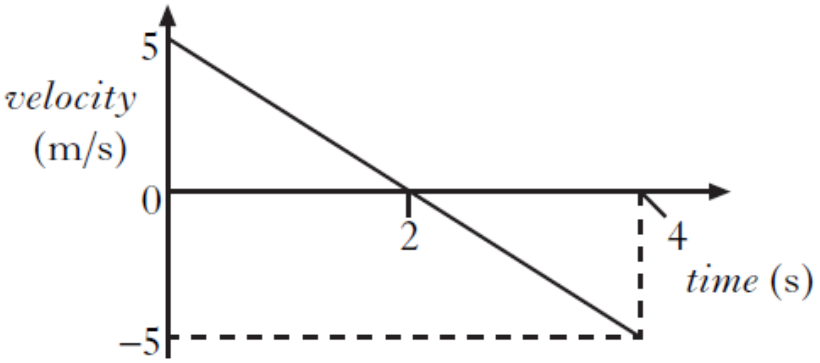
Kinematics Questions – NAT 5

1) A car travelling in a straight line accelerates uniformly from 20ms^{-1} to 12 ms^{-1} in 4 seconds. Calculate or find:

a) Average speed of the car over the 4 seconds.

b) Distance travelled by the car over the 4 seconds.

2) The graph shows how the velocity of an object varies with time.



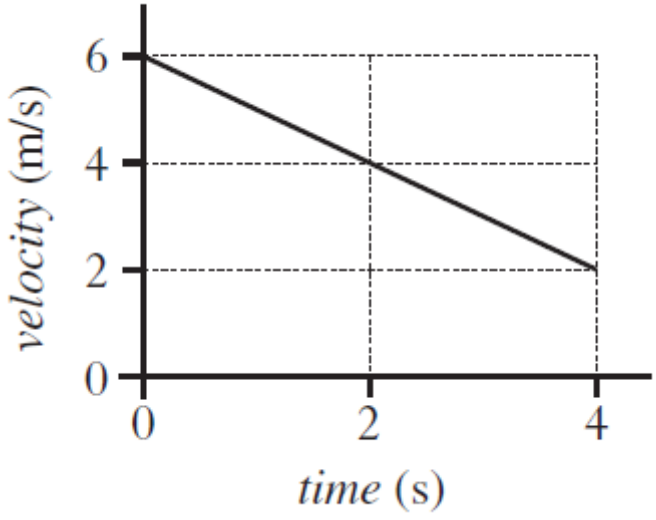
Calculate or find:

a) Acceleration of the object

b) Distance travelled by the object after 4 seconds.

c) Displacement of the object after 4 seconds.

3) The graph below shows how the velocity of a ball changes with time.

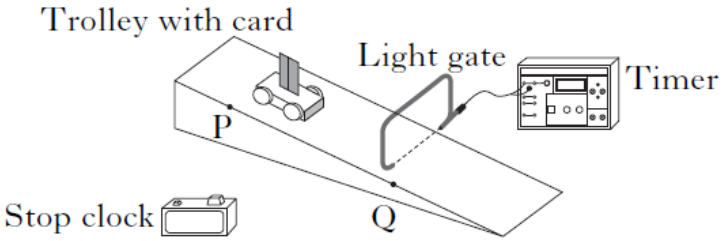


a) Calculate the acceleration of the ball.

b) Calculate the total distance travelled by the ball over the 4 seconds.

4) A student investigates the speed of a trolley as it moves down a slope.

The apparatus is set up as shown below.



The following measurements are recorded.

Distance from P to Q = 1.0m

Length of card on the trolley = 0.04m

Time taken for the trolley to move from P to Q = 2.5s

Time for the trolley to pass through the light gate = 0.05s

Calculate:

a) Average speed of the trolley from P to Q

b) Instantaneous speed of the trolley at Q

5) A walker wears a pedometer. A pedometer is an instrument that measures the distance walked by counting the number of steps. The walker measures the distance of one step as 0.8m, and enters it into the pedometer.

a) The walker completes 9000 steps during the walk.

Calculate the distance travelled.

b) The walker completes the walk in 80 minutes.

Calculate the average speed of the walker in ms^{-1}.

6) A cyclist rides along a road.

