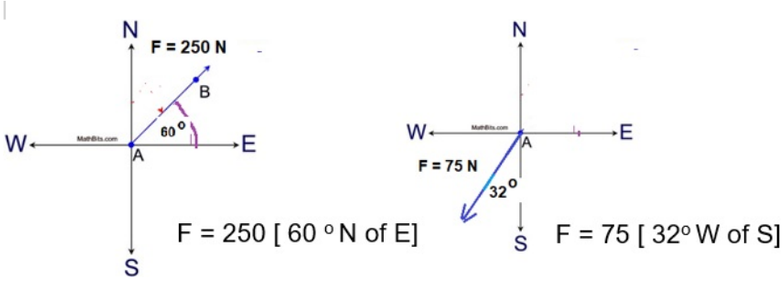
Physics 2204
Unit 2: Dynamics
Worksheet 4: Force Components

STUDENT NAME:_____

What Is The Navigation Method?

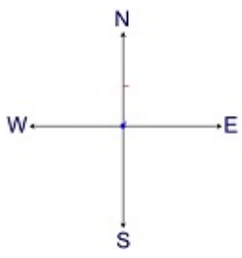
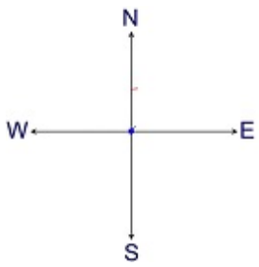
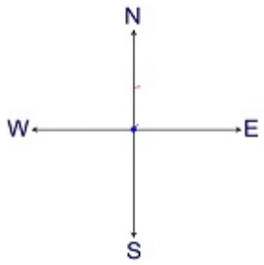
Navigation Method: method commonly used to show direction for vector quantities in two dimension: using compass bearings north [N], south[S], east [E] and west [W] to identify direction

To draw this vector, start with the second compass bearing you are given in the square brackets and then move the angle in the direction of the first bearing you are given.



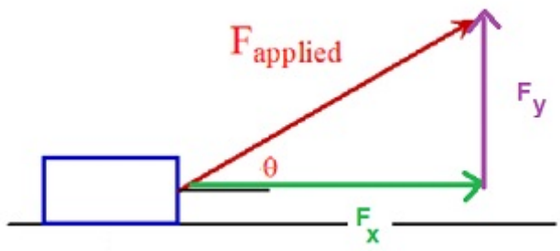
Example 1:

Draw the following forces using the Navigation Method

A) F = 25N [15 ° E of N]	
B) F = 300 N [36 ° N of W]	
C) F = 600 N [78 ° W of S]	

Forces At An Angles – Vector Components

Any force acting at an angle (θ) above the horizontal can be replaced by two forces, horizontal force component (Fx) and vertical force component (Fy). So, how do you find the horizontal and vertical components a result force:

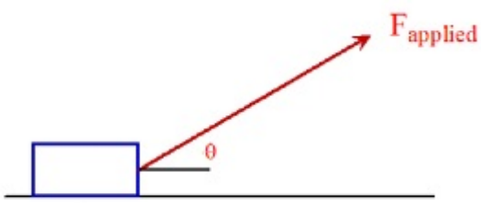


If a force is directed at an angle θ from the horizontal, (*Fy is opposite and that F_x is adjacent in the triangle)*

Horizontal Component (F_x)	Vertical Component (F_y)
From the diagram: $\cos\theta = \frac{F_x}{F_{app}}$ **Cross Multiple:** $F_x = F_{app}Cos\theta$	**From the diagram:** $\sin\theta = \frac{F_y}{F_{app}}$ **Cross Multiple** $F_y = F_{app}\sin\theta$

Example 1:

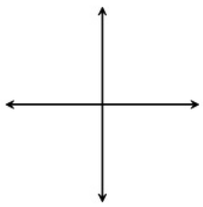
A 100.0 N force is applied to a box at various, increasing angles – Note how the components change:

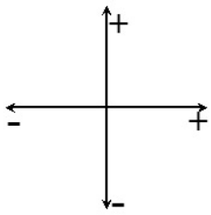


θ	F_x	F_y
0°		
15°		
30°		
45°		
60°		
75°		
90°		

What do you notice?

