

## LEVEL 4 ASSESSMENT SPECIFICATION

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                      |             |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|-------------|
| Student name:                   | Conor Griffiths                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Student ID number:                                   |             |
| Programme:                      | HNC/D MECHANICAL ENGINEERING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                      |             |
| Module:                         | ENGINEERING SCIENCE 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                      |             |
| Module code:                    | M4X00385                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Contribution to Overall Module Assessment (%):       | 30%         |
| Lecturer:                       | Emily Nyathi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Internal Verifier:                                   | Nigel Evans |
| Assignment Title:               | PRACTICALS I & II (SIMPLE HARMONIC MOTION AND BENDING MOMENT)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Word count (or equivalent):                          |             |
| Submission deadline:            | 13/01/2020                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Return date of provisional marks & written feedback: | 21/01/2020  |
| Submission method:              | <p>All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.)</p> <p><b>Alternative submission method (if applicable):</b></p> <p><b>Late submission of the assessment will result in a late penalty mark.</b> Penalties for late submission: Up to one-week late, maximum mark of 40%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.</p> |                                                      |             |
| Academic honesty / referencing: | <p>Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.</p>                                                                                                                                                                                                                                                                                              |                                                      |             |

## STUDENT FEEDBACK FORM

This section details the *extent* to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

| Generic Assessment Criteria                                                                                                                                                                                                                                                                                                                                    | Marks available | Marks awarded |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------|
| <b>1. Engagement with Literature Skills</b>                                                                                                                                                                                                                                                                                                                    |                 |               |
| Your research work shows little evidence of wider reading and no referencing at all.                                                                                                                                                                                                                                                                           | 25              | 7             |
| <b>2. Knowledge and Understanding Skills</b>                                                                                                                                                                                                                                                                                                                   |                 |               |
| You have demonstrated a basic understanding of the applications of some of the equations appropriate to the tasks given, however you need to proofread your work for errors. Labelling your Free Body Diagrams correctly, calculating your shear forces and drawing the correct Bending moment and Shear force Diagrams could have scored you more marks here. | 30              | 14            |
| <b>3. Cognitive and Intellectual Skills</b>                                                                                                                                                                                                                                                                                                                    |                 |               |
| You have presented your results using tables, graphs and diagrams, however your evaluation of the underlying concepts is limited and tending towards description.                                                                                                                                                                                              | 15              | 7             |
| <b>4. Practical Application Skills</b>                                                                                                                                                                                                                                                                                                                         |                 |               |
| Giving real life applications of the SHM and BM applications in the Engineering Industry could have scored you more marks here.                                                                                                                                                                                                                                | 25              | 12            |
| <b>5. Transferable Skills for Life and Professional Practice</b>                                                                                                                                                                                                                                                                                               |                 |               |
| Demonstrates the basic skills for employment requiring the exercise of personal responsibility and decision-making. However, there is need to improve on presentation skills                                                                                                                                                                                   | 5               | 2             |

|                                                                                                                                                                                                           |                                                        |  |            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|--|------------|
| <b>Assessment Mark</b> (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.) | <b>Late Submission Penalties (tick if appropriate)</b> |  | <b>42%</b> |
|                                                                                                                                                                                                           | Up to 1 week late (40% Max)                            |  |            |
|                                                                                                                                                                                                           | Over 1 week late (0%)                                  |  |            |

## Level 4 – Engineering Science 1

### Assignment 2: Experiment Simple Harmonic Motion

Conor Griffiths

#### Experiment 1: Simple Harmonic Motion

i). I was asked to carry out and investigate a simple harmonic motion experiment and record my findings. The purpose of this experiment is to understand how the pendulum is used to demonstrate harmonic motion. In this test I will investigate the effect of mass and length on the period of oscillation of a simple pendulum.

#### Introduction

ii). Galileo Galilei was an Italian physicist and engineer who first demonstrated a pendulum swing back in 1600's. He first discovered the motion of a pendulum whilst observing a lamp swinging and was curious the time it took to complete one period. Galileo studied further into this and in later years discovering The Law of Pendulum. Fast forward to 1650's, where the scientist Christiaan Huygens built the first pendulum clock which was all based off Galileo findings and we still use the pendulum clocks today. For this experiment, we would be doing the same test that Galileo had done in hoping to replicate his results.

#### Theory

iii). A pendulum test is carried out with a mass is hanging at the end of a piece of string, you would then record which angle which you have dropped the mass from and then you would record the time that is taken to complete a cycle within the period. A cycle is when the string is released and swings forward and back to its original starting point. Some physical factors will contribute to behavior of the pendulum such as the mass and what the angle of what the mass is released from. The period of the pendulum would then be worked out using the formula;

$$T = 2\pi\sqrt{\frac{L}{g}}$$

\*T=Period of time\*

\*L=length of string\*

\*G=gravity\*

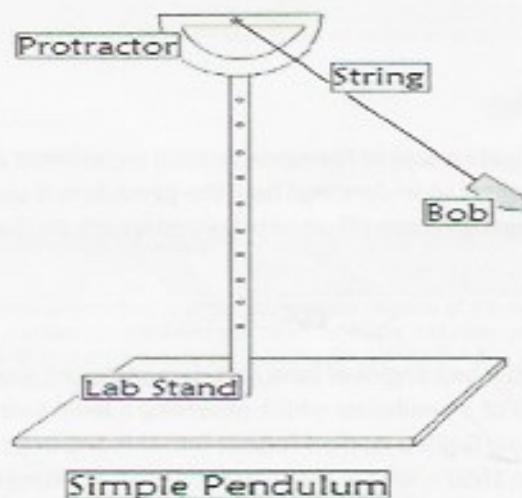
$$T = 2\pi\sqrt{\frac{m}{k}}$$

Hooke's Law

$$F = Mg \sin\theta$$

### Equipment

iv).