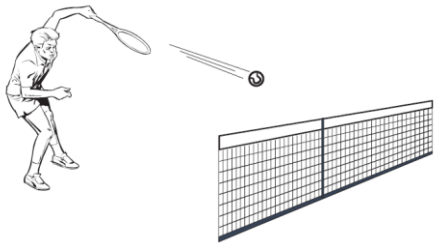
The cyclist approaches traffic lights at a speed of $8ms^{-1}$. He sees the traffic lights turn to red and 3 seconds later he applies the brakes. He comes to rest in a further 2.5 seconds.

a) Calculate the acceleration of the cyclist while braking.

b) Draw a speed – time graph showing the motion of the cyclist from the moment the lights turn red until he stops at the traffic lights. (Numerical values **must** be included.)

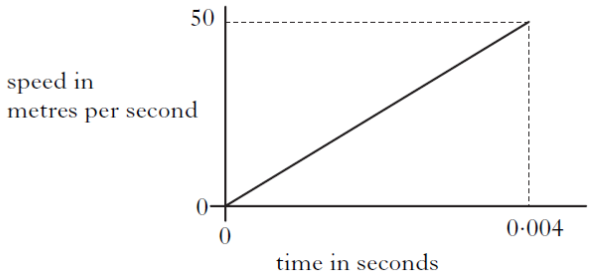
c) Calculate the total distance the cyclist travels from the moment the lights turn red until he stops at the traffic lights.

7) In a tennis match the player hits the ball to serve.



a) The ball travels 24m from the server's racquet the opponent's racquet at an average speed of $40ms^{-1}$. Calculate the time taken.

b) A graph showing how the speed of the ball changes while in contact with the racquet during the serve is shown.

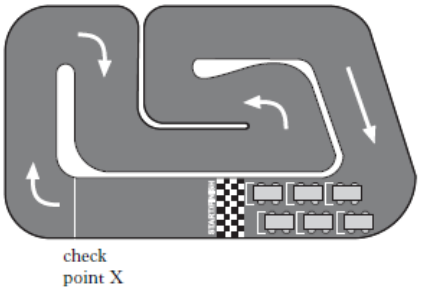


Calculate the acceleration of the ball during the serve.

c) For a second serve, the server hits the ball with a smaller force.

What effect does this have on the speed of the ball when it leaves the racquet?

8) An indoor kart track hosts a racing competition.



a) Describe how to find the **average speed** of the kart for one lap of the track.

You must state the measurements made and how they are used.

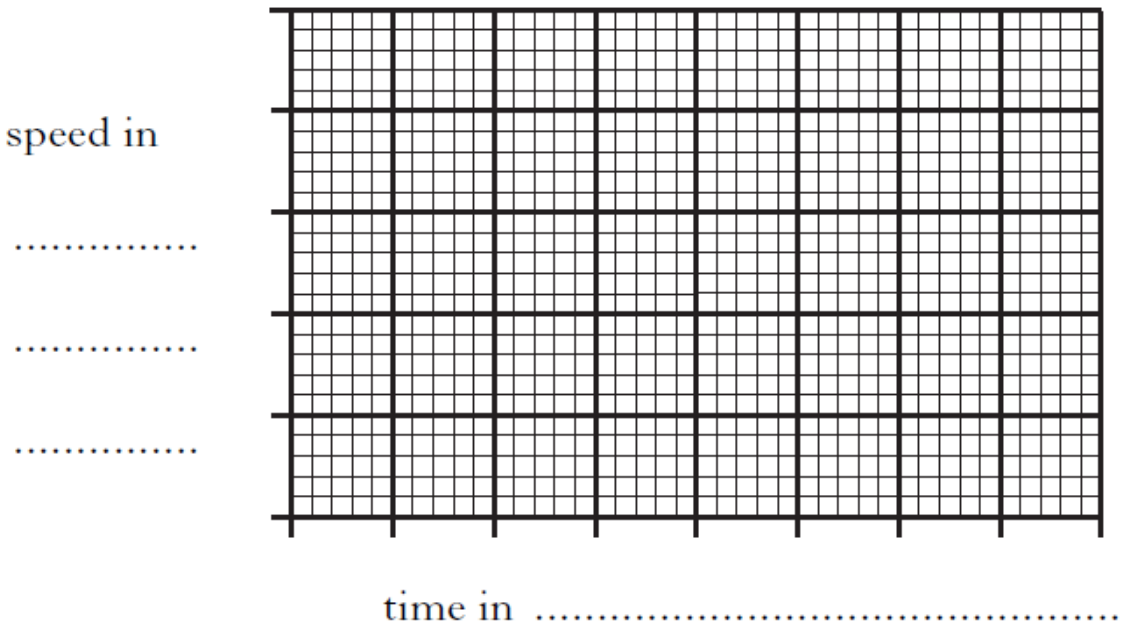
b) The speed of the kart and driver are recorded from the start of the race.

