Newton's second Law of Motion
Practice Problems Set 2

Western International High School

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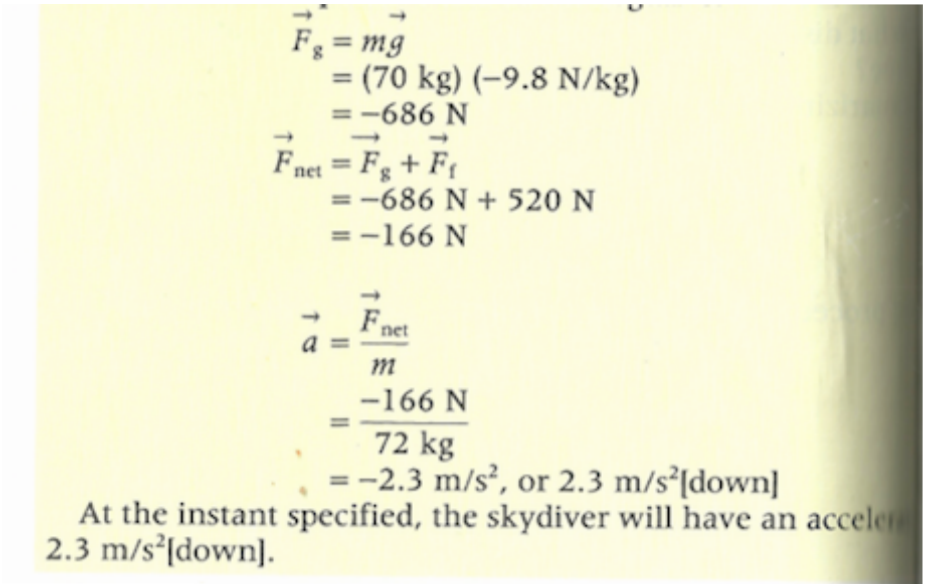
Sample Problem

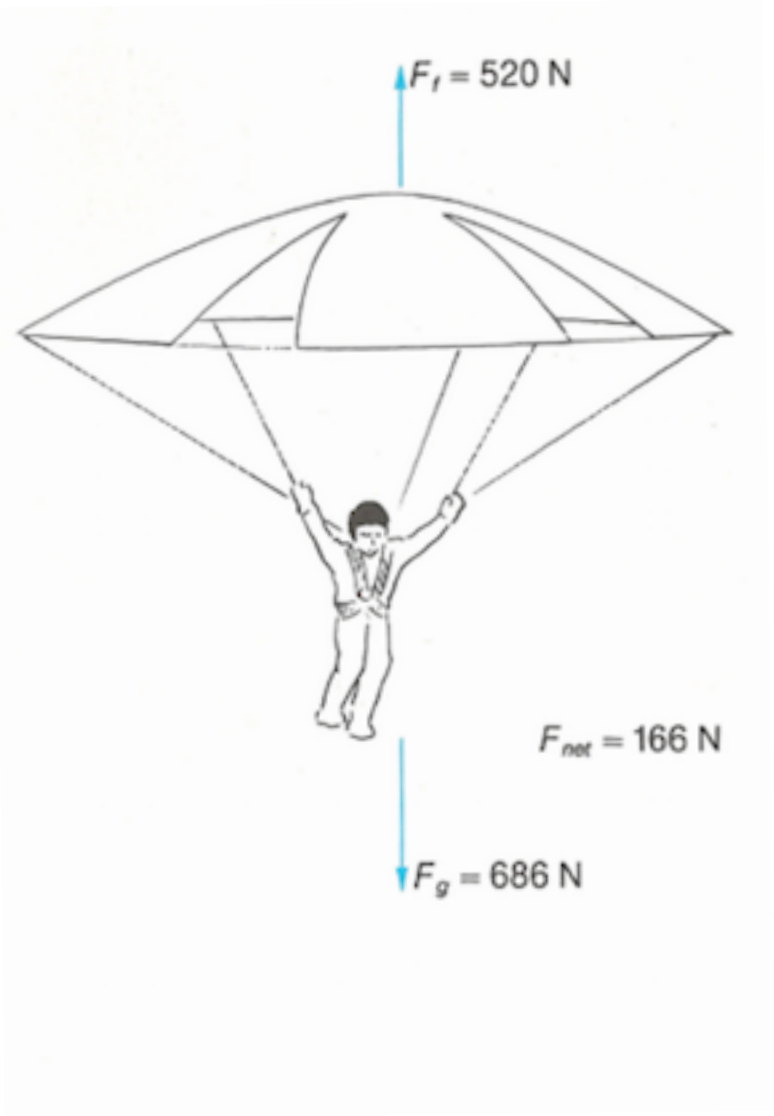
A skydiver, complete with parachute, has a mass of 70 kg. A short time after the skydiver jumps from the aircraft, the force of air resistance acting on him is 520 N. What is his acceleration at that instant?



