

Candidate Name

Candidate Number

Centre Name

Centre Number

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**Paper 1: Physics**

For Examination June 2023

(2 hours)

It is necessary to respond on the answer sheets provided alongside this question paper. Additionally, you must have a soft pencil (preferably of type B or HB), a clean eraser and a dark blue or black pen.

**INSTRUCTIONS:**

- You must write your name, candidate number, centre name and centre number on the answer sheets in the designated spaces.
- Objective section consists of 25 questions, and it is essential that you attempt all of them.
- Each question has four options labelled A, B, C, and D. Select the option that you think is correct. Mark it on the multiple choice answer sheet using a soft pencil.
- Attempt all the questions from subjective section using a dark blue or black pen.
- It is important to follow the instructions provided on the answer sheets.
- Do not use correction fluid.
- Avoid writing on any bar codes.
- You are allowed to use a calculator if needed.

**INFORMATION:**

- This paper has a total of 100 marks.
- In objective section there are 25 questions, each carries one mark. There is no negative marking for incorrect responses.
- In subjective section, 45 marks are for extended theory and 30 marks for practical component.

The number of marks assigned for every question or its parts is indicated within

**MCQ (25 marks)**

Question 1

Which of the following speeds shown below would be normal for a person walking?

- A) 1.0 m/s
- B) 0.1 m/s
- C) 100 m/s
- D) 10 m/s

Question 2

Which of the following is a scalar quantity?

- A) Velocity
- B) Momentum
- C) Acceleration
- D) Energy

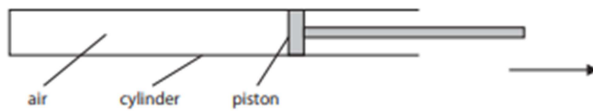
Question 3

Which of these forces keeps the moon moving around the Earth?

- A) Contact
- B) Electrostatic
- C) Gravitational
- D) Magnetic

#### Question 4

The diagram below shows air inside a cylinder. There is a moveable piston positioned inside.



The piston is then moved towards the direction of the arrow, but still remains inside the cylinder. Which of the following increases as a result?

- A) The pressure inside the cylinder
- B) The mass of air inside the cylinder
- C) The rate of which the air particles inside the cylinder collide with the walls
- D) The volume of the air inside the cylinder

#### Question 5

A young girl drops a steel ball from a low window. Ignoring air resistance, which statement describes its motion.

- A) It falls with constant acceleration
- B) It falls with constant speed
- C) It falls with decreasing acceleration
- D) It falls with decreasing speed

#### Question 6

A cyclist is riding at a steady speed on a level road.

According to Newton's third law of motion, what is equal and opposite to the backward push of the back wheel on the road?

- A) The force exerted by the cyclist on the pedals
  - B) The total air resistance and friction force
  - C) The tension in the cycle chain
  - D) The forward push of the road on the back wheel
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Question 7

Which statement about the mass of a falling object is correct?

- A) It decreases as the object falls
- B) It is equal to the weight of the object
- C) It is measured in newtons
- D) It stays the same as the object falls

Question 8

A fire alarm is not loud enough. An engineer adjusts it so that it produces a note of the same pitch which is louder than before.

What overall effect does this have on the amplitude and frequency of the sound?

| amplitude  | frequency |
|------------|-----------|
| A) larger  | greater   |
| B) larger  | smaller   |
| C) smaller | greater   |
| D) smaller | smaller   |

Question 9

Which energy resource shown below is **not** renewable?