### Procedure

v). Firstly, I gathered all the relevant equipment and made sure that the working environment around me was clear and that nothing was going to affect my results. I selected a stand which looked sturdy and had a wide base which I believed would prevent any rocking. I collected the string and scissors and cut the piece to my required length for my first test (310mm), tying a securing knot on the end for my weighted hook. With the equipment ready and set up, I gathered some other relevant equipment such as calculator, stop watch and protractor. In our group we discussed factors of the test such as mass, length of the string, angle of which the mass would be released. We also allocated specific roles to a team member to ensure that our results were as accurate as possible, and that there were no defects e.g. one member releasing the weight, one member checking the angle, and another member being as accurate as possible with the counting and stopwatch. Once all the above was set, we were finally ready to carry out the test. We located our string with our first weight and put it to our required angle making sure that there was no slack within the string. Once the weight was released, we started the stop watch and once we counted 10 oscillations, we would stop the clock and record our results. We carried out the same steps for the rest of the experiment whilst changing up the weight, length of string and angle from where the weight was being released.

## Results

vi).

| WEIGHT | LEGNTH | TIME FOR 10 OSILLATION | PERIOD (s) | THERETICAL PERIOD (s) | ANGLE |
|--------|--------|------------------------|------------|-----------------------|-------|
| 50G    | 310MM  | 12.8                   | 1.28       | 1.116                 | 40    |
| 100G   | 310MM  | 13.26                  | 1.326      | 1.116                 | 40    |
| 150G   | 310MM  | 13.86                  | 1.388      | 1.116                 | 40    |
| 200G   | 310MM  | 13.4                   | 1.34       | 1.116                 | 40    |
| 50G    | 225MM  | 12.03                  | 1.203      | 0.951                 | 40    |
| 100G   | 225MM  | 12.32                  | 1.232      | 0.951                 | 40    |
| 150G   | 225MM  | 12.95                  | 1.295      | 0.951                 | 40    |
| 200G   | 225MM  | 12.6                   | 1.26       | 0.951                 | 40    |
| 50G    | 225MM  | 12.18                  | 1.218      | 0.951                 | 30    |
| 100G   | 225MM  | 12.35                  | 1.235      | 0.951                 | 30    |
| 150G   | 225MM  | 12.24                  | 1.224      | 0.951                 | 30    |
| 200G   | 225MM  | 12.67                  | 1.267      | 0.951                 | 30    |
| 50G    | 150MM  | 10.65                  | 1.065      | 0.776                 | 20    |
| 100G   | 150MM  | 10.79                  | 1.079      | 0.776                 | 20    |
| 150G   | 150MM  | 10.96                  | 1.096      | 0.776                 | 20    |
| 200G   | 150MM  | 10.62                  | 1.062      | 0.776                 | 20    |

Once we completed the experiment, I compared my results of theoretical period and of the experimental period. Theoretical pendulum period example calculation:

The pendulum length (l) = 300mm (0.3m)

Acceleration due to gravity (g) =  $9.81 \text{ m.s}^{-2}$ .

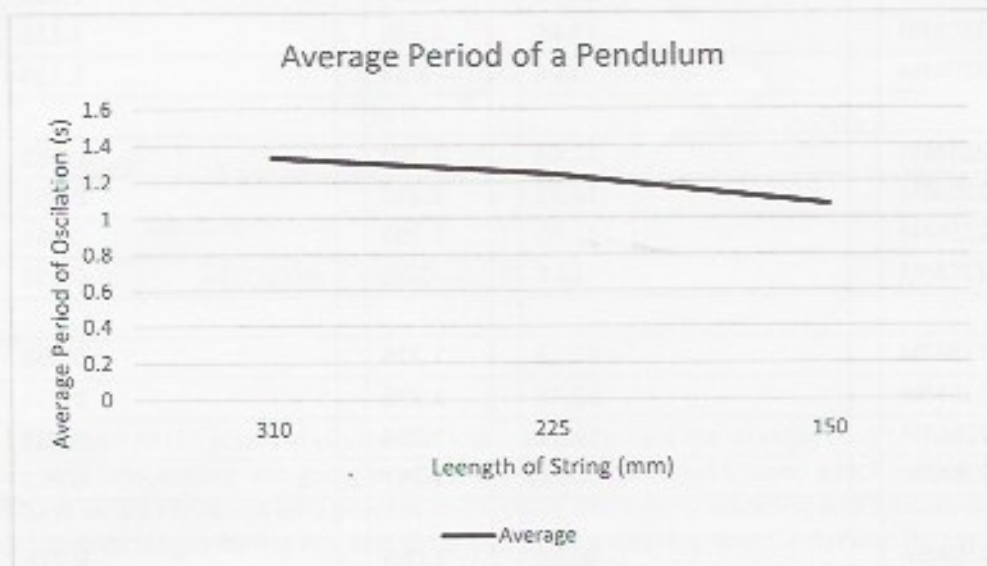
$$l/g = 0.3/9.81 = 0.0306$$

$$\sqrt{0.0306} = 0.175$$

$$2 \cdot \pi \cdot 0.175 = 1.1 \text{ seconds theoretical period.}$$

The following table shows that it does not matter what angle the mass was dropped from as it does not affect the period in which it completes an oscillation. From my results table, I will work out the average of my string length and put them in a graph below.

