Vector addition experiment lab report conclusion

Experiment 2 Vector Addition (Graphical Method) Objectives: The goal is to (1) practice the multi-purpose method of adding vector that is a graphical method, and (2) compare the results with the calculation (analytical method) to get an idea of how accurate the graphical method is. Equipment: A protractor, a metric ruler and a few sheets of paper Theory: The resulting two or more vectors are a single vector that is equivalent to its physical effects to the action of the original vector. For example, if three power carriers acted on an object, these three forces could be replaced by the resulting one and the object would have the same net effect. Note: In the following sections, gf means gram-force. 1gf is the force of gravity in the mass of a gram. Example: Given A = 200gf at 0.0o, B = 150gf at 35.0o, and C = 250 gf at 130o, find R = A + B + C, (1) by graphical method, and (2) by analytical method. Solution: 1) Graphical method (Here the polygon method is used) As shown above, a polygon is designed with the vector data A, B, C placing the vectors one after the other, on a tail-to-edge basis. The first A is far-fetched. Then, from the edge of A, B is dragged. Then, from the edge of B, C set. Finally, the tail of A (the first) is connected to the edge of C (the last) to receive the resulting one. Now, the gram-force equivalent (or the length of the resulting one) must be measured. This length gives us the size of the resulting. The angle that makes the resulting with the positive x-axis gives us its direction. It should be measured by protractor. 2) Analytical method (here the rectangular component method is used). a) Calculate the x and y element of each of items A, B and C.b) Sum the components in the x direction to obtain the Rx . c) Sum the accessories in the y direction to obtain Ry. d) Calculate the size and direction of the resulting using e) Draw a sketch of Rx and Ry, and find i using tan-1. The x- and y-components of vectors are: Ax = 200 cos 0.00° = 200 gf Ay = 200 sin 0.00° = 0.00 gf Bx = 150 cos 35.0° = 123 gf Up = 150 sin 35.0° = 86.0 gf Cx= 250 cos 130° = -161 gf Cy = 250 sin 130° = 192 gf Rx = Ax + Bx + Cx = 162gf. and Ry = Ay + From + Cy = 278gf. R = (Rx+ Ry)1/2 & i = tan-1(Ry /Rx). We get R = (320 gf, 59.8o). Procedure: Three vectors A, B and C are given in Table 1 in the Data section. The purpose is to use a ruler and a protractor and apply the polygonium method to find the resulting R1, R2, and R3 (one at a time) as shown below: R1 = A + B R2 = A + B + C R3 = A + B - C For each of R1, R2, and R3 take the following steps: 1) Choose a logical scale that gives you a design large enough to measure accuracy at the same time small enough to where the drawing does not come off the page. Indicate the selected scale in the drawing. For vector data in Table 1, if the x-axis is 1 inch above the bottom edge of the paper and the y-axis is also 1 inch from the left edge of the paper, none of the R1, R2 and R3 R3 exit the page provided that you can select your scale as 1cm = 2N. 2) Add the vectors using the polygon method to find each resulting one. Record the size and direction of the resulting (measuring from the ruler-protractor set) in Table 2 shown below. These are your measured values. 3) Solve for the same result you found in Step 2, but this time using the analytical method (by calculating and using trigonometry). Calculate the size and direction of the resulting one and record it in calculated (acceptable) values in Table 2. 4) Calculate a % size error and a % directional error and record them in the space provided for in Table 2. The following type of error % is the one we will use in this laboratory throughout the semester. Note: In your report, the error rate type should appear in the Compare results section. You simply display this formula and only the calculated values of errors % . It is not necessary to display repeated number substitution in error type % . Data: Table 1 Vector Direction Size A 25.0N 35.0o B 10.0N 120.0o C 15.0N 155.0o Table 2 Resulting measure Calculated (Acceptable) %error in size error %in direction size (N) Angle (o) Size angle (N) Angle (o) R1 = A+ B R2 = A+ B+C R3 = A+B -C Calculations: Show sample calculation, for example, the full calculation for R1. Comparison of results: Provide the type of percentage error used, as well as the calculation of percentage errors. Conclusion: State your conclusions about the experiment. Discussion: Have a discussion if necessary. Questions: Which method is the most accurate, graphic or analytical method? Why is the polygon method generally considered to be the most logical graphics technique? In this laboratory we studied the addition of vector with graphic means, but also with