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 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></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>

Physics Half yearly exam 2015 – Track 2 - Form 3
SECTION A
This section carries 40 marks.

I. This question is about measurement.

a) Use the scale to measure the length of each object.

![Ruler Image](image1)

(i) ________ cm  
(ii) ________ cm  

[2]

b)  

![Weight Scale and Cylinder Image](image2)

(i) ________ kg  
(ii) ________ cm$^3$  

[2]

c) Complete:
The instrument shown in b ii) is called a ____________ ____________.  

[1]

d) Calculate the total area of the rectangle shown in:

![Rectangle Image](image3)

(i) cm$^2$,  
_________________________________________________________________________  

[1]

(ii) m$^2$,  
_________________________________________________________________________  

_________________________________________________________________________  

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

a) A plastic bottle filled with air is connected to a vacuum pump as shown.

Underline the correct answer.

(i) Before switching on the vacuum pump:
- the air particles inside the bottle exert a pressure by (colliding with, sticking to) the inside walls of the bottle. [1]
- the pressure inside and that outside the bottle are (different, equal). [1]

(ii) After switching on the vacuum pump:
- the number of air particles inside the bottle (decreases, increases). [1]
- the pressure inside the bottle (decreases, increases). [1]
- the plastic bottle (keeps its shape, is crushed). [1]

b) A ball is inflated using a foot pump as shown in the diagram below. State whether each of the following quantities decreases, increases or remains the same.

(i) The volume of air inside the ball. [1]

(ii) The number of air particles inside the ball. [1]

(iii) The air pressure inside the ball. [1]
3. This question is about density.

a) Fill in the missing blanks using some of the words below:

| scalar | mass | vector | volume | area |

(i) Density is defined as the ____________ per unit ____________ of an object.  
(ii) Density is a _____________ quantity because it has magnitude (size) only.

b) Nicole is given an ice cube, a glass filled with water and another one filled with oil.

(i)

<table>
<thead>
<tr>
<th></th>
<th>Ice</th>
<th>Water</th>
<th>Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (g/cm³)</td>
<td>0.93</td>
<td>1.00</td>
<td>0.90</td>
</tr>
</tbody>
</table>

Using the table above, state whether the ice cube will float or sink when placed:

- in water, ____________________________  
- in oil. ________________________________

(ii) Explain the answers in b (i) in terms of density.

_________________________________________________________________________________  
_________________________________________________________________________________

(ii) Explain the answers in b (i) in terms of density.

_________________________________________________________________________________  
_________________________________________________________________________________

(iii) She decides to pour the water and the oil in the container shown below. Draw what is observed after a few minutes. Label clearly the oil and water.
4. This question is about springs.

a) **Complete:** Hooke’s law states that the extension is directly proportional to the load as long as the __________________________________________________________________________. [1]

b) Sam loads a spring by using 10 N weights. Each time he measures the extension and tabulates his results as shown.

<table>
<thead>
<tr>
<th>Load (N)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of spring (mm)</td>
<td>60.0</td>
<td>61.2</td>
<td>62.4</td>
<td>63.6</td>
<td>64.8</td>
<td>66.0</td>
</tr>
<tr>
<td>Total Extension (mm)</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(i) Complete the table by working out the extensions. [2]

(ii) The length of the spring when unloaded is _______ mm. [1]

(iii) The spring used by Sam is quite **stiff (hard)**. Explain why in terms of extension.

_________________________________________________________________________________________________________________________________________________________________________________________ [2]

(iv) **Without plotting a graph**, calculate the extension when a load of 24 N is used.

_________________________________________________________________________________________________________________________________________________________________________________________ [1]

(v) A sketch of the graph obtained by Sam is shown in Figure 2. Draw on the same axes, the graph he obtains if he uses a **softer** spring. [1]
5. This question is about weight, mass and gravity.

a) The diagram shows a man holding a ball at different positions on planet Earth. Draw an arrow on each ball at A, B and C to represent how each one falls after being dropped. [3]

![Diagram of a man holding a ball at different positions on Earth.](image)

b) (i) An astronaut has a mass of 80 kg. Given that on Earth the acceleration due to gravity is 10 m/s\(^2\), calculate his weight on Earth.

\[
\text{Weight on Earth} = m \times g = 80 \times 10 = 800 \text{ N}
\] [1]

(ii) On the moon the astronaut has a weight of only 134 N. Calculate:

- the difference in weight compared to when he is on Earth,

\[
\text{Difference} = 800 - 134 = 666 \text{ N}
\] [1]

- the acceleration due to gravity on the moon.

\[
\text{Acceleration due to gravity on the moon} = \frac{134}{80} = 1.675 \text{ m/s}^2
\] [1]

c) The centre of gravity is the point where the weight of an object seems to act. Mark with an 'X' the position of the centre of gravity of each object. [2]
SECTION B
This section carries 45 marks.

