

# mission briefing for students

In partnership with



## How Fast Is Fast?

Write a list of at least 10 interesting things that move. Find out the speeds that they travel at.

Write your list with the fastest first and the slowest last.

Include an Airbus A320 or A300 aircraft in your list.

Make a number line to show the different speeds.

You will need to divide your line into equal units.



There are three common units for speed miles per hour (mph), kilometres per hour (kph) and metres per second (m/s). You must choose one. Miles per hour is probably best. So, you may have to convert from different units. See the next page to help you.



What did you put as your fastest thing? An aircraft? The fastest aircraft? A rocket? What would it look like if you looked out of the window of these things?

Go to <http://www.claybavor.com/?p=397> and see for yourself.





## mission briefing for students

### How Fast is Fast?

### Converting Speed Units

### Kilometres per hour or miles per hour?

#### Work through this example with your HP Prime

In the Olympic Games, the 1500m race is often called the 'metric mile'. This is because one mile is very roughly 1500 metres or 1.5 kilometres.

More accurately one mile is roughly 1600m or 1.6 kilometres.

On your HP Prime:

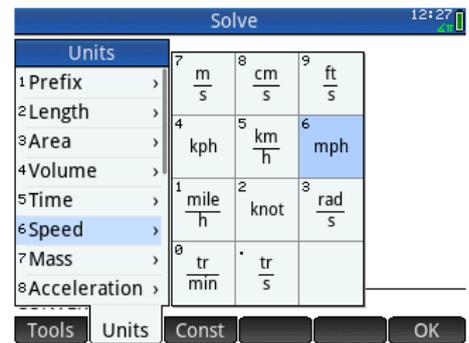
- Press **Shift** 
- Press 
- Click **Units** then **Speed**
- Click **mph**
- Click **Sto ▶**
- Then Press **Shift**  again
- Click **Units** then **Speed**
- Click **kph**
- Finally press 

So, 1 mph is more accurately 1.609344 kph

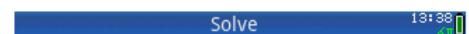
You can use this method to convert any units.

Practice by finding out how many miles per hour is the same as 1 metre per second (m/s)

For example 20m/s is roughly 44.7 mph



CONVERT(1\_mph,0\_kph) 1.609344\_kph



CONVERT(20\_m,0\_mph) 44.7387258411\_mph





## mission briefing for students

### How Fast is Fast?

#### Activity 2: All Around a Circle

Make an experiment to measure circular objects to see that the length of the circumference of a circle is roughly three times the diameter.

You should collect a wide range of objects which have a circle where you can measure the distance across and the distance all the way round. Measure with a piece of string then measure the string accurately with a ruler. Use things like plates and mugs, tin cans, bicycle wheels and so on.

Make a table of your results and use a calculator to divide the two distance to fill in the end column.

What do you notice about the results in your end column?

Object	Distance all the way round in centimetres ( <b>circumference</b> )	Longest distance across in centimetres ( <b>diameter</b> )	circumference÷diameter

If you do this accurately, you will have noticed that if you divide the circumference by the diameter of any circle you always get an answer a little bit more than three.

If you do it accurately enough then you will see it is a little bit more than 3.1.

In fact it is always equal to a special number which can never be written exactly, but is a tiny bit more than 3.1415926535.

It is called pi and to celebrate how important it is, every year there is a national pi day! (See: [www.piday.org](http://www.piday.org)).

We write it like this  $\pi$  which is the Greek letter 'pi'.

This is very useful, because measuring across is much easier than measuring all the way round a circle. Now we know that all around a circle is roughly three times more than all the way across.

Circumference is roughly three times diameter.

Circumference is exactly pi times diameter.

In symbols:

$$C \approx 3 \times d$$

$$C = \pi d$$



## mission briefing for students

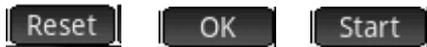
### How Fast is Fast?

### Teach Your HP Prime the Formula

We can teach HP Prime this formula so we can use it over and over.

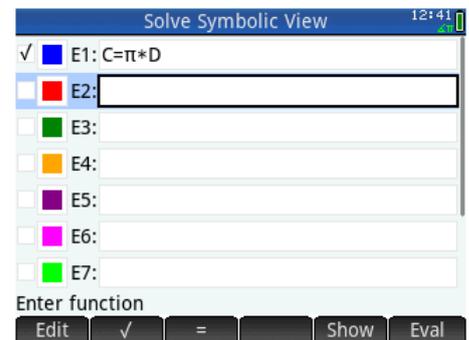
Press and choose

On the screen click **Reset** then **OK** then **Start**



Press

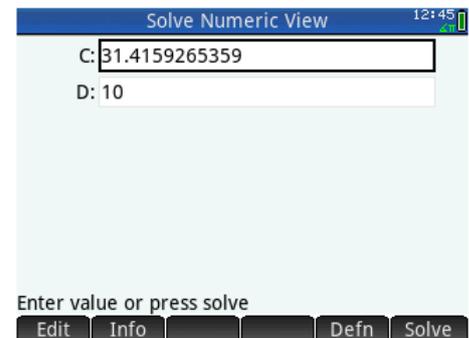
then click **OK**



Now we can use our formula:

Press and press down and enter a number for the diameter and click **OK**. I entered 10.

