Motion

Question Paper

Course	CIE IGCSE Physics
Section	1. Motion, Forces & Energy
Topic	Motion
Difficulty	Hard

Time Allowed 110

Score /84

Percentage /100

Question 1a

A student drops a ball from a high window.

The mass of the ball is 0.12 kg.

Calculate the weight of the ball.

weight = ... N

[3 marks]

Question 1b

Fig. 3.1 shows the speed of the ball while it is falling. The points S, T, U, V and W are shown on the graph.

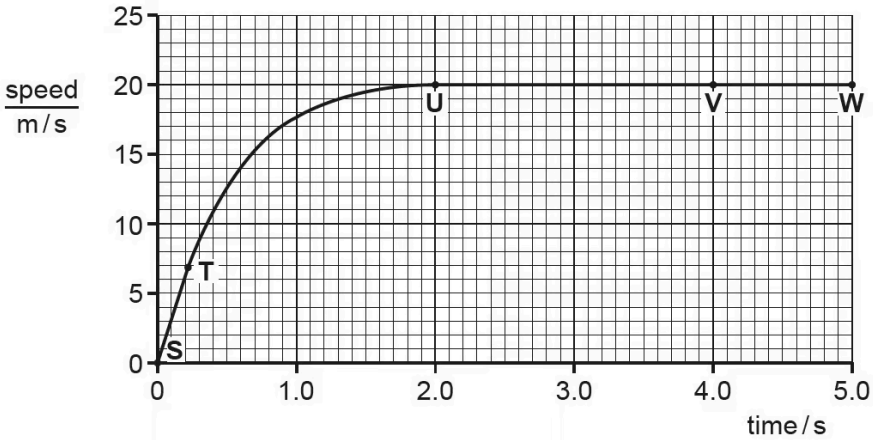

Fig. 3.1

Draw one line from each section of the graph to the correct description of the motion.

One has been drawn for you.

section of graph	description of motion
S – T	at rest
	decreasing acceleration
T – U	constant acceleration
	moving with constant speed
U – V	slowing down

[2 marks]

Question 1c

Determine the distance fallen by the ball in section U – V of the graph.

distance = ... m

[3 marks]

Question 1d

State the distance fallen by the ball in section V – W of the graph.

distance = ... m

[1 mark]

Question 2a

Extended tier only

A rocket is launched vertically upwards from the ground. The rocket travels with uniform acceleration from rest. After 8.0 s, the speed of the rocket is 120 m/s.

Calculate the acceleration of the rocket.

acceleration = ... m/s^2

[2 marks]

Question 2b

(i) On Fig. 1.1, draw the graph for the motion of the rocket in the first 8.0 s.

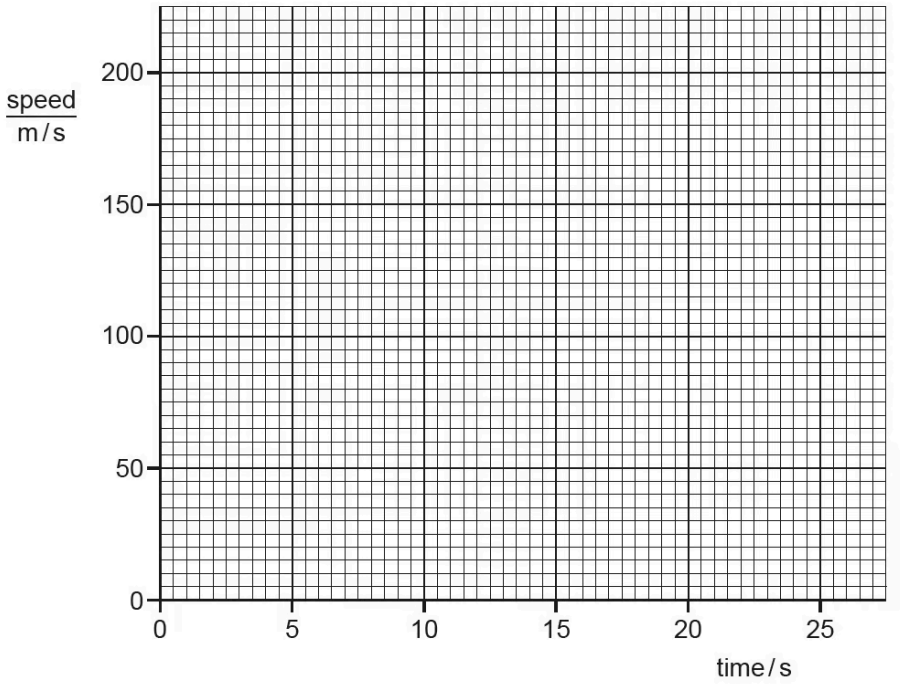

Fig. 1.1

[1]

(ii) Use the graph to determine the height of the rocket at 8.0 s.

height = ... [2]

(iii) From time = 8.0 s to time = 20.0 s, the rocket rises with increasing speed but with decreasing acceleration.

