GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PROVINCIAL EXAMINATION

NOVEMBER 2021

GRADE 10

PHYSICAL SCIENCES (PHYSICS)

(PAPER 1)

TIME: 2 hours

MARKS: 100

10 pages and 1 formula sheet

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of SEVEN questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached data sheets.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, et cetera, where required.
12 Write neatly and legibly.

SECTION A

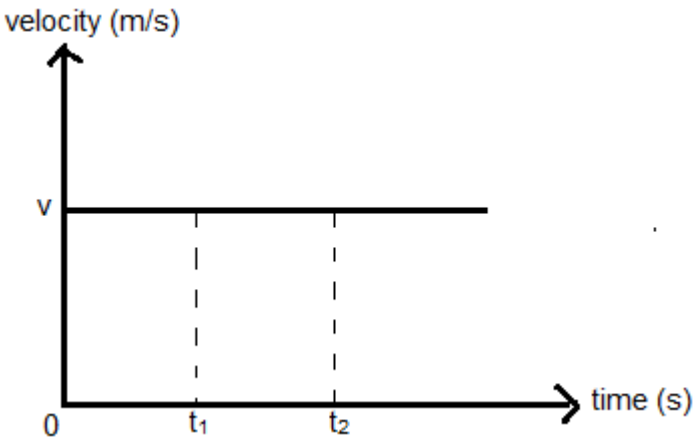
QUESTION 1: MULTIPLE CHOICE QUESTIONS

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 to 1.10) in the ANSWER BOOK, for example, 1.11 E.

1.1 Which of the following pairs consists of SCALAR quantities?

A Time and distance
B Time and velocity
C Distance and acceleration
D Velocity and displacement (2)

1.2 The following graph represents the motion of a car showing velocity versus time.



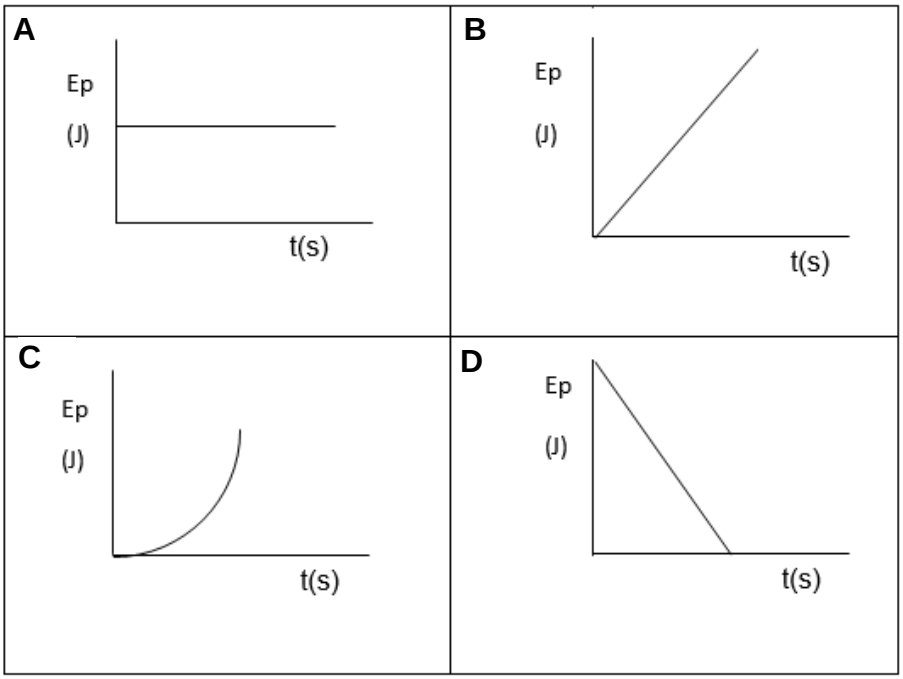
From this graph, we can conclude that between the time interval t_1 and t_2 …

A velocity is constant.
B object is speeding up.
C acceleration is equal to v/t_1.
D object is at rest. (2)

1.3 An object of mass *m* is dropped from a height *h* above the ground. At the point of release, the mechanical energy of the object is *M*. What is the magnitude of its mechanical energy at height *h*/2 above the ground?
Ignore the effects of air friction.

A M
B 2 M
C 0,5 M
D 4 M (2)

1.4 Which of the following graphs best represents the potential energy versus time, for the motion of an object dropped from the top of a tower? (2)



1.5 Radio waves differ from sound waves because ...

A they travel faster than sound waves.
B they are electromagnetic waves.
C they are transverse waves.
D they have all the properties described above. (2)

1.6 What is the frequency of a sound wave traveling at 340 $m \cdot s^{-1}$, with a wavelength of 60 cm?

A 566,67 Hz
B 5,67 Hz
C 204 Hz
D 20 400 Hz (2)

1.7 Which of the following electromagnetic waves has the greatest penetrating ability?

A Infrared waves
B Visible light waves
C Ultraviolet waves
D Microwaves (2)

1.8 The distance between two consecutive crests in a wave train is 8 cm. If two complete waves pass a point in 1 s, then the velocity of the wave is:

A 16 cm·s^{-1}
B 8 cm·s^{-1}
C 4 cm·s^{-1}
D 1,25 cm·s^{-1} (2)

