

Newton's 2nd Law & Weight

- 1. Weight **D** **A** The units of weight and force.
- 2. Mass **E** **B** Newton's Second Law mathematically.
- 3. N **A** **D** The acceleration due to gravity = -9.8 m/s^2 .
- 4. $F = ma$ **B** **D** The force of gravity on matter.
- 5. g **C** **E** How much matter an object contains.

Will an object accelerate faster or slower?
 If its mass is increased? *Slower*
 If the force pulling on it decreases? *Slower*
 If the force pushing on it increases? *Faster*
 If its mass is decreased? *Faster*

Why is $F = ma$ not entirely correct?
*F is only one force
 It should be $F_{\text{net}} = ma$
 all forces*

More, less, or the same as on the Earth?
 When an astronaut lands on the moon:
 The astronaut's mass is: Same
 The astronaut's weight is: less
 The astronaut's inertia is: Same

Without air friction, which falls faster, heavy or light objects?
 Why? Same
acceleration due to gravity

If there is air friction, which falls faster?
 Why? heavier
Fair has a greater effect on the lighter object

How fast is the acceleration due to gravity? -9.8 m/s^2
 If an object falls from rest, how fast will it be going:
 after 1 second? 9.8 m/s after 2 seconds? 19.6 m/s after 6 seconds? 58.8 m/s

Using the weight equation, calculate the weight of a 45 kg rock?
 $g = 10 \text{ m/s}^2$
 $m = 45 \text{ kg}$
 $F_w = ?$
 $F_w = mg = 10 \text{ m/s}^2 \cdot 45 \text{ kg} = 450 \text{ N}$

Calculate the mass of a 10 N apple.
 $g = 10 \text{ m/s}^2$
 $F_w = 10 \text{ N}$
 $F_w = mg$
 $m = \frac{F_w}{g} = \frac{10 \text{ N}}{10 \text{ m/s}^2} = 1 \text{ kg}$

What is the mass of a 100 gram apple in kilograms? 0.1 kg
 $1000 \text{ g} = 1 \text{ kg}$
 What is the weight of the above apple?
 $F_w = ?$ $m = 0.1 \text{ kg}$
 $F_w = ma = 0.1 \text{ kg} \cdot 10 \text{ m/s}^2 = 1 \text{ N}$

What is the weight of a 250 N object?
 $F_w = 250 \text{ N}$
 If 100 kg person weighed 400 N on the planet Zorg, what is the acceleration due to gravity on Zorg?
 $F_w = 400 \text{ N}$ $F_w = m \cdot g$
 $m = 100 \text{ kg}$
 $g = \frac{F_w}{m} = \frac{400 \text{ N}}{100 \text{ kg}} = 4 \text{ m/s}^2$

Which of Newton's Three Laws Applies: Law 1, 2, or 3?

- 1 Pushing a cart down the hall, when you try to turn it if tries to go straight.
- 2 More acceleration takes more force.
- 3 When you push your knuckles into a table, it hurts your knuckles.
- 3 A ball thrown into the ground bounces back up.

A 6 kg object experiences a 5 m/s^2 acceleration? Find the force that caused this acceleration.

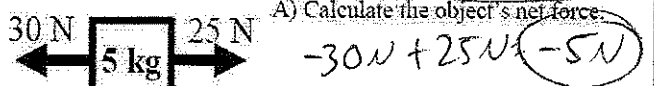
$F = ma$
 $m = 6 \text{ kg}$
 $a = 5 \text{ m/s}^2$
 $F = 6 \text{ kg} \cdot 5 \text{ m/s}^2 = 30 \text{ N}$

A 3 kg rock accelerates to the left at 12 m/s^2 . Find the net force that caused this.

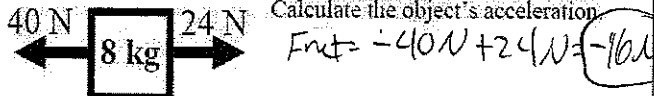
$F = ma$
 $m = 3 \text{ kg}$
 $a = 12 \text{ m/s}^2$
 $F = 3 \text{ kg} \cdot 12 \text{ m/s}^2 = 36 \text{ N}$

A 12 kg box is pushed to the left by a 48 N force. Find its acceleration.

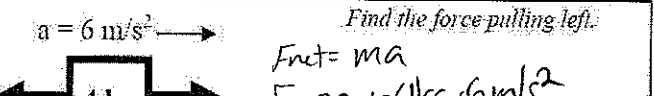
$F = 48 \text{ N}$
 $m = 12 \text{ kg}$
 $a = ?$
 $F = ma$
 $a = \frac{F}{m} = \frac{48 \text{ N}}{12 \text{ kg}} = 4 \text{ m/s}^2$



A) Calculate the object's net force.
 $-30 \text{ N} + 25 \text{ N} = -5 \text{ N}$
 B) Calculate the object's acceleration.
 $F_{\text{net}} = -5 \text{ N}$
 $m = 5 \text{ kg}$
 $a = \frac{F}{m} = \frac{-5 \text{ N}}{5 \text{ kg}} = -1 \text{ m/s}^2$

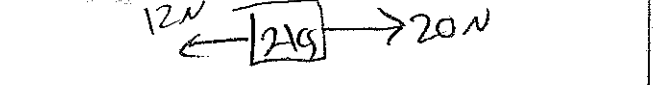


Calculate the object's acceleration.
 $F_{\text{net}} = -40 \text{ N} + 24 \text{ N} = -16 \text{ N}$
 $F = ma$
 $a = \frac{F}{m} = \frac{-16 \text{ N}}{8 \text{ kg}} = -2 \text{ m/s}^2$



Find the force pulling left.
 $F_{\text{net}} = ma$
 $F + 30 \text{ N} = 4 \text{ kg} \cdot 6 \text{ m/s}^2$
 $F + 30 = 24$
 $F = -6 \text{ N}$

12 N pulls to the left and 20 N pulls to the right on a 2 kg object. Draw the problem:



Calculate the object's acceleration.
 $F_{\text{net}} = -12 \text{ N} + 20 \text{ N} = 8 \text{ N}$
 $m = 2 \text{ kg}$
 $a = ?$
 $F = ma$
 $a = \frac{F}{m} = \frac{8 \text{ N}}{2 \text{ kg}} = 4 \text{ m/s}^2$

$F_{\text{net}} = F + 30 \text{ N}$
 $m = 4 \text{ kg}$
 $a = 6 \text{ m/s}^2$