



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

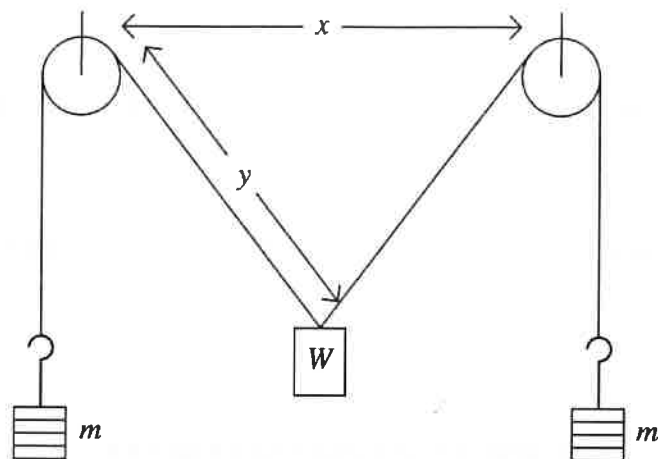
MODULE CODE: M3X01513
SCIENCE

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



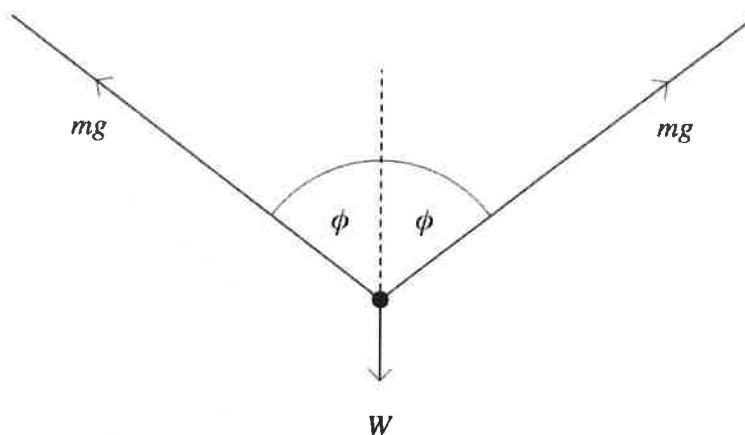
The distance x was kept constant throughout the experiment. The length y was measured for different values of m . The results are shown in the table.

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	2.41	0.790
0.400	0.308	2.64	0.86

- 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.

