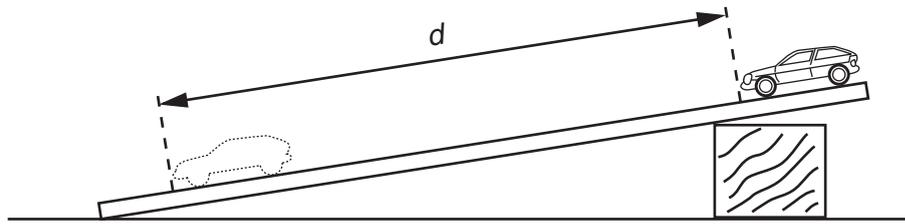
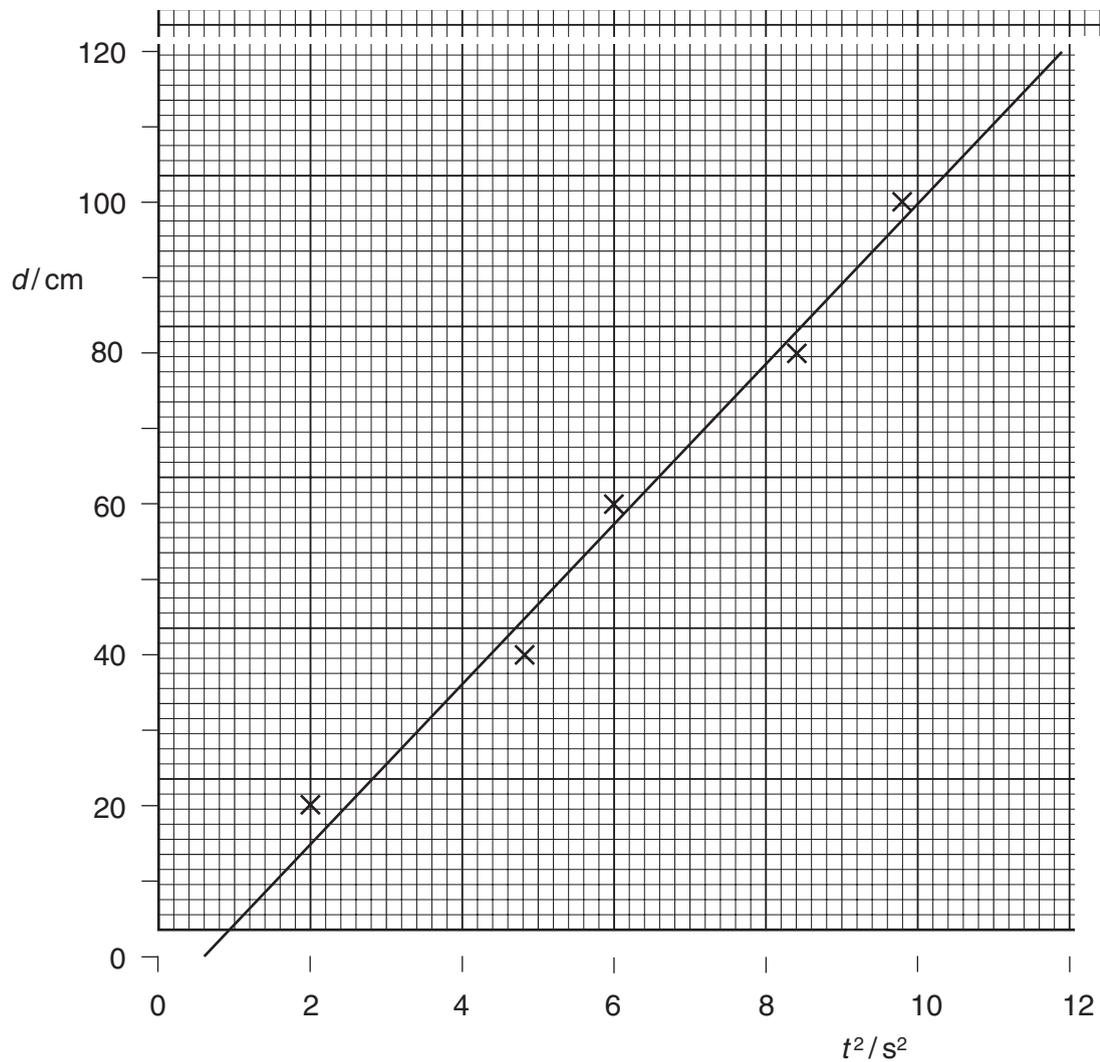


- 5 A student has been asked to determine the linear acceleration of a toy car as it moves down a slope. He sets up the apparatus as shown in Fig. 3.1.



