Newton's Second Law Problems:

$$v_2 = v_1 + a\Delta t \qquad \Delta d = v_1\Delta t + \frac{1}{2}a\Delta t^2 \qquad v_{av} = \frac{\Delta d}{\Delta t} = \frac{(v_1 + v_2)}{2}$$

$$v_2^2 = v_1^2 + 2a\Delta d \qquad \Delta d = v_2\Delta t - \frac{1}{2}a\Delta t^2 \qquad a_g = 9.8\frac{m}{s^2}$$

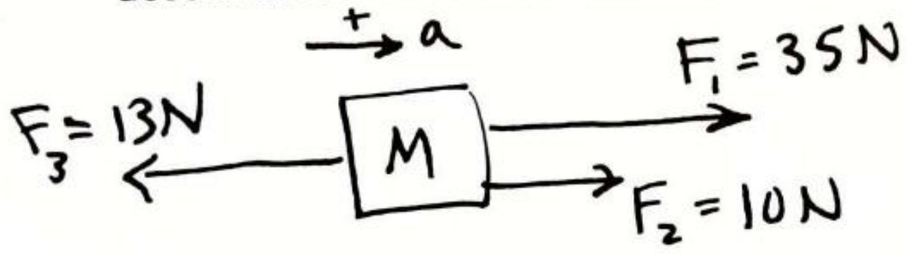
$$\boxed{\Sigma F = ma}$$

{ F.B.Ds are required for all solutions. }

1. A skateboarder of mass 70 kg undergoes an acceleration of 7.8 m/s/s. Determine the net, unbalanced force acting on the object.

$$\Sigma F = Ma$$
$$= (70)(7.8) = \boxed{546N} \checkmark$$

2. A box is pushed horizontally by three forces. 35 N [right], 13 N [Left] and 10 N [right]. The box accelerates from rest to 0.56 m/s over a distance of 8 m. Calculate the mass of the box.



$$a = \frac{v_2^2 - v_1^2}{2\Delta d} = \frac{(0.56)^2 - (0)^2}{2(8)}$$

$$a = 0.0196 m/s/s$$

$$\Sigma F = Ma$$

$$F_1 + F_2 - F_3 = ma$$

$$M = \frac{F_1 + F_2 + F_3}{a}$$

$$= \frac{(35) + (10) - (13)}{(0.0196)}$$

$M = 1632kg$ ← heavy!!

3. A net (unbalanced) force of 300 N is applied to an object, causing its velocity to change from 5 m/s to 20 m/s in 2.5 s. What is the objects acceleration? What is its mass? If you were told that there were only three horizontal forces acting on the object; list two possible three force combinations that would work.

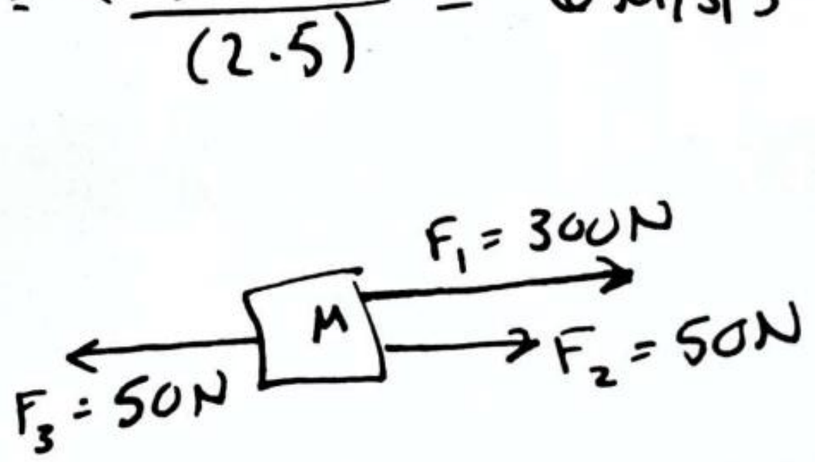
$$\Sigma F = ma \qquad a = \frac{v_2 - v_1}{\Delta t} = \frac{(20) - (5)}{(2.5)} = 6 m/s/s$$

$$M = \frac{\Sigma F}{a}$$

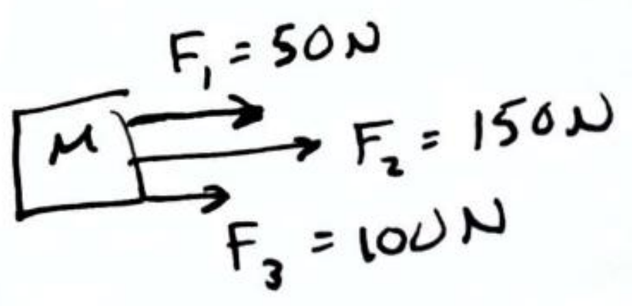
$$= \frac{300\ N}{6\ m/s/s}$$

$M = 50\ kg$ ✓

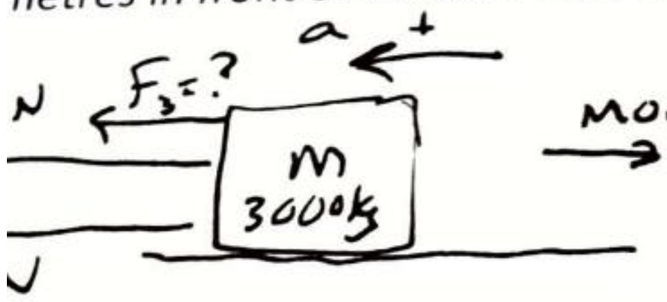
① examples.



②



A 3000 kg transport truck
(1500N) are acting on the truck. The driver sees a car stopped in front of him 50 m ahead. He immediately presses the brakes. If the truck was travelling at 25 m/s and slowed to a stop exactly 2 metres in front of the car. Determine the force that the braking action on the truck.



$$\Sigma F = Ma$$

$$+F_1 + F_2 = Ma$$

$$F_3 = Ma - F_1 - F_2$$

$$= (3000)(6.51) - (1030) - (1500)$$

$$F_3 = 17{,}000\,N \checkmark$$

$$a = \frac{v_2^2 - v_1^2}{2\Delta d}$$

$$= \frac{(0)^2 - (25)^2}{2(48)}$$

$$a = -6.51\ m/s/s$$

↑

left. (see diagram)

urtle is flying in his super turtle balloon. The balloon starts from the ground and accelerates upwards for 100m. The mass of super turtle and the balloon combined is 200 kg. The ift on the balloon is 3000 N, the air resistance is 100 N and the force of gravity acting on the urtle system can be calculated by multiplying the acceleration due to gravity and the mass loon-turtle system. How long does it take for super turtle to reach a height of 100 m?

$$\Sigma F = ma$$

t

a

$$F_1 - F_2 - F_g = Ma$$

00 kg

$$a = \frac{F_1 - F_2 - F_g}{M}$$

$$= \frac{(3000) - (100) - (1960)}{(300)}$$

N

$$a = 4.7\ m/s/s \checkmark$$

x(9.8)

$$v_2^2 = v_1^2 + 2a\Delta d$$

$$= (0)^2 + 2(4.7)(100)$$

$$v_2 = 30.66\ m/s$$

$$a = \frac{v_2 - v_1}{\Delta t}$$

$$\Delta t = \frac{v_2 - v_1}{a} = \frac{(30.66) - (0)}{(4.7)}$$

$$\Delta t = 6.52\ s \checkmark$$