READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions.

2. Section A consists of THREE questions. Candidates must attempt ALL questions in this section. Answers for this section must be written in this answer booklet.

3. Section B consists of THREE questions. Candidates must attempt ALL questions in this section. Answers for this section must be written in this answer booklet.

4. All working MUST be CLEARLY shown.

5. You may use a silent, non-programmable calculator, but you should note that the use of an inappropriate number of figures in answers will be penalised.

6. Mathematical tables are provided.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

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SECTION A

Attempt ALL questions.

You MUST write your answers in this answer booklet.

1. The data in Table 1 showing \( V_p \) and \( V_s \) were obtained when testing a transformer.

   **TABLE 1**

<table>
<thead>
<tr>
<th>( V_p / V )</th>
<th>( V_s / V )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4</td>
<td>21.1</td>
</tr>
<tr>
<td>3.5</td>
<td>22.3</td>
</tr>
<tr>
<td>4.4</td>
<td>40.5</td>
</tr>
<tr>
<td>6.1</td>
<td>54.6</td>
</tr>
<tr>
<td>7.7</td>
<td>69.9</td>
</tr>
</tbody>
</table>

   (a) On page 3, plot a graph of \( V_s \) against \( V_p \).  
    (b) Determine the gradient, \( S \), of the graph.
    (c) Use the gradient, \( S \), to calculate
        (i) the number of turns in the primary, \( N_p \), given that the number of turns in the secondary, \( N_s = 750 \)

   (4 marks)

   (7 marks)

   (4 marks)
(ii) the current in the secondary winding, if the primary current is 1.6 A.

(3 marks)

(d) (i) If the current in the secondary winding is actually 0.15 A, calculate the efficiency of this transformer.

(3 marks)

(ii) How would you know if this was 'an ideal transformer'?

(1 mark)

(e) State THREE features of the transformer that enable it to operate efficiently.

(3 marks)

Total 25 marks
Write your answer to Question 6 here.

2. (a) Complete Table 2 which shows physical quantities and the instruments used to measure them.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter of a wire</td>
<td></td>
</tr>
<tr>
<td>Volume of a liquid</td>
<td>Thermometer</td>
</tr>
<tr>
<td>Time</td>
<td>Spring balance</td>
</tr>
</tbody>
</table>

(5 marks)

(b) A child, drops a stone as shown in Figure 1.

![Figure 1]

(i) Identify the force which acts on the stone, causing it to fall.

(ii) Describe the change in motion of the stone as a result of this force.
(c) (i) Given that the mass of a cricket ball is 0.06 kg, calculate its weight in newtons.


[Acceleration due to gravity, \( g = 10 \text{ m s}^{-2} \)]

(3 marks)

(ii) Figure 2 is a vector diagram representing a cricket ball's velocity, OA, and the wind's velocity, OB.

a) By accurate scale drawing on Figure 2 below, determine the resultant vector.

\[ \text{Scale 1 cm = 2 m s}^{-1} \]

\[ \text{Figure 2} \]

(3 marks)

b) State its magnitude in m s\(^{-1}\) and its direction in degrees from OA.


(2 marks)

Total 15 marks
6. (a) Discuss the importance of alternative energy to the Caribbean with reference to two sources and their uses. (6 marks)

(b) A football is kicked from rest looping over the head of a goalkeeper who is 40 m away.

(i) Describe the energy changes taking place in the ball from when it was kicked to when it hit the ground behind the goalkeeper. (Assume no energy losses.) (4 marks)

(ii) After 1 s, the ball of mass $m$ kg and velocity $v$ m/s is located $h$ m from the ground. Derive an expression in terms of $m$, $h$ and $v$ for the difference between the potential and the kinetic energy of the ball. (2 marks)

(iii) During a game, the ball of mass 0.43 kg hit the head of one of the players of height 1.5 m. The player was standing vertically. If the velocity of the ball at the point of contact with the player’s head was 7 m/s, what momentum was transferred to the player? (3 marks)

Acceleration due to gravity, $g = 10$ N kg$^{-1}$

Total 15 marks

Write your answer to Question 6 here.

3. (a) (i) Draw and label a mercury laboratory thermometer, clearly indicating the fixed points. (4 marks)

(ii) Draw arrows in Table 3 from each thermometer to map it to its operating range.

<table>
<thead>
<tr>
<th>Type of Thermometer</th>
<th>Operating Temperature Range°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical</td>
<td>−20 to 110</td>
</tr>
<tr>
<td>Laboratory thermometer</td>
<td>−250 to 800</td>
</tr>
<tr>
<td>Thermocouple</td>
<td>35 to 43</td>
</tr>
</tbody>
</table>

(3 marks)
(b) Figure 3 shows a scuba diver ascending from 20 m below the surface where the water temperature is 10 °C, to the surface, where the temperature is 25 °C and the pressure is 1.01 x 10⁵ Pa.

Figure 3

(i) Calculate the pressure the diver is subjected to at 20 m below the surface of the water.

(3 marks)

[Density of water = 1025 kg m⁻³]

[Acceleration due to gravity, g = 10 m s⁻²]
Write your answer to Question 5 here.

(ii) By using the general gas law, determine, as a result of the rise, the ratio of the final volume to the initial volume of a bubble.

(5 marks)
Total 15 marks
SECTION B

Attempt ALL questions.

You MUST write your answers in the spaces provided after each question.

4. (a) Describe EACH of the following terms as it relates to the laws of reflection:
   (i) Normal
   (ii) Angle of incidence
   (iii) Angle of reflection
   Describe what EACH of the terms means. (3 marks)

(b) In the description of the formation of an image produced in a plane mirror, a physics student recalled THREE features.
   State the THREE features of an image produced in a plane mirror. (3 marks)

(c) Using a relevant physics concept, explain why the word 'JUBA' is painted in this manner at the front of some emergency vehicles. (4 marks)

(d) Figure 4 shows a ray of white light, AO, incident at 30° to the PS boundary of the rectangular glass block, PQRS.

   (i) Calculate the angle of refraction produced on the PS boundary. (5 marks)

   (ii) Name the angle of refraction produced on the QR boundary. (5 marks)

   [Refractive Index of glass = 1.5]

Total 15 marks
5. (a) (i) Describe a test to show that a semi-conductor diode is defective. (2 marks)
(ii) Sketch the I-V graph for a functioning semi-conductor diode. (2 marks)
(iii) Draw and complete a truth table for a 'NOT gate'. (2 marks)
(b) Figure 5 shows three resistors of values 2Ω, 6Ω and 12Ω in series.
(i) Calculate the equivalent resistance that one can use in series. (2 marks)

Figure 5

(ii) In a second scenario, 2Ω, 6Ω and 12Ω resistors are placed in parallel as seen in Figure 6.

Figure 6

Calculate the equivalent resistance that one can use in parallel. (4 marks)

(c) Last year for Christmas, Paula had to put together a set of bulbs to light her family’s Christmas tree. After much thought, she decided to put together strings of bulbs in series. Was that a wise decision? Justify your answer. (3 marks)

Total 15 marks