



Prifysgol Cymru

Y Drindod Dewi Sant

University of Wales

Trinity Saint David

LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 3

LEFEL 3

**EXAMINATION PERIOD
JANUARY 2019**

**CYFNOD ARHOLIADAU
IONAWR 2019**

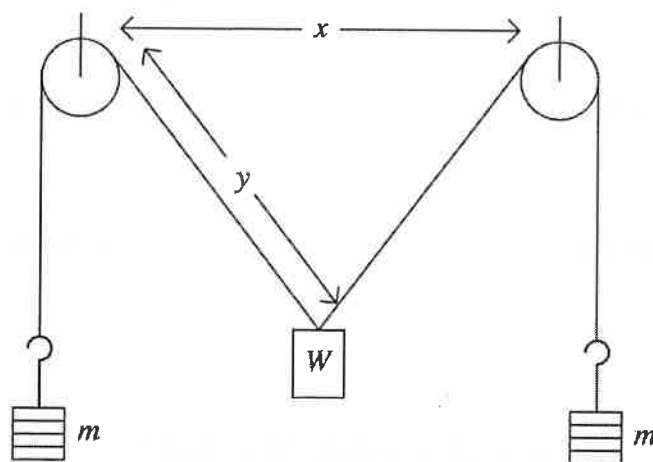
**MODULE CODE: M3X01513
SCIENCE**

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



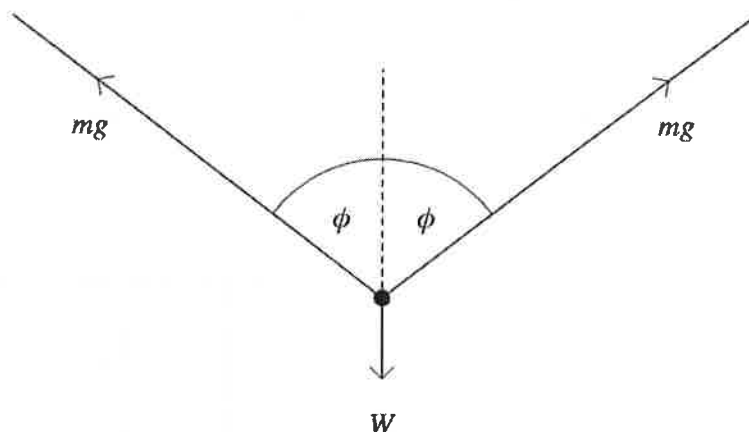
The distance x was kept constant throughout the experiment. The length y was measured for different values of m . The results are shown in the table.

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.