Now click **solve**. So when the diameter is 10 the circumference is 31.4159... cm





## mission briefing for students

### How Fast is Fast?

#### Activity 3: Calculate the speed of the spinning ball.

When you spin a table tennis ball on the end of a string, how fast is it going?

##### Experiment 1:

- Make the string exactly 50cm or 0.5m
- Spin it round and round keeping the speed the same.
- Measure how long it take to make 5 complete circles.

The ball moved through 5 circumferences of the circle.

One circumference is  $0.5m \times \pi = 1.57m$

So, 5 circumferences is  $1.57m \times 5 = 7.85m$

*How fast did it go?*

Divide by the time taken to make the 5 turns to get you answer in m/s

If it took 12 seconds, then  $7.85m \div 12s = 0.65m/s$

$$\text{average speed} = \text{distance} \div \text{time}$$

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

##### Experiment 2:

*So, when it flies off, how long will it take to fly across the room?*

- **SAFETY:** make sure that no-one is in the possible path of the ball
- Stand at one end of the room. Spin the ball at the same speed you did before (you can do both experiments in one for better results).
- Let the ball go so it flies of towards the furthest wall. (You will need to practice this a few times).
- Time how long it takes from flying off to hitting the wall. (A very expert timer and a good stopwatch e.g. on a mobile phone, will be needed).
- Measure the distance it flew with a tape measure.





## mission briefing for students

### How Fast is Fast?

*How fast did it go?*

Divide the distance the ball flew (in metres) by the time it took (in seconds) to get you answer in m/s

You should see that the speed of the ball turning round in the circle is roughly the same as the speed it flies off at.

- *Why is it only 'roughly' the same?*
- *Is it slowing down or speeding up?*
- *What might make it change speed?*

You can put your flying table tennis ball onto your speed poster.

Use your HP Prime to convert to mph.

Solve 13:38

CONVERT(0.65\_m/s,0\_mph)  
1.45400858984\_mph

Sto ▶



## mission briefing for students

### How Fast is Fast?

#### Activity 4: How fast does the ISS travel?

Work through the calculation.

It takes ... “Around 90 minutes to complete one orbit”

How many hours is that? 1.5 hrs

Look up “earth radius”

6371km

How high above the Earth does the ISS fly?

388 km

So, the ISS orbit has a radius of  $6371+388=6759$  km

So, it has a diameter of  $6759 \times 2 = 13,518$  km

So, we find the circumference to know how far it travels in one complete orbit.

The circumference is 42,468 km

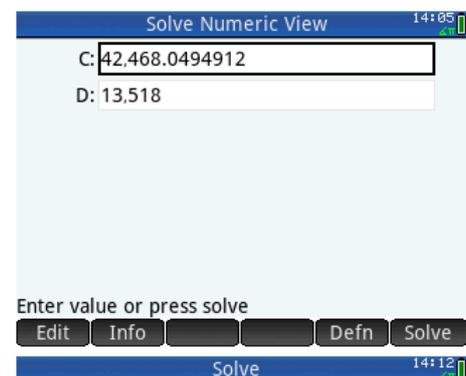
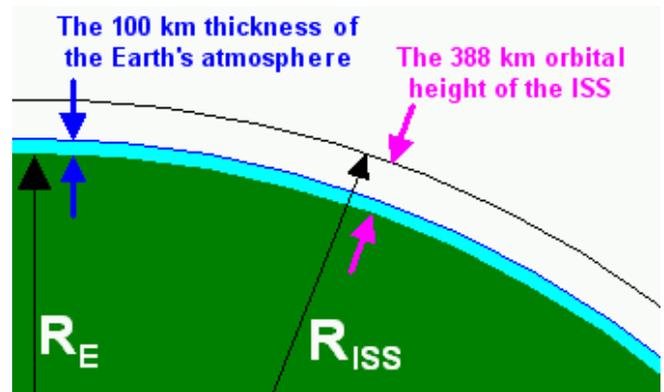
So, it travels 42,468 km in 1.5 hrs.

Speed is  $42468 \div 1.5 = 28,312$  kph

Convert to mph.

That's 17,592 mph

Now go back and put the ISS onto your speeds poster.



CONVERT(28,312\_kph,0\_mph)  
17,592.2611946\_mph

Sto ▶

#### Look out for the International Space Station

On the European Space Agency Site: <http://bit.ly/1jaMtPs>

Read more on Wikipedia: [https://en.wikipedia.org/wiki/International\\_Space\\_Station](https://en.wikipedia.org/wiki/International_Space_Station)