1988

Energy in Perspective Laboratory #5: Working with Triangles

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Laboratory #5 **Working With Triangles**

Exploration Activity

To: Department of Physics Sept 17, 497 B.C.
University of Nebraska at Lincoln

Dear ADAPT Students,

We think that these plane figures can be organized into groups that share common properties. We went to Pythagoras but he died before he could tell us much. His last words were,

"Take measurements and focus on ratios..."

Beside his death bed we found 27 different pieces of cardboard cut into a variety of right triangles of various sizes and shapes.

Please put the triangles into different groups that display at least two common characteristics and be prepared to explain to your instructor how you did it. You may wish to make a table of your measurements and calculations.

Thanks and best wishes from Athens,

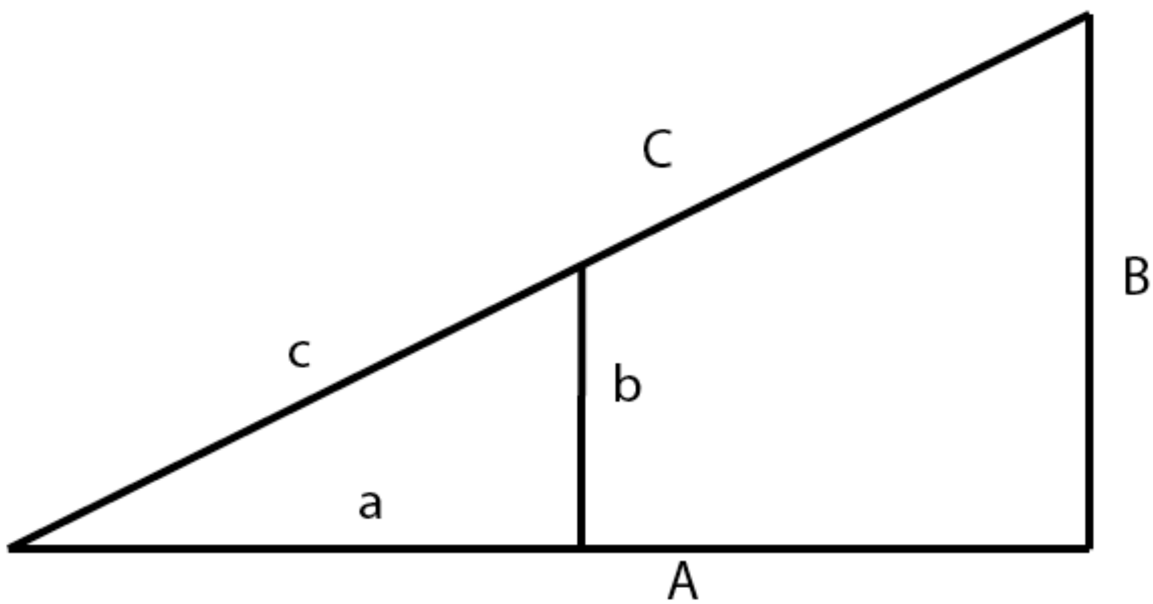
As always,
Your fellow students from Greece

Concept Invention

Two triangles are said to be similar if they have the same shape, that is, if the angles in one triangle are equal to angles in the other triangle. Below are two triangles that are different sizes but similar.

What can you discover about the radio of the lengths of the sides of similar triangles?

Use your metric ruler to measure the sides and record your results in your data sheets using a table similar to the one below.



Measure the length of side a=	Measure the length of side A=	Compute a/c =	Compute A/C =
Measure the length of side b=	Measure the length of side B=	Compute b/c =	Compute B/C=
Measure the length of side c=	Measure the length of side C=	Compute a/b=	Compute A/B=

List some common characteristics of similar right triangles.

Ask your instructor for the next page.

More Concept Invention

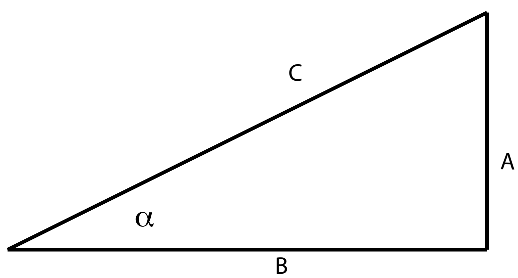
As you have seen, the ratios of the sides to the hypotenuse are equal.
For all similar triangles of one kind :

(shorter side)
-------------------- = a number
(hypotenuse)

(longer side)
------------------- = another number
(hypotenuse)

(shorter side)
-------------------- = a third number
(longer side)

Since these ratios are the same number for all sizes of similar triangles, it is convenient to give them names. Consider the triangle below.



