**INSTRUCTIONS:**

- Use blue or black ink. Pencil should be used for diagrams only.
- Read each question carefully and make sure that you know what you have to do before writing your answer.
- Answer ALL questions.
- All working must be shown.

**INFORMATION FOR CANDIDATES**

- Where necessary take acceleration due to gravity ‘g’ to be 10 m/s².
- The use of a calculator is allowed.
- The number of marks for each question is given in brackets [ ] at the end of each question.
- You may find these equations useful:

<table>
<thead>
<tr>
<th>Density</th>
<th>( m = \rho V )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forces</td>
<td>( W = mg )</td>
</tr>
<tr>
<td>Moments</td>
<td>Moment = ( F \times \text{perpendicular distance} )</td>
</tr>
<tr>
<td>Pressure</td>
<td>( F = PA )</td>
</tr>
</tbody>
</table>
SECTION A
This section carries 40 marks.

1. a) Underline the correct answer:
   i) A force is a push or a pull. It is measured in (Kilogrammes, Newtons). A force is a (vector, scalar) quantity. \[2\]
   ii) The (mass, weight) of an object is the amount of matter it has. \[1\]
   iii) The (mass, weight) of an object has both magnitude and direction. \[1\]

b) Label the forces shown in the diagrams below by using the following words: \[2\]

| Friction, Upthust, Tension, Air Resistance |

i)

ii)

iii)

iv
2. a) Maria needs to cut a piece of cheese. She has two knives. Figure 1 below shows the two knives, A and B.

![Figure 1]

i) Maria makes a force of 10N to cut through cheese using knife A of base area 1cm$^2$. Find the pressure exerted on the cheese in N/cm$^2$.

____________________________________________________________________

____________________________________________________________________

ii) If the base area of knife B is 0.01cm$^2$, find the force Maria needs to make to cut through the cheese with knife B using the same pressure.

____________________________________________________________________

____________________________________________________________________

iii) Why is it easier to cut something using a sharp knife rather than a blunt one?

____________________________________________________________________

b) Maria lies on two different mattresses as shown in the figures below.

![Figure 2]

![Figure 3]

Fill in the missing spaces:

i) The pressure exerted is larger in figure ____

ii) The _________ the contact area, the larger the pressure

iii) Which mattress is most comfortable? Figure _______
Ella found two yellowish rings while she was playing at the beach and decided to do an experiment to find out what material the rings were made of. She labeled the rings, Ring A and Ring B.

a) First she found the mass of each ring. Name the apparatus needed to find the mass of the rings. ___________________________________________________________________ [1]

b) Ella then measured the volume of the rings by placing them in a cylinder filled with water. Figure 4 shows the cylinder with water only. Figure 5 shows the water level after placing ring A in the water.

![Figure 4](image1)  ![Figure 5](image2)

Fill in:

i) The volume of water before placing ring A is _______ cm³ [1]

ii) The volume of water and ring is _______ cm³ [1]

iii) The volume of ring A is __________________________ cm³ [2]

![Volume Calculation](image3)

Fill in:

i) The volume of water before placing ring A is _______ cm³ [1]

ii) The volume of water and ring is _______ cm³ [1]

iii) The volume of ring A is __________________________ cm³ [2]

![Volume Calculation](image4)

c) The table below shows the values he obtained.

<table>
<thead>
<tr>
<th></th>
<th>Mass (g)</th>
<th>Volume (cm³)</th>
<th>Density (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ring A</td>
<td>3800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ring B</td>
<td>1350</td>
<td>150</td>
<td></td>
</tr>
</tbody>
</table>

i) Work out the density of each ring and fill in the missing spaces of the table. Show your working below. [2]

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

ii) How can you deduce that the rings are not made of the same material? [1]
iii) If the density of Gold is 19g/cm³. Which ring, if any, is made of gold? __________ [1]

d) Mention one precaution, Ella needs to take to get accurate results for this experiment.

____________________________________________________________________________________________

4. A student tries to balance a metre ruler by using weights.

A

\[ \begin{array}{c}
0.25 \text{m} \\
\triangle \\
8 \text{N} \\
\text{d} \\
6 \text{N}
\end{array} \]

a) If the pivot is at the mid-point of the metre ruler, what is distance d in m? [1]

\[ d = \underline{\phantom{0}} \text{m} \]

b) Calculate the moment of the 8N force about the pivot. [1]

____________________________________________________________________________________________

c) Calculate the moment of the 6N force about the pivot. [1]

____________________________________________________________________________________________

d) The metre ruler is not balanced. Which way will it turn? Explain. [2]

