**Year 11 Earth and Environmental Science**

**INVESTIGATION 4**

# **Earthquakes and Seismic Activity**

|  |  |  |
| --- | --- | --- |
| **Name:**  **Date:** | **Teacher:** | **Score:**  **/ 26** |

**Investigating Elastic and plastic deformation**

**Introduction**

Stress is the force per unit area applied to the surface of an object. Strain describes the change in volume or shape of a body caused by the stress on it. Materials that are strained may return to their original shape when the stress is removed. This is referred to as elastic behaviour. If a material reaches its elastic limit, the materials will deform and not return to their original shape when the stress is removed and is called **plastic deformation.**

In this investigation you will examine elastic and plastic deformation in order to better understand how rocks under strain store energy.

**Aim**

To assess the relationship between stress, strain and stored elastic potential energy.

**Materials**

- 2 Springs of different stiffness

- Retort stand and clamp

- Slotted mass

- Metre ruler

- 1m of nichrome wire

- Whiteboard marker

**Method**

*PART A: Elastic deformation*

1. Gently test the springs to determine which is more easily extended (soft spring) and which is harder to extend (stiff spring)

2. Hang the softer spring from the clamp on the retort stand

3. Arrange the spring and clamp so the base of the spring is 30 cm above the base of the clamp.

4. Add the 50 g mass carrier to the spring and measure the extension or increase in the length of the spring.

5. Add another mass to the mass carrier. Record the mass added and the extension of the spring relative to the unloaded length.

7. Repeat the step twice

8. Remove the masses from the spring and measure and record the length of the spring.

9. Repeat the steps above using the stiff spring

10. Complete the table by calculating the force applied. To calculate the force in newton, multiply the number of grams by 0.0098. Convert the extension from millimetres to metres by dividing by 1000.

11. Graph the force applied (y-axis) to the spring against the extension (x-axis). Draw a line of best fit for each spring.

*PART B: Non-elastic deformation*

12. Wind the nichrome wire around the whiteboard marker to form a spring. Make a loop in each end of the spring so you can attach it to the clamp and add masses.

13. Hang the spring from the clamp on the retort stand.

14. Measure the length of the spring

15. Hang a empty slotted mass on the spring. Measure and record the extension

16. Remove the mass and record the unloaded length of the spring.

17. Repeat the 3 previous steps, increasing the mass each time.

18. Create a graph of extension against mass added. Draw a line of best fit through the points.

19. Draw a second graph of unloaded length against mass added. Draw a line of best fit through the points.

**Results**

**(5 marks)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Soft Spring** | | **Stiff Spring** | |
| **Mass Added (g)** | **Total Mass applied (g)** | **Force (N)** | **Length of spring (mm)** | **Extension (mm)** | **Length of spring (mm)** | **Extension (mm)** |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

Length of springs after the force is removed:

Spring 1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Spring 2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |
| --- | --- | --- | --- |
| **Mass Added** | **Length** (mm) | **Extension (mm)** | **Unloaded length (mm)** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

On the graph paper attached can you please record both graphs and add the line of best fit

**Discussion**

1. Describe the relationship between the force applied and extension for the first spring you tested. What shape is the graph?

2. Compare the relationships shown on your graph for the two springs

3. Does the stiffer spring require more or less force to produce a particular amount of strain?

4. Did the springs return to the original length when the mass was removed? If so, how was the energy stored in the springs transformed when the springs returned to their original shape?

5. Explain why the spring does not return ot its original shape when using the nichrome spring

6. Relate this to the rocks adjacent to a fault. As stress causes strain in the rock what happens to the amount of elastic potential energy stored in them?

7. If the fault moves and the strained rocks can return to their original shape, what happens to the elastic potential energy?

If the stress is too great, the rock may deform or fracture. If this happens, how is the elastic potential energy transformed?