- A) nuclear fission
- B) solar
- C) wind
- D) geothermal

Question 10

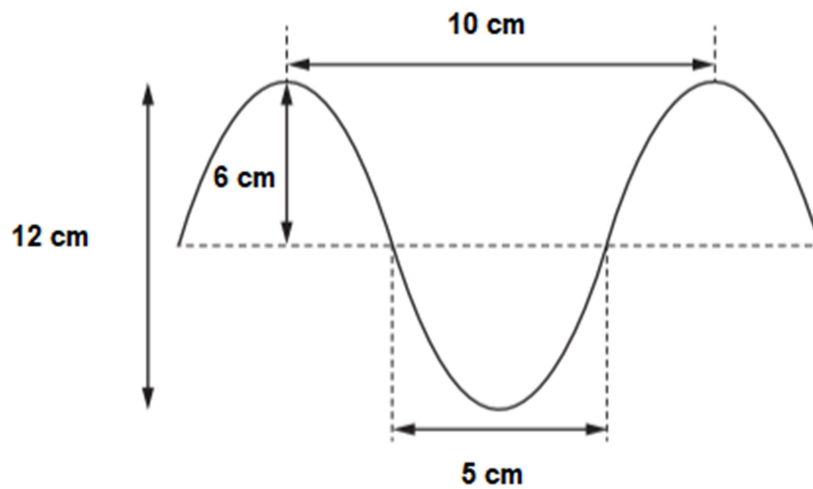
A whale sends out a sound wave. The echo of this wave returns 0.010s later from a large fish that is 11 m away from the whale.

What is the speed of the sound wave in the water?

- A) 1100 m/s
- B) 2200 m/s
- C) 11 m/s
- D) 660 m/s

Question 11

The diagram below shows a wave.



What is the amplitude and the wavelength of this wave?

| Amplitude | Wavelength |
|-----------|------------|
| A) 12 cm  | 5 cm       |
| B) 5 cm   | 12 cm      |
| C) 6 cm   | 5 cm       |
| D) 6 cm   | 10 cm      |

Question 12

A modern day intruder alarm sensor can detect a person who is warmer than their surroundings.

This sensor detects what type of electromagnetic wave?

- A) Radio
- B) Infrared
- C) Visible Light
- D) Ultraviolet

Question 13

An uncharged plastic rod comes into contact with a piece of cloth.

Both the plastic rod and cloth become charged.

Why does the plastic rod become negatively charged and the cloth becomes positively charged?

- A) The rod gains electrons and the cloth gains positive charges
- B) The rod gains electrons while the cloth loses electrons
- C) The rod loses electrons and the cloth gains electrons
- D) The rod loses electrons and the cloth loses positive charges

Question 14

A radioactive isotope has a measured half-life of 100 minutes.

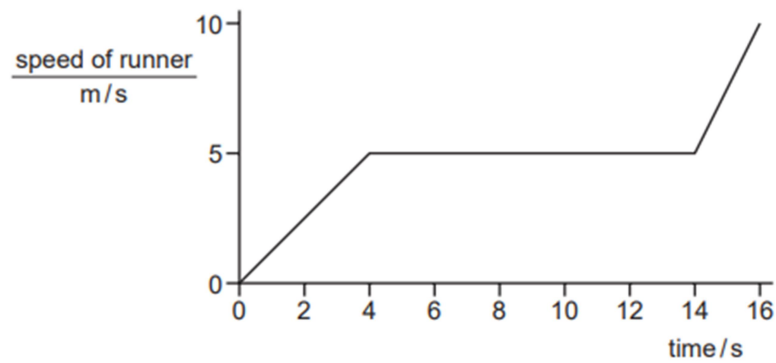
It currently emits particles at a rate of 50 particles per second.

How long does it take for the rate of emission to fall to 12.5 particles per second?

- A) 100 minutes      B) 50 minutes      C) 200 minutes      D) 300 minutes

Question 15

A runner's speed is measured during the course of a race.



Calculate the total distance of the runner during this part of the race.

- A) 90 m      B) 75 m      C) 65 m      D) 50 m

Question 16

What happens to a metal bar when it is heated?

