16 **(a)** A student walks from A to B along the path shown in Fig. 2.1.

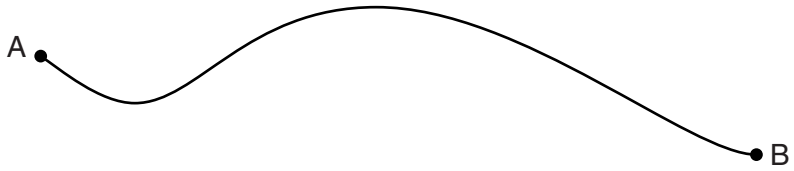

Fig. 2.1

The student takes time *t* to walk from A to B.

(i) State the quantity, apart from *t*, that must be measured in order to determine the average value of

1. speed,

.....

.....[1]

2. velocity.

.....

.....[1]

(ii) Define *acceleration*.

.....[1]

(b) A girl falls vertically onto a trampoline, as shown in Fig. 2.2.

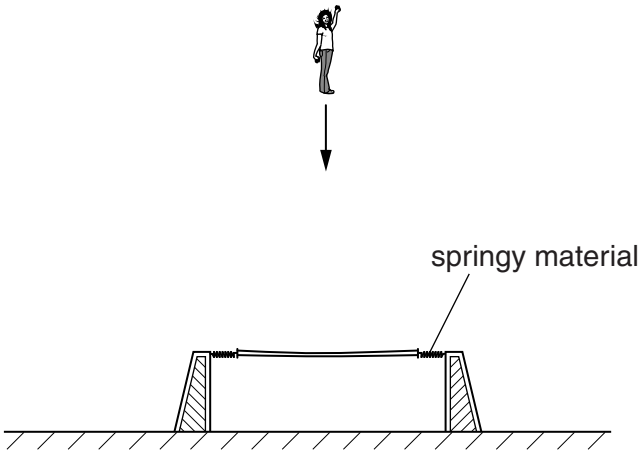

Fig. 2.2

The trampoline consists of a central section supported by springy material. At time $t = 0$ the girl starts to fall. The girl hits the trampoline and rebounds vertically. The variation with time *t* of velocity *v* of the girl is illustrated in Fig. 2.3.

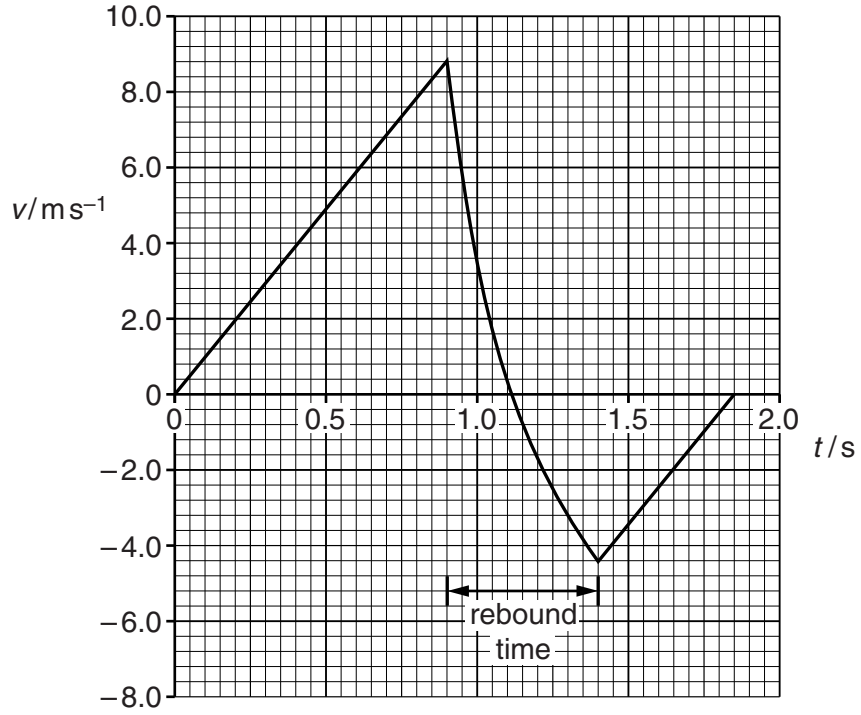

Fig. 2.3

For the motion of the girl, calculate

(i) the distance fallen between time $t = 0$ and when she hits the trampoline,

distance = ... m [2]