$$M = \frac{W}{2g \cos \phi} \quad 2 Mg \cos \phi = W$$

$$\phi = \cos^{-1} \left(\frac{W}{2mg} \right)$$

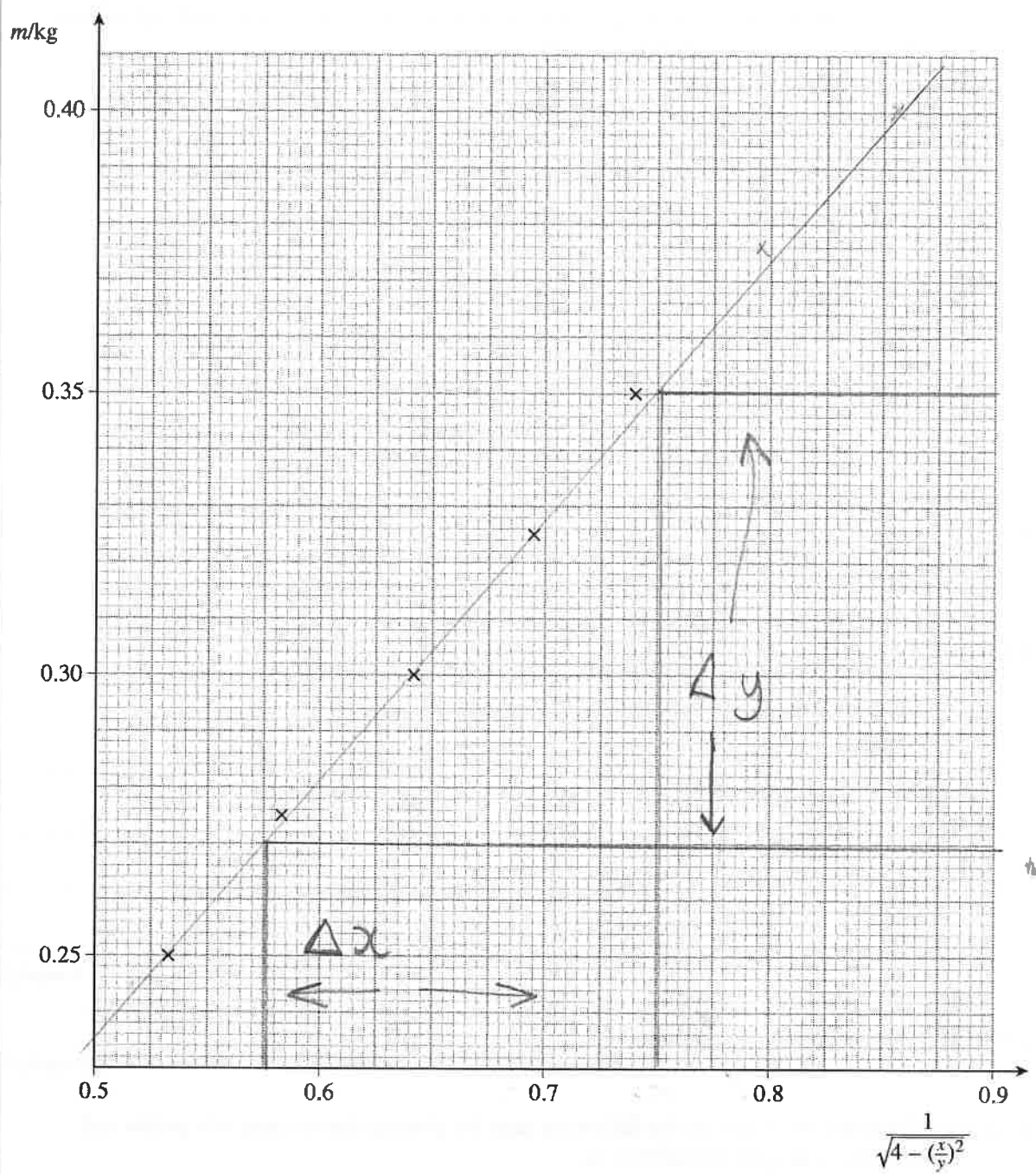
(1 mark)

- 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.

$$M = \text{gradient} \quad \Delta y = 0.35 - 0.27 = 0.08$$

$$\Delta x = 0.75 - 0.575 = 0.175$$

$$M = \frac{\Delta y}{\Delta x} = \frac{0.08}{0.175} = 0.457$$

$$M = 0.457$$

(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 .

$$\frac{0.350}{9.81} = \frac{W}{0.740}$$

$$0.350 \times 9.81 = W \times 0.740$$

$$\frac{0.350 \times 9.81}{0.740} = W \rightarrow W = 4.639$$

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

$$x = \pm 1 \text{ mm}$$

$$\frac{1 \times 10^{-3}}{0.500} \times 100 = 0.2\%$$

$$y = \pm 2 \text{ mm}$$

$$\frac{2 \times 10^{-3}}{0.400} \times 100 = 0.5\%$$

$$(0.2 + 0.5)^2 = 0.7^2$$

$$\text{So } 1.4\% = \text{Percentage Uncertainty}$$

(3 marks)

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

Systematic errors are errors of measurement due to readings that systematically differ from the true readings and follow a pattern or trend or bias.

(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 .

As the weight of m increases, so would the amount of friction on the pulleys, because the amount of friction increases each time, the value of y will decrease less each time more weight is added.

(2 marks)