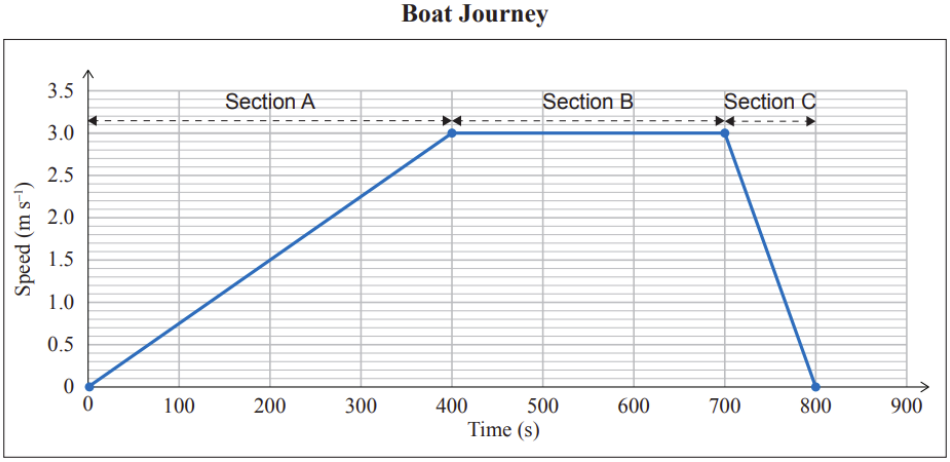
SCIENCE: 90940 DEMONSTRATE UNDERSTANDING OF ASPECTS OF MECHANICS: MOTION

2019:1

A boat travels across a lake to the start of a walking track. The graph below shows the boat's journey.



(a) Describe the motion of the boat during each section of the journey.

(b) Calculate the acceleration of the boat in the first 400 seconds.

(c) Explain the acceleration and motion of the boat shown in Section B of the graph by discussing the horizontal forces acting on the boat.

(d) Show that the total distance travelled by the boat is 1650 m.

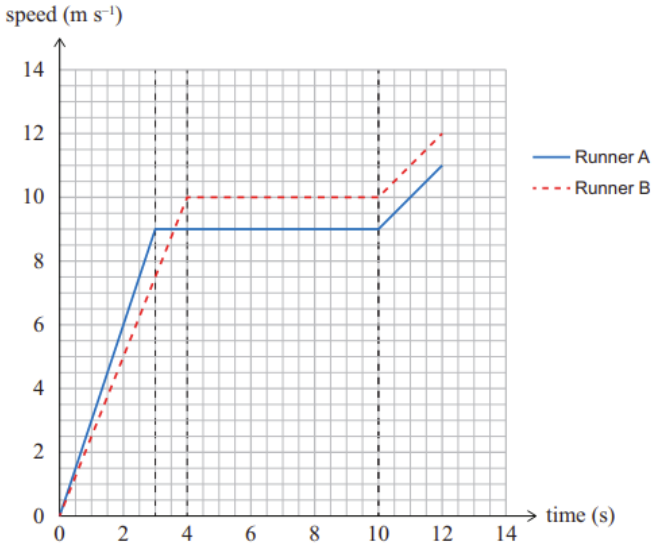
2019:3

A parachutist jumps from a plane.

(b) The parachutist falls a distance of 450 m during the first 9.49 seconds. Calculate the average speed of the parachutist during this time.

2018:1

The speed-time graph shows the motion of two runners in a 100 m race.



(a) From the graph, which runner has the greater acceleration in the first 3 seconds? Explain your answer. Calculations are not required.

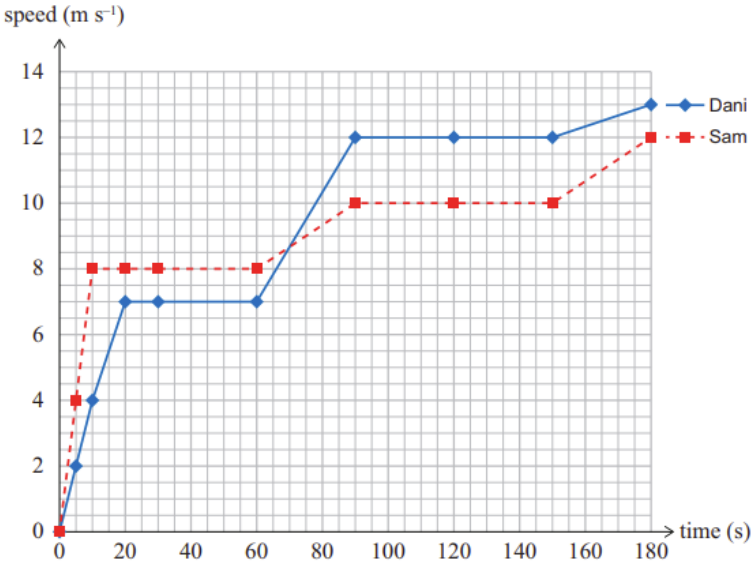
(b) Using the graph, calculate Runner A's acceleration during the first 3 seconds

