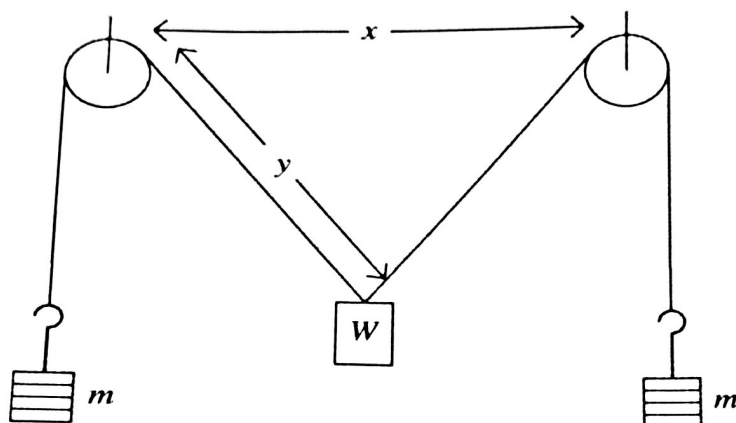


2

In an experiment similar to the one you performed in Stage 1 an unknown load, of weight, W , was supported by two strings kept in tension by equal masses, m , hung from their free ends, with each string passing over a frictionless pulley. The arrangement was symmetrical and is shown in Figure 1.

Figure 1



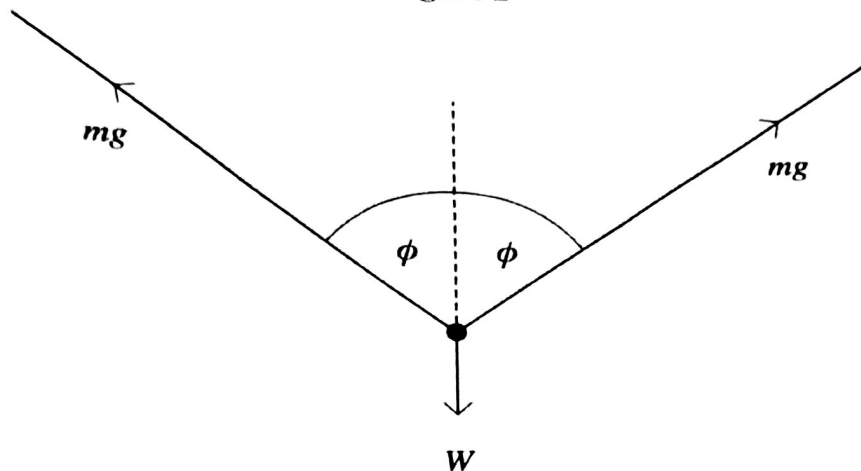
The distance x was kept constant throughout the experiment. The length y was measured for different values of m . The results are shown in the table.

The distance between the strings at the pulleys, $x = 0.500$ m

m/kg	y/m	$(\frac{x}{y})^2$	$\frac{1}{\sqrt{4 - (\frac{x}{y})^2}}$
0.250	0.736	0.462	0.532
0.275	0.484	1.067	0.584
0.300	0.400	1.563	0.641
0.325	0.360	1.929	0.695
0.350	0.339	2.175	0.740
0.375	0.322	2.411	0.793
0.400	0.308	2.636	0.867

- 2 (a) **Figure 2** shows the three forces acting through the point at which the strings are attached to the load. The weight of the load is W and the tension in each string is mg , where g is gravitational field strength.

Figure 2



- 2 (a) (i) By resolving the forces vertically show that $m = \frac{W}{2g \cos \phi}$

where ϕ is the angle between each string and the vertical.