From time = 20.0 s to time = 25.0 s, the rocket has a constant speed of less than 200 m / s.

On Fig. 1.1, draw the graph for this motion.

[3]
[6 marks]

Question 3a

Fig. 1.1 shows a speed-time graph for a student who is running.

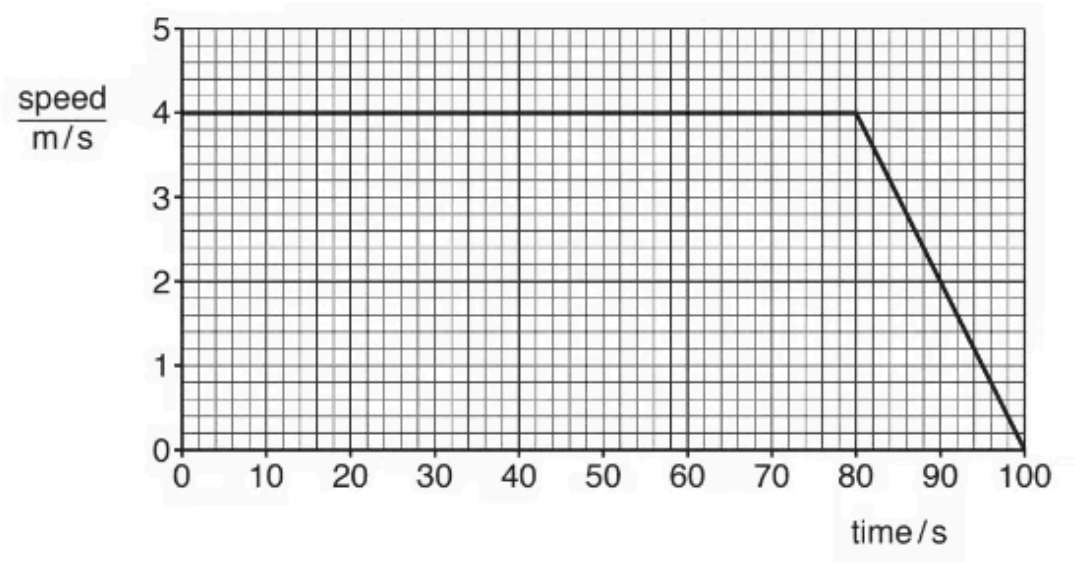

Fig. 1.1

(i) Describe the movement of the student, as shown in Fig. 1.1.

[2]

(ii) Calculate the distance travelled by the student between 80s and 100s.

distance travelled = ...m [3]

[5 marks]

Question 3b

An athlete runs 630 m in 130 s on a flat section of a road and then 254 m in 40 s on a downhill slope.

Calculate the average speed for the total distance run by the athlete.

average speed = ...m/s

[3 marks]

Question 4a

Extended tier only

A train of mass 5.6×10^5 kg is at rest in a station.

At time $t = 0$ s, a resultant force acts on the train and it starts to accelerate forward.

Fig. 1.1 is the distance-time graph for the train for the first 120 s.

