

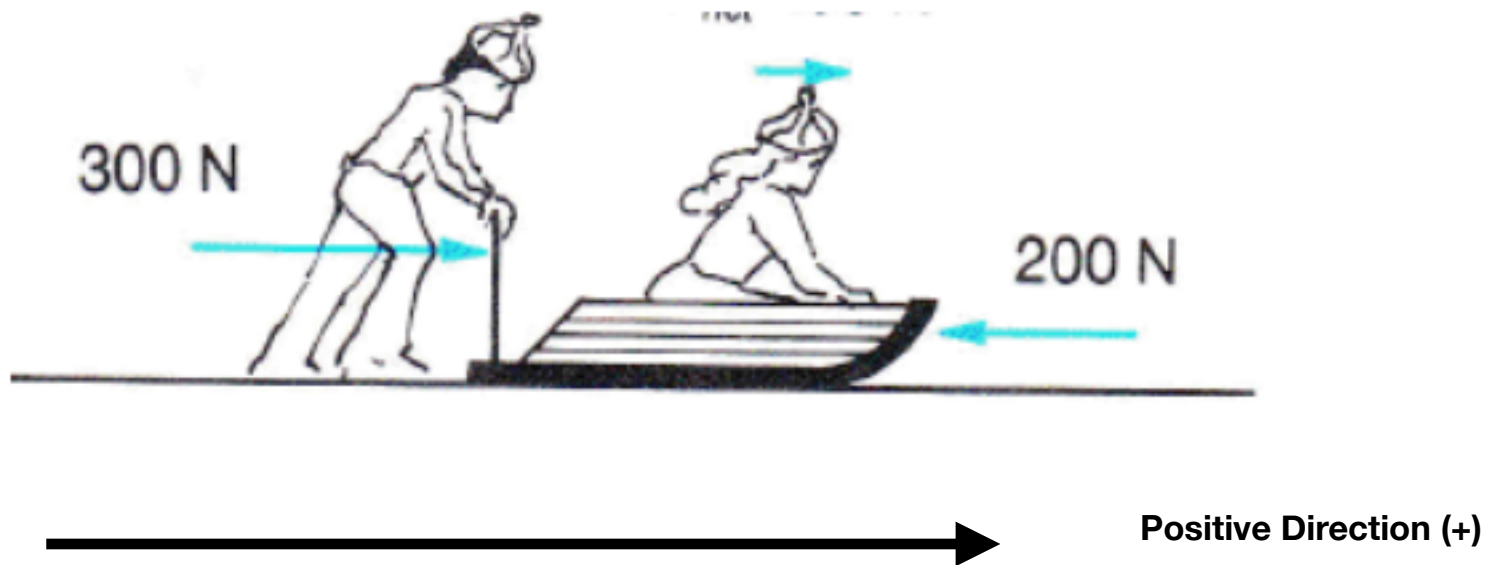
Newton's second Law of Motion

Western International High School

Class Notes

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A boy gives his sister a ride on a sled by exerting a force of 300 N [east]. Frictional resistance exerts a force of 200 N [west]. The sister and the sled have a combined mass of 50 kg.



$$\begin{aligned} \text{Net Force} &= (\text{All positive direction forces}) - (\text{All negative direction forces}) \\ &= 300 \qquad \qquad \qquad - \quad 200 \\ &= 100 \text{ N East direction.} \end{aligned}$$

