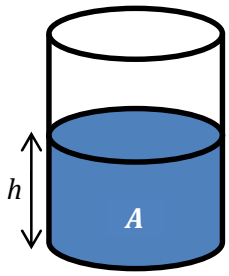
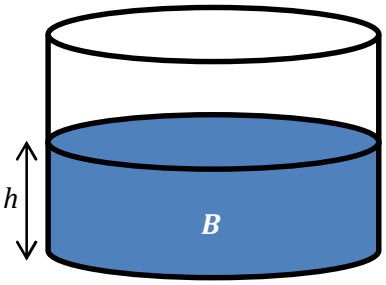
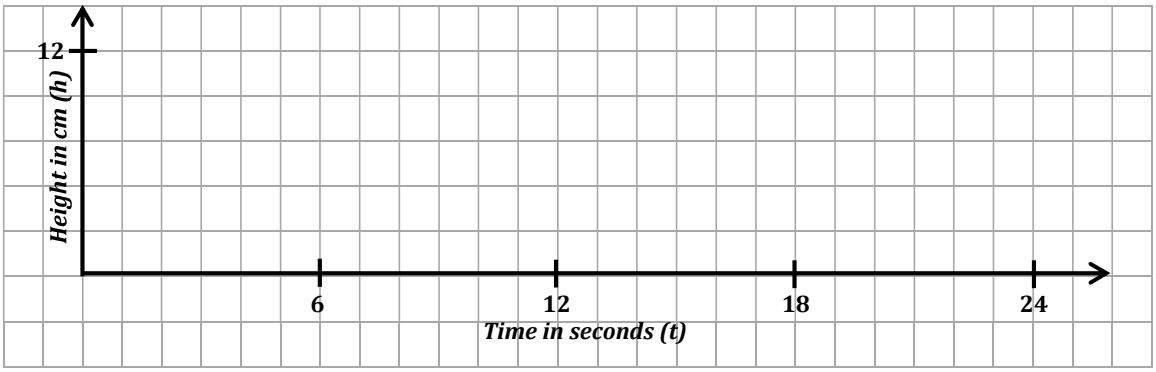
Section A: Student Activity 3 – Part 1

1. (i) Two cylindrical containers, *A* and *B* are being filled with water.
The volume of water increases at the same rate in both and the height of both containers is 12 cm. Sketch a graph to show the rate at which the height of the water level changes with time for both containers. Put both containers on one graph.
Container *A* is full after 6 seconds and container *B* is full after 24 seconds.



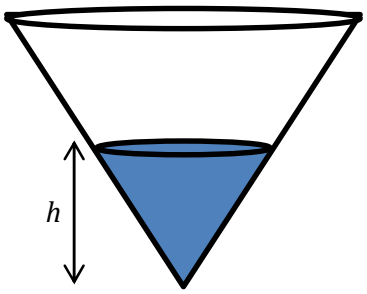


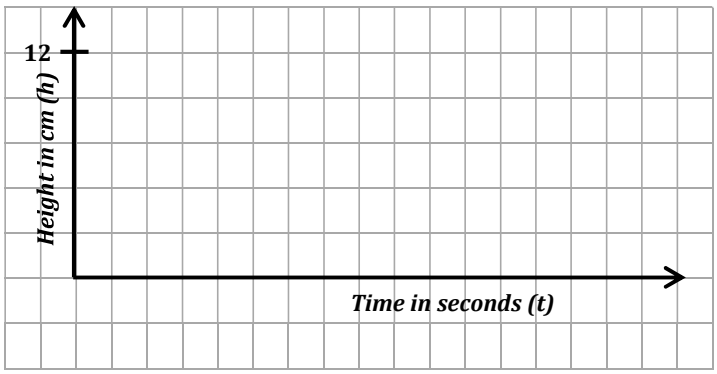


(ii) Why does it take container *B* longer to fill?

2. (i) Water flows into a vessel in the shape of an inverted cone as shown below.
The volume of water increases at the same rate as for the two cylinders above.
The vessel has the same height and radius as container *B*.
How long will it take to fill the vessel?