$$m = \frac{W}{2g \cos \phi}$$

$$W = (mg \cos \phi) + (mg \cos \phi)$$

$$W = 2(mg \cos \phi)$$

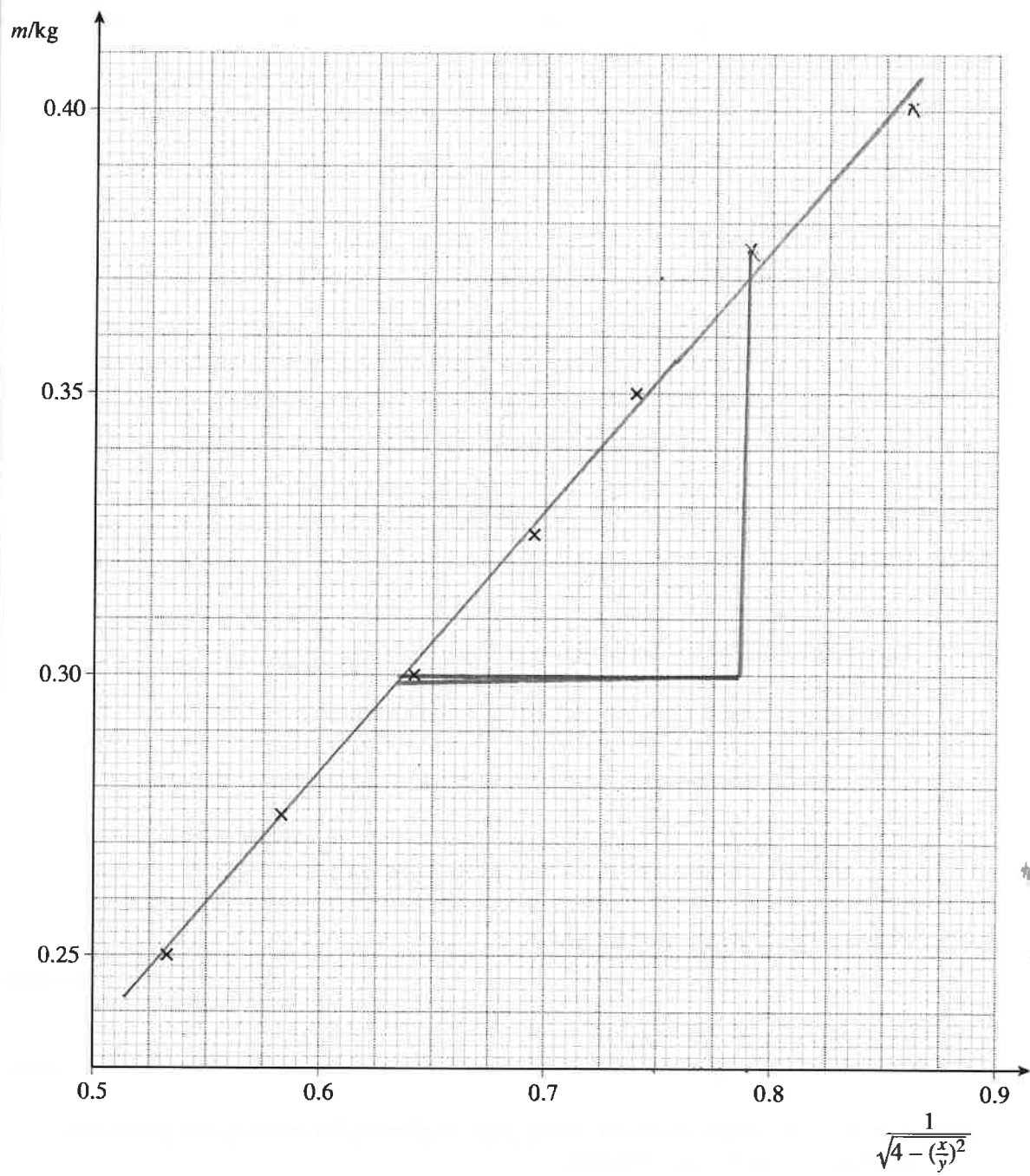
(1 mark)

- 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.

$$\frac{1}{\sqrt{4 - \left(\frac{0.30}{0.74}\right)^2}} = 0.5092642403$$

$$= 0.51 \quad 2dp$$

(3 marks)

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

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

$$4.00 = \frac{W}{9.81} \times 0.86 \quad m = 0.400$$

$$0.400 = \frac{W}{9.81} \times 0.86 \quad \frac{1}{\sqrt{4 - \left(\frac{x}{y}\right)^2}} = 0.790$$

$$9.81 \times 0.86 = \frac{W}{0.790} \quad W = 47.41 \text{ N} \quad \frac{0.40 \times 9.81}{0.790} = 4.56 \text{ N} \quad 2dp$$

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

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

$$\%y = \frac{2 \times 10^{-3}}{0.4} \times 100 = 0.5\%$$

$$(0.2 + 0.5)^2 = (0.7)^2 = 1.400\%$$

$$\text{Percentage uncertainty} = 1.4\%$$

(3 marks)

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

System error means that there is something that isn't recognized or hasn't been noticed before in the system. It also could mean that there has been a change in the procedure (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 friction in the pulleys may cause the ~~less~~ amount of y to increase. The greater the friction in the pulleys, the smaller a amount of y will decrease. The less ~~amount~~ amount of m = an increase of y

(2 marks)