6 **(a)** A student takes measurements to determine the acceleration of a ball as it rolls down a slope. He uses the apparatus illustrated in Fig. 6.1.

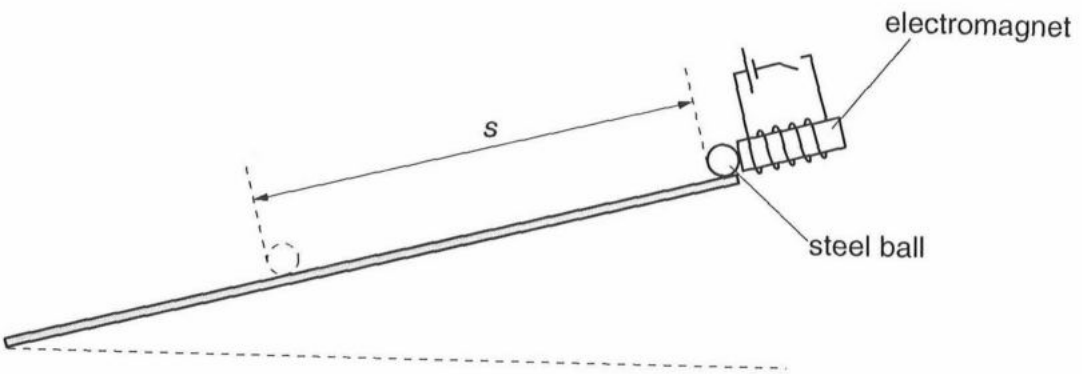

Fig. 6.1

The student measures the time t for the ball to roll a distance s down the slope after the ball has been released from the electromagnet.

The variation with t^2 of the distance s is shown in Fig. 6.2.