The ratio of **A/C is called the sine** (pronounced sign) **of the angle** α (alpha) and is abbreviated **sin**.
The ratio of **B/C is called the cosine** (pronounced co-sign) **of the angle** α and is abbreviated **cos**.
The ratio of **A/B is called the tangent of the angle** α and is abbreviated **tan**.

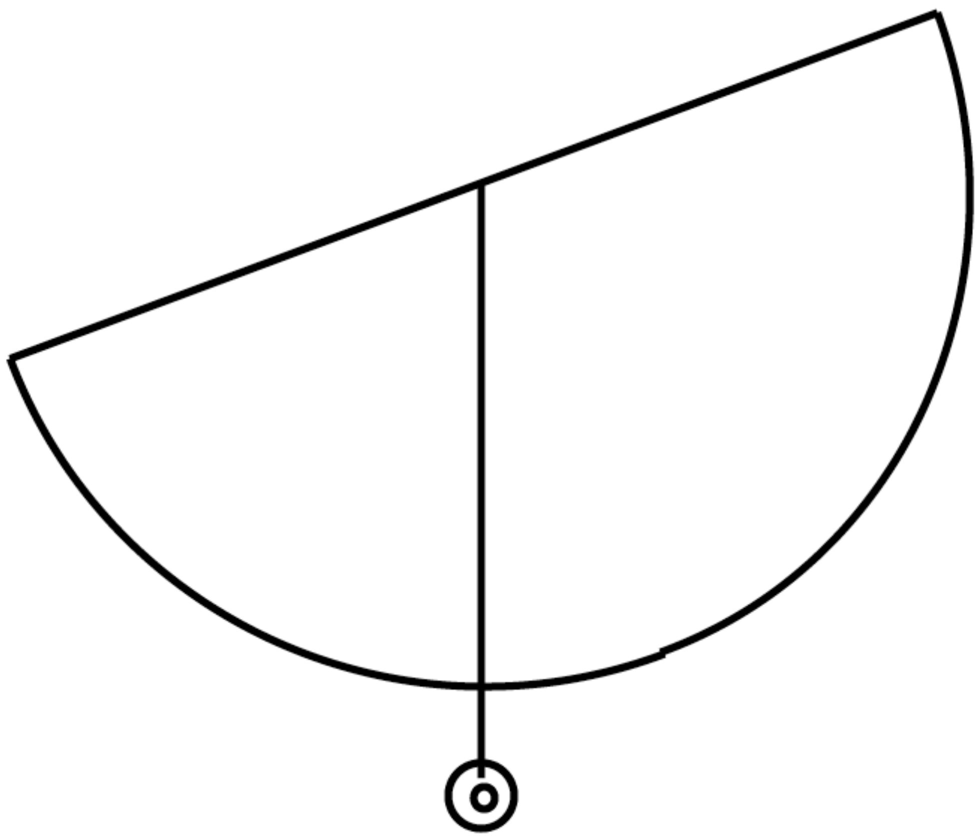
Take several cardboard triangles, let the smallest angle be α. Measure α, A, B and C for at least 4 different triangles. Calculate the sine, cosine and tangent from your measurements. Then compare them with results from your calculator keys of **sin**, **cos**, and **tan**. In your data sheets, make and fill the following table.

	Measurements				Your Computed Ratios	Calculator Results
	α	A	B	C		
1.					sin = cos = tan =	
2.					sin = cos = tan =	
3.					sin = cos = tan =	
4.					sin = cos = tan =	

When you complete this, ask your instructor to review it.

Concept Application

Obtain an angle measuring device from your instructor.