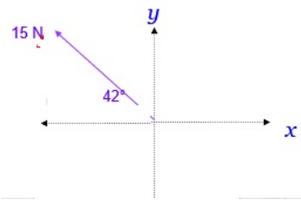
To use these formulas, the angle must be measured above or below the x-axis (or horizontal)





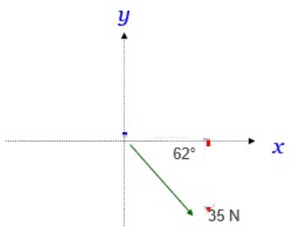
Example 2:

Calculate the Fx and Fy components of the force:



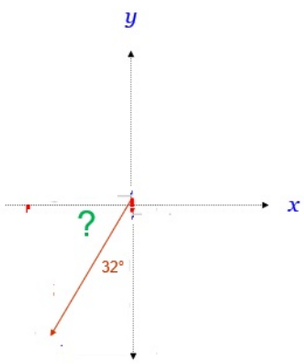
Example 3:

Calculate the F_x and F_y components of the force:



Example 4:

Calculate the F_x and F_y components of the force



Examples 5:

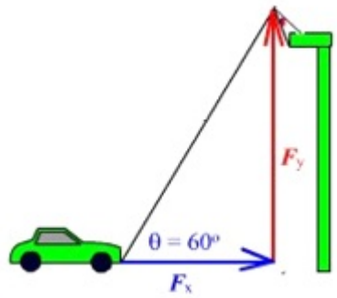
A force of 100.0 N is applied at an angle of 30.0º E of N.
Find the x and y components of this force:

Examples 6:

A force of 500.0 N is applied at an angle of 25.0º S of W.
Find the x and y components of this force:

Examples 7:

A car has become stuck and is being towed using a cable that makes an angle of 60.0º above the horizontal. The 3000.0 N force from the winch is directed along the cable. Calculate the horizontal and vertical components of the force

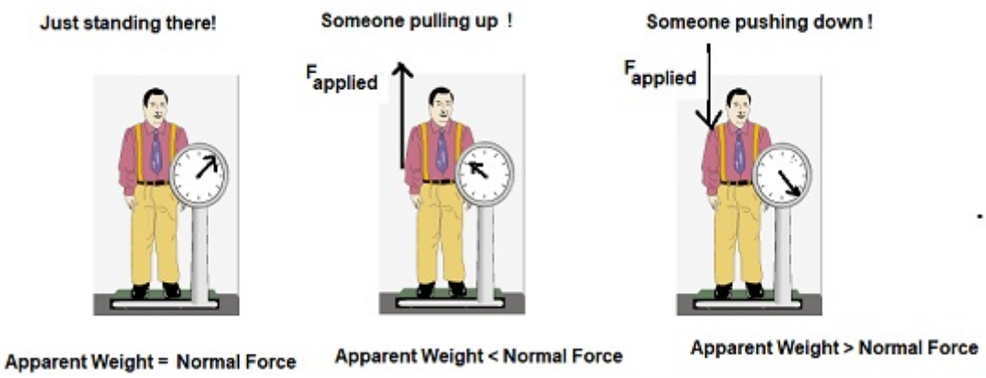


Example 8:

Farmer Brown is cutting sods to cover a bare spot on his lawn. He pushes on the cutter with a force of 180 N at an angle of 72º with the ground. What part of this force is straight down, and what part is used to displace the sod?

What Is Apparent Weight?

Apparent Weight (Effective Weight)is a property of objects that corresponds to how heavy an object is. The apparent weight of an object will differ from the weight of an object whenever the force of gravity acting on the object is not balanced by an equal but opposite normal force. It is the reading you get on a scale. The Apparent weight is equal to the normal force.



Example 9

A force of 950 N is exerted on a heavy object by means of a rope which is held at an angle of 25º to the horizontal.

A) What are the vertical and the horizontal components of the force?

(B) The object has a mass of 130 kg. The rope, however, tends to lift the object, thus decreasing the force between the object and the ground. Calculate the "effective" weight of the object against the ground.