(c) (i) Use the information in the graph to compare the speed AND acceleration of Runner A and Runner B in the first 10 seconds.

(ii) Use the information in the graph and calculations to show which runner, Runner A or Runner B, finished the 100 m first.

2017:1

Two horses, ridden by Dani and Sam, are racing against each other. The speed-time graph of their two horses is shown below.



(a) Use the information in the graph to compare the speed AND acceleration of Dani and Sam in the first 60 seconds.

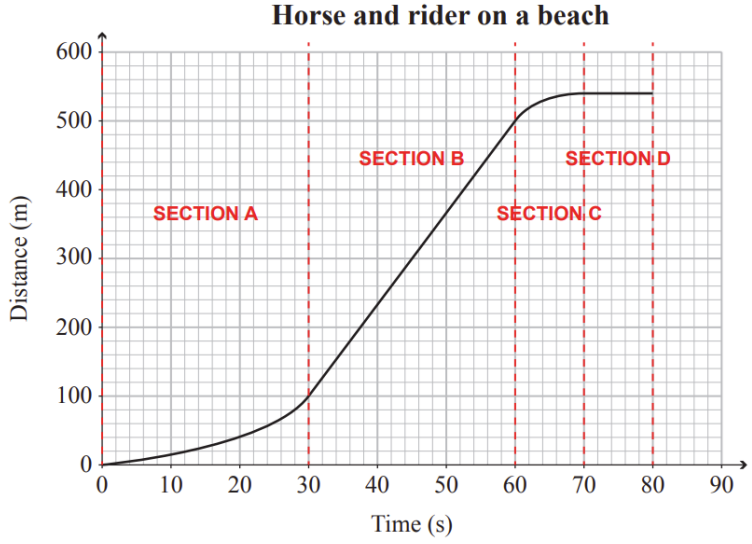
Sam's horse accelerates for the first 10 s of the race AND covers a distance of 40 m. Sam and his horse have a total mass 308 kg.

(b) Use the acceleration to calculate the work that Sam and his horse have done in the first 40 m.

(d) After 90 s, Sam and his horse had travelled 710 m. How much further had they travelled compared to Dani and her horse at this stage in the race? Use the information in the graph and any necessary calculations to answer.

2016:1

The graph below shows the motion of a horse and rider as they travel along a beach.

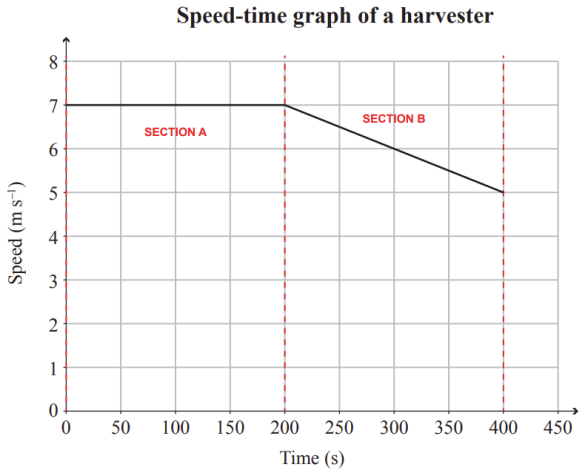


(a) Describe the motion of the horse and rider in each section of the graph. (No calculations are required.)

(b) Calculate the speed of the horse and rider in Section B of the graph.

2016:2

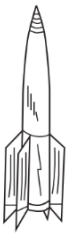
A harvester was working in a paddock. The speed-time graph shows the journey of the harvester.



(a) Calculate the distance the harvester travelled in the first 200 seconds.