$$\cos = \frac{2mg}{W} \quad \cos = \frac{2mg}{W}$$

$$mg \cos \theta + mg \cos \theta = W$$

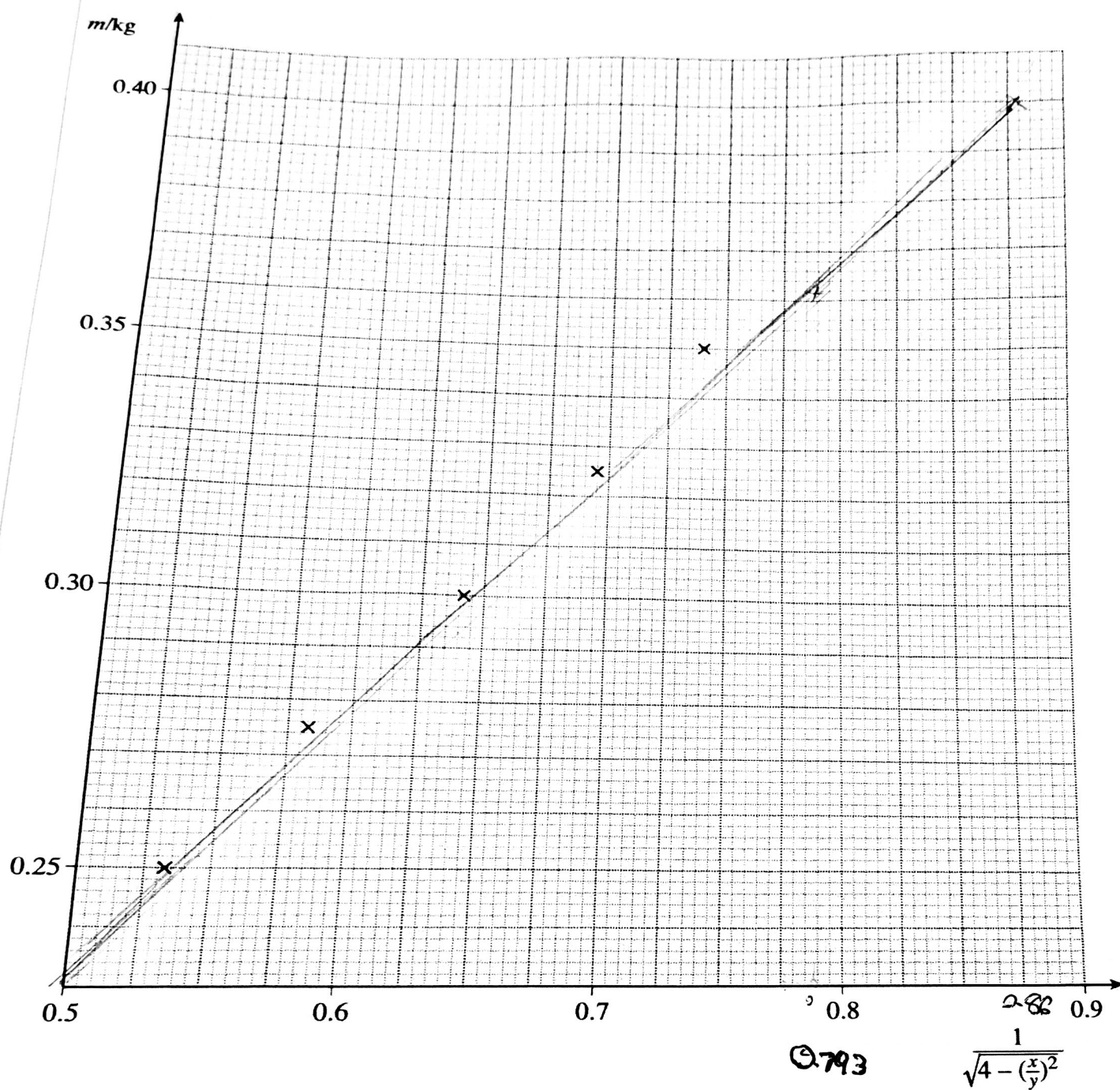
(1 mark)

- 2 (a) (ii) Complete the table on page 4.

(2 marks)

- 2 (a) (iii) Complete the graph on the following page by plotting the missing two points and drawing a straight line of best fit.

(2 marks)



2 (b) (i) Determine the gradient of your graph.

$$y = mx + c$$

$$M = \frac{(0.28 - 0.23)}{(0.48 - 0.50)} = 0.5$$

$$0.23 = (0.48)(0.5) + c$$

$$c = -0.02$$

(3 marks)

2 (b) (ii) The equation for the straight line is $m = \frac{W}{g} \times \frac{1}{\sqrt{4 - (\frac{x}{y})^2}}$

Given that $g = 9.81 \text{ N kg}^{-1}$, determine a value for W .

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(2 marks)

2 (c) The uncertainty in the measurement of x was $\pm 1 \text{ mm}$ and the uncertainty in the measurement of y was $\pm 2 \text{ mm}$. Calculate the percentage uncertainty in $(\frac{x}{y})^2$ for $m = 0.300 \text{ kg}$.

$$\frac{2.173}{2} = \pm 1.087$$

$$\text{mean} = 1.749$$

$$\%R = \frac{1.087}{1.749} = 0.62$$

$$S_p = 0.62\%$$

(3 marks)

2 (d) (i) Explain the term systematic error.

Systematic errors are due to the set up of the equipment ⁱⁿ the experiment. The systematic error can be caused by the equipment as it not balanced properly and also using the wrong measurements units. E.g. cm instead of mm. This will repeat in every reading you take. (1 mark)

2 (d) (ii) There may be a systematic error in this experiment because of friction in the pulleys. When the measurements were taken, increasing values of m were used. State and explain how friction in the pulleys would have affected the measured values of y .

The motion force of friction is against the motion and it affects the motion. To avoid doing this in the experiment some motion can be reduce. Therefore it will produce some ^{inaccuracy} ~~inaccuracy~~ results within the experiment. (2 mark)