1 **(a)** A large stone, initially at rest, falls from the top of a building. The stone takes 3.2 s to fall to the ground. For this stone, air resistance can be ignored.

(i) Stating the formula that you use, show that the speed of the stone when it hits the ground is 32 m / s.

[1]

(ii) On Fig. 1.1, draw the speed-time graph for the fall of the stone. Label with an X the line on the graph. [1]

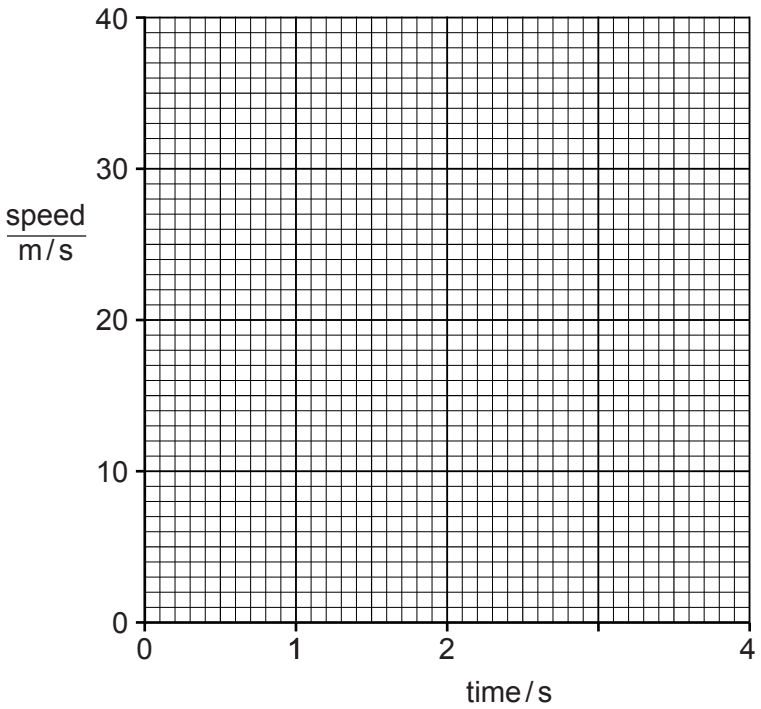

Fig. 1.1

(iii) Use the graph in **(ii)** to determine the height of the building.

height = ... [2]

(b) A smaller stone than the stone in **(a)** falls from the same building. This stone is affected by air resistance.

(i) What happens to the air resistance as the stone falls? Underline your choice of answer.

Air resistance decreases. Air resistance is constant. Air resistance increases. [1]

(ii) On Fig. 1.1, draw a possible speed-time graph for the fall of this stone. Label with a Y this line on the graph. [3]

[Total: 8]

2 Fig. 1.1 shows a distance-time graph for a moving object.

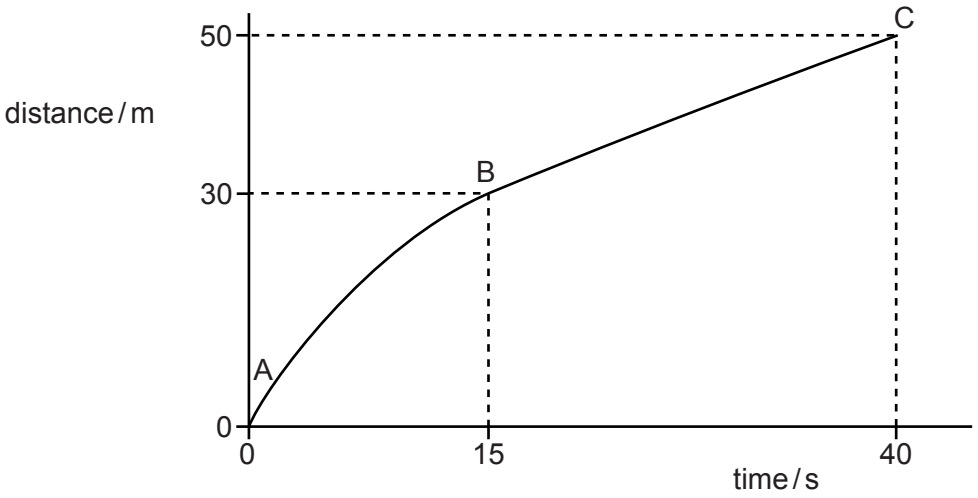

Fig. 1.1

(a) Describe the speed of the object between points

(i) A and B,

.....

(ii) B and C.

.....

[2]

(b) State whether the acceleration of the object is zero, negative or positive, as shown on the graph between points

(i) A and B,

.....