**Fig. 3.1**

The time  $t$  to move from rest through a distance  $d$  is found for different values of  $d$ . A graph of  $d$  (y-axis) is plotted against  $t^2$  (x-axis) as shown in Fig. 3.2.



**Fig. 3.2**

**(a)** Theory suggests that the graph is a straight line through the origin.  
Name the feature on Fig. 3.2 that indicates the presence of

**(i)** random error,

.....

**(ii)** systematic error.

.....

[2]

**(b) (i)** Determine the gradient of the line of the graph in Fig. 3.2.

gradient = ..... [2]

**(ii)** Use your answer to **(i)** to calculate the acceleration of the toy down the slope.  
Explain your working.

acceleration = .....  $\text{ms}^{-2}$  [3]

- 7 A girl stands at the top of a cliff and throws a ball vertically upwards with a speed of  $12 \text{ m s}^{-1}$ , as illustrated in Fig. 3.1.

For  
Examiner's  
Use

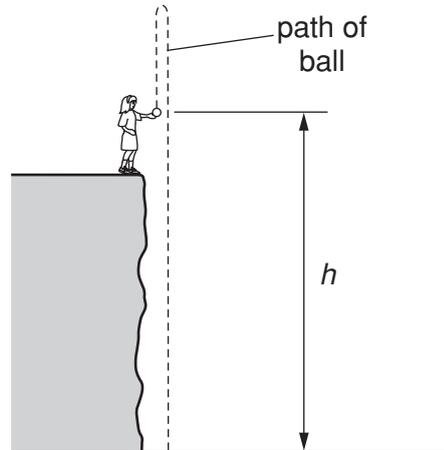


Fig. 3.1

At the time that the girl throws the ball, her hand is a height  $h$  above the horizontal ground at the base of the cliff.

The variation with time  $t$  of the speed  $v$  of the ball is shown in Fig. 3.2.

