FORM 4 PHYSICS

<table>
<thead>
<tr>
<th>Question</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</th>
<th>Practical</th>
<th>Global Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Mark</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>85</td>
<td>15</td>
<td>100</td>
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<td>Mark</td>
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DO NOT WRITE ABOVE THIS LINE

Name: _______________________________  Class: _________

INSTRUCTIONS:

- Use blue or black ink. Pencil should be used for diagrams only.
- Answer ALL questions. All working must be shown.
- Where necessary take acceleration due to gravity ‘g’ to be 10 m/s².
- The use of a calculator is allowed.
- You may find these equations useful:

<table>
<thead>
<tr>
<th>Waves</th>
<th>( \eta = \frac{\text{real depth}}{\text{apparent depth}} )</th>
<th>( \eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( v = f \lambda ) ( f = \frac{1}{T} )</td>
<td>magnification = ( \frac{\text{image height}}{\text{object height}} = \frac{\text{image distance}}{\text{object distance}} )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motion</th>
<th>Average Speed = ( \frac{\text{total distance}}{\text{total time}} )</th>
<th>( s = \frac{(u + v) t}{2} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( v = u + at )</td>
<td>( v^2 = u^2 + 2as )</td>
</tr>
</tbody>
</table>

| Others | Area of triangle = \( \frac{1}{2}bh \) | Area of Trapezium = \( \frac{1}{2}(a + b)h \) |
SECTION A
Each question carries 8 marks. This section carries 40 marks of the total marks for this paper.

1. Fill in the missing spaces.

a) Light travels in _____________ lines. [1]
b) In a mirror, the angle of incidence and the angle of reflection are _____________ . [1]
c) The image in a mirror is laterally _____________ . [1]
d) The speed of light _____________ when it passes from water to air . [1]
e) An incident ray of light which passes from air to a _____________ dense medium will _____________ bend towards the normal. This is called _____________.

f) A _____________ image can be put on a screen. [1]
g) Light travels _____________ than sound. [1]

2. The figure below shows part of the electromagnetic spectrum.

<table>
<thead>
<tr>
<th>Gamma</th>
<th>X-rays</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Microwaves</th>
<th>Radiowaves</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

Figure 1

a) Name the missing parts of the electromagnetic spectrum:
A : _____________
B : _____________
C : _____________

[3]

b) Name the part of the electromagnetic spectrum which has:
   i) the shortest wavelength : _____________
   ii) the lowest frequency : _____________

[2]

c) Name one precaution when using X-rays.
   _______________________________________________________[1]

d) Give one use of Gamma rays.
   _______________________________________________________[1]

e) Mention one common property of all electromagnetic waves.
   _______________________________________________________[1]
3. A surfer rides the waves at Golden bay.

a) The figure below shows the sea waves at a distance from the beach.

![Figure 2]

- On figure 2 above, label:
  - an amplitude 'A' of the wave
  - a crest 'C' and a trough 'T'

b) Using the information from figure 2 above, calculate the wavelength of the wave.

\[ \lambda = \text{distance between successive crests} \]

\[ \lambda = 60 \text{ m} \]

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Echo Sounding is used to detect fish in the sea. Sound waves are emitted from a fishing boat. Some of the sound waves are reflected by the sea bed and detected back at the boat.

a) The speed of sound in seawater is 1.5 km/s. Express the speed of sound in seawater in m/s.

\[
\text{speed of sound in seawater} = \frac{1.5 \text{ km/s}}{1000} = 1.5 \times 10^{-3} \text{ m/s}
\]

b) If the time taken for sound waves being emitted and detected is 0.26 s, calculate the distance between the boat and the sea bed.

\[
\text{distance} = \text{speed of sound} \times \text{time} = 1.5 \times 10^{-3} \text{ m/s} \times 0.26 \text{ s} = 0.00039 \text{ m} = 0.39 \text{ cm}
\]

c) The boat remained at the same position and the sonar wave was detected earlier, what do you think has happened? Explain

\[
\text{earlier detection} \Rightarrow \text{sonar wave is closer to the sea bed}
\]

d) Mention one other use of ultrasound.