(ii) B and C.

.....

[2]

(c) Calculate the average speed of the object during the 40 seconds.

speed = ... [2]

[Total: 6]

3 Parachutes are used to slow down a certain racing car.

Fig. 1.1 shows the racing car, of total mass 750 kg, slowing down by using parachutes.

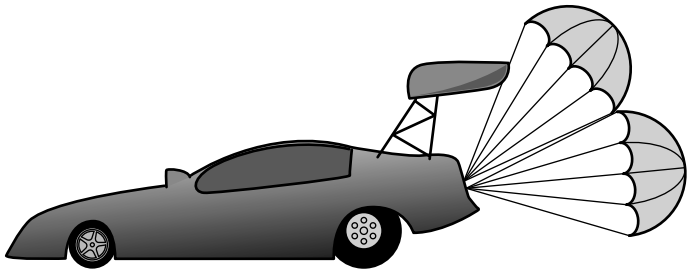

Fig. 1.1

Fig. 1.2 is the speed-time graph for 20 s after the car reaches full speed.

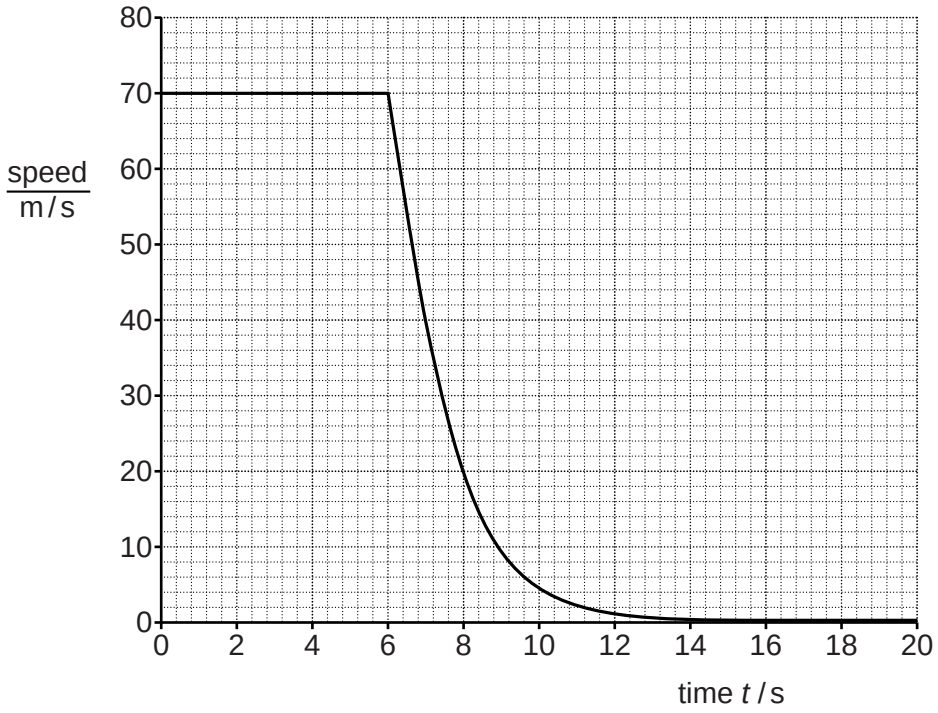

Fig. 1.2

At time t = 6.0 s, the parachutes open.

(a) On Fig. 1.2,

(i) mark a point, labelled A, where the car is moving at constant speed,

(ii) mark a point, labelled B, where the car is decelerating at a uniform rate,

(iii) mark a point, labelled C, where the car is decelerating at non-uniform rate.

[3]

(b) Calculate

(i) the deceleration of the car at time $t = 6.5\,s$,

deceleration = ... [2]

(ii) the resultant force acting on the car at this time.

resultant force = ... [2]

(c) Explain why there is no resultant force acting on the car at time $t = 4.0\,s$.

.....

..... [1]

[Total: 8]

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

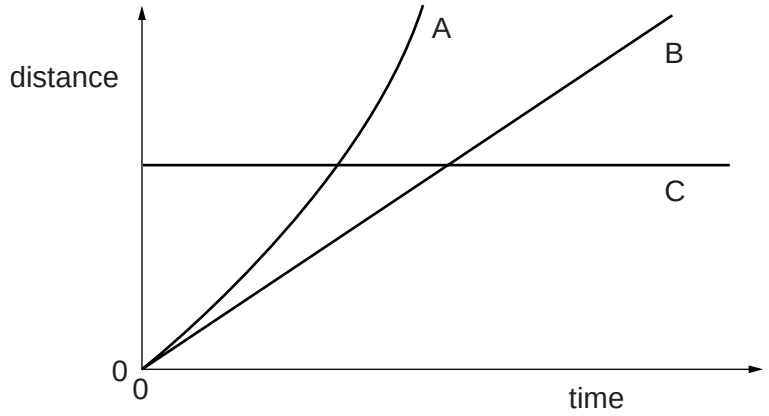

Fig. 1.1

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.