Net Force = mass x acceleration

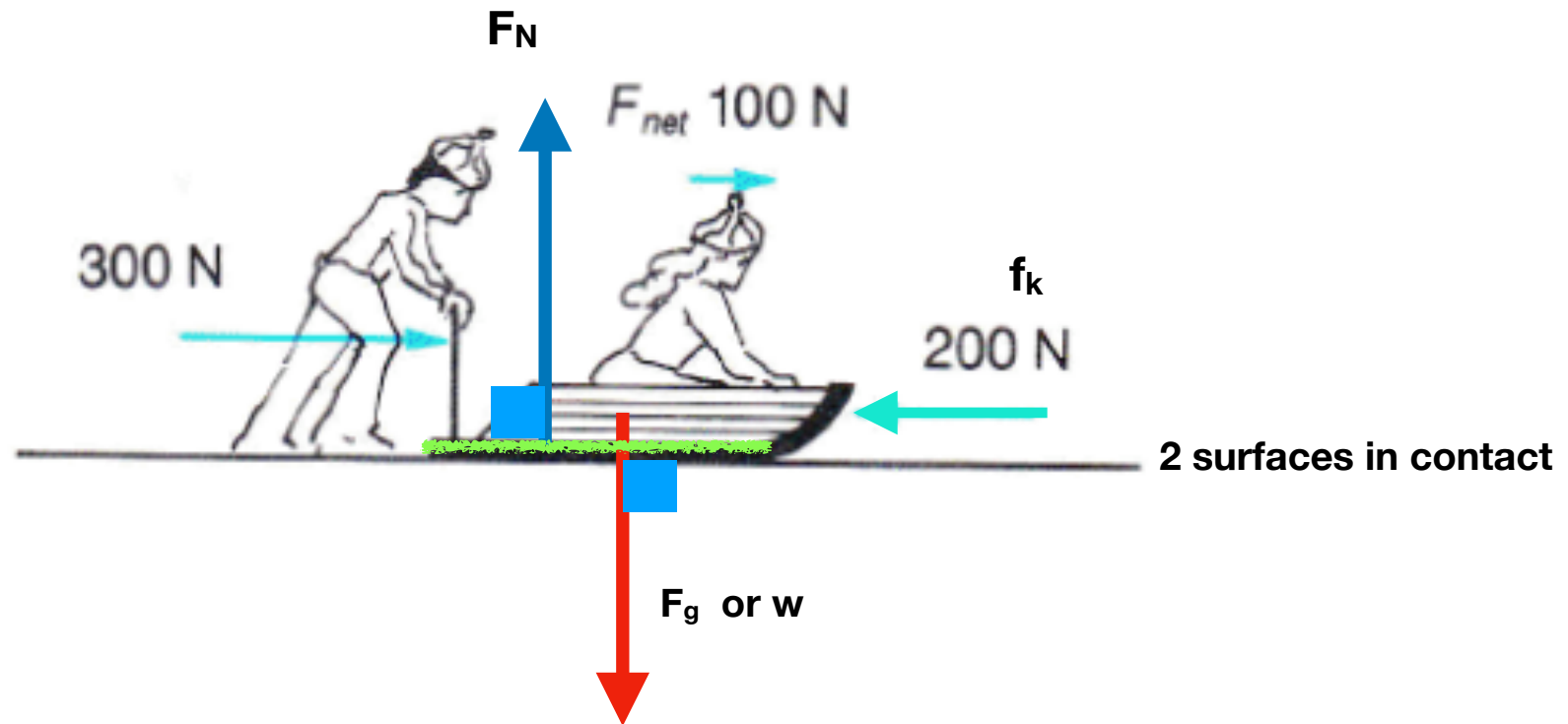
$$F_{\text{net}} = m \times a$$

$$100 = 50 \times a$$

$$\frac{100}{50} = \frac{50}{50} \times a$$

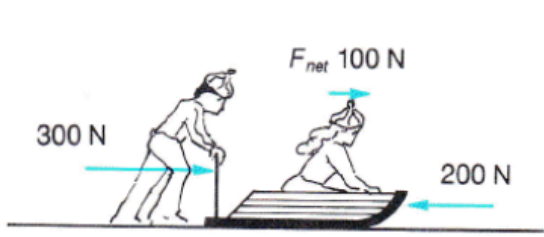
$$\frac{100}{50} = a$$

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



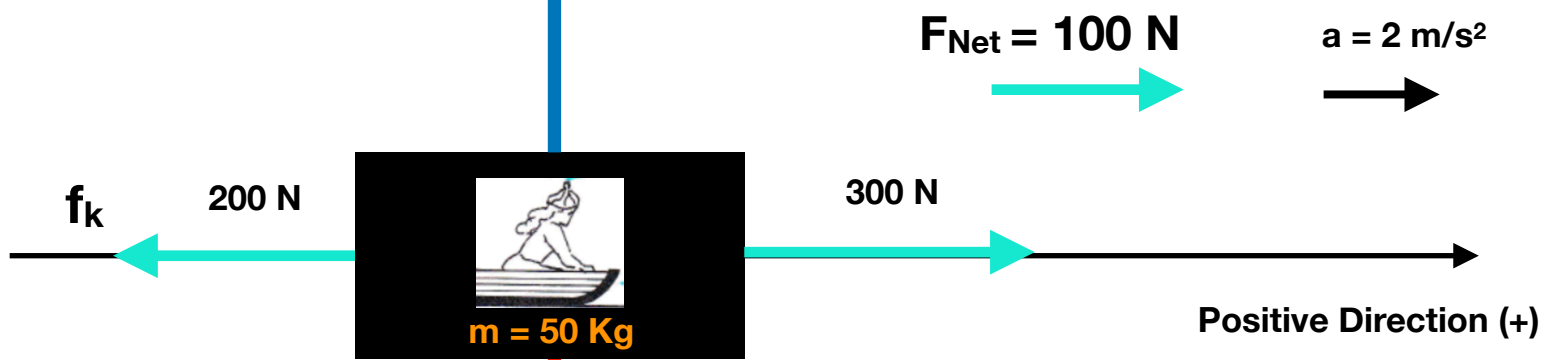
200 N is kinetic frictional force because;

- 1) **Parallel** to the surface of contact
- 2) **Opposite** to the direction of sliding.



Positive Direction (+)

$$F_N = w = 490 \text{ N}$$



$$F_g = w = m \times g = 50 \times 9.8 = 490 \text{ N}$$

What is the velocity (v) of the sled after $t = 5.0$ s.

