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Solution 1

Conservation of energy given by the sum of potential energy due to gravity and kinetic energy can be used to determine escape velocity. In the case of Earth along the potential is given by:

$$\phi(r) = -G \frac{M_E m}{r}$$

where m is the mass of the book. The book will escape if initial kinetic energy is high enough to overcome the potential at $r = R_x$. Thus

$$\frac{mv_E^2}{2} = G\frac{M_E m}{R_E} \text{ thus } v_E = \sqrt{\frac{2GM_E}{R_E}} = 11km/s$$

In the Earth-Moon case the potential is

$$\phi(r) = -G \frac{M_E m}{r} - G \frac{M_M m}{|R_{EW} - r|}$$

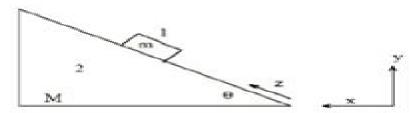
where MM = ME. The potential is a symmetric double-well and in order to leave the surface of the earth the kinetic energy must be high enough to overcome a saddle point right in the middle between earth and moon. Thus the condition for escape velocity is

$$\frac{m v_E^2}{2} - G M_E m \left(\frac{1}{R_E} + \frac{1}{R_{EM} - R_E} \right) = -\frac{4 G M_E m}{R_{ME}}$$

This equation solved for escape velocity gives $v_s = 7.7 km/s$.

Solution 2

Introduce the generalized coordinates as in the figure below.



The Lagrangian for this system will be given by

$$L = T_{undgr} + T_m - V_{undgr} - V_m. \qquad (1)$$

end.

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Jon Magne Leinaas

Classical Mechanics Solutions:

Solution Manual For Classical Mechanics And Electrodynamics (Second Edition) Jon Magne Leinaas, 2025-01-10 As the essential companion book to the second edition of World Scientific 2024 a textbook which aims to provide a general introduction to classical theoretical physics in the fields of mechanics relativity electromagnetism and classical field theory this book provides worked solutions to the exercises in the textbook Detailed explanations are laid out to aid the reader in advancing their understanding of the concepts and applications expounded in the textbook Analytical Mechanics Ioan Merches, Daniel Radu, 2014-08-26 Giving students a thorough grounding in basic problems and their solutions Analytical Mechanics Solutions to Problems in Classical Physics presents a short theoretical description of the principles and methods of analytical mechanics followed by solved problems The authors thoroughly discuss solutions to the problems by taking a comprehensive approach to explore the methods of investigation They carefully perform the calculations step by step graphically displaying some solutions via Mathematica 4 0 This collection of solved problems gives students experience in applying theory Lagrangian and Hamiltonian formalisms for discrete and continuous systems Hamilton Jacobi method variational calculus theory of stability and more to problems in classical physics. The authors develop some theoretical subjects so that students can follow solutions to the problems without appealing to other reference sources This has been done for both discrete and continuous physical systems or in analytical terms systems with finite and infinite degrees of freedom The authors also highlight the basics of vector algebra and vector analysis in Appendix B They thoroughly develop and discuss notions like gradient divergence curl and tensor together with their physical applications There are many excellent textbooks dedicated to applied analytical mechanics for both students and their instructors but this one takes an unusual approach with a thorough analysis of solutions to the problems and an appropriate choice of applications in various branches of physics It lays out the similarities and differences between various analytical approaches and their specific efficiency Classical Mechanics Student Solutions Manual John R Taylor, Jeff Adams, Greg Francis, 2020-07-10 This is the authorized Student Solutions Manual for John R Taylor's internationally best selling textbook Classical Mechanics In response to popular demand University Science Books is delighted to announce the one and only authorized Student Solutions Manual for John R Taylor's internationally best selling textbook Classical Mechanics This splendid little manual by the textbook s own author restates the odd numbered problems from the book and the provides crystal clear detailed solutions Of course the author strongly recommends that students avoid sneaking a peek at these solutions until after attempting to solve the problems on their own But for those who put in the effort this manual will be an invaluable study aid to help students who take a wrong turn who can t go any further on their own or who simply wish to check their work Now available in print and ebook formats Solved Problems in Classical Mechanics O. L. de Lange, J. Pierrus, 2010-05-06 Apart from an introductory chapter giving a brief summary of Newtonian and Lagrangian mechanics this book consists

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