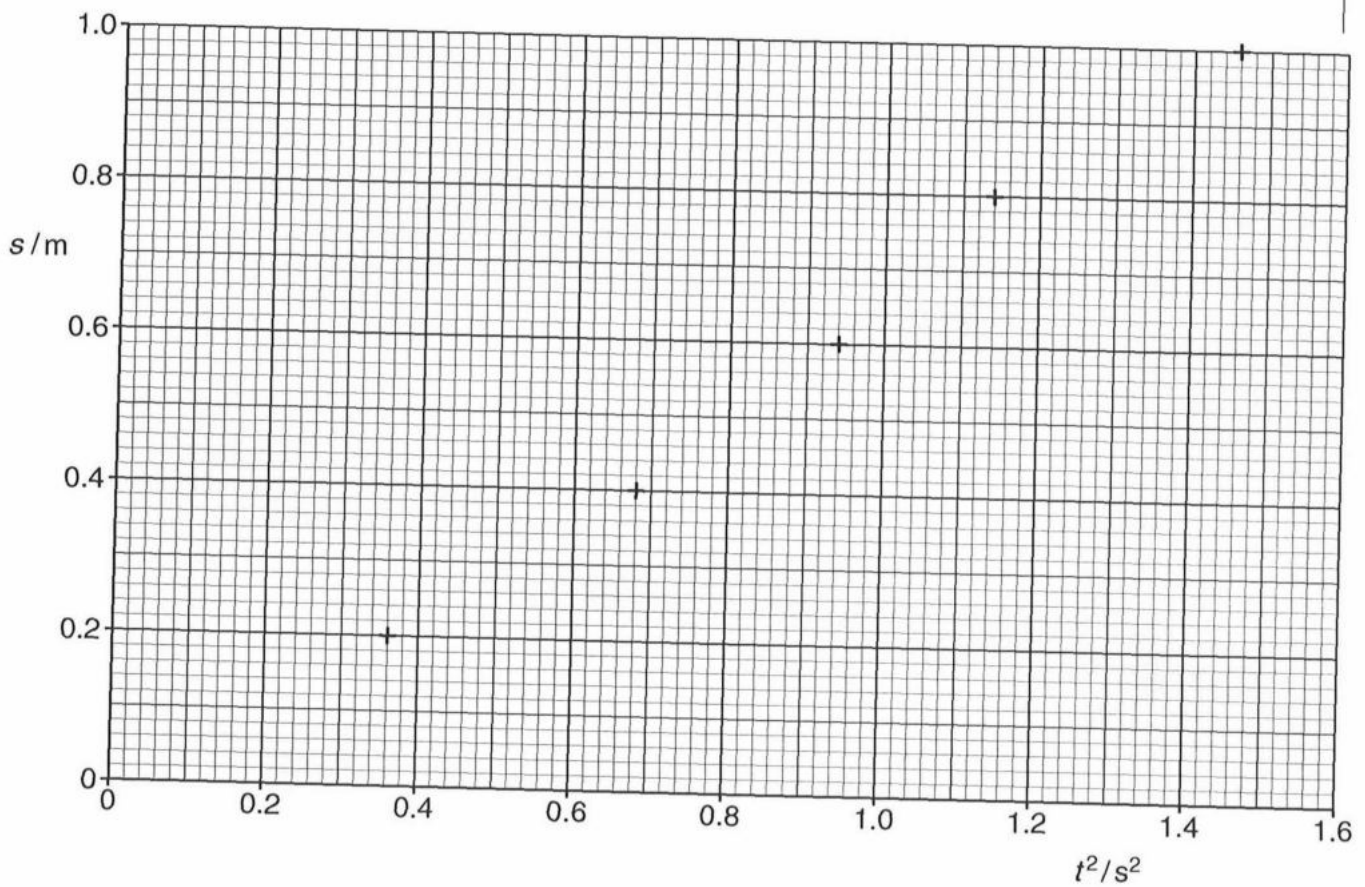

Fig. 6.2

(i) Use Fig. 6.2 to determine a value for the acceleration of the ball down the slope.

For Examiner's Use

acceleration = ... $m\,s^{-2}$ [5]

(ii) State the feature of the data shown in Fig. 6.2 that indicates the presence of

1. random error,

.....

..... [1]

2. systematic error.

.....

..... [1]

(iii) State why, by drawing a line of best fit for the data points on Fig. 6.2, the effect of random error is reduced.

.....

..... [1]

(b) The variation with speed v of the force F_D driving a car forwards is shown in Fig. 6.3.

For Examiner's Use

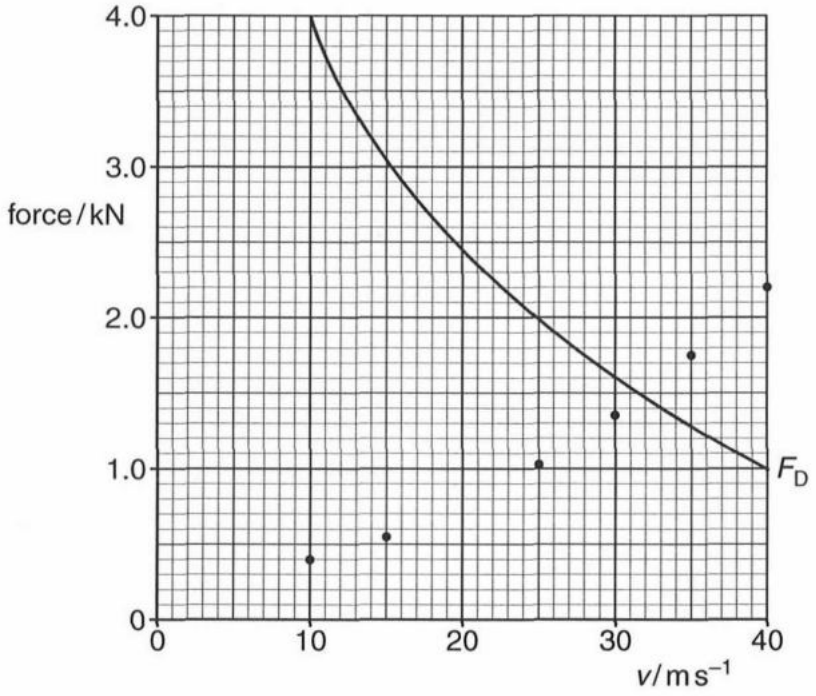

Fig. 6.3

The resistive force F_R, measured in newtons, acting on the car at speed v to oppose its motion is given by the expression

$$F_R = 280 + 1.2v^2$$

where v is measured in $m\,s^{-1}$.

Some data points for F_R have been plotted on Fig. 6.3.

(i) Calculate the force F_R for a speed of $20\,m\,s^{-1}$.

F_R = ... N [1]

(ii) On Fig. 6.3, plot the data point for $v = 20\,m\,s^{-1}$. Draw the line of best fit for all the data points. [1]

For Examiner's Use

(iii) The mass of the car is 950 kg.

Use the completed Fig. 6.3 to determine, for the car travelling along a horizontal road,

1. its maximum speed (explain your answer),

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

2. the total power output of the car at this maximum speed,

power = ... W [2]

3. the acceleration at a speed v of $20\,m\,s^{-1}$.

acceleration = ... $m\,s^{-2}$ [3]

(c) Explain why, when the car in **(b)** is travelling up a slope, the maximum speed is less than that determined in **(b)(iii) part 1**.

.....

.....

.....

..... [3]