**ALEXANDER ROAD HIGH SCHOOL**

June 2022 | **PHYSICAL SCIENCES JUNE PAPER 1** | 1,5 HOURS

PE | **GRADE 10** | TOTAL = 75

Instructions:

- The question paper consists of 6 questions.
- Answer all the questions.
- Answer section A on the answer sheet provided AND section B on folio sheets.
- A non-programmable calculator may be used.
- Number the answers correctly according to the numbering system.
- Round off to two at least (2) decimal places where necessary.
- A formula sheet has been provided on the back of the answer sheet.

## SECTION A

*(answer on the answer sheet)*

**QUESTION 1:**

Four possible options are provided as answers to the following questions. Each question has only one correct answer. Choose the correct answer and write the letter (A – D) next to the relevant question number (1.1 – 1.5) on the answer sheet.

1.1 The amplitude of a sound wave is increased without changing the frequency. How does this change affect the **loudness** and **pitch** of the sound?

| | **LOUDNESS** | **PITCH** |
|---|---|---|
| A. | Decreases | Decreases |
| B. | Decreases | Increases |
| C. | Increases | Unchanged |
| D. | Increases | Increases |

1.2 The wave form is moving from right to left, in the direction of the arrow.

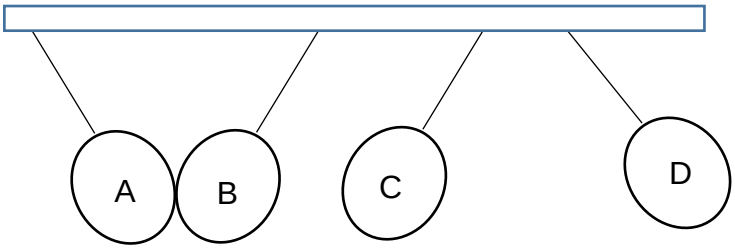

How is the medium moving at the point marked, P?

A. ↓ B. ↑ C. ↘ D. ↖

1.3 An object is positively charged if it has more…

A. electrons than protons.
B. electrons than neutrons.
C. protons than electrons.
D. protons than neutrons.

1.4 Four identical balloons, each carrying a charge, are suspended from a ceiling, as shown in the diagram below. Balloon **B is negatively** charged.




Which combination is CORRECT regarding the charges on the balloons?

| | SIGN OF CHARGE on A | SIGN OF CHARGE on C | SIGN OF CHARGE on D |
|---|---|---|---|
| A. | + | + | + |
| B. | + | + | - |
| C. | - | + | + |
| D. | + | - | - |

1.5 The UNIT in which the rate of flow of charge is measured, is called …

A. Watt.
B. Ampere.
C. Coulomb.
D. Volt.

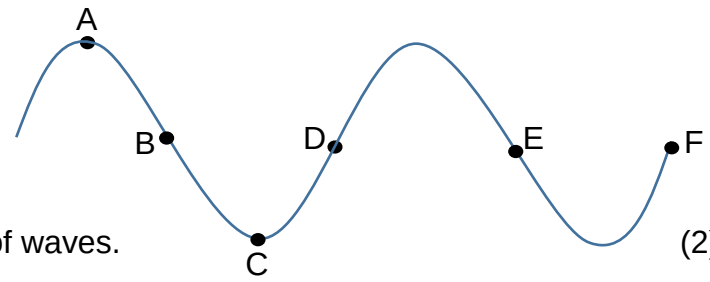
**TOTAL SECTION A = [10]**

## SECTION B

*(answer on folio paper)*

**QUESTION 2:**

2.1 Study the transverse wave alongside and answer the following questions.



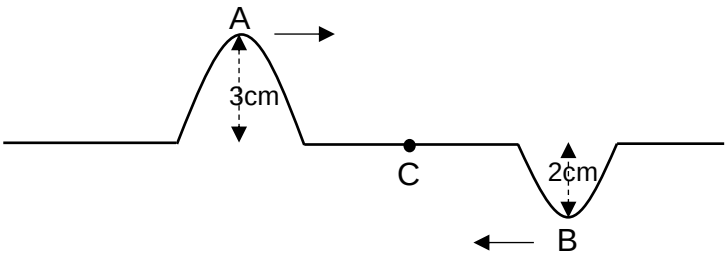

2.1.1 Define the term *frequency* in terms of waves. (2)

2.1.2 Write down ONE letter that indicates a trough. (1)

2.1.3 The distance between B and which other letter indicates one wavelength? (1)

2.1.4 Write down the letters of ANY two points which are *completely* out of phase. (1)

2.2 Two pulses, A and B, move towards each other at the same speed. The amplitude of pulse A is 3 cm and the amplitude of pulse B is 2 cm. The pulses meet each other at C.

