UNIT 17 *Using Graphs* Activities

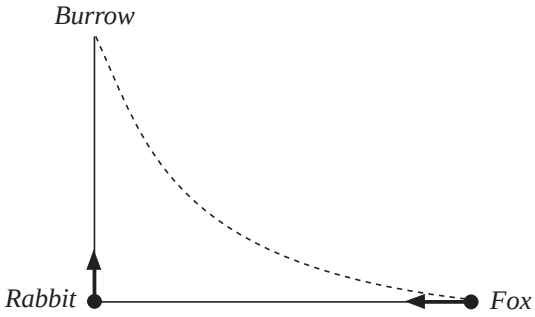
Activities

ACTIVITY 17.1 *Pursuit Curves*

Suppose a rabbit, feeding in the middle of a field, sees a fox running directly towards it. The rabbit runs in a straight line towards its burrow.

If the fox always continues to move towards the rabbit, it will trace out a curve as shown.

Depending on their speeds, the fox will either catch the rabbit or the rabbit will reach home safely.



1. If:

   speed of rabbit = 10 ms^{-1}

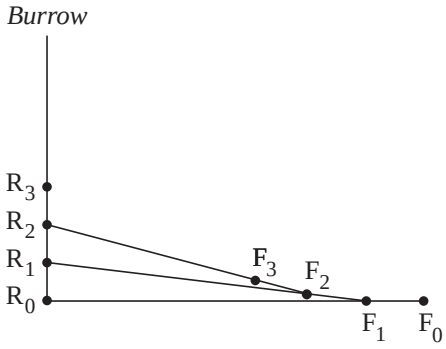
   speed of fox = 15 ms^{-1}

   distance of rabbit from burrow = 100 m

   distance of fox from rabbit = 100 m,

   plot accurately the positions of the fox (F) and rabbit (R) at every second, as shown opposite.

   Will the fox catch the rabbit?

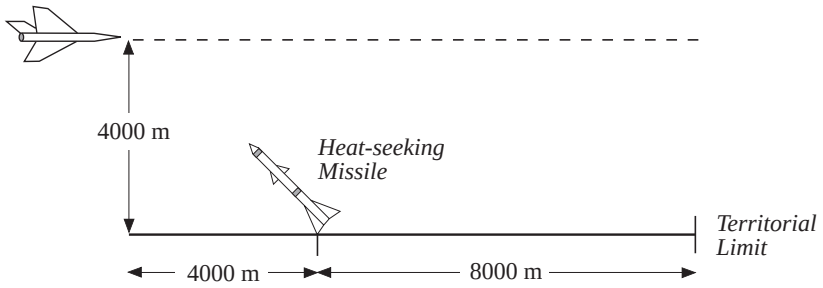


2. Repeat the problem with the fox's speed equal to:
   (a) 16 ms^{-1} (b) 20 ms^{-1}.

3. Find an approximation for the *critical speed* of the fox, i.e. the speed with which the fox will *just* catch the rabbit.

A similar situation arises with heat-seeking missiles. Once they have locked onto their target, they always move directly towards it.

4. A spy plane at a height of 4000 m is travelling at a constant speed of 200 ms^{-1}.
   A heat-seeking missile is fired at the plane when it is 4000 m due west of an airbase.