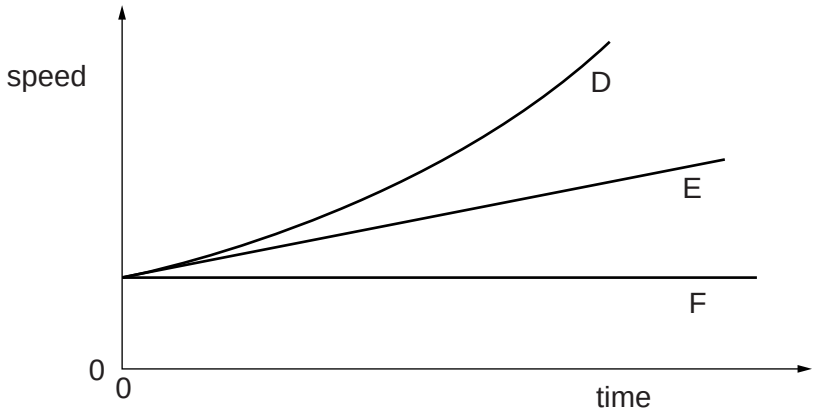

Fig. 1.2

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]

(c) Fig. 1.3 shows a person bungee-jumping from a bridge. The person is attached to a long elastic rope.

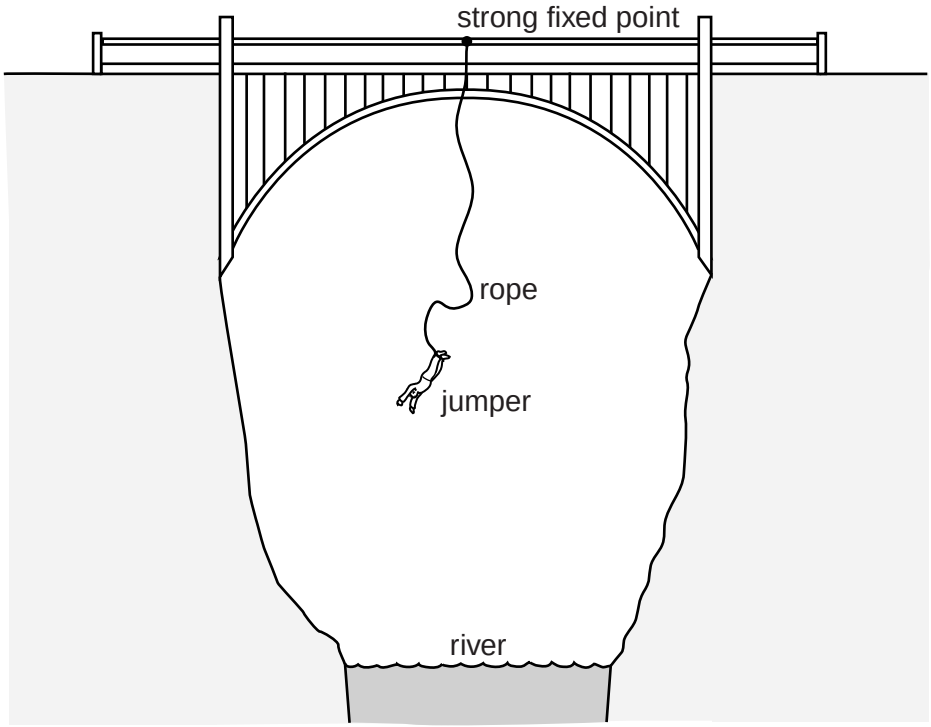

Fig. 1.3

(i) In 1.5 s the speed of the jumper increases from zero to 10.5 m/s.

Calculate her average acceleration during this time.

acceleration = ...[2]

(ii) At one point during the fall, she reaches her maximum speed.

1. State her acceleration at this point.

acceleration = ...[1]

2. What can be said about the forces acting on her at this point?

.....

