



**LOCATION: SWANSEA**

**LLEOLIAD: ABERTAWE**

**LEVEL 3**

**LEFEL 3**

**EXAMINATION PERIOD  
JANUARY 2019**

**CYFNOD ARHOLIADAU  
IONAWR 2019**

**MODULE CODE: M3X01513  
SCIENCE**

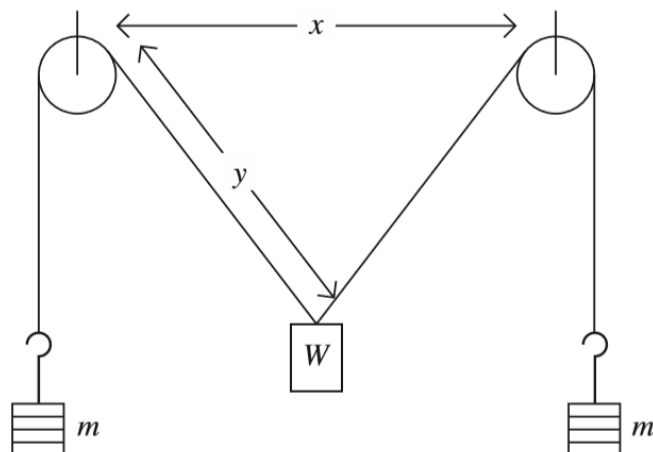
**COURSEWORK PART 2**

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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**



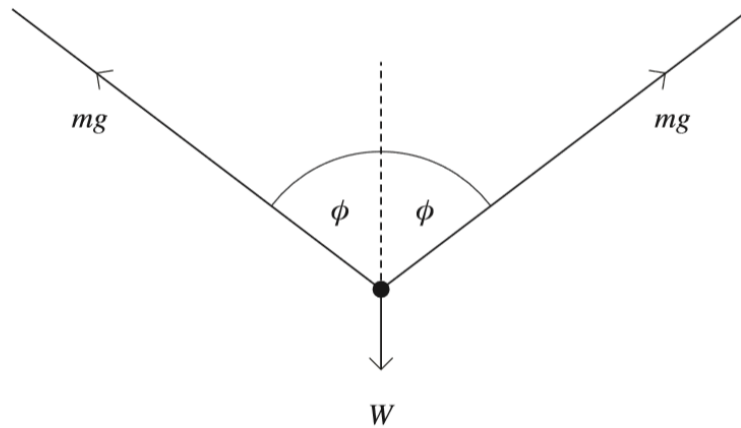
The distance  $x$  was kept constant throughout the experiment. The length  $y$  was measured for different values of  $m$ . The results are shown in the table.

The distance between the strings at the pulleys,  $x = 0.500$  m

| $m/\text{kg}$ | $y/m$ | $(\frac{x}{y})^2$ | $\frac{1}{\sqrt{4 - (\frac{x}{y})^2}}$ |
|---------------|-------|-------------------|----------------------------------------|
| 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  $\phi$  is the angle between each string and the vertical.

