

Homework No. 15 (Fall 2024)

PHYS 205A-002: UNIVERSITY PHYSICS

School of Physics and Applied Physics, Southern Illinois University–Carbondale

Due date: Friday, 2024 Dec 6, 2:00 PM, on D2L

Instructions

- You are encouraged to use any of the resources to complete this homework. However, the extent to which you depend on resources while doing this homework is a measure of how much extra work you need to put in to master the associated concepts. Solutions should be the last resource.
- Links to solutions are provided. Further, links to few variations of the problem are provided that serve as practice problems.
- Describe your thought process in detail and organize it clearly. Make sure your answer has units and right number of significant digits.
- Additional problems, with hyperlinks to exams, are available in [Lecture Notes](#).
- After completion, scan the pages as a single PDF file, and submit the file on D2L (under Assesments → Assignments). You can replace your PDF file, only the last file is graded.

Problems

1. **(10 points.)** Three identical stars, each of mass m , are positioned at the corners of a square of edge length L .
 - (a) Find the magnitude and direction of the gravitational field at the vacant corner of the square due to the three stars.
 - (b) Find the magnitude and direction of the gravitational force a planet of mass M would experience if it is placed in the vacant corner.
 - (c) Find the magnitude and direction of the gravitational field at the center of the square.

[\[Solution\]](#)

2. **(10 points.)** Determine the expression for the gravitational field at point \mathcal{O} in Figure 1, along the bisector of the line segment connecting two identical stars, masses $m_1 = m_2 = m$, that are separated by distance $2a$.

[\[Solution\]](#)

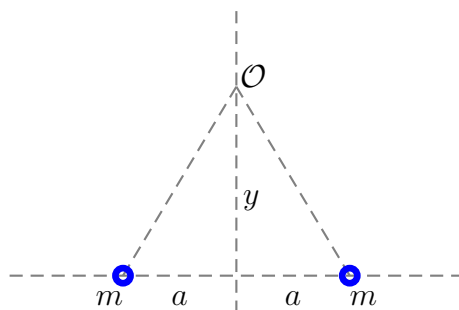


Figure 1: Problem 2

3. (10 points.) Four identical stars, each of mass m , are positioned at the corners of a square of edge length L .
- Find the gravitational potential at a distance very far away from the square, that is, at infinity.
 - Find the gravitational potential at the center of the square.
 - Find the gravitational potential at the center of one of the edges of the square.
 - How much work is done by the gravitational forces when a mass M is moved from infinity to the center of the square?

[Solution]

4. (10 points.) Three identical stars, of mass m each, are positioned at the corners of an equilateral triangle of edge length a . Find the expression for the gravitational potential energy of this three-body configuration up to a constant.

[Solution]