6. This question is about density.
   a) Martina investigates whether metal spheres of different size have a different density or not.
      She is given seven solid metal spheres of different size as shown below.

      ![Image of metal spheres]

      She measures the mass and volume of each sphere and sets up the table below.

      | Volume (cm\(^3\)) | 10   | 20   | 30   | 40   | 50   | 60   |
      |-------------------|------|------|------|------|------|------|
      | Mass (g)          | 50   | 100  | 150  | 200  | 250  | 300  |

      (i) Plot a graph of mass (g) on the y-axis against volume (cm\(^3\)) on the x-axis. [7]

      (ii) Using the graph find the volume of a metal sphere which has a mass of 175 g. [1]

      (iii) Using the values in the table, calculate the density of the sphere which has a mass of:

      - 50 g __________________________________________ [1]
      - 150g __________________________________________ [1]

      (iv) Using the answers in a (iv), what can Martina conclude?

      __________________________________________ [2]

   b) (i) The mass of a can filled with ice tea is 330 g. When empty the mass of the can is 20 g. Calculate the mass of the ice tea only

      __________________________________________ [1]

   (ii) The volume of the ice tea is 285 cm\(^3\). Calculate its density.

      __________________________________________ [1]

   (iii) **Underline the correct answer:**

      If Martina has half the amount of ice tea, the density of ice tea (increases, remains the same, decreases). [1]
7. **This question is about moments.**

a) The principle of moments states that the sum of the ____________________ moments is
   EQual to the sum of the ______________ moments. [2]

b) A student tries to balance two metal blocks as shown in the diagram below.

![Diagram of two metal blocks]

(i) Calculate the anti-clockwise moment
   ______________________________________________________ [2]

(ii) Calculate the clockwise moment
     _____________________________________________________ [1]

(iii) What will happen and why?
     _____________________________________________________ [2]

c) A man holds a mass as shown below. The force F is the force in the biceps muscle.

![Diagram of a man holding a mass]

(i) Calculate the moment caused by the 20N force about the pivot.
   ______________________________________________________ [1]

(ii) Calculate the moment caused by the 120 N force about the pivot.
     _____________________________________________________ [1]

(iii) Work out the **total** clockwise moment.
     _____________________________________________________ [1]

(iv) What is the value of the total anti-clockwise moment? Explain.
     _____________________________________________________ [3]

(v) Would force F increase, decrease or remain the same if a lighter mass is used? Explain.
     _____________________________________________________ [2]
8. This question is about pressure.

a) Pressure is the ________________ per unit area. [1]

b) A concrete brick has the dimensions shown.

(i) Calculate the area of contact when placed on the ground.

______________________________________________________________________________ [2]

(ii) Given that the weight of the brick is 300 N, calculate the pressure it exerts on the ground.

______________________________________________________________________________ [2]

(iii) Five bricks are now placed on top of each other as shown.

- Calculate the total weight in N of the bricks.

______________________________________________________________________________ [2]

- Why does the pressure on the ground increase as more bricks are added?

______________________________________________________________________________ [1]

c) (i) A submarine is at a depth of 80 m below the sea. Given that the density of sea water is 1100 kg/m³, calculate the water pressure acting on it.

______________________________________________________________________________ [2]

(ii) After some time the submarine is at a depth of 40 m. Does the water pressure increase, decrease or remain the same? Explain.

______________________________________________________________________________ [2]

d) Hydraulic systems are very useful in everyday situations.

(i) Name an example where a hydraulic system can be used.

______________________________________________________________________________ [1]

(ii) What is the advantage of using hydraulic systems?

______________________________________________________________________________ [2]