\[
\text{ultrasound for medical imaging (e.g., echocardiography)}
\]
5. Jake drops his goggles in a swimming pool. The pool is 2m deep.

\[ \text{Figure 3} \]

a) The goggles appear to be closer to the surface.

i) On figure 3 above, continue to draw the ray from the object (goggles) to Jake. Draw also the normal and another ray to show how the image is formed. \[2\]

ii) If the image distance is observed 1.5m below the surface, calculate the refractive index

\[
\text{Refractive index} = \frac{d_1}{d_2}
\]

\[
\text{Refractive index} = \frac{2}{1.5}
\]

\[
\text{Refractive index} = 1.33
\]

b) Jake explores the path followed by light incident on a rectangular glass block as shown below.

\[ \text{Figure 4} \]

i) Continue to draw the ray of light until it emerges from side CD. \[1\]

ii) Show clearly on your diagram, the normal, the angle of incidence \( \theta \), and the angle of refraction \( \phi \) on side AB. \[3\]
SECTION B
Each question carries 15 marks. This section carries 45 marks of the total marks for this paper.

6. a) A ray of white light is incident on a glass prism as shown in the diagram below.

i) What happens at points P, Q and R inside the fibre optic? [1]

ii) State one condition needed for this to occur. [1]

b) A ray of white light is incident on a glass prism as shown in the diagram below.

i) Complete the ray diagram in figure 6 above to show the emergent rays. [2]

ii) Name this phenomenon of light. __________________________ [1]

iii) Mark on the screen the position of red and violet light. [1]

iv) Give one reason why different colours are formed on the screen. [1]
c) In the diagram below, the object O is placed 2cm in front of a convex lens. The focal length of the lens is 3cm.

i) Draw rays on figure 7 above, to show where the image I is formed. [3]

ii) Measure the image distance. _____cm [1]

iii) Calculate the magnification of the lens

_____________________________________________________________________

_____________________________________________________________________

iv) Give two properties of the image produced [2]

_____________________________________________________________________

_____________________________________________________________________
7. a) Kristina investigates water waves in a ripple tank. She observes that when waves pass over a sheet of glass they change direction, as shown below.

![Figure 8](image.png)

Figure 8

i) Name the effect shown in figure 8 above. __________________________ [1]

ii) Draw a line on the diagram above to show the edge of the sheet of glass. [1]

iii) Which region A or B is the shallower part? ________ [1]

iv) How does the wavelength of the water waves change from region A to region B? ________________ [1]

v) How does the speed of the water waves change from region A to region B? ________________ [1]

b) Kristina then sets up the ripple tank as shown below:

![Figure 9](image.png)

Figure 9

![Figure 10](image.png)

Figure 10

i) The source is placed in front of a slit of width 0.03m. Complete figure 9 to show how the waves continue to travel as they pass through the slit. [1]

ii) What is the effect shown in figure 9 called? __________________________ [1]

iii) The slit is now widened to 0.09m. Complete figure 10 to show how the waves would continue to travel in this case. [1]
c) Kristina then decided to do an experiment to find the speed of sound in air

Figure 11

i) Write down the steps Kristina needs to take so as to find the speed of sound in air, using the above apparatus.  

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_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

ii) Mention one precaution Kristina should take when doing this experiment.  

_____________________________________________________________________

iii) Speed of sound is higher in solids than in gases. Explain why this is so in terms of molecules.  

_____________________________________________________________________
_____________________________________________________________________

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8. The following measurements were taken from a car speedometer as the car was travelling.

<table>
<thead>
<tr>
<th>Velocity/m/s</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
<th>15</th>
<th>18</th>
<th>21</th>
<th>21</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time/s</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>16</td>
<td>18</td>
</tr>
</tbody>
</table>

a) Plot a graph of velocity (m/s) on the y-axis against time (s) on the x-axis on the graph paper provided. [6]

b) Using your graph find the acceleration of the car. [3]

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c) Find the total distance moved by the car. [3]

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d) Calculate the average velocity of the car. Give your answer to the nearest whole number. [2]

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

e) Use your answer in d) to draw a line on your graph to show the average velocity of the car. [1]