



LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 3

LEFEL 3

EXAMINATION PERIOD
JANUARY 2019

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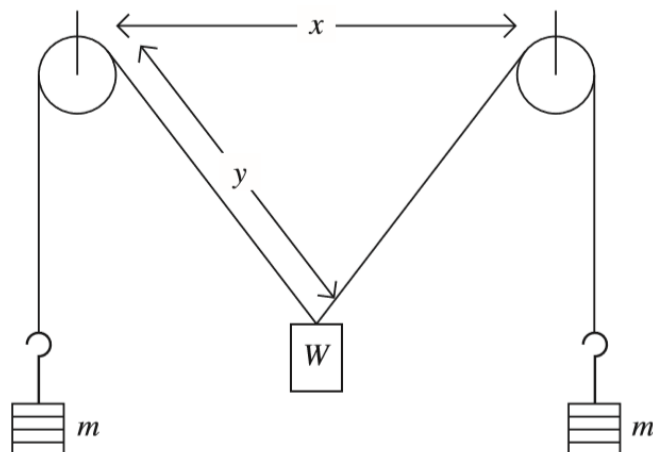
MODULE CODE: M3X01513
SCIENCE

COURSEWORK PART 2

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



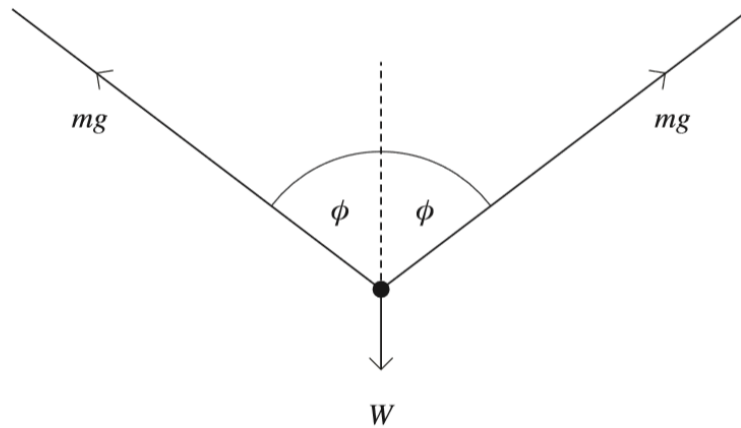
The distance x was kept constant throughout the experiment. The length y was measured for different values of m . The results are shown in the table.

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	2.635	0.856

- 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.

.....
 $\cos\phi = W/2mg$

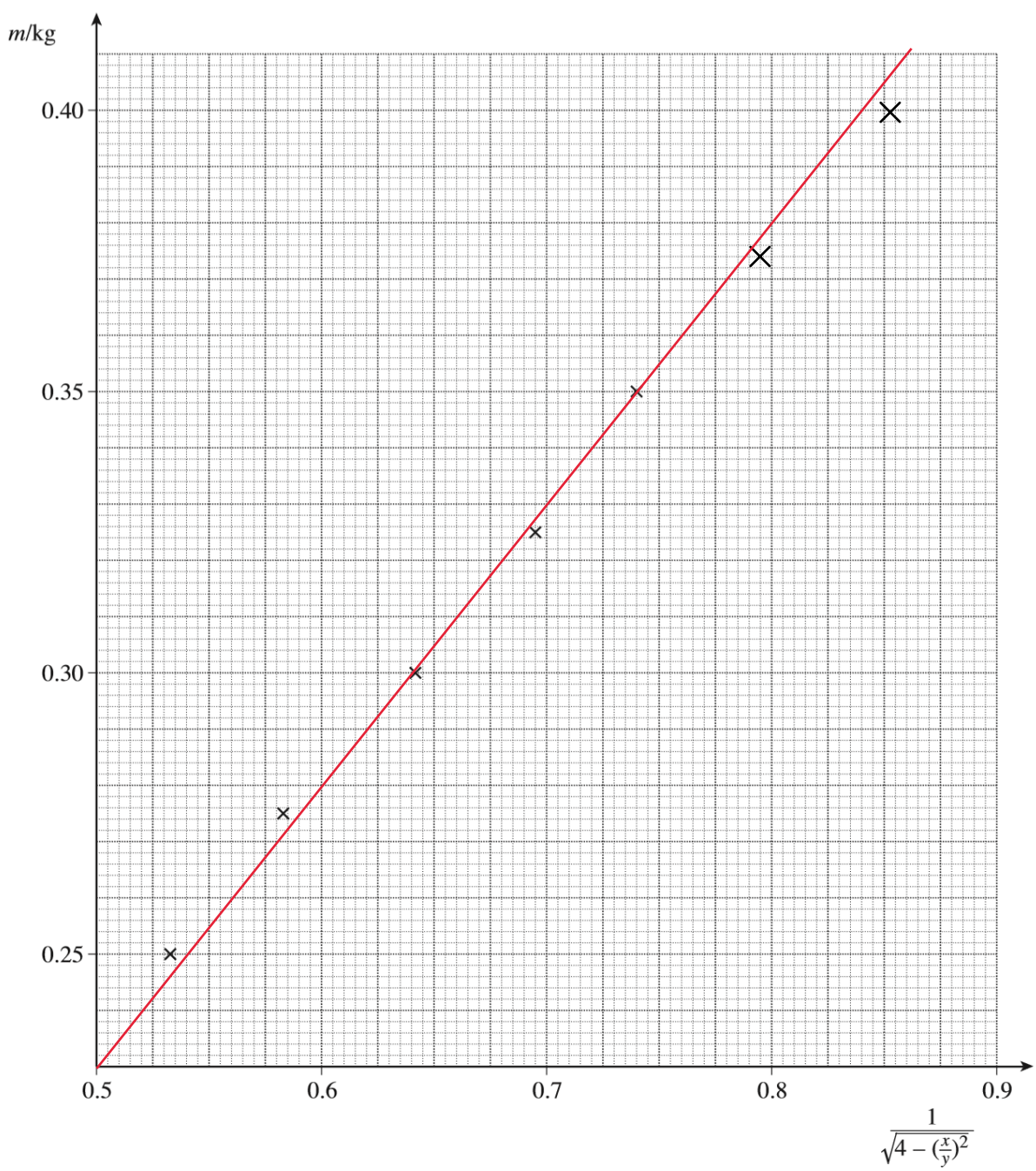
(1 mark)

- 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.

$$y = mx + c \qquad 0.28 = (0.5)(0.6) + c$$

$$m = \frac{y_2 - y_1}{x_2 - x_1} \qquad c = 0.28 - 0.3 = -0.02$$

$$m = \frac{0.28 - 0.23}{0.6 - 0.5} \qquad y = 0.5x - 0.02$$

$$m = 0.5$$

$$y = 0.5x + c$$

(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 .

$$W = mg \sqrt{4 - \left(\frac{x}{y}\right)^2}$$

$$w = 0.5 \times 9.81 \times 0.532$$

$$w = 2.61 \text{ N} \qquad \text{when } m(\text{kg}) = 0.250$$

(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 $\left(\frac{x}{y}\right)^2$ for $m = 0.300 \text{ kg}$.

$$\text{range} = 2.173$$

$$2.173/2 = \pm 1.087$$

$$U = \pm 1.087$$

$$\text{mean} = 1.749$$

$$\%U = 1.087/1.749 = 0.61$$

$$\%u = 0.61\%$$

(3 marks)

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

systematic errors are errors that are not determined by chance but are

introduced by an inaccuracy inherent to the system.

(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 .

friction as a force affects motion by working in the opposite direction, therefore

this would produce inaccurate results in a real life situation.

(2 marks)