.....[1]

5 Fig. 3.1 shows the speed-time graph of a firework rocket as it rises and then falls to the ground.

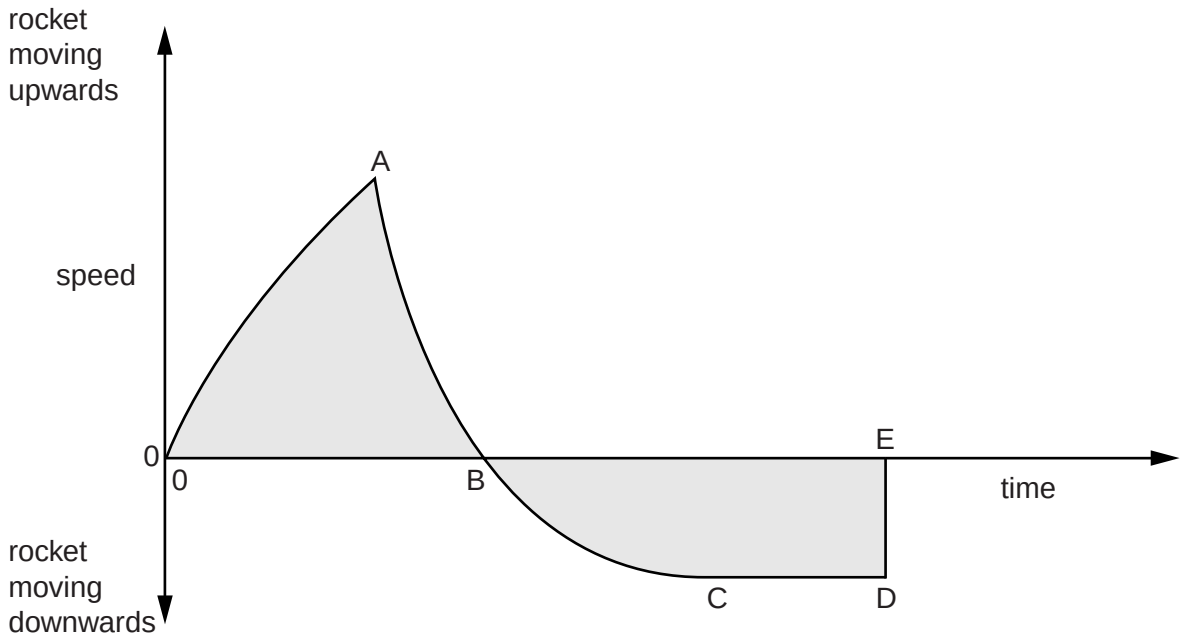

Fig. 3.1

The rocket runs out of fuel at A. It reaches its maximum height at B. At E it returns to the ground.

(a) **(i)** State the gradient of the graph at B. gradient = ... [1]

(ii) State why the gradient has this value at B.

.....

..... [1]

(b) State and explain the relationship between the shaded areas above and below the time axis.

.....

.....

.....

.....

.....

..... [3]

(c) Another rocket, of the same size and mass, opens a parachute at point B.

On Fig. 3.1, sketch a possible graph of its speed from B until it reaches the ground. [3]

[Total: 8]

6 A free-fall parachutist jumps from a helium balloon, but does not open his parachute for some time.

Fig. 1.1 shows the speed-time graph for his fall. Point B indicates when he opens his parachute.

