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

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?

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

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

(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?

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

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

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

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

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

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

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

$$\rho(x = 16\,cm) = B + C(x = 16\,cm)$$

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

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

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

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

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

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

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

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

$$(8.50cm^2)(176) \rightarrow 1496\,g$$

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

Chapter 2 Quiz Problems
Problem 2 - Constant Speed.

(a) Given **Cartesian**

$$x = rcos(\theta) \quad y = rsin(\theta)$$

(b) Given **Polar**

$$\rho(x = 16\,cm) = B + C(x = 16\,cm)$$

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

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

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

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

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

$$(8.50cm^2)(176) \rightarrow 1496\,g$$

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

Problem 15 - Hellicopters & Heights.

(a) Given **Cartesian**

$$x = rcos(\theta) \quad y = rsin(\theta)$$

(b) Given **Polar**

$$\rho(x = 16\,cm) = B + C(x = 16\,cm)$$

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

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

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

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

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

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

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

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

$$(8.50cm^2)(176) \rightarrow 1496\,g$$

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

Chapter 3 Quiz Problems.

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

converting to cartesian to polar.

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

$$x = rcos(\theta) \quad y = rsin(\theta)$$

(b) Given **Partial Cartesian**, where x or $y = $ xx in m and $y = $ xx in degrees θ

$$x = rcos(\theta) \rightarrow (3.00m) = r \cdot \cos(45°)$$

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

$$r = \frac{3.00m}{\cos(45°)}$$

$$y = r \cdot \sin(45°) \quad OR \quad y = \frac{x}{\tan(45°)}$$
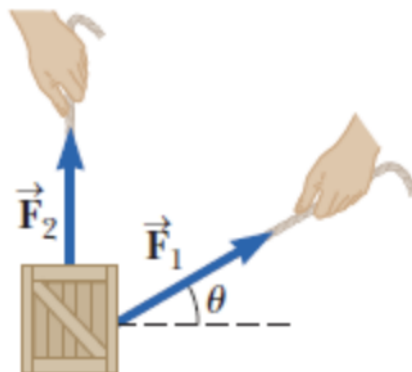
Problem 4 - Forces and Boxes.

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**

$$\vec{F_x} = F \cdot \cos(\theta) \ \ and \ \ \vec{F_y} = F \cdot \sin(\theta)$$

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

$$\vec{F_{2x}} = 0 \ \ and \ \ \vec{F_{2y}} = F_2$$

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

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

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

$$F_R = \sqrt{F_R^2 x + F_R^2 y}$$

$$\theta_R = \tan^{-} 1(\frac{F_R y}{F_R x})$$

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

Chapter 5 Quiz Problems.

Problem 1 - Resultant Forces & More Magnitudes.

converting to cartesian to polar.

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

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

(b) Given **Partial Cartesian**, where x or $y = $ xx in m and $y = $ xx in degrees θ

$$x = r\cos(\theta) \rightarrow (3.00m) = r \cdot \cos(45°)$$

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

$$r = \frac{3.00m}{\cos(45°)}$$

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

Problem 2 - Normal Forces By Ground On Seemingly Normal Boxes.

Vector Addition of Two Forces On a Box.

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

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

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

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

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

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

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

$$F_R = \sqrt{F_R^2 x + F_R^2 y}$$

$$\theta_R = \tan^{-}1(\frac{F_R y}{F_R x})$$
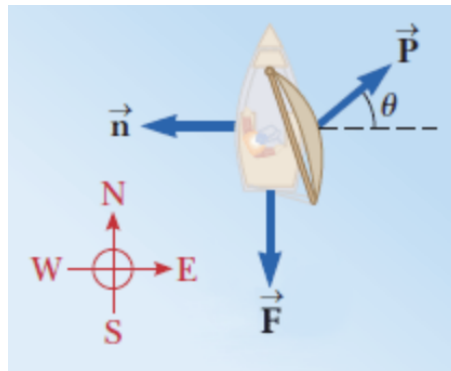
Problem 3 - Sailboats & Constant Velocities.

FIGURE 2. Sailboat being pulled by Forces $\vec{F}, \vec{n}, \ and \ \vec{P}$

Vector Addition of Two Forces On a Box.

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

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

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

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

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

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

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$$F_R = \sqrt{F_R^2 x + F_R^2 y}$$

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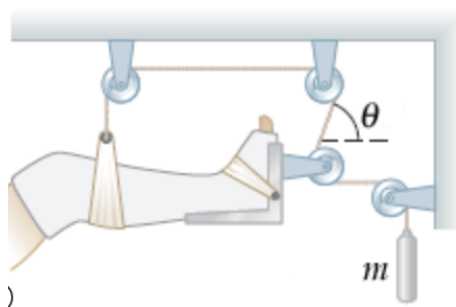
Problem 4 - Stabilizing Broken Legs.

