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} ) \quad P = h \rho g</td>
</tr>
<tr>
<td>Moments</td>
<td>Moment = Force x 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>Actual Mark</th>
<th>Total Theory</th>
<th>Total Practical</th>
<th>Final Mark</th>
</tr>
</thead>
<tbody>
<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 units and measurement.**
   
   a) The mass of an iron block is 680 g. Its **mass** in kilograms = _________ kg. [1]
   
   b) A metal wire is 80 cm long. Its **length** in metres = _________ m. [1]
   
   c) Carl takes 15 minutes to arrive at school. The **time** in seconds = _________ s. [1]
   
   d) On Earth a mass of 1 kg has a **weight** of _________ N. [1]
   
   e) Andrew needs to find the **volume** of a metal key. Apart from the key, he is given a measuring cylinder, a string and some water. Write down the steps (e.g. 1, 2, 3, 4, 5) he needs to take to find the volume of the key. The first one is done for you.

   He notes that the water rises and the new volume is noted.
   He works out the difference in volume.
   He lowers the key until it is fully immersed in water.
   He ties the end of the string to the key.
   He pours some water into the measuring cylinder and notes its volume.

   [4]

2. **This question is about the density of a solid.**

   Jeffrey is given a rectangular block of candle wax as shown in Figure 1.

   a) He measures the length, breadth and height of the block by using a _______________________. [1]
   
   b) Using the values in Figure 1, calculate the **volume** of the block in cm³.

   ___________________________________________________________ [1]
   
   c) He measures the **mass** of the block by using a ____________________________ [1]
   
   d) Given that the mass of the block is 2760 g, calculate the **density** of candle wax.

   ___________________________________________________________ [2]
e) **Underline the correct answer:**

(i) If the block of candle wax is placed in water, it would (sink, float) because its density is (smaller, greater) than that of water. [2]

(ii) A smaller block of candle wax would have (the same, a different) density. [1]

3. **This question is about stretching springs.**

After Aaron loads a spring with a weight of 2N, its length increases from 25 cm to 37 cm.

a) The change in the length of the spring is called ___________________. [1]

b) The change in length = ________ cm [1]

c) When the weight is removed, the spring becomes once again 25 cm long. This means that the ________________________________ of the spring was **not** exceeded. [1]

d) Aaron hangs his mobile phone **instead** of the 2 N weight. He notices that the spring becomes 34 cm long.

(i) Does the mobile phone weigh more or less than 2 N?

_______________________________________________________________ [1]

(ii) Calculate the weight of the mobile phone.

_______________________________________________________________

_______________________________________________________________ [2]

e) Name **two** precautions that Aaron needs to take so that he gets an accurate result.

_______________________________________________________________

_______________________________________________________________ [2]
4. This question is about forces.

Fill in with the correct force from the ones shown below. Not all forces need to be used. However, the same force can be used more than once.

\[\begin{array}{cccc}
\text{friction} & \text{air resistance} & \text{weight} & \text{lift} \\
\text{engine force} & \text{upthrust} & \text{tension} & \text{reaction}
\end{array}\]

A = _________________________  
B = _________________________  
C = _________________________  
D = _________________________

E = _________________________  
F = _________________________  
G = _________________________  
H = _________________________

[8]

5. This question is about the pressure exerted by a person.

a) Miguel needs to find the pressure he exerts when standing on one leg. First he needs to find his mass by using ________________. To change his mass to weight he has to use the formula ________________. Then he has to find the area of his foot by using a __________ paper and count the number of 1 cm squares.

b) Miguel finds that his weight is 640 N. The area of one foot is 160 cm\(^2\).

Calculate the pressure he exerts in:

(i) N/cm\(^2\).

[1]

(ii) pascals (Pa)

[2]

c) Underline the correct answer:

If Miguel stands on two feet he would exert (more, less) pressure on the floor as area of contact and pressure are (directly, inversely) proportional.  

[2]
SECTION B
This section carries 45 marks.

6. This question is about the pressure in liquids.

A fish is swimming in a river at a depth of 18 m. The density of water is 1000 kg/m³ and atmospheric pressure is 100 kPa.

a) Using the equation \( P = h \rho g \), calculate the pressure exerted by the water on the fish at that depth.

__________________________________________________________________________ [2]

b) Change the value of atmospheric pressure from 100 kPa to Pascals (Pa).