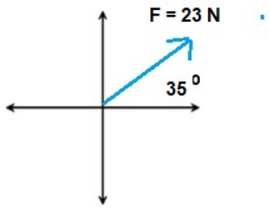
(C) Calculate the effective or apparent weight if the object was pushed with the same amount of force and at the same angle. What do you notice?

PART A: MULTIPLE CHOICE

Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided

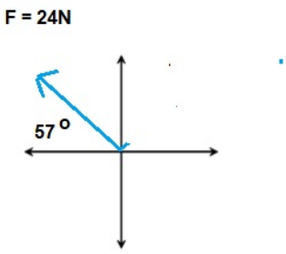
1. How do you write the magnitude and direction for the following vector?

(A) 23 N [35° N of E]
(B) 23 N [35° E of N]
(C) 35 N [23 ° E of N]
(D) 35 N [23° N of E]



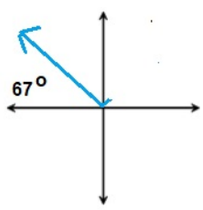
2. How do you write the magnitude and direction for the following vector?

(A) 24 N [57° N of W]
(B) 24 N [57° W of N]
(C) 57 N [24 ° W of N]
(D) 57 N [24° N of W]

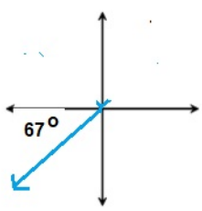


3. Which diagram represents [67 ° W of S]?

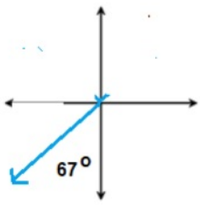
(A)



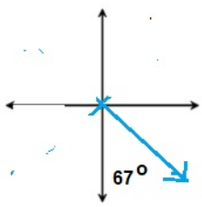
(B)



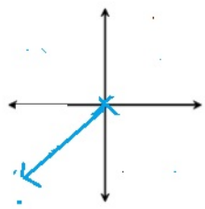
(C)



(D)



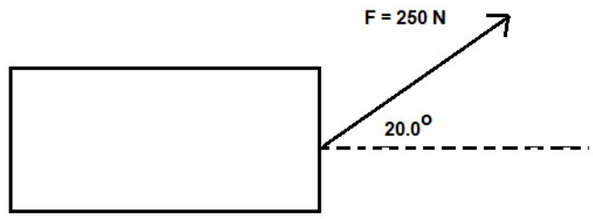
4. What is the value of the horizontal and vertical components of the vector shown below?



	Horizontal Component	Vertical Component
(A)	Negative	Positive
(B)	Negative	Negative
(C)	Positive	Negative
(D)	Positive	Positive

5. A force of 250.0 N is applied to an object at an angle of 20.0° above the horizontal as shown. What is the vertical component of this force?

(A) 0.342 N
(B) 0.940 N
(C) 85.5 N
(D) 235 N

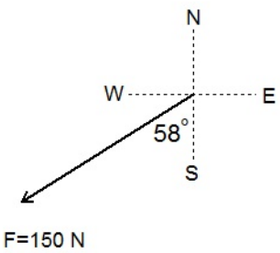


6. A force of 200.0 N is applied to an object at an angle of 25.0° above the horizontal. What is the magnitude of the horizontal component of this force?

(A) 0.423 N
(B) 0.906 N
(C) 84.5 N
(D) 181 N

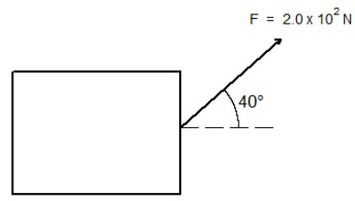
7. What is the horizontal component of the force shown?