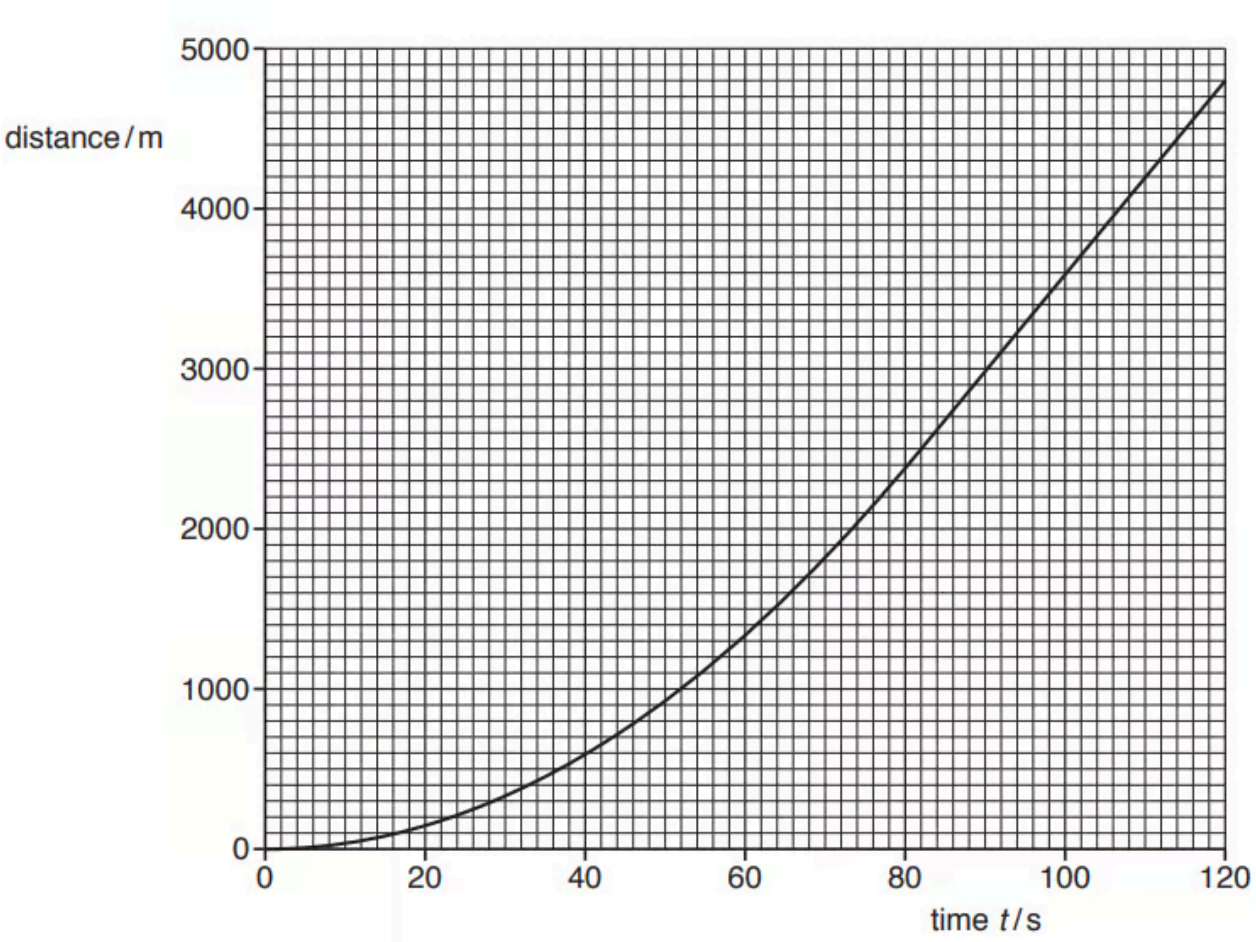

Fig. 1.1

(i) Use Fig. 1.1 to determine:

1. the average speed of the train during the 120 s

average speed = ...[1]

2. the speed of the train at time t = 100 s.

speed = ...[2]

(ii) Describe how the acceleration of the train at time t = 100 s differs from the acceleration at time t = 20 s.

[2]

[5 marks]

Question 4b

Extended tier only

(i) The initial acceleration of the train is 0.75 m/s^2.

Calculate the resultant force that acts on the train at this time.

resultant force = ...[2]

(ii) At time t = 120 s, the train begins to decelerate.

State what is meant by deceleration.

.....

.....

[1]

[3 marks]

Question 5a

Extended tier only

A rocket is stationary on the launchpad. At time $t = 0$, the rocket engines are switched on, and exhaust gases are ejected from the nozzles of the engines. The rocket accelerates upward.

Fig. 1.1 shows how the acceleration of the rocket varies between time $t = 0$ and time $t = t_f$.

