Forces

Tuesday, December 07, 2010 1:59 PM

A force is any push or pull. Forces are measured in units of NEWTONS. (N)

Force of gravity (Fg) [near Earth' surface]

$F_g = m g$ m is mass of object in kg, g acceleration due to gravity (9.8 m/s^2)

$F = ma$

F_{net}

Normal Force (F_n)

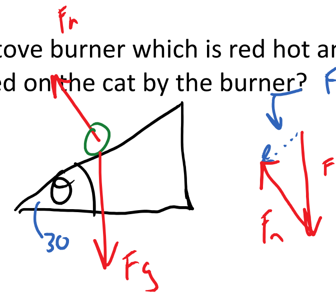
Supporting force exerted by a surface AT 90^o to the surface which holds a mass in place

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

$F_n = F_g$

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

Ficticious Force



$F_n = F_g \cos\theta$
$= 3(9.8)(\frac{\sqrt{3}}{2})$
$= 25.5 N$

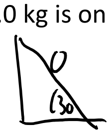
Force of Friction (F_f)

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

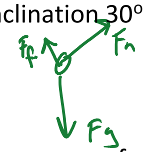
$F_f = \mu F_n$

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

A cat of mass 5.0 kg is on a ramp of inclination 30^o with coefficient of friction 1.5 find Ff



$\mu = 1.5$



$F_f = \mu F_n$
$= \mu m g \cos\theta$
$= 1.5(5)(9.8)(\frac{\sqrt{3}}{2}) = 63.7N$

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

≈ double

Elastic Force (F_e)

This is the force which acts to restore the shape of a deformed object

$F_e = kx$ $F_e = k \Delta x$

k spring constant (N/m) and high values (10000'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.

Elastic limit <= the point when an object displays plastic behaviour <= stretches but doesn't bounce back

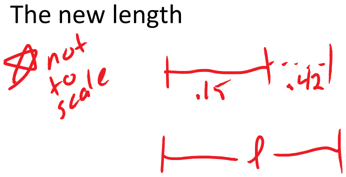
Brittle behaviour <= occurs after plastic behaviour when the object fails (breaks)

A rubber band of length 0.15 m and spring constant 12 N/m experiences a force of 5.0 N. What is

a) The amount it stretches

$F_e = kx$ $5.0 = 12x$ $\frac{5}{12} = x = .42m$

b) The new length



ℓ

.567 m

The Force of Gravity Between ANY 2 masses:

Fg = 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

If the Fg is between 2 masses and one is NOT the Earth or you're far from Earth we use

NEWTON'S LAW OF UNIVERSAL GRAVITATION

$$F_g = \frac{G m_1 m_2}{d^2}$$

G = universal gravitational constant = 6.67×10^{-11} N m^2 / kg^2

m_e = mass of Earth = 5.98×10^{24} kg

d = distance between the CENTRES of the masses (for a planet use its radius)

r_e = radius of the Earth 6.38×10^{6} m

Calculate the force of gravity on you (68 kg) on the moon, where $r_m = 1.74 \times 10^{6}$ m, and $m_m = 7.35 \times 10^{22}$ kg.

$$F_g = \frac{G m_1 m_2}{r^2} = \frac{6.67 \times 10^{-11}(68)(7.35 \times 10^{24})}{(1.74 \times 10^{6})^2} = 1.9 \times 10^{-22} N$$

Calculate the force of gravity between Mr. Connor (80 kg) and his coffee cup 1.0 kg if the centers are separated by
1.2 m