DIRECTORATE FOR QUALITY AND STANDARDS IN EDUCATION
Department for Curriculum Management
Educational Assessment Unit
Annual Examinations for Secondary Schools 2014

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/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:

| Density | m = \rho V |
| Pressure | P = \rho g h \quad F = PA |
| Forces | W = mg |
| Moments | Moment = F \times \text{perpendicular distance} |
| Energy | P.E. = mg h \quad K.E. = \frac{1}{2}mv^2 \quad \text{Work Done} = Fs |
| Heat | \Delta Q = m c \Delta \theta |

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 Mark</th>
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<tbody>
<tr>
<td>1</td>
<td>8</td>
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<td>2</td>
<td>8</td>
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<td>15</td>
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<td>8</td>
<td>15</td>
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<tr>
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<td>85</td>
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<td>Practical</td>
<td>15</td>
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<td>Total</td>
<td>100</td>
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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. The Maltese islands are almost totally dependent on fossil fuels as a source of energy.
   a) i) Give an example of a fossil fuel. ____________________________________________ [1]
   ii) State one advantage of using fossil fuels. ______________________________________ [1]
   iii) Why are fossil fuels considered to be non-renewable?
       ____________________________________________________________ [1]

b) Wind energy is more environmentally friendly than fossil fuels. State:
   i) one disadvantage of using wind energy,
       ____________________________________________________________ [1]
   ii) two other forms of energy that are considered to be renewable.
       ____________________________________________________________ [2]

c) A wind turbine converts 100 000 J of wind energy into 45 000 J of electrical energy. Calculate its efficiency.
   ____________________________________________________________ [2]

2. In 1738, Daniel Bernoulli, a Swiss physicist, laid the basis for the kinetic theory of gases. He proposed that gases consist of a large number of particles moving in all directions.
   a) A closed glass container is filled with a gas at room temperature. State whether each of the following quantities increases, decreases or remains the same as the gas cools:
      i) mass of the gas, ____________________________________________ [1]
      ii) pressure of the gas, ____________________________________________ [1]
      iii) density of the gas, ____________________________________________ [1]
      iv) speed of the gas particles, ____________________________________ [1]
v) internal energy of the gas particles. [1]

b) A closed container is filled with air. The container has a length of 0.8 m, a breadth of 0.3 m and a height of 0.5 m as shown in Figure 3. Calculate the:

i) volume of air inside the container, [11]

ii) mass of air, given that the air density is 1.1 kg/m³. [1]

c) All the air particles are now removed from the container. This empty space is called a ____________________. [1]

3. This question is about Earth and space.

a) Underline the correct answer:

i) Seasons on Earth are caused by a (tilt, spin) in the Earth’s axis. [1]

ii) In winter, regions on Earth receive (less, more) solar energy. [1]

b) Put the following in order of size, smallest first: star, planet, galaxy, solar system. [1]

c) Curiosity is a robotic rover that has been active on planet Mars since 2011. It has provided further evidence about the presence of water on Mars in the distant past.

The mass of Curiosity on Earth is 900 kg. Complete the table below.

<table>
<thead>
<tr>
<th></th>
<th>On Earth (g = 10 N/kg)</th>
<th>On Mars (g = 4 N/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mass</strong> of Curiosity (kg)</td>
<td>900</td>
<td></td>
</tr>
<tr>
<td><strong>Weight</strong> of Curiosity (N)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[3]

d) Name TWO benefits of space exploration.
4. **This question is about energy and energy changes.**

a) **Complete:**

The principle of _________________________________ states that energy can neither be created nor destroyed but only changed from one form to another. [1]

![Figure 5](image)

b) Figure 5 shows a ball of mass 0.25 kg being kicked vertically upwards with a speed of 5 m/s.

   i) Calculate the kinetic energy of the ball just after being kicked.

   ________________________________________________________ [2]

   ii) What is the value of the potential energy of the ball at maximum height? (Assume there are no energy losses)

   ________________________________________________________ [1]

   iii) Calculate the maximum height reached by the ball.

   ________________________________________________________
   ________________________________________________________
   ________________________________________________________

   ________________________________________________________ [2]

c) **Complete:**

   After hitting the ground the kinetic energy of the ball is changed to ______________ and ______________. [2]

5. **This question is about forces and Hooke’s law.**

a) Malcolm uses a rope to pull a large wooden box as shown in Figure 6.
i) Name the force:

- ‘A’ acting between the block and the ground. _____________________________ [1]
- ‘B’ acting in the stretched rope. _____________________________ [1]

ii) Draw on Figure 6 the reaction of the ground on the wooden block. [1]

b) Jasmine loads the spring shown in Figure 7 using 1 N weights. She plots a graph of extension (cm) against load (N).