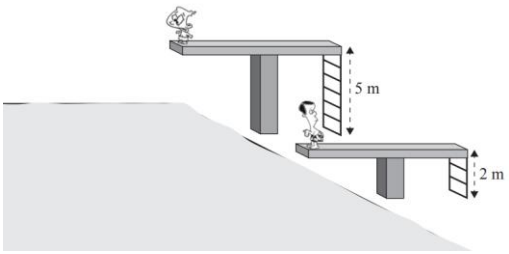
2016:3

(b) The rocket was fired vertically. It left the launch pad and after 1.2 s was travelling at 20 ms^{-1}. Calculate the rocket's acceleration.



2015:1

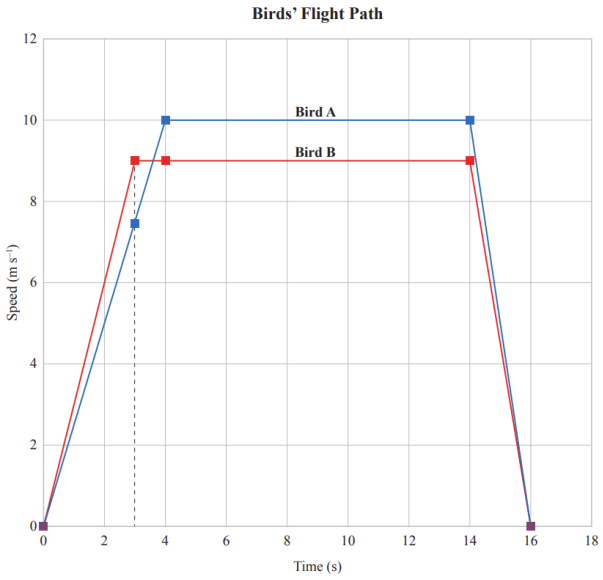
Chris and Ian were jumping off different platforms into a pool.



(a) It took Chris 0.60 s to reach the water once he had jumped from the 2 m platform. Calculate his average speed.

2015:2

(c) The speed-time graph shows the flights of two birds.

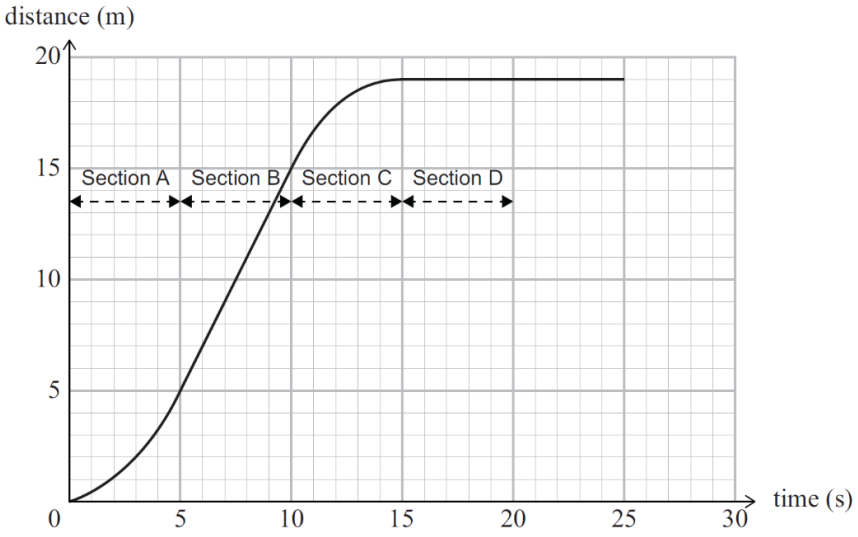


(i) Use the graph to explain which bird has the greater acceleration in the first 3 seconds. *Calculation is not required but may be used.*

(ii) In 16 s, Bird B travelled 121.5 m. How much further did Bird A travel in the same time? Show all working

2014:1

(b) The cyclist's journey was plotted on the distance / time graph below.



(i) Describe the motion of the cyclist in each of sections A, B, C, and D.
No calculations are required.

(ii) Calculate the cyclist's speed during Section B.

2014:2

(a) It took 6 seconds to push the footstool a distance of 8.0 m across a room. Calculate the average speed of the footstool as it is pushed.

2014:4

Two go-carts were racing on a track.