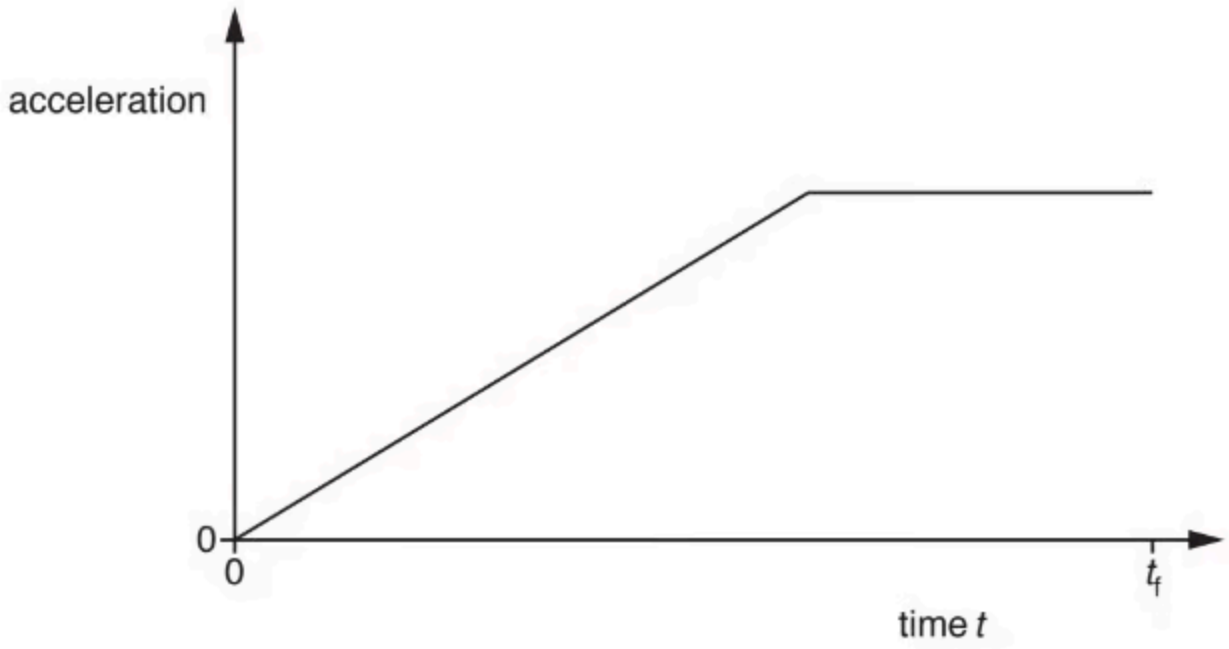

Fig. 1.1

Define *acceleration*.

[1 mark]

Question 5b

On Fig. 1.2, sketch a graph to show how the speed of the rocket varies between time $t = 0$ and time $t = t_f$.

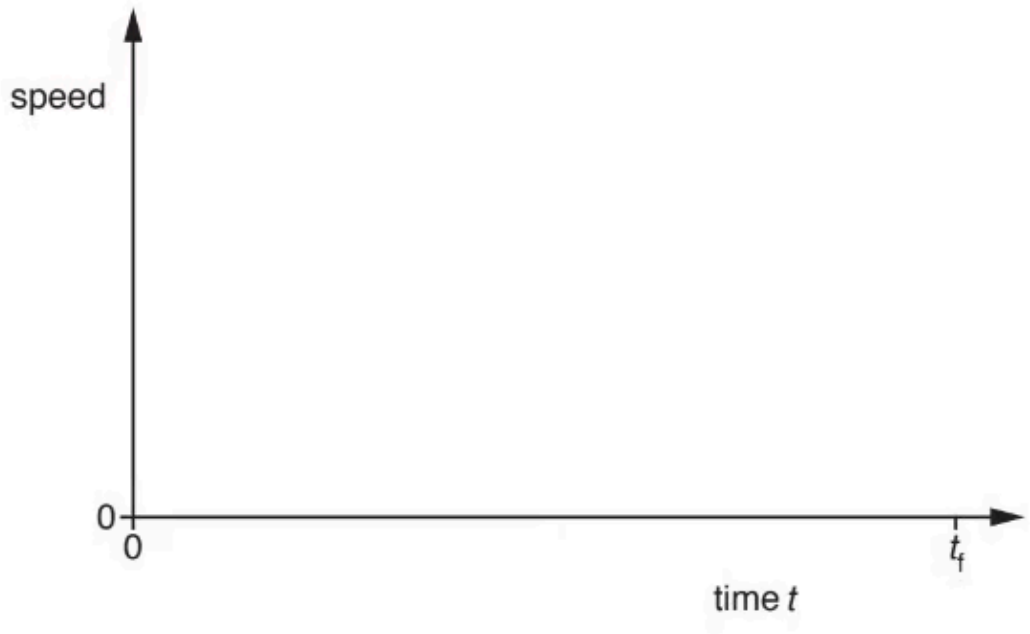

Fig. 1.2

[3 marks]

Question 5c

Extended tier only

Some time later, the rocket is far from the Earth. The effect of the Earth's gravity on the motion of the rocket is insignificant. As the rocket accelerates, its momentum increases.

