

University of Wales Trinity Saint David

School of Engineering

Science practical and report

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Motorcycle Engineering

23/01.1019

Science m3x01513

Content

1. Apparatus set up
2. Method
3. Data
4. Uncertainties
5. Conclusion

1. Apparatus set up

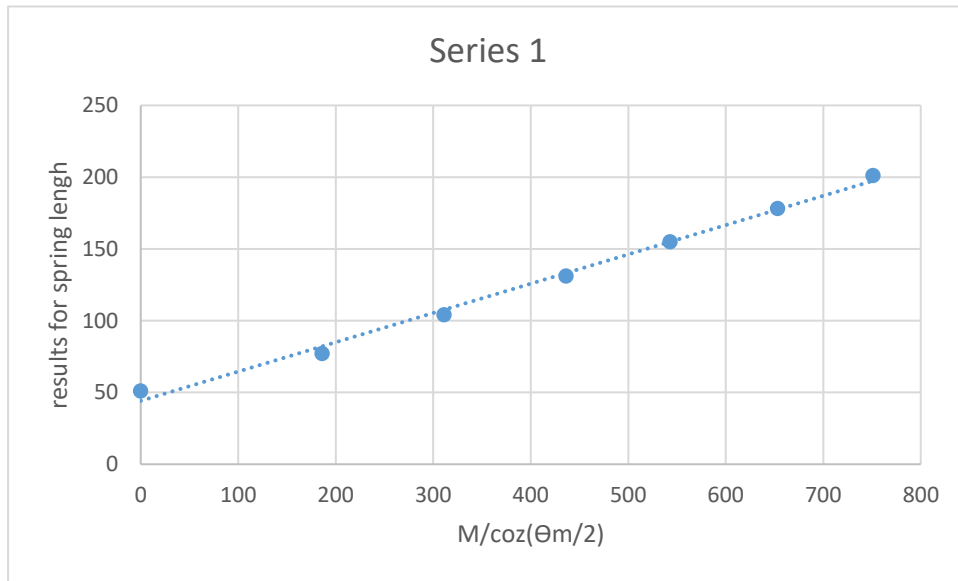
The apparatus was already set up but before using it I made sure all the clamps were tight and secure, then using a spirit level I made sure that the meter ruler on top was perfectly straight by ensuring the bubble on the level was dead centre. I leant down to eye level to get an accurate conclusion. Then the next step I did was to make sure the springs weren't stretched and that they were fixed exactly at 20 and 80 cm marks at vertical.

To build the apparatus and items used in the method are, retort stand, boss clamp, 1m wooden rule, two springs, attached 0.6m apart, 0.3m rule, protractor, spirit level, 0.05kg mass hanger, 11 x 0.05kg slotted masses.

2. Method

Before starting I made a table to record my data, I then checked I had all my items ready and all was secured and ready to go. I then began to measure each spring with zero mass on it, I did this with a ruler and got down to eye horizontal level. It was the whole length of the spring including the loops and then recorded down on the table I had made. I then applied a mass of 0.05kg on to the hanger which already had a mass of 0.05kg. I then continued the process again by measuring the spring length including the loops at the end of the springs. But before doing it I made sure the weight and everything was stationary and not bouncing as that would affect the results. Then I measured the angle with a protractor. This is done by the zero line at one side of the string then the angle is shown on the other string. Then to obtain a valid range of data you add 0.1kg of mass each time up to 0.6kg. And continue to do so step by step each time. To get a reliability recording you remove all mass and proceed to do so a second time. To get the best accuracy readings you hold the mass with your hands and rest your elbows on the table as a sturdy platform. Also make sure you hang the mass at the centre of the apparatus so it falls as equal as possible. When writing the results you write them in mm and kg and also with the protractor is measured in degrees.

