a place of mind

FACULTY OF EDUCATION

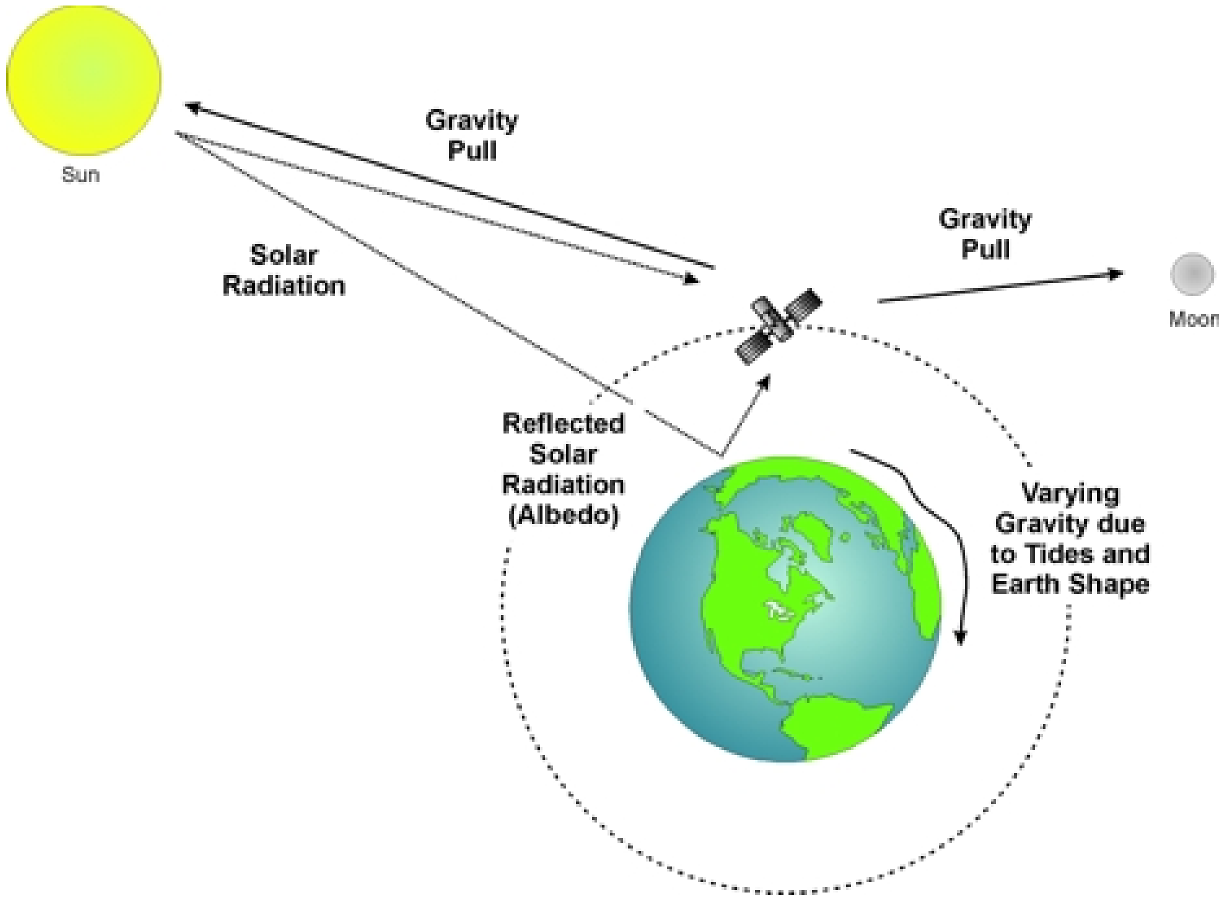
Department of
Curriculum and Pedagogy

Physics
Gravitation

Science and Mathematics
Education Research Group

Supported by UBC Teaching and Learning Enhancement Fund 2012-2015

Gravitation



http://www.wirelessdictionary.com/wireless_Dictionary_GPS_Satellite_Perturbing_Forces_Definition.html

Gravitation

The following questions have been compiled from a collection of questions submitted on PeerWise (https://peerwise.cs.auckland.ac.nz/) by teacher candidates as part of the EDCP 357 physics methods courses at UBC.

Gravitation Problems I

If the value of the earth's gravitational field strength at the earth's surface is $\boldsymbol{g}$, and the earth's radius is $\boldsymbol{r}$, what would the gravitational field strength be at a distance of $\mathbf{30}\,\boldsymbol{r}$ from the centre of earth?

