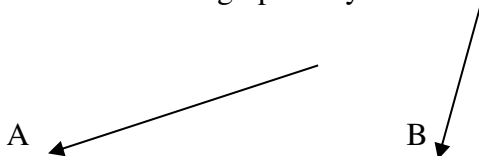


Module 3 & 4 Test Practice Problems

1. Calculate the x and y components of a vector that is 420 meters long at a 218° angle.
2. Change this vector to $\hat{i}$ and $\hat{j}$ notation: 36 m/s at 125° .
3. Convert the x and y notation to a length and angle: $X = 26$ miles, $Y = -14$ miles
4. Add Vector A and Vector B graphically.
5. Subtract Vector A and Vector B graphically.



6. Add Vector C and Vector D numerically. $\vec{C} = 45$ m at 32° , $\vec{D} = 68$ m at 143°
7. Honors: For these vectors, $E = 7\hat{i} - 4\hat{j}$ and $F = 11\hat{i} + 5\hat{j}$, calculate:
 - a. $E + F$
 - b. $F - E$
 - c. $E \cdot F$
 - d. $E \times F$
8. A circus clown is fired out of a cannon at a velocity of 26 m/s at 50° .
 - a. Find his x and y initial velocities.
 - b. What is the maximum height the clown will reach?
 - c. What is the maximum distance the clown will travel?
 - d. How long will it take the clown to land on the ground?
9. You slide your physics book across a 1.1 meter tall granite countertop and it goes right over the edge. The horizontal velocity of the book is 8 m/s. How far away from the countertop does the book land?
10. A ninja was trying to shoot a grappling hook through a third-story window that was 60 feet in front of him and 28 feet above the ground. He threw the hook and it took 2.5 seconds to reach the window. What was the initial velocity of the hook? (speed and direction)
11. Honors: An object is launched and follows a parabolic path. Its initial velocity is 829 m/s at 62° .
 - a. How long will it take the object to reach a height of 1200 meters on the way up?
 - b. How long will it take the object to reach 1200 meters on the way down?
12. Honors: A golf ball is hit at an initial velocity of 52 m/s and it travels 270 meters down the fairway. At what angle was the ball hit?

Module 3 & 4 Test Practice Problems Answers

1. Calculate the x and y components of a vector that is 420 meters long at a 218° angle.

$$X = 420 \cos 218^\circ = -331.0 \quad Y = 420 \sin 218^\circ = -258.6$$

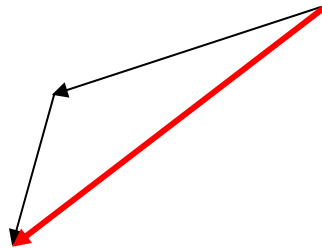
2. Change this vector to $\hat{i}$ and $\hat{j}$ notation: 36 m/s at 125° .

$$X = 36 \cos 125^\circ = -20.6 \quad Y = 36 \sin 125^\circ = 29.5 \quad -20.6\hat{i} + 29.5\hat{j}$$

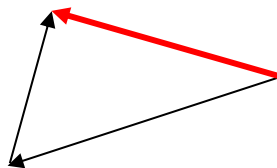
3. Convert the x and y notation to a length and angle: $X = 26$ miles, $Y = -14$ miles

$$L = \sqrt{26^2 + (-14)^2} = 29.5 \text{ miles} \quad \text{Angle} = \tan^{-1}(-14/26) = -28.3^\circ + 360^\circ = 331.7^\circ$$

4. Add Vector A and Vector B graphically.



5. Subtract Vector A and Vector B graphically.



6. Add Vector C and Vector D numerically. $\vec{C} = 45 \text{ m at } 32^\circ$, $\vec{D} = 68 \text{ m at } 143^\circ$

	X	Y
C: 45 m at 32°	$45 \cos 32^\circ = 38.2$	$45 \sin 32^\circ = 23.8$
D: 68 m at 143°	$68 \cos 143^\circ = -54.3$	$68 \sin 143^\circ = 40.9$
	<u>-16.1</u>	<u>64.7</u>

$$C + D = -16.1\hat{i} + 64.7\hat{j} \text{ or } 66.7 \text{ m @ } 104^\circ$$

7. Honors: For these vectors, $E = 7\hat{i} - 4\hat{j}$ and $F = 11\hat{i} + 5\hat{j}$, calculate:

- $E + F$ $18\hat{i} + 1\hat{j}$
- $F - E$ $4\hat{i} + 9\hat{j}$
- $E \cdot F$ 57
- $E \times F$ $79\hat{k}$