__________________________________________________________________________ [1]

c) Calculate the \textbf{total} pressure exerted on the fish.

__________________________________________________________________________ [1]

d) The fish swims to a different point and the \textbf{total pressure} on it becomes 255 000 Pa.

(i) What is the pressure due to the water only (without the atmospheric pressure)?

__________________________________________________________________________ [1]

(ii) Using the formula \( h = \frac{P}{\rho g} \) find the depth at which the fish is now.

__________________________________________________________________________ [2]

e) The table below shows how the water pressure increases with depth as the fish swims from the water surface to the river bed.

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water pressure (kPa)</td>
<td>0</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>200</td>
</tr>
</tbody>
</table>

(i) On the graph paper, plot a graph of \textbf{water pressure} (kPa) on the y-axis against \textbf{depth} (m) on the x-axis. [5]

(ii) What is the relationship between water pressure and depth?

__________________________________________________________________________ [1]

(iii) Using the graph, find the:

\begin{itemize}
  \item water pressure at a depth of 9 m _________________ [1]
  \item depth at which the water pressure is 125 kPa _________________ [1]
\end{itemize}
7. This question is about hydraulic machines.

Figure 2 shows a hydraulic jack. When Piston A is pushed down Piston B is pushed up and the car rises upwards

![Figure 2](image)

**Piston A** (Area = 0.02m²)  **Piston B** (Area = 8m²)

**a)** Calculate the pressure exerted by the piston when a force of 50 N is applied to it.

__________________________________________________________________________

__________________________________________________________________________

[2]

**b)** Tick (✓) the right answer:

<table>
<thead>
<tr>
<th>Pressure in the liquid is the largest at piston A</th>
<th>Pressure in the liquid is the largest at piston B</th>
<th>Pressure at piston A and piston B are equal</th>
</tr>
</thead>
</table>

[1]

**c)** How much is the pressure at Piston B?

__________________________________________________________________________

[1]

**d)** Using the formula, **Force = Pressure x Area**, calculate the force at Piston B.

__________________________________________________________________________

[2]

**e)** Calculate the car’s mass in kilograms.

__________________________________________________________________________

__________________________________________________________________________

[2]

**f)** If the car is replaced by a truck that weighs 40,000N, calculate the pressure that would be needed to raise this truck?

__________________________________________________________________________

__________________________________________________________________________

[2]
g) Why are liquids used in hydraulic systems?
__________________________________________________________________ [1]

h) If bubbles of air are trapped inside the oil, the system would not work properly. Explain why.
__________________________________________________________________
__________________________________________________________________ [2]

i) What is the main advantage of using a hydraulic machine?
__________________________________________________________________
__________________________________________________________________ [1]

j) Name one other example where hydraulic machines are useful.
__________________________________________________________________ [1]

8. This question is about moments.

Nicholas is given a stand, a clamped nail, some weights, two hangers and a metre rule. He needs to prove the principle (law) of moments. The diagram below shows how he set up his apparatus.

![Diagram of apparatus](image)

a) Fill in the table below with the correct letters (a, b, c or d) from the above diagram.

<table>
<thead>
<tr>
<th>The force which creates a clockwise moment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The distance of the anti-clockwise force from the pivot</td>
<td></td>
</tr>
<tr>
<td>The distance of the clockwise force from the pivot</td>
<td></td>
</tr>
<tr>
<td>The force which creates an anti-clockwise moment</td>
<td>[4]</td>
</tr>
</tbody>
</table>
b) Fill in the missing words.

A moment is the product of a ________ and its perpendicular ________ from the pivot. [2]

c) Fill in this description of the experiment shown above using some of the words below:

spring, ruler, weights, centre, pivot, equilibrium, distances, stretches, heavy

The __________ is suspended and balanced freely from its __________.
This point is acting as a __________. Unequal __________ are then placed on each side of the pivot. The weights are then moved until the metre ruler is in __________. The anti-clockwise and clockwise moments are calculated. This is then repeated several times by changing the __________ on each side. [6]

d) Figure 3 shows a metal ball being balanced by a coin on a uniform wooden bar which is pivoted at its centre.

(i) Calculate the clockwise moment of the coin in Ncm.

(ii) What is the value of the anti-clockwise moment?

(iii) What would be observed if the metal ball is moved away from the pivot?

END OF PAPER