the use of vector components. The materials for reproduction of this workshop are as follows: Circular Power Table 4 pulleys Masses Mass Holders string Protractor and Ruler Intro: Vectors are arrows with a certain length, which describes the size of an object, and the direction. To add vectors you must have vector components that describe how far along the x and y axes the size of the vector journey will give you <i, j=>where i is the direction x and j is the direction y. To find the item x: cosϴ = Vx / M Mcosϴ = Vx To find the item y: sinϴ = Vy / M Msinϴ = Vy Once you find your vector components the notation of your vector you will have <Vx ,vy=>. When you have two elements you can now add together by adding the x and y elements to get the components of the two added vectors that will form a new vector that you can chart. Another method you can use to add vectors is graphics. In this image you can see that to find V3 you will draw it</Vx> </i,> </i,> the tail of the first carrier that is V1 on the head of the last carrier that is V2. Procedure: In this workshop we are given 3 masses and a corner by our teacher. The 3 masses and angles given to us were: 150 g @ 0° 110 g @ 70° 250 g @ 135° We were given a conversion to convert the masses into lengths for the size of our data vectors. The conversion was 1cm = 20 g. We used the conversion and found the sizes of our vectors: We charted the 3 vectors using the head-to-tail method first to find the size and direction of the angle. We measured the length of the resulting vector with a ruler being 14.0 cm and 87.75° with a protractor. Once we found the resulting vector using the graphical method we then solved for the resulting vector by finding the components of the specific vectors. With these components we were able to find the size and angle of the resulting vector. Data analysis: Now that we have a size and direction for our new vector we are now converting it into grams using the 1 cm = 20 g conversion that gives us 280.4 grams for our resulting vector. Then we set up our circular power table with the four pulleys. In the center there is a ring with 4 strings tied from the one that hung away from the pulleys. The first 3 pulleys were set at specific angles, 0°, 70°, and 135°. The fourth was set 180° across the corner we found which was 87.8. This gave us a new angle of 267.8° which now makes our vector negative. After having all the pulleys then hooked the massholders to the ends of all the strings and added the masses onto the massive: The central ring was in balance at the circular power table meaning that the masses were hanging at the end of the strings that hung from the pulleys at the right angles suspended the ring in the center without touching anything. We showed the direction of all players to understand the direction they go to the table. Conclusion: We calculated our wrong percentage to be 0.14%. It was a low one because we were able to control most of our experiment as we were only trying to find a vector from 3 vectors. What was further away was when we solved for this graphics just because we were physically measuring rather than working with the components. In this workshop we learned how to add vectors from their components, but also graphics with head to tail method. 141f11l02 To test the assumption that forces are combined with the rules of carrier addition, and confirm that the net force acting on an object at rest is zero (Newton's First Law). Dual-range power sensor with computer with power table arm with signal interface and pasco capstone sin, cos, tan definitions of sine, cosini and tangent of an angle: Examine the (less than 90°) angle i of the correct triangle shown in Figure 1. The three sides of the triangle are named after their positions in relation to i. The side opposite i is called the opposite side, the side next to the i is called the adjacent side, and the third and largest larger She's the hypothin. The right corner (90°) is always formed by the adjacent and opposite sides. As a result, the hypothinous is always greater than the adjacent or opposite side, but smaller than the combined lengths of the adjacent and opposite sides. The size of the angle i is related to the lengths of the three sides of the right triangle through the trigonometric functions Sine, Cosine and Tangent. These functions are abbreviated sin, cos, and tan, and are defined below. $$ sin (\theta) = \frac{oppose}{hypotenuse} $$ $$$ cos (\theta) = \frac{assinad}{hypotenuse} $$ $$ tan (\theta) = \frac{opposite}{added} $$ (1) Vector Addition Graphical method - Also known as polygne method. Vectors are repositioned so that the tail of each vector is at the head of the previous vector (see Figure 2). The resultant, which represents the sum of the forces, lies