Name: ________________________________  Class: _______________________

Answer ALL questions in the spaces provided on the Examination Paper. 
All working must be shown. The use of a calculator is allowed.
Where necessary take the acceleration due to gravity \( g = 10 \text{ m/s}^2 \).

### Density
\[ m = \rho V \]

### Pressure
\[ P = \rho gh \quad F = PA \]

### Moments
\[ \text{Moment} = F \times \text{perpendicular distance} \]

### Energy
\[ \text{PE} = mgh \quad \text{KE} = \frac{1}{2} mv^2 \quad \text{Work Done} = Fs \]

### Force
\[ F = ma \quad W = mg \]

### Motion
\[ \text{Average Speed} = \frac{\text{total distance}}{\text{total time}} \quad s = \frac{(u + v) t}{2} \quad s = ut + \frac{1}{2}at^2 \]
\[ v = u + at \quad v^2 = u^2 + 2as \quad \text{Momentum} = mv \]

### Electricity
\[ Q = It \quad V = IR \quad E = QV \]
\[ P = IV \quad R \propto L/A \quad E = IVt \]

### Electromagnetism
\[ \frac{N_1}{N_2} = \frac{V_1}{V_2} \]

### Heat
\[ \Delta Q = mc\Delta \theta \]

### Waves
\[ \eta = \frac{\text{real depth}}{\text{apparent depth}} \quad \eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}} \]
\[ v = f\lambda \quad m = \frac{h_i}{h_o} = \frac{\text{image distance}}{\text{object distance}} \]

### Radioactivity
\[ A = Z + N \]

**Marks Grid: For the Examiner’s use ONLY**

<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>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>Th.</th>
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</table>
Section A: This section has 7 questions. Each question carries 10 marks (70 marks).

1. Miriam wanted to find the density of a liquid from the measurements shown below.

<table>
<thead>
<tr>
<th>Mass of measuring cylinder (g)</th>
<th>Mass of measuring cylinder and liquid (g)</th>
<th>Volume of liquid (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>360</td>
<td>80</td>
</tr>
</tbody>
</table>

a) Define density. [2]

b) Which instrument did Miriam use to measure mass? [1]

c) Calculate the mass of liquid in grams. [1]

d) Calculate the density of the liquid. [2]

e) Name ONE precaution that the student should take during such an experiment. [2]

f) Miriam places a glass block of density 2.6 g/cm³ in the liquid.
   i) Would the glass block float or sink in this liquid? [1]
   ii) Give a reason for your answer. [1]

2. The diagram below shows a box on a rough surface. It is being pulled by a string with a force A = 5 N. The force, acting between the box and the surface, B = 3 N.

A = 5 N  
B = 3 N

a) Name the force A in the string. [1]

b) Name the force B between the box and the ground. [1]

c) Forces are vector quantities. Explain what is meant by the term vector quantity. [2]

d) Calculate the resultant force acting on the object. [1]

e) State the direction of the resultant force. [1]

f) Given that the mass of the object is 0.5 kg, calculate its acceleration. [2]

g) State whether the box will travel at constant speed, accelerate or decelerate when:
   i) Force A is reduced to 3 N [1]
   ii) Force A is removed completely [1]
3. Sally and Harry were playing with toy trucks.
   The diagram shows the two trucks being pushed towards each other.
   a) Calculate the momentum of trucks A and B.
      i) Truck A ______________________________ [2]
      ii) Truck B ______________________________ [1]
   b) By considering their direction, calculate the total momentum before they collide.
      ______________________________________________ [2]
   c) Fill in the blanks by choosing some of the words from the list below:
      bigger than, equal to, smaller than, external, forward
      The principle of conservation of momentum states that the total momentum before collision
      is ____________ the total momentum after collision provided that there is no
      ____________ force during the collision. [2]
   d) After the collision, the two toy trucks move together.
      i) In which direction do they move? _____________________ [1]
      ii) Calculate their common speed.
          ______________________________________________ [2]

4. The diagram shows a marble placed at position A in a liquid
   whose density is 1000 kg/m³. A child is playing with the
   marble and moves it around.
   a) What is the pressure at the water surface called?
      ______________________________________________ [2]
   b) The child moves the marble from position A to B. What happens to the amount of pressure
      exerted on the marble? Explain.
      ______________________________________________ [2]
   c) The child then raises the marble from position B to position C, 10 cm above.
      i) Calculate the change in pressure it experiences.
          ______________________________________________ [3]
      ii) Does the pressure increase or decrease? _____________________ [1]
   d) The child removes the marble from this liquid and puts it at the same depth in a denser liquid.
      Does the marble experience more, less or the same pressure as before? Explain.
      ______________________________________________ [2]
5. Sound and light energies are transmitted using different types of waves.
   a) Fill in the blanks by choosing some of the words from the list below:
      **transverse, vacuum, greater, longitudinal, smaller, water**
      Sound travels as ____________ waves while light travels as ____________ waves.
      Sound cannot travel through ____________ but light can. The speed of sound in air is much ____________ than the speed of light.
   [4]
   b) John stands 153 m from a high wall and fires a starting pistol into the air. He hears an echo after 0.90 s. Calculate the speed of sound in air.

