

change relationships to circle

Name Key-2015 Hour _____



FORCE NOTES

Force (F) - A push or a pull

unit for F : Newton (N) -

1 Newton = the force needed to accelerate a 1 kg mass at 1 m/s²

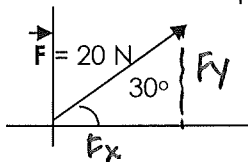
net force = Total force acting on object

Friction: Force that opposes motion

Forces are vectors!

vector- any quantity that has magnitude and direction

Every vector has 2 components: an x component and a y component. Force is a vector.



$$\sin 30^\circ = \frac{F_y}{20} \quad F_y = 10\text{ N}$$

$$\cos 30^\circ = \frac{F_x}{20} \quad F_x = 17.3\text{ N}$$

Equilibrium: No change in an object's velocity Total/Net force = 0
2 cases

1. object is at rest $V=0, a=0, \text{ so } F=0$

2. object is moving at a constant speed $a=0 \quad F=m \cdot a \text{ so } F=0$

*Ex of 2: Terminal Velocity: Force down = Force up so $a=0$
weight air resistance

Newton's Laws of Motion:

Newton's 1st Law* - An object at rest remains at rest and an object in motion continues in motion unless acted upon by an outside force

*This is also known as Law of Inertia - property of matter to resist changes in motion

Examples:

Egg Spin Ball and card demo Seatbelt Tablecloth

Newton's 2nd Law - $F = ma$ kg m/s²

$$N \quad \boxed{Force = mass \times acceleration}$$

$$1\text{ N} = \underline{1\text{ kg} \cdot \text{m/s}^2}$$

Mass and weight are NOT the same thing!

Mass- the amount of **matter** in kg

Weight- the **force** due to gravity on the mass in Newtons

Force and mass are directly related.

Force and acceleration are directly related.

Mass and acceleration are inversely related

• BMW underclip
• mythbusters
videoclip
(clip 2)



→

balloon rocket

Newton's 3rd Law - For every action there is an equal and opposite reaction

Action/reaction pair: book sitting on desk

action - book pushes on desk

reaction - desk pushes equally on book

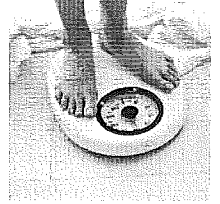


Ex. 1 Calculate the **mass** in kilograms of a 150 lb person. (1 kg = 2.2 lb)

$$150 \text{ lb} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} = 68.2 \text{ kg}$$

Ex. 2: Find the **weight** of a 150 lb person in Newtons. $F = ma$, or $F_g = mg$ or $w = mg$

$$W = m \cdot g = (68.2 \text{ kg})(-9.8 \text{ m/s}^2) = -668 \text{ N}$$



***Weight is a FORCE measured in Newton's

Ex. 3: A 6-lb. mallard is trying to land on a frozen pond. The duck hits the ice going at 15 m/s and stops after a distance of 20 meters. Calculate the **force** due to friction.

$m = 6 \text{ lb} / 2.2 = 2.73 \text{ kg}$
 $v_i = 15$
 $v_f = 0$
 $\Delta x = 20 \text{ m}$

① $v_f^2 = v_i^2 + 2a\Delta x$
 $0 = 15^2 + 2a(20)$
 $-225 = 40 \cdot a$
 $a = -5.6 \text{ m/s}^2$

② $F = m \cdot a$
 $(2.73 \text{ kg})(-5.6 \text{ m/s}^2)$
 $F = -15.3 \text{ N}$



Bucket Day Questions for FORCES

- 1) What is a vector? magnitude + direction
- 2) What is a force? push or a pull
- 3) What unit do we use to measure force? N
- 4) What is meant by net force? total force
- 5) What is Newton's 1st Law? inertia
- 6) What is Newton's 2nd Law? (just the equation is fine) $F = m \cdot a$
- 7) What is Newton's 3rd Law? action/reaction
- 8) What is the unit for acceleration? m/s^2
- 9) What is the unit for mass? kg
- 10) What is equilibrium? no change in velocity
- 11) What is one of the two cases when equilibrium can occur? ① not moving, ② constant speed
- 12) If an object is in equilibrium, what is the sum of all of the forces acting on it? 0
- 13) What is inertia? property of matter to resist changes in motion
- 14) What is the mathematical relationship between vector F , F_x and F_y ? $F^2 = F_x^2 + F_y^2$
- 15) If you know an object's mass, how can you find its weight in Newtons? $\times -9.8 \text{ m/s}^2$
- 16) If you know an object's weight in Newtons, how can you find its mass? $\div -9.8 \text{ m/s}^2$
- 17) What quantity do you get if you divide force by mass? a
- 18) What exactly is a Newton? (Definition) force needed to accelerate 1 kg at 1 m/s^2
- 19) What other units are equal to a Newton? $1 \text{ kg} \cdot \text{m/s}^2$
- 20) Force is a vector because... magnitude + direction
- 21) What quantity do you get if you divide force by acceleration? m
- 22) If you know an object's weight in lbs, how can you find its weight in Newtons? $\div 2.2 \times -9.8 \text{ m/s}^2$
- 23) What outside force slows down an object? friction, air resistance
- 24) Which can change when you change locations, mass or weight? weight
- 25) What quantity do you get if you divide weight by acceleration? m
- 26) What unit do you end up with when you divide force by mass? $a = \text{m/s}^2$
- 27) What unit do you end up with when you divide weight by acceleration? kg
- 28) What unit do you get when you multiply mass and acceleration? $\text{kg} \cdot \text{m/s}^2$ or N
- 29) What unit do you get when you divide force by acceleration? kg
- 30) Terminal velocity is when the force of your weight = the force of air resistance