Speedy calculations

To answer these questions, do any working you need to in your book. Then record your answers on this sheet.

1. Using the formula Speed = Distance / Time, complete the table below.

	Speed	Distance	Time
(a)	2 ms^{-1}	10 m	
(b)		25 m	5 s
(c)	100 ms^{-1}		6 s
(d)	10 ms^{-1}	50 m	
(e)		40 m	60 s
(f)	3 ms^{-1}		9 s

2. A cyclist travels 20 km in 4 hours.

   (a) What speed did the cyclist travel in kmh^{-1}?

   (b) What speed did the cyclist travel in ms^{-1}? (Hint: 20 km is 20 000 m and 4 hours is 4 x 3 600 s.)

3. Do some speedy calculations for these world record holders.

   (a) Usain Bolt broke the world record for the men's 100 m sprint with a time of 9.58 s. How fast was he going?

   (b) Florence Griffith Joyner broke the world record for the women's 100 m sprint with a time of 10.49 s. How fast was she going?

   (c) How much slower than Usain was Florence?

4. The fastest horse in the world, Winning Brew, completed a quarter-mile (402 m) race in 20.57 s. Calculate how fast this filly (young female horse) was travelling.

5. Compare the top speeds of Winning Brew and Usain Bolt. Explain which of them was going faster, including reasons with your answer.

6. Sarah has been training for a marathon, which will cover a distance of 42.195 kilometres. In training she has consistently run 1 km each 6 minutes. How long will it take Sarah to complete the marathon if she runs at this pace consistently throughout the race?

Graphs of motion

1. In your book, compare and contrast the following pairs of words related to graphs and motion.

   (a) Speed and velocity

   (b) Distance and displacement

   (c) Constant speed and zero acceleration

   (d) Instantaneous and average speed

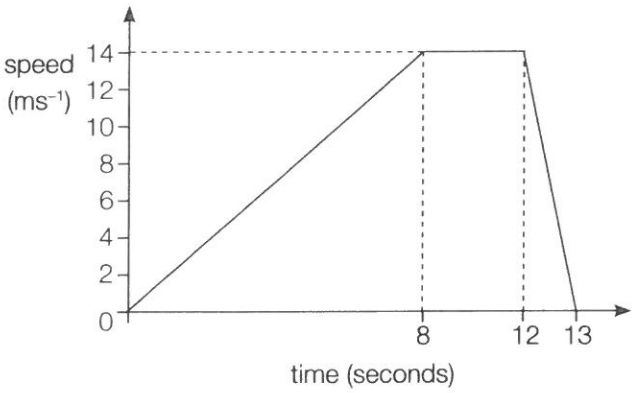
   (e) Uniform motion and non-uniform motion

2. Explain why an 800 m track runner has zero displacement.

3. Using your own graph paper and the information below, plot a distance–time graph to show the journey of the cyclist during the first 12 s.

   A cyclist starts from rest and travels a distance of 10 m in 2 s. The cyclist then travels another 30 m at a constant speed of 3 ms^{-1} for 10 s.

4. Use the graph below to answer the questions about the speed of rugby league player Benji Marshall during sprint training. Do any working in your book.



   (a) What is Benji's speed at 9 s?

   (b) What is the acceleration of Benji in the first 8 s?

   (c) Describe the motion of Benji between 10 and 11 s.

   (d) Explain how you know Benji has travelled 119 m in his sprint training.

5. Olivia starts a race from rest and runs at 3 ms^{-1} for 4 minutes. She then runs at 4 ms^{-1} for 8 minutes before stopping for 30 s at a drinks station. Next she runs at 3 ms^{-1} for 2 minutes, increasing her speed to 4 ms^{-1} for 7 minutes, until she sees the finish line and increases her speed to 8 ms^{-1} for 40 s.

   (a) Using your own graph paper and the information above, plot a speed–time graph to show Olivia's journey. Then use your graph to answer the remaining questions.

   (b) How long in seconds did it take Olivia to complete the race?

   (c) What was her average speed over the entire race?

   (d) How far was the race that she took part in?