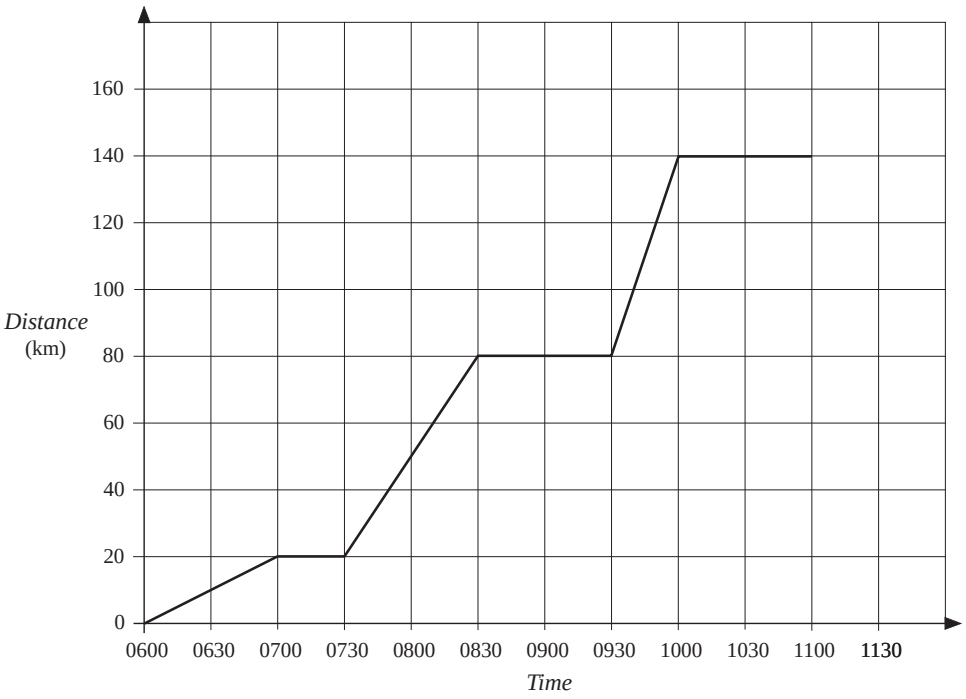


   If the missile's speed is 220 ms^{-1}, will the missile hit the plane before it reaches the limit of territorial land, 8000 m due east? (Use approximations every 10 seconds.)

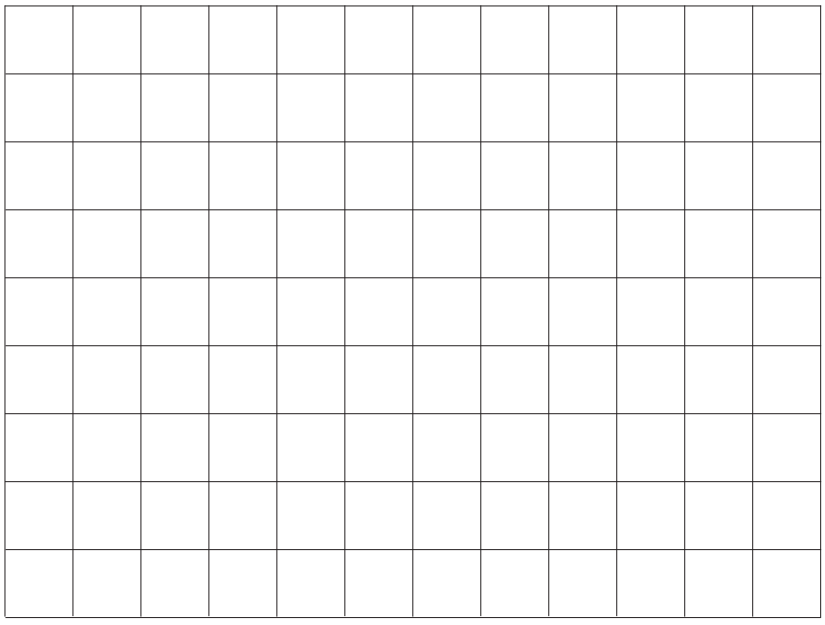
Extension Find the *critical speed* for Problem 4.

ACTIVITY 17.2 *Relationship between Distance-Time and Speed-Time Graphs*

The following shows the distance-time graph for a journey.