3. Data



mass	length 1	length 2	angle °Θ	length 1	length 2	angle °Θ	Lm	Θm	$\frac{m}{\cos\left(\frac{\theta M}{2}\right)}$
(kg)	(mm)	(mm)	(Θ)	(mm)	(mm)	(Θ)	(mm)	(Θ)	
0	52	50	180	52	50	180	51	180	0
100	85	69	115	84	69	115	77	115	186
200	112	97	100	112	96	100	104	100	311
300	140	122	93	140	120	92	131	93	436
400	165	144	85	165	145	85	155	85	543
500	189	166	80	186	169	80	178	80	653
600	210	192	73	209	192	75	201	74	751

4. Uncertainties

mass	range	uncertainty	%uncertainty
(g)	(mm)	(mm)	
0	2	± 1	1.96
100	16	± 8	10.39
200	16	± 8	7.69
300	20	± 10	7.63
400	21	± 10.5	6.77
500	23	± 11.5	6.46
600	18	± 9	4.48

Uncertainty for Length

mass	range	uncertainty	%uncertainty
(g)	(°)	(°)	
0	0	± 1	0.56
100	0	± 1	0.87
200	0	± 1	1
300	1	± 1	1.08
400	0	± 1	1.18
500	0	± 1	1.25
600	2	± 1	1.35

Uncertainty for Angle

The angle measurements are very precise. The length measurements are somewhat precise except the 100 g. The rule of measurement is measured in mm with the ruler and the rule of angle is measured with a protractor in degrees

5. Conclusion

By looking through my results my conclusion is the more mass you add to the apparatus the smaller the angle gets from the centre of mass. The springs get longer and strings get more taught which gives a more accurate reading to the results.



LOCATION: SWANSEA

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LEVEL 3

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EXAMINATION PERIOD
JANUARY 2019

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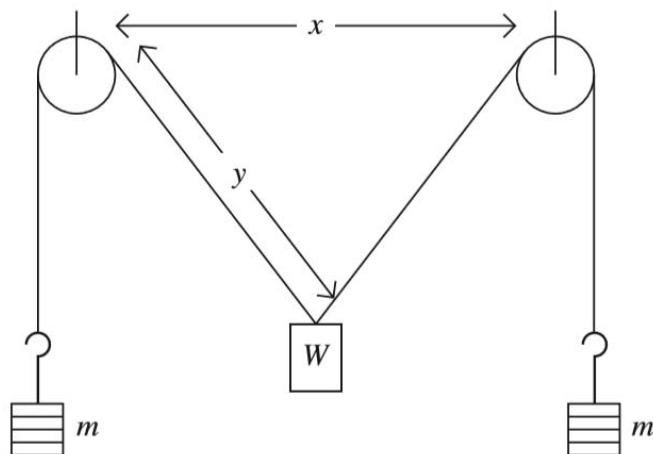
MODULE CODE: M3X01513
SCIENCE

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



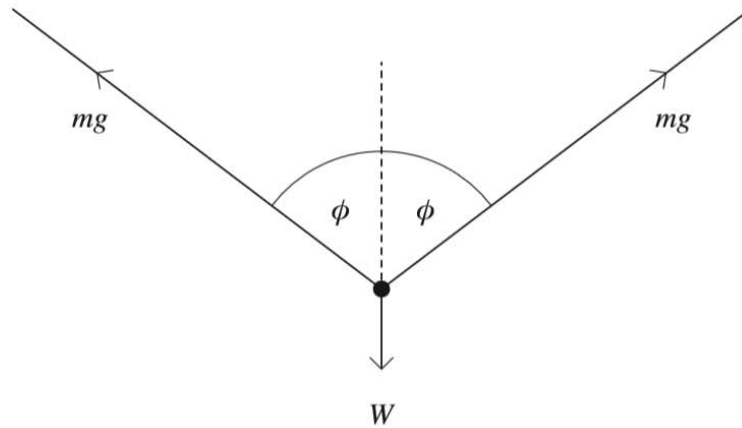
The distance x was kept constant throughout the experiment. The length y was measured for different values of m . The results are shown in the table.

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.