| Length (mm) | Time for 10 Oscillations (s) | Period (s) | Average Period (s) |
|-------------|------------------------------|------------|--------------------|
| 310         | 13.33                        | 1.333      | 1.3335             |
| 225         | 12.4175                      | 1.24175    | 1.24175            |
| 150         | 10.755                       | 1.0755     | 1.0755             |



### Observations

vii). Whilst I was happy with my results from my experiment, I also believe that there might have been a few issues that I think might have affected the results. When I was undertaking the experiment, I noticed a couple of human errors which I believed to have influence on my results. Errors such as measuring the period of an oscillation, reaction time of starting and stopping the stop watch and angle from which the mass was being released from. I found when we upped the mass and angle that it would cause the working surface to shake and make the mass swing more round than back forth. For future experiments I would take these factors into account and pick a more solid working platform to more accurate results.

*What effect (if any) does mass have on the period of oscillation of the pendulum?*

### Task B

i).  $T = 2\pi\sqrt{l/g}$   $T^2 = 4\pi^2 l/g$   $g = 4\pi^2 l/T^2$

ii). Looking at my results from my experiment, it can be shown that the period of oscillation of a pendulum is determined by only the length of the string that the mass is being released from, although the mass does not affect the oscillation.

$$\text{iii). } T = 2\pi\sqrt{\frac{l}{g}}$$

$$T^2 = 4\pi^2 \frac{l}{g}$$

$$l = \frac{T^2 g}{4\pi^2}$$

$$l = \frac{1.5^2 \times 9.81}{4\pi^2} = 0.559m$$

iv).

When simple pendulum will be placed on the surface of moon then its time period increases hence simple pendulum oscillates slowly.  $T=2\pi\sqrt{l/g}$ , put the value of  $g=1/6$  because gravity on moon is one sixth as compare to the Earth. Then, we get the value which prove simple pendulum will works slowly.

#### References

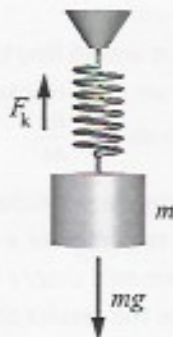
<https://www.quora.com/What-will-happen-to-simple-pendulum-set-in-motion-on-moon>

*use scholarly sources*

#### Experiment 1 – Simple Harmonic in a Spring

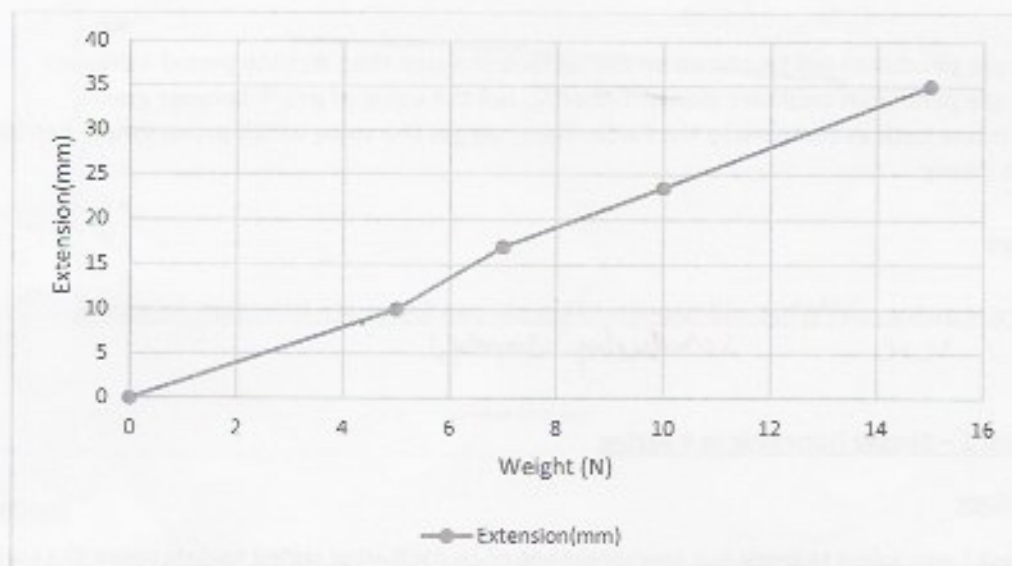
##### Methodology

For this task I was asked to carry out an experiment of an oscillating spring to determine the spring constant of a spring. Firstly, I gathered all the relevant equipment and made sure that the working environment around me was clear and that nothing was going to affect my results. Using a clamp stand, I attached my selected spring to the hook provided and attached my meter-long rule to the stand. A weight is then hooked on and released, and we then take the measurement when it reaches full extension. I then input my results to the below table and repeated this test with several different weights.