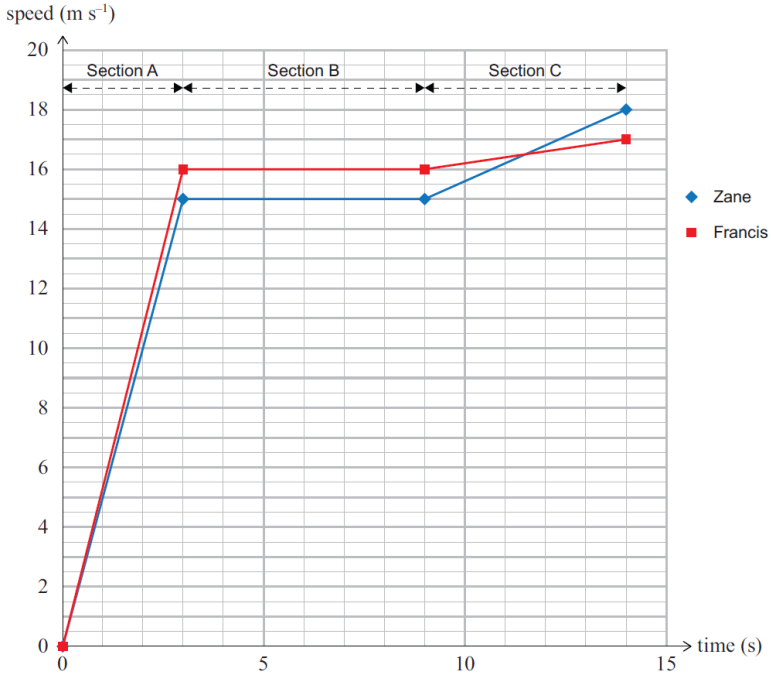
A speed / time graph is shown below for each go-cart. Zane's graph is shown in blue, and Francis's in red.

(a) Calculate the acceleration of Zane in the first 3 seconds.

(c) Explain which go-cart travelled 200 m around the track first.

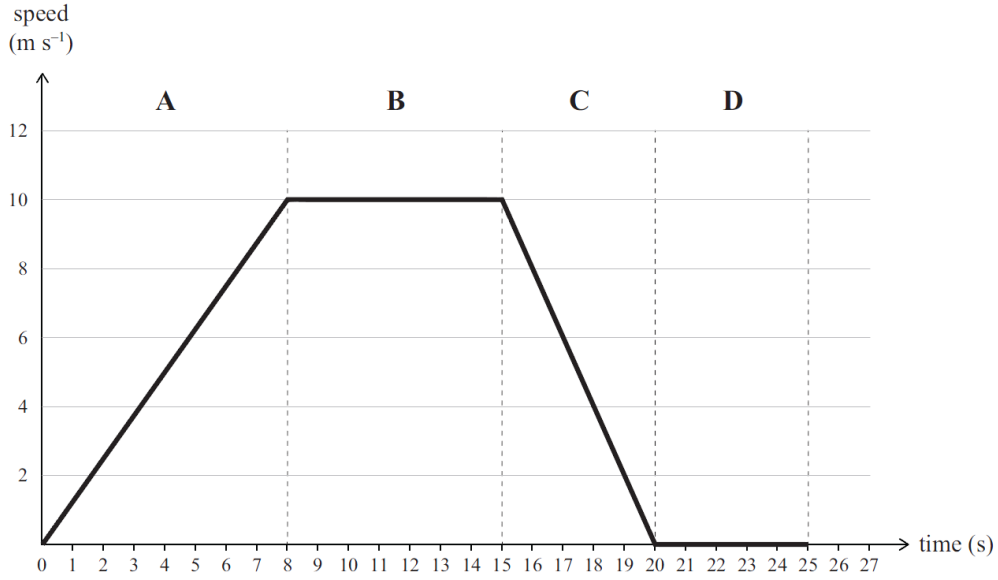
In your answer you should:

- use the information in the graph
- show all working for the calculations
- compare the distances travelled by Zane and Francis by the end of 14 s.



2013:1

A runner's speed is recorded for 25 seconds and graphed below.



(d) Calculate the total distance the runner travels.