   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
   [3]
   c) Visible light forms part of a group of waves called the electromagnetic spectrum.
      i) Name ONE common property of electromagnetic waves.
       __________________________________________________________________________
       [1]
      ii) Fill in the missing waves below.
       | Gamma rays | X-rays | Visible light | Microwaves | Radio waves |
       |------------|--------|--------------|------------|------------|
       |            |        |              |            |            |
       [2]

6. A GM tube is placed next to a radioactive isotope. The corrected count rate is 1200 counts per minute. After 30 minutes, the count rate falls to 150 counts per minute.

   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________

   a) Give the meaning of the following terms:
      i) Isotope
       __________________________________________________________________________
       __________________________________________________________________________
       [2]
      ii) Half-life
       __________________________________________________________________________
       __________________________________________________________________________
       [2]
b) Calculate the half-life of this radioactive isotope.

__________________________________________________________________________
__________________________________________________________________________ [3]

c) When the isotope was put in a cardboard box, only the background radiation was detected.
   i) Which of the following is being emitted: alpha particles, beta particles or gamma rays?
   ______________________________________________________________________ [1]
   ii) Name TWO sources of background radiation.
   ______________________________________________________________________ [2]

7. The diagram shows a 12 V battery which causes a 2 A current to flow in the 4 Ω resistor.

![Diagram of a 12 V battery with 4 Ω and 10 Ω resistors in parallel]

Using the above diagram, calculate:

a) the voltage across the 4 Ω resistor
__________________________________________________________________________ [2]

b) the voltage across the two resistors in parallel
__________________________________________________________________________ [1]

c) the current in the 10 Ω resistor
__________________________________________________________________________ [2]

d) the current flowing through R ______________________________ [1]

e) the resistance of the resistor R
__________________________________________________________________________ [2]

f) the power delivered by the battery
__________________________________________________________________________ [2]
Section B. This section has 5 questions. Each question carries 20 marks (100 marks).

8. The engine of a small car produces a force of 500 N. The car travels 1200 m in 60 s.
   a) Calculate the car’s average speed.
      _______________________________________________ [2]
   b) Calculate the work done by the force on the car during this time.
      _______________________________________________ [2]
   c) Calculate the kinetic energy of the car given that its mass is 900 kg.
      _______________________________________________ [2]
   d) Fill in the blanks by choosing some of the words from the list below:
      kinetic, heat, destroyed, potential, changed, chemical, created
      Energy can neither be _____________ nor _____________, but it can be _____________ from one form to another. The car has _____________ energy in its fuel, part of which is converted to kinetic energy as it moves. The engine also produces a lot of _____________ energy as well as sound. [5]
   e) Calculate the car’s efficiency if 800 kJ of chemical energy is used from the fuel.
      _______________________________________________ [2]
   f) Name TWO ways how car engineers make cars more efficient.
      _______________________________________________ [2]
   g) The car crashes into a wall.
      i) Name ONE safety feature which cars have in order to reduce injuries.
         _______________________________________________ [1]
      ii) Explain in physics terms how this safety feature reduces injuries.
         _______________________________________________ [2]
   h) The car exerts a force of 1000 N on the wall during the accident.
      i) How much force does the wall exert on the car during the accident?
         _______________________________________________ [1]
      ii) Which one of Newton’s laws of motion predicts this?
         _______________________________________________ [1]
9. Stephanie is required to find if colour affects heat emission.

a) She has two identical metal cans. She paints one white and the other black. She also has a measuring cylinder, a stopwatch and an electric kettle with water.

i) She needs an instrument to measure temperature. Name this instrument.

ii) Draw a labelled diagram of the setup.

iii) Describe how Stephanie carries out the experiment.

iv) State TWO precautions she takes during this experiment.

b) Stephanie records how the temperature of the water changes with time. On the same axes, sketch a graph for each can.

i) Label each axis.

ii) Label each graph clearly.

iii) What can be concluded from this experiment?

iv) State TWO precautions she takes during this experiment.

c) What temperature will the water in each can reach after several hours?

d) Name the way by which heat mainly travels through:

i) a metal

ii) a liquid

iii) a vacuum

e) What name is given to materials that resist heat flow?
10. Lisa has a **uniform** metre ruler. She is required to find its weight without using a balance. She uses the setup shown in the diagram. The pivot is 30 cm from the right edge of the ruler.

