Forces

Tuesday, December 07, 2010 1:59 PM

A force is any push or pull. Forces are measured in units of NEWTONS (N).
Forces are vectors, which may mean tip-to-tail diagrams with resultants.

Force of gravity (Fg)

$F_g = m g$ m is mass of object in kg, g gravitational field (On Earth : 9.8 m/s^2)

Only works near Earth's surface

Calculate the force of gravity at the Earth's surface on a non-physics student of mass 60 kg and IQ 26.

Normal Force (Fn)

Supporting force exerted by a surface AT 90º to the surface which holds a mass in place

$F_n = F_g \cos\theta$ where θ is the angle of the surface from horizontal

A 3.0 kg cat is placed on a stove burner which is red hot. What normal force is exerted on the cat by the burner if the burner is inclined at 30º?

Force of Friction (F_f)

This is force which resists motion due to the grinding together of molecules.

$F_f = \mu F_n$

μ is called the coefficient of friction <= is a value which describes how sticky 2 surfaces are

Wet roads have a coefficient of friction of 0.20, a 1000 kg car is on a level, wet road.

Find the force of friction on that car.

Dry roads have $\mu = 0.60$, how many times more force of friction is on a dry road than a wet road?

Elastic Force (Fe)

- This is the force which acts to restore the shape of a deformed object
- $F_e = kx$
- k spring constant (N/m) and high values (1000's) show a really stiff object, low values (10's) show really stretchy objects.
- X is the distance you stretch or compress the object in METERS.

A cat has k = 12 N/m and is 45 cm long. You stretch the cat to 50 cm, how much force did you use?

Elastic behaviour is when you apply a force to deform object, remove F and it bounces back
Elastic limit <= the point when an object displays plastic behaviour
<= stretches but doesn't bounce back
Brittle behaviour <= occurs after plastic behaviour when the object fails (breaks)

A rubber band of length 15 cm and spring constant 12 N/m experiences a force of 0.05 N. What is

a) The amount it stretches
b) The new length

The Force of Gravity Between ANY 2 masses:
$F_g = mg$ <= works for finding the force of gravity between 1 mass and Earth near Earth's surface
We cannot use this if: 1) the force of gravity does not involve the Earth
2) we're not near* the Earth's surface

*near = 10 km or less

NEWTON'S LAW OF UNIVERSAL GRAVITATION

$F_g = \frac{Gm_1m_2}{\quad}$ G = universal gravitational constant = 6.67×10^{-11} N m^2 / kg^2

NEWTON'S LAW OF UNIVERSAL GRAVITATION

$F_g = \frac{Gm_1m_2}{d^2}$

G = universal gravitational constant = 6.67×10^{-11} N m^2 / kg^2
m_1 = 1st mass in kg
m_2 = 2nd mass in kg
d = distance between the CENTRES of the masses
(for a planet use the radius of the planet)
$r_e = 6.38 \times 10^6$ m
m_e = mass of Earth = 5.98×10^{24} kg

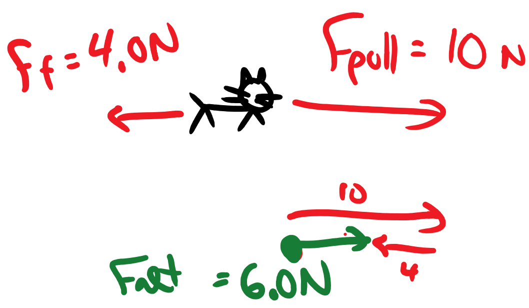
Calculate the force of gravity on a random physic kid (65 kg) on the moon, where $r_m = 1.74 \times 10^6$ m, $m_m = 7.35 \times 10^{22}$ kg.

The total of all forces: Fnet

Calculate the force of gravity between Strachan (72 kg) and his coffee cup 1.0 kg if the centers are separated by 1.2 m

Fnet = total of all forces

Find Fnet by adding the forces (look at their directions)



Newton's 1^{ST} Law: If there is no Fnet ($F_{net}=0$) then the object stays at constant speed.

Newton's 2^{nd} Law: For an object to accelerate there must be a Fnet not zero

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

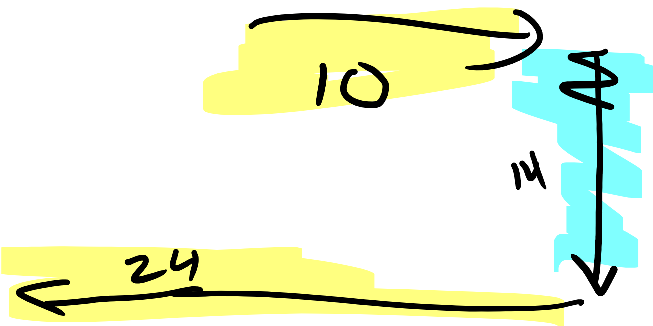
A cat had 2 force acting on it, 4.0 N [N] 3.0 N [W], if the cat has $m = 10kg$ find its acceleration

5.0N

$\theta = \tan^{-1}\left(\frac{3}{4}\right) = 37°$ W from N

$$a = \frac{F_{net}}{m} = \frac{5}{10} = 0.5\frac{m}{s^2}$$

A cat is pulled by 3 forces, 10 N [E], 14 N [S], and 24 N [W]. The cat has an acceleration of 2.25 m/s² find its mass.



$\tan^{-1}\left(\frac{14}{14}\right) = \theta = 45^\circ$ S from W

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

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

$\frac{19.8\,N}{2.25\,\frac{m}{s^2}} = 8.8\,kg$