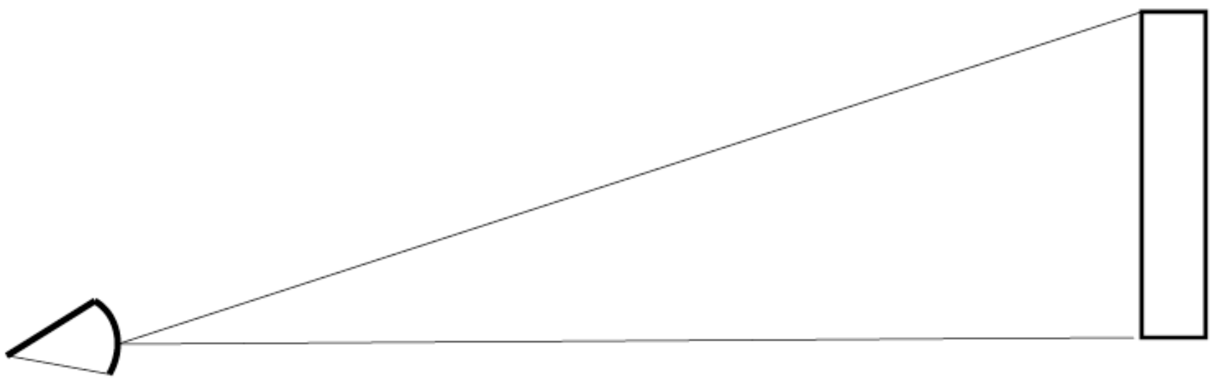


1) How can you use this device for measuring the elevation angle?
2) How can you use this device and your pace length to determine the distance d?
3) Use this to determine the distance from the floor to the ceiling of the physics classroom. Show your calculations in data sheets!

More Concept Application

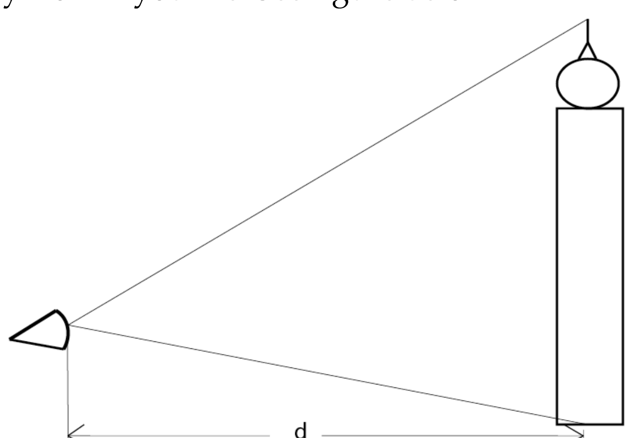
As you have seen from your computation of the height of physics classroom, the properties of right triangles can be used to calculate distances that are not easily measured. We can make use of the constant ratios for the sides of right triangles with known angles to do these calculations.
Consider two different problems.

1. You want to calculate the height of the top of a tower above the campus, as shown below.



What 2 measurements do you need to make and how can you calculate the height of the tower?

2. You know the height of an object (e.g. the State Capitol Building) and you wish to calculate how far away from it you are. See figure below.



What 2 measurements do you need to make in this case and how can you calculate the the distance d?

How can you calculate the distance from the object to your eye?

When you have completed writing out your explanation of how to do these calculations, be prepared to explain them to your instructor.

Still More Concept Application

GROUP DATA REPORT **(This page is to be included in data sheets)**

Names: ______________________________ ______________________________

______________________________ ______________________________

Go out onto the campus and determine the height of: (a) Hamilton Hall and (b) Mueller Tower. *Make three different determinations of each height. (Hint: Use a position near the structure, far from the structure, and a medium distance from the structure.)* Which gives the best value for the height? Why?
Record your **careful measurements** for paces and angles on this sheet. Return to the classroom to make the calculations.

Hamilton Hall

A) near distance__________paces = ___________m

angle =_________________________° computed height_______________m.

B.) medium distance____________paces = ___________m

angle =_________________________° computed height_______________m.

C.) far distance___________paces = ___________m

angle =_________________________° computed height_______________m.

We think the BEST value for the height of Hamilton Hall is ______________m because

Mueller Tower:

A) near distance__________paces = ___________m

angle =_________________________° computed height_______________m.

B.) medium distance____________paces = ___________m

angle =_________________________° computed height_______________m.

C.) far distance___________paces = ___________m

angle =_________________________° computed height_______________m.

We think the BEST value for the height of Mueller Tower is ______________m because

Write-up:

I. PURPOSE

II. DISCUSSION

A) How are the Exploration, Invention, and Application parts of this lab similar?

B) How are they different?
Note: you may make references to data sheets if needed.

III. CAMPUS DATA

A) Sketch a map of Hamilton and Mueller Tower from above showing locations
your group took the experimental data.

B) State calculated heights. (refer to calculations in data sheets)

C) Given: Hamilton is 33.5 m tall and Mueller Tower is 25.0 m tall, explain any differences between the calculated and known heights.

IV. PROBLEMS (these may be hand written. draw a brief sketch and show your work.)

A) A student measures the angle made by the length of a football field (91.5m) while sitting in line with the south goal line. The angle is 63° How far is the student from the field?

B) A student anchors a large hot air balloon th the ground with a 100 m cable. The cable makes an angle of 25° with the ground. How high is the balloon above the ground? How far along the ground from beneath the balloon is the cable anchored?

C) A student stands 48 meters from the State Office Building and measures an angle of 40° to the top. How high above the student's head is the top of the building?

V. CONCLUSIONS AND DATA
State any conclusions from the lab.
Include data sheets.