

The following Exam Review is for my Physics with General Calculus I course for the Fall of 2025, which was taken during my gap year at Palm Beach State College under Professor Leo Bae.

The content covered in the final exam will be a culmination of quiz problems from the following chapters:

- Unit 1: Chapters 1, 2, 3, and 4
 - Unit 2: Chapters 5, 6, and 13
 - Unit 3: Chapters 7, 8, and 9
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Chapter 1 Quiz Problems

Problem 1 - Milky Way Galaxy Distance.

The disk of the Milky Way galaxy is about 1.0×10^5 light-years (ly) in diameter. The distance from the center of the Milky Way to the center of the Andromeda galaxy is about 2.0 million ly.

- (a) Imagine a scale model where the two galaxies are represented by circular plates. If the plate representing the Milky Way has a diameter of 16 cm, what would be the distance between the centers of the two plates in meters?

$$\frac{1.0 \times 10^5 \text{ ly}}{2.0 \times 10^6 \text{ ly}} = \frac{\text{diameter in cm}}{x}$$

From here, solve the proportion for x and take cm \rightarrow m, where $1 \text{ cm} = \frac{1 \text{ m}}{100 \text{ cm}}$

- (b) What if? The Milky Way and Andromeda galaxies are members of the Local Group, a cluster of more than 50 galaxies spread across a spherical volume with a diameter of 10 million light years. Imagine you could create a scale model of the Local Group with the Milky Way and represented as circular plates with diameters of 16 cm. What would be the diameter (in m) of your spherical scale model of the Local Group?

$$\frac{1.0 \times 10^5 \text{ ly}}{1.0 \times 10^7 \text{ ly}} = \frac{\text{diameter in cm}}{x}$$

From here, solve the proportion for x and take from cm \rightarrow m, where $1 \text{ cm} = \frac{1 \text{ m}}{100 \text{ cm}}$

Problem 4 - Rod's and Cross Section's.

A thin rod extends from $x = 0$ to $x = 16.0 \text{ cm}$. It has a cross-sectional area $A = 8.50 \text{ cm}^2$, and its density increases uniformly in the positive x-direction from $3.00 \frac{\text{g}}{\text{cm}^3}$ at one endpoint to $19.0 \frac{\text{g}}{\text{cm}^3}$ at the other.

Note the ρ at the start and the end of x (i.e ρ at $x = 0$ and ρ at $x = xx\text{ cm}$).

(a) Solve for B by plugging in $C = 0$ and solve the ρ function

$$\rho(0) = B + C(0) \rightarrow B = 3.00\text{cm}^3$$

(b) To find the C, you need to plug in $x = 16\text{cm}$ into the ρ function and solve

$$\rho(x = 16\text{ cm}) = B + C(x = 16\text{ cm})$$

$$19.0 \frac{g}{\text{cm}^3} = 3.00 \frac{g}{\text{cm}^3} + 16C$$

$$C = 1.00 \frac{g}{\text{cm}^4}$$

(c) To find the **total mass**, this requires us to integrate over the whole ρ function

$$\int_0^{16} (B + Cx)(8.50\text{cm}^2) \cdot dx$$

$$(8.50\text{cm}^2) \int_0^{16} (Bx + \frac{Cx^2}{2})$$

$$(8.50\text{cm}^2) \int_0^{16} ((3.00)x + \frac{(1.00)x^2}{2})$$

$$(8.50\text{cm}^2) \int_0^{16} ((3.00)(16.00) + \frac{(1.00)(16.00)^2}{2})$$

$$(8.50\text{cm}^2) \int_0^{16} (48 + 128)$$

$$(8.50\text{cm}^2)(176) \rightarrow 1496\text{ g}$$

$$1496\text{g} \frac{1\text{kg}}{1000\text{g}} = 1.496\text{ kg}$$

Chapter 2 Quiz Problems

Problem 2 - Constant Speed.

converting to cartesian to polar.

