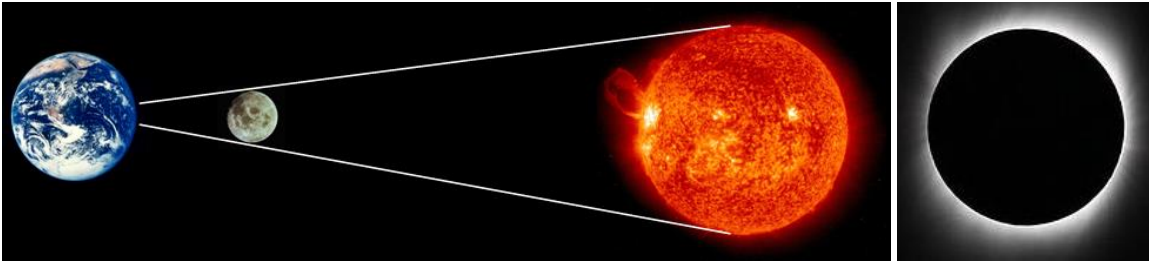


## Mathematics of a Total Solar Eclipse



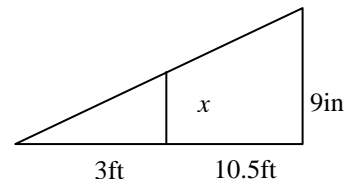
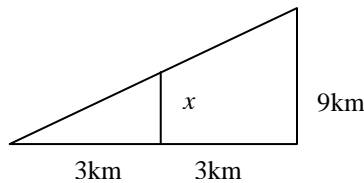
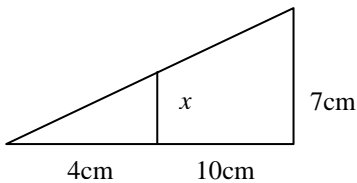
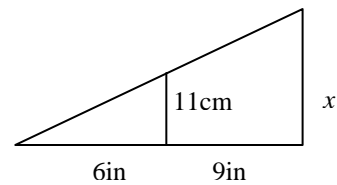
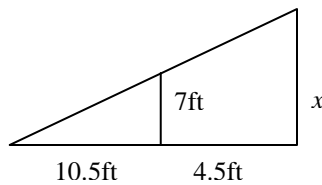
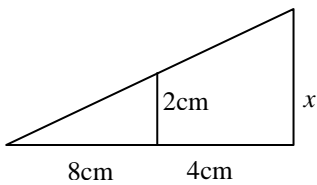
*(Not to scale!)*

A [solar eclipse](#) occurs when the [Moon](#) passes between the [Earth](#) and the [Sun](#). A [total solar eclipse](#) occurs when the path of the Moon produces a relatively small area of shadow on the Earth known as the '[umbra](#)' where it completely covers the face of the [Sun](#). The view of a solar eclipse from this [area](#) is [quite spectacular](#).

The Moon completely covers the face of the Sun as its distance and size just happens to be in the same proportions as that of the Sun. This brings about an interesting mathematical situation involving similar triangles concerning the sizes of and distances to the Sun and the Moon. But first some practice...

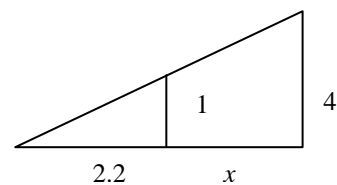
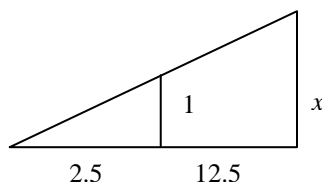
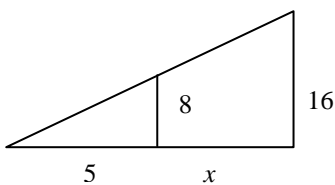
### Task 1

Find the missing sides in each figure below:



### Task 2

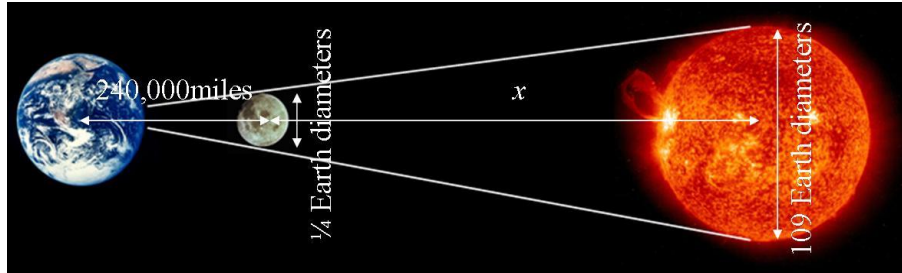
Now try these metric imperial conversions. State which measurements each conversion is for.



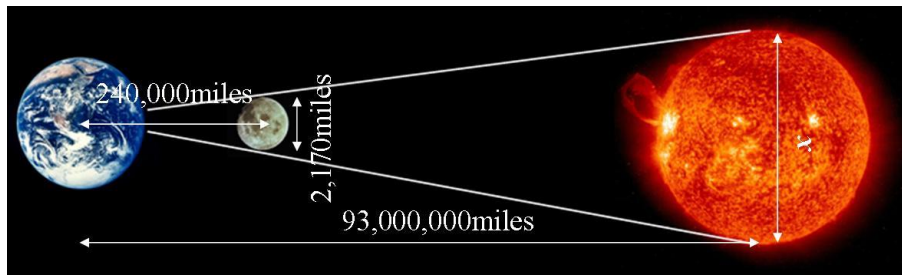
### Task 3 - The Total Solar Eclipse

If we know three of our Sun/Moon Size/Distance figures then we're able to find the fourth.

- a) Use the figures below to show how to find the distance between the Earth and the Sun, and hence [distance to the Sun](#), during a total solar eclipse.



- b) Use the figures below to find the diameter of the Sun, and hence the Earth.



- c) Using a pinhole camera with a distance of 1m between the 'camera' and 'projection screen', how large would you expect the image of the Sun to be?

### Internet Links

Moon <http://en.wikipedia.org/wiki/Moon>

Earth <http://en.wikipedia.org/wiki/Earth>

Sun <http://en.wikipedia.org/wiki/Sun>, <http://sohowww.nascom.nasa.gov/>

Solar eclipse [http://en.wikipedia.org/wiki/Solar\\_eclipse](http://en.wikipedia.org/wiki/Solar_eclipse),  
<http://csep10.phys.utk.edu/astr161/lect/time/eclipses.html>

