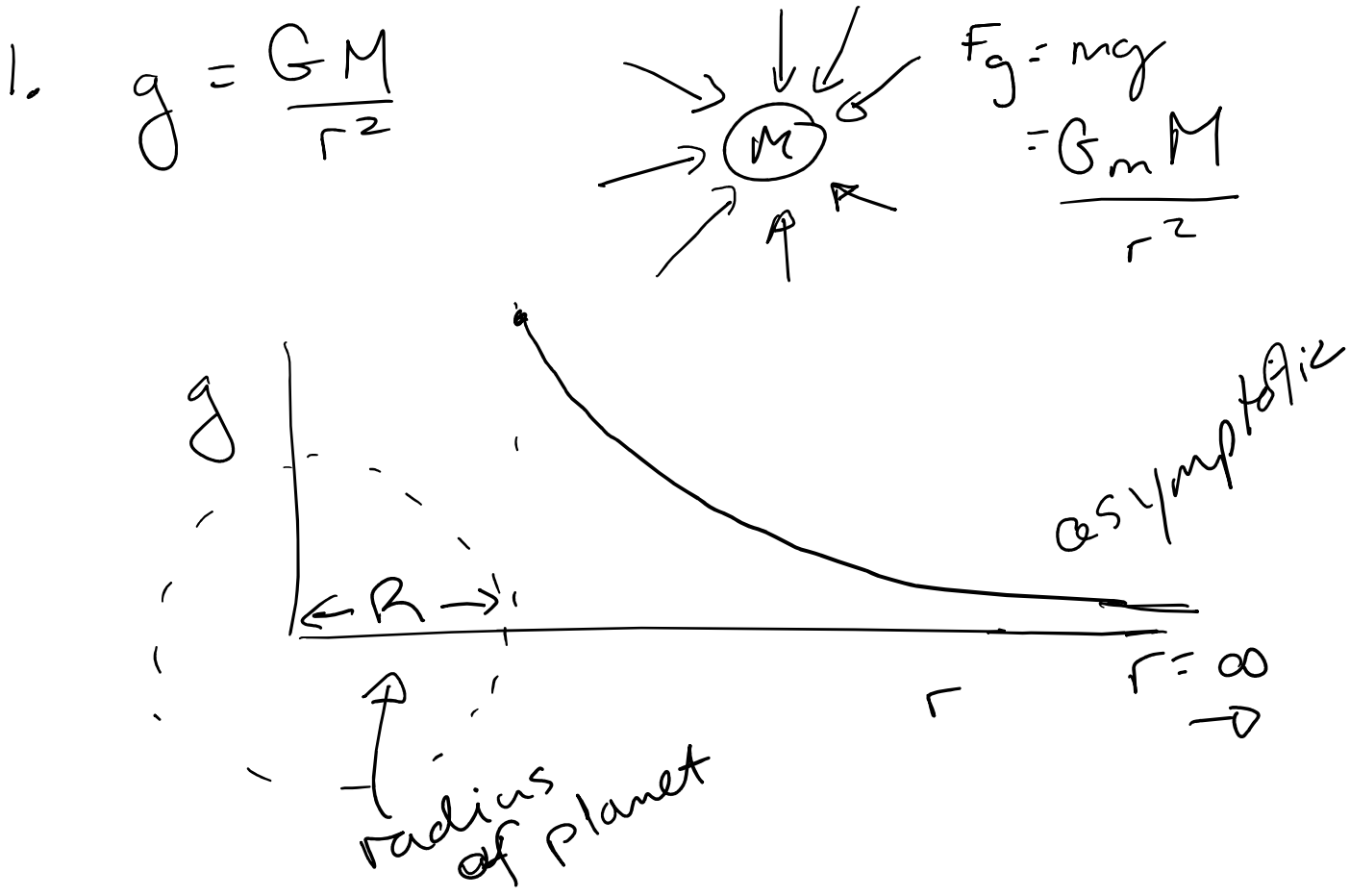
March 13, 2024

**Physics 11 Lesson – Gravitation**

1) g vs R graph: https://xmphysics.com/2023/01/02/7-2-2-gravitational-field-of-a-point-mass/
2) Algebraic method for determining g' after the dimensions of a planet are changed (changing mass M and radius R)
3) a of the Earth (or any other object) toward a falling mass
4) **Videos:**
   Gravity https://www.youtube.com/watch?v=MTY1Kje0yLg
   Gravity videos and news items:
   "What Happens When it Rains Space Debris" https://www.bbc.com/reel/video/p0hdkrc2/what-happens-when-it-rains-space-debris
   Space debris timeline: https://www.youtube.com/watch?v=wPXCk85wMSQ
   Critical amount of space junk: https://www.youtube.com/watch?v=HVov8o9x0yI
   Space Junk Harpoon: https://www.space.com/space-junk-harpoon-removedebris-satellite-video.html
   What if you fall into a Black Hole? https://www.bbc.com/reel/video/p03shhgv/the-strange-fate-of-a-person-falling-into-a-black-hole
   Picture of a Black Hole: https://www.bbc.com/news/science-environment-47873592



2. $$F_g = \frac{G m M}{R^2}$$