The kart starts from rest and accelerates uniformly until it reaches checkpoint X.

Its speed at X is 12ms^{-1} and it has taken 4 seconds to reach it.

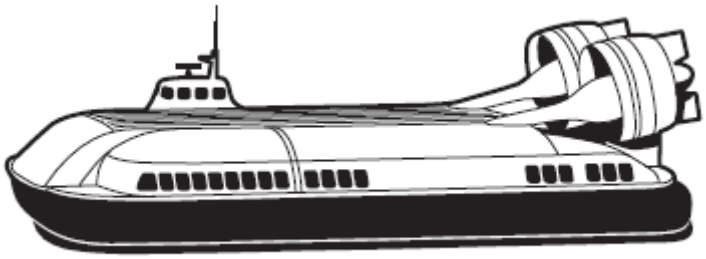
Complete the speed – time graph below to show the motion of the kart from the

Start until it reaches point X.



c) Calculate the acceleration of the kart between the start and point X.

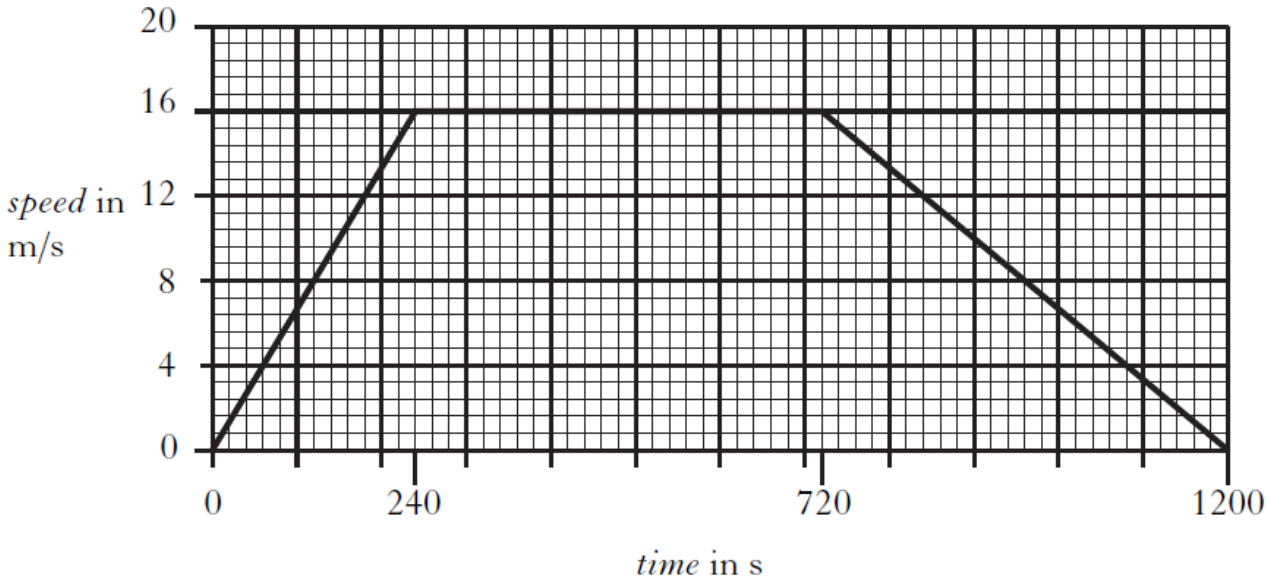
9) A hovercraft service was trialled on the Firth of Forth from Kirkcaldy to Leith.



The hovercraft and the passengers have a total weight of 220,000N

a) State the value of the upward force exerted on the hovercraft when it hovers at a constant height.

b) The graph bellow shows how the speed of the hovercraft varies with time for one journey from Kirkcaldy to Leith.