8. A circus clown is fired out of a cannon at a velocity of 26 m/s at 50°.

a. Find his x and y initial velocities.

$$V_x = 26 \cos 50^\circ = 16.7 \quad V_y = 26 \sin 50^\circ = 19.9$$

b. What is the maximum height the clown will reach?

$$V_{fy} = 0 \text{ at max. height} \quad 0^2 = 19.9^2 + 2(-9.8)\Delta y \quad \Delta y = 20.2 \text{ meters}$$

c. What is the maximum distance the clown will travel?

$$\text{Range} = \frac{26^2 (\sin 100)}{9.8} = 67.9 \text{ meters}$$

d. How long will it take the clown to land on the ground?

$$\Delta x = v_{ix}(t) + \frac{1}{2} a t^2 \quad 67.9 = 16.7 t + \frac{1}{2}(0)t^2 \quad t = 4 \text{ seconds}$$

9. You slide your physics book across a 1.1 meter tall granite countertop and it goes right over the edge. The horizontal velocity of the book is 8 m/s. How far away from the countertop does the book land?

$a_x =$	0	$a_y =$	-9.8 m/s ²
$v_{xi} =$	8 m/s	$v_{yi} =$	0 m/s
$v_{xf} =$	8 m/s	$v_{yf} =$	
$\Delta x =$		$\Delta y =$	
$t =$			

$$\begin{aligned} \text{First, calculate } t. \quad \Delta y &= v_{it} + \frac{1}{2} a t^2 & -1.1 &= 0t + \frac{1}{2}(-9.8)t^2 \\ & & -1.1 &= -4.9t^2 \\ & & 0.22 \text{ sec} &= t \end{aligned}$$

$$\text{Then calculate } \Delta x. \quad \Delta x = 8(.22) + \frac{1}{2}(0)(.22)^2 = 1.76 \text{ meters}$$

10. A ninja was trying to shoot a grappling hook through a third-story window that was 60 feet in front of him and 28 feet above the ground. He threw the hook and it took 2.5 seconds to reach the window. What was the initial velocity of the hook? (speed and direction)

The units are feet, so you have to use -32 ft/s² for your y-acceleration.

Use $\Delta x = v_{it} + \frac{1}{2} a t^2$ to solve for the velocity in the x and the y direction.

$$60 = v_{ix}(2.5 \text{ sec})$$

$$24 \text{ ft/s} = v_{ix}$$

$$\Delta y = v_{it} + \frac{1}{2} a t^2$$

$$28 = v_{iy}(2.5 \text{ sec}) + \frac{1}{2}(-9.8)(2.5)^2$$

$$51.2 \text{ ft/s} = v_{iy}$$

Change the x and y components into length (speed) and direction.

$$\text{Speed} = \sqrt{24^2 + 51.2^2} = 56.5 \text{ m/s}$$

$$\text{Angle} = \tan^{-1} (51.2/24) = 64.9^\circ$$

11. Honors: An object is launched and follows a parabolic path. Its initial velocity is 829 m/s at 62° .

a. How long will it take the object to reach a height of 1200 meters on the way up?

$$v_{iy} = 732 \text{ m/s}$$

$$1200 = 732t - 4.9t^2$$

$$t = 1.658 \text{ seconds}$$

b. How long will it take the object to reach 1200 meters on the way down?

$$t = 147.73 \text{ seconds}$$

12. Honors: A golf ball is hit at an initial velocity of 52 m/s and it travels 270 meters down the fairway. At what angle was the ball hit?

$$270 = 52^2 (\sin 2\theta)/9.8$$

$$\theta = 39^\circ$$