<table>
<thead>
<tr>
<th>Load (N)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension (cm)</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
</tr>
</tbody>
</table>

Figure 7

i) She measures the extensions of the spring by using a __________________________ [1]

ii) How does she know that the spring obeys Hooke’s law?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________ [1]

iii) The original length of the spring is 40 cm. Calculate the new length of the spring when the total load is 6 N. (Assume that the spring continues to obey Hooke’s law).

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________ [2]

iv) Jasmine performs the same experiment with a similar spring which is **stiffer**.
Draw on the same axes the graph that would result. [1]

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

6. This question is about moments.
   a) Fill in the missing words:
      The moment of a force depends on the size of the _____________ and its perpendicular _____________ from the pivot. [2]

   b) Amy sets up a metre rule of negligible weight such that it is pivoted at one end and is kept horizontally by the pull of a force sensor at the other end (see Figure 8).
      She moves the block towards the force sensor and records the force exerted by the force sensor to keep the ruler horizontal. The data she obtains is given in the table below.

      | Distance of mass from pivot (cm) | 10 | 20 | 30 | 40 | 50 | 60 | 70 |
      |---------------------------------|----|----|----|----|----|----|----|
      | Force measured by force sensor (N) | 2.5 | 5.0 | 7.5 | 10.0 | 12.5 | 15.0 | 17.5 |

      i) Plot a graph of Force (N) on the y-axis against Distance (cm) on the x-axis. [5]
      ii) Amy repeats the experiment using a block of larger mass. She places it on the 40 cm mark.
          Underline the correct answer.
          The increase in mass will bring about:
          (an increase, a decrease, no change) in the weight of the block,
          (an increase, a decrease, no change) in the force measured by the force sensor,
          (an increase, a decrease, no change) in the clockwise moment. [3]

   c) Alex is practising windsurfing as in Figure 9. The windsurf and Alex are balanced.
      i) Continue the principle of moments: In equilibrium total anti-clockwise moments __________________________
      ________________________________________________________________________________________ [1]
ii) Calculate the moment produced by the wind force.

__________________________________________________________ [2]

iii) What is the moment caused by Alex if he balances his windsurf?

__________________________________________________________ [1]

iv) The wind force increases. What does Alex do to remain balanced?

(leans backwards, goes forward towards the sail, stays in the same position) [1]
7. This question is about density and pressure in liquids.
   
a) A piece of wood floats when placed in a container filled with water. Explain why this happens using the term ‘density’.

   _____________________________________________________________
   _____________________________________________________________

b) Samuel is provided with the equipment shown in Figure 10. He needs to find the density of water.
   i) Explain how he can use the equipment to find
      • the mass of water;

   _____________________________________________________________
   _____________________________________________________________
      • the volume of water.

   _____________________________________________________________
   _____________________________________________________________

   ii) Which formula is used to find the density of water?

   _____________________________________________________________
   _____________________________________________________________

   c) Tank A is a large wide tank which is filled with water. Tank A needs to be painted and all the water needs to be transferred into tank B.
   i) Will the water pressure at the bottom of tank B be greater than, smaller than or equal to the water pressure at the bottom of tank A? Give a reason for your answer.

   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________

   ii) Tank B has two taps as shown in the diagram. Draw (on Tank B) how water would flow out of each tap when turned on at the same time.

   _____________________________________________________________
   _____________________________________________________________

   d) On March 26, 2012, film director James Cameron reached the deepest known underwater point on Earth inside a special submersible. The depth of the sea at this point was 10 900 m.
i) Given that the density of sea water is 1050 kg/m$^3$, calculate the water pressure at that depth.

ii) The pilot window has an area of 0.15 m$^2$. Calculate the force due to the water acting on it.

iii) Whilst going down the pressure inside the submersible was kept unchanged at atmospheric pressure. Explain why.

8. This question is about specific heat capacity.

a) The iron block and the aluminium block in Figure 13 have a mass of 1 kg each.

i) Explain in terms of ‘density’ why the iron block is smaller in size.

ii) Identical heaters are used to heat each block. Calculate the power of the heater if it changes 900 J of electrical energy into heat energy every 20 seconds.

iii) The specific heat capacity of iron is 450 J/kg°C while that of aluminium is 900 J/kg°C. When both blocks that are initially at room temperature are heated for five minutes it is noted that the iron block reaches a higher temperature than the aluminium one. Explain.
iv) Name TWO processes by which heat is lost from each block.

__________________________________________________________________________

__________________________________________________________________________ [2]

b) Stefan is asked to find the specific heat capacity of water. He is given the following apparatus:

i) Label the parts of the apparatus in the space shown above. [3]

ii) With this set up, heat energy is lost to the surroundings. What can Stefan do to reduce heat losses?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________ [2]

iii) Stefan uses 0.2 kg of pure water for this experiment. Given that 54 600 J of heat energy are used to raise the temperature from 20°C to 85°C, calculate the specific heat capacity of water.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________ [3]
END OF PAPER