(ii) the average acceleration during the rebound.

acceleration = ... $m\,s^{-2}$ [2]

(c) **(i)** Use Fig. 2.3 to compare, without calculation, the accelerations of the girl before and after the rebound. Explain your answer.

.....

.....

.....[2]

(ii) Use Fig. 2.3 to compare, without calculation, the potential energy of the girl at $t = 0$ and $t = 1.85\,s$. Explain your answer.

.....

.....

.....[2]

17 **(a)** Define

(i) *velocity*,

.....

.....[1]

(ii) *acceleration*.

.....

.....[1]

(b) A car of mass 1500 kg travels along a straight horizontal road.
The variation with time t of the displacement x of the car is shown in Fig. 3.1.

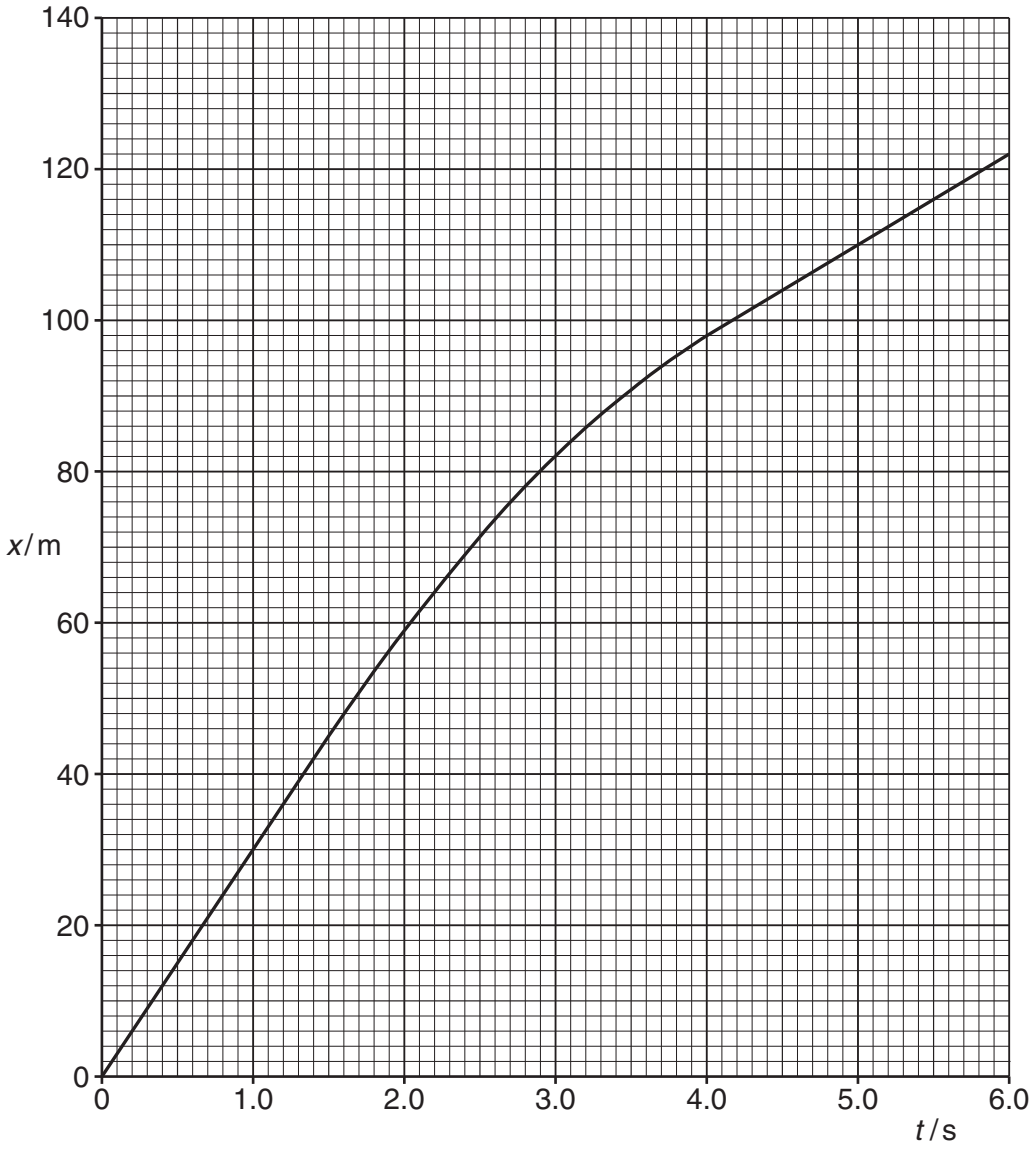

Fig. 3.1

(i) Use Fig. 3.1 to describe qualitatively the velocity of the car during the first six seconds of the motion shown.
Give reasons for your answers.

.....

.....

.....

.....

..... [3]

(ii) Calculate the average velocity during the time interval $t = 0$ to $t = 1.5\,s$.

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

(iii) Show that the average acceleration between $t = 1.5\,s$ and $t = 4.0\,s$ is $-7.2\,m\,s^{-2}$.

[2]

(iv) Calculate the average force acting on the car between $t = 1.5\,s$ and $t = 4.0\,s$.

force = ... N [2]

18 **(a)(i)** Define *velocity*.

.....

..... [1]

(ii) Distinguish between *speed* and *velocity*.

.....

..... [2]

(b) A car of mass 1500 kg moves along a straight, horizontal road. The variation with time t of the velocity v for the car is shown in Fig. 1.1.

