DISTANCE-TIME GRAPHS

1 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 forwards.

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

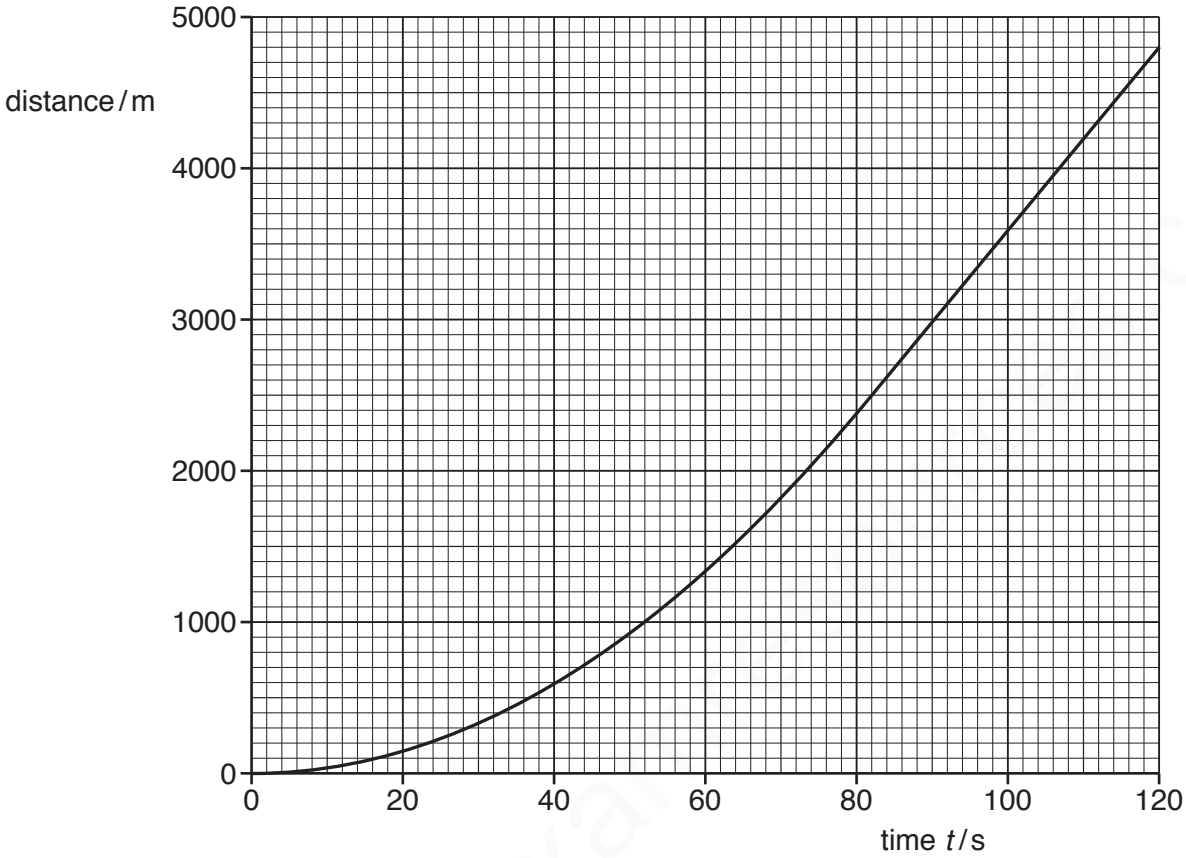

Fig. 1.1

(a) (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]

(b) (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]

[Total: 8]

MARKING SCHEME:

1(a)(i)1	(4800 / 120 =) 40 m / s	**B1**
1(a)(i)2	(v =) gradient of any part of straight line	**C1**
	Value between 50 and 60 m / s	**A1**
1(a)(ii)	At t = 20 s, acceleration > zero / acceleration is taking place / greater acceleration than at 100 s	**B1**
	At t = 100 s, acceleration = zero / 0	**B1**
1(b)(i)	(F =) ma OR $5.6 \times 10^5 \times 0.75$	**C1**
	4.2×10^5 N	**A1**
1(b)(ii)	Speed / velocity decreases (with time) OR slowing down OR negative acceleration OR Rate of decrease of speed / velocity	**B1**

2 A lorry is travelling along a straight, horizontal road.

Fig. 1.1 is the distance-time graph for the lorry.