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

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

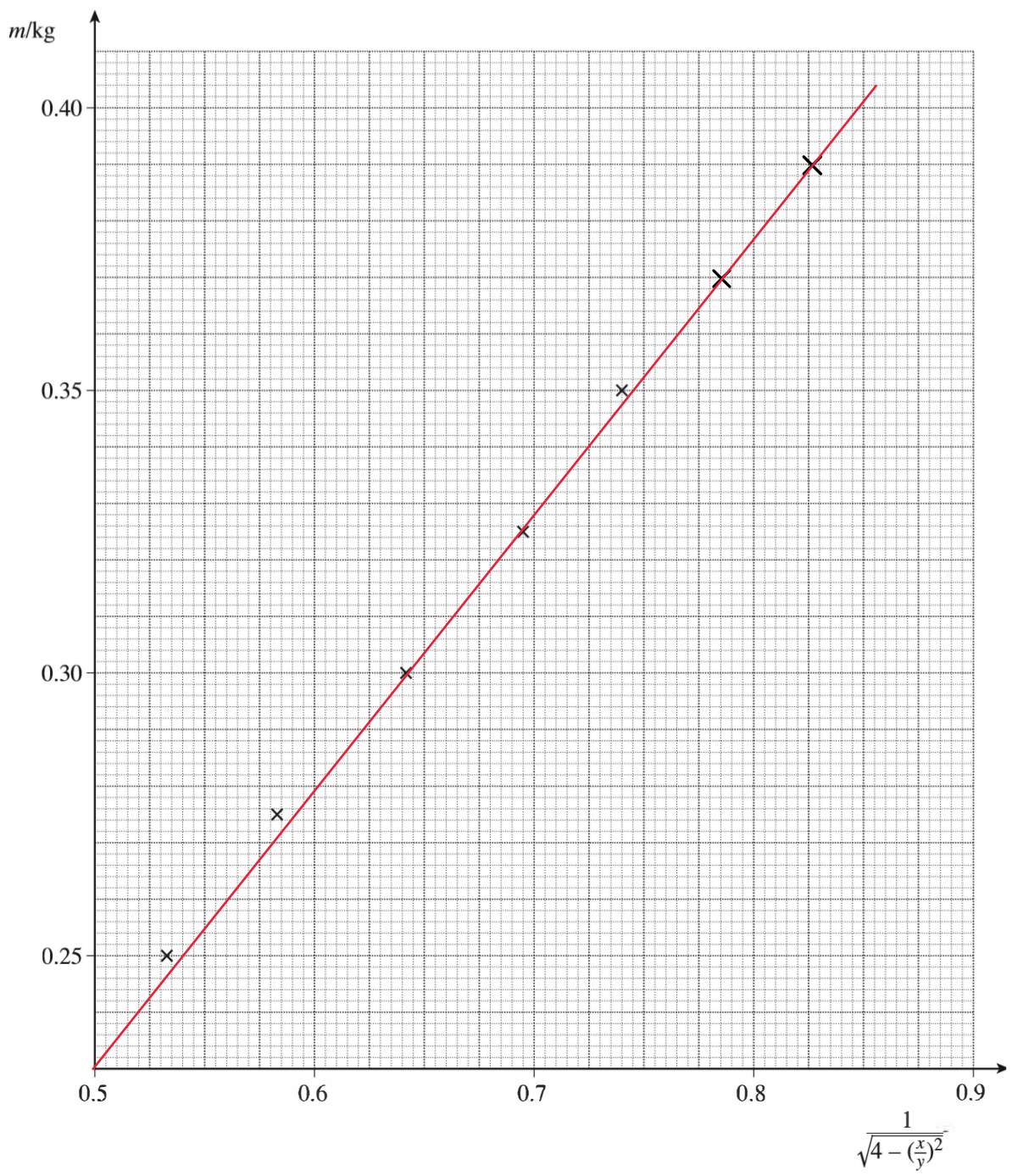
(1 mark)

- 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.

$$y = mx + c$$

$$m = 0.25/0.5, m = 0.5$$

$$y = .5(x) + c = 5$$

$$y = 0.5(0.5) + 0.5$$

$$y = 0.75$$

(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  $W$ .

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

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

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

$$\text{Range} = 2.173$$

$$2.173 / 2 = + \text{ or } - 1.087$$

$$U = + \text{ or } - 1.087$$

$$\text{Mean} = 1.749$$

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

$$\%U = 0.61\%$$

(3 marks)

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

Are errors that is not determined by chance, but through inaccuracy.  
.....  
.....  
.....

(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  $y$ .

Force of friction effects motion, Friction move's in the opposite direction of the  
motion, so it would produce a slightly inaccurate data in a practical experiment.  
.....  
.....  
.....

(2 marks)