



LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 3

LEFEL 3

EXAMINATION PERIOD
JANUARY 2019

CYFNOD ARHOLIADAU
IONAWR 2019

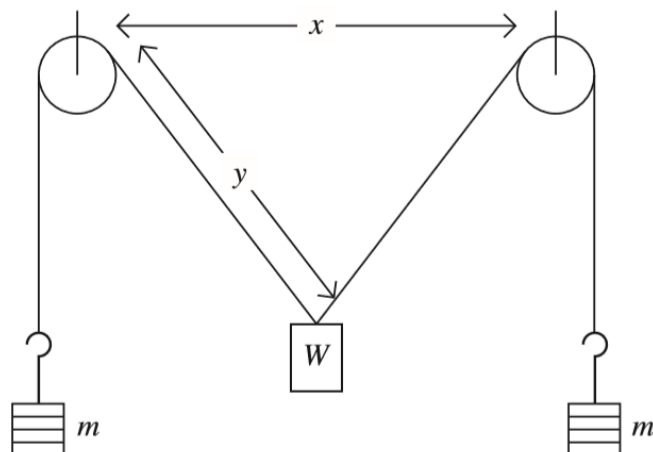
MODULE CODE: M3X01513
SCIENCE

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



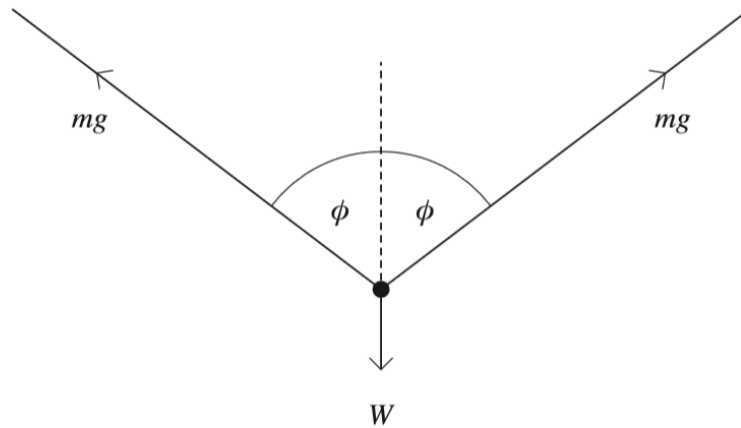
The distance x was kept constant throughout the experiment. The length y was measured for different values of m . The results are shown in the table.

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.

The forces are balanced on each side of the weight. If the formula is transposed

to make W the subject of the equation, $mg\cos\theta + mg\cos\theta$ would be equal to W .

This could also be written as $W=2mg\cos\theta$.