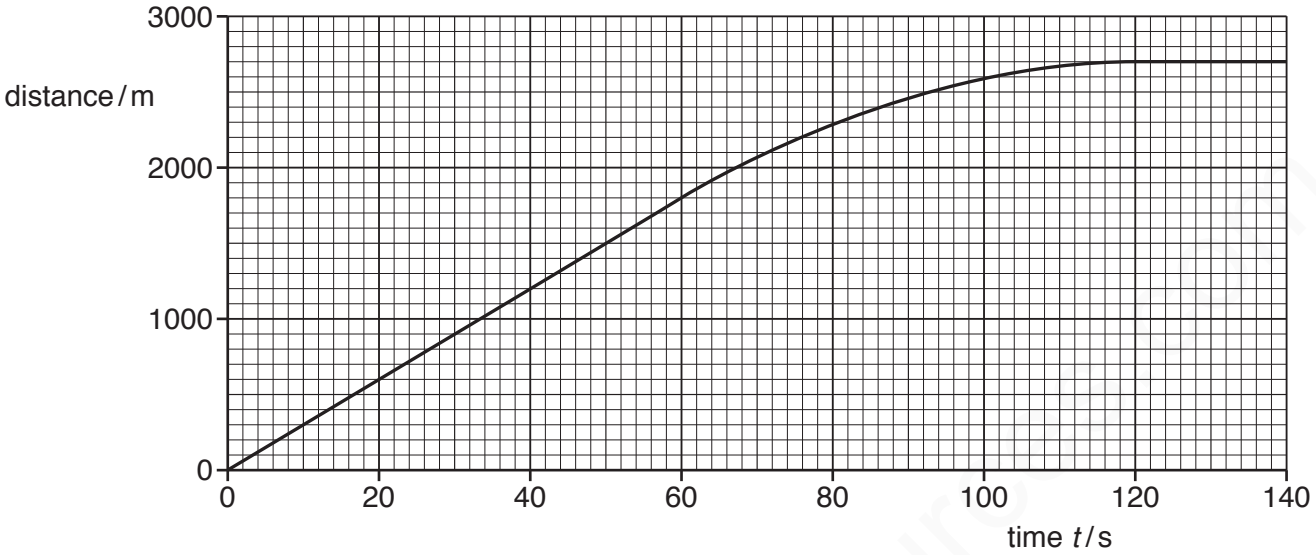

Fig. 1.1

(a) Using Fig. 1.1, determine:

(i) the speed of the lorry at time $t = 30\,s$

speed = ...[2]

(ii) the average speed of the lorry between time $t = 60\,s$ and time $t = 120\,s$.

average speed = ...[2]

(b) At time $t = 30\,s$, the total resistive force acting on the lorry is $1.4 \times 10^4\,N$.

(i) Using Fig. 1.1, determine the magnitude of the acceleration of the lorry at time $t = 30\,s$.

acceleration = ...[1]

(ii) Determine the forward force on the lorry due to its engine at time $t = 30\,s$.

forward force = ...[1]

(c) Describe the motion of the lorry between time $t = 60\,s$ and time $t = 130\,s$.

.....

.....

.....[2]

[Total: 8]

MARKING SCHEME:

(a)(i)	(v =) gradient **or** 1800 / 60 **or** 900 / 30	**C1**
	30 m/s	**A1**
(a)(ii)	(v =) d / t or (average speed =) d / t **OR** (2700 – 1800) / (120 – 60) = 900 / 60	**C1**
	(v =) 15 m/s	**A1**
(b)(i)	0 (m/s^2)	**B1**
(b)(ii)	1.4×10^4 N	**B1**
(c)	speed / velocity decreases (with time) **or** negative acceleration **or** deceleration	**B1**
	to zero (speed) / stationary	**B1**

