



LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 3

LEFEL 3

EXAMINATION PERIOD
JANUARY 2019

CYFNOD ARHOLIADAU
IONAWR 2019

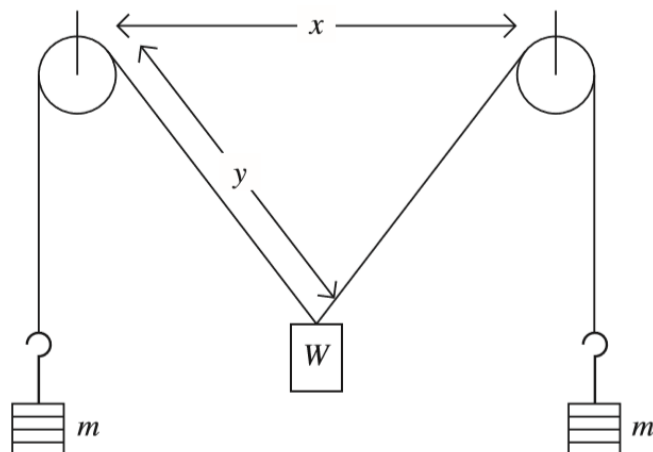
MODULE CODE: M3X01513
SCIENCE

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



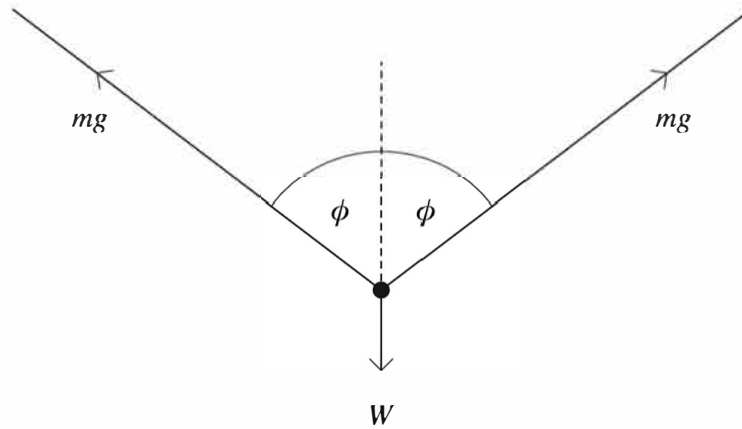
The distance x was kept constant throughout the experiment. The length y was measured for different values of m . The results are shown in the table.

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.

As this is a equilibrium the equation will be $w=2mg\cos\phi$

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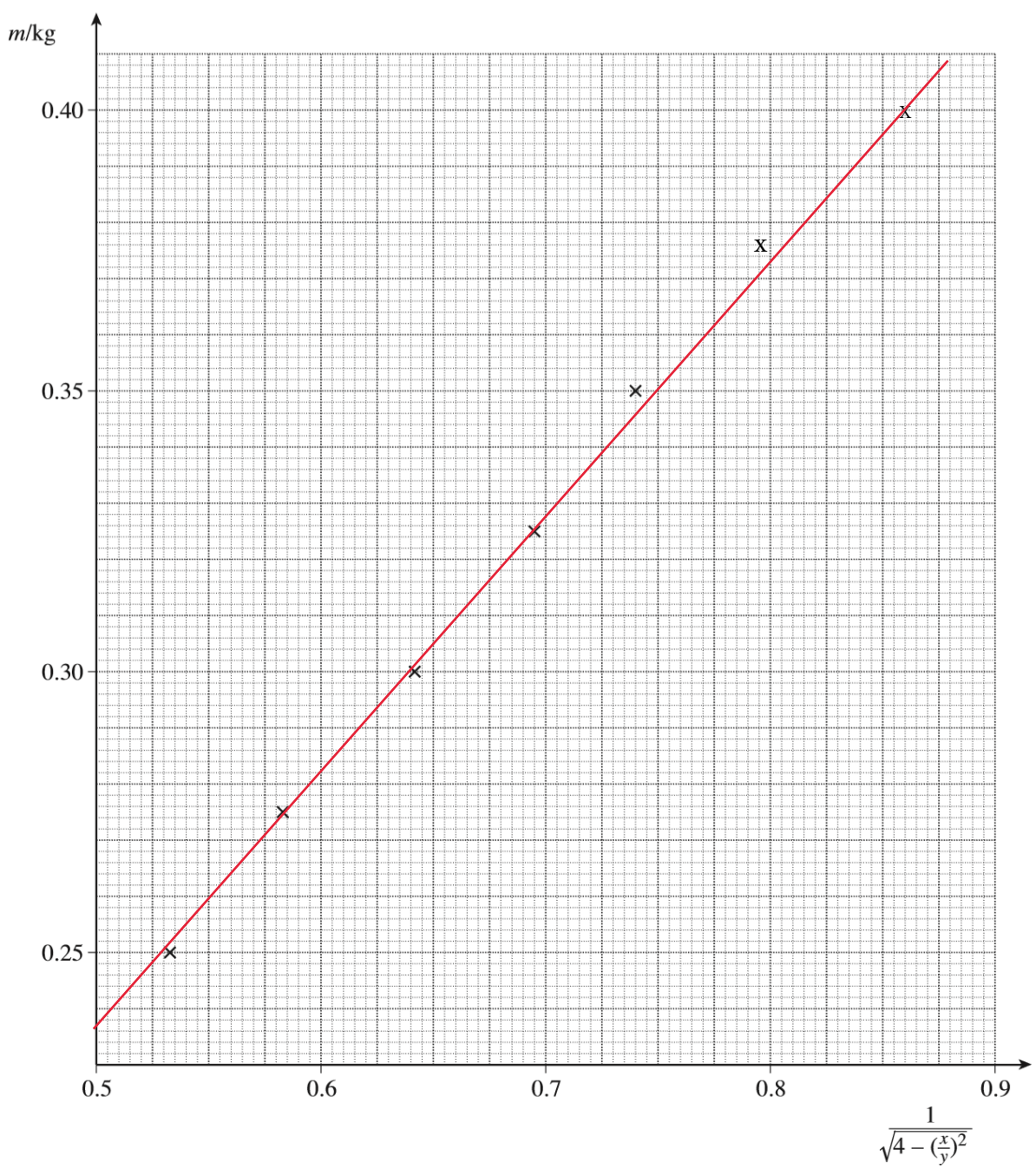
(1 mark)

- 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.

$$d = (\text{change in } y) / (\text{change in } x)$$

$$d = (0.641 - 0.584) / (0.300 - 0.275)$$

$$d = 0.057 / 0.025$$

$$d = 2.28$$

(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 .

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

$$W / 9.81 = 0.469924812$$

$$W = 4.609962406$$

$$W = 4.610$$

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

$$0.500 \text{ mm} \pm 1 \text{ mm} \quad 1 \text{ mm} / 0.500 \text{ mm} \times 100\% = 0.2\%$$

$$0.400 \text{ mm} \pm 2 \text{ mm} \quad 2 \text{ mm} / 0.400 \times 100\% = 0.5\%$$

$$D = M/V \quad 0.2\% + 0.5\% = \quad 0.7\%$$

$$\text{Times by the powers} \quad 0.7\% \times 2 = \quad 1.4\%$$

$$\text{Percentage uncertainty for } (x/y)^2 = \pm 1.4\%$$

(3 marks)

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

A systematic error is an error that is caused by a human error, meaning that it
cannot be caused by chance. for example, reading a measurement wrong on a
ruler.

(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 .

It would be a systematic error because of frictional losses. It would have meant
that the value of y would have been seen as less, meaning the value recorded
would not have been as much

(2 marks)