Level Descriptors
<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 5</td>
<td>GOOD</td>
</tr>
<tr>
<td>Level 4</td>
<td>SOUND</td>
</tr>
<tr>
<td>Level 3</td>
<td>GENERAL</td>
</tr>
<tr>
<td>Level 2</td>
<td>BASIC</td>
</tr>
<tr>
<td>Level 1</td>
<td>ELEMENTARY</td>
</tr>
</tbody>
</table>
Level 5

- demonstrates extensive knowledge and understanding of facts, concepts and principles in physics
- displays ability to apply the concepts of physics to a wide range of unfamiliar situations
- demonstrates ability to analyse, synthesise and critically evaluate information from multiple perspectives and in an in-depth manner
- effectively communicates ideas in a succinct, logical and coherent manner with an accurate use of scientific terminologies and appropriate formats consistently
- demonstrates ability to design and conduct scientific investigations, evaluate procedures, handle and analyse data collected, and draw valid conclusions
Level 5

能處理廣泛及不常見的問題

從不同層次分析問題、準確作出關鍵性的判斷

能以簡明、合邏輯、條理清晰及連貫地表達構思

有能力設計及進行科學探究、程序鑑定及數據收集、作出有效結論
2. A ball is kicked to move with an initial velocity of $10 \text{ m s}^{-1}$, making an angle of $40^\circ$ with the horizontal. The ball then just passes a block of height 1.6 m, reaching the highest point D, and finally hits the ground at E as shown in Figure 2.1. (Neglect air resistance and the size of the ball.)

(a) Draw an arrow to indicate the direction of acceleration of the ball at C. (1 mark)

(b) For a projectile of initial velocity $u$ that makes an angle $\theta$ with the horizontal, show that its horizontal range is given by $\frac{u^2 \sin 2\theta}{g}$. Hence, or otherwise, find another angle of projection such that the ball can still reach E with the same initial speed of $10 \text{ m s}^{-1}$.

(Given: $2 \sin \theta \cos \theta = \sin 2\theta$) (4 marks)

\[
x = \frac{u^2 \sin \theta}{g} \quad (\text{i})
\]

\[
x = \frac{10 \sin 80^\circ}{g}
\]

\[
\therefore \theta = \theta - \theta^3
\]

\[
\text{Let} \quad \theta = \theta
\]

\[
\therefore \theta = \frac{2 \sin \theta}{3}
\]

\[
\text{Another angle of projection}
\]

\[
x = \frac{u \cos \theta}{g}
\]

\[
\therefore \quad \sin \theta = \frac{3}{5}
\]

(c) Calculate the speed of the ball at C. (2 marks)

\[
y = (10 \sin 40^\circ) = 2 \times (0.69) \quad (1.6)
\]

\[
\therefore \quad \frac{1}{2} \times 10 \times (0.69) = \frac{1}{2} \times 10 \times (0.69)
\]

\[
\therefore \quad \sqrt{(3.2 + (\cos 40^\circ))}
\]

\[
\frac{1}{2} \times 10 \times (0.69) + (\cos 40^\circ)
\]

\[
\text{The speed} = \quad \sqrt{(3.2 + (0.69))(0.69)}
\]
10. Josephine conducts an investigation on transformers. Primary and secondary coils are wound on two soft-iron C-cores to form a transformer. She sets up a circuit as shown in Figure 10.1.

![Circuit diagram](image)

**Figure 10.1**

(a) Josephine varies the input voltage $V_1$ to the transformer and records the corresponding output voltage $V_2$. The results are shown in Table 10.2. In Figure 10.3, plot a graph of $V_2$ against $V_1$. Hence draw a conclusion for this investigation.

<table>
<thead>
<tr>
<th>$V_1$ / V</th>
<th>$V_2$ / V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>2.5</td>
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<tr>
<td>3.0</td>
<td>5.1</td>
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<tr>
<td>6.0</td>
<td>10.0</td>
</tr>
</tbody>
</table>

**Table 10.2**

![Graph](image)

**Figure 10.3**

Input voltage $V_1$ is directly proportional to output voltage $V_2$.

