

1 A rocket, initially at rest on the ground, accelerates vertically.

It accelerates uniformly until it reaches a speed of 900 m/s after 30 s.

After this period of uniform acceleration, the rocket engine cuts out. During the next 90 s, the upward speed of the rocket decreases uniformly to zero.

(a) On Fig. 4.1, plot a speed-time graph for the rocket for the first 120 s of its flight.

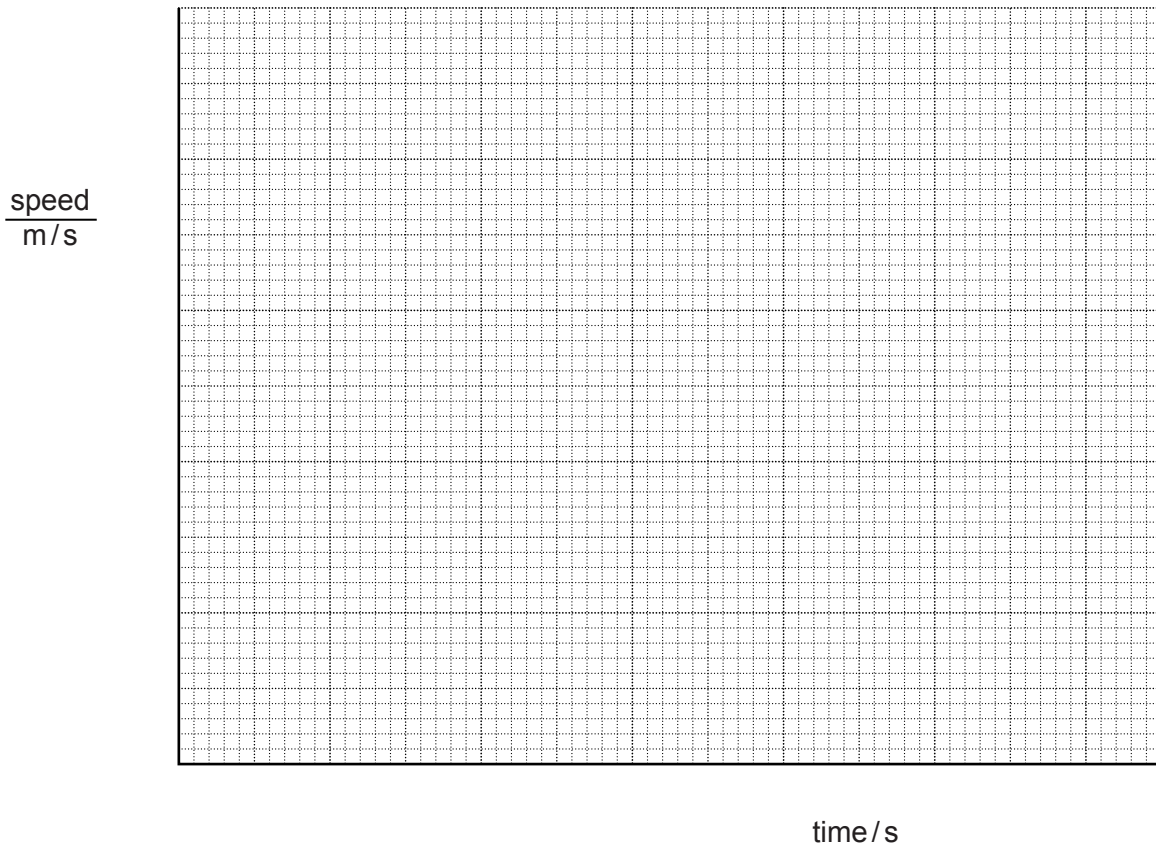


Fig. 4.1

[4]

(b) Using the graph,

(i) calculate the acceleration during the first 30 s,

acceleration = [2]

(ii) determine the height reached by the rocket after 120 s.

height reached = [2]

[Total: 8]

- 2 A train is at rest in a railway station. At time $t = 0$, the train starts to move forwards with an increasing speed until it reaches its maximum speed at time $t = 48$ s.

Fig. 1.1 is the speed-time graph for the first 48 s of the journey.