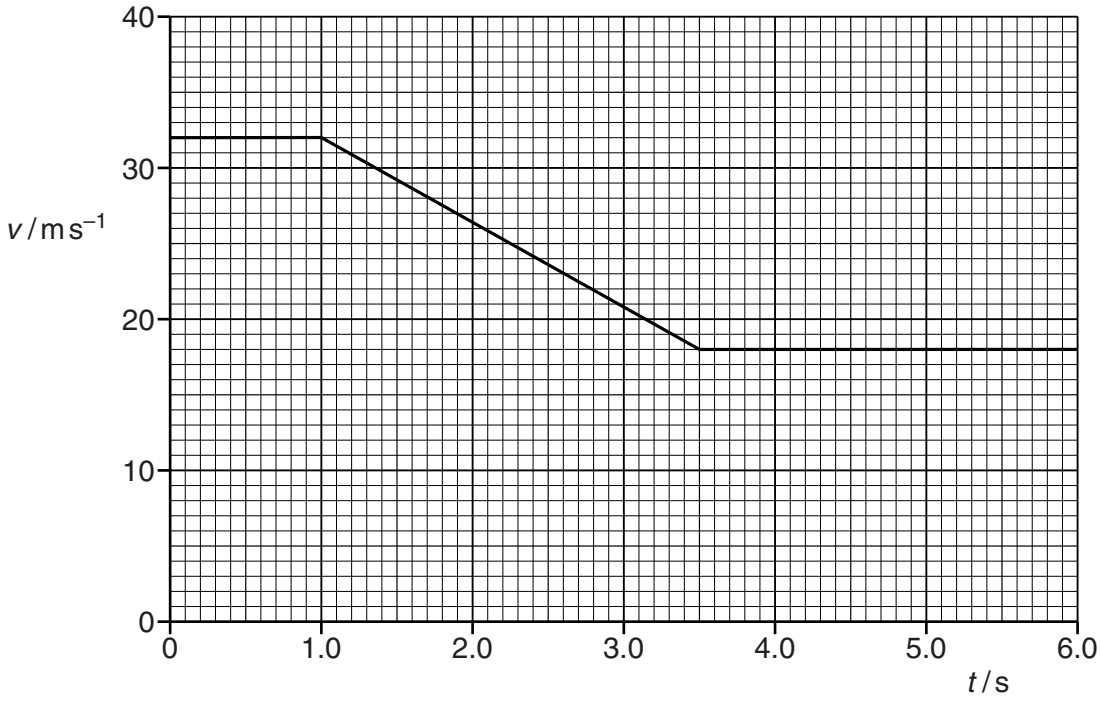

Fig. 1.1

The brakes of the car are applied from t = 1.0 s to t = 3.5 s.
For the time when the brakes are applied,

(i) calculate the distance moved by the car,

distance = ... m [3]

(ii) calculate the magnitude of the resultant force on the car.

resultant force = ... N [3]

(c) The direction of motion of the car in **(b)** at time $t = 2.0\,s$ is shown in Fig. 1.2.

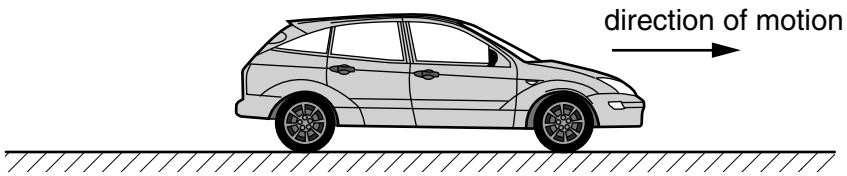

Fig. 1.2

On Fig. 1.2, show with arrows the directions of the acceleration (label this arrow A) and the resultant force (label this arrow F). [1]

19 **(a)** Explain what is meant by a *scalar* quantity and by a *vector* quantity.

scalar: .....

.....

vector: .....

.....

[2]