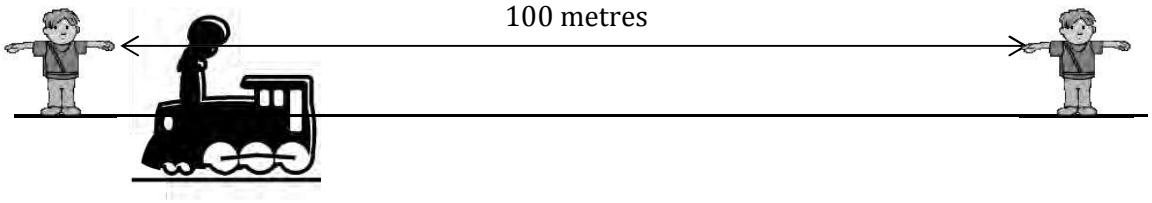
(ii) As water is poured into the vessel, sketch a rough graph to show how the height of the water level changes with time.

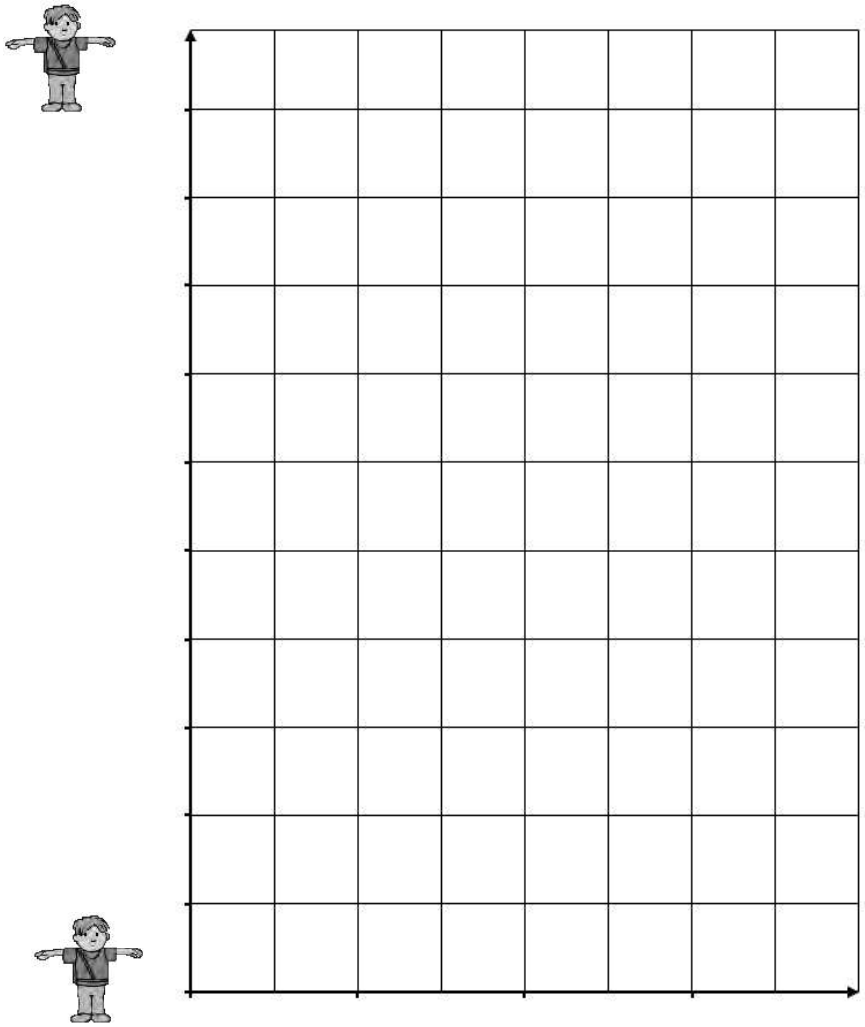




Section A: Student Activity 4

Some Transition Year students decide to carry out an experiment on constant speed. They have a class discussion on where they might see a model for constant speed. They decide that if they go to a train station and choose a train that is not scheduled to stop there, that the train will most likely pass them at a constant speed. Two students from the class arrange to stand 100 meters apart at either end of the platform and time the train between these two positions.