A. $\sqrt{30}g$

B. $30\ g$

C. $\frac{g}{30}$

D. $\frac{g}{30^2}$

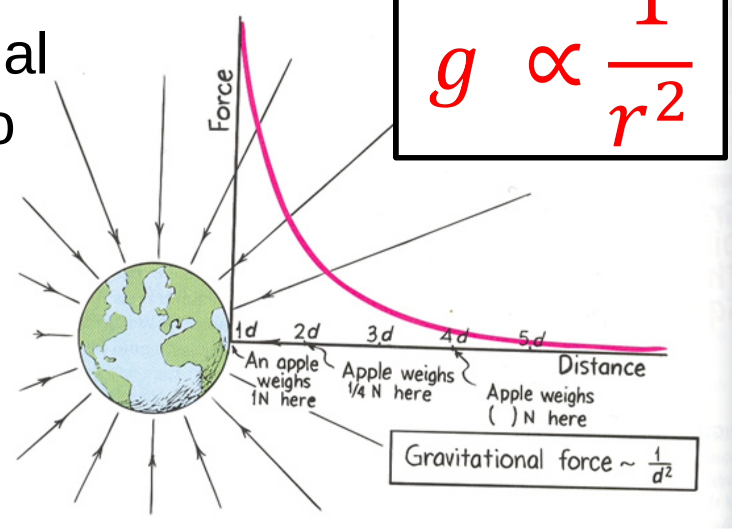
E. $\frac{g^2}{30^2}$

Solution

Answer: D

Justification: Note that the gravitational field strength is inversely proportional to the square of distance between the center of the body to the point in question. As the gravitational field strength at $\boldsymbol{r}$ is $\boldsymbol{g}$, then at $\mathbf{30}\ \boldsymbol{r}$, the gravitational field strength must be $\frac{\boldsymbol{g}}{\mathbf{30^2}}$.

$$g \propto \frac{1}{r^2}$$



Thus, by increasing the distance by a factor of ***30***, the gravitational field strength decreases by a factor of $\mathbf{30^2}$.

Therefore, **D** is the correct answer.

Gravitation Problems II

The gravitational field strength at the surface of Jupiter is ***25 N/kg***. What is the gravitational field strength at a distance of ***1.5*** times the radius from the center of Jupiter?

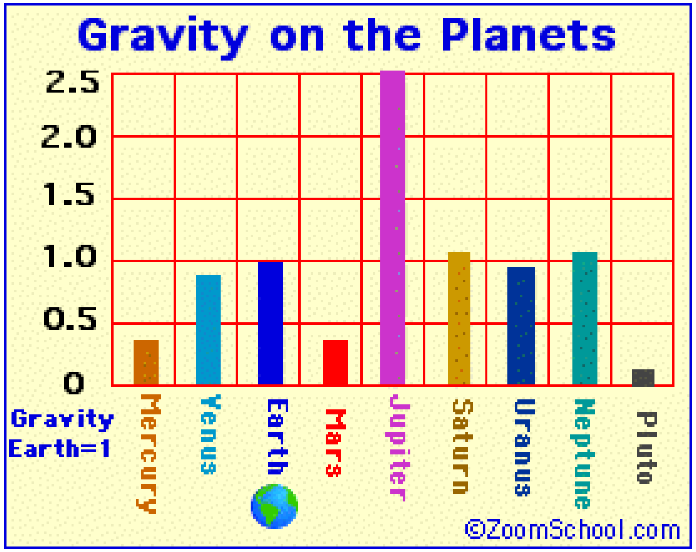
A. 5 N/kg

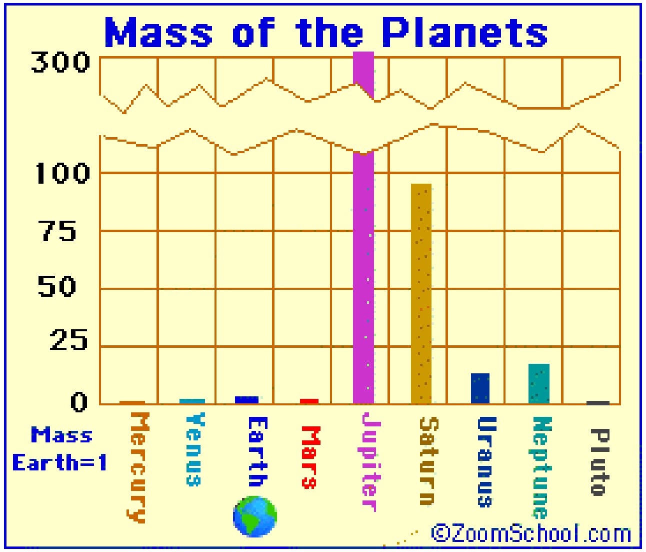
B. 11 N/kg

C. 17 N/kg

D. 20 N/kg

E. 25 N/kg





http://www.enchantedlearning.com/subjects/astronomy/planets/

Solution

Answer: D

Justification: Note that the gravitational field strength is inversely proportional to the square of distance between the center of the body to the point in question. By using the gravitational field formula: $g = \frac{G\,m}{r^2}$, where m is the mass of the body, r is the distance between the two body of masses, and $G = 6.67 \times 10^{-11}\,N\,(\frac{m}{kg})^2$ is the gravitational constant, we can solve this problem using proportions. We need to solve for $\boldsymbol{x}$ from the following two equations ($\boldsymbol{Eq1}$ and $\boldsymbol{Eq2}$):

$$\boldsymbol{Eq1}\text{: } g = 25 = \frac{G\,m}{r^2} \text{ and } \boldsymbol{Eq2}\text{: } x = \frac{G\,m}{(1.5r)^2}$$

Solution continued

Answer: D

After dividing these two equations and then simplifying the result, we get:

$$\frac{Eq2}{Eq1} = \frac{x}{25} = \frac{\frac{G\,m}{(1.5r)^2}}{\frac{G\,m}{r^2}} \rightarrow x = \frac{25}{1.5^2} \cong 11\,N/kg$$

Thus, the gravitational field strength at a distance of 1.5 times the radius from the center of Jupiter is approximately 11 N/kg.

Therefore, **D** is the correct answer.

Watch: https://www.youtube.com/watch?v=4a4p9bW9tRI