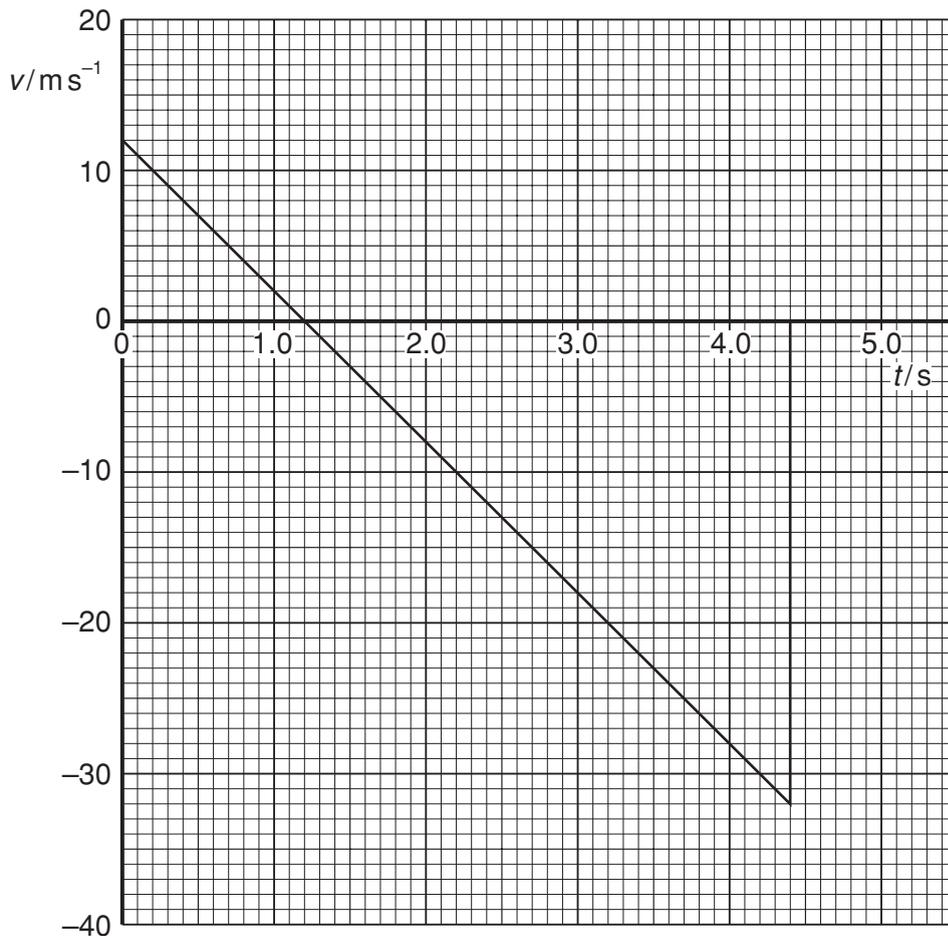


Fig. 3.2

Speeds in the upward direction are shown as being positive. Speeds in the downward direction are negative.

For  
Examiner's  
Use

- (a) State the feature of Fig. 3.2 that shows that the acceleration is constant.

..... [1]

- (b) Use Fig. 3.2 to determine the time at which the ball

- (i) reaches maximum height,

time = ..... s

- (ii) hits the ground at the base of the cliff.

time = ..... s  
[2]

- (c) Determine the maximum height above the base of the cliff to which the ball rises.

height = ..... m [3]

- (d) The ball has mass 250 g. Calculate the magnitude of the change in momentum of the ball between the time that it leaves the girl's hand to time  $t = 4.0$  s.

change = ..... N s [3]

- 13 A student investigates the speed of a trolley as it rolls down a slope, as illustrated in Fig. 2.1.

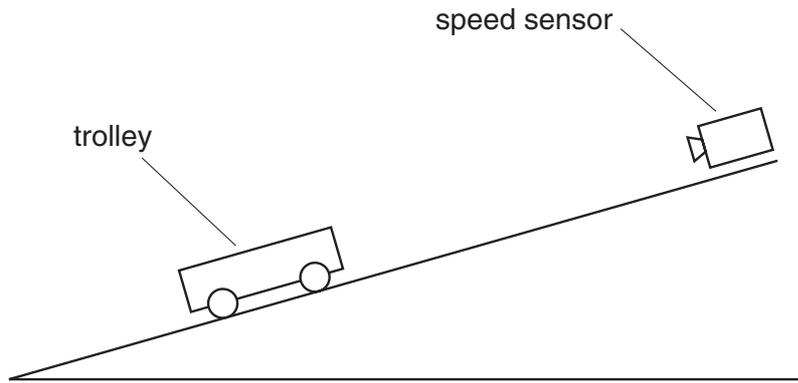


Fig. 2.1

The speed  $v$  of the trolley is measured using a speed sensor for different values of the time  $t$  that the trolley has moved from rest down the slope.

Fig. 2.2 shows the variation with  $t$  of  $v$ .

