NAME: ___________________________________________   CLASS: ______  

Answer ALL questions in the spaces provided on the exam paper.  
All working must be shown. The use of a calculator is allowed.  
Where necessary take the acceleration due to gravity, \( g = 10 \text{ m/s}^2 \).

<table>
<thead>
<tr>
<th>Forces</th>
<th>( W = mg )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>( \rho = \frac{m}{V} )</td>
</tr>
<tr>
<td>Pressure</td>
<td>( P = \frac{F}{A} )</td>
</tr>
<tr>
<td>Moments</td>
<td>Moment = Force ( \times ) perpendicular distance</td>
</tr>
<tr>
<td>Others</td>
<td>Area of rectangle/square: ( L \times B )</td>
</tr>
<tr>
<td></td>
<td>Volume of cuboid/cube: ( L \times B \times H )</td>
</tr>
</tbody>
</table>

For examiner’s use:

<table>
<thead>
<tr>
<th>Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum mark</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>85</td>
</tr>
<tr>
<td>Actual mark</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Total Theory</th>
<th>Total Practical</th>
<th>Final Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Mark</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Mark</td>
<td>85</td>
<td>15</td>
<td>100</td>
</tr>
</tbody>
</table>
**SECTION A**
This section carries 40 marks.

1. This question is about the density of a liquid.

Mandy needs to find the density of an unknown liquid.

   a) Name the measuring instruments she uses in Figure 1 to measure:

   i) the mass of the liquid

   ________________________________________________________________ [1]

   ii) the volume of the liquid

   ________________________________________________________________ [1]

   ![Figure 1](image.png)

b) Using Figure 1:

   i) calculate the mass of the liquid.

   ________________________________________________________________ [1]

   ii) state the volume of liquid used.

   ________________________________________________________________ [1]

   iii) calculate the density of the liquid in g/cm³.

   ________________________________________________________________ [1]

c) Mandy repeats the same experiment with a larger volume of the same liquid.

Underline the correct answer:

   i) The **mass** of the liquid (increases, remains the same, decreases). [1]

   ii) The **density** of the liquid (increases, remains the same, decreases). [1]

   d) When Mandy lowers an iron sphere in the liquid, she notices that it sinks. Explain.

   ________________________________________________________________ [1]
2. **This question is about hydraulic systems**

Waste paper is compressed into bales using a hydraulic press as shown in Figure 2.

![Figure 2](image)

Fill in the blanks by using **some** of the words below:

<table>
<thead>
<tr>
<th>liquid</th>
<th>decreases</th>
<th>gas</th>
<th>compressible</th>
</tr>
</thead>
<tbody>
<tr>
<td>increases</td>
<td>larger</td>
<td>incompressible</td>
<td>smaller</td>
</tr>
<tr>
<td>equally</td>
<td>unchanged</td>
<td>differently</td>
<td>directions</td>
</tr>
</tbody>
</table>

As the lever is pushed down, a large pressure is created at piston A and this results in a force acting on piston B, causing the waste paper to be compressed. The force applied on the lever is much ________________ than the force that compresses the waste paper. This is why hydraulic machines are force multipliers. These machines are filled with a ________________ because this is ________________. As a result the pressure is transmitted ________________ in all ________________. The advantage of compressing the waste paper is to save space. As the paper bale is compressed, its volume ________________, its density ________________ while its mass is _________________.

[8]
3. **This question is about turning forces.**

Maya uses a spanner as shown in Figure 3.

![Figure 3](image.png)

a) **Underline the correct answer.**

i) Maya is turning the spanner (clockwise, anticlockwise)  

ii) The (nut, hand) is acting as a pivot.  

iii) If a longer spanner is used a (greater, smaller) force is required to loosen the nut.  

iv) The moment is increased if a (greater, smaller) force is used.  

b) Calculate the moment produced in Figure 3 when a force of 8 N is applied.

\[
\text{Moment} = \text{Force} \times \text{Distance}
\]

\[
= 8 \text{ N} \times 20 \text{ cm} = 160 \text{ Ncm}
\]

\[\text{(2 marks)}\]

c) A moment of 180 Ncm is required to loosen the nut. Calculate the least force she needs to apply to loosen the nut.

\[
\text{Force} = \frac{\text{Moment}}{\text{Distance}}
\]

\[
= \frac{180 \text{ Ncm}}{20 \text{ cm}} = 9 \text{ N}
\]

\[\text{(2 marks)}\]
4. This question is about centre of gravity, mass and weight.

a) Complete:

The centre of gravity of an object is the point where the _______________ of an object seems to act.  