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

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

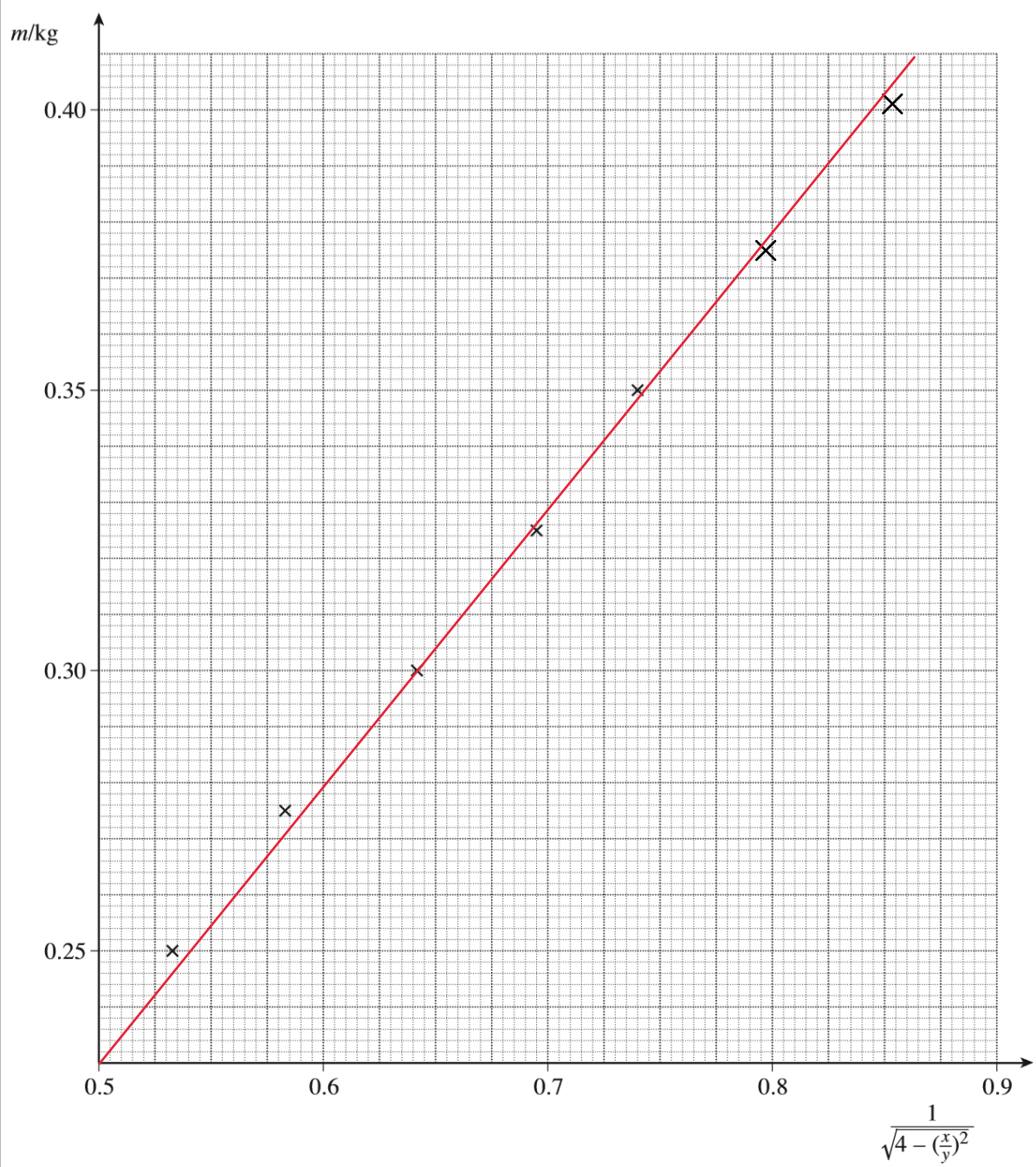
(1 mark)

- 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.

$$y = mx + c$$

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

$$y = .5x + c$$

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

$$c = -0.01$$

(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 .

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

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

(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 are not determined by chance but are introduced by an inaccuracy
inherent to the system.

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

(2 marks)