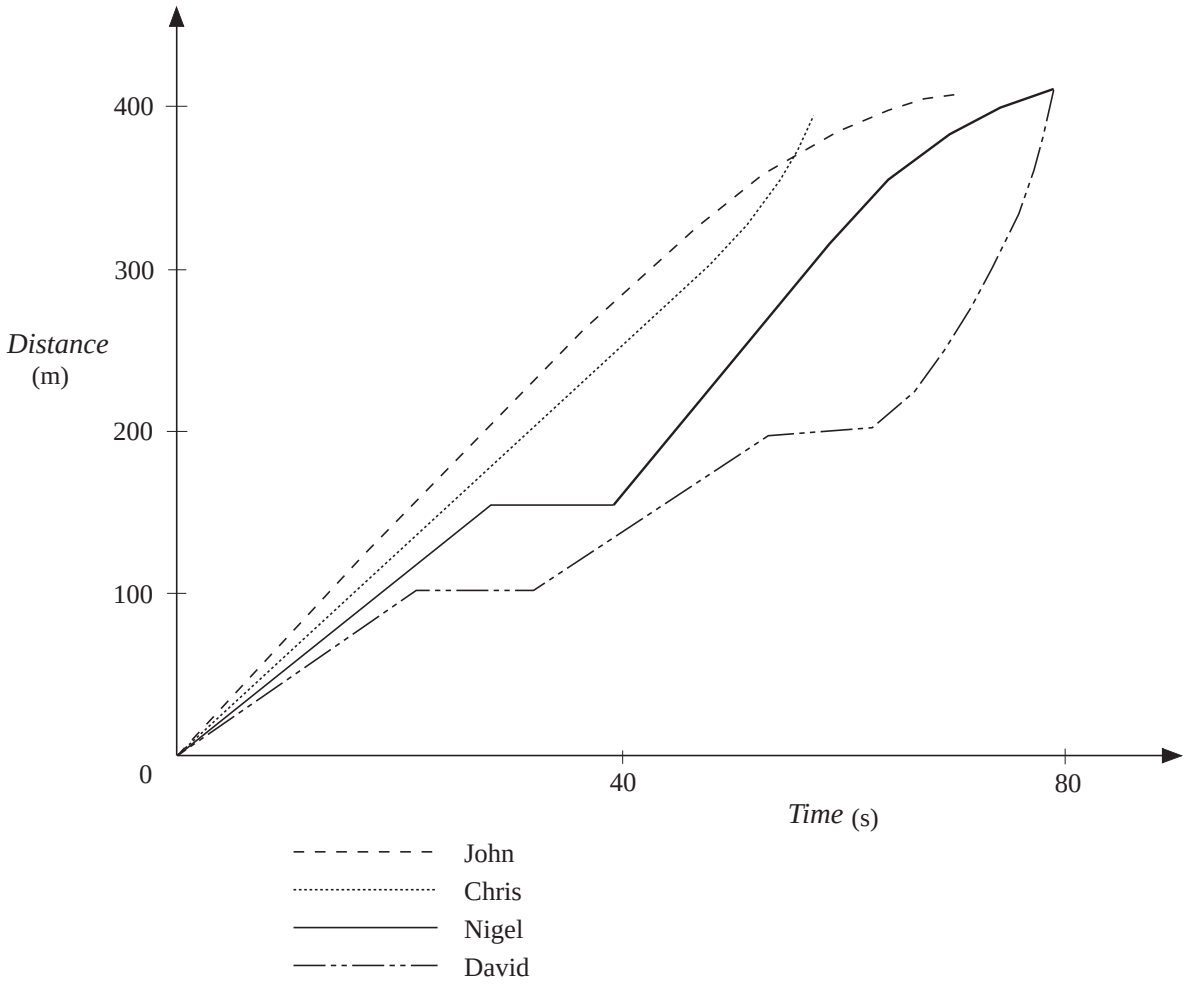


On the grid draw the speed-time graph for the same journey.



ACTIVITY 17.3 *Race Commentary*

The distance-time graphs for 4 athletes competing in a 400 m hurdle race are shown below.

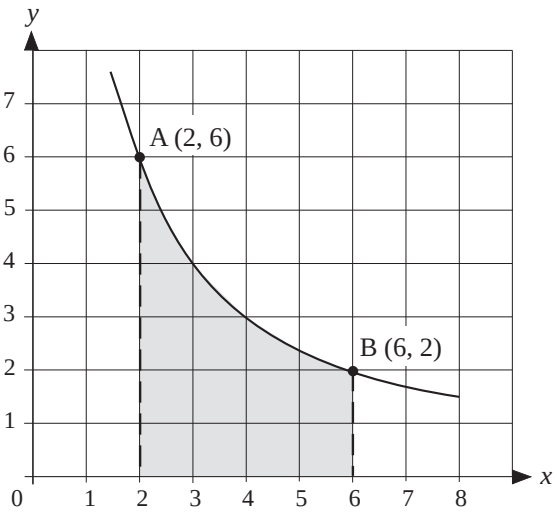


Imagine that you are the commentator for the race and write down (or record) your commentary.

ACTIVITY 17.4 *Estimating Distance Travelled*

The distance travelled is the area under a speed-time graph and one way of finding an estimate of the area is by counting squares.

1.



(a) By counting squares (and parts of squares), estimate the area under the curve

$$y = \frac{12}{x}$$

between $x = 2$ and $x = 6$.

(b) Estimate the area by forming a trapezium for each unit increase in the x-axis and adding up the area of the four trapezia.

(c) The area (to 4 d.p.) is 13.1833. Which of these two methods is more accurate?

2. The graph below shows a speed-time graph for a train.
Estimate the distance travelled by the train in the first 5 seconds.