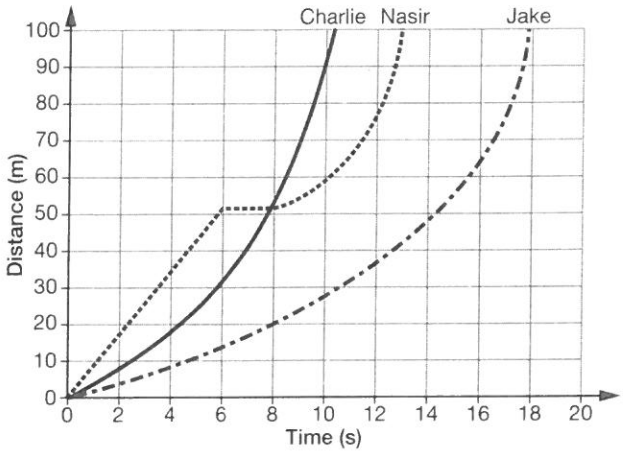
   (e) If she had not stopped at the drinks station, what would her average speed and her total time for the race have been?

8.2 Distance– and displacement–time graphs

Science understanding

Visual/Spatial Logical/Mathematical

1 Jake, Charlie and Nasir compete in a 100-metre race. The distance–time graph of their motion is shown. **Analyse** this graph to answer the following questions.



(a) **State** who won the race.

_____

(b) **Calculate** the average speed of the three runners in metres per second (m/s). Express your answer to one decimal place.

(i) Charlie's average speed = $\frac{\text{distance travelled}}{\text{time taken}}$ = _____

(ii) Jake's average speed = _____

(iii) Nasir's average speed = _____

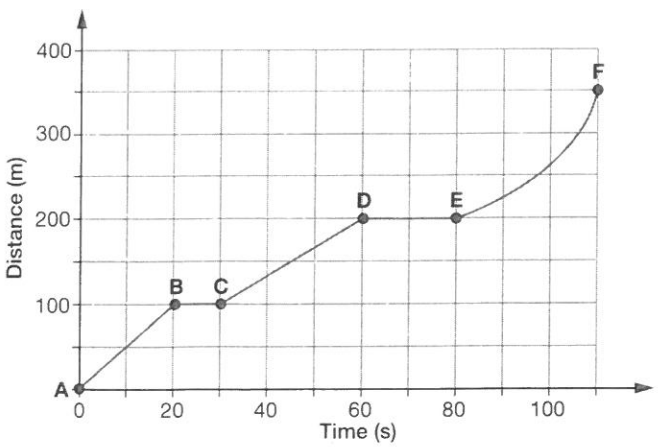
(c) **Compare** Nasir's motion to that of Charlie and Jake.

_____

_____

_____

2 The following distance–time graph applies to Lucy as she rides her bike along a bike path along a beach. **Analyse** Lucy's motion to answer the following questions.



(a) **Calculate** Lucy's average speed as she travels from A to B.

(b) **Calculate** Lucy's average speed as she travels from C to D.

(c) **Identify** the interval(s) in which Lucy:

(i) stops

(ii) travels with constant speed

(iii) travels with increasing speed.

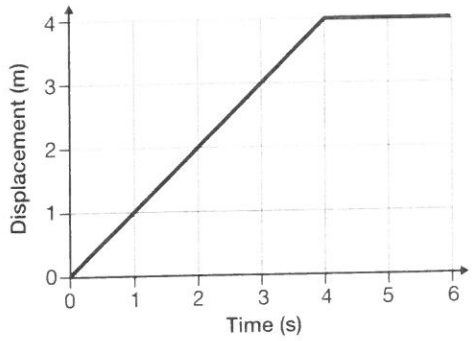
(d) **Calculate** Lucy's average speed for the entire journey.

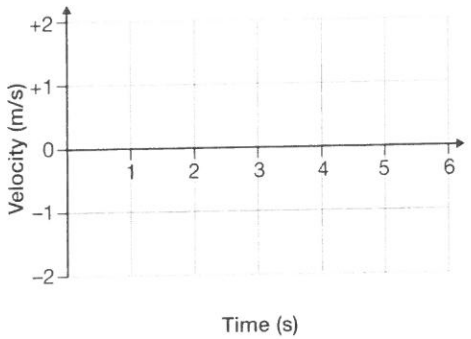
(e) **Explain** how this average speed does not fully describe Lucy's motion over the entire journey.