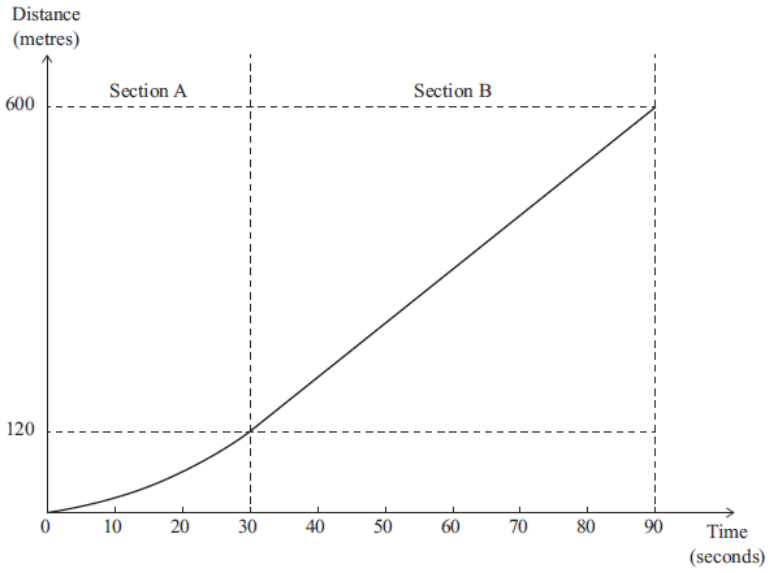
Distance travelled, section A:

Distance travelled, section B:

Distance travelled, section C:

2012:1

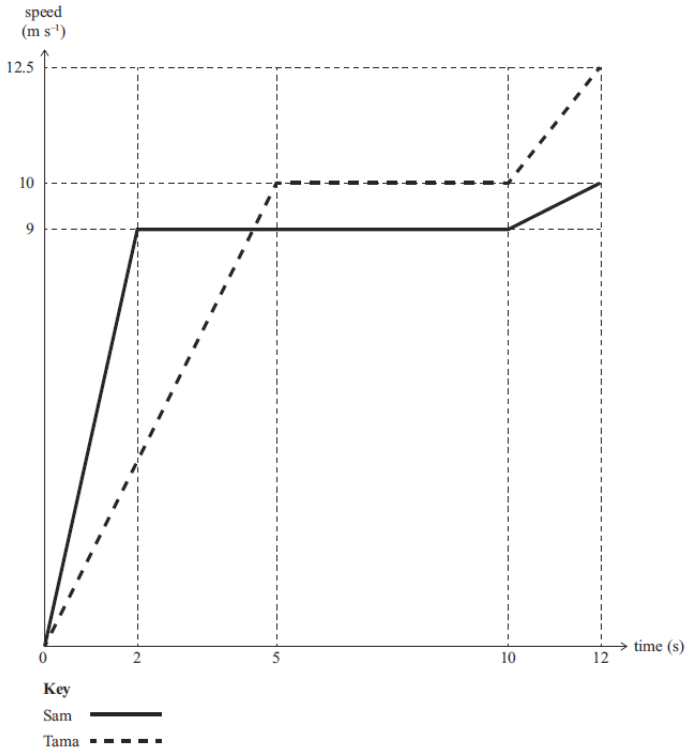
A woman drives her tractor down a sandy beach to pick up her friend's boat. The distance-time graph below shows part of the journey.



(a) Use the information from the graph to calculate the **average speed** of the tractor during the 90 seconds.

2012:2

On athletics day, two friends compete in the same 100 metre race. The speed-time graphs for 12 seconds of their race are shown here.



(a) From the graph, who has the greater acceleration in the first 2 seconds? Give a reason with your answer. No calculation is required.

(c) (i) Use the information in the graph to compare the speed AND acceleration of Sam and Tama in the first 10 seconds.

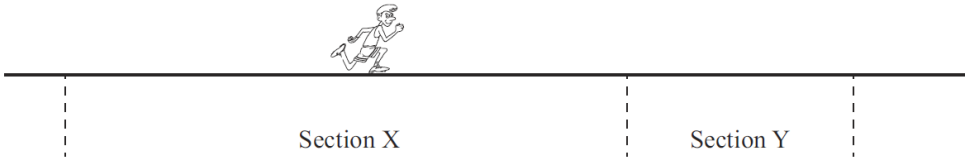
(ii) At 12 seconds, one of the runners has finished the 100 metre race. Use the information in the graph and any necessary calculations to show which runner, Sam or Tama, finished at 12 seconds.

2011:1

A parachutist of mass 75 kg jumps from a plane at a height of 4 000 m above sea level.

(a) The parachutist falls through a distance of 2400 m during the first 60 seconds. Calculate the average speed of the parachutist during this time.

2011:2



A boy runs along a track, as shown above.

During section X, he runs with a **constant speed** of 2 ms^{-1} for 15 seconds.
During section Y, he runs with a **constant acceleration** of 0.2 ms^{-2}.