(A) 79 N [E]
(B) 79 N [W]
(C) 130 N [E]
(D) 130 N [W]

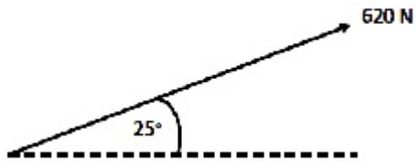


8. What is the magnitude of the vertical component of the 2.0×10^2 N applied force shown?

(A) 1.3×10^2 N
(B) 1.5×10^2 N
(C) 1.7×10^2 N
(D) 2.0×10^2 N



9. What are the horizontal and vertical components of the force shown?



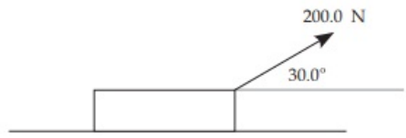
	HORIZONTAL	VERTICAL
(A)	262 N	289 N
(B)	262N	562 N
(C)	562 N	262N
(D)	562 N	289 N

10. What angle causes the horizontal component and vertical component of a force to be equal?

(A) 0 °
(B) 45 °
(C) 55 °
(D) 90 °

11. An object is pulled along a horizontal surface by a force that is directed up and to the right. The mass of the object is 50.0 kg. The applied force is 200.0 N directed at an angle of 30.0° above the horizontal. What is the apparent weight?

(A) 1.00×10^2 N
(B) 3.90×10^2 N
(C) 4.90×10^2 N
(D) 5.90×10^2 N



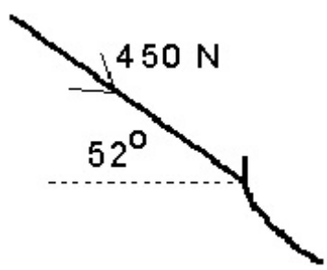
PART B: WRITTEN RESPONSE

1. A toy wagon is towed by a force of 75.0 N. The handle makes an angle of 35° above the horizontal.

a. Calculate the horizontal and vertical components of the force.

b. Explain why towing the wagon in this way actually decreases the downward force of the wagon on the ground. (That is, why does the wagon seem lighter to the ground when you tow it this way?)

2. Snow pushers similar to the one shown are frequently used to clear snow from driveways. Assume that a snow pusher's handle makes an angle of 52° with the horizontal and that a force of 450 N is applied along the handle. Determine the horizontal and vertical components of the force.



3. A tugboat applies a force of 2.0 x 104 N to a tanker in a direction 70° North of East. What are the [East] and [North] components of the force?

4. Evaluate the following:

a. A force of 950 N is exerted on a heavy box by means of a rope. The rope is held at an angle of 42.3º with the horizontal. What are the vertical and the horizontal components of the force?

b. The box in part (a) has a mass of 130 kg. The rope, however, tends to lift the box, thus decreasing the force between the box and the ground. Calculate the "effective" weight of the box against the ground.

5. Ralph is mowing the back yard with a push mower that he pushes downward with a force of 20.0 N at an angle of 30.0 º to the horizontal. What are the vertical and the horizontal components of the force exerted by Ralph?

6. Ivan pulls a sled loaded with logs to his cabin in the woods. If Ivan pulls with a force of 800 N in a direction 20.0 degrees above the Horizontal, what are the horizontal and vertical components of the force exerted by Ivan?

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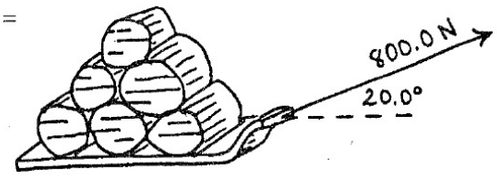

7. A person pushes with 150 N of force along the handles of a lawn roller. The angle of the handle and the ground is 55 degrees. Determine the magnitudes of the horizontal and vertical components of this force.

8. A person pulls a sled along level ground. The rope which the person pulls the sled makes an angle of 35 degrees with the ground as the person pulls with a force of 82 N. Determine the horizontal and vertical components of the force.

9. A force of 1050 N is exerted to the right on a heavy box by means of a rope. The rope is held at an angle of 41.7 º above the horizontal.

a) Draw a FDB and determine the vertical and the horizontal components of the force?

b) The box in part (a) has a mass of 145 kg. The rope, however, tends to lift the box, thus decreasing the force between the box and the ground. Calculate the Normal Force or “effective weight” of the box against the ground