She hangs different weights \( W \) at different distances \( d \) from the pivot to balance the ruler. Her measurements are shown below:

<table>
<thead>
<tr>
<th>Weight ( W ) (N)</th>
<th>0.96</th>
<th>1.20</th>
<th>1.92</th>
<th>2.40</th>
<th>3.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perpendicular distance ( d ) (m)</td>
<td>0.250</td>
<td>0.200</td>
<td>0.125</td>
<td>0.100</td>
<td>0.080</td>
</tr>
<tr>
<td>( 1/d ) (1/m)</td>
<td>4.0</td>
<td></td>
<td></td>
<td></td>
<td>12.5</td>
</tr>
</tbody>
</table>

a) What is meant by the term **uniform**?

__________________________________________________________ [2]

b) At what distance, in metres, is the weight of the ruler from the pivot?

__________________________________________________________ [2]

c) Complete the missing values in the above table.

[3]

d) Plot a graph of Weight \( W \) on the y-axis against \( 1/d \) on the x-axis.

[5]

e) What is the relationship between \( W \) and \( 1/d \)?

__________________________________________________________ [2]

f) Calculate the gradient of the graph.

__________________________________________________________ [2]

g) The gradient of the graph gives the clockwise moment of the weight \( W \).

i) State the principle of moments.

__________________________________________________________ [2]

ii) Find the weight of the ruler.

__________________________________________________________ [2]
11. John, George and Paul were in the physics lab investigating some properties of light.

a) John aimed a ray of light towards a rectangular glass block as shown in the diagram.

i) Name the angle labelled ‘a’ in the diagram. ______________________ [1]

ii) Complete the path of the light ray through and out of the glass block. [3]

iii) What happens to the speed of light when the ray enters the glass block? ___________________________ [1]

iv) Does the frequency of light change or stay the same when the ray enters the glass block? ______________________________________________________________ [1]

v) At one point, a light ray inside the glass block hits the glass-air boundary at an angle of 60°. If the critical angle of this glass is 42°, state what happens to the light ray now. ____________________________________________ [2]

b) Paul places a well-lit object O in front of a converging (convex) lens as shown below.

i) Name the points labelled F. ____________________________________________ [2]

ii) State a use for the lens in this setup. __________________________________________ [1]

iii) Complete the ray diagram above to find where the image I of the object O forms. [3]

iv) State THREE properties of the image formed. _______________________________________________________ [3]

v) Calculate the magnification of the lens in this setup. _______________________________________________________ [3]
12. Ringo wants to investigate the generation of electricity using magnets. He sets up the apparatus as shown on the right.

a) He moves the magnet towards the solenoid.
   i) Explain why a current is induced in the solenoid.
      _______________________________________________________________________
      _______________________________________________________________________
      _______________________________________________________________________
      [2]
   ii) Name the law that predicts this.
      _________________________________________________
      [1]
   iii) State TWO ways through which he can induce a larger current.
      _______________________________________________________________________
      _______________________________________________________________________
      _______________________________________________________________________
      [2]
   iv) Name the magnetic pole induced on the side of the solenoid facing the magnet.
      _____________________________________________
      [1]
   v) What happens to this induced magnetic pole as the magnet is moved away?
      _____________________________________________
      [1]
   vi) Which law predicts this?
      _____________________________________________
      [1]
   vii) The magnet is kept stationary inside the solenoid. What is observed on the galvanometer? Explain.
      _______________________________________________________________________
      _______________________________________________________________________
      _______________________________________________________________________
      [2]

b) Linda sets up two solenoids near each other as shown on the diagram below. She connects an alternating e.m.f. to one of the coils.

   i) Complete: An ideal transformer is _______________ efficient. [2]
   ii) Label the two coils in the spaces provided on the diagram. [2]
iii) What is the purpose of the iron core?
____________________________________________________________________ [2]

iv) Why is the core not made of steel?
____________________________________________________________________ [2]

v) The supply e.m.f. is 120 V. The number of turns in the secondary coil is 3 times that of the primary coil. Calculate the value of the induced e.m.f.
____________________________________________________________________
____________________________________________________________________ [2]