## Results

| Weight(N) | Original Length(mm) | Final Length (mm) | Extension(mm) |
|-----------|---------------------|-------------------|---------------|
| 0         | 20                  | 20                | 0             |
| 5         | 20                  | 30                | 10            |
| 7         | 20                  | 37                | 17            |
| 10        | 20                  | 43.5              | 23.5          |
| 15        | 20                  | 55                | 35            |



To calculate the spring constant,  $k$  it is necessary to find the gradient of the graph:

$$k = \frac{\Delta F}{\Delta x}$$

$$k = 1.933 \text{ N/mm} = 1933 \text{ N/m}$$

## Conclusion

In our first experiment, the test we carried out was to find the spring constant of a spring. Using the results plotted in the table and graph above, we used Hooke's law to help us investigate the simple harmonic motion of the spring using the formula  $k = \frac{\Delta F}{\Delta x}$ .

In my second experiment, I demonstrated a simple pendulum test by simply releasing a mass from a required angle and recorded the time it took to complete a period of oscillation. As shown in my table above, my results have proven the simple harmonic theory that depending on the length of which the mass is being released from only has effect on the results of the time of the period of the oscillation. Therefore, the mass or angle from where it is being released does not have an effect.

*Give real-life examples of the applications of SHM.*

## Level 4 – Engineering Science 1

### Assignment 2: Bending Moments in Beams

Conor Griffiths

#### Experiment 2 – Bending Moments in Beams

i). For this task I was asked to carry out a bending moments experiment and recording my findings. The purpose of this experiment is to determine the bending moment of a beam that is supported but also put under various concentrated loads.

#### Introduction

ii). A bending moment is a <sup>ref</sup>measure of the bending effect that can occur when an <sup>ref</sup>force is applied to a structural element. This concept is important in structural engineering as it can be used to calculate where and how much bending is occurring when forces are being applied. A structural element such as a beam is designed to withstand or to support a reaction from external force. The bending moment experiment is to help understand the effects of when an external force is applied as it is important when studying the strength of a beam. Bending moments that bend a beam upwards are positive bending moments, bending down are negative bending moments.

#### Theory

iii). To help with my understanding of what formulas I would need to help assist me in the experiment, I researched online and found formulas that would help me with converting Kilograms to newtons etc.

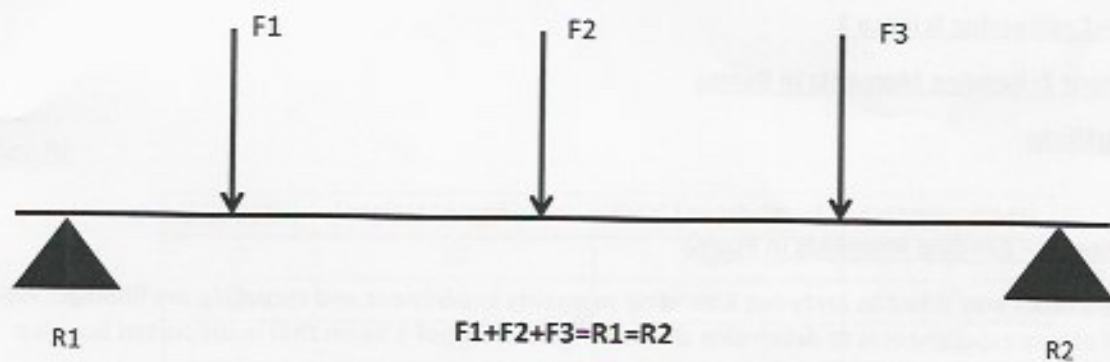
$$F=ma$$

Where  $m$  is the inertial mass and  $a$  is the acceleration.