FIGURE 3. Sailboat being pulled by Forces $\vec{F}, \vec{n}, and \vec{P}$

Vector Addition of Two Forces On a Box.

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

$$\vec{F_x} = F \cdot \cos(\theta) \ \ and \ \ \vec{F_y} = F \cdot \sin(\theta)$$

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

$$\vec{F_{2x}} = 0 \ \ and \ \ \vec{F_{2y}} = F_2$$

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

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

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

$$F_R = \sqrt{F_R^2 x + F_R^2 y}$$

$$\theta_R = \tan^{-}1(\frac{F_R y}{F_R x})$$
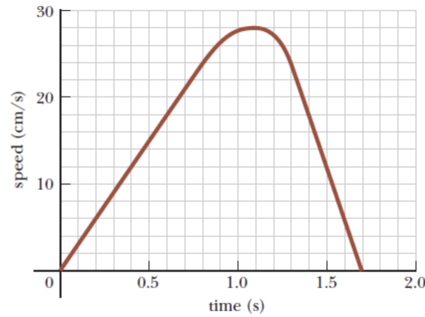
Problem 5 - Speed Over Time Curves.

FIGURE 4. Speed Over Time Curve

Vector Addition of Two Forces On a Box.

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

$$\vec{F_x} = F \cdot \cos(\theta) \ \ and \ \ \vec{F_y} = F \cdot \sin(\theta)$$

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

$$\vec{F_{2x}} = 0 \ \ and \ \ \vec{F_{2y}} = F_2$$

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

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

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

$$F_R = \sqrt{F_R^2 x + F_R^2 y}$$

$$\theta_R = \tan^- 1(\frac{F_R y}{F_R x})$$

Problem 6 - Elevators Experiencing Tension.

Vector Addition of Two Forces On a Box.

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

$$\vec{F_x} = F \cdot \cos(\theta) \ \ and \ \ \vec{F_y} = F \cdot \sin(\theta)$$

$$\vec{F_{1x}} = F_1 \cdot \cos(\theta_1) \ \ and \ \ \vec{F_{1y}} = F_1 \cdot \sin(\theta_1)$$
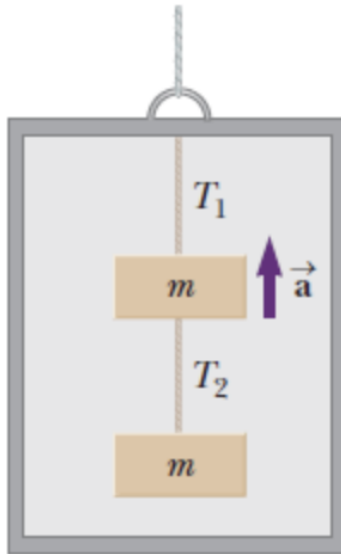
$$\vec{F_{2x}} = 0 \ \ and \ \ \vec{F_{2y}} = F_2$$

FIGURE 5. Two masses, m suspended in an elevator, uphel by two T_1 and T_2

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

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

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

$$F_R = \sqrt{F_R^2 x + F_R^2 y}$$

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

Chapter 6 Quiz Problems.
Problem 1 -Station Rotation.

converting to cartesian to polar.

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

$$x = rcos(\theta) \quad y = rsin(\theta)$$

(b) Given **Partial Cartesian**, where x or $y =$ xx in m and $y =$ xx in degrees θ

$$x = rcos(\theta) \rightarrow (3.00m) = r \cdot \cos(45°)$$

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

$$r = \frac{3.00m}{\cos(45°)}$$

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

Problem 2 - Coins on a turntable.

Vector Addition of Two Forces On a Box.

Chapter 13 Quiz Problems.
Problem 1, 2, & 3 - Polar $\rightarrow$ Cartesian & Back.

converting to cartesian to polar.

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

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

(b) Given **Partial Cartesian**, where x or $y = $ xx in m and $y = $ xx in degrees θ

$$x = r cos(\theta) \rightarrow (3.00m) = r \cdot \cos(45°)$$

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

$$r = \frac{3.00m}{\cos(45°)}$$

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

Problem 4 - Forces and Boxes.

Vector Addition of Two Forces On a Box.

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

$$\vec{F_x} = F \cdot \cos(\theta) \ and \ \vec{F_y} = F \cdot \sin(\theta)$$

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

$$\vec{F_{2x}} = 0 \ and \ \vec{F_{2y}} = F_2$$

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

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

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

$$F_R = \sqrt{F_R^2 x + F_R^2 y}$$

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