

Homework No. 10 (Fall 2021)

PHYS 203A: COLLEGE PHYSICS

Department of Physics, Southern Illinois University–Carbondale

Due date: Thursday, 2021 Dec 2, 12.30pm, on D2L

Instructions

- Describe your thought process in detail and organize it clearly. Make sure your answer has the correct units and the right number of significant digits.
- After completion, scan the pages as a single PDF file, and submit the file on D2L (Assessments → Assignments).

1. **(10 points.)** Planets S, E, and J, are hypothetical planets. When the three planets align in a straight line the distance between planet S and planet E is 2×10^{11} m while the distance between planet E and planet J is 6×10^{11} m. Mass of planet E is 6×10^{24} kg, mass of planet J is 8×10^{30} kg, and mass of planet S is 2×10^{30} kg.

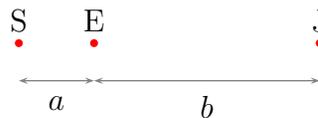


Figure 1: Problem 1

- (a) What is the magnitude and direction of the gravitational field due to planet S at the position of planet E?
 - (b) What is the magnitude and direction of the gravitational field due to planet J at the position of planet E?
 - (c) What is the magnitude and direction of the total gravitational field at the position of planet E due to planets S and J?
 - (d) What is the total gravitational force on the planet E due to planets S and J.
2. **(10 points.)** Planets S, E, and J, are hypothetical planets. When the three planets form a right triangle in space the distance between planet S and planet E is 2×10^{11} m while the distance between planet E and planet J is 3×10^{11} m. Mass of planet E is 6×10^{24} kg, mass of planet J is 8×10^{30} kg, and mass of planet S is 2×10^{30} kg.

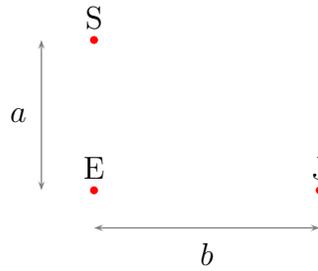


Figure 2: Problem 2

- (a) What is the magnitude and direction of the gravitational field due to planet S at the position of planet E?
 - (b) What is the magnitude and direction of the gravitational field due to planet J at the position of planet E?
 - (c) What is the magnitude and direction of the total gravitational field at the position of planet E due to planets S and J?
 - (d) What is the total gravitational force on the planet E due to planets S and J.
3. (10 points.) Planets S, E, and J, are hypothetical planets. When the three planets align in a straight line the distance between planet S and planet E is 2×10^{11} m while the distance between planet E and planet J is 6×10^{11} m. Mass of planet E is 6×10^{24} kg, mass of planet J is 8×10^{30} kg, and mass of planet S is 2×10^{30} kg.

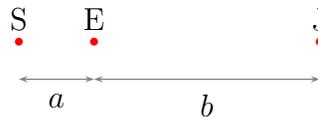


Figure 3: Problem 3

- (a) What is the gravitational potential at the position of planet E due to planet S?
 - (b) What is the gravitational potential at the position of planet E due to planet J?
 - (c) What is the total gravitational potential at the position of planet E due to planets S and J?
 - (d) How much energy is needed to move planet E to infinity, keeping S and J fixed.
4. (10 points.) Derive and calculate the escape velocity on Jupiter. Compare it with the escape velocity on Earth.