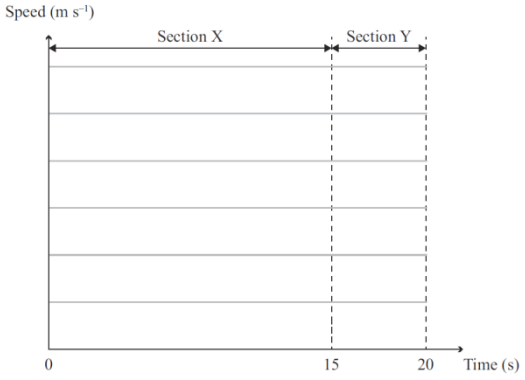
(a) Calculate the net force acting on the boy (mass 60 kg) during **section Y**. Give an appropriate unit with your answer.

(b) The boy runs 12.5 m during section Y in 5 seconds. Calculate the power required by the boy to produce the constant acceleration of 0.2 ms^{-2} in 5 seconds during section Y. Give an appropriate unit with your answer.

(c) (i) Calculate the speed of the boy as he reaches the end of section Y.

(ii) Use this and the other information provided in the question to complete the speed / time graph. On your graph, you should:

- label the speed values on the vertical axis
- draw a line on the graph to show the speeds for section X **and** section Y.

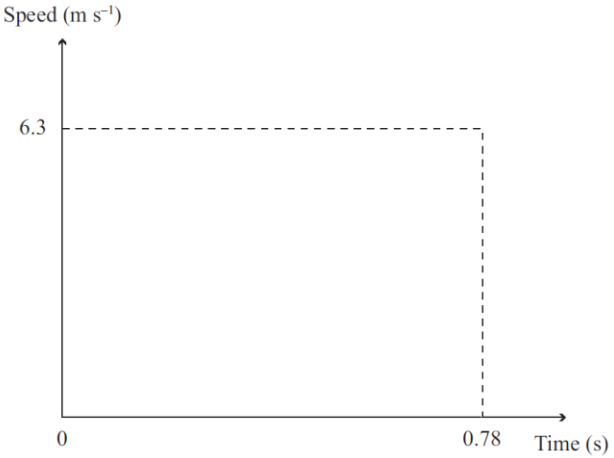


Please note – the questions that follow are from an older Achievement Standard where the questions were more short answer-type questions:

FALLING (2010;3 – AS90191)

(b) The apple (m = 0.15 kg) falls to the ground in 0.78 s, hitting the ground with a speed of 6.3 ms^{-1}.

Complete the speed-time graph.

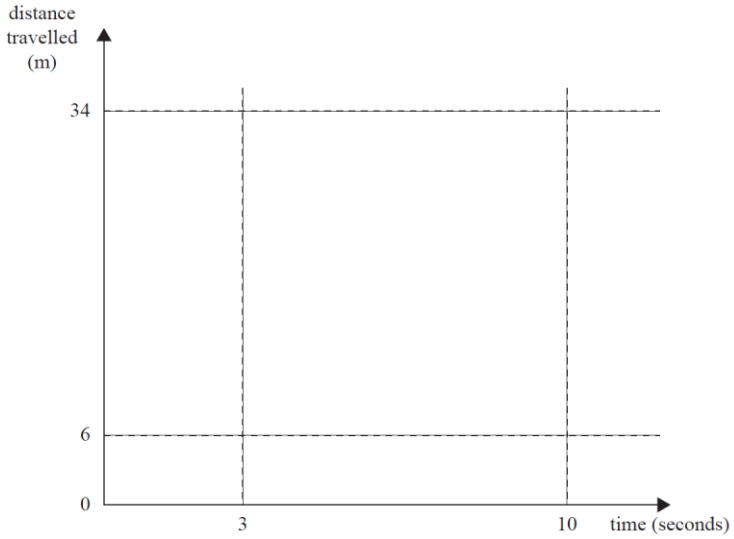


A REMOTE CONTROL CAR (2008;2 – AS90191)

A child plays with a remote control car on concrete.

(a) The car starts from rest and travels a distance of 6 m in 3 seconds. Calculate the average speed of the car in the 3 seconds.

(c) The car then travels a further 28 m at a constant speed of 4 ms^{-1} for 7 seconds. Draw in the appropriate shaped lines on the distance-time graph below to represent the journey of the car during the first 10 seconds.



