Physics 20 Unit 0 - Review

Accuracy and Precision, Graphing and Algebra

Review:

1. **Convert the following time measurements into seconds.**

a. **58 ns**

b. **9270 ms**

c. **12.3 ks**

2. State the number of significant digits.

a. 3218 kg

b. 0.000534 m

c. 60.080 W

d. 5.60×10^{1} m

Accuracy vs. Precision

Physics deals with making sense of the physical world. One of the most basic ways of doing this is by taking measurements.

A simple measuring device: the metre stick. How long is this metre stick (that I'm holding)?

1 m? Okay.

Now, how can we be certain that this stick measures 1 m and not 1.0 m? Or 1.00 m? Or 1.000 m? Wood expands and contracts in environments of different temperature, pressure and humidity. So is this really a metre stick?

We can only have a certain amount of accuracy and precision in measuring this stick. Even the best measuring instruments have some amount of uncertainty, or error built into them.

Our job as physicists is to take that error into account and reduce it as much as possible, because we can't get rid of it entirely.

Error

- the amount of uncertainty in a measurement.

ex) My metre stick has a length of one metre, give or take one cm.

$l = 1\ m \pm 0.01$

This means that the length of the ruler is somewhere between 0.99 m and 1.01 m.

Now, how could we reduce this error range?

In order to determine the error range of a measuring device, we look at the smallest measuring increment. The smallest increment on the device is the margin of error (unless otherwise noted).

ex) A metre stick has an error of + 1 cm.
A standard ruler has an error of + 1 mm.
An odometer has an error of + 0.1 km.

Accuracy vs. Precision

Accuracy: How closely you can measure a given value.

Precision: How exact you can be in getting the same measurement every time.

To explain this distinction, imagine three groups of students are attempting to measure the speed of light in a vacuum (3×10^8 m/s)...

Group A makes three measurements:

2.5×10^8 m/s
3.0×10^8 m/s
2.1×10^8 m/s

Are these measurements accurate?

Well, the middle one is. The other two are not because they are off of the accepted value.

Are these measurements precise?

No, as they are not the same (or close to the same) value repeated.

Group B makes three measurements:

2.0×10^8 m/s
2.0×10^8 m/s
2.0×10^8 m/s

Are these measurements accurate? Are they precise?

Group C makes three measurements:

3.0×10^8 m/s
3.0×10^8 m/s
3.0×10^8 m/s

Are these measurements accurate? Are they precise?

Graphing — See UA pt B

Some graphing guidelines to follow:

1. Title: Printed at top of graph and underlined. It should be titled in a "y variable vs. x variable" format.

2. Label the axes: manipulated variables go on the x-axis, responding on the y-axis. INCLUDE UNITS!

3. Incriments: use the entire graph paper and choose appropriate incriments that will make an easy to read graph.

4. Dots: always graph in pencil and circle your points.

5. Line of Best Fit: put the same number of dots above the line as below the line. Don't just connect the dots!

6. Interpolating: means to estimate a value between two data points.

7. Extrapolating: means to estimate a value beyond the data
points.

8. Slope: can be found using m = rise/run or m = $y_2 - y_1 / x_2 - x_1$

Manipulation of Equations: Algebra

Algebra is used every single day in Physics. Therefore, you must have mastery of this concept.

— See UA pt B

What you do to one side, you do to the other.

ex) $v = \frac{d}{t}$ Solve for t.

ex) $T = \frac{1}{f}$ Solve for f.

ex) $E = mgh$ Solve for h.

ex) $a = \frac{v_f - v_i}{t}$ Solve for v_i

ex) $T = 2\pi\sqrt{(l/g)}$ **Solve for l.**

ex) $\lambda = \frac{d\sin\theta}{n}$ **Solve for θ.**

Trigonometry Review

Special TI-83 Note:

By default, your calculator is set to RADIAN mode (this is a different unit of angle measurement using in 30 level math classes). We will be using exclusively the DEGREE mode on our calculators.

You will need to set your calculators to DEGREE each time after the calculator is reset (i.e. during exams/quizzes).

degree mode

Special Hint: Rounded vs. Unrounded Answers

The trig ratios for most angles are irrational numbers. As such, you will want to keep your answers unrounded in your calculator if you want to get the correct answer.

