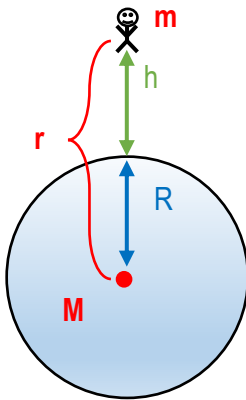


CONCEPT: Acceleration Due to Gravity

- Use Newton's Law of Gravity to determine the acceleration due to gravity ($a_g \rightarrow g$) at different distances from a planet.

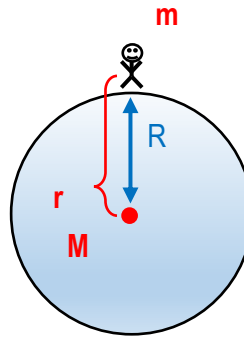
Any Distance

$$g = \underline{\hspace{2cm}}$$



On Surface

$$g_{\text{surf}} = \underline{\hspace{2cm}}$$



- Use g when specifically given/asked for _____. Use g_{surf} when on the _____. ("surface gravity")
 - Note that both g 's only depends on ($M \mid m$)
 - g_{surf} is a local constant, g decreases as r _____.
- Your weight at *any* distance from a planet is the force of gravity $\rightarrow W = F_G = \frac{GMm}{r^2} = \underline{\hspace{2cm}}$.
 - On the surface, $W = \underline{\hspace{2cm}}$.

EXAMPLE: Compare the exact acceleration due to gravity on the top of Mount Everest, which has a height of 8.85km, with the surface gravity of the Earth.

GRAV. CONSTANTS
$G = 6.67 \times 10^{-11} \frac{\text{m}^3}{\text{kg} \cdot \text{s}^2}$
$M_E = 5.97 \times 10^{24} \text{ kg}$
$R_E = 6.37 \times 10^6 \text{ m}$

PRACTICE: You stand on the surface of a mysterious planet with a mass of 6×10^{24} kg and measure the surface gravity to be 7 m/s^2 . What must the radius of the planet be?

EQUATIONS	GRAV. CONSTANTS
$F_G = \frac{Gm_1m_2}{r^2}$ $r = R + h$ $g = \frac{GM}{r^2}$ $g_{\text{surf}} = \frac{GM}{R^2}$	$G = 6.67 \times 10^{-11} \frac{\text{m}^3}{\text{kg} \cdot \text{s}^2}$ $M_E = 5.97 \times 10^{24} \text{ kg}$ $R_E = 6.37 \times 10^6 \text{ m}$

EXAMPLE: An astronaut drops a rock from rest on the surface of an unknown planet. It takes 0.6 seconds to fall 1.5m. If the radius of this unknown planet is $4 \times 10^6 \text{ m}$, what is the mass?

EQUATIONS	GRAV. CONSTANTS
$F_G = \frac{Gm_1m_2}{r^2}$ $r = R + h$ $g = \frac{GM}{r^2}$ $g_{\text{surf}} = \frac{GM}{R^2}$	$G = 6.67 \times 10^{-11} \frac{\text{m}^3}{\text{kg} \cdot \text{s}^2}$ $M_E = 5.97 \times 10^{24} \text{ kg}$ $R_E = 6.37 \times 10^6 \text{ m}$

PRACTICE: How far would you have to be above Earth's surface for g to be $\frac{1}{2}$ of its surface value?

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$F_G = \frac{Gm_1m_2}{r^2}$ $r = R + h$ $g = \frac{GM}{r^2}$ $g_{\text{surf}} = \frac{GM}{R^2}$	$G = 6.67 \times 10^{-11} \frac{\text{m}^3}{\text{kg} \cdot \text{s}^2}$ $M_E = 5.97 \times 10^{24} \text{ kg}$ $R_E = 6.37 \times 10^6 \text{ m}$