with the training of a new carrier from the tail of the first carrier to the head of the latter. Component Method - Resolve the vector to elements by selecting two vertical axes, X and Y, and projecting each vector on those axes. You can think of these elements as the opposite and adjacent sides of a right triangle. When the angle that makes the vector with the positive x-axis is called i, these elements are given by $$F_{x} = Fkos(\theta)$ $$F_{y} = Fsin(\theta)$$ (2) The X element of the resulting vector is the sum of the X elements of each separate vector and the Y component of the resulting vector is the sum of the Y elements of each vector. The angle between the resultant and the X axis is given by: $$ \theta = arctan(\frac{F_{y}}{F_{x}}) $$ (3) The resulting size is given by: $$F <7>= \sqrt{F^{\ 2}_{x} + F^{\ 2}_{y}}$$ (4) Newton's First Balance Treaty Act provides that a body will not accelerate when the net force acting on it is zero. So, to be an object at rest, the resulting forces acting on it must be zero. That is, the sum of all the forces acting on the body must be zero. In equation format, the above sentence can be written $$ \sum \vec{F} = 0 $$ (5) So, if three forces act on an object at rest, the following relationship must be satisfied: $$\vec {F_1} + \vec {F_2} + \vec {F_3} = 0 (6) An equivalent sentence is $$\vc {F_3} = -(\vec {F_1} + \vec {F_2})$$ (7) so that $$\vec {F_3}$$ is equal in size and opposite to the direction that results from the other two Forces. Suppose you have a force of magnitude 3.0 N directed in the positive direction x (i1 = 0°), and a second force of magnitude 4.0 N is directed in the positive direction y (i2 = 90°). In your calendar, add vectors using the graphics method. Draw the resultant, and then find and draw the vector that cancel the two initial vectors. PASCO Capstone setting: Adjust the power panel by screwing the legs so that it stands without swinging. Connect a power table bracket to the Force panel. Connect a power sensor to the bracket. Connect a fixed pulley directly opposite the power sensor. Power. a row on the power sensor and hang the free end over the pulley. Make sure the string is parallel to the force table. Open capstone and click the Hardware Setup button on the left. Connect the power sensor to the analog channel A of the signal interface. In Capstone, click channel A of the interface and select Power Sensor from the menu. Set the sampling rate (located in capstone's middle right bottom tool menu) to 1000 Hz (1.00 KHz). Click The Calibration button. Select Power Measurements and two templates. *NOTE: You can calibrate both sensors at the same time if you have checked both channel boxes. Make sure that if you do this, both sensors have determined weight when you click Set Current Value to Standard. Enter 0 in the Standard value box.* Without volume in the string, click Set current value to standard to set the force to 0 N. Now the current value should point very close to zero (swing in mass will cause some variance.) Hang a mass of 500 g from the end of the string hanging over the pulley. If you do both calibrations at the same time, make sure that both power sensors have a mass of 500 g. The voltage force is equal to the weight of the mass, which is (0,500 kg)(9.8 m/s2) = 4.90 N. Enter 4.9 in the Standard value box. Click Set Current Value to Standard to set the power to 4.9 N. Click Next and make sure that the live values are different. Click Finish. On the main screen, click Two large digits. To adjust the number of digits displayed, go to Data Summary. Then go to Enforce Properties and increase the number of decimal places under Numeric format. Concept Checkpoint 1: Discuss with your partner why calibration is necessary. What would happen if you didn't calibrate the power sensor? Call over a TA or trainer and explain your conclusion to them. Data collection: Tie two large pieces of string together in the middle. When you hook the ends of the string to the power sensor and weights, the knot should remain in the middle of the Power table. (see Figure 5). Adjust the pulleys until the strings are parallel to the power panel and as close to the surface as possible. Force a table setting for the installation power panel of Part A, as in Figure 6a, by connecting fixed pulleys to 0o and 90°. Hang 200 g (F1 = 0.200 kg * 9.8 m/s2 = 1.96 N) from the fixed pulley at 0o, and 300 g (F2 = 0.300 kg * 9.8 m/s2 = 2.94 N) from the pulley at 90 °. Adjust the position of the power sensor, FFS, the knot is in the center of the table. Record the angle of the power sensor. Enter a panoramic view of the setting in your online calendar. In Capstone, click Record. Record the power in the power sensor. You should see it appear on capstone's digit screen. Fill