INFORMATION FOR CANDIDATES

- Where necessary take acceleration due to gravity ‘g’ to be 10 m/s^2.
- 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>$P = \rho gh$</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>$P.E. = mgh$</td>
</tr>
<tr>
<td>Work Done = Energy Converted</td>
<td>$E = P \times t$</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.

For Examiner’s Use Only

<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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<tr>
<td>3</td>
<td>8</td>
<td></td>
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<tr>
<td>4</td>
<td>8</td>
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<td>5</td>
<td>8</td>
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<td>6</td>
<td>15</td>
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<tr>
<td>8</td>
<td>15</td>
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<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>
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.

<table>
<thead>
<tr>
<th>Mass of ring = 4 g</th>
<th>Volume of ring = 0.38 cm³</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>Density (g/cm³)</th>
<th>Steel</th>
<th>Aluminium</th>
<th>Silver</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.0</td>
<td>2.7</td>
<td>10.5</td>
<td></td>
</tr>
</tbody>
</table>

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.

______________________________ [2]

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.

______________________________________________________________________ [2]

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

______________________________________________________________________ [1]

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.

______________________________ [2]

ii) On Figure 3 draw a box which experiences the same pressure as X. [1]

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.

______________________________________________________________________ [2]

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

______________________________________________________________________ [1]

v) On Figure 3 draw TWO arrows to show how the atmospheric pressure acts on the water surface. [1]

b) Deep sea divers rise to the surface slowly. Explain why they do this.

______________________________________________________________________ [1]
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.

   
   A
   B
   D
   C
   Earth

   Sun

   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 filled with concrete from street level to the roof of a house. A force \( X \) called the tension force, acts vertically upwards on the rope supporting the bucket.

a) Name force \( Y \) acting on the bucket containing concrete.

_________________________________________________________ [1]

b) Underline: When the bucket is not moving, the size of force \( X \) is (bigger than, smaller than, equal to) that of force \( Y \). [1]

c) The mass of the bucket is 2 kg and the mass of the concrete in it is 13 kg. Find the:

i) total mass of the bucket and concrete, 

_________________________________________________________ [1]

ii) total weight of the bucket and concrete, 

_________________________________________________________ [2]

iii) size of force \( X = \) ___________ N [1]

iv) size of the kinetic energy of the bucket when it is at rest on the roof of the house = _______ J [1]

d) The table below shows how the gravitational potential energy changes while the bucket is lifted.

<table>
<thead>
<tr>
<th>Potential Energy PE / J</th>
<th>0</th>
<th>150</th>
<th>300</th>
<th>450</th>
<th>600</th>
<th>750</th>
<th>900</th>
<th>1050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height h / 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 (J) on the y-axis against height (m) on the x-axis. [4]

e) Use your graph to find the value of the:

i) height in metres when the potential energy is 550 J

______________________________________________________________________ [2]

ii) potential energy when the height is 2.5 m

______________________________________________________________________ [2]
Graph of potential energy $PE / J$ against height $h / m$. 
7. Jessica and Nicky are investigating turning forces.

a) Complete the following using the correct word from the list below.

perpendicular distance - pivot - force - equilibrium - mass

The moment (turning effect) of a force is the ___________ multiplied by the _______________ between the force and the _______________. [3]

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

Underline:

i) The force on the handle is acting (to the right, upwards, downwards). [1]

ii) The direction of the moment of the force on the handle about the pivot is (clockwise, upwards, anticlockwise). [1]

iii) The direction of the reaction force at the pivot acts (downwards, clockwise, anticlockwise). [1]

c) Calculate:

i) the total distance in cm between the force on the handle and the pivot;

________________________________________________________________________

________________________________________________________________________

[1]

ii) the moment produced by the force on the handle.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

[2]

iii) the moment produced by the nut.

________________________________________________________________________

________________________________________________________________________

[1]
d) 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). [2]

![Figure 7]

![Figure 8]

ii) By writing down numbers from 3 to 5, arrange in order the steps that Nicky should follow to prove the principle of moments. The first two have been done for you.

<table>
<thead>
<tr>
<th>Steps</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weights are placed on the ruler and moved until the system is in equilibrium.</td>
<td>2</td>
</tr>
<tr>
<td>The apparatus is set up as shown in the diagram.</td>
<td>1</td>
</tr>
<tr>
<td>The distances of the weights from the pivot are measured.</td>
<td></td>
</tr>
<tr>
<td>Process is repeated several times by changing the position of the weights.</td>
<td></td>
</tr>
<tr>
<td>The anti-clockwise and clockwise moments are calculated and tabulated.</td>
<td></td>
</tr>
</tbody>
</table>

[3]

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]

a) Label the following apparatus in the experimental set-up above from the following list:

**beaker - stirrer – temperature - spring balance - thermometer - mass balance – heat**

i) Q is the ________________ and measures the ______________ of the water. [2]

ii) R is the ________________ and is used to spread the __________ evenly throughout the water. [2]
b) Jamie is told that the way the apparatus is set up, will not result in an accurate experiment. Tick ☑ TWO correct reasons.

<table>
<thead>
<tr>
<th>Reason</th>
<th>☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q is not totally under water in both beakers.</td>
<td></td>
</tr>
<tr>
<td>The quantity of water in the aluminium cans is not the same.</td>
<td></td>
</tr>
<tr>
<td>The aluminium cans are of the same size.</td>
<td></td>
</tr>
<tr>
<td>The heater is not at the same distance from each aluminium can.</td>
<td></td>
</tr>
</tbody>
</table>

[2]

c) Tick ☑ TWO changes required in the experimental set-up for a fair test.

<table>
<thead>
<tr>
<th>Change Required</th>
<th>☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>The heater must be placed closer to the black aluminium can.</td>
<td></td>
</tr>
<tr>
<td>Both aluminium cans must contain the same mass of water.</td>
<td></td>
</tr>
<tr>
<td>The heater must be placed at the centre between the two aluminium cans.</td>
<td></td>
</tr>
<tr>
<td>The aluminium cans must contain the same mass of different liquids.</td>
<td></td>
</tr>
</tbody>
</table>

[2]

d) Jamie fixes the setup shown in Figure 9 so that the experiment would be fair.

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

______________________________________________________ [1]

ii) The graph in Figure 10 shows how the temperatures of the water in the two cans change with time. Which of the two graphs (A or B) represents the change in temperature of the water in the shiny can?_________________________ [2]

![Figure 10](image)

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e) Frozen items can be kept cool on hot summer days by keeping them in a container as shown in Figure 11.

i) Draw on Figure 11 at least one arrow to represent the direction of heat transfer. [1]

![Figure 11](image)

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]