- A) The molecules get larger which makes the bar longer  
B) The molecules vibrate much faster, which makes the bar more dense  
C) The distance between the molecules increase which causes the bar to get longer  
D) The speed of the molecules increases, which makes the bar thinner

Question 17

There are many types of nuclear emissions, but the main ones are:

- A) A-type, B-type, C-type  
B) Alpha, Beta, Gamma  
C) Neutrons, Protons, Electrons  
D) Radio, Infra-red, X-rays
-

Question 18

Thermal energy can be transferred via three methods depending on the presence and state of matter. The form of heat transfer that explains how energy reaches us from the Sun is

- A) Conduction
- B) Convection
- C) Radiation
- D) Transformation

Question 19

A simple parallel circuit is constructed with 4 resistors of equal value connected to a 12 V battery. The potential difference across any one of the resistors will be:

- A) 3 V
- B) 4 V
- C) 12 V
- D) 24 V

Question 20

A simple series circuit has 4 resistors of equal value connected to a 12 V battery. The potential difference across any one of the resistors will be:

- A) 3 V
- B) 4 V
- C) 12 V
- D) 24 V

Question 21

A temperature of 1245 K is closest to

- A) 970 °C
- B) 1245 °C
- C) 1520 °C
- D) 2975 °C



Question 22

The definition of Power, whether electrical or not, is the amount of energy

- A) used/supplied per hour
- B) used/supplied per minute
- C) used/supplied per second
- D) used/supplied per kelvin

Question 23

A ball rolls along a table in a straight line. It is seen to change its speed from  $8.5 \text{ ms}^{-1}$  to  $3.5 \text{ ms}^{-1}$  in a time of 2 seconds. The average acceleration of the ball is closest to:

- A)  $-4.0 \text{ ms}^{-2}$
- B)  $-2.5 \text{ ms}^{-2}$
- C)  $2.5 \text{ ms}^{-2}$
- D)  $8.0 \text{ ms}^{-2}$

Question 24

The current through and the Potential Difference across a resistor are 2.0 A and 20.0 V, respectively. What is the resistance of the resistor?

- A) 5 ohms
- B) 10 ohms
- C) 20 ohms
- D) 40 ohms

Question 25

The refractive index is best described as:

- A) A number that describes how much a material changes speed
- B) A number that indicates how much the speed changes
- C) A number that is assigned to particular colours/wavelengths of light
- D) A value that is calculated from (angle of incidence) divided by (angle of refraction)

**Part 2: Extended Theory (45 marks)**

**Question 1**

A student is researching different types of renewable energy sources but they are finding it difficult to find information.

State one example of a renewable source of energy. [1 mark]

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State one example of a fuel in which chemical energy is stored. [1 mark]

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Provide one example of an energy resource that involves liquid water (not steam/water vapour) [1 mark]

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Give two reasons why it is important that nations investigate alternative energy sources to fossil fuels (coals, natural gas, oil). [2 marks]

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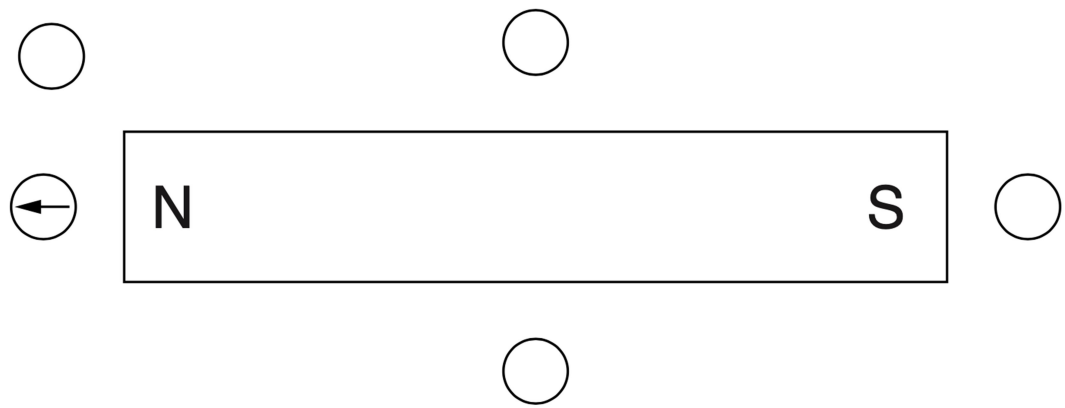
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**[Total 5 marks]**

**Question 2**

The figure below shows the image of a bar magnet. Several compasses are placed around it, as shown by the circles. The needle of the compass helps to demonstrate the magnetic field pattern surrounding the bar magnet.