Start from rest:

$$V_0 = 0 \text{ m/s}$$

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

$$t = 5\text{s}$$

$$v = ?$$

$$V = V_0 + a t$$

$$V = 0 + 2 \times 5 = 10 \text{ m/s}$$

Guessing:

The speed increases 2 m/s every one second.

For 5 seconds, the speed would be $2 \times 5 = 10$ m/s

$$V_o = 0 \text{ m/s}$$

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

$$t = 5\text{s}$$

$$V = 10 \text{ m/s}$$

$$W = 490 \text{ N}$$

Calculate the **distance traveled x** after 5 s?

Kinematic Equations for Motion with Constant Acceleration
$v = v_o + at$
$x = \frac{1}{2}(v_o + v)t$
$v^2 = v_o^2 + 2ax$
$x = v_o t + \frac{1}{2}at^2$

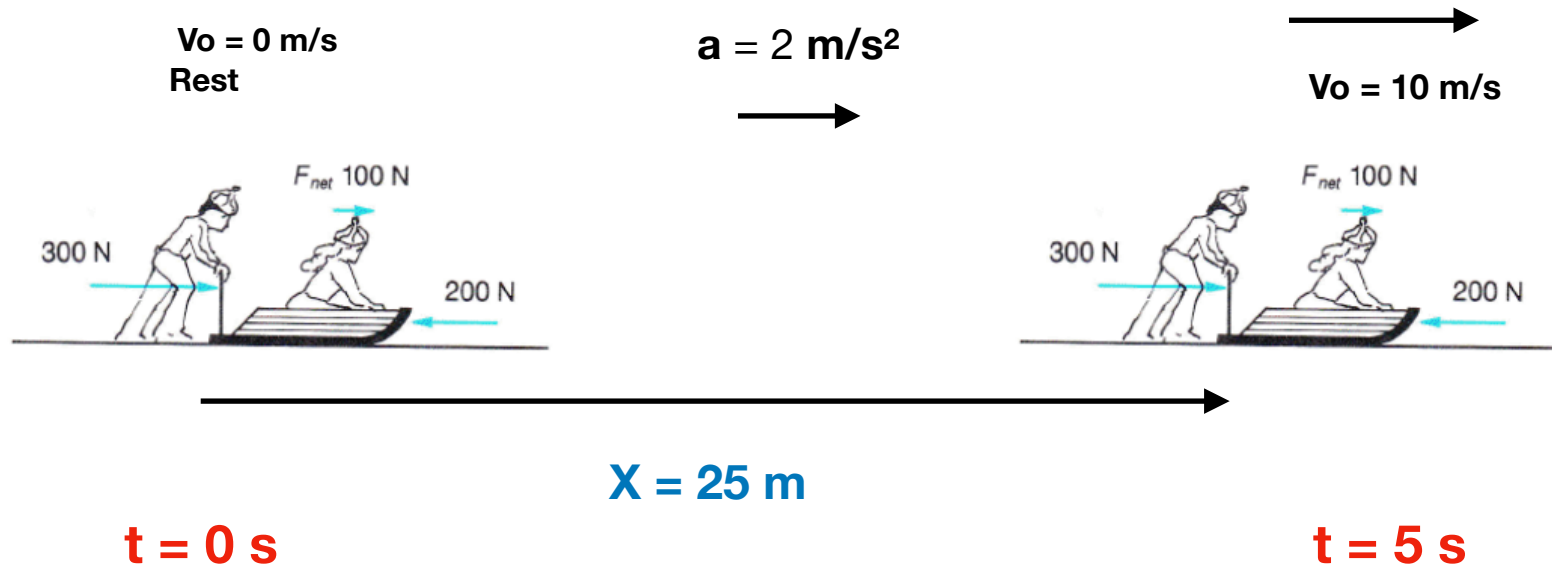
Calculate the distance travelled by the sled in 5.0 s.

Apply the second or the 4th equation;

2nd equation: $X = 1/2 (V_o + V) t = 1/2 (0 + 10) 5 = 1/2 (10) 5 = 25 \text{ m}$

4th equation: $X = V_o t + 1/2 a t^2 = 0 \times 5 + 1/2 (2) (5)^2 = 1 (25) = 25 \text{ m}$

3rd equation: $V^2 = V_o^2 + 2 a x$
 $10^2 = 0^2 + 2 (2) X$
 $10^2 = 4 X$
 $\frac{100}{4} = \frac{4 X}{4}$
 $25 \text{ m} = X$



A boy pushed horizontally on a 10 Kg wagon and it accelerates at 2.5 m/s^2 . If the frictional force is 50 N. $g = 9.8 \text{ m/s}^2$

1. Calculate the net force acting on the wagon
2. What force must the boy push on the wagon.
3. Calculate the weight of the wagon
4. What is the value of the normal force?
5. Calculate the coefficient of kinetic friction
6. Calculate the velocity of the wagon after 10s.
7. Calculate the distance traveled by the wagon after 10s.