3 Fig. 1.1 is the distance-time graph for a moving car.

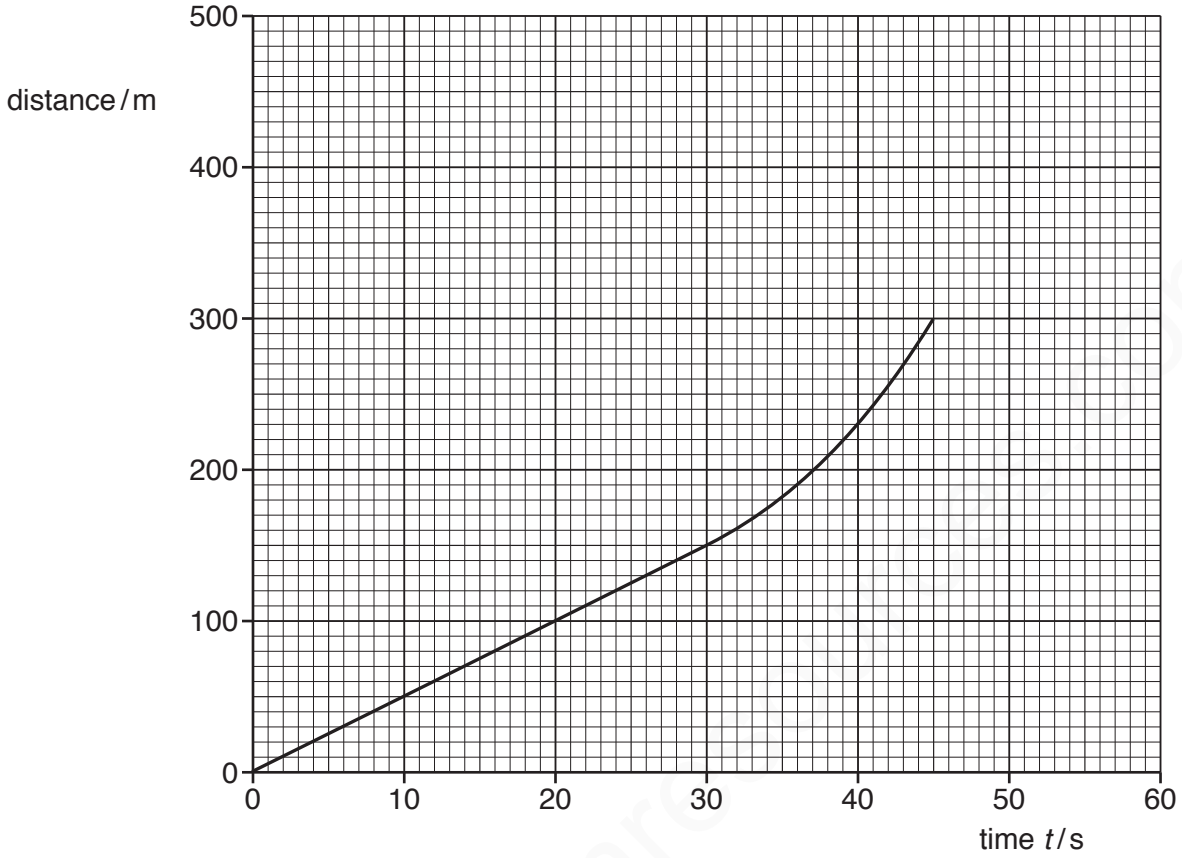

Fig. 1.1

(a) On Fig. 1.1, mark a point P where the acceleration of the car is zero. [1]

(b) Determine:

(i) the speed of the car at time $t = 15\,s$

speed = ...[2]

(ii) the average speed of the car between time $t = 30\,s$ and time $t = 45\,s$.

average speed = ...[2]

(c) At time $t = 45\,s$, the car starts to decelerate. At time $t = 55\,s$ and at a distance of 400 m from the starting point, the car stops. It then remains stationary for 5.0 s.

On Fig. 1.1, draw a possible continuation of the distance-time graph. [3]

[Total: 8]

MARKING SCHEME:

(a)	P marked on line between t = 0 s and t = 30 s	**B1**
(b)(i)	(v =) gradient **or** 150 / 30 **or** appropriate division using other points	**C1**
	5.0 m / s	**A1**
(b)(ii)	(v =) x / t **or** (300 – 150) / (45 – 30) **or** 150 / 15	**C1**
	10 m / s	**A1**
(c)	gradient decreasing	**B1**
	smooth transition to horizontal **and** line not too thick	**B1**
	horizontal to (60 s, 400 m)	**B1**

