

1st Newtonian Law

Object in motion remains in motion unless acted upon by an outside force.

Object at rest will remain at rest unless acted upon by an outside force.

Inertia mass - proportional to the resistance in the change in motion

Newton's 2nd Law

$$F = ma$$

Force = mass * acceleration

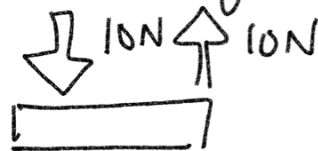
"moving at constant velocity" $a = 0$

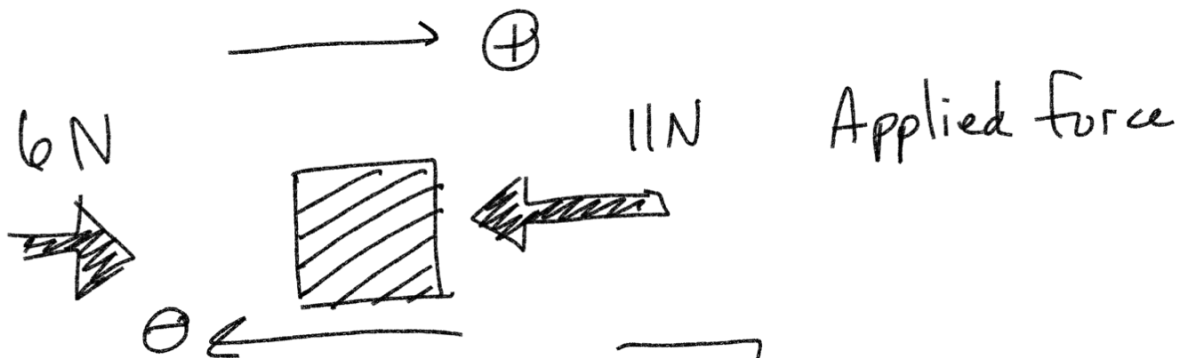
$$F = ma$$

$$F_{\text{net}} = 0$$

3rd Law

Each force is met with an equal and opposite force



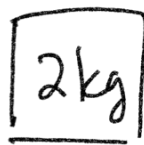
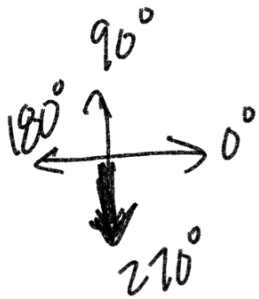
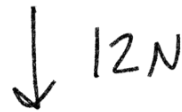
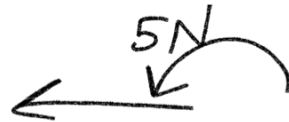


$$F_{\text{net}} \quad 6N + (-11N) = \boxed{-5N}$$

Force
vector

(r, θ)