(b) Deduce the value of $V_2$ when $V_1$ equals 8.0 V.

\[
\frac{0}{6.0} = \frac{\sqrt{2}}{8.0} \\
\sqrt{2} = \frac{13.3}{\sqrt{4}}
\]
(c) Josephine wants to study the relationship between the output voltage and the number of turns in the secondary coil of the transformer. Describe how she can conduct the experiment. (2 marks)

Use a fixed output input voltage and \( N_1 \).

Vary the number of turns in the secondary coil and record the output voltage \( V_2 \).

Plot a graph of \( N_2 \) against \( V_2 \).

(d) Josephine adds a bulb to the circuit as shown in Figure 10.4. Suggest a method that Josephine can use to estimate the efficiency of the transformer and specify the measurement(s) to take. Additional apparatus may be used if necessary. (3 marks)

![Figure 10.4](image.png)

Efficiency: \[ \text{Efficiency} = \frac{\text{Output power}}{\text{Input power}} \times 100\% \]

Add ammeters at both sides of the transformer.

As long as the bulb bulb lights up, measure the voltages and current at both sides. Use \( P = IV \) input and output power can be obtained.

END OF PAPER
Level 4

- demonstrates sound knowledge and understanding of facts, concepts and principles in physics
- displays ability to apply the concepts of physics to unfamiliar situations
- demonstrates ability to analyse, synthesise and evaluate information from several perspectives
- communicates ideas in a logical and coherent manner using scientific terminologies and appropriate formats
- demonstrates ability to design and conduct scientific investigations, handle and interpret data collected, and draw conclusions
Level 4

- 能處理不常見的問題
- 能從數個層次分析問題、結合、作出判斷
- 用科學術語及適當形式，以合邏輯及連貫地表達構思
- 有能力設計及進行科學探究、分析及數據收集、並作出結論
A ball is kicked to move with an initial velocity of \( \frac{10}{s} \) m\(^s^{-1}\), making an angle of 40° with the horizontal. The ball then just passes a block of height 1.6 m, reaching the highest point \( D \), and finally hits the ground at \( E \) as shown in Figure 2.1. (Neglect air resistance and the size of the ball.)

Figure 2.1

(a) Draw an arrow to indicate the direction of acceleration of the ball at \( C \). (1 mark)

(b) For a projectile of initial velocity \( y \) that makes an angle \( \theta \) with the horizontal, show that its horizontal range is given by \( \frac{u^2 \sin 2\theta}{g} \). Hence, or otherwise, find another angle of projection such that the ball can still reach \( E \) with the same initial speed of 10 m\(^s^{-1}\). (Given: \( 2 \sin \theta \cos \theta = \sin 2\theta \)) (4 marks)

(c) Calculate the speed of the ball at \( C \). (2 marks)
10. Josephine conducts an investigation on transformers. Primary and secondary coils are wound on two soft-iron C-cores to form a transformer. She sets up a circuit as shown in Figure 10.1.

![Figure 10.1](image)

(a) Josephine varies the input voltage $V_1$ to the transformer and records the corresponding output voltage $V_2$. The results are shown in Table 10.2. In Figure 10.3, plot a graph of $V_2$ against $V_1$. Hence draw a conclusion for this investigation.

<table>
<thead>
<tr>
<th>$V_1 / \text{V}$</th>
<th>$V_2 / \text{V}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>2.5</td>
</tr>
<tr>
<td>3.0</td>
<td>5.1</td>
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<td>4.5</td>
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</tr>
<tr>
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<td>10.0</td>
</tr>
</tbody>
</table>

Table 10.2

![Figure 10.3](image)

(2 marks)

$V_1$ is directly proportional to $V_2$.

(b) Deduce the value of $V_2$ when $V_1$ equals 8.0 V.

The slope of the graph is $\frac{10 - 2}{6 - 1.5} = \frac{8}{4.5} = 1.6667$.

$\sqrt{V_2} = \frac{1.5 + 7.5}{2} = 1.6667$.