(i) State the principle of the conservation of momentum.

[2]

(ii) Explain how the principle of the conservation of momentum applies to the accelerating rocket and the exhaust gases.

[2]

[4 marks]

Question 6a

A student watches a car race around a track. He uses a stopwatch to measure the time for the car to make one lap of the track.

The student forgets to reset the stopwatch at the start of the race. Fig. 1.1 shows the time on the stopwatch at the start and the time after going around the track once.

Fig. 1.1

Calculate the time the car takes to go around the track once, in seconds.

time = ... s

[2 marks]

Question 6b

The length of the track is 4.0 km. The car goes around the track 20 times. The car takes 26 minutes and 40 seconds to complete the 20 laps.

Calculate the average speed of the car in m / s.

average speed = ... m / s

[4 marks]

Question 6c

Fig. 1.2 shows a speed-time graph for the car during part of the race.

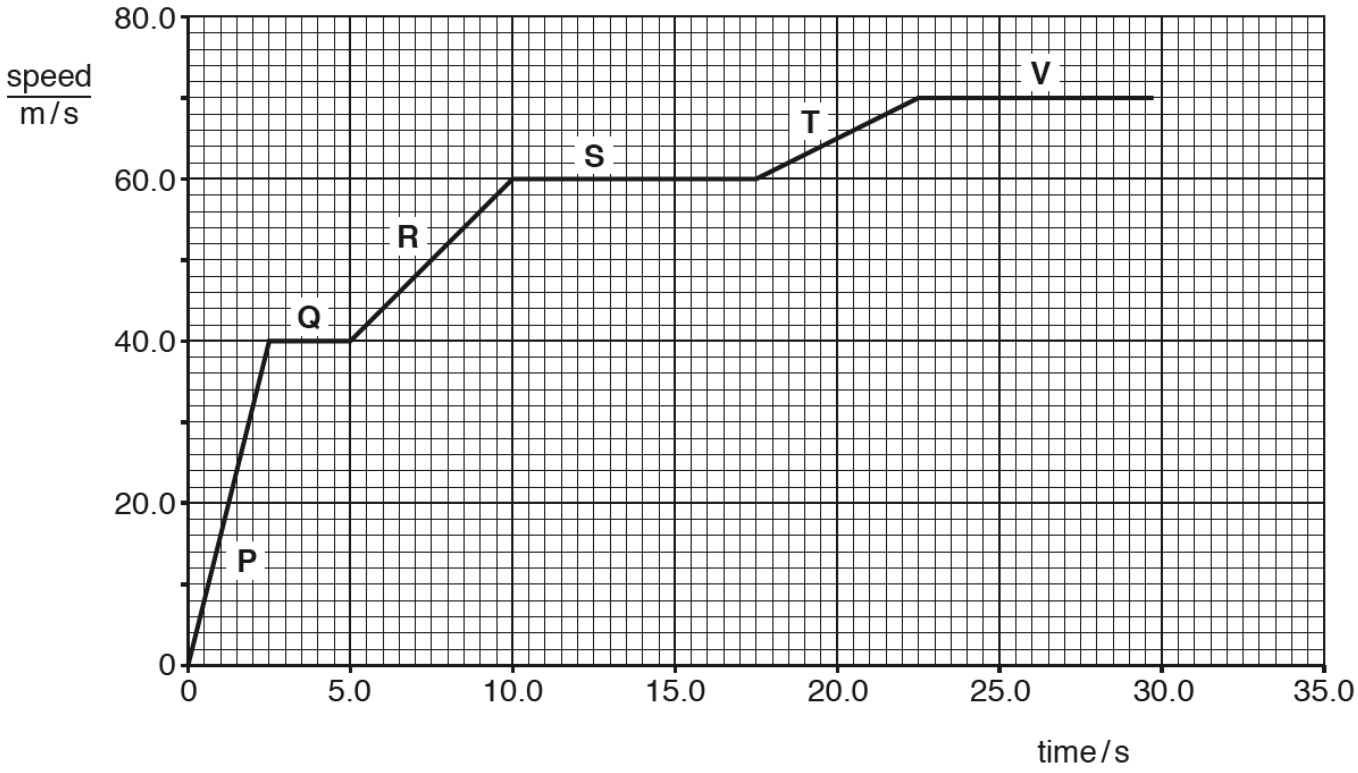

Fig. 1.2

(i) State the section of the graph that shows the greatest acceleration.

