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>
</tbody>
</table>
| Pressure        | \( P = \frac{F}{A} \)  
|                 | \( P = h \rho g \) |
| Moments         | Moment = Force x perpendicular distance |
| Others          | Area of rectangle/square: \( L \times B \) |
|                 | Volume of cuboid/cube: \( L \times B \times H \) |

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>
SECTION A
This section carries 40 marks.

1. This question is about scales and measuring instruments.
   
a) Use the scale to read the length of each object.

   ![Scale Image]

   (i) __________ cm  

   (ii) __________ cm  [2]

b) Jean Claude has the following measuring instruments:

<table>
<thead>
<tr>
<th>thermometer</th>
<th>metre rule</th>
<th>measuring cylinder</th>
<th>stopwatch</th>
<th>top pan balance</th>
<th>spring balance</th>
</tr>
</thead>
</table>

Which of the following measuring instruments would you use to measure the:

(i) **mass** of an empty beaker. 
(ii) **length** of a tennis racket. 
(iii) **friction** acting on a wooden block. 
(iv) **temperature** of a hot liquid. 
(v) **time** taken to run 100 m. 
(vi) **volume** of water in a container. 

[6]
2. *This question is about pressure in gases.*

Figure 1 shows air particles moving in a **closed container**.

Underline the correct answer:

a) The air particles move in (different directions, one direction). [1]
b) At room temperature they move very (slow, fast). [1]
c) If the container is **heated**, the particles move at (lower, higher) speeds. [1]
d) If the same number of particles are placed in a **smaller container** they hit the inside of the container (more, less) often. [1]
e) If some **particles are removed** from the container, the particles collide (more, less) often. [1]
f) In which case (c, d or e) will the pressure **decrease**? Explain.

__________________________________________________________________
__________________________________________________________________ [3]

3. *This question is about scalar and vector quantities.*

a) Physical quantities can be either scalars or vectors.

   (i) A scalar quantity has ________________ only. [1]

   (ii) A vector quantity has both _______________ and _________________. [2]

b) The following are six physical quantities:

   mass velocity time
   weight density friction

   (i) Which **three** of them are scalars?

   _____________________  _____________________  _____________________ [3]

   (ii) Which **two** of them are forces?

   _____________________  _____________________ [2]
4. This question is about density.

a) Density is the mass per unit _____________. [1]

b) Andrea wants to know if apples and pears float or sink in water. He measures the mass and the volume of an apple and a pear.

<table>
<thead>
<tr>
<th></th>
<th>Mass (g)</th>
<th>Volume (cm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>145</td>
<td>150</td>
</tr>
<tr>
<td>Pear</td>
<td>145</td>
<td>125</td>
</tr>
</tbody>
</table>

(i) Using the values in the table, work out the density of each fruit in g/cm$^3$.

Apple ______________________________________________________ [1]

Pear ______________________________________________________ [1]

(ii) Water has a density of 1 g/cm$^3$. When he places the apple and the pear in a sink filled with water, he notices that only the ___________ floats because its density is __________ than that of water. [2]

c) Andrea finds five iron nails of different size. Underline the correct answer.

The iron nails have:
(i) (the same, a different) mass. [1]

(ii) (the same, a different) volume. [1]

(iii) (the same, a different) density. [1]
5. **This question is about the centre of gravity.**

   a) The centre of gravity of an object is the point where the ______________ of an object seems to act.  

   b) **Circle ONE** of the letters P, Q or R showing the correct position of the centre of gravity of each object:

   (i) mirror

   (ii) guitar

   (iii) hammer

   (iv) plate

   c) Figure 2 shows the apparatus used to find the centre of gravity of an irregular flat shape. List **in order** (e.g. 1, 2, 3 and 4) the steps to find the centre of gravity of the irregular flat shape. The first one is done for you.

   - This is repeated for holes B and C.

   - Three holes A, B and C are punched in the flat shape.  

   - A string with a mass is suspended from the nail and its position is noted.

   - The shape is suspended freely from hole A using a clamped nail.
SECTION B
This section carries 45 marks.

6. This question is about Hooke’s law.

a) State Hooke’s law.
_________________________________________________________________________________________________________________________ [2]

b) In the space below, draw the setup used to investigate Hooke’s law. Include a spring, a stand with two clamps, a metre rule, a pointer, a hanger with weights.

Robert Hooke
(1635-1703)

[4]

c) After carrying out the investigation, the following results are obtained:

<table>
<thead>
<tr>
<th>Load (N)</th>
<th>0</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>
</tr>
</thead>
<tbody>
<tr>
<td>Length of spring (mm)</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>50</td>
<td>55</td>
<td>60</td>
<td>65</td>
<td>72</td>
<td>80</td>
</tr>
<tr>
<td>Extension</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(i) The length of the unloaded spring is ______ mm. [1]

(ii) Complete the missing values by calculating the extension in each case. [3]

(iii) Plot a graph of Extension (mm) on the y-axis against Load (N) on the axis. [5]
7. **This question is about pressure.**

a) Ryan is lifting his younger brother Isaac on his shoulders. Ryan has a mass of 60 kg while Isaac has a mass of 30 kg.

(i) Calculate their **total** weight in Newtons.

_________________________________________________________________________________________ [2]

(ii) The total area of contact of Ryan’s shoes while standing on both legs is 360 cm$^2$. Calculate the **total** pressure on the ground in N/cm$^2$.

_________________________________________________________________________________________ [2]

(iii) Ryan tries to stand on **one leg** with Isaac still on his shoulders. Work out the new pressure he exerts.

_________________________________________________________________________________________ [2]

b) Ryan’s favourite hobby is scuba diving.

(i) Name the **three** factors which affect the pressure in liquids.

_________________________________________________________________________________________

_________________________________________________________________________________________

_________________________________________________________________________________________ [3]

(ii) If the density of sea water is 1050 kg/m$^3$, calculate the:

• pressure caused by sea water at a depth of 14 m.

_________________________________________________________________________________________

_________________________________________________________________________________________ [2]

• total pressure at a depth of 14 m, if the atmospheric pressure is 101 kPa.

_________________________________________________________________________________________ [2]

(iii) Why should Ryan rise to the surface very slowly?

_________________________________________________________________________________________

_________________________________________________________________________________________ [2]
8. *This question is about moments.*

a) State the law of moments.

________________________________________________________________
__________________________________________________________________ [2]

b) Andrew needs to loosen a nut by using a spanner.

(i) Calculate the resulting moment in Nm.

__________________________________________________________________ [2]

(ii) State the direction of the moment.

__________________________________________________________________ [1]

(iii) The nut will become loose when the moment is equal to 3.25 Nm. Explain why he will not manage to loosen it by applying a force of 11 N.

__________________________________________________________________
__________________________________________________________________ [2]

(iv) Calculate the least force he needs to exert to loosen the nut.

__________________________________________________________________
__________________________________________________________________ [2]
c) Kim and Nicole are playing with their friend Stephanie on a see-saw.

(i) Calculate the total moment produced by Kim and Nicole.

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

(ii) Calculate the moment produced by Stephanie.

_________________________________________________________________
_________________________________________________________________

(iii) Will the see-saw be balanced? Explain.

_________________________________________________________________
_________________________________________________________________

END OF PAPER