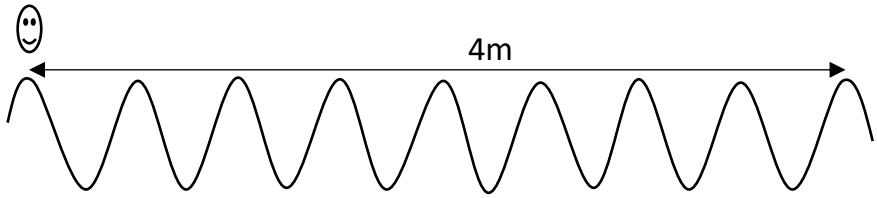



2.2.1 Name the type of interference that occurs at C. (1)

2.2.2 Draw a rough labelled sketch (not to scale) to show the resultant pulse at C. Indicate the amplitude of the resultant pulse in cm. (2)

2.2.3 What is the amplitude of pulse A when it passes the point where pulse B was originally? (1)

2.3 An observer counts 9 wave crests passing her in 5 seconds, by which time the first crest is 4 metres away.




Calculate:

2.3.1 the wavelength of the waves. (2)

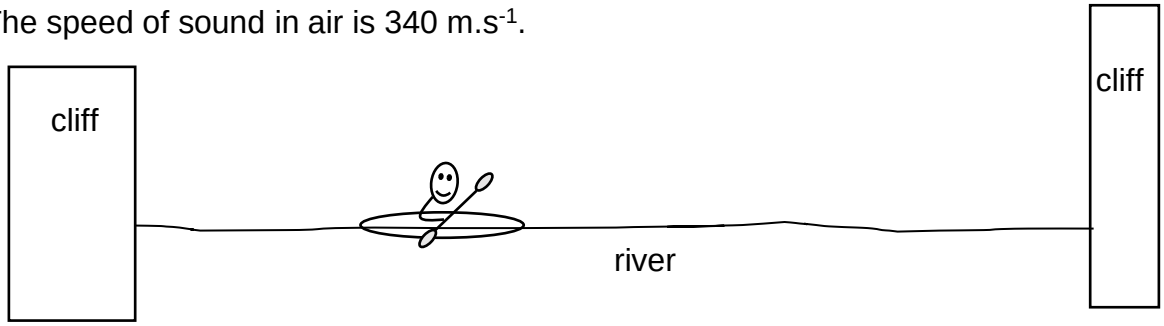
2.3.2 the speed of the waves. (3)

**[14]**

**QUESTION 3:**

3.1 Define *longitudinal wave.* (2)

3.2 A canoeist rows on a river between two cliffs. She claps her hand and hears the echo from the left 1 second later and the echo from the right 2 seconds later.
The speed of sound in air is 340 $m.s^{-1}$.




**Calculate the distance between the cliffs.** (6)

3.3.1 Above which frequency is a sound wave classified as ultrasound? (1)

3.3.2 Name ONE use of ultrasound in the medical treatment of patients. (1)

**[10]**

**QUESTION 4:**

The frequency and corresponding energy of electromagnetic waves are given in the table below.

| | **Frequency (Hz)** | **Energy (J)** |
|---|---|---|
| **A** | $2 \times 10^{9}$ | $1{,}33 \times 10^{-24}$ |
| **B** | $4 \times 10^{12}$ | $2{,}65 \times 10^{-21}$ |
| **C** | $3{,}5 \times 10^{15}$ | $2{,}32 \times 10^{-18}$ |
| **D** | $1{,}8 \times 10^{18}$ | $1{,}19 \times 10^{-15}$ |
| **E** | **f** | $4{,}97 \times 10^{-14}$ |

4.1 Arrange the following types of electromagnetic radiation in order of **decreasing** wavelength: infrared, gamma rays, visible, X-rays. (2)

