



HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 10
PAPER 1 - Physics



NOVEMBER 2014
TIME: 2 HRS

Total 140

Instructions

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
SECTION B (120)

Answer SECTIONS A and B in the ANSWER BOOK.
4. Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Data sheets and a periodic table are attached for your use.
8. Give brief motivations, discussions, et cetera where required.
9. Numbers must be rounded off to **two decimal** places.

SECTION A

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK.

- 1.1 The energy of a sound wave is most closely related to its:
- A. Period
 - B. Frequency
 - C. Amplitude
 - D. Wavelength
- 1.2 The area under a velocity-time graph indicates the:
- A. Acceleration
 - B. Average velocity
 - C. Slope
 - D. Displacement
- 1.3 Ayanda rubs a balloon against her hair then touches it to the wall. The balloon “sticks” to the wall due to:
- A. Electrostatic forces between the particles of the balloon
 - B. Electrostatic forces between the particles of the wall
 - C. Electrostatic forces between the particles of the balloon and the particles of the wall
 - D. Magnetic forces between the particles of the balloon and the particles of the wall
- 1.4 The direction of magnetic field lines of a magnet, externally, is towards...
- A. South pole
 - B. North pole
 - C. Geographic South pole
 - D. Geographic North pole

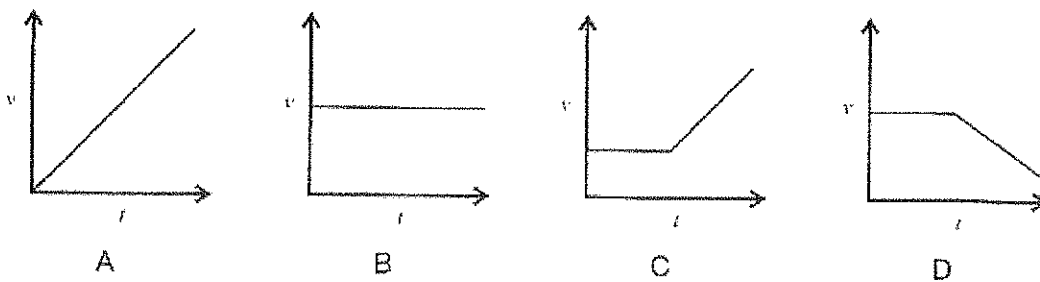
1.5 A wave with a period of 0,2 s has a frequency of:

- A 20 Hz
- B 0,5 Hz
- C 5 Hz
- D 2 Hz

1.6 The "Volt" can be described as:

- A. Coulomb per second
- B. Ampere per volt
- C. Coulomb per ampere
- D. Joule per coulomb

1.7 A truck is travelling at a constant velocity along a straight road. As it travels up a steep hill it slows down uniformly. Which ONE of the following velocity vs time graphs best represents the motion of the truck?



1.8 The troughs of two waves combine when they reach the same point in a medium. This phenomenon is known as:

- A. Reflection
- B. Diffraction
- C. Oscillation
- D. Superposition

1.9 The angle between the direction of a disturbance and direction of propagation of a transverse wave is:

- A. 0°
- B. 45°
- C. 60°
- D. 90°

1.10 A pulse does not have:

- A. Frequency
- B. Amplitude
- C. Wavelength
- D. Speed

[2 x 10 = 20]

SECTION B

INSTRUCTIONS AND INFORMATION

1. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
2. Show the formulae and substitutions in ALL calculations.
3. Round off your numerical answers to **TWO** decimal places.

QUESTION 2

The following table shows the typical wavelengths and corresponding frequencies for given electromagnetic waves.