(f) Assuming the bike path followed a northerly direction, **state** Lucy's displacement for the journey.

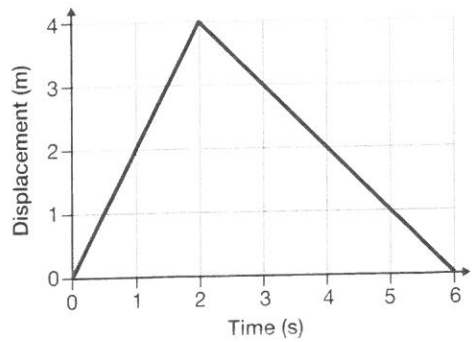
3 **Calculate** the gradient ($\frac{\text{rise}}{\text{run}}$) for each stage of the two displacement–time graphs shown below. **Use** your results to plot the corresponding velocity–time graph of each using the axes provided.

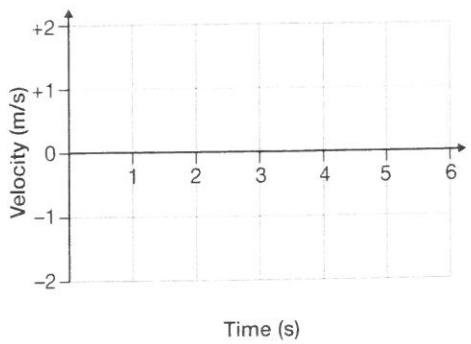
(a)





(b)





8.3 Speed–time graphs

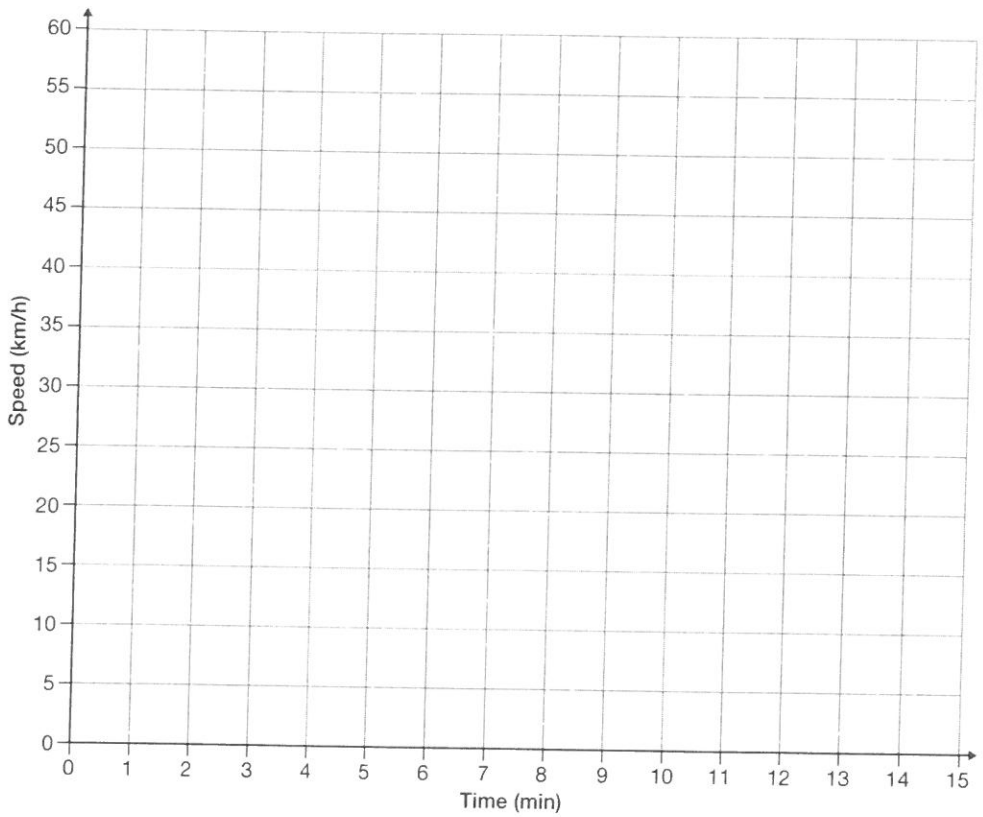
Science inquiry

Visual/Spatial Logical/Mathematical

1 The table shows the instantaneous speed recorded from the speedometer in a car at every minute of a 15-minute journey.

Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Speed (km/h)	0	22	47	50	50	50	35	11	29	60	32	3	0	0	25	60

(a) **Use** this data to **construct** a speed–time graph of the car's motion on the axes below.



