Physics Half yearly exam 2016– Track 2 - Form 3

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BOYS’ SECONDARY MOSTA
HALF-YEARLY EXAMINATIONS 2015/2016

SUBJECT: PHYSICS                      Form 3
NAME : ____________________________
CLASS: ___________
INDEX NO : ___________

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 m/s².

<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} ] [ 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 x B</td>
</tr>
<tr>
<td></td>
<td>Volume of cuboid/cube: L x B x 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>15</td>
<td>15</td>
<td>15</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Actual mark</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>85</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 measuring lengths**

a) A rectangular shape is shown below in Figure 1.

![Figure 1](image)

(i) Use your ruler to measure sides ‘a’ and ‘b’.

Length of side **a** = _______ cm. [1]

Length of side **b** = _______ cm. [1]

(ii) Calculate the area of the rectangle in cm\(^2\).

___________________________________________________________ [1]

(iii) Calculate the area of the rectangle in m\(^2\).

___________________________________________________________ [2]

(iv) Name one precaution which you have taken while measuring the sides of the rectangle.

___________________________________________________________ [1]

b) **Underline the correct answer:**

(i) Length and area are called (scalar, vector) quantities. [1]

(ii) Length and area have (magnitude only, magnitude and direction). [1]
2. This question is about Hooke’s law.

James loads a spring as shown in Figure 2.

![Figure 2](image)

a) Fill in the missing labels in Figure 2. [3]

He obtains the following results.

<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>
</tr>
</thead>
<tbody>
<tr>
<td>Length of spring (mm)</td>
<td>32</td>
<td>35</td>
<td>38</td>
<td>41</td>
<td>44</td>
<td>47</td>
</tr>
<tr>
<td>Total Extension (mm)</td>
<td>0</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) Complete the table by filling in the missing extensions. [2]

c) Explain why the spring returns to its original length once the loads are removed.

__________________________________________________________________________ [1]

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

d) State two things that James would observe if a much softer spring is used.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________ [2]
3. This question is about moments.

a) Three students X, Y and Z play on a see-saw as shown below. They stay at equal distance from the pivot.

![See-saw diagram]

Complete: The heaviest student is _____, while the lightest student is _____. [2]

b) In Figure 3 below, a uniform wooden rod is resting on a pivot at its midpoint.

![Figure 3 diagram]

(i) Calculate the anti-clockwise moment.

(ii) Calculate the clockwise moment.

(iii) Underline the correct answer:
The wooden rod in Figure 3 will (turn clockwise, turn anti-clockwise, balance). [1]

(iv) Given that the mass of the wooden rod is 1.5 kg, calculate its weight.

(v) Calculate the value of the reaction at the pivot.
4. This question is about pressure.

a) Martin stands on his skateboard as shown in Figure 4. Martin has a weight of 340 N while the skateboard’s weight is 20 N. Calculate the total force acting on the ground.

b) The skateboard has four wheels. Each wheel has an area of 2.5 cm² in contact with the ground. Calculate:

(i) the total area in contact with the ground in cm²

(ii) the total pressure exerted on the floor in N/cm².

c) Would the pressure on the ground increase, decrease or remain the same compared with Figure 4, when:

(i) Martin stands on the skateboard wearing his school bag? Explain.

(ii) Martin balances his skateboard on two wheels only? Explain.
5. This question is about hydraulic machines.

A driver applies a force with his foot on the brake pedal as shown in Figure 5. (The diagram is not to scale).

![Diagram of hydraulic machine with pistons and brake pads]

Figure 5

a) Use the words below to fill in the blanks:

<table>
<thead>
<tr>
<th>compressible</th>
<th>large</th>
<th>incompressible</th>
<th>transmitted</th>
<th>small</th>
</tr>
</thead>
</table>

In hydraulic machines, oil is used since liquids are ________________. The pressure in the oil is ________________ equally in all directions. If air bubbles are trapped in the oil, the brakes do not work well because air is ________________. The advantage of hydraulic machines is that they can turn a ________________ force into a ________________ force. [5]

b) A force of 50 N is applied on piston A which has an area of 0.4 cm².

(i) Calculate the pressure exerted by piston A.

___________________________________________________________ _____________

___________________________________________________________ _____________ [1]

(ii) What is the pressure exerted on piston B?