____________________________________________________________________________________________

____________________________________________________________________________________________

____________________________________________________________________________________________

____________________________________________________________________________________________

e) A weight W is now placed at point A in order to balance the system. The metre ruler is now in equilibrium.

i) Draw an arrow at point A to show the direction of the weight W and label it W. [1]

ii) By taking moments, calculate the size of weight W. [2]

____________________________________________________________________________________________

____________________________________________________________________________________________

____________________________________________________________________________________________

____________________________________________________________________________________________

____________________________________________________________________________________________
5.

a) Figure 6 shows a hydraulic jack that is used to lift very heavy loads. Piston A has an area of 0.002m² and piston B has an area of 6m².

i) If a force of 8N is applied on piston A, find the pressure exerted by piston A.

ii) What is the pressure on piston B?

iii) Give a reason for your answer in a) ii)

iv) Calculate the weight of the load being lifted.

b) Why are liquids used in hydraulic machines?

c) Mention an advantage of using a hydraulic machine?

d) Name another example where hydraulic machines are used.
6 a) The turning effect of a force is called the ______________ of the force. [1]

b) From the diagram above, how much is the force pulling the ruler? _____ [1]

ii) If the spring balance is at the edge of the metre ruler, find the moment of the force made by the spring balance.
Assume the ruler has negligible weight (Ignore the weight of the ruler)

___________________________________________________________________ [2]

c) Jake and Sara found several spanners of different lengths in their dad’s garage. They think that the greater the length of the spanner the smaller the force they need to do in order to loosen a nut. Jake and Sara decide to test their idea.

i) Draw a labeled diagram to show how a spring balance can be attached to a spanner to find the force used to untighten a screw. [2]
ii) Describe how they can show that the greater the length of the spanner the smaller the force. [3]

___________________________________________________________________
___________________________________________________________________

iii) Fill in the missing spaces:
Jake and Sara measured the ________ of the spanner in cm and the force by the spring balance in _____. [2]

iv) From the results above, can Jake and Sara conclude that the longer the spanner, the smaller the force they have to use? ________ [1]

v) Jake wanted to take repeated readings, explain why this is a good idea. [1]

___________________________________________________________________

vi) Mention one precaution Jake and Sara should take. [2]

___________________________________________________________________

7. a) The spring shown in figure 8 is 300mm long. When a mass of 100g is hung on the spring it becomes 320mm long.

![Figure 8](image)

i) What is the force extending the spring called? ________________ [1]

ii) How much is this force? [2]

___________________________________________________________________

iii) Calculate the extension. [2]

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________
iv) What would the extension be if the mass were 400g? (Assume that the elastic limit has not been exceeded) [3]

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

v) Hooke’s law states that the ______________ is ______________ proportional to _______________. [3]

b) Another student found in a text book the following three graphs for three different springs, A, B and C.

![Graph of Extension/cm vs Load/N]

i) Which spring is least stiff? ___________ Explain your reasoning. [2]

____________________________________________________________________
____________________________________________________________________

ii) Which spring does not obey Hooke’s Law at any point? ___________

[1]

c) In the graph below mark the elastic limit (E) [1]

![Graph of Extension/cm vs Load/N]
Karl performed an experiment in the lab to find how pressure varies with depth. He set up the apparatus as shown in the diagram. He lowered the tube in the water, measured the depth and recorded the corresponding pressure from the data logger.

Figure 7

a) Name the apparatus needed to measure the depth \(d\) of the liquid. \[1\]

b) The table below shows the readings which Karl recorded.

<table>
<thead>
<tr>
<th>Depth (d) (cm)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Pressure</td>
<td>101000</td>
<td>102000</td>
<td>103000</td>
<td>104000</td>
<td>105000</td>
<td>106000</td>
<td>107000</td>
</tr>
<tr>
<td>Pressure due to the liquid only (Pa)</td>
<td>0</td>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td>5000</td>
<td></td>
</tr>
</tbody>
</table>

i) What is the pressure at the surface of the liquid called? \[1\]

ii) Use the table above to record the value of this pressure (at \(d = 0\)). \[1\]

iii) Karl worked out the pressure due to the liquid only. He left out some of the values. Continue to work out the missing values in the table. \[2\]
iv) Plot a graph of Pressure due to the liquid only (Pa) on the y-axis against Depth (cm) on the x-axis. [6]

v) The depth and Pressure due to the liquid are directly proportional. How does your graph show this? [2]

vi) Use your graph to find:

i) the pressure due to the liquid at a depth of 45cm. __________ [1]

ii) the depth when the pressure due to the liquid only, is 2500Pa. __________ [1]