FORM 3 PHYSICS TIME: 1 hr 30 min

Name: ______________________ Class: ____________________

INFORMATION FOR CANDIDATES
• Where necessary take acceleration due to gravity ‘g’ to be 10 m/s².
• The use of a calculator is allowed.
• The number of marks for each question is given in brackets [ ] at the end of each question.
• You may find these equations useful:

<table>
<thead>
<tr>
<th>Density</th>
<th>( m = \rho V )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>( P = \rho g h ) ( F = PA )</td>
</tr>
<tr>
<td>Forces</td>
<td>( W = mg )</td>
</tr>
<tr>
<td>Moments</td>
<td>Moment = ( F \times ) perpendicular distance</td>
</tr>
<tr>
<td>Energy</td>
<td>P.E. = ( mg ) ( ) ( K.E. = \frac{1}{2}mv^2 ) ( ) Work Done = ( F ) ( s )</td>
</tr>
<tr>
<td></td>
<td>Work Done = Energy Converted ( E = Pt )</td>
</tr>
<tr>
<td>Heat</td>
<td>( \Delta Q = mc \Delta \theta )</td>
</tr>
</tbody>
</table>

INSTRUCTIONS TO CANDIDATES
• Use blue or black ink. Pencil should be used for diagrams only.
• Read each question carefully and make sure that you know what you have to do before writing your answer.
• Answer ALL questions.
• All working must be shown.

<table>
<thead>
<tr>
<th>Question</th>
<th>Max</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td></td>
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<td>3</td>
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<td>8</td>
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<td>8</td>
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<td>6</td>
<td>15</td>
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<td>7</td>
<td>15</td>
<td></td>
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<tr>
<td>8</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Written</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Practical</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

This document consists of 10 printed pages.
SECTION A
Each question carries 8 marks. This section carries 40 marks of the total marks for this paper.

1. Rebecca finds a shiny greyish metal ring. She thinks it is made of silver but she is not sure. Her teacher suggests that she can find out by measuring its density.
   a) Name an instrument she can use to measure the mass of the ring.  
   ____________________________________________________________________________________[1]

   b) Describe how she can measure the volume of the ring.  
   ____________________________________________________________________________________
   ____________________________________________________________________________________
   ____________________________________________________________________________________
   ____________________________________________________________________________________
   ____________________________________________________________________________________
   ____________________________________________________________________________________
   ____________________________________________________________________________________
   [3]

   c) She obtains the following results.
      Mass of ring = 4 g                  Volume of ring = 0.38 cm³

      In her Physics textbook, Rebecca finds the densities of three materials.

      | Steel  | Aluminium | Silver |
      |--------|-----------|--------|
      | Density (g/cm³) | 8.0      | 2.7    | 10.5   |

      Using the results, determine the material of the ring.  
      ____________________________________________________________________________________
      ____________________________________________________________________________________
      [3]

   d) Underline:
      For a larger ring made up of the same material the density is (smaller, larger, the same).  [1]
2. Jean loads a spring with a mass of 9 kg making its length increase from 21.2 cm to 21.5 cm.
   a) From the information provided, is Jean using a soft or stiff (hard) spring? Why?

   ____________________________________________________________ [2]

   b) Complete: On removing the load, the spring becomes once again 21.2 cm long. This means
       that the ________________ ________________ of the spring was not exceeded. [1]

   c) Calculate the force in the spring due to the 9 kg mass.

       ____________________________________________________________ [1]

   d) Jean loads the spring with his school bag instead of the 9 kg mass. The spring extends to a
       length of 21.4 cm.

      i) Calculate the weight of the school bag.

         ____________________________________________________________ [2]

      ii) Name TWO precautions that he needs to take while measuring the extension of the spring.

         ____________________________________________________________ [2]

3. Mr Spiteri uses the model shown in Figure 1 to teach
   his students about a process through which a liquid
   changes into a gas. He shakes a tray full of marbles
   from side to side. Some of the marbles jump out of the
   tray.

   a) 

      i) Complete:
      The marbles represent the particles at the liquid surface. Mr Spiteri is teaching his students
      about a process called ________________________ . [1]

      ii) When alcohol is rubbed on the skin it produces a cooling effect. Explain why in terms of
      the kinetic theory.

         ____________________________________________________________

         ____________________________________________________________ [2]
b) The heating element of an electric iron rated at 800 W causes the temperature of the sole plate to rise by 40°C in 30 seconds.

i) Calculate the amount of heat energy transferred to the sole plate.

ii) Given that the mass of the sole plate is 1.2 kg, calculate the specific heat capacity of the metal used to make the sole plate.

iii) The answer calculated in part (b)(ii) is greater than the actual value of the specific heat capacity of the sole plate. Explain.

4. Two identical boxes, X and Y, are in a pool of water as shown in Figure 3.

a) i) Is the pressure greater on X or on Y? Explain.

ii) On Figure 3 draw a box which experiences the same pressure as X.

iii) The water in the pool has a density of 1020 kg/m³. Given that the water is 3 m deep, calculate the water pressure acting at the bottom of the pool.

iv) Given that the atmospheric pressure is equal to 101 500 Pa, calculate the total pressure acting at the bottom of the pool.

v) On Figure 3, draw TWO arrows to show how the atmospheric pressure acts on the water surface.

b) Deep sea divers rise to the surface slowly. Explain why they do this.
5. In November 2014, the European Space agency performed the first soft landing on a comet. The comet is about 4 km wide.

a)  
   i) List in order of size (smallest first) the following celestial bodies in our solar system.
   