Umbra <http://en.wikipedia.org/wiki/Umbra>

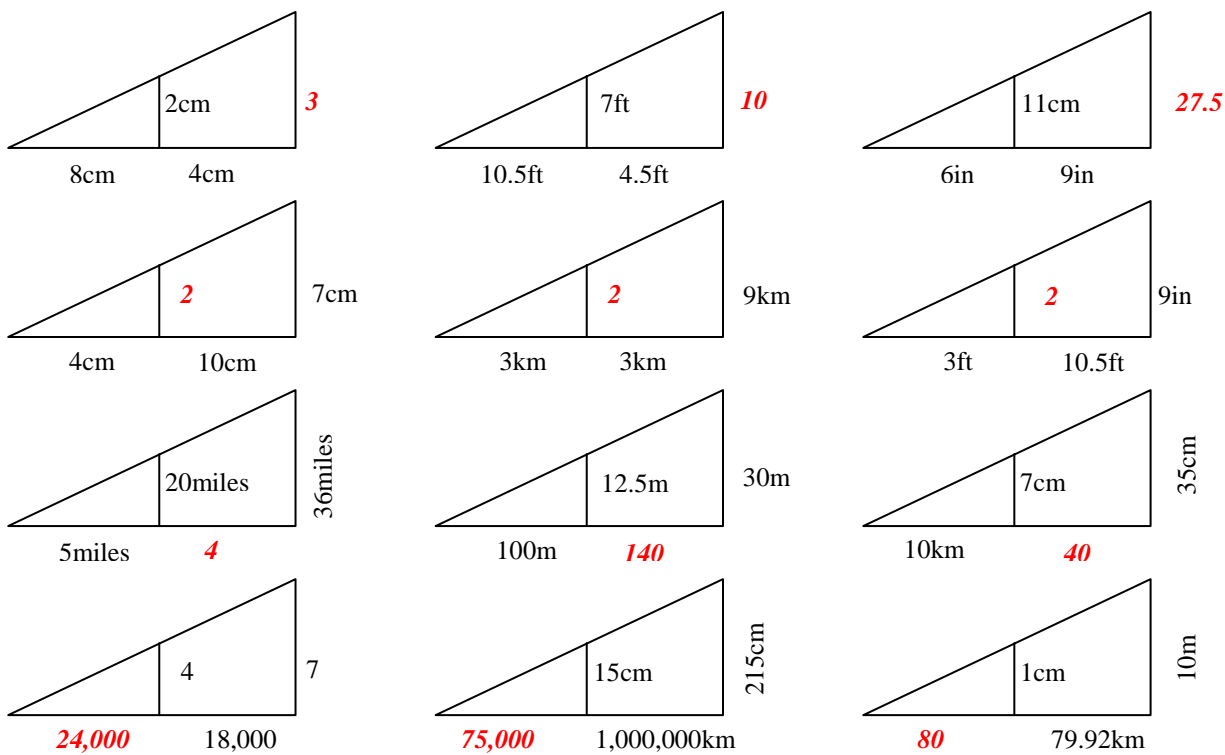
NASA's Eclipse page <http://eclipse.gsfc.nasa.gov/solar.html>

Solar eclipse on Youtube <http://www.youtube.com/watch?v=XMyqPxFh5Zw>

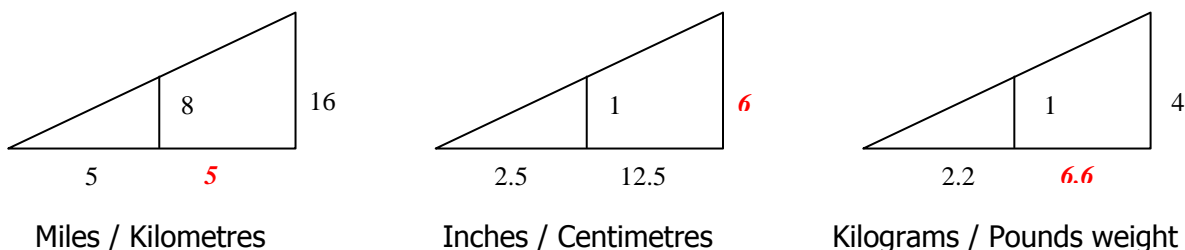
Distance to the Sun [http://en.wikipedia.org/wiki/Astronomical\\_unit](http://en.wikipedia.org/wiki/Astronomical_unit)

## Mathematics of a Total Solar Eclipse - Answers

### Task 1



### Task 2



### Task 3

a)  $x = 103,440,000$  miles      Distance to Sun = 103,464,000 miles

Actual distance to Sun is 93,500,000 miles, 10.7% error. Our answer is different as figures were rounded in question. Actual figures: Moons diameter = 0.27 Earth, distance to Moon = 240,249 miles.

b)  $x = 840,875 \approx 841,000$  miles      Using Sun = 109 Earths, Earth Diameter  $\approx 7,700$  miles.

Actual diameter of Sun is 870,000 miles, 3.5% error. Actual Earth diameter is 8,000 miles, 3.3% error.

c) Image around 9mm diameter. This is calculated using proportional figures of part (b).