[1]

b) i) Label with a letter ‘x’ the centre of gravity of each of the two vases shown in Figure 4.

![Figure 4]

A B

Figure 4

ii) The position of the centre of gravity determines whether an object is stable or more likely to topple over. Which of the two vases is more stable? ____________  

[1]

c) A block rests on the ground as shown in Figure 5.

![Figure 5]  

Figure 5

i) Mark clearly on Figure 5:

- the weight of the block.  
- the reaction of the ground on the block.  

[1]

[1]

ii) Underline the correct answer.

If the block is taken on the moon, the mass of the block (decreases, remains the same, increases), while the weight (decreases, remains the same, increases).  

[2]
5. This question is about pressure.

a) A truck of mass 3500 kg is shown in Figure 6. The area of contact of each tyre with the ground is $0.025 \, \text{m}^2$.

![Figure 6](image_url)

i) Calculate the weight of the truck in N.

________________________________________________________________________ [1]

ii) Given that the truck has **six wheels**, calculate the total area of contact with the ground.

________________________________________________________________________ [1]

iii) Calculate the average pressure exerted on the ground.

________________________________________________________________________ [2]

b) A block of marble of mass 900 kg is loaded onto the truck as shown in Figure 7.

![Figure 7](image_url)

i) Calculate the total weight in N.

________________________________________________________________________

________________________________________________________________________ [1]

ii) **Underline the correct answer.**

When the block is loaded onto the truck, the pressure acting on the ground (decreases, remains the same, increases) because the force (decreases, remains the same, increases) while the area of contact with the ground (decreases, remains the same, increases). [3]
6. a) State the **two** conditions required for a system to be in equilibrium.

__________________________________________________________________________________ [2]

b) Why is the moment of a force a vector quantity?

__________________________________________________________________________________ [2]

c) A girl and her brother are balancing on a see-saw as shown in Figure 8.

![Figure 8](image)

i) Calculate the moment of the girl about the pivot. State its direction.

__________________________________________________________________________________ [2]

ii) What is the value of the moment of the boy? State also its direction.

__________________________________________________________________________________ [2]

iii) Calculate the weight $W$ of the boy.

__________________________________________________________________________________ [2]

iv) Calculate the reaction at the pivot.

__________________________________________________________________________________ [2]

v) A cat jumps onto the pivot of the see-saw. Does the see-saw remain balanced? Why?

__________________________________________________________________________________ [3]
7. Harry needs to carry out an experiment to show that a spring obeys Hooke's law.

a) In the space provided draw a labelled diagram of the apparatus he needs to set up. [2]

b) Describe briefly the method he has to follow.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________ [2]

c) State Hooke's law.

________________________________________________________________________ [2]

d) List one suitable precaution he can take while carrying out the experiment.

________________________________________________________________________ [1]

e) Harry tabulates his results as shown in the table below. Fill in the missing values.

<table>
<thead>
<tr>
<th>Load (N)</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension (mm)</td>
<td>0</td>
<td></td>
<td></td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of spring (mm)</td>
<td>200</td>
<td>208</td>
<td>216</td>
<td>224</td>
<td>232</td>
<td>240</td>
<td>255</td>
</tr>
</tbody>
</table>

[2]

f) Plot a graph of Extension (mm) on the y-axis against Load (N) on the x-axis. [4]

g) State what Harry observes when the spring is unloaded completely. Explain.

________________________________________________________________________ [2]
8. a) The Magdeburg hemispheres consist of two separate hemispheres as shown in Figure 9. When the air between the two hemispheres is removed, it is almost impossible to pull them apart. Explain why.

b) The water inside Tank A is transferred to Tank B.

i) Does the water pressure at the bottom of tank B increase, decrease or remain the same when compared to the water pressure in tank A? Give a reason for your answer.

ii) On Figure 10 draw the path of the water coming out of each tap in Tank B.

c) A water storage tank is shown in Figure 11. Given that the density of water is 1000 kg/m$^3$,

i) Calculate the pressure of the water at the tap.

ii) Atmospheric pressure is equal to 102 kPa. Calculate the total pressure acting at the tap.

iii) If a wider storage tank is used but everything else is unchanged, does the pressure at the tap increase, decrease or remain the same? Explain.

iv) The tank is filled with oil of density 900 kg/m$^3$ instead of water. Does the pressure at the tap increase, decrease or remain the same? Explain.