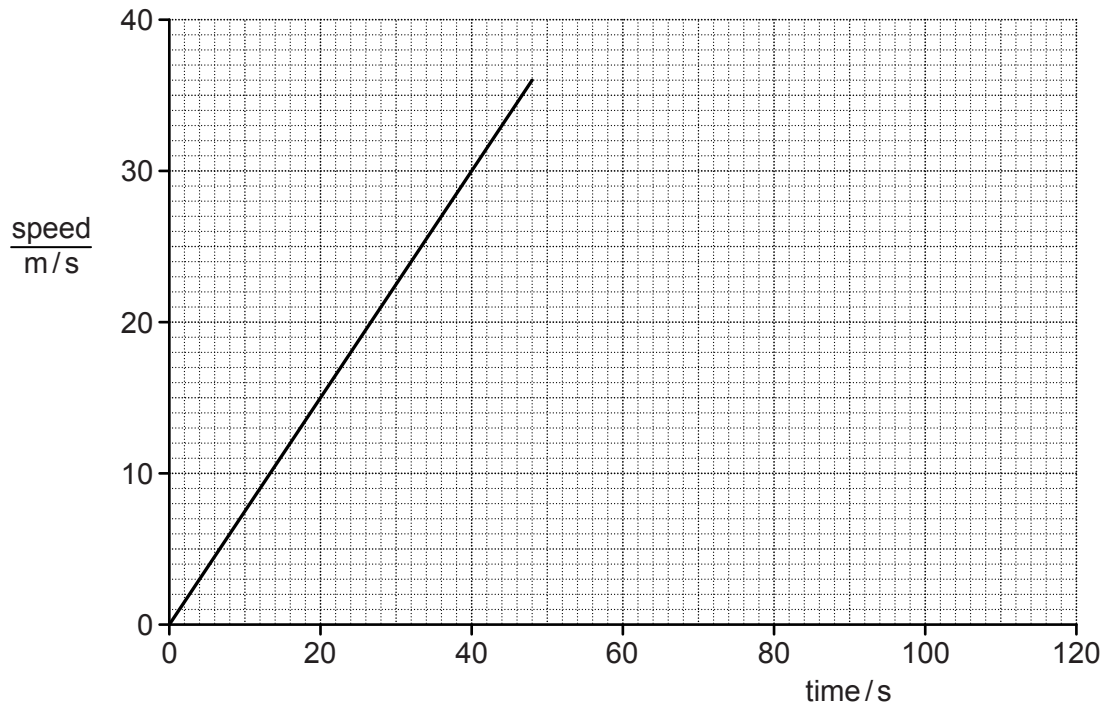


Fig. 1.1

- (a) (i) State how the graph shows that, during the first 48 s of the journey, the acceleration of the train is constant.

.....
..... [1]

- (ii) Calculate the acceleration of the train during the first 48 s of the journey.

acceleration = [2]

(b) After time $t = 48\text{ s}$, the train continues at its maximum speed for another 72 s .

(i) On Fig. 1.1, sketch the speed-time graph for the next 72 s of the journey. [1]

(ii) Determine the total distance travelled by the train in the 120 s after it starts moving.

distance = [3]

[Total: 7]

3 A train has a total mass of 7.5×10^5 kg.

(a) The train accelerates from rest at a constant rate along a straight, horizontal track. It reaches a speed of 24 m/s in 60 s.

Calculate

(i) the train's acceleration,

acceleration = [2]

(ii) the resultant force acting on the train.

force = [2]

(b) The train now travels with a constant speed of 24 m/s along a straight, horizontal track. The total force opposing the motion due to friction and air resistance is 7.2×10^4 N.

(i) By considering the work done by the train's engine in 1.0 s, calculate its output power.

power = [2]

(ii) The train begins to travel up a slope.

Explain why the power of the train's engine must be increased to maintain the speed of 24 m/s.

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.....
.....
.....
..... [3]

[Total: 9]