4.2 Describe how an electromagnetic wave propagates. (2)

4.3 What is the relationship between frequency and energy of an electromagnetic wave, as shown in the table above? (2)

4.4 Calculate the:

4.4.1 Wavelength of wave D. (3)

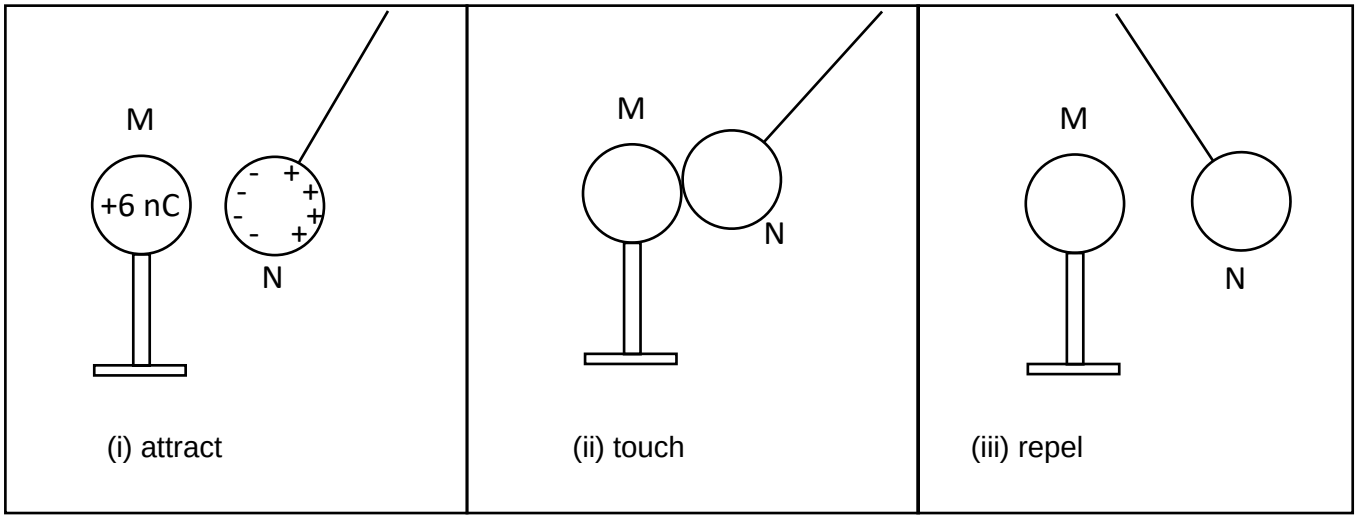
4.4.2 Frequency of wave E. (3)

4.5 Give a useful application of Gamma Rays. (1)

**[14]**

**QUESTION 5:**

Two identical spheres M and N are arranged as shown in the diagram below.
M is mounted on an insulated stand whilst N is hanging close by.
M is charged by friction to form a positive charge of +6 nC. N is neutral.
When N is brought close, it is attracted to M.
Once they touch, N is repelled by M.




5.1 How many electrons were removed from sphere M when it was first charged? (3)

5.2 Explain how a neutral object, like N, is attracted to a positively charged object, like M. (2)

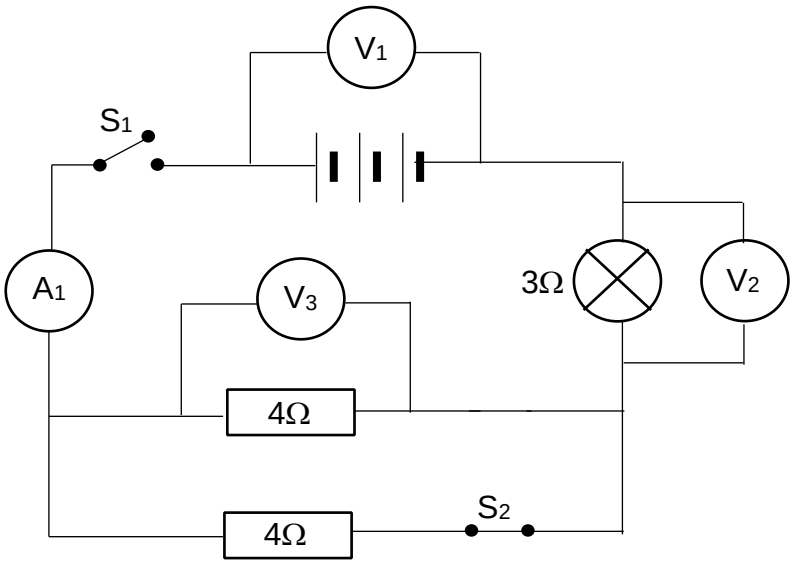
5.3 What happens when the spheres touch?
Explain in terms of movement of subatomic particles. (2)

5.4 Calculate the final charge on spheres M and N. (2)

**[9]**

**QUESTION 6:**

A 10 V battery is connected to a circuit with a bulb of resistance 3 Ω and two identical 4 Ω resistors connected as shown.




