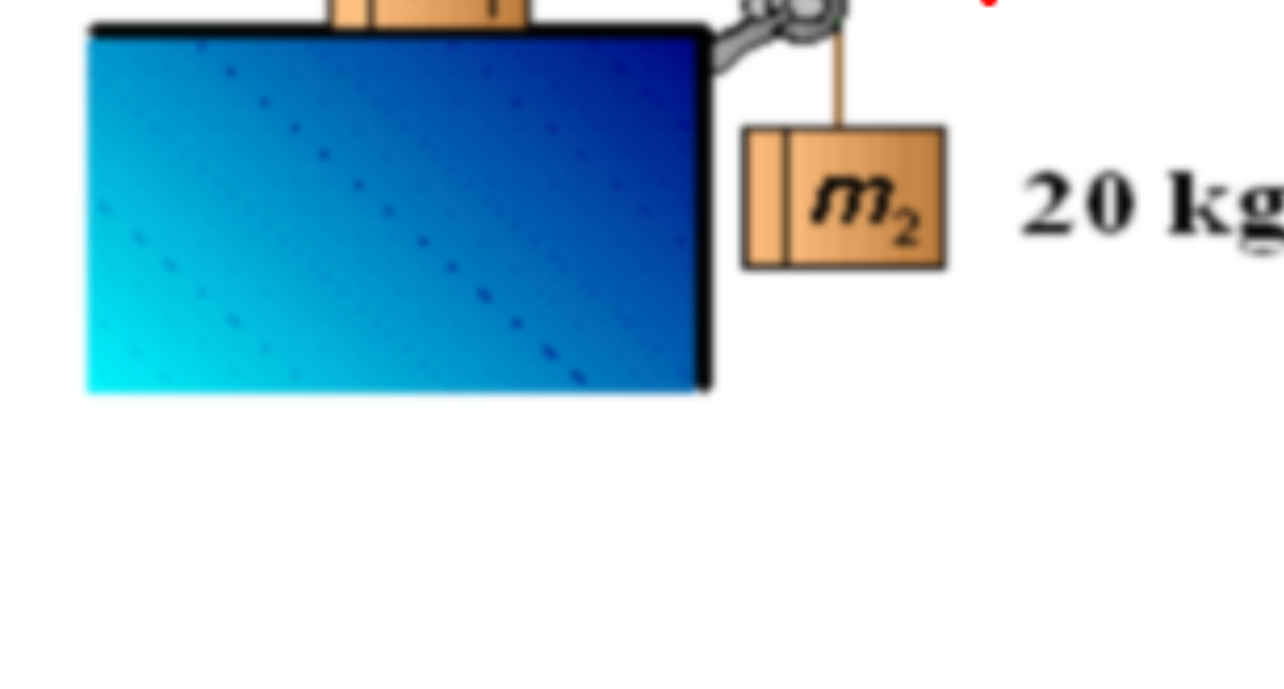
$$0 = 625 + 2(-5) \cdot \Delta x$$

$$0 = 625 - 10 \cdot \Delta x$$

$$-625 = -10 \cdot \Delta x$$

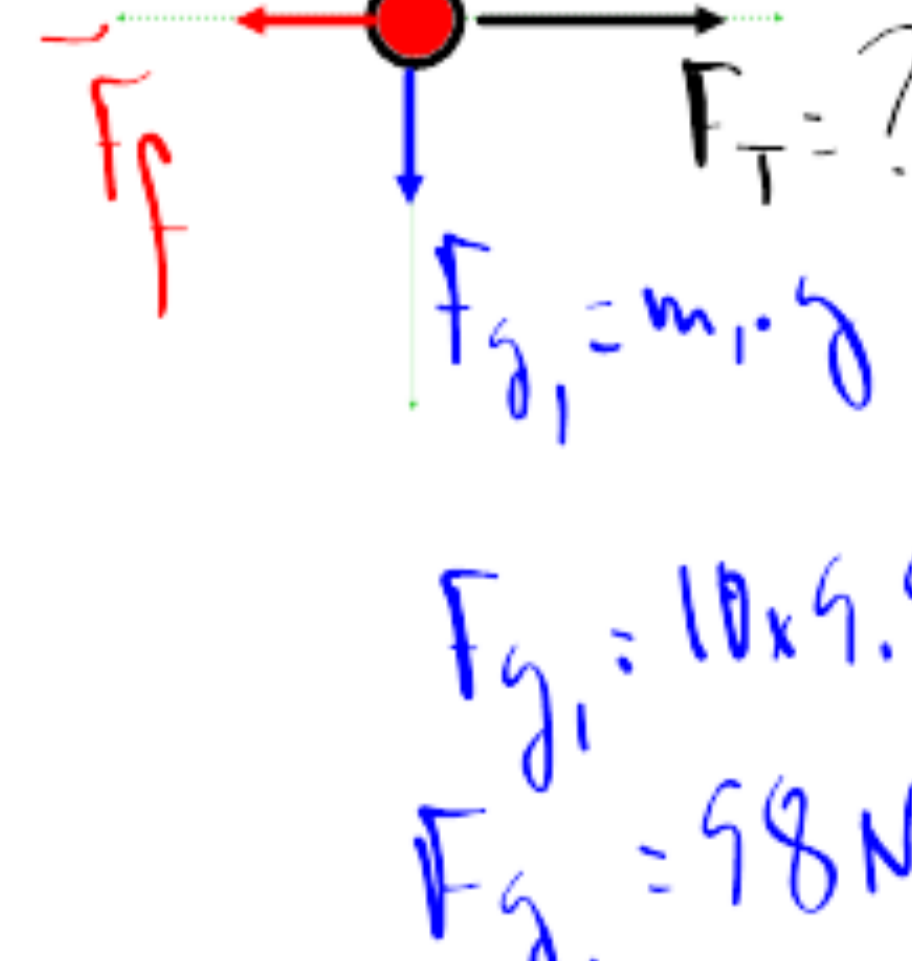
$$\frac{-625}{-10} = \Delta x = 62.5 \text{ m}$$

A 10 kg block is connected to a 20 kg mass by a cord running over a frictionless pulley as shown below. The coefficient of kinetic friction between the table and the block is 0.10 .



A) Determine the acceleration of the system

B) Determine the Tension in the string



$$F_{g1} = 10 \times 9.8$$

$$F_{g1} = 98 \text{ N}$$

$$F_f = \mu \cdot F_N = 0.1 \times 98 \text{ N}$$

$$F_f = 9.8 \text{ N}$$

$$\vec{F}_{net,x} = m \cdot \vec{a}_x$$

$$F_T - F_f = m \cdot a$$

$$F_T - 9.8 = 10 \cdot a$$

$$F_T = ?$$

$$a = ?$$

$$F_T = ?$$

$$F_{g2} = m_2 \cdot g$$

$$F_{g2} = 20 \cdot 9.8$$

$$F_{g2} = 196 \text{ N}$$

$$\vec{F}_{net,y} = m \cdot \vec{a}_y$$

$$F_{g2} - F_T = m_2 \cdot a$$

$$196 - F_T = 20 \cdot a$$

$$196 - 9.8 = 10a + 20a = 30a$$

$$186.2 = 30 \times a$$

$$\frac{186.2}{30} = a = 6.21 \frac{\text{m}}{\text{s}^2}$$

From I

$$F_T - 9.8 = 10 \times 6.21$$

$$F_T = 62.1 + 9.8 = 71.9 \approx 72 \text{ N}$$