$(5, 180^\circ)$

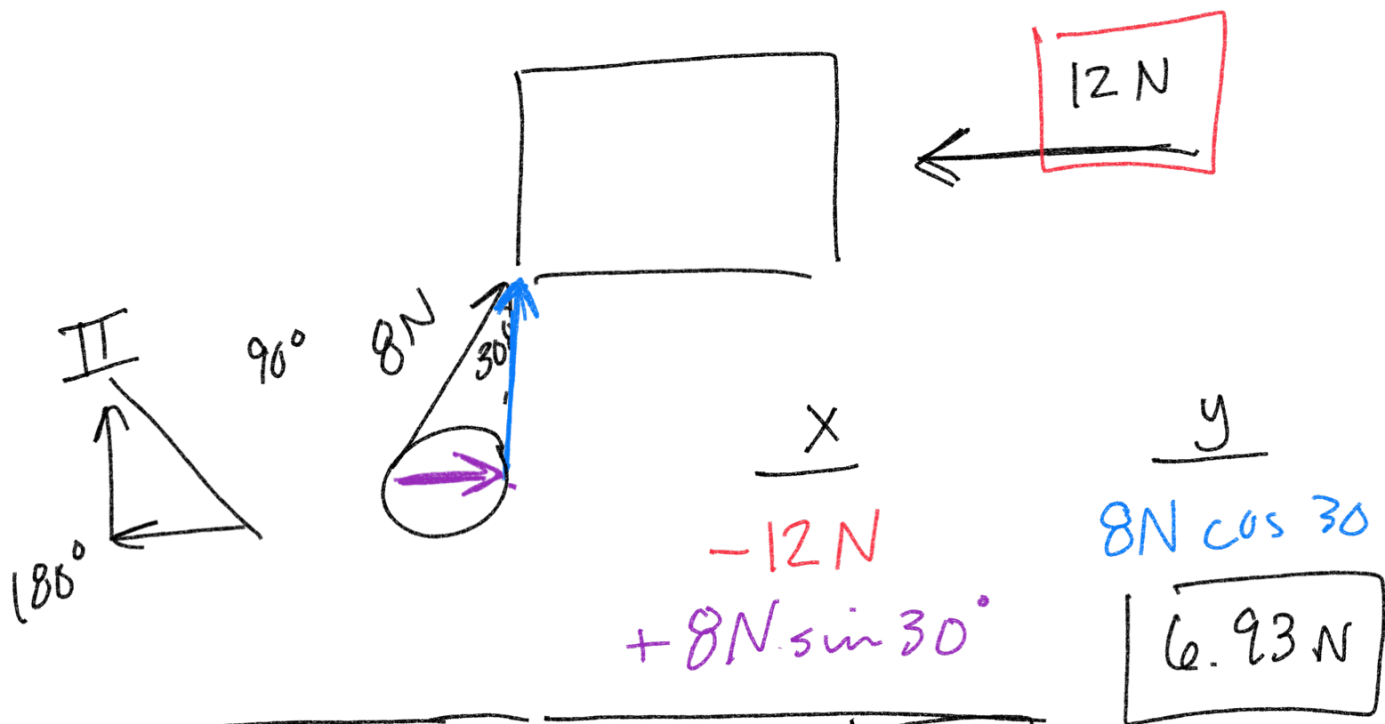


$$F_{\text{net}} \quad 8N + (-12N) = \boxed{-4N}$$

$$\boxed{(4N, 270^\circ)}$$

$$a = \frac{F}{m} = \frac{4N}{2\text{kg}} = 2\text{ m/s}^2$$

$$\frac{F}{m} = \frac{ma}{m} \quad \boxed{(2\text{ m/s}^2, 270^\circ)}$$



$$r = \sqrt{(8)^2 + (6.93)^2} \quad -12 + 4 = \boxed{-8N}$$

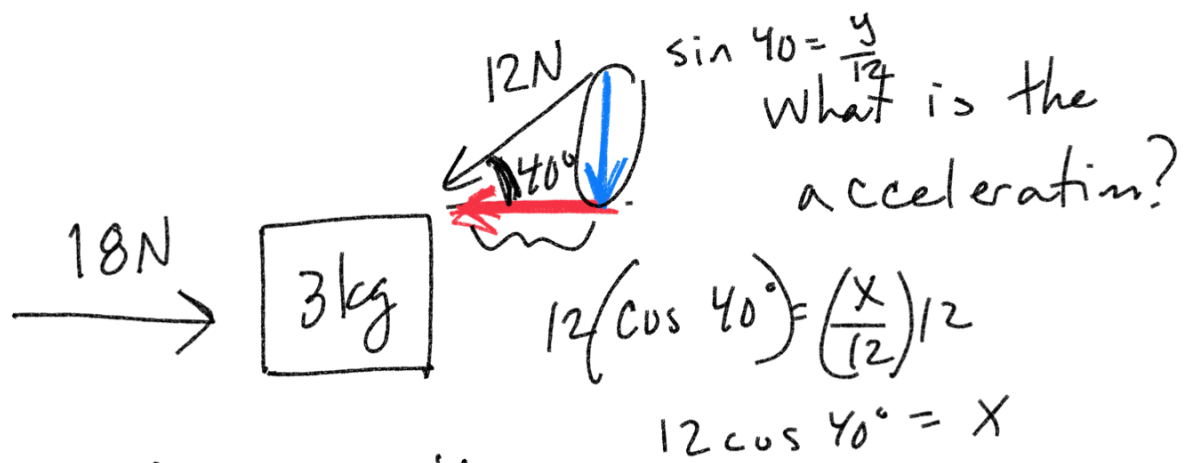
$\downarrow \quad \downarrow$
 $\sqrt{64 + 48} = \sqrt{112} = 10.58N$

$4\sqrt{3}$
 $-8N, 6.93N$

$$\theta = \tan^{-1} \frac{y}{x} = \tan^{-1} \left(\frac{6.93}{-8} \right) = \frac{-40.9}{+180}$$

139.1°

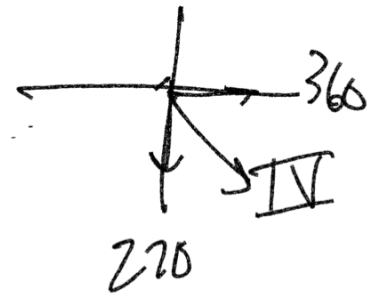
$$\boxed{10.58N, 139.1^\circ}$$



$$\frac{x}{18N} \quad y$$

$$-12 \sin 40$$

$$y \boxed{-7.7}$$



$$-12 \cos 40^\circ$$

$$18 - 12 \cos 40$$

$$18 - 9.19$$

$$x = \boxed{8.81}$$

$$r = \sqrt{(-7.7)^2 + (8.81)^2}$$

$$r = 11.7 \quad F = \boxed{11.7, 318.6^\circ}$$

$$\theta = \tan^{-1} \frac{-7.7}{8.81} = \frac{360}{-41.4} = 318.6^\circ$$

$$\frac{F}{m} = \frac{ma}{m} \quad m = 3\text{kg}$$

$$a = \frac{F}{m} = \frac{11.7}{3} = (3.9 \text{ m/s}^2, 318.6^\circ)$$