6.1 Define *potential difference.* (2)

6.2 Which one of the voltmeters has a non-zero reading while switch $S_1$ is open? (1)

**Switch $S_1$ is now closed.**

6.3 Calculate the total resistance in the circuit. (3)

6.4 Calculate the reading on $A_1$. (3)

6.5 Calculate the reading on $V_3$. (3)

6.6.1 What happens to the brightness of the bulb when switch $S_2$ is opened? Only write BRIGHTER, DIMMER or STAYS THE SAME. (1)

6.6.2 Give a reason for your answer in 6.6.1 above. (2)

6.7 A scientist wishes to investigate the relationship between the potential difference across a lightbulb and the current flowing through it. The scientist gradually increases the potential difference by adding more cells to the circuit whilst simultaneously measuring the current in the lightbulb. The scientists obtains the following results:

| **Potential Difference (V)** | **Current (A)** | **Relative Brightness of the Lightbulb** |
|---|---|---|
| 3 | 0,41 | dim |
| 6 | 0,86 | brighter |
| 9 | 1,28 | brightest |

6.7.1 Write an investigative question for this experiment. (2)

6.7.2 How must the cells be added to the circuit to increase the potential difference across the lightbulb? (1)

6.7.3 What conclusion can be made about the relationship between the potential difference across the lightbulb and the relative brightness of the bulb? (1)

**[19]**

**TOTAL SECTION B = [65]**

## 10 June Exam 2022 P1 MEMO

1.1 C ✓✓ 1.2 A ✓✓ 1.3 C ✓✓ 1.4 A ✓✓ 1.5 B ✓✓

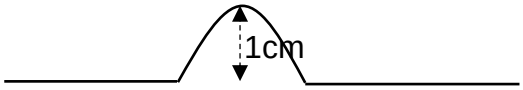
2.1.1 The number of waves passing a point / generated per second. ✓✓ (2 or 0)

2.1.2 C ✓

2.1.3 E ✓

2.1.4 A & C or B & D or D & E or E & F ✓

2.2.1 (Partial) destructive interference ✓

2.2.2 

✓ shape ✓ 1cm

2.2.3 3 cm ✓

2.3.1 $\lambda = 4/8$ ✓ = 0.5 m ✓

2.3.2 v = d/t ✓ = 4/5 ✓= 0.8 s ✓ or v = fλ ✓ = (8/5)(0.5) ✓ = 0,8 $m.s^{-1}$ ✓

3.1 A wave in which the particles of the medium vibrate parallel ✓
to the direction of propagation of the wave. ✓

3.2 Distance to cliff: Left: d = v.t ✓ = 340 x 0.5 ✓ = 170 m ✓
Right: d = v.t = 340 x 1 ✓ = 340 m ✓
Distance between cliffs: d = 170 + 340 = 510 m ✓

3.3.1 frequency > 20 000 Hz ✓

3.3.2 pregnancy scan ✓

4.1 Infrared, visible, X-rays, Gamma ✓✓ (one mark if reverse order)

4.2 Mutually induced electric and magnetic fields ✓ oscillating at right angles ✓ to each other.

4.3 Energy is directly proportional to the frequency OR
As the frequency increases so does the energy. ✓✓

4.4.1 c=fλ ✓ $\therefore \lambda = c/f = 3x10^{8} / 1,8x10^{18}$ ✓ = $1.67x10^{-10}$ m ✓

4.4.2 E=hf ✓ $\therefore f=E/h = 4,97x10^{-14} / 6,63x10^{-34}$ ✓ = $7,50x10^{19}$ Hz ✓

4.5 Radiation treatment ✓ of cancer tumours.

5.1 $n = Q/q_e$ ✓ $= 6x10^{-9}/1,6x10^{-19}$ ✓ $= 3,75x10^{10}$ ✓ electrons

5.2 The electrons in N are attracted to the positive charge of M ✓ resulting in N being polarised / becoming an induced dipole. ✓

5.3 Electrons ✓ move from N to M. ✓

5.4 $Q_{new} = (6+0)/2$ ✓ $= +3$ nC ✓

6.1 Energy transferred per unit charge. ✓✓ (2 or 0)

6.2 $V_1$ ✓

6.3 $R_p$ = prod/sum = 16/8 ✓ = 2 Ω ✓ $R_T = 2 + 3 = 5$ Ω ✓

6.4 $I = V/R$ ✓ = 10/5 ✓ =2 A ✓

6.5 $V_3$: $V = IR$ ✓ = 2 x 2 ✓ = 4 V ✓

6.6.1 DIMMER ✓

6.6.2 Removing a pathway (resistor in parallel) results in higher (total) resistance ✓ therefore less (total) current. ✓

6.7.1 What is the relationship between the potential difference and the current?

OR

How does the potential difference affect the current?

✓correct variables ✓open-ended question

6.7.2 In series. ✓

6.7.3 The larger the potential difference, the brighter the lightbulb. ✓