$$\vec{F}_g = m\vec{g}$$
$$= (70\text{ kg})(-9.8\text{ N/kg})$$
$$= -686\text{ N}$$
$$\vec{F}_{net} = \vec{F}_g + \vec{F}_f$$
$$= -686\text{ N} + 520\text{ N}$$
$$= -166\text{ N}$$

$$\vec{a} = \frac{\vec{F}_{net}}{m}$$
$$= \frac{-166\text{ N}}{72\text{ kg}}$$
$$= -2.3\text{ m/s}^2\text{, or } 2.3\text{ m/s}^2\text{[down]}$$

At the instant specified, the skydiver will have an accele
2.3 m/s²[down].


$F_r = 520$ N
$F_{net} = 166$ N
$F_g = 686$ N

Practice Problems

1) The net force on a 5.0 kg bowling ball is 20 N. What is its acceleration?
   Answer: 4.0 m/s^2

Net force = mass x acceleration

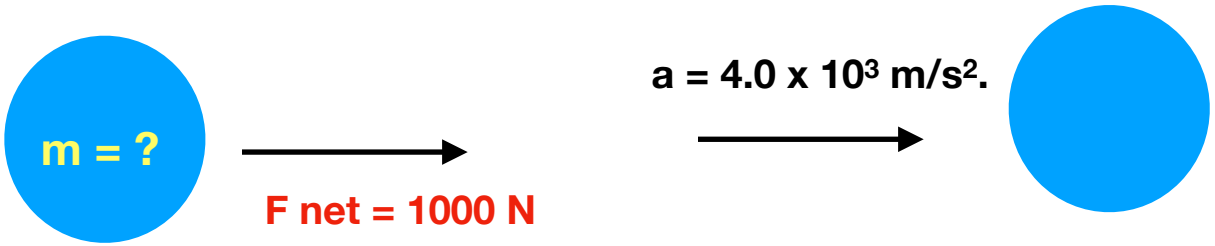
$$F_{net} = m \times a$$

$$20 = 5.0 \times a$$

$$\frac{20}{5.0} = \frac{5.0}{5.0} \times a$$

$$a = 4.0 \text{ m/s}^2$$

2) A baseball hit by a bat with an average force of 1000 N accelerates at 4.0×10^3 m/s^2. What is the ball's mass? Answer: 0.25 kg



Net force = mass x acceleration

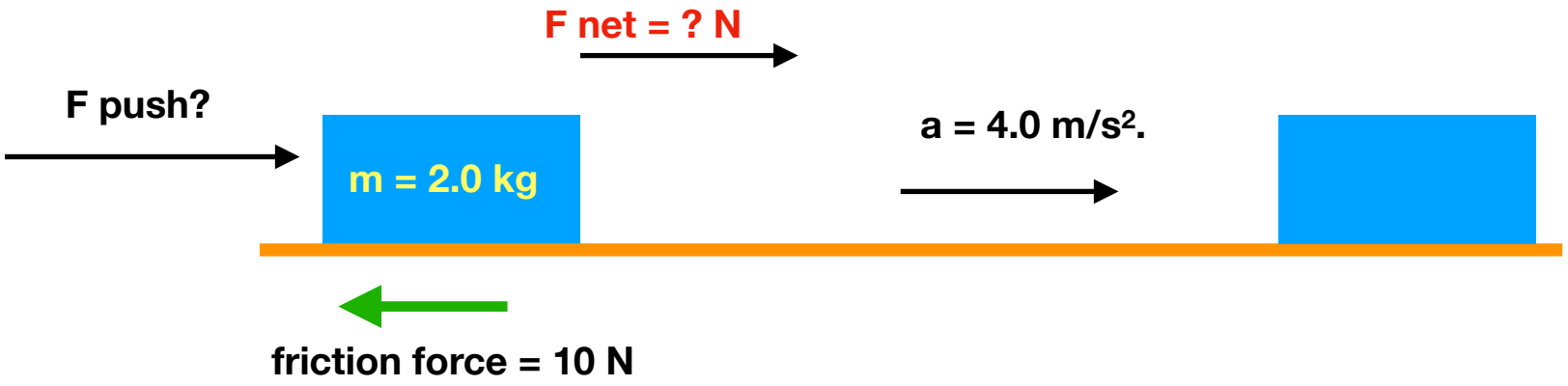
$$F_{net} = m \times a$$

$$1000 = m \times 4000$$

$$\frac{1000}{4000} = m \times \frac{4000}{4000}$$

$$m = \frac{1000}{4000} = 0.25 \text{ Kg}$$

3) What unbalance force (F push) is needed to accelerate a 2.0 kg block of wood at 4.0 m/s^2 along a rough table, against a 10 N force of friction?