Alternatively, you can carry 4 or 5 guard digits on your page to get about the right answer.

ex) Solve. Express your answer to the nearest tenth.

$3(\sqrt{2}) + 7(\sqrt{9})$

ex) Take your answer from the last example and multiply by $5\sqrt{2}$. What number do you get, rounded to the nearest tenth?

The Three Trig Ratios

Recall for any right angle triangle:

SOH $\sin\theta = \dfrac{\text{opposite}}{\text{hypotenuse}}$

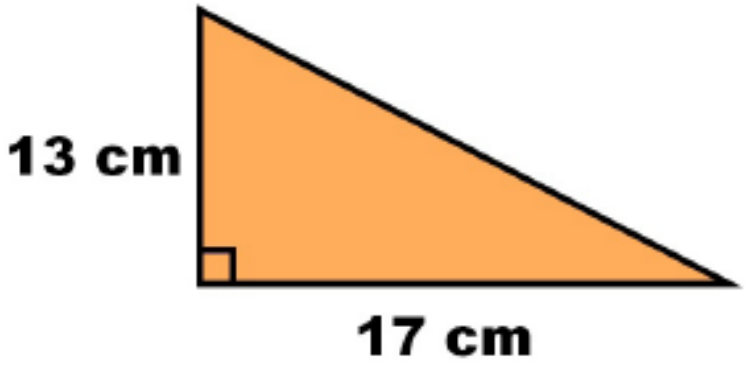
CAH $\cos\theta = \dfrac{\text{adjacent}}{\text{hypotenuse}}$

TOA $\tan\theta = \dfrac{\text{opposite}}{\text{adjacent}}$

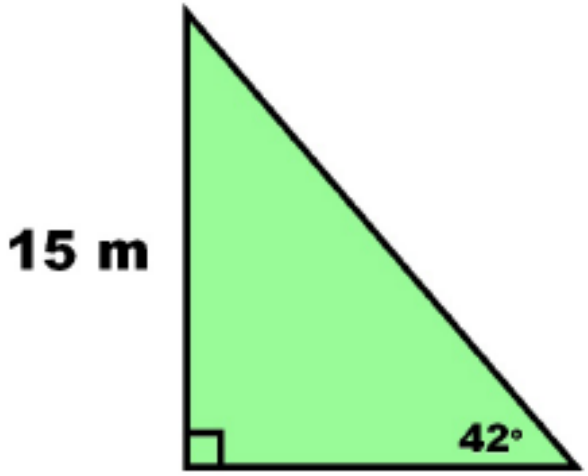
Use these ratios to find:

1. A side, if the angle and one side is known.
2. An angle, if two sides are known.

ex) Solve the triangle.

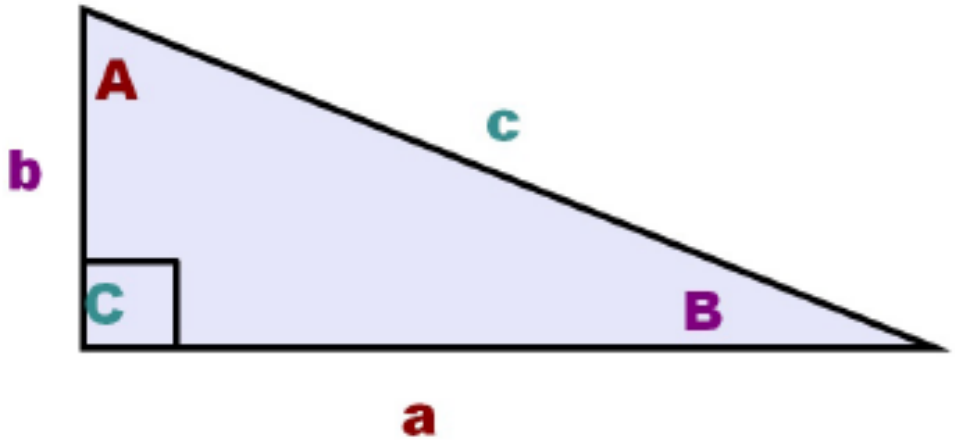


ex) Solve the triangle.



The Pythagorean Theorem

For use in right angle triangles when two sides are known and you want to find the third side.



$$c^2 = a^2 + b^2$$

Where c = hyp

ex) Solve for the missing side.