SPORTS TRAINING (2007;1 – AS90191)

The speed-time graph below represents sprint training for an athlete.

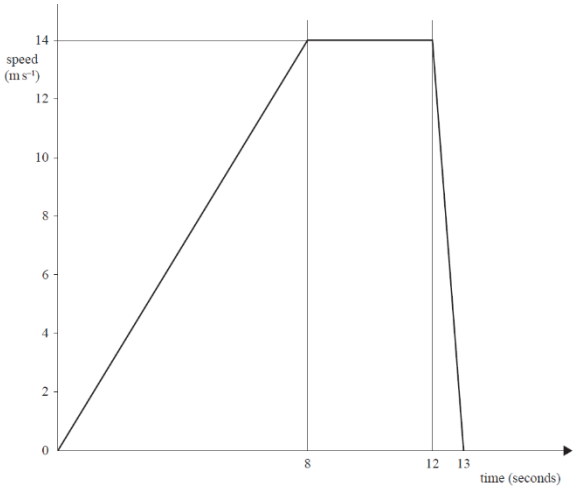
(a) State the speed of the athlete at 10 seconds.

(b) Describe the motion of the athlete between 12 and 13 seconds.

(c) Calculate the acceleration of the athlete during the first 8 seconds.

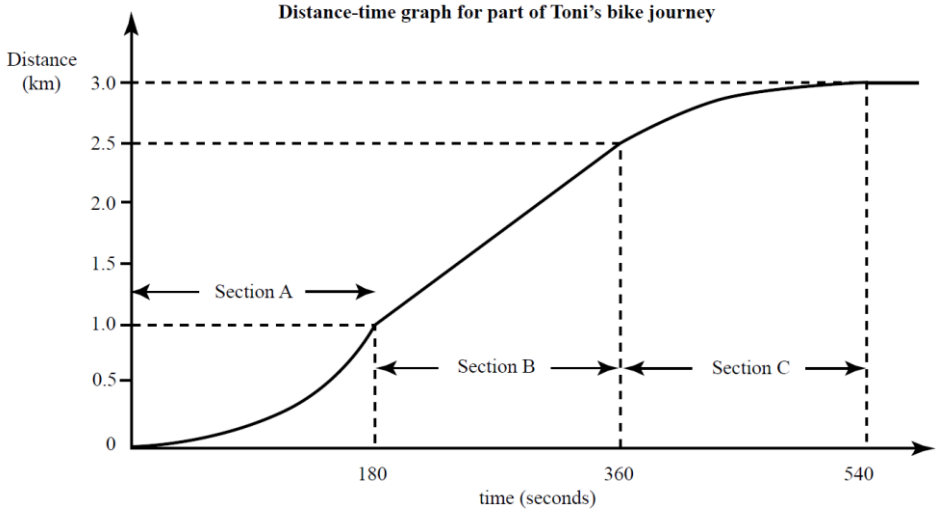
(d) Using the graph, calculate the total distance travelled by the athlete in the first 12 seconds.

(e) Another part of the athlete's training is swimming. Calculate the average speed of the athlete during the 90 seconds that the athlete swims two lengths (one length = 50 m) of a pool.



CYCLING (2006;1 – AS90191)

Toni cycles each day on her mountain bike. The distance-time graph below shows part of her journey on one day.



(a) How far, in metres, does Toni travel in the first 360 seconds?

(b) Calculate Toni's average speed over the 540 second bike journey.

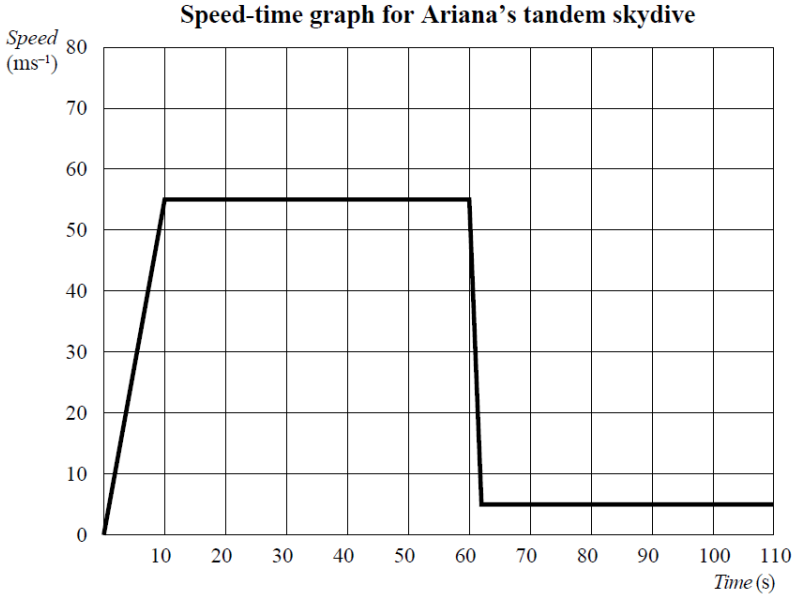
(c) Describe the motion of Toni and the bike during Section A.