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

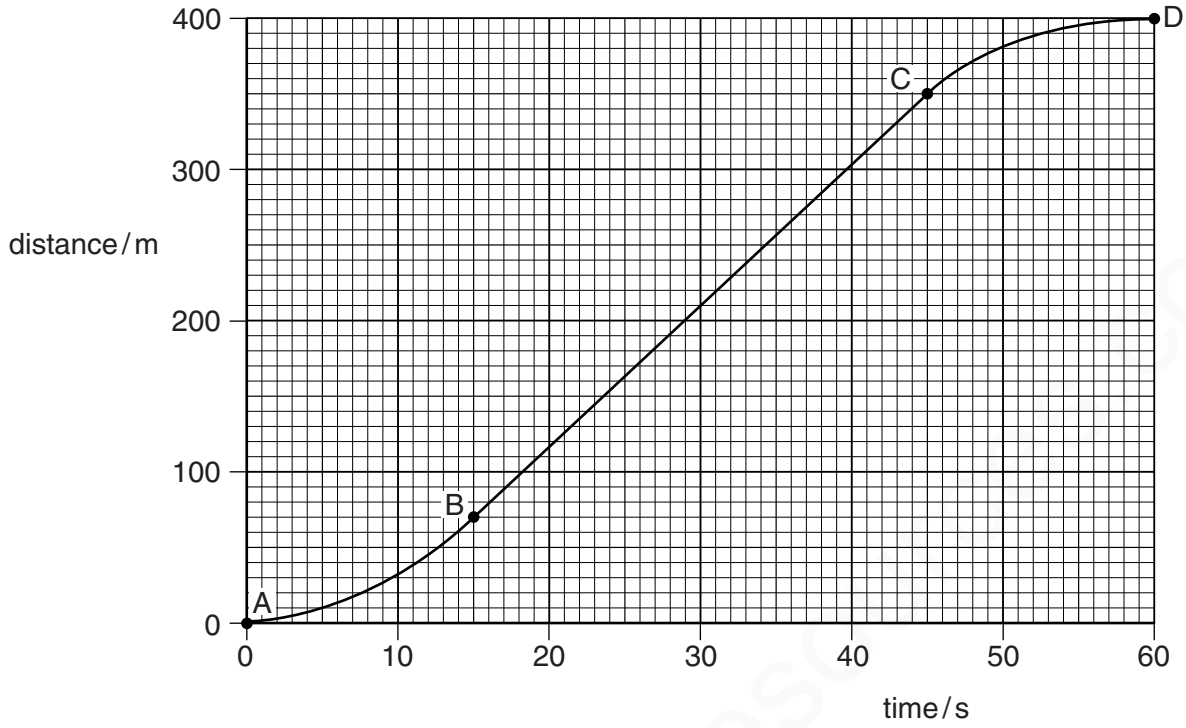

Fig. 2.1

(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]

MARKING SCHEME:

(a)	**(i)**	Increasing speed / acceleration	B1
	(ii)	Constant / steady / uniform speed or motion	B1
	(iii)	Decreasing speed / deceleration / braking / slowing / stopping / negative acceleration	B1
(b)	**(i)**	(Total) distance / (total) time OR d / t OR 400 / 60	C1
		6.67 m/s at least 2 s.f.	A1
	(ii)	Mention of maximum gradient OR clear that whole or part of B to C is used	C1
		Use of correct data from graph to +/– ½ square	C1
		Answer rounds to 9.2 to 9.4 m/s, at least 2 s.f.	A1

[Total: 8]

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

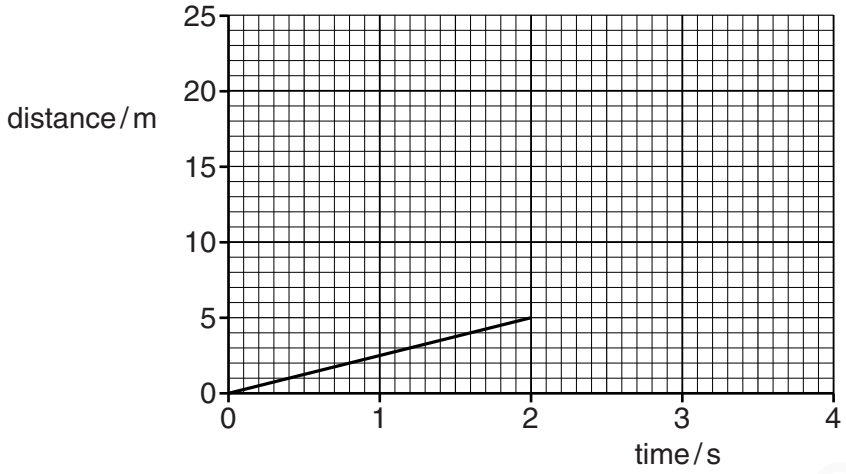

Fig. 1.1

(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.

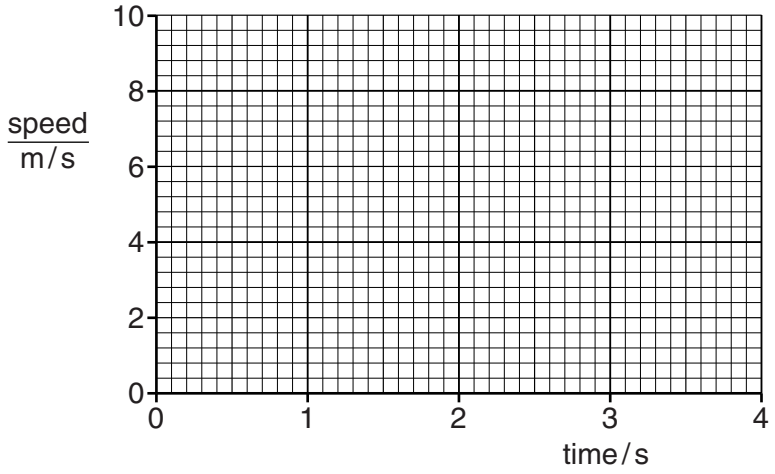

Fig. 1.2

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.

