5 A skydiver X jumps from an aeroplane. The total mass of the skydiver X and parachute is 90 kg.

(a) Fig. 5.1 shows a displacement-time graph for the first one second interval of the descent of skydiver X.

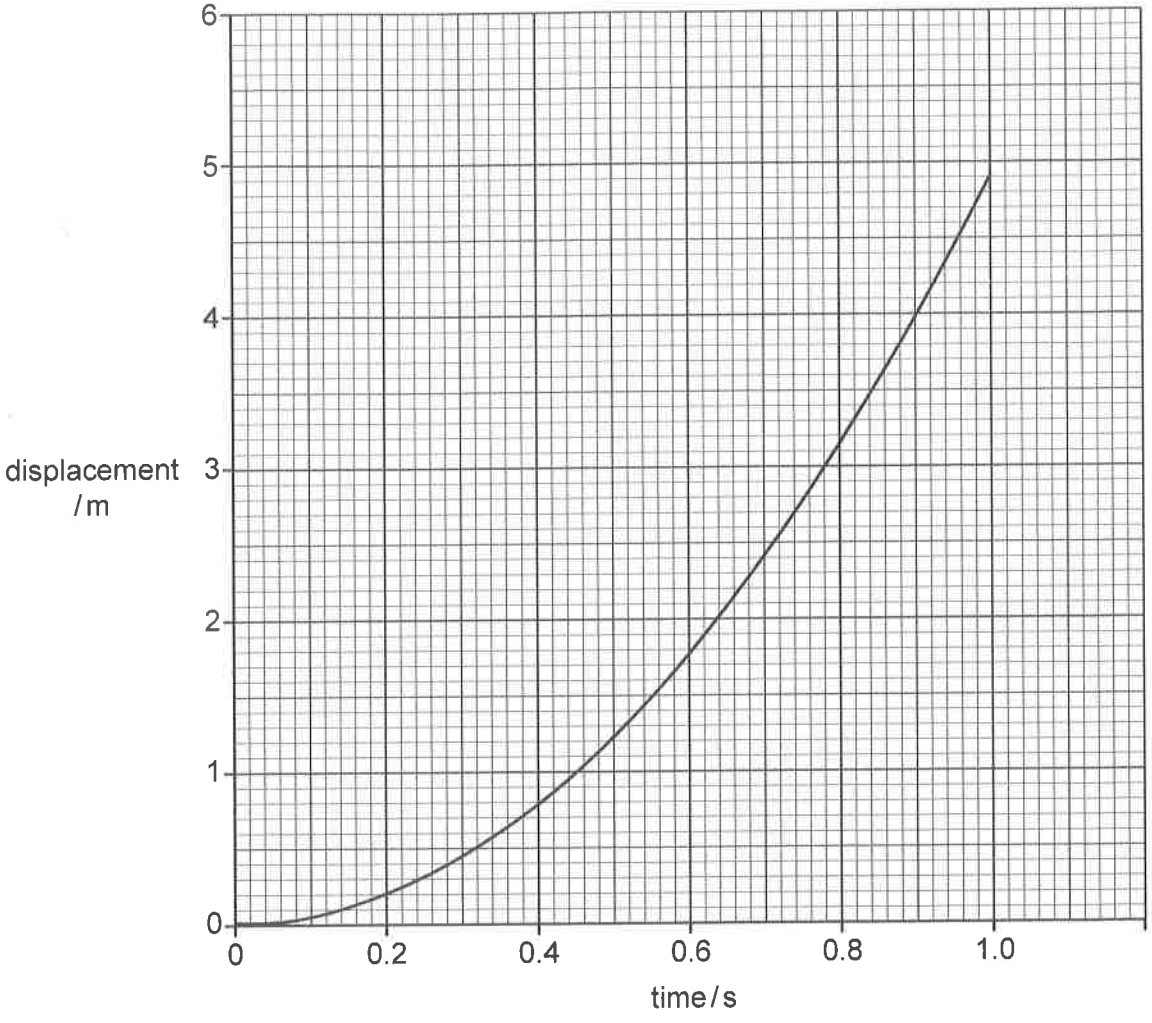

Fig. 5.1

(i) Calculate the velocity of the skydiver X after 0.60 seconds.

velocity = ... $m s^{-1}$ [3]

(ii) Calculate the average velocity of the skydiver X during the first one second interval.

velocity = ... $m s^{-1}$ [1]

(b) Skydiver X reaches a constant velocity before the parachute is opened.

Describe and explain in terms of acceleration and forces, the vertical motion of the skydiver X from the time of jumping from the aeroplane to a time before opening the parachute. Air resistance increases with speed.

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..... [4]

(c) The force due to air resistance D acting on the skydiver X is given by:

$$D = \frac{1}{2}\rho A v^2$$

where ρ is the density of air ($1.2\,\text{kg}\,\text{m}^{-3}$), A is the surface area of skydiver X ($0.50\,\text{m}^2$) and v is the velocity of skydiver X.

Calculate the constant velocity of skydiver X.

terminal velocity = ... $\text{m}\,\text{s}^{-1}$ [2]

(d) Skydiver X opens the parachute. A student explains the resulting motion:

"The parachute causes a large upwards force on the skydiver due to air resistance. This causes the skydiver to travel upwards for a short time."

Explain whether the student's explanation is correct.

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..... [3]

(e) On Fig. 5.2, sketch a velocity-time graph for skydiver X during the whole of his descent.

Fig. 5.2

[4]

(f) A second skydiver, skydiver Y, has a greater weight but the same surface area as skydiver X.

Compare the motion of skydiver X and skydiver Y from when they leave the aeroplane until they reach constant velocity before opening their parachutes.

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..... [3]

[Total: 20]