2. At what speed does the train pass the two students in km/hour?

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_____

3. If the teacher was standing half way between the students during the experiment to supervise, at what speed do you think the train passed the teacher? Give a reason for your answer.

_____

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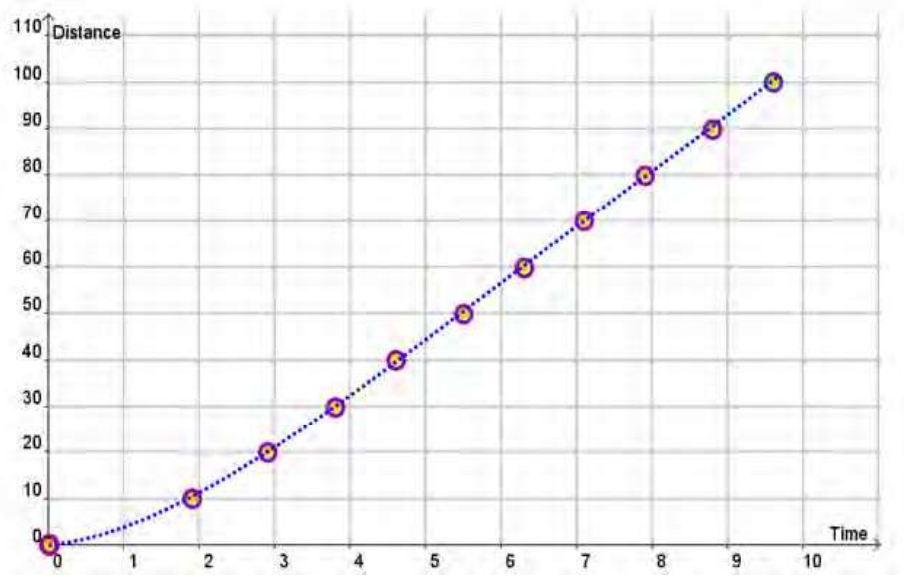
Section A: Student Activity 5

In the 2009 World Championships in Berlin, Usain Bolt set the World Record for the Men's 100 *m* sprint, running it in 9.58 seconds.
Below is a table of Usain Bolt's split times every 10 metres during the race.

Distance *(m)*	10	20	30	40	50	60	70	80	90	100
Time *(s)*	1.89	2.88	3.78	4.64	5.47	6.29	7.10	7.92	8.75	9.58

