Solar Angles Assignment

To be mathematically literate it is imperative that you be able to effectively communicate mathematical concepts in a written fashion using correct mathematical notation. It is important that you be able to understand diagrams, create diagrams and use diagrams to generate mathematical relationships. This assignment is one step in helping you become both more mathematically literate and review the mathematics of angles.

Aligning Solar Panels

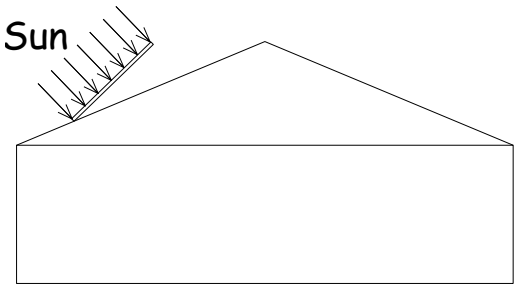


figure 1

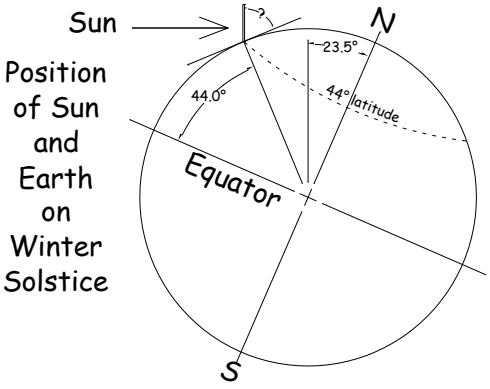


figure 2

Solar energy is an ever more important component in our energy needs. In order for solar panels to be most effective they would need to be angled so that the panel's face is *perpendicular to the sun*. See figure 1. Unfortunately the only way this can be accomplished is for the panel to both rotate throughout the day (follow the sun) and change its inclination (angle off the horizontal) throughout the year to accommodate the tilt of the Earth as it orbits around the sun. A simple/cheap alternative is to fix the panel at one 'average' angle.

Assignment

What angle (off the horizontal) would a solar panel need to have so that a panel set on the ground would be perpendicular to the sun (at the sun's high point) at the Winter Solstice?

Write a paper (one side of one page maximum length) that outlines the above problem and then answers the question. Your paper must follow the guidelines given below. It will be graded on presentation, completeness, accuracy, punctuality and approach to the problem. It will be graded using the attached rubric which should be attached to your paper when submitted.

Guidelines

- Your paper must be typed or neatly handwritten
- Your paper (with diagram) must neatly fit entirely on <u>one side of one page</u>.
- Attach (staple) this page but all the pertinent information including diagrams must be on your page.
- There should be a **Title** and 3 distinct sections: **Introduction, Solution, and Conclusion**.
- Your **Introduction** should include some human interest to motivate the purpose of aligning solar panels.
- Your **Introduction** should include a clear <u>problem statement</u> (your paper's purpose) *in your own words* so that someone not familiar with this assignment would understand the purpose of the paper.
- The **Solution** must clearly show/describe the calculations in <u>a step by step</u> process.
- The paper should assume the ground is flat (perpendicular to the radius of the Earth).
- The Earth's axis of rotation is tilted 23.5° from the plane of its orbit. This is a known fact. You do not need to derive this angle.
- Assume the house is located at about 44° N latitude. (Bend's latitude)
- Your paper must contain at least one well placed diagram that is appropriately labeled and enhances your paper.

Solar Assignment Grading Rubric **NAME** _____

OVERALL FORMAT- Layout/Organization/Presentation

8 pts	*Typed with clearly readable font or neatly handwritten. Uses title and other clarifying headings. Layout and information organization/presentation flows for easy readability.*		
0 pts	*Readability is significantly hindered by font type, handwriting, layout and/or information presentation.*		
☐	Includes Title	☐	Rubric is Stapled to Report
☐	Includes all three Sub-Headings	☐	Appropriate Layout of Multiple Steps
☐	Appropriate use of White Space	☐	Spelling / Grammar
☐	Easy on the Eyes / Overall Readability	☐	Appropriate for Audience
☐	Clear Well Placed Diagram(s)	☐	Fits Nicely on One Page
☐	Copied Diagram(s) given Credit	☐	Solution is Readily Apparent