___________________________________________________________ _____________ [1]

(iii) Calculate the force exerted by each braking pad on the steel disc given that the area of piston B is 20 cm².

___________________________________________________________ _____________ [1]
SECTION B
This section carries 45 marks.

6. This question is about pressure in liquids.
   a) To calculate the pressure in a liquid we use the equation \( P = h \rho g \).
      Complete: ‘\( h \)’ is the __________ of the liquid.
                ‘\( \rho \)’ is the __________ of the liquid.
                ‘\( g \)’ is the acceleration due to __________. \[3\]
   b) Holes are punched in a plastic bag filled with water as shown in the diagram below.

   This experiment shows that pressure in a liquid acts in all _________________. \[1\]
   c) A large water tank is placed on top of a building as shown below in Figure 6.

   (i) The pressure on the surface of the water is called ________________ pressure. \[2\]
   (ii) If a wider tank is used, would the pressure at the bottom of the tank be equal to, smaller
         than or greater than the one in Figure 6?
         ________________________________________________________________________ \[2\]
   (iii) Given that the density of water is 1000 kg/m\(^3\), calculate the water pressure at the bottom of
         the water tank.
         ________________________________________________________________________ \[2\]
   (iv) What is the total vertical height of water above point A?
         ________________________________________________________________________ \[1\]
   (v) Calculate the water pressure at point A.
         ________________________________________________________________________ \[2\]
   (vi) Why is the water pressure at B equal to that at A?
         ________________________________________________________________________ \[2\]
7. This question is about forces.
   a) Label the force acting in each case.

   ![Image](image1.png)

   ![Image](image2.png)

   (i) [2]

   b) Sam pulls a metal block using a force sensor connected to a data logger and measures the friction just before the block moves. He repeats the experiments by adding more metal blocks on top of each other.

   (i) Draw on the diagram an arrow showing the direction of friction acting on the blocks. [1]

   ![Diagram](image3.png)

   He obtains the results in the table below.

<table>
<thead>
<tr>
<th>Mass of metal blocks (kg)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frictional force (N)</td>
<td>0</td>
<td>0.5</td>
<td>1.0</td>
<td>1.5</td>
<td>2.0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

   (ii) Plot a graph of Frictional force (N) on y-axis against mass of blocks (kg) on x-axis. [6]

   (iii) Complete:
       As the mass of the metal blocks increases, the frictional force _______________. [1]

   (iv) Using the graph or otherwise, find the frictional force when the total mass is 2.5 kg.
       ________________________________________________________________________ [2]

   (v) Sam thinks that there is more friction if oil is applied on the ground surface? Is he correct? ____________ [1]

   (vi) On the diagram draw an arrow to show the upward force exerted by the ground on the blocks. [1]

   (vii) This upward force is called ___________________________. [1]
8. This question is about the density.

Stefan needs to find the density of cooking oil. First he measures the mass of an empty beaker. Then he fills it with oil and measures the mass once again.

a) (i) The instrument to measure the mass of the oil is called _________. [1]

He obtains the following readings:

<table>
<thead>
<tr>
<th>Mass of empty beaker</th>
<th>120 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass of beaker filled with oil</td>
<td>200 g</td>
</tr>
</tbody>
</table>

(ii) The mass of oil used = ________ g [1]

(iii) He then pours the oil in the apparatus shown in Figure 7.

Name this apparatus. ___________________________________________ [1]

(iv) The volume of the oil = ________ cm³. [1]

(v) Using your answers in a) (ii) and a) iv), calculate the density of oil in g/cm³.

___________________________________________________________ [2]

b) Jodie finds a shiny solid metal block. She wants to know what material it is made of by measuring its density. The dimensions of the block are shown below.

(i) Calculate the volume of the block in cm³.

___________________________________________________________ [1]

(ii) Given that the block has a mass of 506 g, calculate its density.

___________________________________________________________ [3]

(iii) Jodie compares the result obtained with the densities found in a Physics textbook.

<table>
<thead>
<tr>
<th>Aluminium = 2.7 g/cm³</th>
<th>Silver = 10.5 g/cm³</th>
<th>Iron = 7.9 g/cm³</th>
</tr>
</thead>
</table>

What material is the block made of? ________________________________________ [2]

(iv) Underline the correct answer.

If the block is placed in water, it would (float, sink) as its density is (smaller, greater) than that of water. A smaller block made of the same material would have (a different, the same) density. [3]