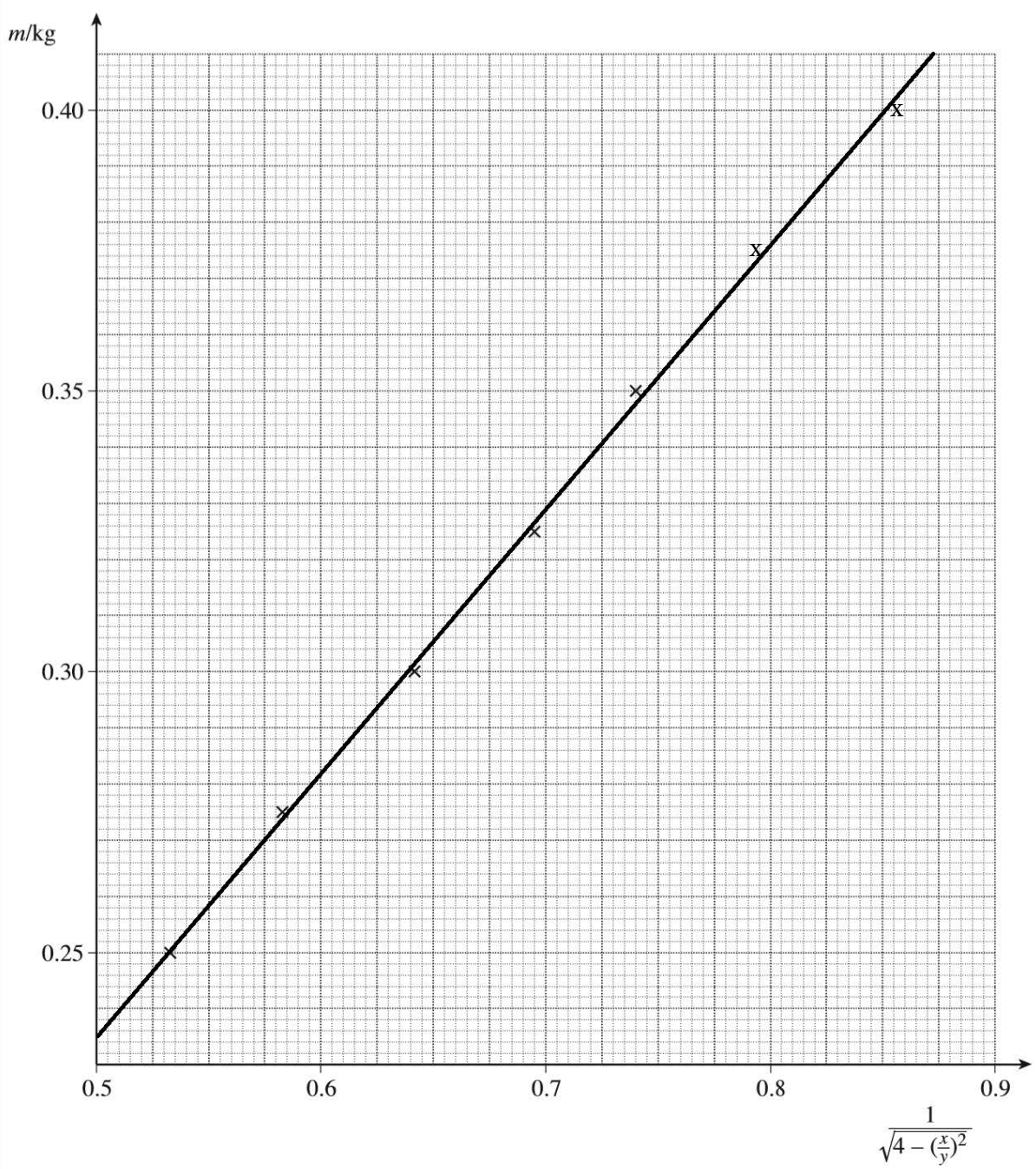
(1 mark)

- 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.
 $(y_2 - y_1) / (x_2 - x_1)$

$$(0.34 - 0.25) / (0.725 - 0.532)$$

$$(0.09) / (0.193)$$

The gradient would be 0.466 3dp

(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 .

$$W = (mg/1) / \sqrt{4 - (x/y)^2}$$

$$W = (0.250 \times 9.81) / 0.532$$

$$W = 2.453 / 0.532$$

$$W = 4.610 \text{ N}$$

(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 $m = 0.300 \text{ kg}$.

Percentage uncertainty = (probable error / measurement) $\times 100\%$

$$x = 0.5 \text{ m} = 500 \text{ mm} \pm 1 \text{ mm} \quad (1/500) \times 100 = 0.2\%$$

$$y = 0.4 \text{ m} = 400 \text{ mm} \pm 2 \text{ mm} \quad (2/400) \times 100 = 0.5\%$$

$$0.5\% + 0.2\% = 0.7\%$$

$$0.7\% \times 2 = 1.4\%$$

$$1.563 \pm 1.4\%$$

(3 marks)

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

A systematic error is an error that is consistent throughout the results. An example of this would be a calibration issue, if a piece of equipment was reading out my 10mm for instance and this was consistent throughout the results, this would be a systematic error. Another example would be human error, such as reading from the wrong end of a ruler throughout the experiment. (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 within the pulleys would give a false value for m . This is because the friction would not be taken into account even though it was affecting the results. It is likely that if friction was present, it would negate some of the mass. This mass would be used to rotate the pulleys meaning the results would read as if a lower figure for m was used. If friction was present and affecting the results, the measurement for Y would be larger than it should be. (2 marks)