Newton’s second Law of Motion

Western International High School

Class Notes

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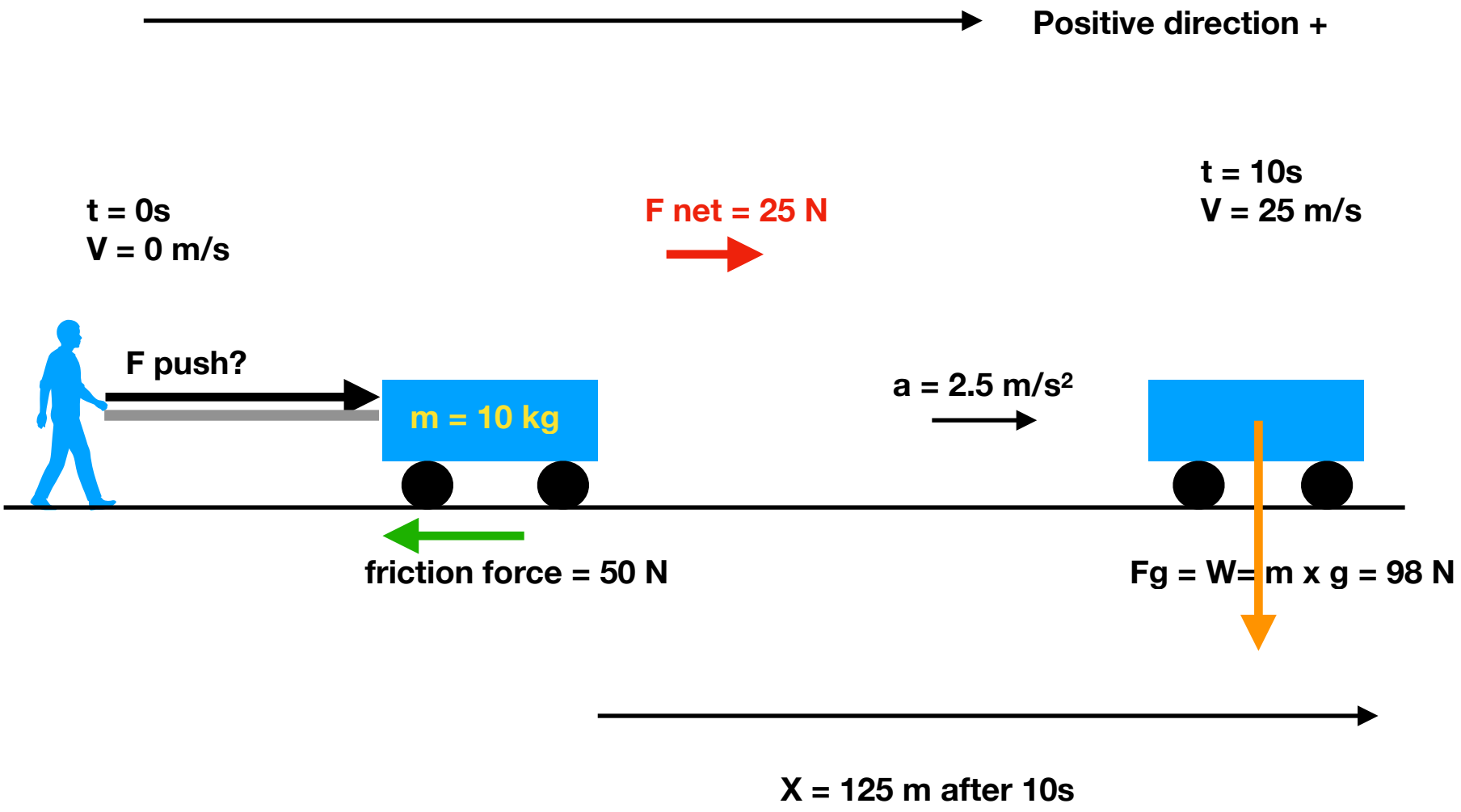
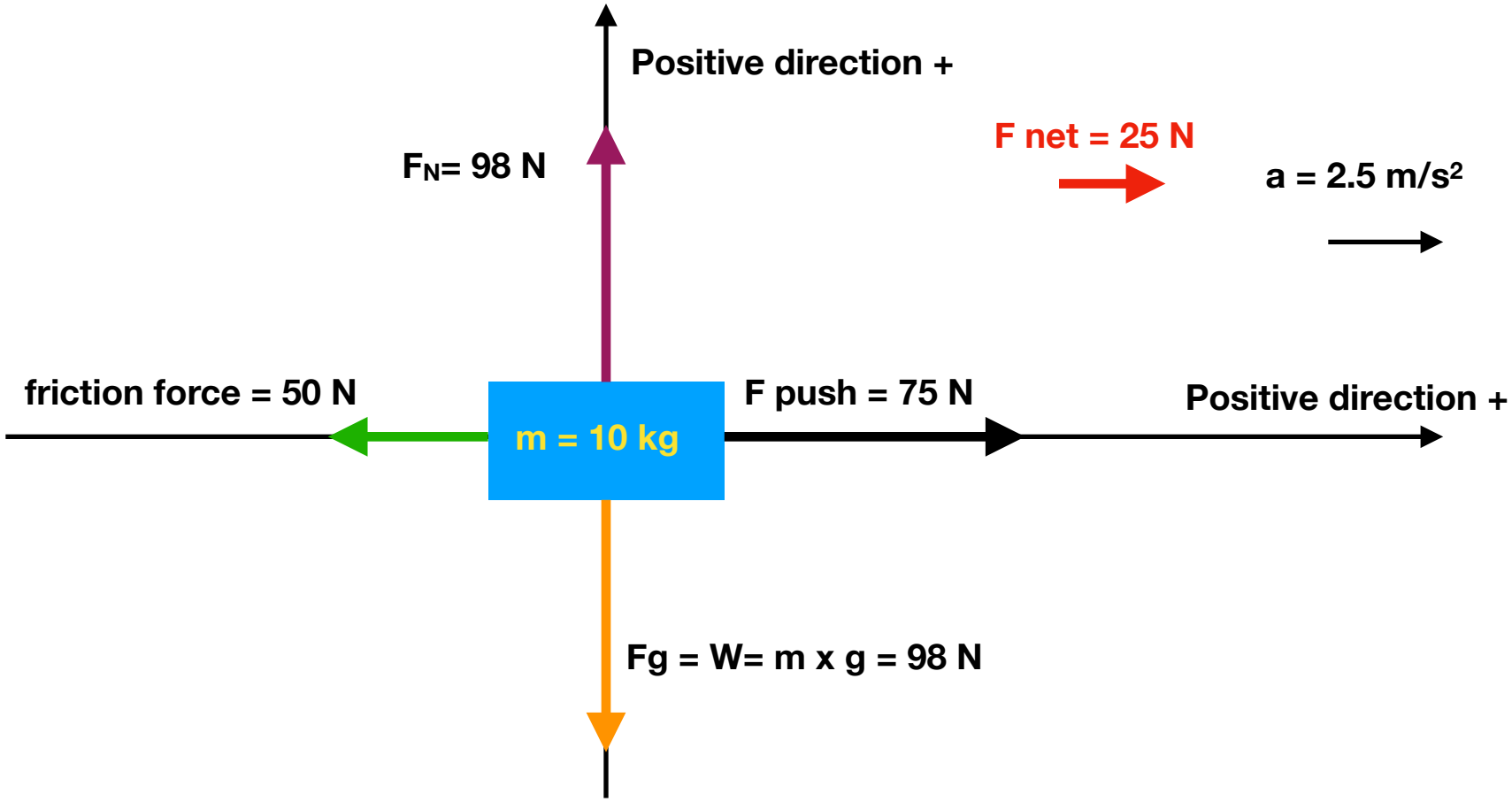
A boy pushed horizontally on a 10 Kg wagon from rest and it accelerates at 2.5 m/s^2. If the frictional force is 50 N.