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

.....

..... [2]

[Total: 9]

MARKING SCHEME:

(a)	**(i)**	constant/steady/uniform speed/velocity OR speed/velocity = 2.5 (m/s)	B1	
		speed/velocity = 2.5 m/s accept fraction, average speed/velocity = 2.5 m/s	B1	[2]
	(ii)	shape curving upward but not to vertical, at least to 3.5 s unless reaches 25 m	B1	[1]
(b)		horizontal (straight) line OR careful sketch accept parallel to time/*x*-axis	B1	[1]
(c)		tolerance on both axes ± ½ small square throughout both parts		
	(i)	horizontal straight line at 2.5 m/s from 0 to 2 s, ecf from **(a)(i)**	B1	
	(ii)	straight line rising to the right as far as the edge of the graph area	M1	
		Δv = 4 m/s or gradient clearly 2 m/s^2	A1	[3]
(d)		horizontal (straight) line	M1	
		at 0 m/s	A1	[2]
		accept for both marks: line in/along time/*x*-axis OR line with y/v = 0 OR careful sketch		

[Total: 9]

6 **(a)** Fig. 1.1 shows the distance-time graphs for three different objects A, B and C.

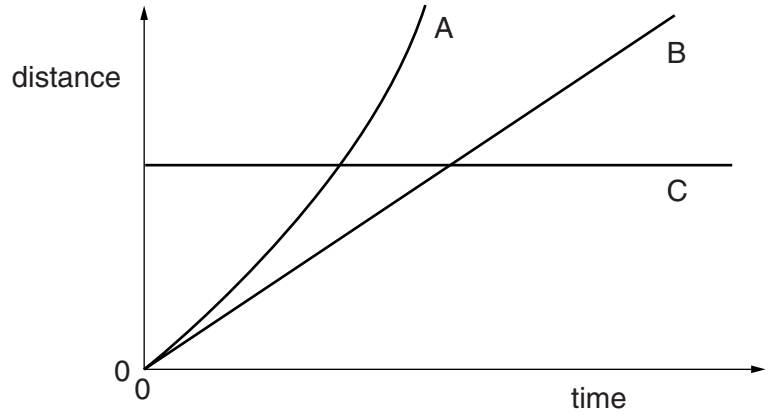

Fig. 1.1

Describe the motion of each of the objects A, B and C by selecting the appropriate description from the list below.

constant speed increasing speed decreasing speed stationary

A .....

B .....

C .....

[2]

(b) Fig. 1.2 shows the speed-time graphs for three more objects D, E, and F.

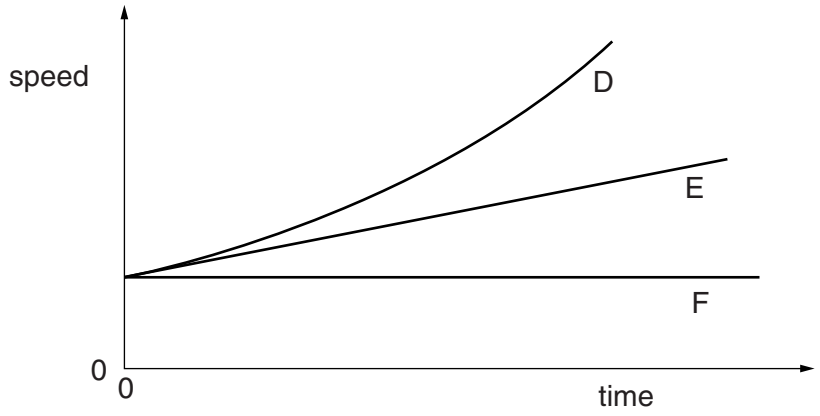

Fig. 1.2

Describe the motion of each of the objects D, E and F by selecting the appropriate description from the list below.

constant speed constant acceleration increasing acceleration stationary

D .....

E .....

F .....

[2]

MARKING SCHEME:

(a) A increasing speed
B constant speed
C stationary B2
Note: one mark lost for e.e.o.o.

(b) D increasing acceleration
E constant acceleration
F constant speed B2
Note: one mark lost for e.e.o.o.