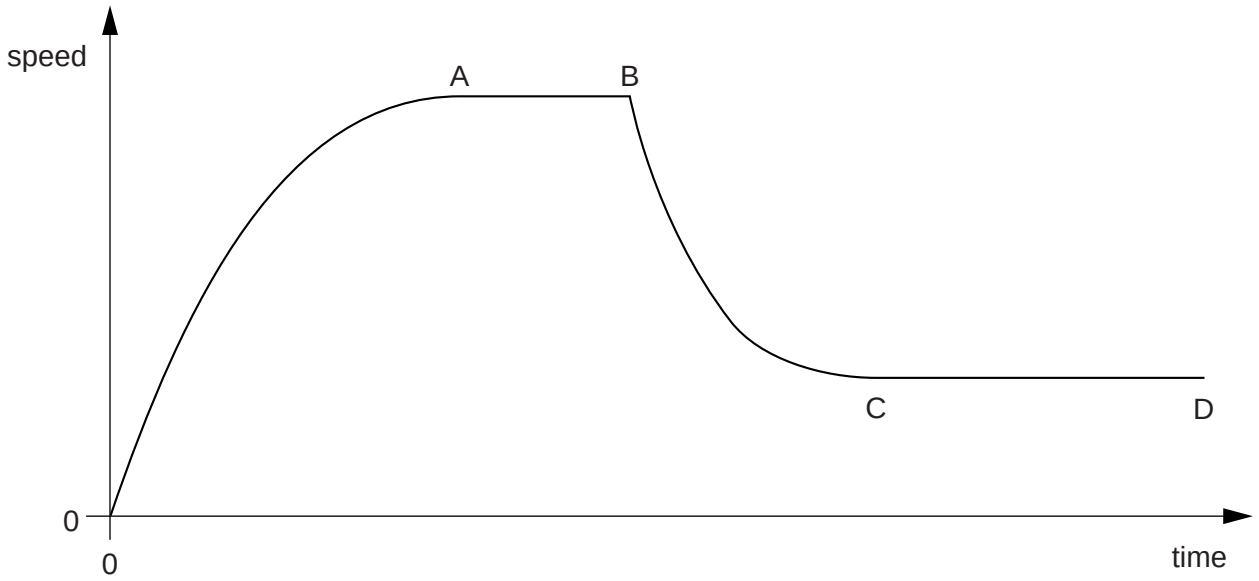

Fig. 1.1

(a) **(i)** State the value of the gradient of the graph immediately after time $t = 0$.

gradient = ... [1]

(ii) Explain why the gradient has this value.

.....

.....[1]

(b) State how Fig. 1.1 shows that the acceleration decreased between time $t = 0$ and the time to A.

.....

.....[1]

(c) Explain, in terms of forces, what is happening in section AB of the graph in Fig. 1.1.

.....

.....

.....[2]

(d) A second parachutist of the same size and mass jumps from the balloon with a larger parachute. He also opens his parachute at point B.

On Fig. 1.1, sketch a possible speed-time graph for his fall after he opens his parachute. [3]

[Total: 8]

7 **(a)** Underline the vectors in the following list of quantities.

density energy force mass velocity volume [2]

(b) A small metal ball is projected into the air with a velocity of 40 m / s vertically upwards.

The graph in Fig. 2.1 shows how the velocity changes with time until the ball reaches its maximum height.

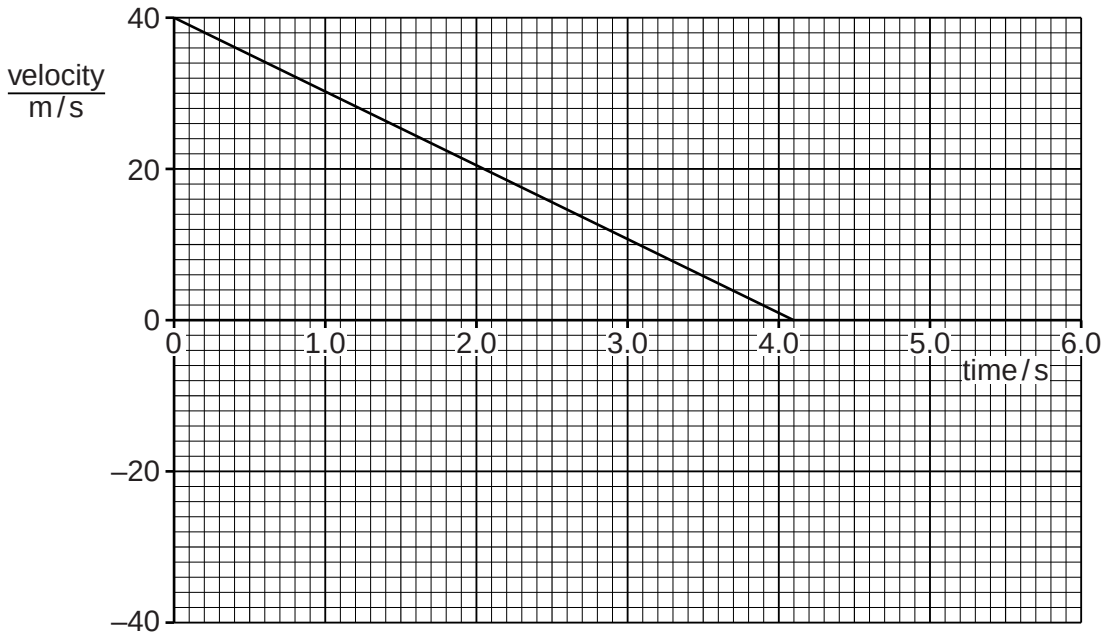

Fig. 2.1

Use the graph to find,

(i) the time at which the ball reaches its maximum height,

time = ... [1]

(ii) the deceleration of the ball,

deceleration = ... [2]

(iii) the maximum height reached by the ball.

maximum height = ...[2]

(c) On Fig. 2.1, add a line to the graph to show how the velocity of the ball changes after it reaches its maximum height. Your line should extend to time 6.0 s. [1]

[Total: 8]