$$\therefore \cancel{m} g = \frac{G \cancel{m} M}{R^2}$$

$$\therefore g = \frac{GM}{R^2}$$

if M and/or R change...

the new g is g'

$$g' = \frac{GM'}{R'^2}$$

eg: if $M' = 5 \times M$

and $R' = \frac{R}{3}$

$$g' = \frac{G(5M)}{\left(\frac{R}{3}\right)^2} = \frac{5GM}{\frac{R^2}{9}}$$

$$\therefore g' = \frac{5GM}{1} \times \frac{9}{R^2} = 5 \times 9 \left(\frac{GM}{R^2}\right)$$

$$= g \text{ (original)}$$

$$\therefore \boxed{g' = 45g}$$

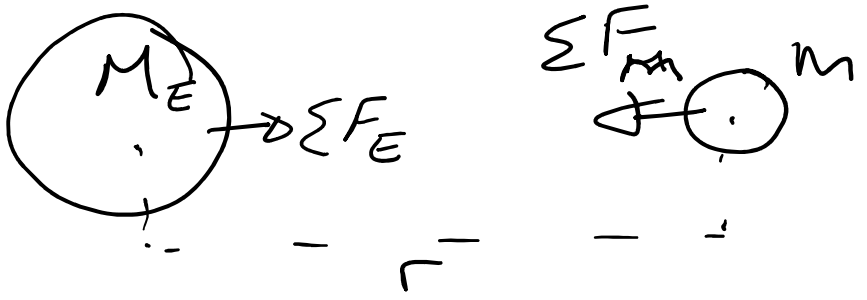
or if $M' = 2M$ and $R' = 3R$

$$g' = \frac{G(2M)}{(3R)^2}$$

$$g' = \frac{2GM}{9R^2}$$

$$\boxed{g' = \frac{2}{9}g}$$

3.




$\Sigma F_E$ = net force on the Earth

$\Sigma F_m$ = net force on the mass

$$\Sigma F_E = M_E \vec{a}_E = \frac{G m M_E}{r^2}$$

$$\Sigma F_m = m \vec{a}_m = \frac{G m M_E}{r^2}$$

$$\therefore \quad \Sigma F_E = \Sigma F_m$$

$$M_E \vec{a}_E = m \vec{a}_m$$

$$a_E = \frac{m \vec{a}_m}{M_E}$$

if $R = R_E$, $a_m = g$

$$a_E = \frac{mg}{M_E}$$

$m = 0.200\ kg$

$a_m = 9.80\ m/s^2$

$a_E = \dfrac{(0.200)(9.80)\ m/s^2}{5.979 \times 10^{24}}$

$a_E = 3.28 \times 10^{-25}\ m/s^2$