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

The general bending equation

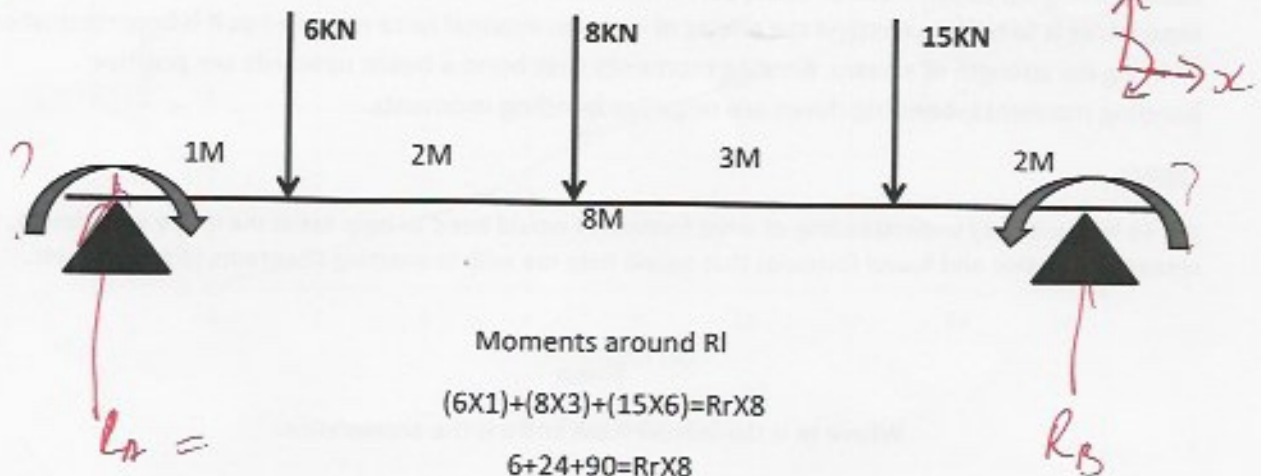




$\sum \text{Forces up} = \sum \text{Forces down}$

$\sum \text{Clockwise moments} = \sum \text{Anticlockwise moments}$

F.B.D.



Moments around  $R_1$

$$(6 \times 1) + (8 \times 3) + (15 \times 6) = R_2 \times 8$$

$$6 + 24 + 90 = R_2 \times 8$$

$$120 = R_2 \times 8$$

$$120/8 = R_2$$

$$R_2 = 15kN$$

Using forces up = forces down

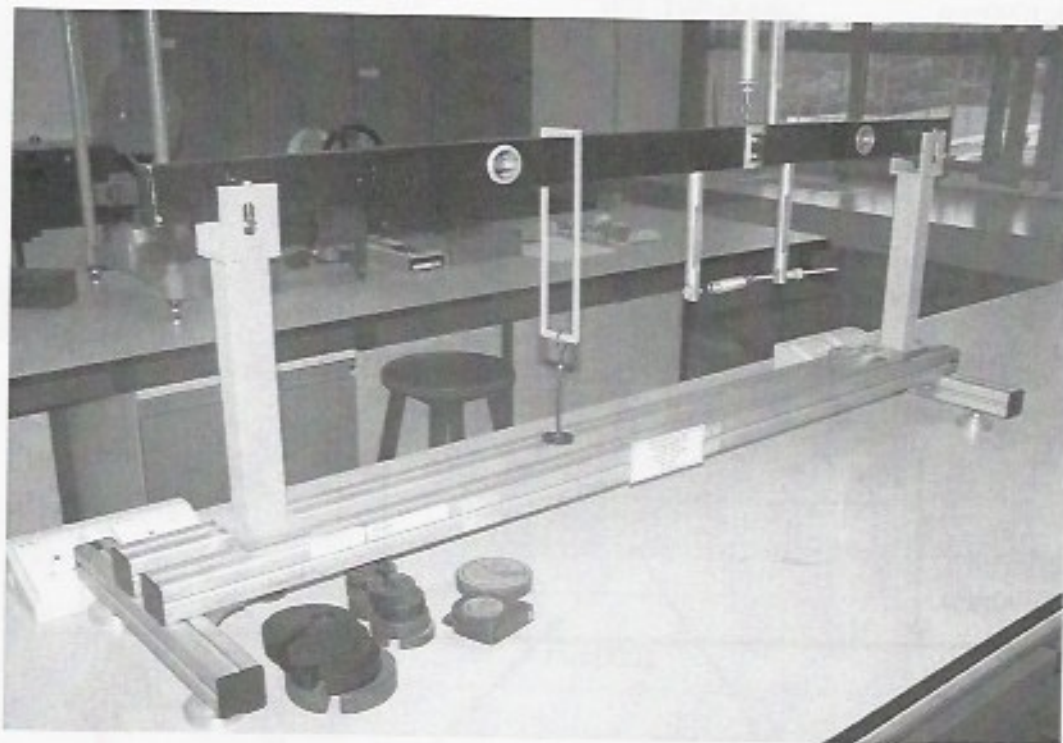
$$R_1 + R_2 = 6 + 8 + 15$$

$$R_1 + 15 = 29$$

$$R_1 = 29 - 15 = 14kN$$

### Equipment Used

iv). For this experiment I used a bending moment apparatus, the equipment I used is as per picture below;



The bending moments apparatus that we used consisted of an experimental beam, 3 weight hangers, 100kg of weights in various sizes, 2 supports and a spring balance which would give your results of the bending moment applied to the beam. The hangers were mountable, and you could locate to any position along the beam. The experimental beam is designed to be in two parts but joined with low friction ball bearings. The spring would then be supporting the beam giving it resistance which helps to give you your measurements. We also used a rule to measure the placement of hangers and our supports and a spirit level to check beam is flat.

### Procedure

v). Firstly, I gathered all the relevant equipment and documents and made sure that the working environment around me was clear and that nothing was going to affect my results. I selected a solid working platform and set up my bending moment apparatus. I then had to decide my datum edge, this is where all my measurements for my table was going to be documented from. I then distanced each of my three hangers across the beam and checked that the level of my beam was straight using a spirit level, this would be done by tightening up a butterfly nut which would pull the spring balance back to zero. I then proceeded with the experiment and added weight to each hanger ( $W_1=1\text{kg}$ ,  $W_2=2.5\text{kg}$ ,  $W_3=1\text{kg}$ ) and the tightened up the butterfly nut until liquid of the spirit level was once again in the center position. This would then give you a reading of how much force was being applied to the beam, I documented my results into a table as you can see below.