in Table 1 in your calendar, recording the size and directions of the three forces, F1, F2 and FFS. Calculate the resulting vector using the Pythagorean theorem. Compare the resulting vector with the power force sensor Calculated and measured values must be equal in size but opposite to direction. Calculate the resulting vector angle using the reverse tangent. The difference % between the measured and calculated forces shall be calculated. Reverse the direction of force by subtracting 180° from the angle of the power sensor, calculate the angle difference between this angle and the calculated resulting angle. Checkpoint Concept 2: Talk to your partner about why it's important to be sure that the laundry center strings focus on the power table. Call over a TA or trainer and explain your conclusion to them. Store F1 at 0° and move F2 to 120° (see Figure 6b). Adjust the power sensor until the knot is in the center of the Power table. Insert a webcam image of the new setting into your online calendar. In PASCO Capstone, click Record and record the value on the Digits screen as power on the power sensor. Fill in Table 2 in your calendar, recording the size and directions of each of the three forces, F1, F2 and FFS. Calculate the resulting power, FR Calculate the resulting angle. Reverse the direction of the force by subtracting 180° from the angle of the power sensor, then calculate the percentage difference between this angle and the calculated angle resulting and calculate the angle difference. Store F1 at 0° and move F2 to 60° (see Figure 6c). Adjust the power sensor until the knot is in the center of the Power table. Insert a webcam image of the new setting into your online calendar. In Capstone, click Record and record the value on the Digits screen as power on the power sensor. Fill in Table 4 in your online calendar, recording the size and directions of each of the three forces, F1, F2 and FFS. Fill in Table 5 in your online calendar by calculating vector data using the data in Table 4. Calculate the resulting force. Calculate the resulting angle. The difference % between the measured and calculated forces shall be calculated. Calculate the angle difference between the measured and calculated resulting factors. Place three fixed pulleys at three corners of your choice on the power table. Choose three weights (100g -500g) and hang them from the pulleys. Adjust the power sensor until the knot is in the middle of the power table. Insert a webcam image of the new setting into your online calendar. In Capstone, click Record. Record the value on the Digits screen as power in the power sensor. Fill in Table 6 in your online calendar, recording the size and directions of each of the forces, F1, F2, F3 and FFS. Fill in Table 7 in your online calendar by calculating vector components using the data recorded in Table 6. Calculate the resulting force. Calculate the resulting angle. Calculate the % difference between calculated and measured forces. Calculate the angle difference between calculated and measured resulting angles. Using four different forces and a power sensor, repeat the measurements and calculations you made in Part D. Compare the readings from the power sensor with power calculated using the vector addition. Do these results satisfy Newton's First Law? Instructions Copy and paste the entire eJournal Report section into an empty WORD file. Fill in the report in WORD. You may want to modify the borders in the tables. Submit your report if you upload it as part of a Moodle submission. If this doesn't work, you can send the completed report by email directly to a TA lab. Names: (Put scribe next to the name of the person writing the summary, conclusion, etc. Your lab partner and you are expected to exchange tasks, so this must be a different person each week.) Personalized target statement: Methods used: (Enter an image tagged with the device. Describe the measurements you made and the methods you used to collect data.) Predictions made : (Include sketches, plots, and descriptions of expected results.) Describe the data collection techniques for finding the resulting from two right-angle forces. Place a panoramic view of the power panel, complete with pulleys, strings and weights. Record the sizes and directions of the three forces in Table 1. Table 1: (Give it a logical title). Mass (kg) Power = Mass * g (N) i (degrees) Power 1 Power 2 Power Sensor —— (you may need to select the panel control in the upper-left corner of the panel, right-click and select distribute the rows evenly and distribute the columns evenly, then select the borders and shading to activate the grid) Calculate the size of the resulting vector using the Pythagorean theorem : $$F_R = \sqrt{F_1^2 + F_2^2}=$$ Compare this to