4 A school athlete does a sprint training run. Fig. 1.1 shows how her speed varies with time.

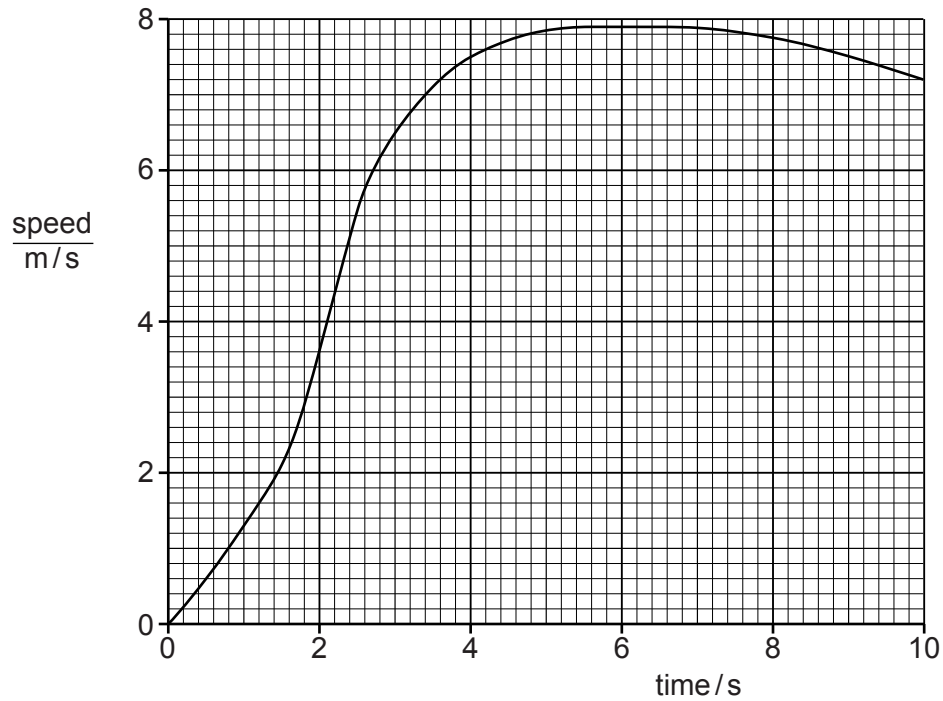


Fig. 1.1

(a) Explain how the graph in Fig. 1.1 can be used to determine the distance she runs.

.....
 [1]

(b) Determine her maximum acceleration. Show clearly on the graph how you obtained the necessary information.

maximum acceleration = [4]

- (c) She runs a distance of 62 m.
Calculate her average speed.

average speed = [2]

[Total: 7]

- 5 A girl rides her bicycle along a straight level road. Fig. 2.1 shows a graph of her distance moved against time.

