NAME: _____________________________________                      CLASS: _______________

Answer all questions. All working must be shown. The use of a calculator is allowed. Where necessary take acceleration due to gravity g = 10 m/s².

You may find some of these equations useful:

<table>
<thead>
<tr>
<th>Energy and Work</th>
<th>W = Fs</th>
<th>PE = mgh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forces</td>
<td>W = mg</td>
<td>Moment = Force x perpendicular distance</td>
</tr>
<tr>
<td>Pressure</td>
<td>P = \frac{F}{A}</td>
<td>P = h\rho g</td>
</tr>
<tr>
<td>Density and Heat</td>
<td>Density (\rho) = \frac{m}{V}</td>
<td>Q = mc\Delta\Theta</td>
</tr>
</tbody>
</table>

For office use only:

<table>
<thead>
<tr>
<th>Question No.</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 Mark</th>
<th>Practical Mark</th>
<th>Final Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SECTION A: Answer all questions. This section has a total of 40 marks.

1. The diagram shows a lady and a child pushing a shopping trolley. The lady pushes with a force of 40 N and the child with a force of 10 N.

   (a) What is the total horizontal force on the trolley?
   ______________________________________________________________________
   (1)

   (b) Calculate the work done to push the trolley a distance of 80 m.
   ______________________________________________________________________
   (2)

   (c) On the diagram draw two other forces acting on the trolley.
   ______________________________________________________________________
   (2)

   (d) Name one of these forces acting on the trolley.
   ______________________________________________________________________
   (1)

   (e) It takes 100 seconds to push the trolley a distance of 80 m. Calculate the power.
   ______________________________________________________________________
   ______________________________________________________________________
   (2)

2. (a) Complete the following sentences about the energy changes in a washing machine.

   (i) An electric motor in a washing machine is designed to transform ____________ energy into ____________ energy. (2)

   (ii) Some of the energy supplied to the motor is wasted as ____________ energy and ____________ energy. (2)

   (b) Would more or less energy be required to wash the clothes at a temperature of 60 °C instead of 40 °C? Explain.
   ______________________________________________________________________
   (2)

   (c) An ‘A’ rated washing machine uses an input power of 600 W to give 420 W of output power. Calculate its efficiency.
   ______________________________________________________________________
   (2)
3. The diagram shows a set of shelves with a number of jars on it.

(a) Complete the Principle of Conservation of Energy.

Energy is neither ______________ nor ______________ but only changed from one form to another. (2)

(b) (i) The distance between the floor and one of the shelves is 1.2 m. The mass of one jar is 0.4 kg. Calculate the potential energy gained when one jar is lifted from the floor onto this shelf.

(ii) Accidentally this jar falls off the shelf. What is the kinetic energy of the jar just above the floor?

(iii) Calculate the velocity of the jar just before it hits the floor.

(iv) What would happen to the velocity if the same jar falls from the top shelf?
4. (a) A student holds a ruler at one end and slides a weight along the ruler.

(i) What is meant by the moment of a force?

(ii) At which point A, B or C will the turning effect of the weight feel greatest? Explain.

(iii) In which direction will the moment of the weight act?

(b) The diagram shows a mobile crane. The crane driver finds that a load of 10 000 N would be safe at a distance, \( d \), of 6.0 m.

(i) Calculate moment produced by this force.

(ii) What might happen if a very large load is lifted by the crane? Explain.
5. Joanne collects data from the Internet about planets in the solar system as shown below.

<table>
<thead>
<tr>
<th>Name of Planet</th>
<th>Distance from sun in millions of kilometres</th>
<th>Time taken for one orbit of the sun in years</th>
<th>Time taken to spin on its axis in hours</th>
<th>Average temperature °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>60</td>
<td>0.24</td>
<td>1400</td>
<td>430</td>
</tr>
<tr>
<td>Venus</td>
<td>110</td>
<td>0.60</td>
<td>5800</td>
<td>470</td>
</tr>
<tr>
<td>Earth</td>
<td>150</td>
<td>1</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>Mars</td>
<td>230</td>
<td>2</td>
<td>25</td>
<td>-20</td>
</tr>
<tr>
<td>Jupiter</td>
<td>780</td>
<td>12</td>
<td>10</td>
<td>-150</td>
</tr>
<tr>
<td>Saturn</td>
<td>1400</td>
<td>30</td>
<td>10</td>
<td>-180</td>
</tr>
<tr>
<td>Uranus</td>
<td>2900</td>
<td>84</td>
<td>17</td>
<td>-220</td>
</tr>
<tr>
<td>Neptune</td>
<td>4500</td>
<td>165</td>
<td>16</td>
<td>-230</td>
</tr>
</tbody>
</table>

(a) Name the force which keeps planets in their orbits. ________________________________________________ (1)

(b) What is the name of the galaxy which contains our Solar System? ____________________________________ (1)

(c) Pluto is missing from the above table. Explain why. ______________________________________________ (1)

(d) Which two planets have the same length of day? ___________________________________________________ (1)

(e) Which planet has the longest year? _______________________________________________________________ (1)

(f) Explain why is the temperature on Neptune is very cold. ____________________________________________ (1)

(g) What form of energy would be very useful to use in space? Name one advantage of using this source. ___________________________________________________________ (2)
SECTION B: Answer ALL questions. This section has a total of 45 marks.