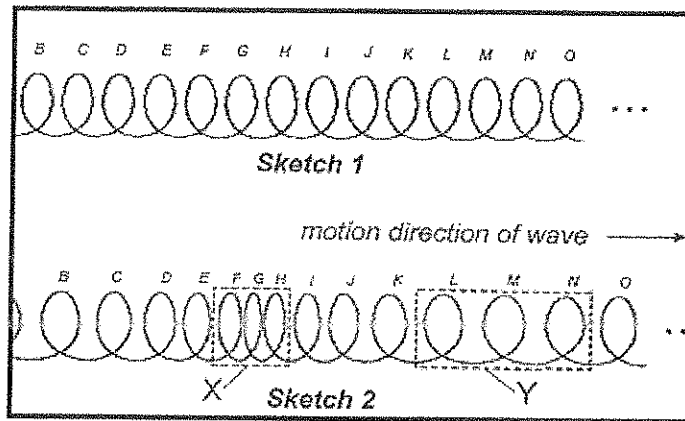
Name of electromagnetic wave	Typical wavelength λ and its corresponding frequency f
Gamma rays	$\lambda = 1 \text{ pm} = 10^{-12} \text{ m}$ $f = 3 \times 10^{20} \text{ Hz}$
X-rays	$\lambda = 100 \text{ pm} = 10^{-10} \text{ m}$ $f = 3 \times 10^{18} \text{ Hz}$
Ultraviolet (UV)	$\lambda = 10 \text{ nm} = 10^{-8} \text{ m}$ $f = 3 \times 10^{16} \text{ Hz}$
Visible light	$\lambda = 0,6 \text{ }\mu\text{m (green)} = 0,6 \times 10^{-6} \text{ m}$ $f = 5 \times 10^{14} \text{ Hz}$
Infrared (IR)	$\lambda = 100 \text{ }\mu\text{m} = 10^{-4} \text{ m}$ $f = 3 \times 10^{12} \text{ Hz}$
Micro waves	$\lambda = 3 \text{ cm} = 3 \times 10^{-2} \text{ m}$ $f = 10^{10} \text{ Hz}$
Radio waves	$\lambda = 3 \text{ m}$ $f = 10^8 \text{ Hz}$

- 2.1 What is the relationship between the energy of a photon and its frequency? (1)
- 2.2 What is the relationship between the energy of a photon and its wavelength? (1)
- 2.3 Which one of the electromagnetic waves in the above table, have photons with the greatest amount of energy? (1)
- 2.4 Calculate the energy of a photon of infrared light. (3)
- 2.5 Which one of the electromagnetic waves have photons with the lowest penetration ability? Explain your answer. (2)
- 2.6
- 2.6.1 Calculate the wavelength of a photon with $6,63 \times 10^{-24} \text{ J}$ of energy. (4)
- 2.6.2 Identify this type of electromagnetic radiation. (1)

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QUESTION 3

George moves the free end of a spring (sketch 1) repeatedly forwards and backwards to create a wave to the right of the spring (sketch 2).

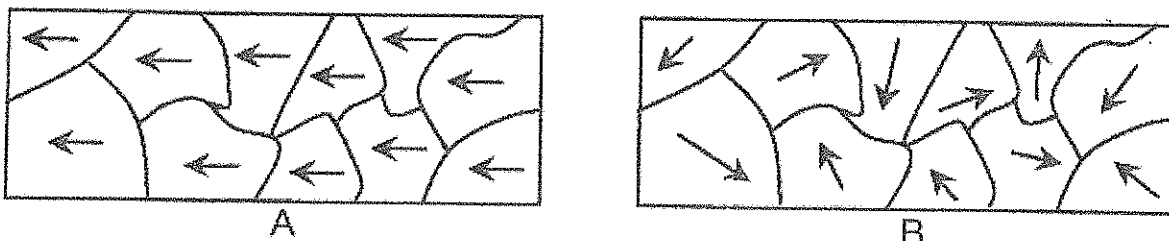


- 3.1 Name the areas marked X and Y in sketch 2. (2)
- 3.2 Name and give the definition for the type of wave that is illustrated in the sketches above. (3)
- 3.3 Use your knowledge about waves and draw a sketch graph for a **TRANSVERSE WAVE**. The following labels need to be included: (5)
- wavelength
 - amplitude
 - wave crest
 - wave trough
 - rest position

[10]

QUESTION 4

- 4.1 Define the term magnetic field. (2)
- 4.2 The microscopic diagrams below show samples of a ferromagnetic substance.