- a) The needle of one compass (next to the N pole of the magnet) is pointing in the direction shown by the arrow.

For each of the four surrounding circles (i.e. compasses), draw an arrow to show the direction in which you would expect the compass needle to point at.

[4 marks]

- b) Around the S pole of the magnet, five different pieces of metal are placed by a student to see what might happen.

In the table below, tick the one box that correctly matches what will happen to **each** of the different metals.

| Type of metal | Attracted by the magnet | Repelled by the magnet | No overall effect |
|---------------|-------------------------|------------------------|-------------------|
| Aluminium     |                         |                        |                   |
| Copper        |                         |                        |                   |
| Gold          |                         |                        |                   |
| Iron          |                         |                        |                   |
| Steel         |                         |                        |                   |

[5 marks]

**[Total: 9 marks]**

### Question 3

Plutonium-212 ( $^{212}_{84}\text{Po}$ ) is an isotope that is commonly used in nuclear reactions.

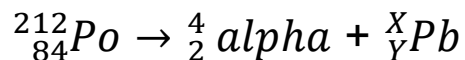
- a) How many protons are there in the nucleus of a single atom of  $^{212}_{84}\text{Po}$  ? ..... [1 mark]  
b) How many neutrons are there in the nucleus of a single atom of  $^{212}_{84}\text{Po}$  ? ..... [1 mark]  
c) i) How many electrons are there in a single neutral atom of  $^{212}_{84}\text{Po}$ ? ..... [1 mark]

ii) Whereabouts in the atom do you expect these electrons to be located? [1 mark]

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- b) One of the possible decay reactions involving  $^{212}_{84}\text{Po}$  sees it decay into a lead (Pb) nucleus by emitting an alpha-particle.

This decay process is represented by the equation below:



Determine the values of X and Y from the equation.

X = .....

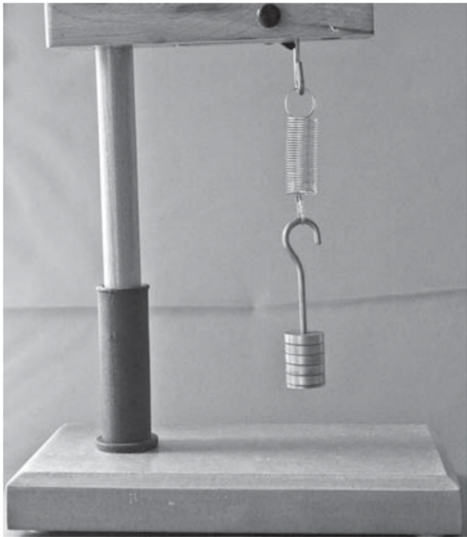
Y = .....

[2 marks]

**[Total: 6 marks]**

**Question 4**

A group of students decide to investigate whether a spring follows Hooke's Law. They use the apparatus shown in the photograph below.



(a) For this investigation, what additional measuring instrument is needed? (1 mark)

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(b) The students continue their investigation by loading the spring with different weights.

The table below show the results they obtained.

| Mass of weights (in grams) | Force (in N) | Distance $d$ (in cm) |
|----------------------------|--------------|----------------------|
| 20                         | 0.2          | 4.8                  |
| 40                         | 0.4          | 3.8                  |
| 60                         | 0.6          | 3.0                  |
| 80                         | 0.8          | 2.4                  |
| 100                        | 1.0          | 1.6                  |
| 120                        | 1.2          | 0.8                  |

i) Name the dependent variable in this investigation.