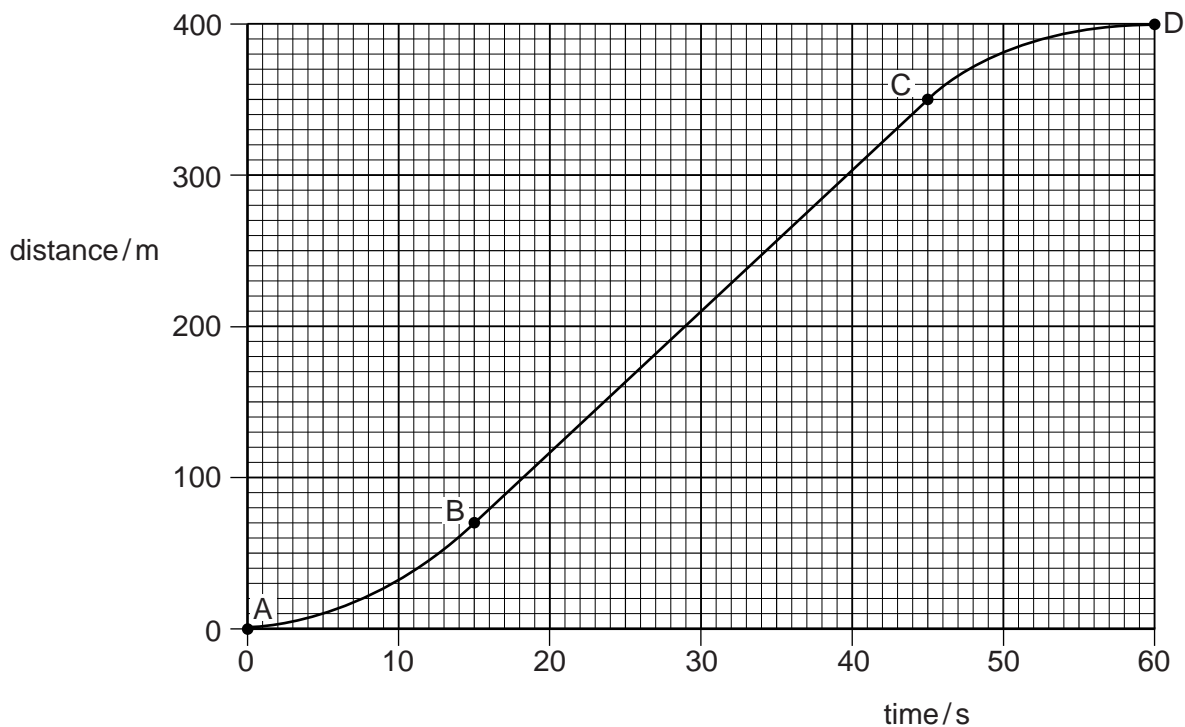


Fig. 2.1

(a) Describe her motion

(i) from A to B,

(ii) from B to C,

(iii) from C to D.

[3]

(b) Calculate

(i) her average speed from A to D,

average speed = [2]

(ii) her maximum speed.

maximum speed = [3]

[Total: 8]

6 Fig. 1.1 is a distance/time graph showing the motion of an object.

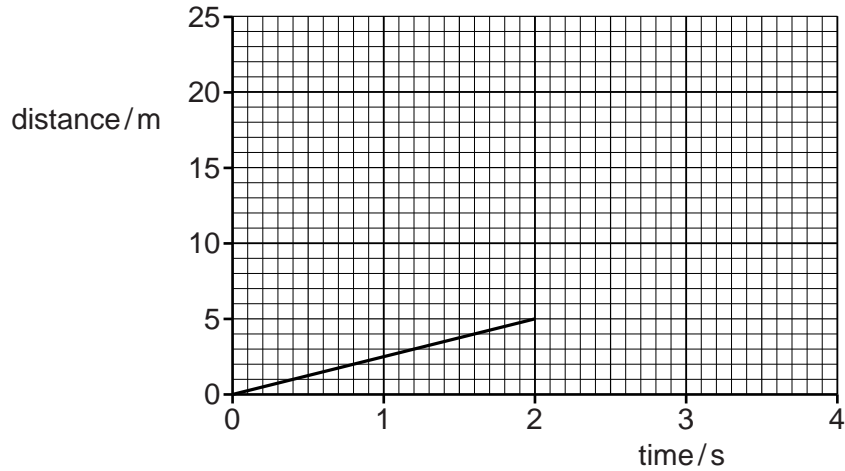


Fig. 1.1

(a) (i) Describe the motion shown for the first 2 s, calculating any relevant quantity.

.....
.....

[2]

(ii) After 2 s the object accelerates.

On Fig. 1.1, sketch a possible shape of the graph for the next 2 s.

[1]

(b) Describe how a distance/time graph shows an object that is stationary.

.....
.....

[1]

(c) Fig. 1.2 shows the axes for a speed/time graph.

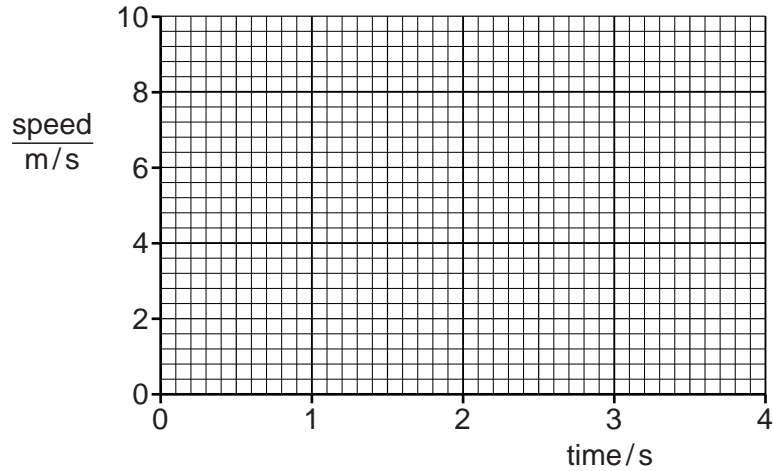


Fig. 1.2

On Fig. 1.2, draw

- (i) the graph of the motion for the first 2 s as shown in Fig. 1.1,
- (ii) an extension of the graph for the next 2 s, showing the object accelerating at 2 m/s^2 . [3]

(d) Describe how a speed/time graph shows an object that is stationary.

.....
..... [2]

[Total: 9]