Forces and Mass

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Force = any push or pull
Force is an interaction between bosons and the fermions affected by each.

The Standard Model: Everything is made of particles
3 categories:

Hadrons: (protons and neutrons) these are held together by the strong nuclear force
Leptons: (electrons and electron like stuff, neutrinos) held in place by electromagnetic force

BOSONS: force carriers, these interact with Hadrons and Leptons giving the 4 fundamental forces

The forces are: Strong Nuclear Force, ElectroMagnetic Force, Weak Nuclear Force, Gravitational Force

Forces only exist between matter when bosons communicate information.

Contact forces: all a generalization of EM force, involve exchange of PHOTON

MASS: 2 types of mass, inertial mass, gravitational mass

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)

Normal Force (F_n)

Supporting force exerted by a surface AT 90° to the surface which holds a mass in place
$F_n = F_g \cos\theta$ where θ is the angle of the surface

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

Force of Friction (F_f)

This is the force which resists motion due to the grinding together of molecules.
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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° with coefficient of friction 1.5 find Ff

$F_f = \mu F_n$ $\quad F_n = F_g \cos\theta$

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

Elastic Force (F_e)

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

$F_e = kx$

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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.

stretch or compress

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

b) The new length

extension

$F_g = G \frac{m_1 m_2}{d^2} = \frac{6.67 \times 10^{-11} (68)\ 7.35 \times 10^{22}}{(1.74 \times 10^6)^2} = 110\text{N}$

r_m

$(1.74 \times 10^6)^2$

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

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

$m_1 m_2$

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