- 4.2.1 Which diagram, A or B represents a magnetised material? (1)
- 4.2.2 What is the name given to the defined areas in the diagram above? (1)
- 4.2.3 Give any two examples of ferromagnetic substances. (2)

- 4.3 Draw the field pattern that forms around a bar magnet. (2)
- 4.4 Describe in detail, how you would go about magnetising a ferromagnetic substance. (2)
- 4.5

Paul explores the relationship between the attraction and the distance between two identical bar magnets. A bar magnet, X, is stuck onto a work bench with masking tape and equal distances of 1 cm each are measured from the N pole, up to a distance of 9 cm. A pull scale is attached to the other identical bar magnet, Y. It is placed flat on the workbench with the opposite pole, virtually against that of X, and they attract each other.

Paul pulls the scale until the magnet Y is a distance of 1 cm from magnet X. He takes the reading on the pull scale to obtain the size of the force of attraction (in N) between the two magnets. He continues to take the readings from the pull scale for the force of attraction between the magnets on distances of 2 cm, 3 cm, etc., until the magnets are 9 cm apart.

- 4.5.1 Suggest an investigative question for the experiment above. (2)
- 4.5.2 Write a possible hypothesis for the experiment. (2)
- 4.5.3 Identify the independent variable. (1)
- 4.5.4 Identify the dependant variable. (1)
- 4.5.5 Look at the table given below and sketch a graph for force vs. distance between magnets X and Y.

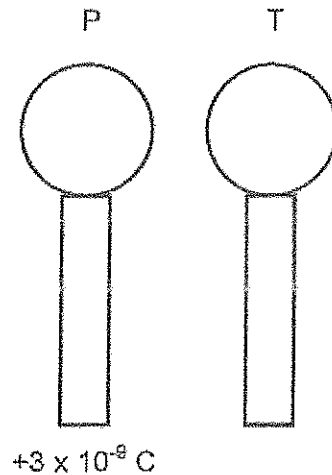
Distance between X and Y	1	2	3	4	5	6	7	8	9
Force between X and Y (N)	4,5	2,3	1,5	1,2	0,9	0,8	0,7	0,6	0,5

- 4.5.6 What is the shape of the graph? (4)
- 4.5.7 Write down a possible conclusion for this investigation. (1)
- 4.5.8 Write down a possible conclusion for this investigation. (2)
- 4.5.8 What will the force of attraction between magnets X and Y be if they are a distance of 1,5 cm apart? (1)
- 4.5.9 Name one variable that should be kept constant during this investigation. (1)

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QUESTION 5

Two charged metal spheres, P and T, are mounted on insulated stands. P carries a charge of $+3 \times 10^{-9} \text{C}$ and T has an unknown charge.



5.1 Were electrons added to or removed from sphere P in order for it to have a charge of $+3 \times 10^{-9} \text{C}$? (1)

5.2 State the principle of the conservation of charge. (2)

The spheres are allowed to touch each other and are then separated. After separation, it is found that each sphere carries a charge of $-1.5 \times 10^{-9} \text{C}$.

5.3 Is the electrostatic force of between the two spheres now one of attraction or repulsion? Explain. (2)

5.4 Calculate:

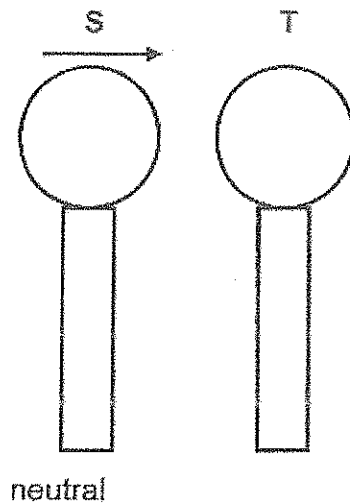
5.4.1 The charge that was carried by sphere T **before** it came into contact with sphere P. (4)

5.4.2 The charge transferred from one sphere to the other when they were in contact. (2)

5.4.3 The number of electrons transferred during the process in 5.4.2. (3)

5.5 In which direction did the electrons flow while the spheres were in contact? Write down only from P to T or from T to P. (1)

Sphere P is now removed and replaced by sphere S which is neutral.