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.

mass = 10 kg
a = 2.5 m/s^2
Frictional force = 50 N


Positive direction +
t = 0s
V = 0 m/s
F net = 25 N
t = 10s
V = 25 m/s
F push?
m = 10 kg
a = 2.5 m/s²
friction force = 50 N
Fg = W= m x g = 98 N
X = 125 m after 10s



Net force = sum of all forces = (75 - 50) + (98 - 98) = 25 N
Net force is driving the wagon to accelerate at 2.5 m/s^2.

1) Net Force = mass x acceleration

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

$$= 10 \times 2.5 = 25 \text{ N}$$

2) Net Force = (All positive direction forces) - (All negative direction forces)

$$25 = F_{push} - 50$$

$$25 + 50 = F_{push} - 50 + 50$$

$$75 = F_{push}$$

$$F_{push} = 75 \text{ N}$$

3) Calculate the weight

$$W = F_g = m \times g \; (g = 9.8 \; m/s^2, N/kg)$$

$$W = 10 \; (-9.8) = -98 \; N$$

4) Normal or support force = 98 N

5) Coefficient of kinetic friction: f_k = 50 N , FN = 98 N

Calculate the coefficients of kinetic friction (μ_k).

$$f_{kinetic\ frictional\ force} = (\text{coefficient of kinetic friction})\ F_{Normal}$$

$$f_k = \mu_k \times F_N$$

$$50 = \mu_k \times 98$$

$$\frac{50}{98} = \mu_k \times \frac{98}{98}$$

$$\mathbf{0.51 = \mu_k}$$

8. Calculate the velocity of the wagon after 10s. **(V ?)**

mass = 10 kg
a = 2.5 m/s^2
Frictional force = 50 N, Net force = 25 N
Weight = 98 N, Normal force = 98 N
t = 10 s
rest , Vo = 0 m/s

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

$$V = Vo + at$$

$$V = 0 + 2.5\ (10)$$

$$V = 25\ m/s$$

9. Calculate the distance traveled by the wagon after 10 s.

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2nd equation: $X = 1/2\ (Vo + V)\ t = 1/2\ (\ 0 + 25)10 = 1/2\ (25)\ 10 = 125$ m

4th equation: $X = Vo\ t + 1/2\ a\ t^2 = 0 \times 10 + 1/2\ (\ 2.5)\ (10)^2 = 125$ m

3rd equation: $V^2 = Vo^2 + 2\ a\ x$

$25^2 = 0^2 + 5\ X$

$625 = 0 + 5\ X$

$625 = 5\ X$

$\frac{625}{5} = \frac{5\ X}{5}$

$125\ m = X$