



LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 3

LEFEL 3

EXAMINATION PERIOD
JANUARY 2019

CYFNOD ARHOLIADAU
IONAWR 2019

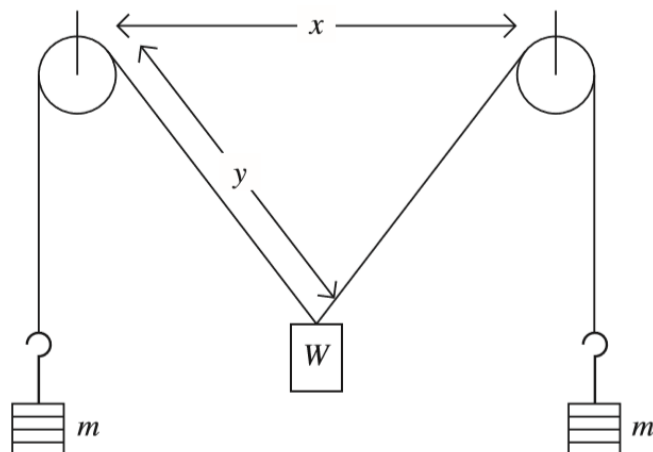
MODULE CODE: M3X01513
SCIENCE

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



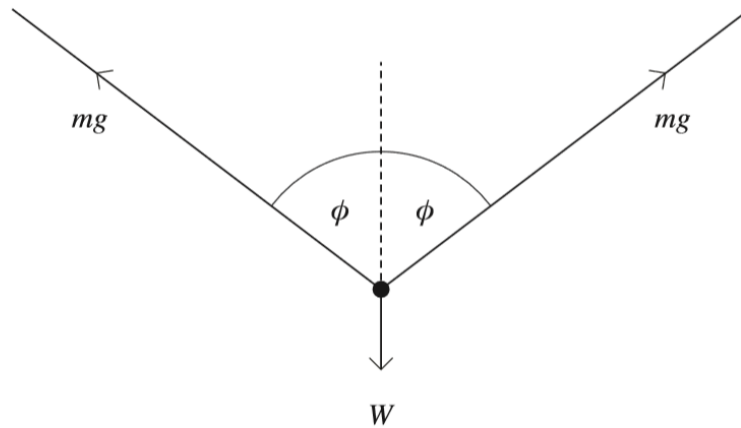
The distance x was kept constant throughout the experiment. The length y was measured for different values of m . The results are shown in the table.

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.

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

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

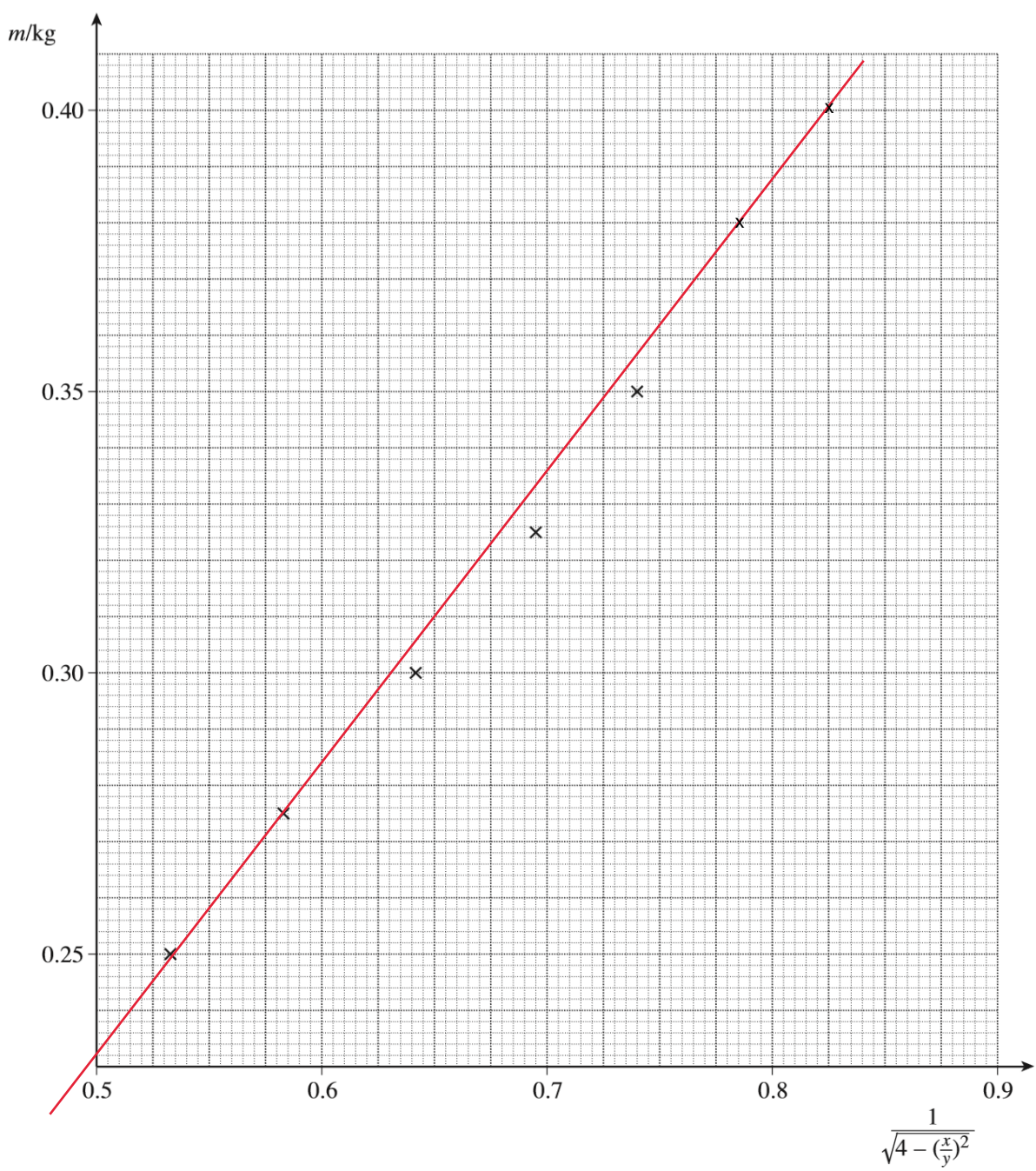
(1 mark)

- 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 - step (ΔY)
.....

x - step (ΔX)
.....

$$= \frac{0.267 - 0.250}{0.556 - 0.536}$$

$$= \frac{0.017}{0.020}$$

$$= \frac{17}{20}$$

$$= 0.85$$

(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 .

$$W = m g \sqrt{4 - (\frac{x}{y})^2}$$

$$W = (0.48) (0.695) (9.81) = 3.273$$

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

$$\text{Range} = 2.173$$

$$2.173 / 2 = 1.086$$

$$U = 1.086$$

$$\text{Mean} = 1.749$$

$$\%U = 1.086 / 1.749 = 0.62$$

$$\%U = 0.61\%$$

.....
.....
(3 marks)

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

A systematic error is an error that can be something done by the
system or device of which was an inaccurately gathered/entered.

(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 is the opposite to the applied force (motion) so accurately
measuring data will be difficult because the more applied force
you add the more friction you can expect.

(2 marks)