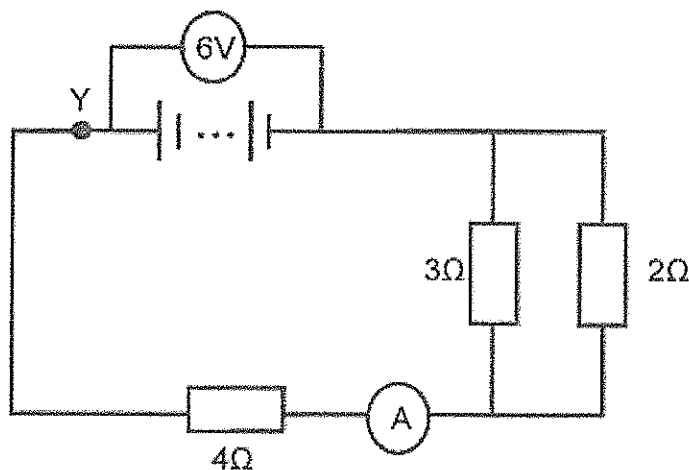


5.6 It is found that sphere S is attracted to sphere T. Explain how this observation is possible by making reference to polarisation of molecules. (3)

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QUESTION 6

Three resistors and an ammeter are connected to a 6V battery and zero internal resistance as shown in the figure below.



- 6.1 State whether resistors connected in SERIES are current dividers or potential difference dividers. Explain your answer. (2)
- 6.2 Define the term electric current. (2)
- 6.3 Calculate:
 - 6.3.1 Resistance of the parallel branch. (3)
 - 6.3.2 Total resistance in the circuit. (2)

- 6.3.3 Reading on the ammeter. (3)
 6.3.4 Amount of charge that flows in the 4Ω resistor in 2 minutes. (3)
 6.3.5 Voltmeter reading across the parallel branch of resistors. (3)

6.4 Will there be a change in the ammeter reading if the ammeter is moved to point Y? Explain your answer. (2)

6.5 State any two factors that will affect the resistance of a conductor. (2)

6.6 The 2Ω resistor is now removed from the circuit. Explain what the effect will be on:

Write down only INCREASE, DECREASE or REMAIN THE SAME.

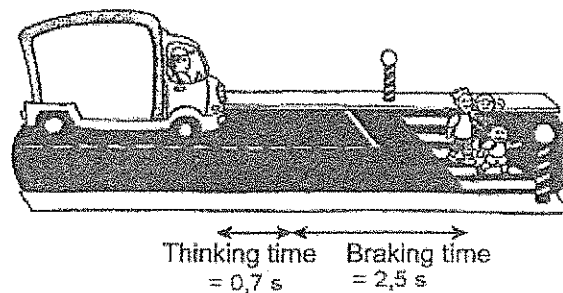
6.6.1 Ammeter reading. Explain your answer. (3)

6.6.2 Voltmeter reading across the battery. Explain your answer. (2)

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QUESTION 7

Mark is travelling at a constant speed of $12 \text{ m}\cdot\text{s}^{-1}$ in his delivery van along a straight road when he sees children walking across a pedestrian crossing ahead of him. His reaction time is $0,7 \text{ s}$, i.e. it takes him $0,7 \text{ s}$ to react before applying the brakes as hard as he can. It takes a further $2,5 \text{ s}$ for the van to come to a stop.