Take bending  $M_o$  @ ant

$$M_c = F_c \times 0.15\text{m}$$

### Results of Experiment

Overall Length: 1000mm

Load At: W1: 10N

W1: 80mm

W2: 20N

W2: 635mm

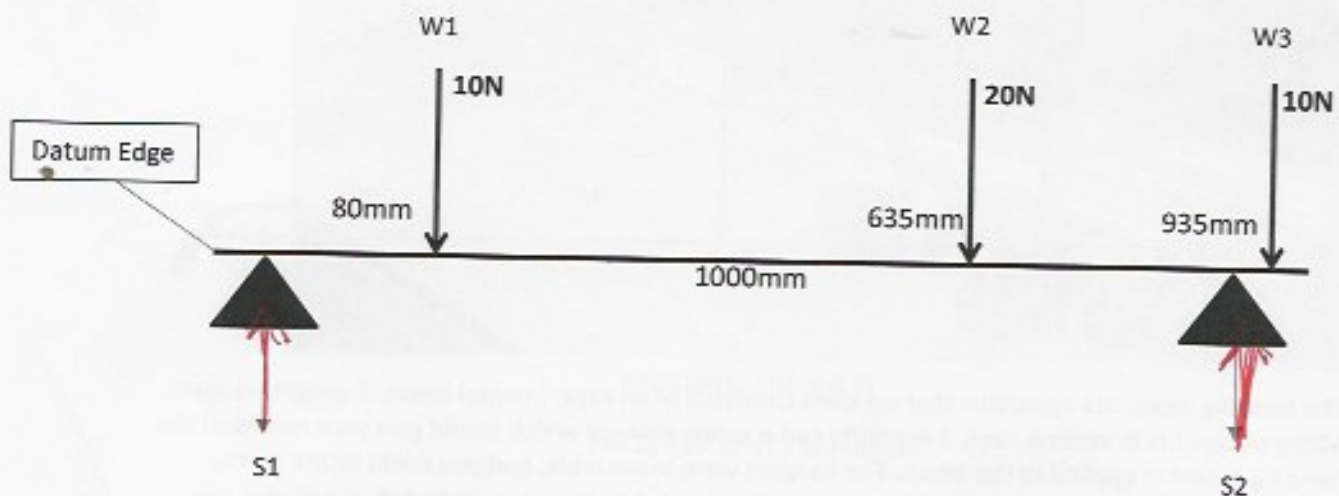
W3: 10N

W3: 935mm

S1: 170mm

$N/m = 3N/m$

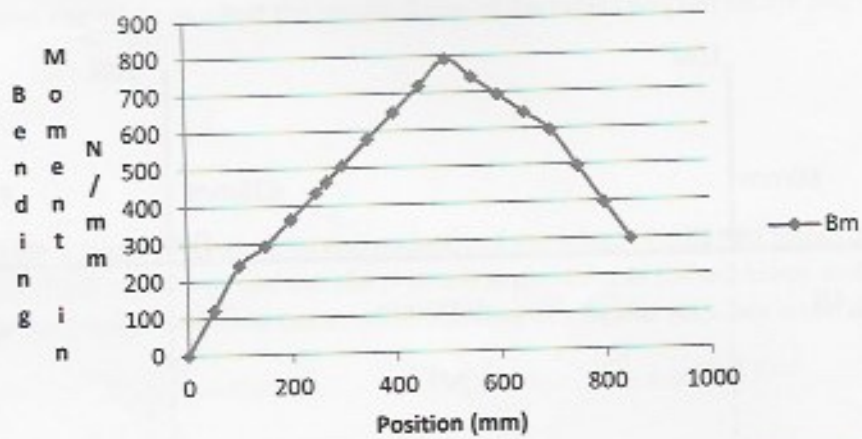
S2: 840mm



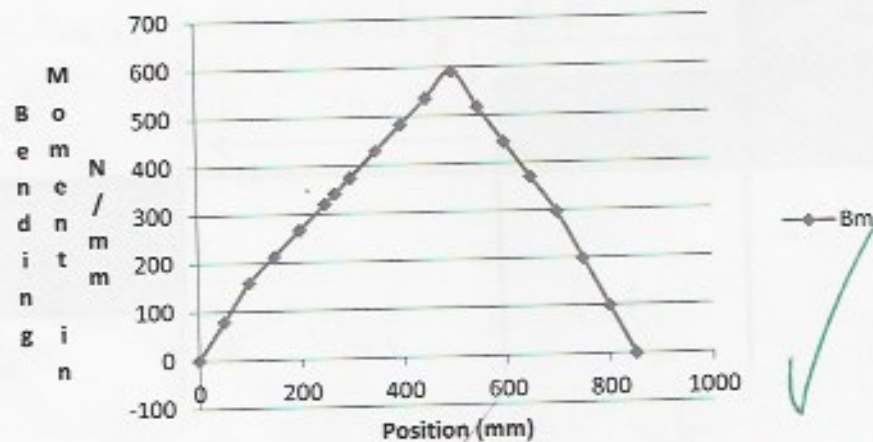
I then input my results into an excel spread sheet and compared them to official results, I also plotted a graph of my results and compared them to other results. When comparing the results from my experiment to the theoretical results, it is easy to notice a number differentness between them. Starting off test one is using a longer beam than test two for the experiment, the supports holding the beam are also in different locations for each other in both tests. The position of each hanger is in different places and also different measurement of weight was use, leaving the results being different.