$V_2 = (2.3) \text{ V}$.
(c) Josephine wants to study the relationship between the output voltage and the number of turns in the secondary coil of the transformer. Describe how she can conduct the experiment. (2 marks)

She can vary the number of turns in the secondary coil of the transformer and record the corresponding output voltage of the transformer. Keep the input voltage and the turns of the primary coil unchanged.

(d) Josephine adds a bulb to the circuit as shown in Figure 10.4. Suggest a method that Josephine can use to estimate the efficiency of the transformer and specify the measurement(s) to take. Additional apparatus may be used if necessary. (3 marks)

Connect an ammeter in series with the bulb and connect another ammeter in the input circuit. Since \( P = VI \), the current and voltage can be read from an ammeter and a voltmeter in both coils, respectively. Efficiency can be found using the power ratio.
Level 3

- demonstrates general knowledge and understanding of facts, concepts and principles in physics
- displays ability to apply the concepts of physics to unfamiliar situations under suitable guidance
- demonstrates ability to construct relationships and analyse information
- communicates ideas in a clear structured manner using scientific terminologies and appropriate formats
- demonstrates ability to design and conduct scientific investigations, handle and interpret data collected, and draw conclusions under suitable guidance
Level 3

- 適當引導下有能力處理不常見的問題
- 能建構關係及分析訊息
- 能用科學術語及適當形式、以清晰明顯方法表達構思
- 能進行科學探究、數據收集及處理、再得出結論
2. A ball is kicked to move with an initial velocity of $10 \text{ m s}^{-1}$, making an angle of $40^\circ$ with the horizontal. The ball then just passes a block of height $1.6 \text{ m}$, reaching the highest point $D$, and finally hits the ground at $E$ as shown in Figure 2.1. (Neglect air resistance and the size of the ball.)

![Figure 2.1](image)

(a) Draw an arrow to indicate the direction of acceleration of the ball at $C$. (1 mark)

(b) For a projectile of initial velocity $u$ that makes an angle $\theta$ with the horizontal, show that its horizontal range is given by \( \frac{u^2 \sin 2\theta}{g} \). Hence, or otherwise, find another angle of projection such that the ball can still reach $E$ with the same initial speed of $10 \text{ m s}^{-1}$. (Given: \( 2 \sin \theta \cos \theta = \sin 2\theta \)) (4 marks)

The time travelled:
\[
\begin{align*}
8 &= u \sin \theta \cdot t + \frac{1}{2} \cdot (-g) \cdot t^2 \\
0 &= u \sin \theta \cdot t - \frac{1}{2} g t
\end{align*}
\]
\[ t = \frac{2u \sin \theta}{g} \]

The horizontal range:
\[
\begin{align*}
\text{Horizontal range} &= \frac{u^2 \sin 2\theta}{g} \\
&= \frac{u^2 \cos^2 \theta \sin \theta}{g} \\
&= \frac{(u^2 \sin \theta \cos \theta)^2}{g} = \frac{(u^2 \sin 2\theta)^2}{g} \\
&= \frac{(u^2 \sin 2\theta)^2}{g}
\end{align*}
\]

(c) Calculate the speed of the ball at $C$. (2 marks)
\[
\begin{align*}
v &= u + gt \\
v &= \sqrt{(u \sin 40^\circ)^2 + 2 \cdot (-10) \cdot 1.6} \\
v &= 3.05 \text{ m s}^{-1}
\end{align*}
\]
Josephine conducts an investigation on transformers. Primary and secondary coils are wound on two soft-iron C-cores to form a transformer. She sets up a circuit as shown in Figure 10.1.

![Diagram of transformer circuit](image)

Figure 10.1

(a) Josephine varies the input voltage $V_1$ to the transformer and records the corresponding output voltage $V_2$. The results are shown in Table 10.2. In Figure 10.3, plot a graph of $V_2$ against $V_1$. Hence draw a conclusion for this investigation.