6. (a) Jeffrey hangs different weights at the end of a spring. Each time he measures the length of the spring. The results are shown below.

<table>
<thead>
<tr>
<th>Weight (N)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (mm)</td>
<td>40</td>
<td>48</td>
<td>60</td>
<td>64</td>
<td>72</td>
<td>80</td>
<td>88</td>
<td>96</td>
</tr>
<tr>
<td>Extension (mm)</td>
<td>0</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(i) Complete the above table by filling in the missing values. (3)
(ii) What is the original length of the spring? ___________ (1)
(iii) Plot a graph of Extension (mm) on the y-axis against Weight (N) on the x-axis. Draw the best straight line through your points. (5)
(iv) Jeffrey reads one of the lengths incorrectly. Which one is it? _________ (1)

(b) The same spring is now attached to a block resting on a rough surface, as shown below.

(i) As the pulling force is increased, the block just starts to move to the right when the spring is 68 mm long. What is the extension of the spring when it is 68 mm long?

__________________________________________________________________________ (1)

(ii) The same spring is now used to pull a much heavier block. The spring becomes permanently deformed. Explain.

__________________________________________________________________________
__________________________________________________________________________ (2)

(iii) Name two ways in which this frictional force can be reduced.

__________________________________________________________________________
__________________________________________________________________________ (2)
7. (a) The diagram below shows a simple heat exchanger. Heat is transferred from the hot water to the cold water through the walls of the pipe.

Rachel and Caroline investigate if the efficiency of a heat exchanger depends on the material used to make the pipe. The students test three different materials.

(i) Name the main process by which heat is transferred from the hot water inside the pipe to the cold water in the tank.

__________________________________________________________________________

(1)

The results obtained are recorded in the table below.

<table>
<thead>
<tr>
<th>Material</th>
<th>Initial temperature of cold water (°C)</th>
<th>Final temperature of the cold water (°C)</th>
<th>Change in temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>20</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>20</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Plastic</td>
<td>20</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

(ii) Fill in the missing values in the above table. (3)

(iii) Name one precaution to obtain accurate results.

__________________________________________________________________________

(2)

(iv) Use the above table to choose which one of the three materials is the best heat exchanger. Give a reason for your answer.

__________________________________________________________________________

(2)

(v) The density of water is 1 g/cm³ and volume of water is 15 000 cm³. Calculate its mass.

__________________________________________________________________________

(2)
(vi) The specific heat capacity of water is 4200 J/kg°C. Calculate the energy transferred when 50 kg of water pass through the heat exchanges assuming that the most efficient material is used.

___________________________________________________________________________
___________________________________________________________________________

(3)

(b) The diagram shows a heat exchanger used in an industrial laundry. What is the advantage of having a coiled pipe?

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________ (2)

8.(a) Heavy furniture sometimes marks the floor on which it stands. Four tables A, B, C and D of the same weight, have legs of different shapes as shown below.

(i) Which leg is **least** likely to mark the floor underneath it? Explain your answer.

___________________________________________________________________________
___________________________________________________________________________ (2)

(ii) Leg A has an area of 30 cm² in contact with the ground. Calculate the **total** area of the table in contact with the ground if the table has four legs.

___________________________________________________________________________ (1)

(iii) The mass of table A is 20 kg. Calculate the pressure exerted by the table on the floor.

___________________________________________________________________________ (2)
(b) In 1851 Richard Dudgeon invented the hydraulic jack. The diagram below shows how the hydraulic jack is applied to lift a car. The hydraulic fluid transmits pressure caused by piston A.

(i) Calculate the pressure caused by a force of 1000 N on piston A of area 0.01 m².

___________________________________________________________________________
___________________________________________________________________________

(ii) What is the pressure at each of the four pistons holding the car? Explain your answer.

___________________________________________________________________________
___________________________________________________________________________

(iii) Calculate the force on each piston of area 0.02 m².

___________________________________________________________________________
___________________________________________________________________________

(iv) Calculate the total upward force provided by the hydraulic lift on the car.

___________________________________________________________________________

(v) The weight of the car is 7000 N. Is the hydraulic lift able to lift the car? Explain.

___________________________________________________________________________