

PHYSICS – VECTOR COMPUTER LAB

Objective: To use the formula-calculating and charting tools in Excel to resolve vectors, determine the resultant magnitude and direction, and graphically display the vectors head-to-tail.

Equipment: PC with Excel in the computer lab.

Procedure:

- Log on to the PC and launch Excel. Immediately save the file as ‘vector computer lab’ in your server space in a folder for ‘Physics.’
- Label cells A2 to A12 as follows:

| |
|---|
| given vector 'magnitude' value |
| given vector 'direction' value (degrees) |
| |
| given vector 'x' value |
| given vector 'y' value |
| |
| cumulative 'x' value |
| cumulative 'y' value |
| |
| resultant magnitude |
| resultant direction angle (degrees) |

- Click on cell B1 and label as **Start**.
- Label cells C1 to V1 as **Vector 1, Vector 2, Vector 3**, etc.
- Highlight cells C2 to V3, choose Format, then Format Cells, then Fill, and choose a color such as yellow. This will indicate the cells you will use for data entry.
- Highlight cells B2 to V30, choose Format, then Format Cells, then Number, 2 decimal digits is ok.
- Enter the number **zero** in cells B2, B3, B5, B6, B8 and B9.
- Click on cell C5 and type $=C2*\text{COS}(C3/360*2*\text{PI}())$
- Click on cell C6 and type $=C2*\text{SIN}(C3/360*2*\text{PI}())$
- Highlight C5 and C6 and copy using CONTROL C. Click on D5 and paste using CONTROL V. Click on E5 and paste. Click on F5 and paste. Do this up to cell V5.
- Click on C8 and type $=C5$
- Click on C9 and type $=C6$
- Click on D8 and type $=C8+D5$
- Click on D9 and type $=C9+D6$
- Highlight D8 and D9 and copy using CONTROL C. Click on E8 and paste using CONTROL V. Click on F8 and paste. Click on G8 and paste. Do this up to cell V8.
- Click on B11 and type $=(V8^2+V9^2)^{0.5}$
- Click on B12 and type $=360/\text{PI}()/2*\text{ATAN2}(V8,V9)$

- Highlight cells B8 to V9, choose INSERT then CHART then SCATTER. Select the last chart, which shows only zigzag lines (no curves or dot points).
- You are ready to enter vector magnitude and direction data in cells C2 to V3. Enter the following data from the recent test on vectors:

| | | | | |
|-----|-----|-----|------|-----|
| 6.8 | 5 | 0.4 | 10.7 | 5.9 |
| 210 | 260 | 180 | 80 | 340 |

Do you recognize the vector drawing, and the resultant magnitude and direction?

- Highlight upper left cells that include your chart. Choose File, Print Area, Set Print Area. Adjust the print area so that it is one page. Then print the page as part of your 'data' for this experiment.
- As your graded exercise for this assignment you must also create an alphabetic letter such as your first or last name first initial, or some other design, using at least 10 vectors. Each student should have a unique design and set of vectors, so get approval first before starting. Print your 'data' as above.

Analysis (include answers to the following questions):

- You entered several formulas in your Excel spreadsheet. Formulas begin with an equal sign. What is the purpose for each formula? Does a particular formula represent one of the four vector equations for resolving vectors and finding the resultant? If so, indicate this association. Which formula puts the vectors that you entered head-to-tail in the chart?
- Excel uses the ATAN2 function for calculating the direction of the resultant. What problem did we have with calculators, which is fixed by using Excel and the ATAN2 function?
- You created your personal design by creating a set of vectors. What challenges did you have creating the set of vectors? How does Excel, particularly the real-time chart update, help your design process?
- What other applications might an Excel vector mapping program be used for?

Format and Rubric for Lab Report:

Title Page: title describing the experiment, your name, partners' names, day & period, teacher's name, date of experiment. (10)

Abstract: an 'executive summary' of nearly one page that helps the reader decide whether this is a document they need to continue to read. In your own words, describe the purpose of the experiment, the learning you accomplished in the experiment, your results including successes and failures, implications of the experiment in your course of study and the field of science in general, and what you might do differently in a future experiment. (10)

Objective(s): purpose of the experiment. (10)

Theory: concepts and principles previously learned that apply to this experiment. (10)

Materials: equipment and supplies used. (10)

Procedure: list of activities performed including brief explanation, in your own words. (10)

Results including:

Data: all measurements and calculated data, in tables with headings and units. (10)

Analysis: explanation of calculations, answers to **questions**. Include diagrams and graphs. (10)

Error Discussion: possible sources of error in measuring or calculating, along with apparent discrepancies in your results from the data values that you would have expected. (10)

Conclusion: overview of results of experiment, what it accomplished, and an explanation of the data. Use your own words, write in full sentences, and apply appropriate vocabulary terms. (10)