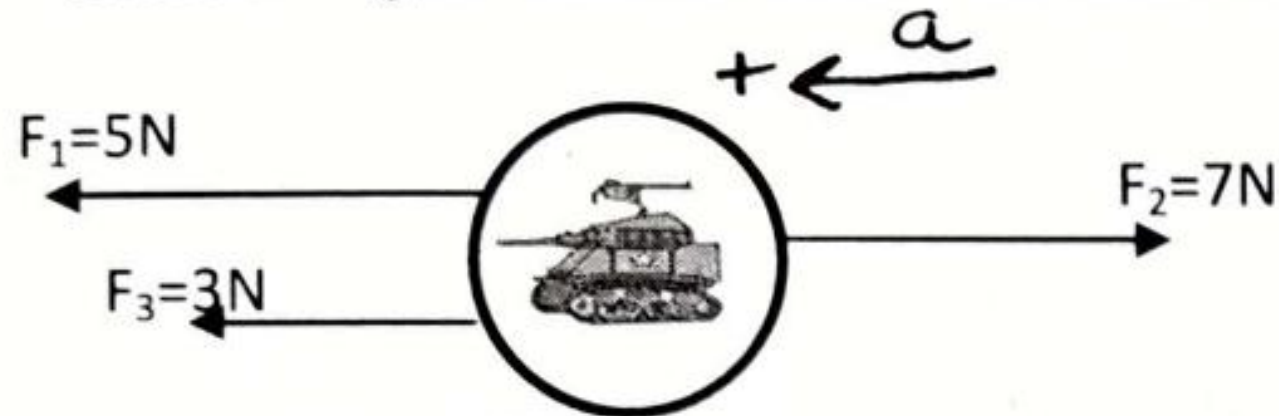# Mini-Tank Physics

Name: _____     Date: _____

Use your understanding of Newton's Laws of motion to find the missing quantity in each question.

1.  A **2 kg mini-tank** has the following forces acting on it.  Determine the **Net/Unbalanced/Sum** of the forces acting on this mini-tank.  Also determine the acceleration of the tank.

$F_1 = 5N$

$F_3 = 3N$

$F_2 = 7N$

$$\sum \vec{F} = \vec{F_1} + \vec{F_2} + \vec{F_3}$$

remove → signs and assign +/- based on acceleration

$$\sum F = F_1 - F_2 + F_3$$

$$= (5) - (7) + (3)$$

$$\boxed{\sum F = 1N \ [left]} \checkmark$$

$$\boxed{\sum \vec{F} = m\vec{a}}$$

$$a = \frac{\sum F}{M} = \frac{1N}{2 \, kg}$$

$$\boxed{a = 0.5 \, m/s/s} \checkmark$$

2.  The 2 kg mini-tank is now moving at a constant speed of 15 m/s.  What is the acceleration?  What is the net force acting on the tank?  Determine the unknown force, $F_3$.