(b) **(i)** Using a red pen, **identify** on your graph when the car was speeding up.

(ii) Using a blue pen, **identify** on your graph when the car was slowing down.

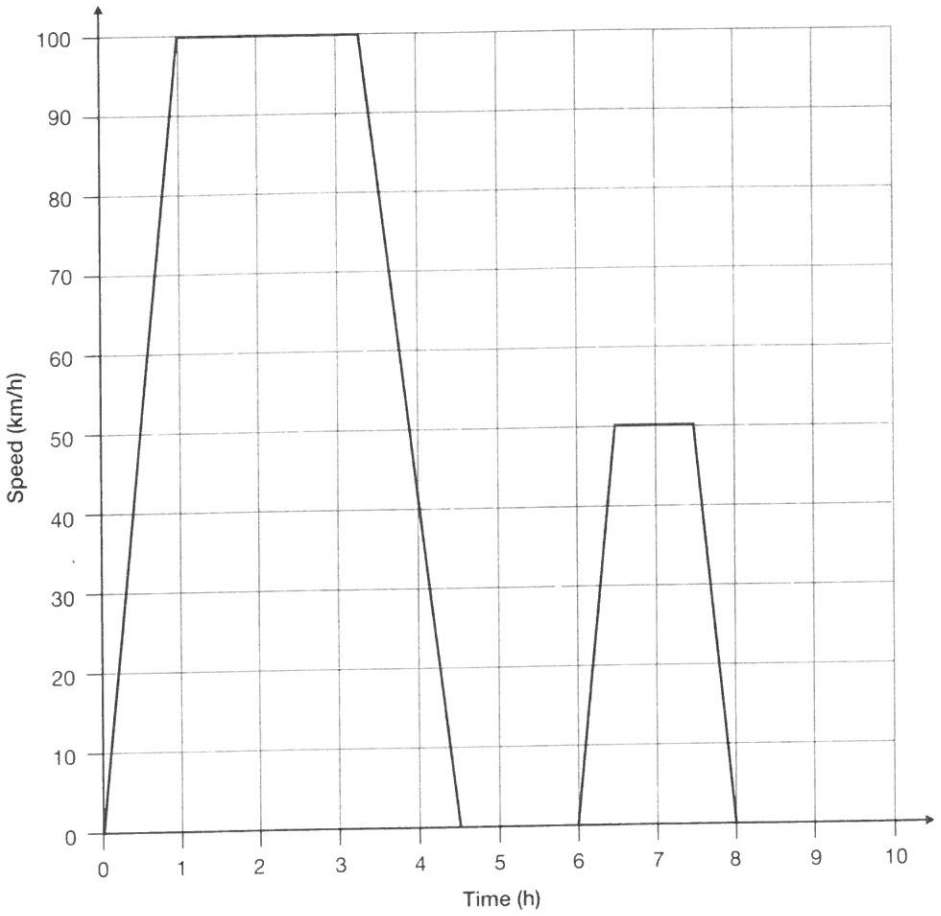
(c) **(i)** At one stage of the journey, the driver slowed down and turned a corner. **Propose** how many minutes into the trip this occurred.

_____

(ii) At another stage of the journey, the driver stopped at a set of traffic lights. **Propose** how many minutes into the trip this occurred.

_____

2 A family set out on a long car journey to reach a holiday destination. A speed–time graph of their motion is shown below. They drive for a certain time on freeways before having a break for a meal, then drive a further distance through a major city before reaching their accommodation.



(a) **Describe** the family's motion:

(i) 1–4 hours into the trip _____

(ii) 4–4.5 hours into the trip _____

(iii) 4.5–6 hours into the trip _____

(iv) 6–6.5 hours into the trip _____

(v) 6.5–7.5 hours into the trip _____

(b) Recalling that the distance travelled is equivalent to the area below the speed–time graph for the journey, **calculate** the distance the family travelled to reach their holiday destination.