Oxford Cambridge and RSA

A level Physics A

H556/03 Unified physics

Question Set 10

1 Fig. 4.1 shows an arrangement used by a student to determine the acceleration of free fall.

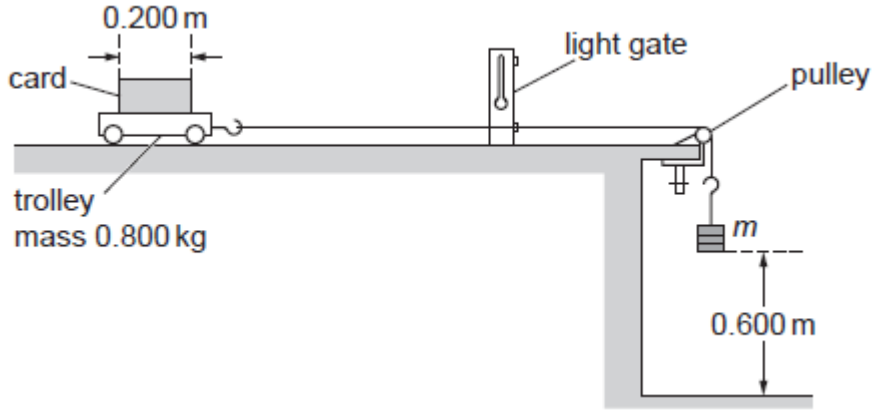

Fig. 4.1

A trolley is attached to a variable mass m by a string which passes over a pulley.

The mass m is released from rest and falls through a fixed height of 0.600 m accelerating the trolley of mass 0.800 kg. When the mass m hits the floor, the trolley then continues to move at a **constant** velocity v.

This constant velocity v is determined by measuring the time t for the card of length 0.200 m to pass fully through a light gate connected to a timer.

Frictional forces on the trolley and the falling mass m are negligible.

(a) Show that the relationship between v and m is

$$v^2 = \frac{1.20mg}{(m + 0.800)}$$

where g is the acceleration of free fall.

[2]

(b) The student records the information from the experiment in a table. The column headings and just the last row for m = 0.600 kg from this table are shown below.

m / kg	t / 10^{-3} s	$\frac{m}{(m + 0.800)}$	v / m s^{-1}	v^2 / m^2 s^{-2}
0.600	90 ± 2	0.429	2.22 ± 0.05	

(i) Complete the missing value of v^2 in the table including the absolute uncertainty. **[2]**

(ii) Fig. 4.2 shows some of the data points plotted by the student. Plot the missing data for $m = 0.600\,\text{kg}$ on Fig. 4.2 and draw the straight line of best fit. **[2]**

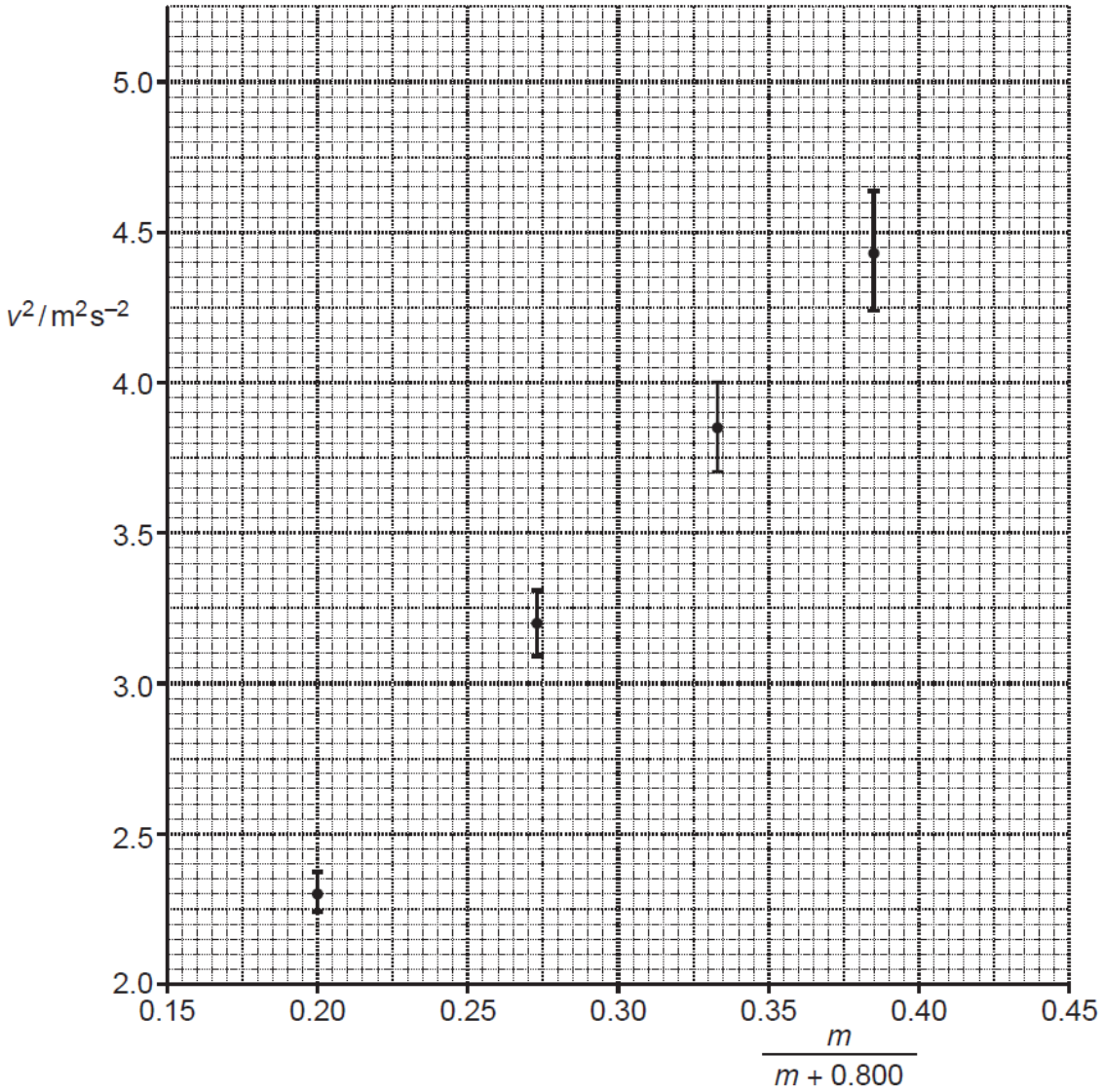

Fig. 4.2

(c) (i) Use the equation given in **(a)** to show that the gradient of the graph of v^2 against $\frac{m}{(m+0.800)}$ is equal to $1.20g$.

[1]

(ii) Assume that the best-fit straight line through the data points gives $9.5\ \text{m s}^{-2}$ for the experimental value of g. Draw a worst-fit line through the data points on Fig. 4.2 and determine the absolute uncertainty in the value for g.

absolute uncertainty = ± ..... ms^{-2} **[4]**

(d) It is suspected that the card on the trolley did not pass at right angles through the light beam.

Discuss, without doing any calculations, the effect this may have on the experimental value for the acceleration of free fall *g*.

[4]

Total Marks for Question Set 10: 15

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