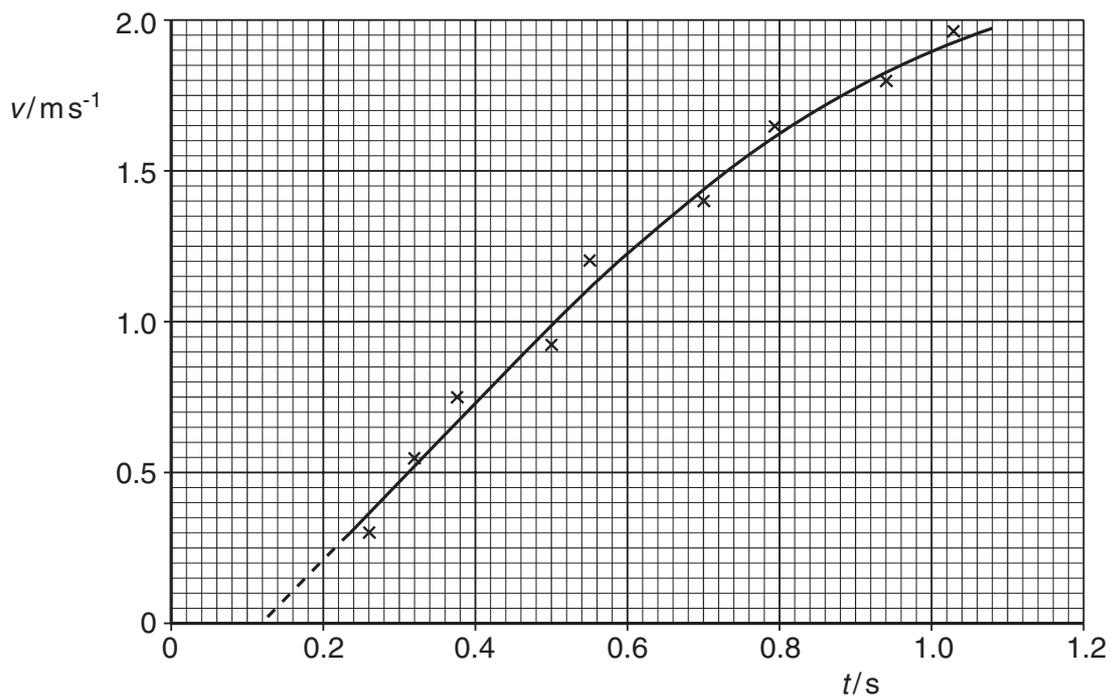


Fig. 2.2

- (a) Use Fig. 2.2 to determine the acceleration of the trolley at the point on the graph where  $t = 0.80$  s.

acceleration = .....  $\text{m s}^{-2}$  [4]

- (b) (i) State whether the acceleration is increasing or decreasing for values of  $t$  greater than 0.6 s. Justify your answer by reference to Fig. 2.2.

.....  
.....  
..... [2]

- (ii) Suggest an explanation for this change in acceleration.

.....  
..... [1]

- (c) Name the feature of Fig. 2.2 that indicates the presence of

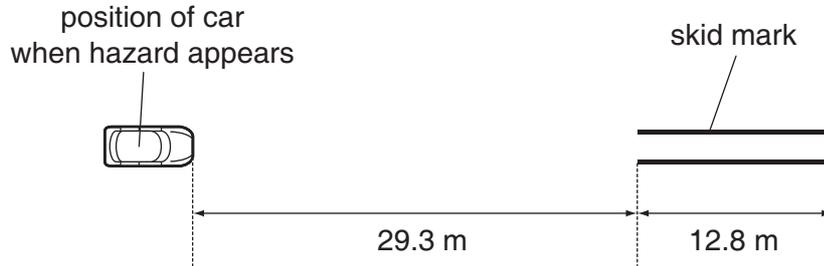
- (i) random error,

.....  
..... [1]

- (ii) systematic error.

.....  
..... [1]

- 18** A car is travelling along a straight road at speed  $v$ . A hazard suddenly appears in front of the car. In the time interval between the hazard appearing and the brakes on the car coming into operation, the car moves forward a distance of 29.3 m. With the brakes applied, the front wheels of the car leave skid marks on the road that are 12.8 m long, as illustrated in Fig. 2.1.



**Fig. 2.1**

It is estimated that, during the skid, the magnitude of the deceleration of the car is  $0.85g$ , where  $g$  is the acceleration of free fall.

**(a)** Determine

- (i)** the speed  $v$  of the car before the brakes are applied,

$$v = \dots\dots\dots \text{ms}^{-1} \quad [2]$$

- (ii)** the time interval between the hazard appearing and the brakes being applied.

$$\text{time} = \dots\dots\dots \text{s} \quad [2]$$

**(b)** The legal speed limit on the road is 60 km per hour.  
Use both of your answers in **(a)** to comment on the standard of the driving of the car.

*For  
Examiner's  
Use*

.....

.....

.....

..... [3]