(1 mark)

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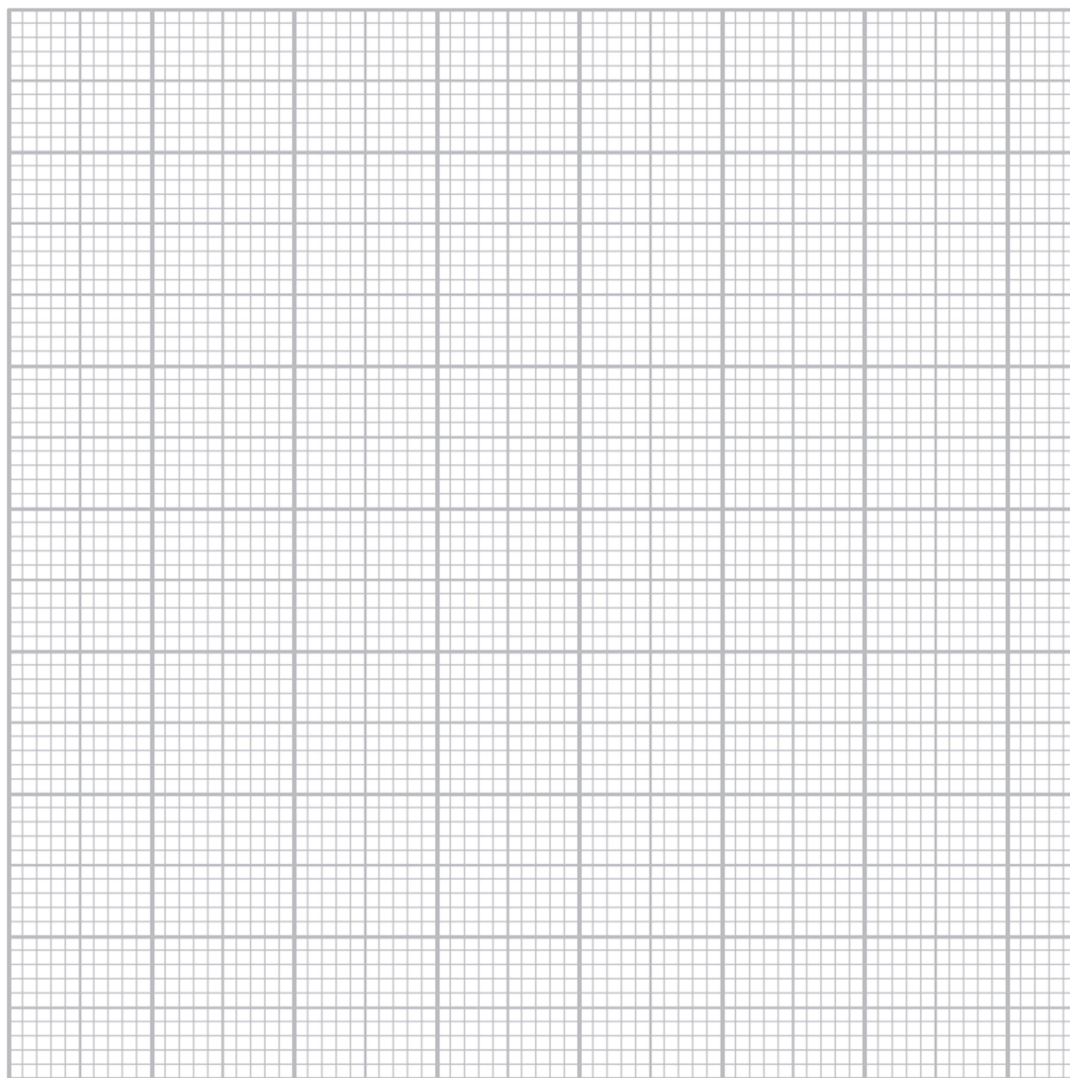
ii) Explain how the force values in the table are determined.