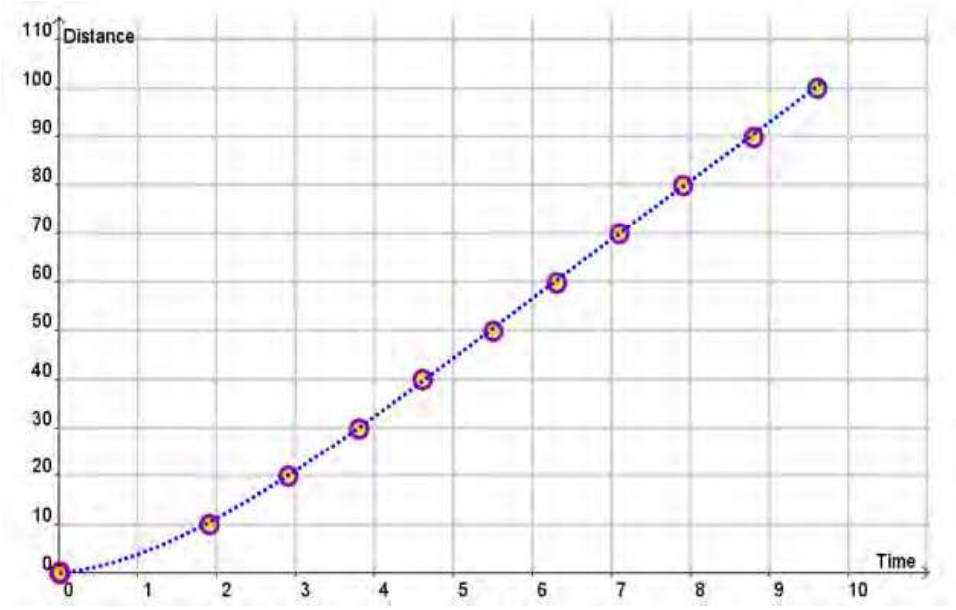


1. How fast do you think Usain Bolt ran during the race? Give your answer correct to 2 decimal places in m/sec.

2. Do you think he ran at this speed throughout the whole race? Give *two* reasons for your answer.

3. What do you think your answer for Question 1 represents?

4. **(i)** Using a ruler, join the points (0, 0) and (9.58, 100) on the graph below.



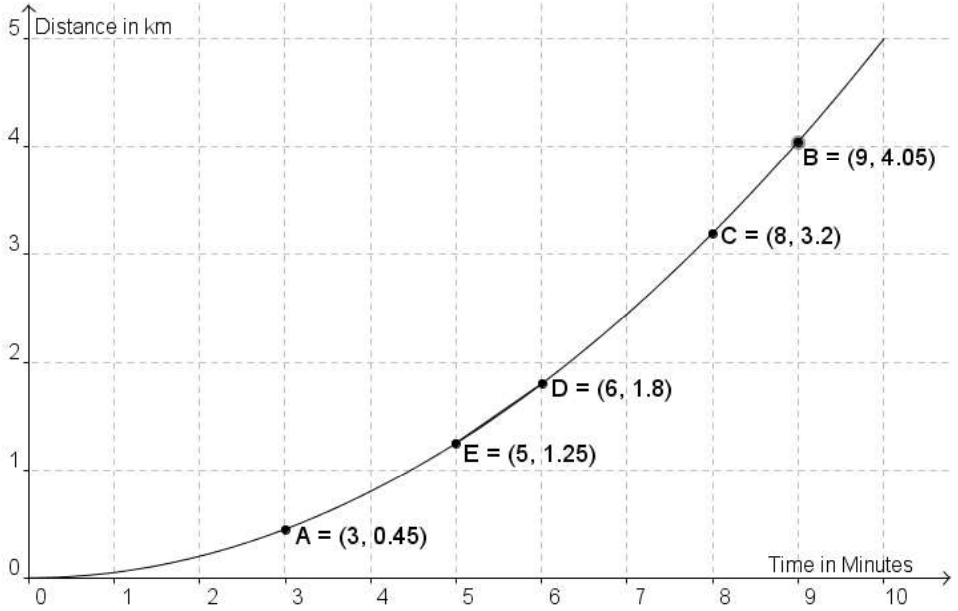
(ii) Find the slope of this line.

(iii) The line that joins (0,0) to (9.58,100) has a special name.
It is called a *secant line* to the above curve.
What observation can you make about the slope of this secant line?

5. How do you think we could calculate Usain's speed at *precisely* 1 second into the race?

Section A: Student Activity 6 – Part 1

Below is a distance-time graph of the first ten minutes of a warm up cycle by Olympic Gold medallist Victoria Pendleton.



1. Over these 10 minutes, what is Victoria Pendleton's average speed in km/min?

2. The coach wants to know what her speed is at exactly 3 minutes during this warm up. To help answer this question do the following:

(i) Using your ruler, draw in the secants $[AB]$, $[AC]$, $[AD]$, $[AE]$.

(ii) Fill in the following table. Answers correct to 2 decimal places.

Slope of Secant $[AB] =$	Average speed between A and $B =$
Slope of Secant $[AC] =$	Average speed between A and $C =$
Slope of Secant $[AD] =$	Average speed between A and $D =$
Slope of Secant $[AE] =$	Average speed between A and $E =$

3. The slope of which secant is the nearest estimate to Victoria's speed after exactly 3 minutes?

_____

4. How might you find a better estimate for Victoria's speed after exactly 3 minutes?

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