|        | L    | A   | B   | W1(KG) | P1  | W2(KG) | P2  | W3(KG) | P3  | Before (N/m) | After |
|--------|------|-----|-----|--------|-----|--------|-----|--------|-----|--------------|-------|
| Test 1 | 1000 | 170 | 150 | 1      | 80  | 2.4    | 635 | 1      | 935 | 0            | 3     |
| Test 2 | 850  | 270 | 150 | 0.51   | 100 | 2.55   | 500 | 0.51   | 700 | 1            | 3.3   |

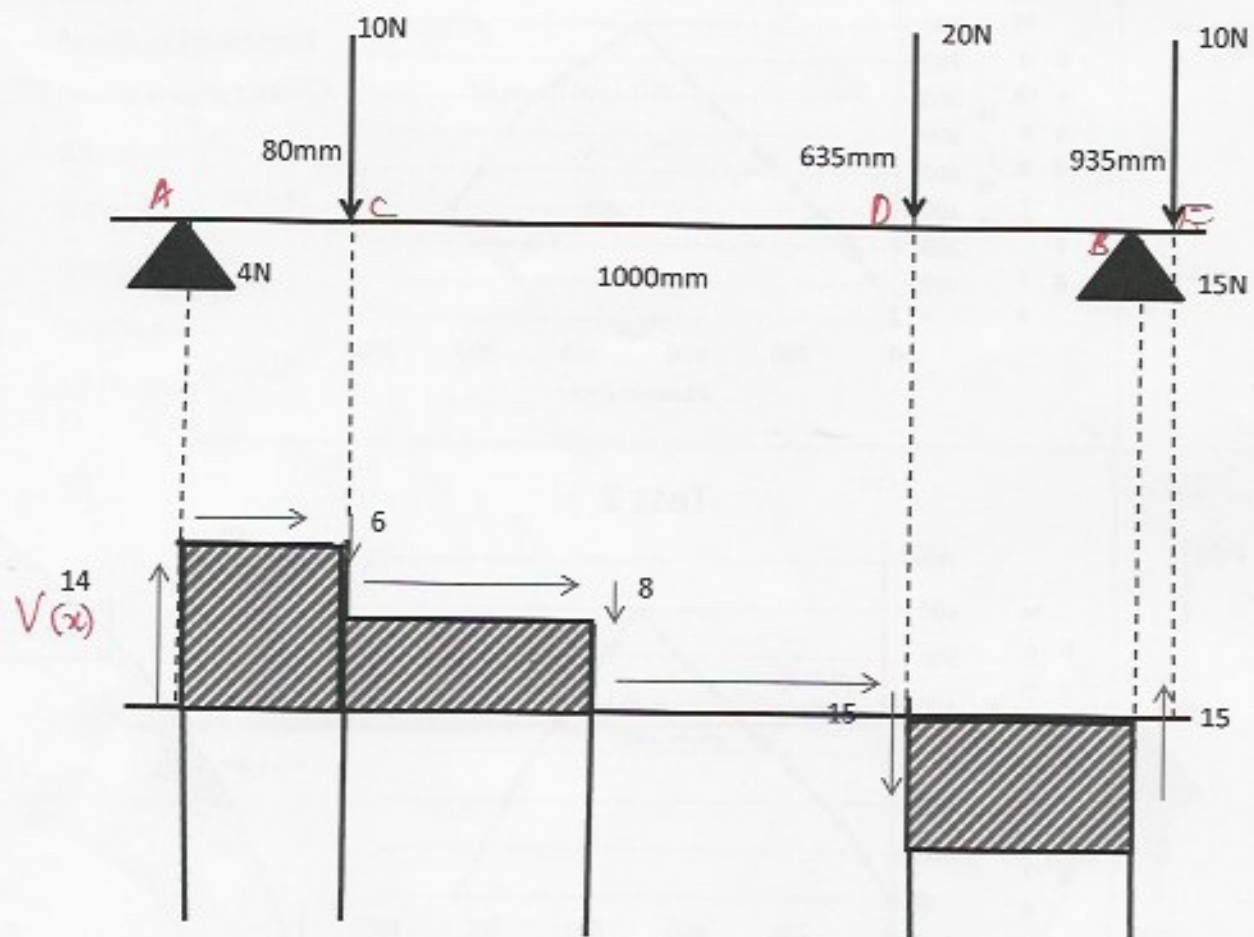
### Test 1



### Test 2



## Shear force diagrams



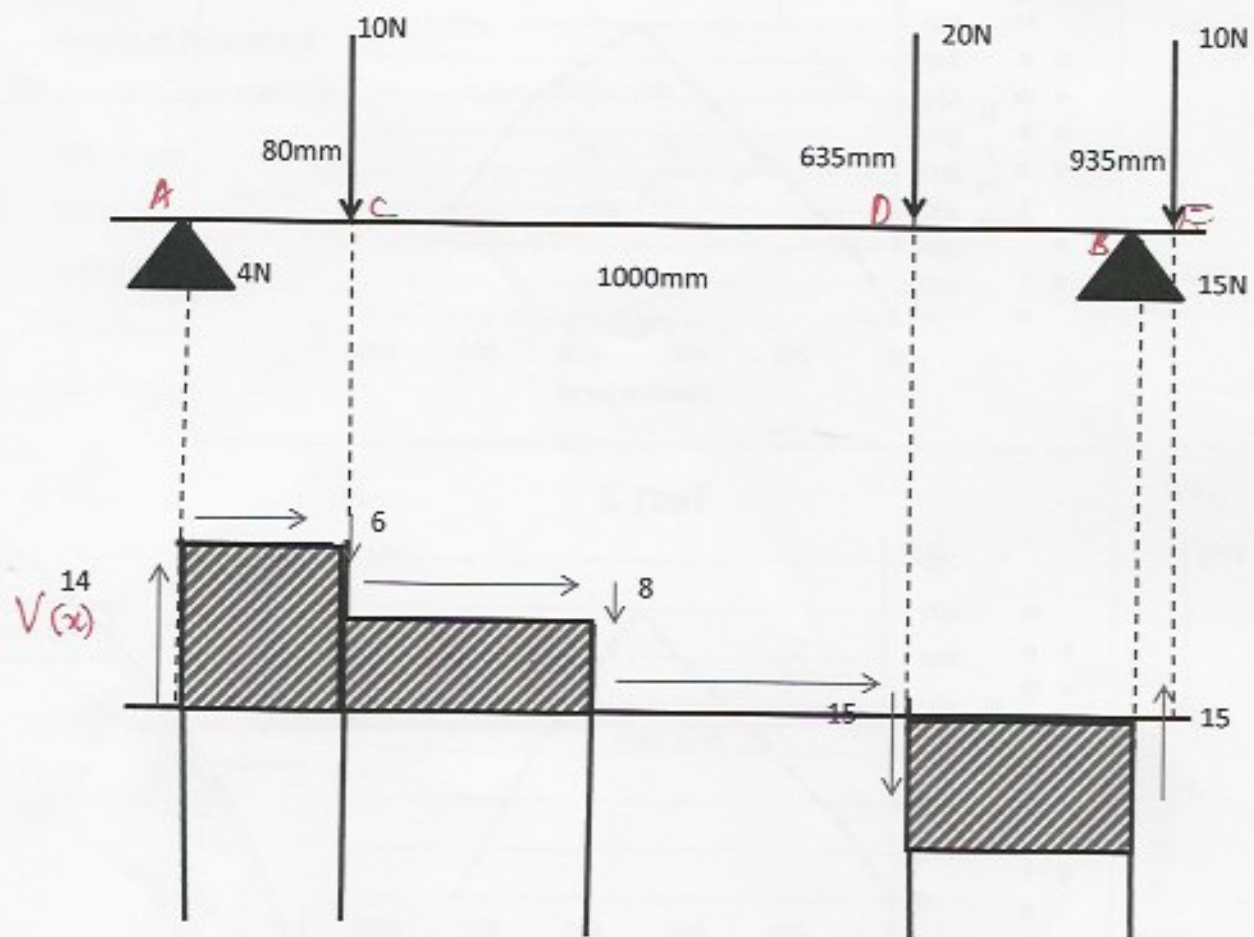
Above you can see how a shear force diagram represents the forces involved in loading beams, the diagram would have to be drawn to scale to accurately represent the forces, the scale used is 1cm = 1M and 1kN=2mm

*Check your shear force calculations  
Calculate S.F @ each point along the beam*

## Observations

vii). Whilst I was happy with my results from my experiment, I also believe that there might have been a few issues that I think might have affected the results. Once I applied the weight to each of my hangers, I was then required to tighten up the butterfly nut on the screw. Although with wear in the spring due to

## Shear force diagrams



Above you can see how a shear force diagram represents the forces involved in loading beams, the diagram would have to be drawn to scale to accurately represent the forces, the scale used is 1cm = 1M and 1kN=2mm

*Check your shear force calculations  
Calculate S.F @ each point along the beam*

## Observations

vii). Whilst I was happy with my results from my experiment, I also believe that there might have been a few issues that I think might have affected the results. Once I applied the weight to each of my hangers, I was then required to tighten up the butterfly nut on the screw. Although with wear in the spring due to

previous experiments I was unable to get an accurate result and due to the running out of thread of the bolt. Another issue would have been that I had the bending moments apparatus equipment spread over two big tables, and this might affect the results if one of the tables was not secure and wobbling.

### Conclusion

viii). The aim of this experiment was to try and understand the effect of different forces of a bending moment on a structural beam. I carried out the practical experiment in the workshop and based on my results shown in my graph, I now have better understanding of a beams response when a load is applied.

Compare experimental B.M to theoretical B.M  
to get % error.

Your conclusion should include your findings on  
whether the experimental B.M. supports the  
theoretical B.M, errors, recommendations?

# Reference your work in-text  
Include your reference list here

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