   Earth  Sun  Earth’s moon  The comet  

   ____________________________________________ [1]

   ii) Complete: Comets can be seen because they ______________ light from the sun. [1]

   iii) What keeps a comet in orbit around the sun?

   ____________________________________________ [1]

   iv) The comet was at a distance of 510 million km away from planet Earth. The average temperature on the surface of the comet is –68°C. Explain in terms of ‘solar energy’ why the comet has this surface temperature.

   ____________________________________________ [1]

b) Points A, B, C and D are different regions on Earth. The diagram is not to scale.

   ![Diagram of Earth and Sun with points A, B, C, and D labeled]

   Figure 4

   i) In which regions on Earth is it day?

   ____________________________________________ [1]

   ii) Explain your answer to part (i).

   ____________________________________________ [1]

   iii) Which regions on Earth are experiencing winter?

   ____________________________________________ [1]

   iv) Explain your answer to part (iii).

   ____________________________________________ [1]
SECTION B  
Each question carries 15 marks. This section carries 45 marks of the total marks for this paper.

6. A hoist is used to lift a heavy bucket from street level to the roof of a high building.
   a) Draw and label (on Figure 5) the TWO forces acting in the rope and on the bucket.  
      [2]
   b) The table below shows how the gravitational potential energy changes while the bucket is lifted.

<table>
<thead>
<tr>
<th>Potential Energy (kJ)</th>
<th>0</th>
<th>0.15</th>
<th>0.30</th>
<th>0.45</th>
<th>0.60</th>
<th>0.75</th>
<th>0.90</th>
<th>1.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (m)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

   Plot a graph of potential energy (kJ) on the y-axis against height (m) on the x-axis.  
   [4]
   c) Use the graph to find the gravitational potential energy when the bucket is at a height of 5.4 m. Mark this point on the y-axis with a letter ‘X’.

   ___________________________________________  [2]

   d) Determine the mass of the bucket in kilograms.

   ___________________________________________  [2]

   e) Accidentally the bucket falls off when it reaches a height of 7 m. Assuming no energy losses, what is the value of the kinetic energy of the bucket just before it hits the ground?

   ___________________________________________  [1]

   f) Calculate the speed of the bucket just before hitting the ground.

   ___________________________________________  [2]

   g) The hoist makes use of a motor rated at 560 W. Given that the power output of the motor is 480 W, calculate its percentage efficiency.

   ___________________________________________  [1]

   h) State why the motor is not 100% efficient.

   ___________________________________________  [1]
7. Jessica and Nicky are investigating turning forces.
   a) Define the term ‘moment of a force’.

   b) Jessica designs a simple nut cracker as shown in Figure 6. When the force she applies on the
   handle reaches 16 N, the nut is about to break. The arm and handle have a negligible weight.

   ![Figure 6](image)

   i) Calculate a value for the force F in Figure 6. (Assume that the system is in equilibrium).

   ii) State TWO changes she could make to break the nut with a smaller force.

   iii) Given that the area of the hand in contact with the handle is 8 cm², calculate the pressure
   she exerts in N/cm².

   c) Nicky needs to prove the principle of moments by using the apparatus shown in Figure 7.
   i) Draw how he should set up the apparatus in the space provided (Figure 8).
ii) State the principle of moments.

_________________________________________________________________________
_________________________________________________________________________

iii) Describe how he should use the apparatus to prove this principle.

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

[4]

8. Jamie investigates which coloured surface is a better absorber of heat. He uses a black can and a shiny can as shown in Figure 9.

![Figure 9](image)

a) Jamie is told that the way the apparatus is set up will not result in a fair experiment.
   i) Suggest TWO reasons why this is so.

_________________________________________________________________________

[2]

ii) The heat does not reach the cans by conduction. Why?

_________________________________________________________________________

[1]

iii) Name the process by which heat reaches the two cans.

_________________________________________________________________________

[1]

iv) Jamie fixes the setup shown in Figure 9 so that the experiment would be fair. Sketch on the same axes the graph that is expected for each can after several minutes of heating. Label each graph.

__________________________________________________________________________

[2]
v) What should Jamie conclude from his results? Explain.

____________________________________________________________________________________ [2]

vi) Jamie repeats the experiment but this time he wants to obtain results in a shorter time. Name TWO ways through which he can achieve this.

____________________________________________________________________________________ [2]

b) Frozen items can be kept cool on hot summer days by keeping them in a container as shown in Figure 10.

![Image of a container with frozen items, lagging material, and lid]

**Figure 10**

i) Draw on Figure 10 at least one arrow to represent the direction of heat transfer. [1]

ii) Name a suitable material that is used to lag the container. [1]

iii) Complete: The lagging material reduces heat transferred by _____________________, while the lid reduces heat transferred by _____________________.[2]

iv) Explain why the frozen items inside the container will stay cooler for much longer on a cold winter day.

____________________________________________________________________________________ [1]

END OF PAPER