reading the power sensor, which should be equal in size but opposite to direction: $$\% Diff = \frac{| F_R - F_{FS}|}{F_R} \times 100 \% =$$ Calculate the angle of the resulting vector using the reverse tangent. Make sure your calculator is in degree mode. $$\theta_R = tan^{-1}(\frac{F_2}{F_1})$$ Reversal of the direction of power in the power sensor removing 180° from the corner: $$\theta_{FS } - 180^\circ =$$ Find the angle difference between calculated and measured angles: $$\theta_{FS} - 180^\circ -\theta_R =$$ Place a panoramic view of the new installation. Full Table 2. Table 2: (Give it a logical title). Mass (kg) Power = Mass * g (N) i (degrees) Force 1 Power 2 Power Sensor —— (you may need to select the table control in the upper-left corner of the table, right-click and select distribute the rows evenly and distribute columns evenly, then select borders and shading to activate the grid) vector components using Table 3. Table 3: (Give it a logical title). x-components y-components F1 $$F_{1x} = F_{1}cos\theta$ $$F_{1y} = F_{1}sin\theta$ $F2 $$F_{2x} = F_{2}cos\theta$$ $$F_{2y } = F_{2}sin\theta$FR $$F_{Rx} = F_{1x} + F_{2x}$ $$F_{Ry} = F_{1y} + F_{2y}$$ (you may need to select the table control in the upper-left corner of the table, right-click and select Distribute Rows evenly and distribute the columns evenly and distribute the columns evenly, and then select borders and shading to turn on the Calculate the size of the resulting force: $$F_R = \sqrt{F^2_{RX} + F^2_{Ry}}$$Angle$ tan ^{-1}(\frac{F_{Ry}}{F_{Rx}})$$ F_{measured} - F_{calurs})}}} {F_{measured}} \times 100 \% $$ Calculate the angle difference between calculated and measured angles: Angle difference = Enter a bird's eye view of the new installation. Full Table 4. Table 4: (Give it a logical title). Mass (kg) Power = Mass * g (N) i (degrees) Power 1 Power 2 Power Sensor———— (you may need to select the table control in the upper-left corner of the table, right-click and select distribute the rows evenly and distribute columns evenly, then select borders and shading to activate the grid) Calculate the vector components and record them in Table 5. Table 5: (Give it a logical title). x-components y-components F1 F2 Resultant, FR (you may need to select the table control in the upper-left corner of the table, Right-click and select uniform row distribution and column distribution, then select borders and shading to activate the grid) Calculate the size of the resulting force: $$ \sqrt{F_{x}^{2} + F_{y}^{2}}=$$ Calculate the angle of the resulting power : $$Angle = \tan^{-1}(\frac{F_{y}}{F_{x}})=$$ Compare the size of the resulting power with the power sensor indicator : $$ \% Diff = \frac{| F_{measured} - F_{calurs})}}} {F_{measured}} \times 100 \% =$$ Calculate the angle difference: Angle difference = Enter a bird's eye view of the new installation. Full Table 6. Table 6: (Give it a logical title). Mass (kg) Power = Mass * g (N) i (degrees) Power 1 Power 2 Power 3 Power Sensor———— (you may need to select the table control in the upper left corner of the panel, right-click and select distribute the rows evenly and distribute columns evenly, and then select borders and shading to activate the grid) Calculate the vector components and record them in Table 7. Table 7: (Give it a logical title). x-accessories y-accessories F1 F2 F3 Resultant, FR (you may need to select the table control in the upper-left corner of the table, right-click and select distribute rows evenly and distribute the columns evenly, then select borders and shading to activate the grid) Calculate the size of the resulting force: $$ \sqrt{F_{x^}{2} + F_{y}^{2}}$$ = : $$Angle = \tan^{-1}(\frac{F_{y}}{F_{x}})$$ = Compare the size of the resulting power with the power sensor indicator : $$ \% Diff = \frac{| F_{measured} - F_{calurs})}}} {F_{measured}} \times 100 \% $$ = angle difference: Angle difference = Add 4 power carriers In this section you should include general statements that say: If your measurements confirm the stated goals. What fundamental natural laws are depicted by the experiment. How your experimental error could have been reduced. Discuss whether your Measurements from Part D satisfy Newton's First Law. Always include a constructive critique of the lab. State what went well, what went bad, and how the lab could be improved. This is an official statement of what this lab experiment was. Included in this paragraph should be something about: Goals your results your conclusions Document your completion from this lab by inserting a photo of your camera, your lab partner, the TA, and your device. Include a statement that the work done in the lab and in the workshop report is yours and your partner's. 141f11l02.txt · Last modified: 2015/09/01 12:15 by snelling snelling