.....

Explain your answer.

.....

[2]

(ii) Calculate the distance travelled by the car during the first 2.5 seconds.

distance = ... m [3]

[5 marks]

Question 7a

Extended tier only

Fig. 1.1 shows the speed-time graph for a vehicle accelerating from rest.

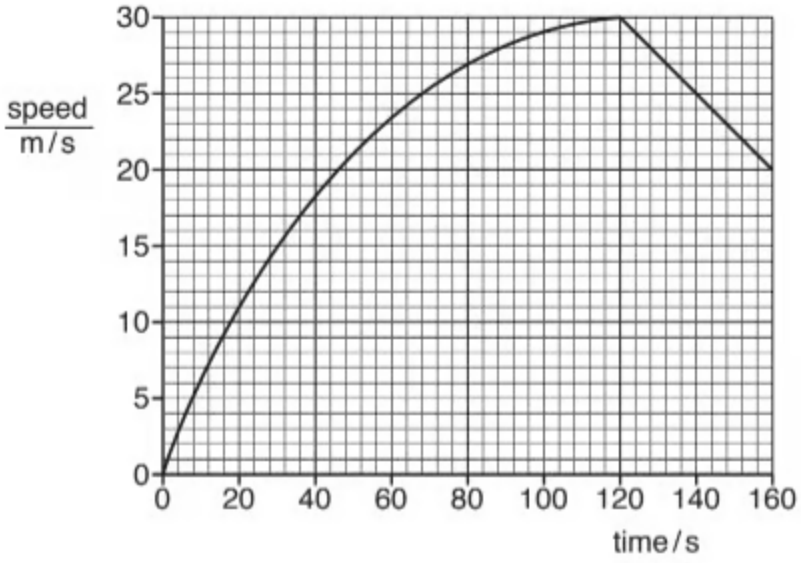

Fig. 1.1

Calculate the acceleration of the vehicle at time = 30s.

acceleration = ...

[2 marks]

Question 7b

Extended tier only

Without further calculation, state how the acceleration at time = 100 s compares to the acceleration at time = 10 s.
Suggest, in terms of force, a reason why any change has taken place.

[3 marks]

Question 7c

Determine the distance travelled by the vehicle between time = 120 s and time = 160 s.

distance = ...

[3 marks]

Question 8a

Extended tier only

Define acceleration.

[1 mark]

Question 8b

Fig. 1.1 shows two speed–time graphs, A and B, and two distance–time graphs, C and D.