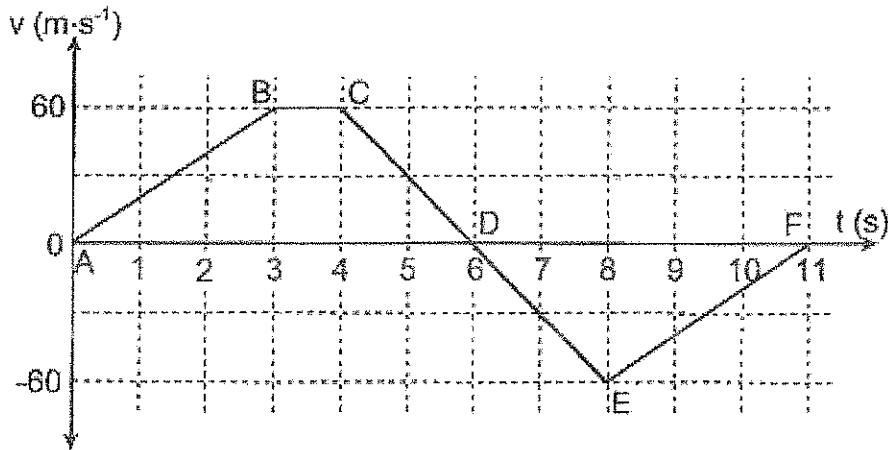


- 7.1 Calculate the distance Mark and his van travels during the $0,7 \text{ s}$ reaction time. (3)
 7.2 What was the total time taken by Mark to come to a complete stand still once he saw the children? (1)
 7.3 Draw a velocity-time graph for the entire motion. (3)
 7.4 Calculate the acceleration of the van while slowing down to come to a stop. (3)
 7.5 Prove that the distance that Mark and his van travelled while slowing down to come to a stop is 15 m . (You may NOT use this value in this calculation) (3)
 7.6 Calculate the total distance covered by Mark after seeing the children. (2)

[15]

QUESTION 8

The motion of a trolley that initially moves northwards is represented by the velocity-time graph below.



- 8.1 Which part of the graph represents the following? (Write only the correct letters eg. AB or YX). (1)
- 8.1.1 Constant velocity? (1)
 - 8.1.2 A forward motion? (1)
 - 8.1.3 A backward (southward) motion? (1)
 - 8.1.4 The furthest point from the starting point. (1)
- 8.2 Using the graph calculate the acceleration of the trolley for section EF. (3)
- 8.3 Use the graph to determine the total displacement of the trolley for the 11s. (3)
- 8.4 Sketch a labelled acceleration-time graph for the trolley's motion during section EF. (2)

[12]

TOTAL = 140

TABLE 1: PHYSICAL CONSTANTS

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity <i>Swartekragversnelling</i>	g	9,8 m·s ⁻²
Speed of light in a vacuum <i>Speed van lig in 'n vakuum</i>	c	3,0 x 10 ⁸ m·s ⁻¹
Planck's constant <i>Planck se konstante</i>	h	6,63 x 10 ⁻³⁴ J·s
Coulomb's constant <i>Coulomb se konstante</i>	k	9,0 x 10 ⁹ N·m ² ·C ⁻²
Charge on electron <i>Lading op elektron</i>	e	-1,6 x 10 ⁻¹⁹ C
Electron mass <i>Elektronmassa</i>	m _e	9,11 x 10 ⁻³¹ kg
speed of sound in air (at 25°C)	v	343 m·s ⁻¹

MOTION/BEWEGING

$v_f = v_i + a \Delta t$	$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ or/of $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/of $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$ or/of $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$

WORK, ENERGY AND POWER/ARBEID

$K = \frac{1}{2} mv^2$ or/of $E_k = \frac{1}{2} mv^2$	$U = mgh$ or/of $E_p = mgh$
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WAVES, SOUND AND LIGHT

$v = f \lambda$	$T = \frac{1}{f}$
	$E = hf$
	$E = h \frac{c}{\lambda}$

ELECTROSTATICS

$F = \frac{kQ_1 Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{V}{d}$	$E = \frac{F}{q}$

ELECTRIC CIRCUITS

$R = \frac{V}{I}$	$\text{emf } (\varepsilon) = I(R + r)$ $\text{emk } (\varepsilon) = I(R + r)$
$R_s = R_1 + R_2 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$Q = I \cdot \Delta t$
$W = Vq$ $W = V\Delta t$ $W = I^2 R \Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \frac{V^2}{R}$