<table>
<thead>
<tr>
<th>$V_1$ (V)</th>
<th>$V_2$ (V)</th>
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</thead>
<tbody>
<tr>
<td>1.5</td>
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<tr>
<td>3.0</td>
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</tr>
<tr>
<td>6.0</td>
<td>10.0</td>
</tr>
</tbody>
</table>

Table 10.2

The transformer is a step-up one which increases the voltage by 1.67 times.

\[
\frac{\text{No. of turns secondary coils}}{\text{No. of turns primary coils}} = 1.67
\]

(b) Deduce the value of $V_2$ when $V_1$ equals 8.0 V.

\[
V_2 = 8 \times 1.67
\]

\[
= 13.36 \text{ V}
\]
(c) Josephine wants to study the relationship between the output voltage and the number of turns in the secondary coil of the transformer. Describe how she can conduct the experiment. (2 marks)

Vary the input voltage.

Keep the input voltage constant.

Vary the number of turns in the secondary coil. Then measure the output voltage.

Plot a graph of output voltage against the number of turns in the secondary coil.

(d) Josephine adds a bulb to the circuit as shown in Figure 10.4. Suggest a method that Josephine can use to estimate the efficiency of the transformer and specify the measurement(s) to take. Additional apparatus may be used if necessary. (3 marks)

Figure 10.4

The readings in the voltmeter and ammeter connected in series to the bulb are taken. Efficiency of the transformer

\[ \text{Efficiency} = \left( \frac{V_2}{V_1} \right) \times 100\% \]

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<table>
<thead>
<tr>
<th></th>
<th>Level 5</th>
<th>Level 4</th>
<th>Level 3</th>
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<tr>
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<tr>
<td>3(c)</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
</tbody>
</table>
Level 2

- demonstrates basic knowledge and understanding of facts, concepts and principles in physics
- displays ability to apply the concepts of physics to familiar situations
- demonstrates ability to describe relationships and handle information
- communicate ideas with some correct use of scientific terms
- demonstrates ability to conduct practical work by following instructions, handle and interpret data collected, and draw simple conclusions
Level 2

有能力處理常見的問題

能以常用術語表達構思

能描述問題間的關係

在指導下能進行數據演繹及作出簡單結論
Figure 6.1 shows a microwave oven. Mary wants to conduct an experiment to estimate the useful output power of the oven. She is provided with the apparatus and material shown in Figure 6.2.

Figure 6.2

(a) Describe how Mary should conduct the experiment. Specify all measurements Mary has to take and state ONE precaution/assumption of the experiment. Write down an equation for calculating the useful output power.

Record initial temperature of water. Put the beaker of water into the microwave oven for 1 minute. Take it out and record the final temperature. Immediately after taking it out, record the time used to warm it up.

The energy absorbed transferred to water will be \( q = mc_\text{T} \)

The useful output power of the oven will be \( \frac{q}{t} \)

One assumption is that the beaker itself did not consume any energy, which means no energy is used to heat up the beaker.
(b) The value obtained by Mary is found to be smaller than the rated power of the oven. Suggest one possible reason to account for this difference. (1 mark)

The heat will be transferred to Mary. First, if she took out the bread out with her hands. Instead of tongs. Since heat temperature measured will be smaller, the rated power will be smaller than the actual one.

(c) Explain whether increasing the mass of water used in the experiment would improve the accuracy of the experiment. (1 mark)

Since m has a large value, the error of ±1 due to the significant figure of the thermometer will be comparatively smaller.
10. Josephine conducts an investigation on transformers. Primary and secondary coils are wound on two soft-iron C-cores to form a transformer. She sets up a circuit as shown in Figure 10.1.

(a) Josephine varies the input voltage $V_1$ to the transformer and records the corresponding output voltage $V_2$. The results are shown in Table 10.2. In Figure 10.3, plot a graph of $V_2$ against $V_1$. Hence draw a conclusion for this investigation.

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</tr>
</tbody>
</table>

Table 10.2

![Figure 10.3](image)

The output voltage $V_2$ is directly proportional to input voltage $V_1$.

