

**Activity 2.1.4 Calculating Force Vectors Answer Key**

Introduction

If guy wires are used to stabilize a tower, what is the minimum number of wires necessary? Imagine what would happen if you only used one or two wires. The guy wires work together so that the tower does not fall in any direction. As long as there are no external forces, each of the wires should be experiencing an equal amount of tension. The tension in each guy wire can be expressed as a vector force. It is important that values are given for each force so that engineers can make informed decisions about the necessary strength of guy wires and their support mechanisms.

Equipment

* Calculator

Procedure

In this activity you will calculate force vectors.

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| 1. What is the magnitude of vector A?

5.0N | 2-1-4 image1 |
| 1. What is the direction of vector A relative to the negative y-axis?

30° CCW |
| 1. What is the sense of vector A?

Down and to the right |
| 1. Sketch vector A with itsx and y components.*(Solve for component forces with a precision of 0.0)*
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| 1. What is the magnitude of vector B?

5.0N | 2-1-4 image2 |
| 1. What is the direction of vector B relative to the negative y-axis?

30° CW |
| 1. What is the sense of vector B?

Down and to the left |
| 1. Sketch vector B with itsx and y components*(Solve for component forces with a precision of 0.0)*
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| B |  |

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| A picture is hung from a nail with wire. The nail supports two forces A = 5.0N and B = 5.0N. |
| 2-1-4 image3 |
| 1. Draw a free body diagram of the nail, illustrating the x and y components of vector A and B.*(Solve for component forces with a precision of 0.0)*

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| 1. Calculate the x and y components of the resultant force (R) by summing the x and y components of vectors A and B.

Fx = FAx + FBxFy = FAy +FByFx= -2.5N + 2.5N = 0Fy= -4.3N + -4.3N = -8.6 N |
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| An eye screw is experiencing two tension forces G 100N and H 50N. | 2-1-4 image4 |
| 1. Sketch vector G with itsxand ycomponents. *(Solve for component forces with a precision of 0.0)*
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| 1. Sketch vector G with itsx and y components. *(Solve for component forces with a precision of 0.0)*
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| 1. Calculate the sum of the x and y components of vectors G and H.*(precision of 0.0)*
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| Fx= FGx + FHx46.98 N + 25.88 N = 72.86 N = 72.9 N | Fy = FGy+ FHy17.1 N + 96.59 N = 113.69 N = 113.7 N |
| 1. If you know the components of a vector, what mathematical relationshipcan be used to find the magnitude of the vector?

Pythagorean Theorem, $a^{2}+b^{2}=c^{2}$. Since the vector components are at right angles to each other, they are the legs of a right triangle, lengths and b in the Pythagorean Theorem,and the hypotenuse is the resultant. c in the Pythagorean theorem is the magnitude of that resultant.  |
| 1. Sketch the resultant force (R) and calculate the magnitude and angle of the vector.

RRy=114NθRx=73N |

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**Conclusion**

1. You and someone else are pulling with forces of equal magnitude. You each pulling at an angle of 25° from the X axis (see top view below). How could you reduce the amount of force each of you must exert?



You could both pull in a direction with a smaller angle from the x-axis. When pulling at an angle, each of the two forces has a component perpendicular to the direction of motion, and these y components are acting against each other, cancelling, giving no contribution to the net force.

1. You and someone else are pulling on an object with forces of 50N and 75N respectively. If you are allowed to pull in any direction, what range of values is possible for the magnitude of the resultant force?

The resultant force could have values ranging from 25N to 125N. The resultant would be 25N if the two forces were in opposite directions, 180° apart. The resultant would be 125N if the two forces were in the same direction, 0° apart. If the angle between the two forces were between 0° and 180°, the resultant would be between 25N and 125 N.