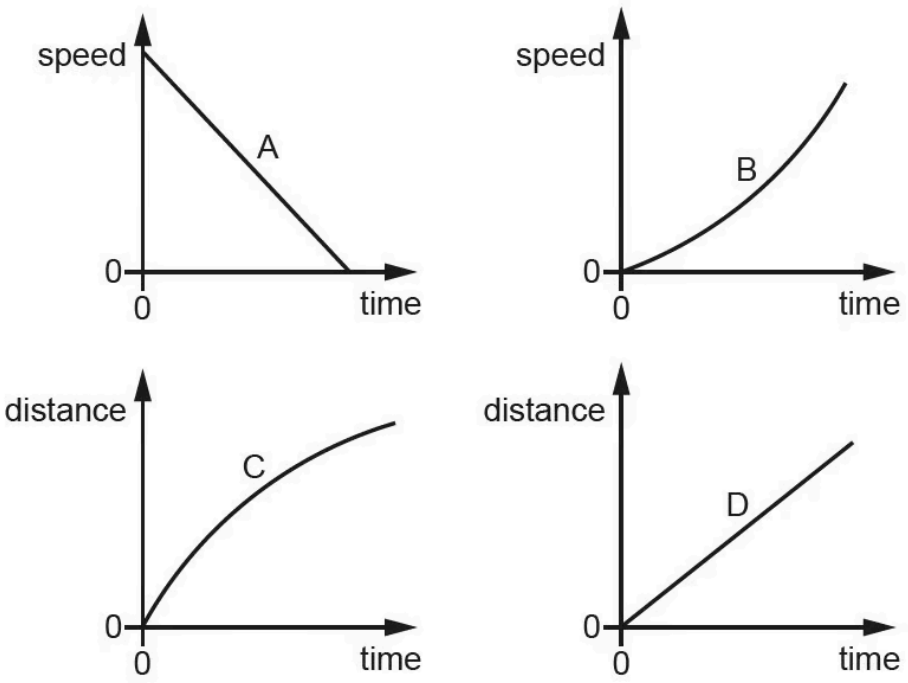

Fig. 1.1

Describe the motion shown by:

(i) graph A

[2]

(ii) graph B

[2]

(iii) graph C

[1]

(iv) graph D

[1]

[6 marks]

Question 9a

Extended tier only

Fig. 1.1 shows the axes of a distance-time graph for an object moving in a straight line.

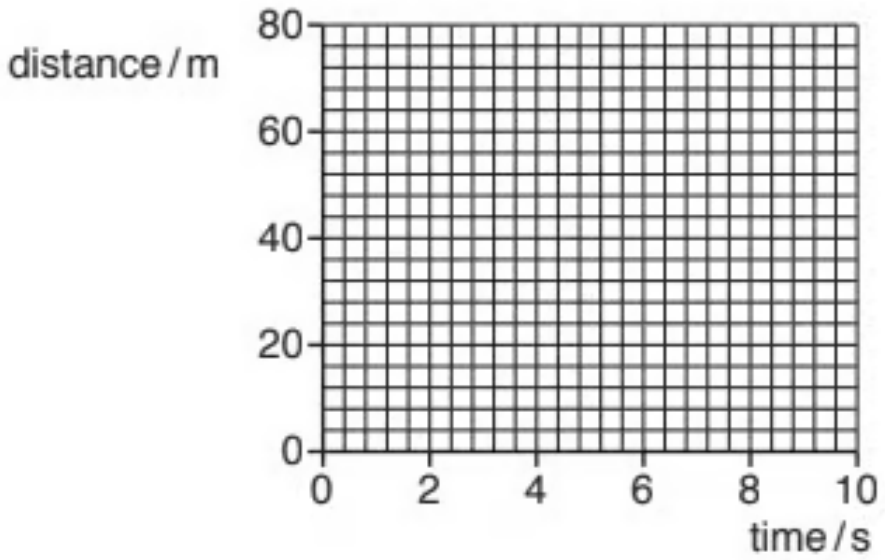

Fig. 1.1

(i) On Fig. 1.1, draw between time = 0 and time = 10 s, the graph for an object moving with a constant speed of 5.0 m/s. Start your graph at distance = 0 m.

State the property of the graph that represents speed.

[2]

(ii) Between time = 10 s and time = 20 s the object accelerates. The speed at time = 20 s is 9.0 m/s.

Calculate the average acceleration between time = 10 s and time = 20 s.

acceleration = ...[2]

[4 marks]

Question 9b

Fig. 1.2 shows the axes of a speed-time graph for a different object.

