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LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 3

LEFEL 3

EXAMINATION PERIOD
JANUARY 2019

CYFNOD ARHOLIADAU
IONAWR 2019

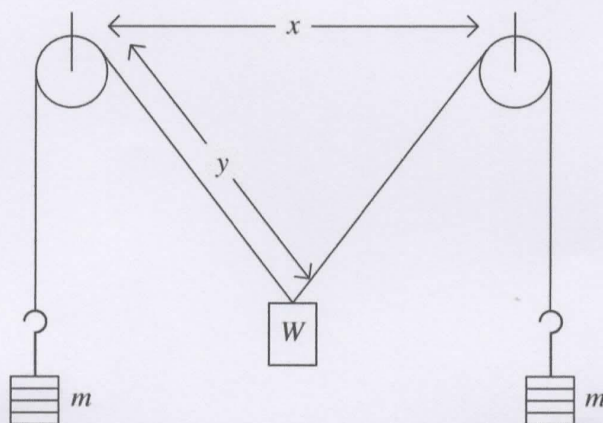
MODULE CODE: M3X01513
SCIENCE

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



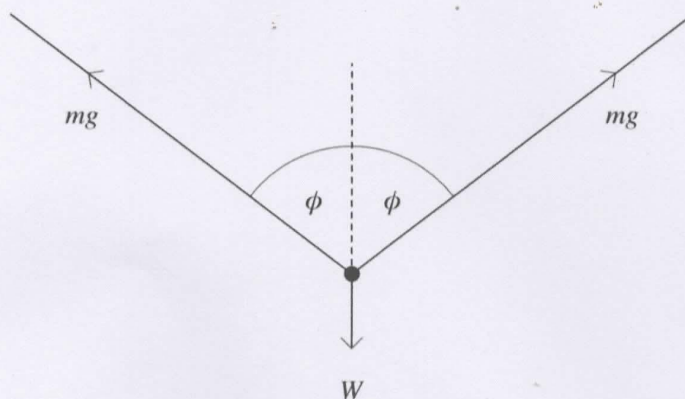
The distance x was kept constant throughout the experiment. The length y was measured for different values of m . The results are shown in the table.

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.

$$\cos \theta = 2mg/W$$

$$mg \cos \theta + mg \cos \theta = W$$

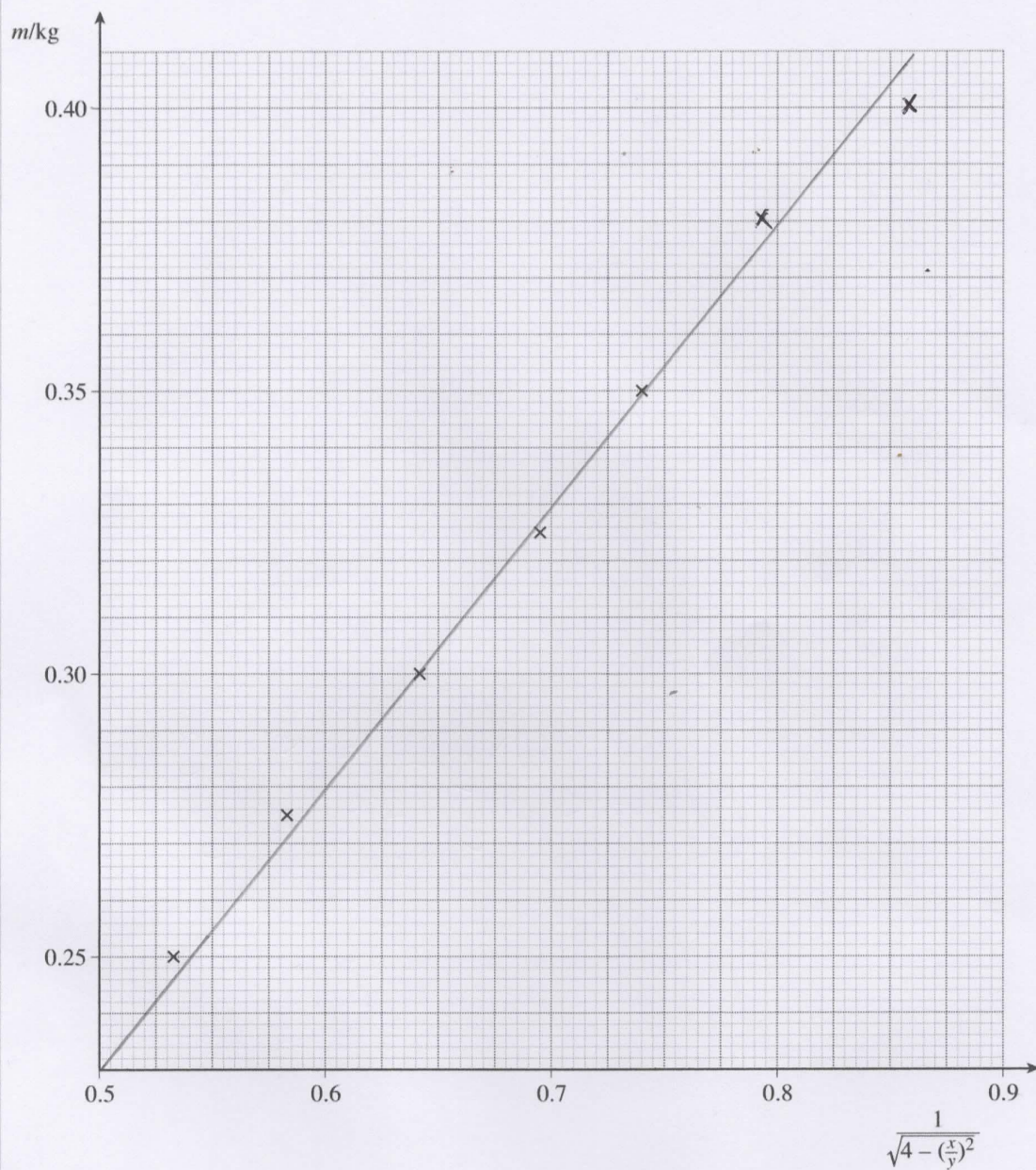
(1 mark)

- 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.

$$y = mx + c$$

$$m = (.28 - .23) / (.60 - .50) = .5$$

$$y = .5x + c$$

$$.23 = (.48)(.5) + c$$

$$c = -0.01$$

(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 .

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

$$W = (.48)(.695)(9.81) = 3.273$$

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

$$\text{Range} = 2.173$$

$$2.173 / 2 = \pm 1.087$$

$$U = \pm 1.087$$

$$\text{mean} = 1.749$$

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

$$\%U = 0.61 \%$$

(3 marks)

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

Systematic error is consistent, repeatable error association with faulty equipment or flawed experiment design.

(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 force of friction affects motion. Friction acts in the opposite direction of the motion, therefore it would produce a slightly inaccurate result in a practical experiment.

(2 marks)