

Physics

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(Chapter 7) (Gravitation) (Exercises)
(Class 11)

Question 7.16:

Assuming the earth to be a sphere of uniform mass density, how much would a body weigh half way down to the centre of the earth if it weighed 250 N on the surface?

Answer 7.16:

Weight of a body of mass m at the Earth's surface, $W = mg = 250 \text{ N}$

Body of mass m is located at depth, $d = \frac{1}{2} R_e$

Where, R_e = Radius of the Earth

Acceleration due to gravity at depth g (d) is given by the relation: $g' = \left(1 - \frac{d}{R_e}\right)g = \left(1 - \frac{R_e}{2 \times R_e}\right)g = \frac{1}{2}g$

Weight of the body at depth d ,

$$W' = mg' = m \times \frac{1}{2}g = \frac{1}{2}mg = \frac{1}{2}W = \frac{1}{2} \times 250 = 125 \text{ N}$$

Question 7.17:

A rocket is fired vertically with a speed of 5 km s^{-1} from the earth's surface. How far from the earth does the rocket go before returning to the earth? Mass of the earth = $6.0 \times 10^{24} \text{ kg}$; mean radius of the earth = $6.4 \times 10^6 \text{ m}$; $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$.

Answer 7.17:

Velocity of the rocket, $v = 5 \text{ km/s} = 5 \times 10^3 \text{ m/s}$

Mass of the Earth, $M_e = 6.0 \times 10^{24} \text{ kg}$ and radius of the Earth, $R_e = 6.4 \times 10^6 \text{ m}$

Height reached by rocket mass, $m = h$

At the surface of the Earth,

$$\text{Total energy of the rocket} = \text{Kinetic energy} + \text{Potential energy} = \frac{1}{2}mv^2 + \left(\frac{-GM_e m}{R_e}\right)$$

$$\text{At highest point } h, v = 0 \text{ and, Potential energy} = -\frac{GM_e m}{R_e + h}$$

$$\text{Total energy of the rocket} = 0 + \left(\frac{-GM_e m}{R_e + h}\right) = \frac{-GM_e m}{R_e + h}$$

From the law of conservation of energy, we have,

Total energy of the rocket at the Earth's surface = Total energy at height h

$$\frac{1}{2}mv^2 + \left(\frac{-GM_e m}{R_e}\right) = \frac{-GM_e m}{R_e + h} \Rightarrow \frac{1}{2}v^2 = GM_e \left(\frac{1}{R_e} - \frac{1}{R_e + h}\right)$$
$$= GM_e \left(\frac{R_e + h - R_e}{R_e(R_e + h)}\right) \Rightarrow \frac{1}{2}v^2 = \frac{GM_e h}{R_e(R_e + h)} \times \frac{R_e}{R_e} \Rightarrow \frac{1}{2}v^2 = \frac{gR_e h}{R_e + h}$$

Where $g = \frac{GM_e}{R_e^2} = 9.8 \text{ m/s}^2$ (Acceleration due to gravity on the Earth's surface)

$$\therefore v^2(R_e + h) = 2gR_e h \Rightarrow v^2 R_e = h(2gR_e - v^2)$$

$$h = \frac{R_e v^2}{2gR_e - v^2} = \frac{6.4 \times 10^6 \times (5 \times 10^3)^2}{2 \times 9.8 \times 6.4 \times 10^6 - (5 \times 10^3)^2} = \frac{6.4 \times 25 \times 10^{12}}{100.44 \times 10^6} = 1.6 \times 10^6 \text{ m}$$

Height achieved by the rocket with respect to the centre of the Earth

$$= R_e + h = 6.4 \times 10^6 + 1.6 \times 10^6 = 8.0 \times 10^6 \text{ m}$$

Chapter 7 Physics Answers

Peipei Pang



Chapter 7 Physics Answers:

Prentice Hall Physical Science Concepts in Action Program Planner National Chemistry Physics Earth Science ,2003-11

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CliffsNotes HESI A2 Science Cram Plan Michael Reid,2021-04-13 A study guide for the HESI A2 science nursing school test that calendarizes a study plan for test takers depending on how much time they have left before taking the test Get a plan and make the most of the time you have left Whether you have two months one month or one week left before the exam you can turn to the experts at CliffsNotes for a trusted and achievable cram plan to ace the HESI A2 Science without ever breaking a sweat First you ll determine exactly how much time you have left to prepare for the exam Then you ll turn to the two month one month or one week cram plan for week by week and day by day schedules of the best way to focus your study according to your unique timeline Each stand alone plan includes Diagnostic tests help you pinpoint your strengths and weaknesses so you can focus your review on the topics in which you need the most help Subject areas review of material you should know for the exam biology chemistry anatomy and physiology and physics Practice exams with answers and detailed explanations **God's Existence: Truth or Fiction? The Answer Revealed** Gary R. Lindberg,2021-03-04 God s Existence Truth or Fiction The Answer Revealed By Gary R Lindberg Studying the existence of God Lindberg takes a different approach by investigating science as well as Christian research Lindberg s unique approach suggests that both science and the Bible were created by God and as a result the two say the same thing Lindberg s message will show that science itself proves the existence of God because of the evidence presented **Revise GCSE Physical Education (2010 Exams Only)** Don E.

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Matter and Interactions Ruth W. Chabay, Bruce A. Sherwood, Aaron P. Titus, Stephen J. Spicklemire, 2005-01-10 Matter Interactions is a calculus based introductory physics text that reflects a modernized view of physics It stresses reasoning from powerful physics principles and integrates contemporary insights such as the atomic nature of matter quantized energy and relativistic dynamics throughout the curriculum Students engage in the full process of creating and refining physical models Computational modeling is integrated to allow students to apply fundamental principles to more complex realistic systems and to explore the possible ranges of behavior of physical models

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