Calculate or find:

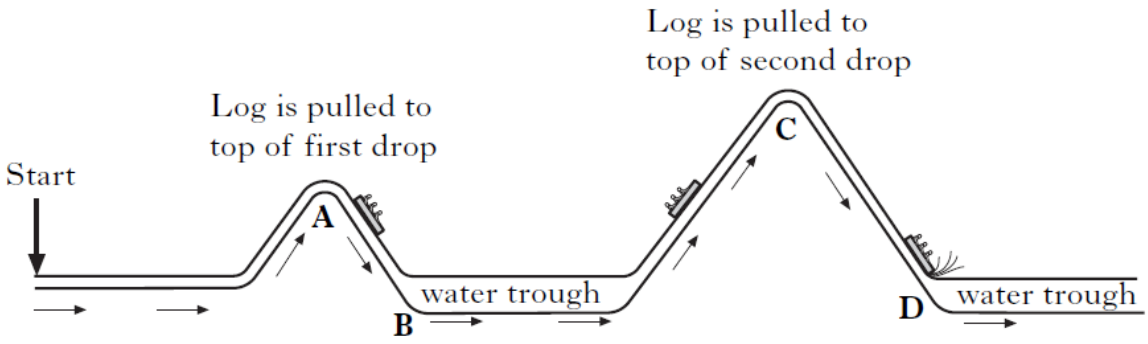
i) The total distance travelled during the journey.

ii) The average speed for the whole journey.

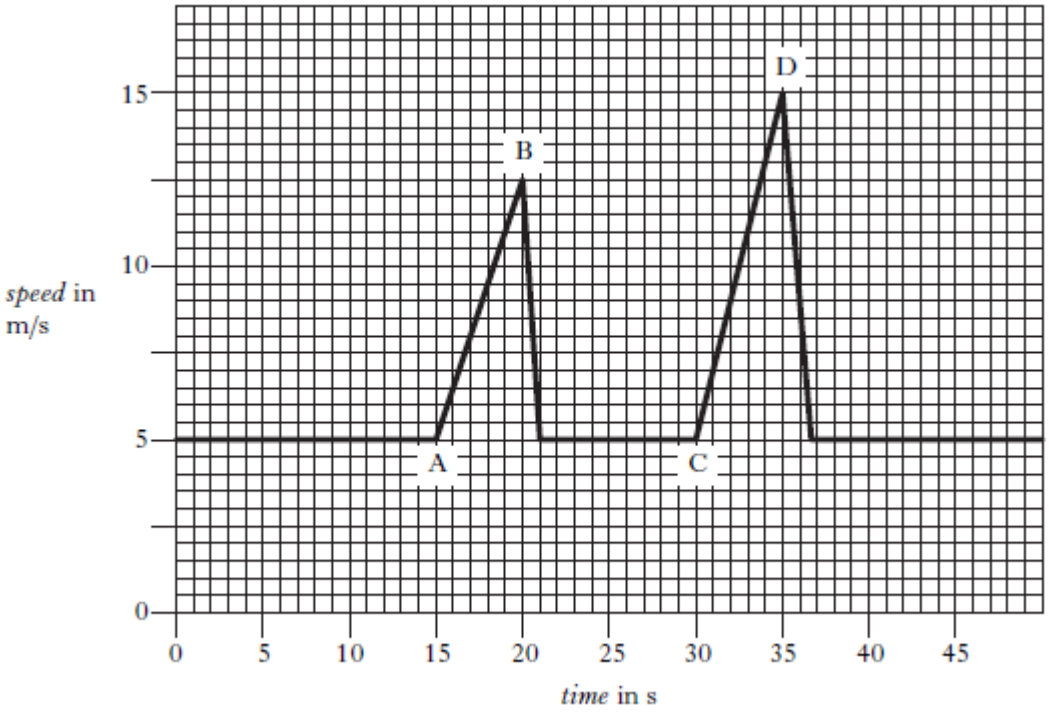
iii) The acceleration from 0 to 240 seconds.

iv) The acceleration from 720 to 1200 seconds.

10) On a visit to a theme park four students ride the log flume.



a) The graph below shows how the speed of the log varies during the ride.



i) Describe the motion of the log during **AB** in the ride.

ii) Calculate the distance travelled by the log from the start of the ride to the bottom of the first drop.

iii) Calculate the logs acceleration as it goes down the second drop.

b) Describe how the **instantaneous speed** of the log could be measured at **position D** of the log flume.