(e) Using the graph above show that the speed of Toni and the bike during Section B is 8.3 m s^{-1}

(h) As shown on Section C of the graph, Toni reduces her speed from 8.3 m s^{-1} to 0 m s^{-1} in 180 seconds to come to a stop. Calculate the deceleration of Toni during these 180 seconds.

TANDEM SKYDIVING (2005;1 – AS90191)

Ariana wins a competition for a Tandem Skydive. The plane flies to a height of 5 000 m above sea level. Ariana is strapped to her jumpmaster. Ariana and the jumpmaster jump out of the plane. After 60 seconds the jumpmaster pulls the cord and releases the parachute. The speed-time graph below shows the motion of Ariana and the jumpmaster from when they leave the plane until after the parachute is released.

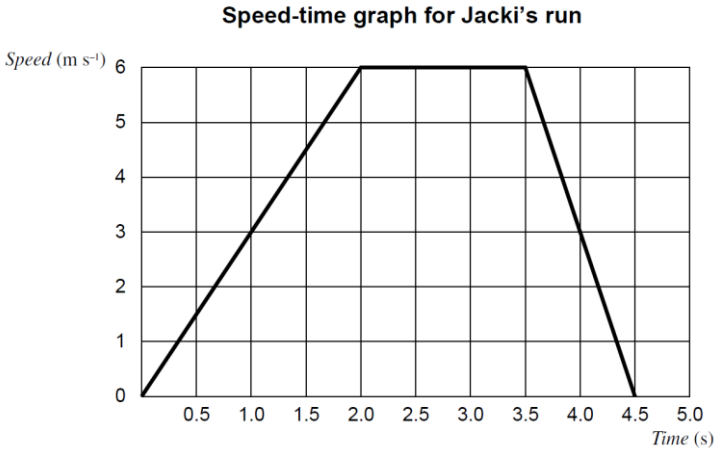


(f) Describe the motion of Ariana and the jumpmaster during the first 10 seconds.

(h) Calculate how far Ariana and the jumpmaster fell during the first 60 seconds.

THE GAME BEGINS! (2004;2 – AS90191)

In the team's first game, Jacki is the opening bowler. The speed-time graph shows the motion of Jacki as she runs in to bowl.



(a) What is the maximum speed Jacki reaches?

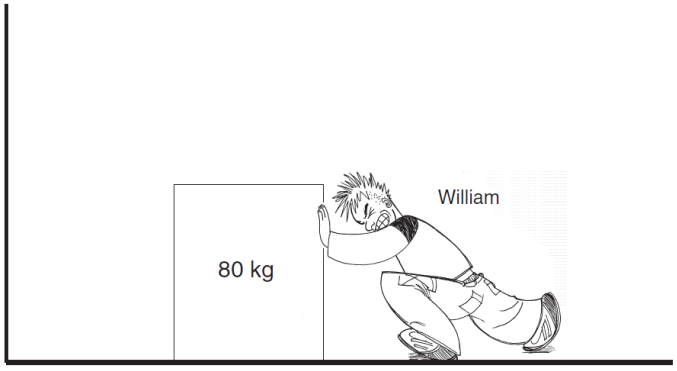
(b) Fully describe the motion of Jacki between 2.0 s and 3.5 s.

(c) Calculate Jacki's acceleration between 0 s and 2.0 s.

(d) Using the speed-time graph, calculate the total distance travelled by Jacki as she ran in to bowl.

QUESTION TWO (2003;2 – AS90191)

A group of friends have decided to help in the school stage production. William helped the sound technician to bring in boxes of sound gear. The boxes were pushed across the stage.



(b) The stage floor is 15 m from one side to the other. It takes 5 seconds to push the box across the stage. Calculate the average speed of the box. Show all working. The units are required.