Unit 3: Dynamics

3.0 Gravity & Weight

<u>Gravity</u> is an attractive force that acts between any two bodies and depends on their mass and the distance separating them.

Newton's Law of Universal Gravitation is:

$F_g = \frac{Gm_1m_2}{r^2}$	where	F _g = Force due to gravity (in Newtons)
		G = universal gravitational constant
		$= 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$
		m_1 = mass of first body
		m ₂ = mass of second body
		r = dist. between centres of mass

<u>Mass</u> is the stuff that an object is made of and <u>does not change</u> regardless of the object's position in the universe.

<u>Weight</u> on the other hand, is the gravitational pull on an object towards the centre of Earth (or another object). Weight is a force measured in Newtons... not kg or lbs.

ex. What is the force of gravity between a sumo wrestler of mass 300 kg and Mr. Grottoli (75 kg) if they are standing 50 cm apart?

$$F_{g} = G_{M,M_{2}}$$

$$= (6.67 \times 10^{-11} (Nm^{2}/kg^{2})(300 kg)(75 kg))$$

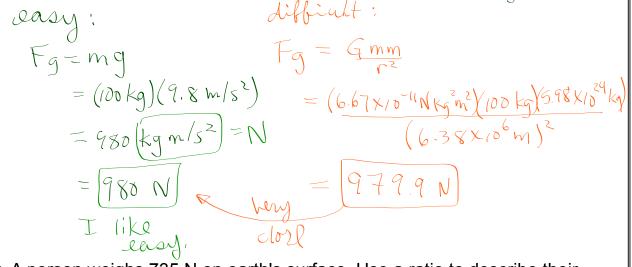
$$(0.5 m)^{2}$$

$$= 0.000006003$$
with one sig fig. $F_{g} = 6 \times 10^{-6} N$

 \overline{g} is the gravitational field strength at a given distance from the centre of a celestial object. As long as an object is at or near the surface of the celestial body (earth, moon...) and we know the value of g, we can calculate the weight To find g for any $\vec{g} = \frac{Gm_{planet}}{r_{planet}}$ the set \vec{r}_{planet} Note: m2 of a object with:

ex. Find the weight of a 100 kg Vampire by using the equation above as well as Newton's Law of Universal Gravitation. \rightarrow on earth $(\overline{q} = 9.8 \text{ m/s})$

 $\vec{F}_{a} = m\vec{q}$



ex. A person weighs 735 N on earth's surface. Use a ratio to describe their weight at 3 times the distance from centre of the Earth. What is the gravitational field strength at that distance?

field strengthean = $\frac{\sqrt{1}}{\sqrt{1}} = \frac{1}{\sqrt{1}}$ field strengthean = $\frac{\sqrt{1}}{\sqrt{1}} = \frac{1}{\sqrt{1}}$ $\frac{\sqrt{1}}{\sqrt{1}} = \frac{1}{\sqrt{1}}$ $\vec{g} = \frac{1}{9}(9.8 \text{ m/s}^2) \text{ or } \vec{g} = 1.09 \text{ m/s}^2$

practice: pg. 181 #20ac, 21-24, 26, 29, 30