(b) A ball leaves point P at the top of a cliff with a horizontal velocity of $15\,m\,s^{-1}$, as shown in Fig. 2.1.

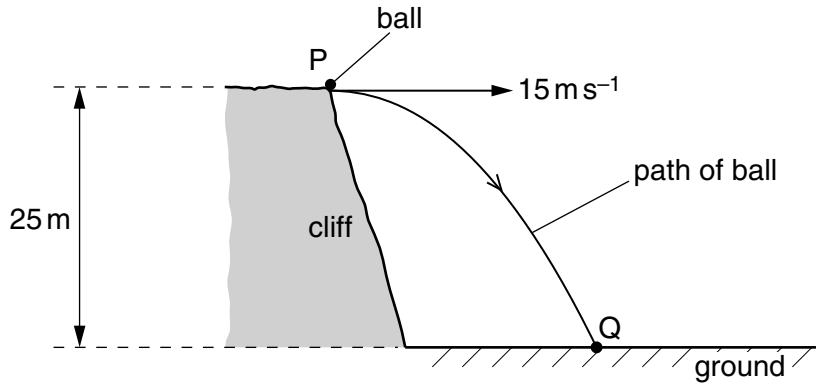

Fig. 2.1

The height of the cliff is 25 m. The ball hits the ground at point Q.
Air resistance is negligible.

(i) Calculate the vertical velocity of the ball just before it makes impact with the ground at Q.

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

(ii) Show that the time taken for the ball to fall to the ground is 2.3 s.

[1]

(iii) Calculate the magnitude of the displacement of the ball at point Q from point P.

displacement = ... m [4]

(iv) Explain why the distance travelled by the ball is different from the magnitude of the displacement of the ball.

.....

.....

.....[2]