1) Net Force = mass x acceleration

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

$$F_{net} = 2 \times 4 = 8 \text{ N}$$

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

Net Force = 8 N

Friction force = 10 N

F push = ?

Net force = F push - Friction force

8 = F push - 10

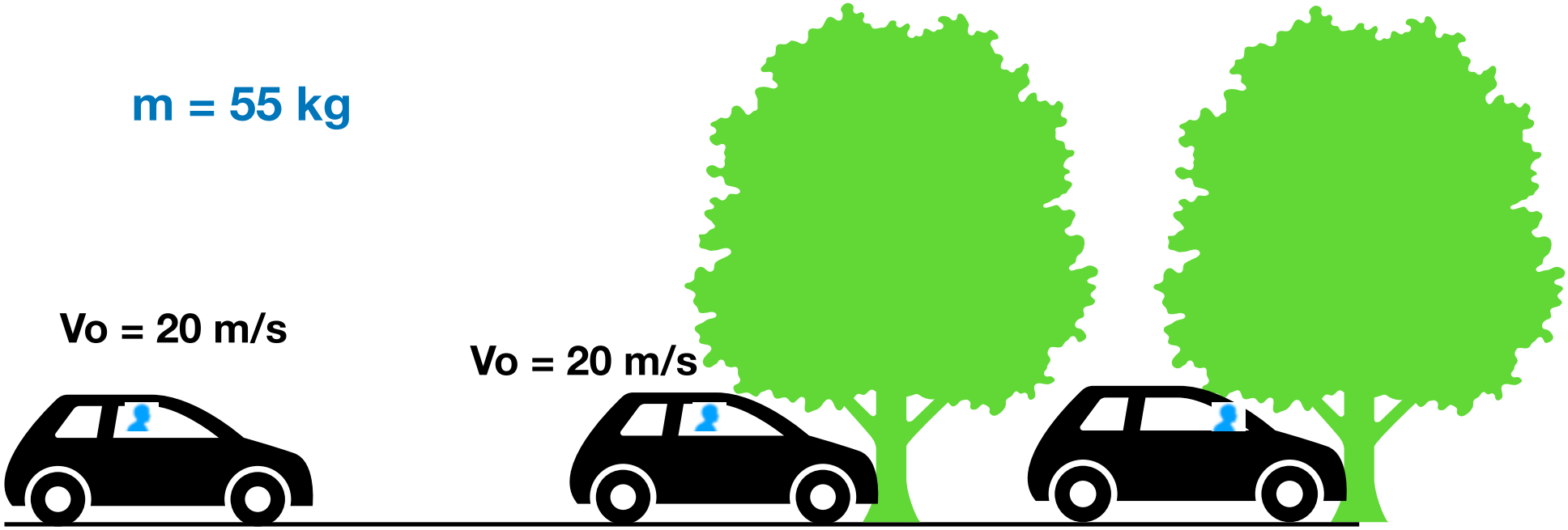
8 + 10 = F push - 10 + 10

18 N = F push

4) An automobile traveling at 20 m/s hits a tree. The driver who has a mass of 55 kg comes to rest in 0.10 s after the impact.

a) What is the average force that acts on the driver?
b) What distance does the driver travel after the car firs this the tree.

Answer: (a) a = -200 m/s^2, F net = -11000N
(b) 1.0 m



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 acceleration a:

$V_o = 20$ m/s
$V = 0$ m/s
$t = 0.1$ s

$$a = \frac{V - V_o}{t}$$

$$a = \frac{0 - 20}{0.1} = -200 \text{ m/s}^2$$

Calculate the acceleration with another equation;

$$V = Vo + at$$

$$0 = 20 + a\,(0.1)$$

$$-\ 20 = \cancel{20} \cancel{-20} + a\,(0.1)$$

$$-\ 20 = a\,(0.1)$$

$$-\ \frac{20}{0.1} = a\,\frac{(0.1)}{0.1}$$

$$a = -\ 200\ m/s^2$$

2) Net force = mass x acceleration

m = 55 kg

$a = -200\ m/s^2$

$$F_{net} = m \times a$$
$$= 55 \times a$$
$$= 55 \times -200$$
$$= -11{,}000\ N$$

3) The distance travelled by the driver (X = ?)

V = 0 m/s

Vo = 20 m/s

t = 0.1 s

$a = -200\ m/s^2$

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$$X = 1/2\ (Vo + V\ )\ t$$

$$X = 1/2\ (\ 20 + 0)\ 0.1$$

$$X = 1/2\ (20)\ 0.1$$

$$X = 10 \times 0.1$$

$$X = 1m$$

Formulas and equations

1) Net Force = mass x acceleration

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

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

3) W = Fg = m x 9.8

4)

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

$$f_k = \mu_k \times F_N$$

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