(a) Given **Cartesian**

$$x = r\cos(\theta) \quad y = r\sin(\theta)$$

(b) Given **Polar**

$$\rho(x = 16 \text{ cm}) = B + C(x = 16 \text{ cm})$$

$$19.0 \frac{g}{cm^3} = 3.00 \frac{g}{cm^3} + 16C$$

$$C = 1.00 \frac{g}{cm^4}$$

(c) To find the **total mass**, this requires us to integrate over the whole ρ function

$$\begin{aligned} & \int_0^{16} (B + Cx)(8.50 \text{ cm}^2) \cdot dx \\ & (8.50 \text{ cm}^2) \int_0^{16} (Bx + \frac{Cx^2}{2}) \\ & (8.50 \text{ cm}^2) \int_0^{16} ((3.00)x + \frac{(1.00)x^2}{2}) \\ & (8.50 \text{ cm}^2) \int_0^{16} ((3.00)(16.00) + \frac{(1.00)(16.00)^2}{2}) \\ & (8.50 \text{ cm}^2) \int_0^{16} (48 + 128) \\ & (8.50 \text{ cm}^2)(176) \rightarrow 1496 \text{ g} \end{aligned}$$

$$1496 \text{ g} \frac{1 \text{ kg}}{1000 \text{ g}} = 1.496 \text{ kg}$$

Chapter 3 Quiz Problems

Problem 1, 2, & 3 - Polar \rightarrow Cartesian & Back.

converting to cartesian to polar.

(a) Given **Polar**, where $r = \text{xx cm}$ and $\cos = \theta$

$$x = r\cos(\theta) \quad y = r\sin(\theta)$$

(b) Given **Partial Cartesian**, where x or $y = \text{xx in m}$ and $y = \text{xx in degrees } \theta$

$$x = r\cos(\theta) \rightarrow (3.00 \text{ m}) = r \cdot \cos(45^\circ)$$

(c) Solve for r and then use r and the angle to solve for y

$$r = \frac{3.00m}{\cos(45^\circ)}$$

$$y = r \cdot \sin(45^\circ) \text{ OR } y = \frac{x}{\tan(45^\circ)}$$

Problem 4 - Forces and Boxes.

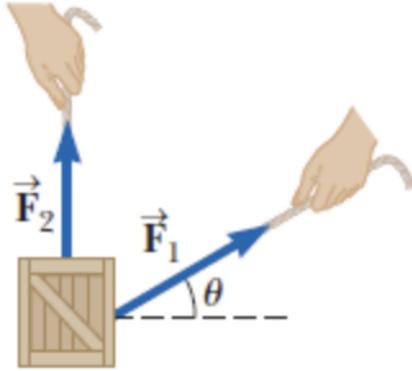


FIGURE 1. Forces \vec{F}_1 and \vec{F}_2 acting on a box at an angle θ

Vector Addition of Two Forces On a Box.

(a) Given \vec{F}_1 and \vec{F}_2 both have magnitudes of F_1 and F_2 as well as an angle θ , we can **resolve each vector into it's components**

$$\vec{F}_x = F \cdot \cos(\theta) \text{ and } \vec{F}_y = F \cdot \sin(\theta)$$

$$\vec{F}_{1x} = F_1 \cdot \cos(\theta_1) \text{ and } \vec{F}_{1y} = F_1 \cdot \sin(\theta_1)$$

$$\vec{F}_{2x} = 0 \text{ and } \vec{F}_{2y} = F_2$$

(b) Therefore we can calculate the **resultant vector, magnitude, as well as angle**

$$F_{Rx} = F_{1x} + F_{2x}$$

$$F_{Ry} = F_{1y} + F_{2y}$$

$$F_R = \sqrt{F_{Rx}^2 + F_{Ry}^2}$$

$$\theta_R = \tan^{-1}\left(\frac{F_{Ry}}{F_{Rx}}\right)$$

$$y = r \cdot \sin(45^\circ) \text{ OR } y = \frac{x}{\tan(45^\circ)}$$