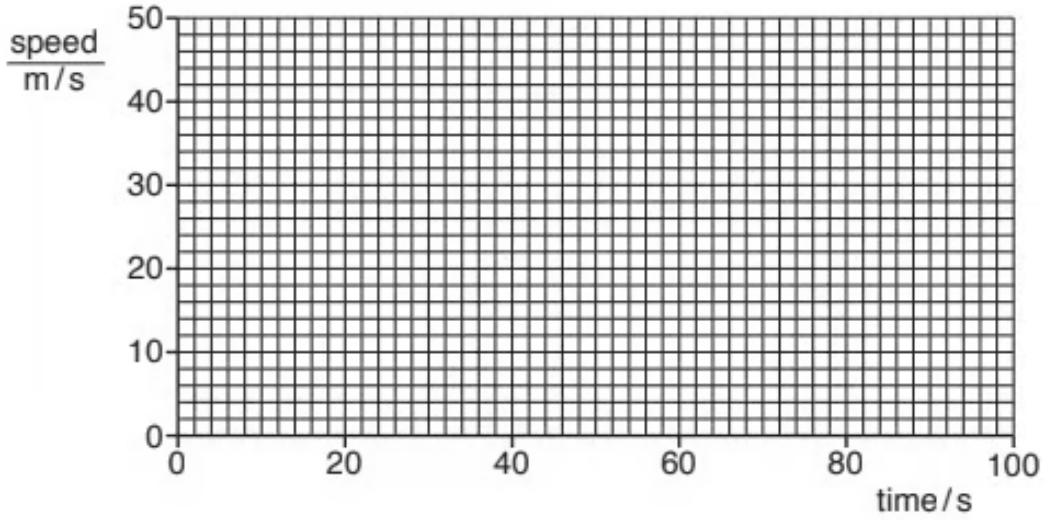

Fig. 1.2

(i) The object has an initial speed of 50 m/s and decelerates uniformly at 0.35 m/s^2 for 100 s.

On Fig. 1.2, draw the graph to represent the motion of the object.

[2]

(ii) Calculate the distance travelled by the object from time = 0 to time = 100 s.

distance = ...[3]

[5 marks]

Question 10a

Fig. 2.1 shows students getting onto a school bus.

Fig. 2.1

A student describes part of the journey.

The bus accelerates from rest at a constant rate for 10 s. It reaches a maximum speed of 10 m/s.

The bus maintains a constant speed of 10 m/s for 60 s.

The bus then decelerates at a constant rate for 15 s, until it stops.

On Fig. 2.2, draw the speed-time graph for this part of the journey made by the bus.

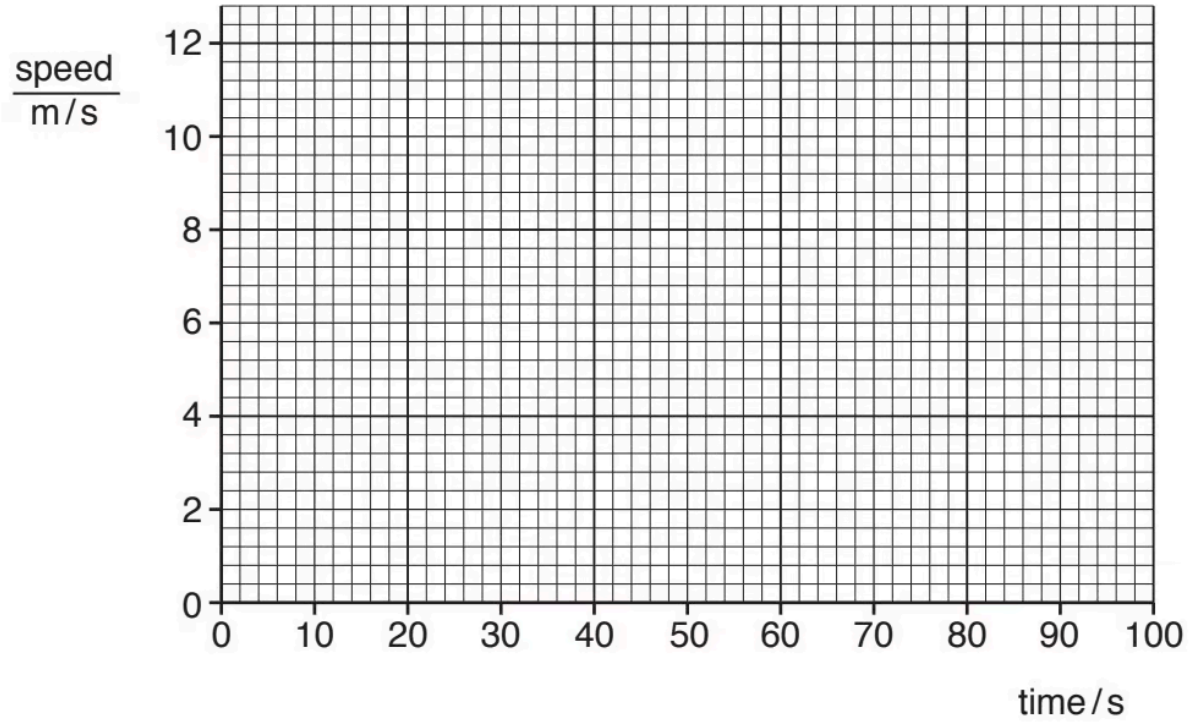

Fig. 2.2

[5 marks]

Question 10b

On another part of the journey, the average speed of the bus is 7.5 m/s.

Calculate the distance the bus travels in 150 s.

distance = ... m

[3 marks]