(b) Deduce the value of $V_2$ when $V_1$ equals 8.0 V.

\[
\frac{8.0}{V_2} = \frac{1.5}{2.5}
\]

\[
V_2 = 13.3 \text{ V}
\]
(c) Josephine wants to study the relationship between the output voltage and the number of turns in the secondary coil of the transformer. Describe how she can conduct the experiment. (2 marks)

She can first use the same number of turns in the primary and secondary coil to measure the output voltage. Then she can increase the number of turns in the secondary coil while keeping that in the primary coil constant to see the change of the output voltage.

(d) Josephine adds a bulb to the circuit as shown in Figure 10.4. Suggest a method that Josephine can use to estimate the efficiency of the transformer and specify the measurement(s) to take. Additional apparatus may be used if necessary. (3 marks)

![Figure 10.4](image.png)

Turn on the a.c. power so that the bulb is light on. Measure the input voltage by a voltmeter across the a.c. power. Measure the output voltage by another voltmeter across the light bulb. By \( \frac{\text{output voltage}}{\text{input voltage}} \times 100\% \), the efficiency of the transformer can be estimated.

END OF PAPER
Level 1

- recalls facts and principles in physics
- displays ability to apply the concepts of physics to simple and familiar situations
- demonstrates ability to handle simple information presented in a straightforward manner
- communicates ideas with occasional correct use of scientific terms
- demonstrates ability to conduct simple practical work by following instructions and collect data
Level 1

- 有能力處理簡單及常見的問題
- 在指導下能進行簡單的數據演繹
- 能以簡單及常用術語表達構思
- 部份結論常依賴記憶
Figure 6.1 shows a microwave oven. Mary wants to conduct an experiment to estimate the useful output power of the oven. She is provided with the apparatus and material shown in Figure 6.2.

![Figure 6.2](image)

(a) Describe how Mary should conduct the experiment. Specify all measurements Mary has to take and state one precaution/assumption of the experiment. Write down an equation for calculating the useful output power.

First, Mary should use the thermometer to measure the initial temperature of the water. Then, Mary should put the water into the oven and start the stop watch when the oven operates. After 1 minute, Mary should take out the water and measure the temperature of the water immediately with a thermometer.

By comparing experimental energy by \( E_t = mc^2 \triangle T \) and theoretical value by \( E_t = P \cdot t \), the useful output power can be calculated by \( P = \frac{E_t - E_0}{t} \).

One precaution is Mary should take out the water from the oven with care because water may be very hot.
(b) The value obtained by Mary is found to be smaller than the rated power of the oven. Suggest one possible reason to account for this difference. (1 mark)  

Eddy current in the oven

(c) Explain whether increasing the mass of water used in the experiment would improve the accuracy of the experiment. (1 mark)

It would increase the accuracy.
10. Josephine conducts an investigation on transformers. Primary and secondary coils are wound on two soft-iron C-cores to form a transformer. She sets up a circuit as shown in Figure 10.1.

![Diagram of transformer circuit](image)

**Figure 10.1**

(a) Josephine varies the input voltage $V_1$ to the transformer and records the corresponding output voltage $V_2$. The results are shown in Table 10.2. In Figure 10.3, plot a graph of $V_2$ against $V_1$. Hence draw a conclusion for this investigation.

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</table>

**Table 10.2**

![Graph](image)

**Figure 10.3**

(2 marks)

(b) Deduce the value of $V_2$ when $V_1$ equals 8.0 V.

\[
\frac{V_2}{V_1} = \frac{5}{3}
\]

\[
V_2 = 13.33 \ldots V
\]
(c) Josephine wants to study the relationship between the output voltage and the number of turns in the secondary coil of the transformer. Describe how she can conduct the experiment. (2 marks)

By changing the turns of the secondary coil of the transformer, measure the output voltage. Change.

(d) Josephine adds a bulb to the circuit as shown in Figure 10.4. Suggest a method that Josephine can use to estimate the efficiency of the transformer and specify the measurement(s) to take. Additional apparatus may be used if necessary. (3 marks)

By comparing the experimentally observed data with the theoretical data, the efficiency of the transformer can be found.

END OF PAPER
<table>
<thead>
<tr>
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<th>Level 1</th>
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