(2 marks)

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iii) On the grid below, plot a graph of distance  $d$  against force, and draw the line of best fit.

(5 marks)



iv) Using your graph, determine the force for which distance  $d$  is zero.

Force = .....N

(2 marks)

v) Explain whether the spring the student's used in their investigation, obeys Hooke's Law.

(2 marks)

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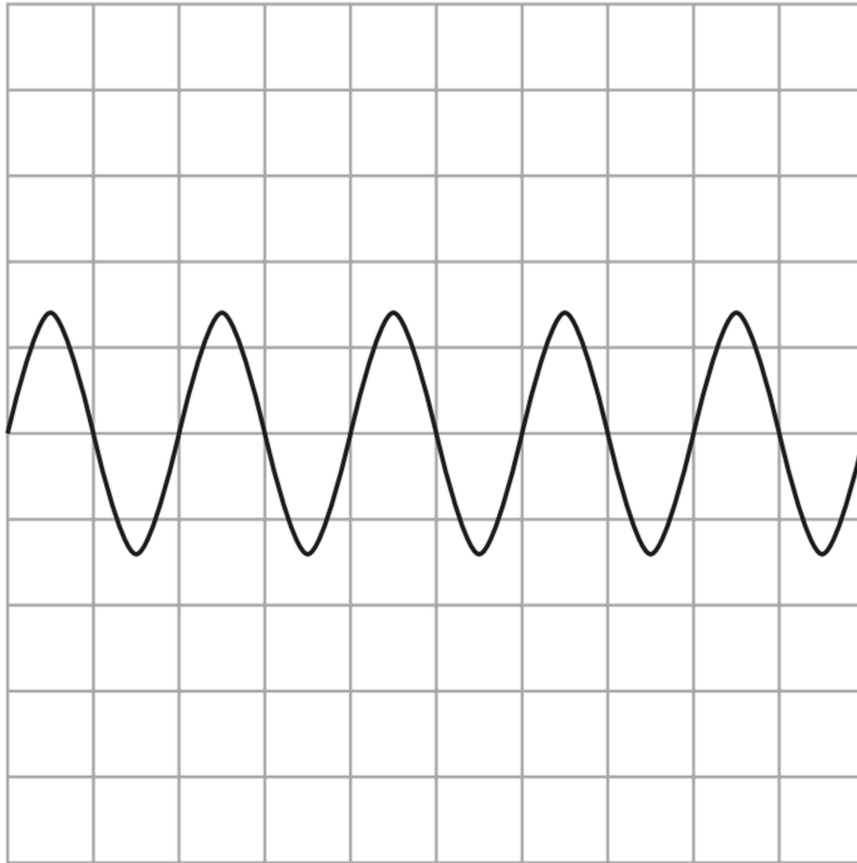
[Total: 14 marks]

### Question 5

Waves are able to travel in a vacuum, through air, and on water.

a) The diagram below is of a wave travelling on the surface of a lake.

Each square shown on the grid is 1 cm x 1 cm.



(i) Determine the wavelength of the wave shown above.

Wavelength = ..... cm

(1 mark)

(ii) On the grid above, draw a wave which would be travelling with a larger amplitude, lower frequency and same speed.

(2 marks)

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(b) A group of students decide to investigate how quickly sound waves travel in air.

They use a straight red pavement that is 100m long for their measurement of distance.

They also use a stopwatch that records times to the nearest 0.1 s.

Describe what else they must do to obtain a value for the speed of sound waves.

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(4 marks)

(c) i) Wave speed, frequency and wavelength are linked together by an equation.

State the equation below.

(1 mark)

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ii) A radio wave travelling through the air has a frequency of 30 MHz and a speed of 300 000 000 m/s.

Calculate the wavelength of this radio wave.

Wavelength ..... m

(3 marks)

**[Total: 11 marks]**