$F_1 = 14N$

$F_2 = 5N$

$F_3$
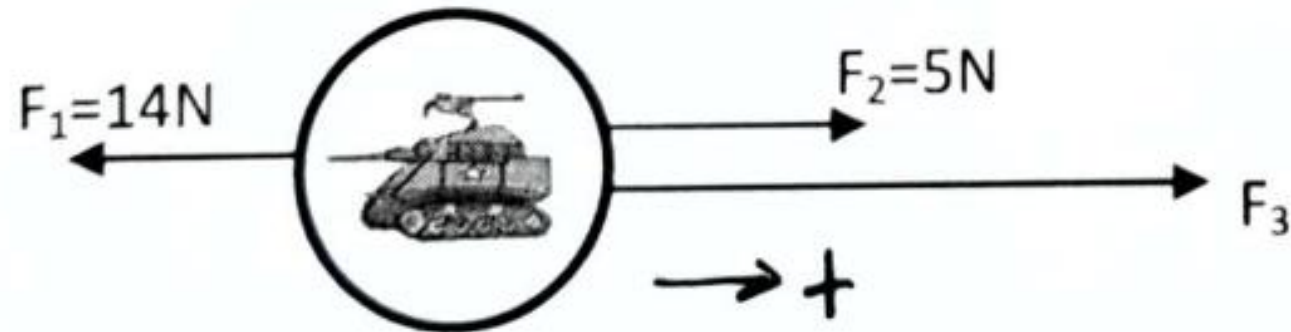
constant speed = No acceleration

$a = \emptyset \, m/s/s$

$$\sum F = M\cancel{a}^{\emptyset}$$

$$\sum F = \emptyset \quad (forces \ are \ balanced)$$

$$\sum F = F_3 + F_2 - F_1 \quad \binom{right \ is}{+ \ ture}$$
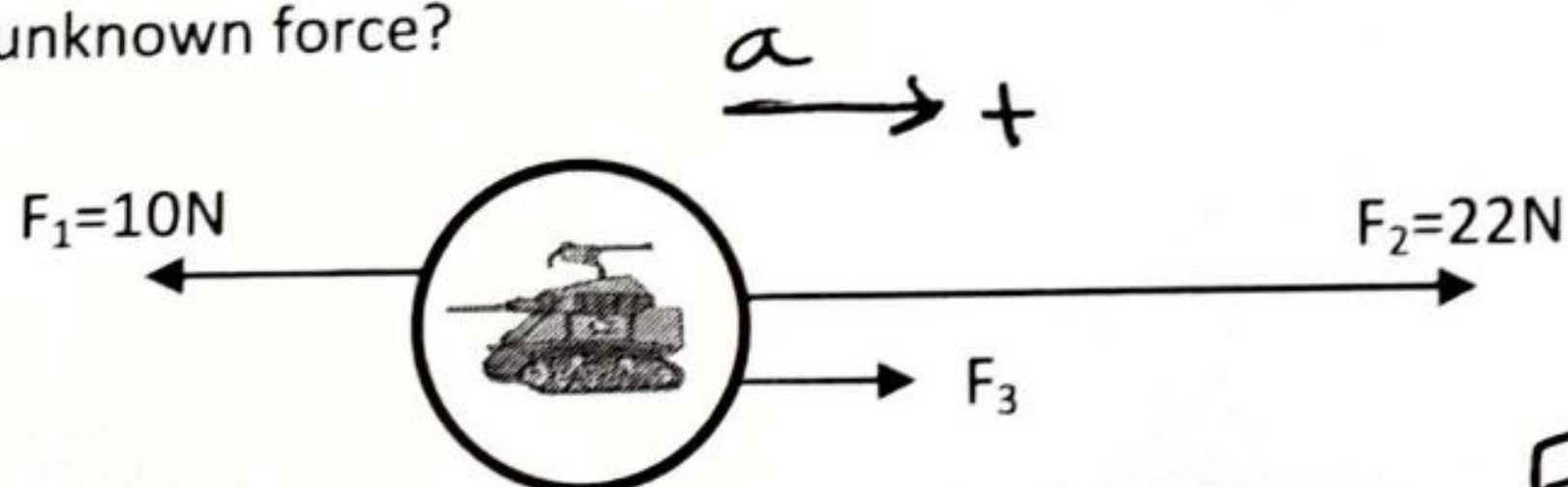
$$\emptyset = F_3 + (5) - (14)$$

$$F_3 = 14 - 5$$

$$\boxed{F_3 = 9N} \checkmark$$

1

*Make positive direction in the same direction as the acceleration

3. The mini-tank (2 kg) is now <u>accelerating to right</u> with an acceleration of 9 m/s/s. What is the value of the unknown force?

$a \rightarrow +$

$F_1 = 10N$ ← [tank] → $F_2 = 22N$

→ $F_3$

$\sum F = ma$

$F_3 + F_2 - F_1 = ma$

$F_3 = ma - F_2 + F_1$

$= (2)(9) - (22) + (10)$

$\boxed{F_3 = 6N}$

*check:
$\sum F = 22 + 6 + 10$
$\sum F = 18N$

$a = \dfrac{18N}{2kg} = 9 \, m/s/s \checkmark\checkmark$

4. The mini-tank (2 kg) stops to pick up a mini-elf passenger. The tank begins accelerating to left with an acceleration of 6 m/s/s. There is a 40 N motor force acting to the left. Two resistive forces also act on the tank; air resistance of 2 N and frictional force of 8 N. Complete the diagram. Determine the mass of the tank (including the passenger). Using this answer determine the mass of the magical elf. $a = 6m/s/s$

(Find total mass then subtract 2 kg)

$+ \leftarrow$

$F_1 = 40N$ ← [tank] → $F_2 = 2N$

→ $F_3 = 8N$
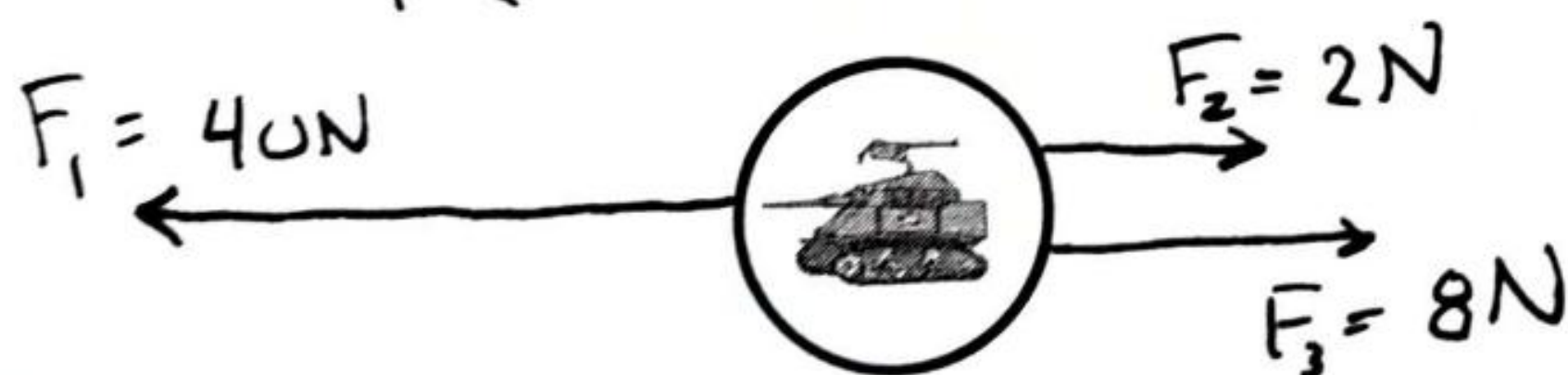
$\sum F = ma$

$F_1 - F_2 - F_3 = ma$

$m = \dfrac{F_1 - F_2 - F_3}{a}$

$= \dfrac{(40) - (2) - (8)}{(6)}$

$m = 5kg \, (total)$

→ so, mass of elf is

$5kg - 2kg =$

3 Kg
yay!!

2