itute.com

Online & home tutors ***Registered business name: itute*** ***ABN:*** *96 297 924 083*

2027
Math Methods

Year 11
Topic Assessment Task

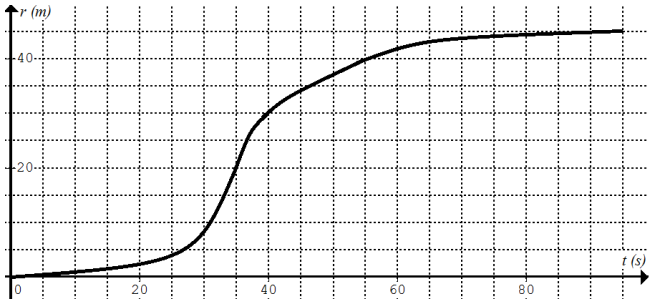
Average and instantaneous rates of change

(Time allowed: 1 hour plus)

© itute.com 2026

Year 11 Topic Assessment Task
Topic: Average and instantaneous rates of change

Question 1 (10 marks)
A particle travels in a straight line in the same direction. It starts at time $t = 0$ and its position r (i.e. distance from the starting point in metres) at time $t > 0$ in seconds is recorded and plotted for $0 \le t \le 95$.
A smooth curve is drawn through the plotted points as shown below.



Correct answers to 1 decimal place. Include units in your answers.

a. State two periods of 5 minute duration when the particle moves at (i) approximately constant lowest speed, and (ii) approximately constant highest speed.

2 marks

b. Estimate the speeds in parts a(i) and a(ii). 2 marks

c. Calculate the average rate of change in the particle's position with respect to time for the period shown in the graph.

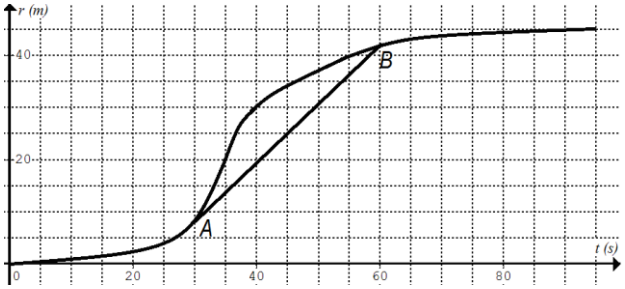
1 mark

d. State the time(s) when the particle's instantaneous speed equals to the answer in part c. 2 marks

e. Estimate the longest period of time when the particle's speed is increasing. 2 marks

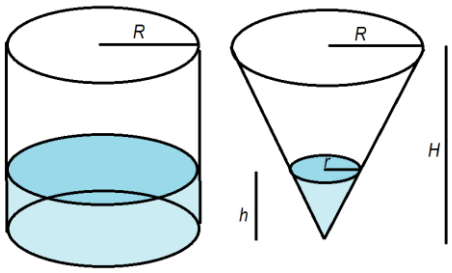
f. The average rate of change of position with respect to time from *A* to *B* changes as *A* approaches *B*. Estimate the **limit** of the average rate of change of position with respect to time.

1 mark



© itute.com 2026

Question 2 (12 marks)
Consider two containers one is cylindrical shape and the second conical. Both have the same radius R and height H in metres.



$$V = \pi R^2 H$$

$$V = \frac{1}{3}\pi R^2 H$$

Both are being filled with water at the same constant rate of L litres per minute starting at time $t = 0$.
Let h metres be the depth of water in each container at time t minutes.

a. Sketch a depth versus time graph for the cylindrical container. Label the axes and the end point.

2 marks

b. Sketch a depth versus time graph for the conical container. Label the axes and the end point.

3 marks

Instead of being filled water runs out at the bottom of the containers at the same constant rate. Both containers are full at $t = 0$.

c. Sketch a depth versus time graph for the cylindrical container. Label the axes and the end point.

2 marks

d. Sketch a depth versus time graph for the conical container. Label the axes and the end point.

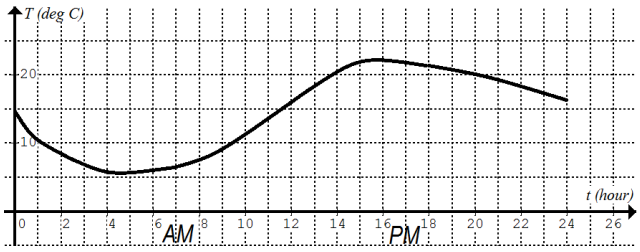
3 marks

e. State the relationship between the emptying times of the containers. 1 mark

f. Compare the average rates of change in depth of water in the two containers while emptying. 1 mark

© itute.com 2026

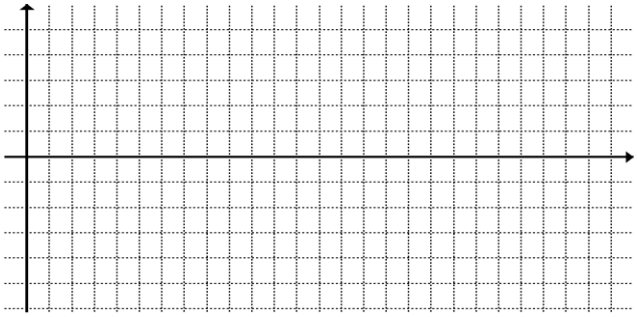
Question 3 (13 marks)
The temperature $T(°C)$ over 24 hours in Melbourne during a winter day is shown below.



a. Determine the rates of change in temperature at $t=0$, $t=12$ and $t=24$ in $°C$ per hour. 3 marks

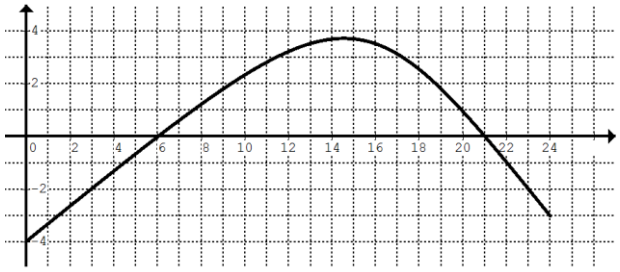
b. Sketch the corresponding graph of rate of change in T ($°C$ per hour) versus t on the following grid. Label the axes including units.

4 marks

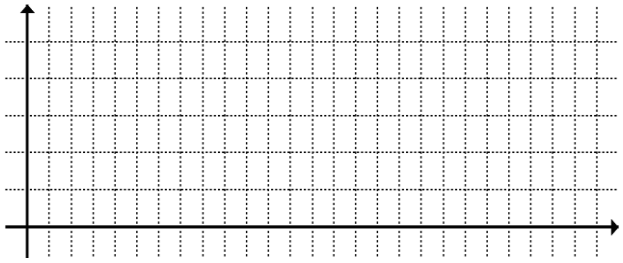


c. Calculate the average rate of change in T over the 24 hour period. Sketch it on the grid above. 2 marks

The following graph shows the rate of change in T ($°C$ per hour) versus t over 24 hours on a different day.



d. Sketch the corresponding graph of T versus t on the grid below, given $T=5$ at $t=6$.
Label and scale the axes, and include units. 4 marks



End of Topic Assessment Task

© itute.com 2026