INTRODUCTION

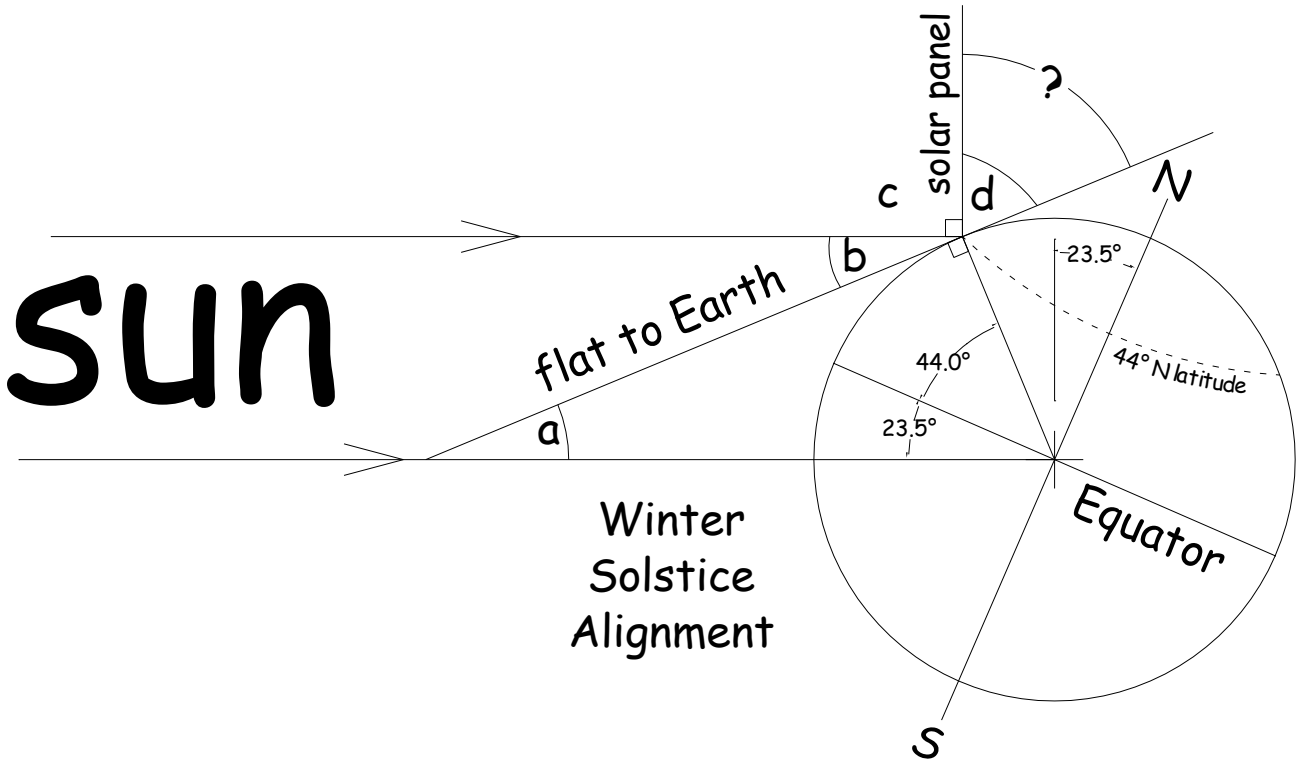
3 pts	*Clear, easy to read. Provides motivation, includes clear problem statement and flows naturally into the General Procedure. Makes the reader want to continue reading. Diagrams enhance Introduction.*		
0 pts	*Quite confusing / disorganized. Motivation missing or unclear. Problem statement missing, awkward or incorrect. Makes the reader want to tear out their hair (even if they are already bald).*		
☐	Includes Heading	☐	Explicit Problem Statement (purpose of paper)
☐	Human Interest Included	☐	Human Interest Appealing

SOLUTION

7 pts	*Processes/Strategies/Calculations used follow paper's General Procedure. They are easy to follow, accurate, complete and lead to a correct solution. Charts/diagrams enhance the paper.*		
0 pts	*Processes/Strategies/Calculations used do not follow paper's General Procedure or are so unclear or contain substantial errors suggesting significant misunderstanding. The reader is now bald and screaming.*		
☐	Includes Heading	☐	Diagram(s) Enhance Explanation
☐	Procedure/Calculations Clearly Explained	☐	Appropriate Calculation Detail
☐	Procedure is Valid	☐	Result(s) Easily Identified
☐	Appropriate Notation is Used	☐	Result(s) is Correct

CONCLUSION/SUMMARY

2 pts	*Conclusion/Summary is easy to ready and is consistent with the Introduction.*		
0 pts	*Conclusion/Summary is missing, confusing or does not fit with the Introduction.*		
☐	Includes Heading	☐	Ties in with Introduction



Some Hints

We want to find angle 'd'

There are many ways to approach this problem! One approach:

Use 180° in a triangle to find 'a'.

Use the parallel nature of the sun's rays to find 'b'.

Use 180° in a straight line to find 'd' which is the angle we want.

The Earth's Fate is in Your Hands

Title

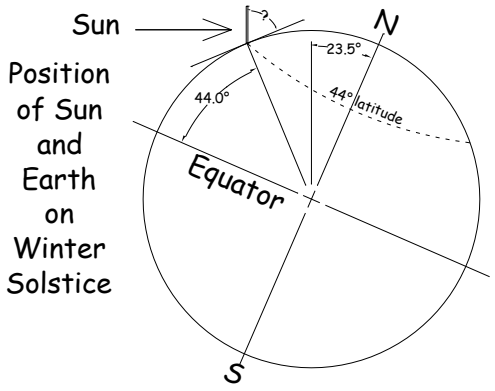
INTRODUCTION

Global Warming is threatening Earth. Mathman can help reduce carbon production if he can make solar energy more efficient. Fortunately this is easy to do by just understanding the angles of the Sun …..

Introduction
w/ human interest and problem statement

The Problem

…. This paper shows how to determine the optimum angle for a solar panel at the Winter Solstice when the solar panel is located in Bend, OR.



SOLUTION

Find angles of the Sun pertinent to solar panel orientation requires some basic geometry …..

Step 1

Step 2

…

Solar Panel Angle ☐

Solution
answer easily identified

SUMMARY / CONCLUSION

With this procedure we can make solar energy more efficient. …... The Earth is now better off!

Conclusion