1.9 If a metal sphere has a charge of +1,6 x 10^{-17}C, it means ...

A 1000 electrons were added to it.
B 100 electrons were removed from it.
C 100 electrons were added to it.
D 1000 electrons were removed from it. (2)

1.10 One volt of potential difference is equivalent to:

A 1 C·s^{-1}
B 1 A·Ω
C 1 J·C^{-1}
D 1 A·s (2)

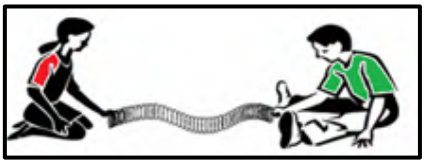
[20]

TOTAL SECTION A: 20

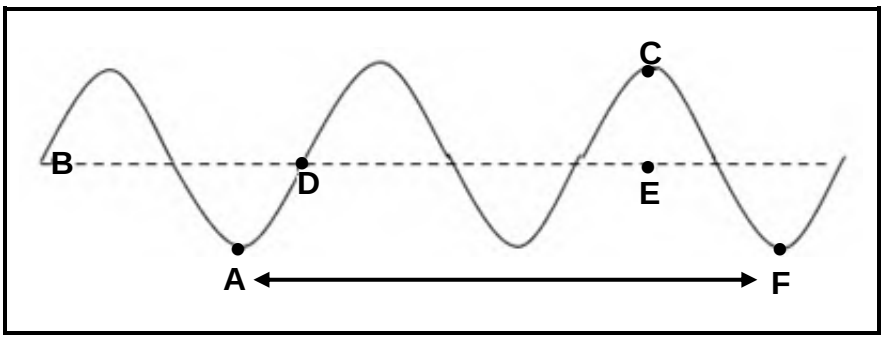
SECTION B

QUESTION 2 (Start on a new page.)

A slinky spring was used to generate the transverse waves. Two learners held the spring at both ends stretched out horizontally. One learner flicked one end of the spring up and down as shown in the diagram below, whilst the other held the spring stationary.



The following diagram represents the simple illustration of the transverse wave formed. Various points associated with the wave are labelled with letters.



2.1 Define the term *superposition*. (2)

2.2 What does each of the following represent?

2.2.1 Distance **BD** (1)

2.2.2 Point **A** (1)

2.2.3 Point **C** (1)

2.2.4 Distance **CE** (1)

2.3 Identify any TWO points that are:

2.3.1 In-phase (2)

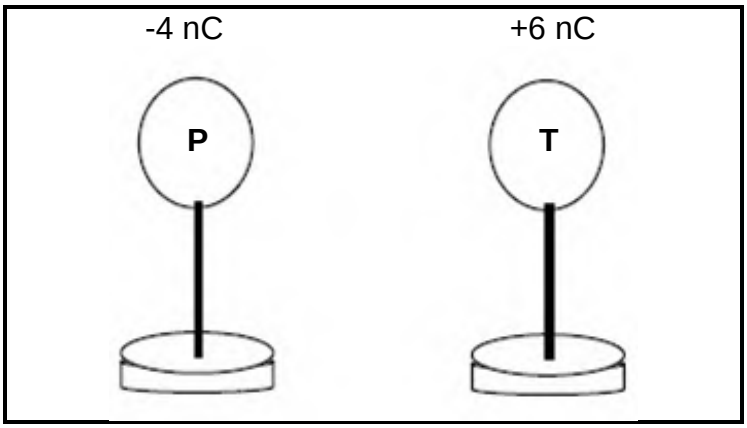
2.3.2 Out-of-phase (2)

2.4 If the distance between points **A** and **F** is 4 cm, what is the wavelength of this wave? (2)

[12]

QUESTION 3 (Start on a new page.)

The figure below shows two spheres **P** and **T** on insulated stands. The charge on sphere **P** and **T** are -4 nC and +6 nC, respectively.



3.1 State the principle of *conservation of charge*, in words. (2)

3.2 Calculate the net charge of this system. (3)

3.3 The two spheres are brought into contact and separated.

3.3.1 Calculate the charge on sphere **T** after separation. (3)

3.3.2 State the *principle of quantisation of charge*, in words. (2)

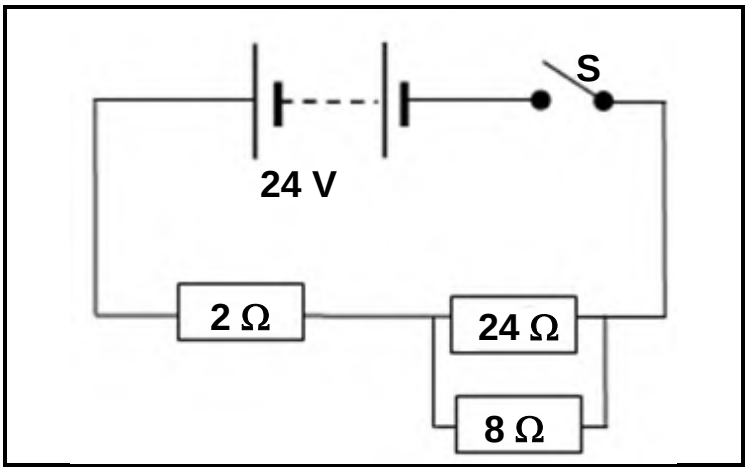
3.3.3 Calculate the number of electrons transferred between the two spheres while they are in contact. (3)

3.3.4 Were electrons transferred from SPHERE **P** to SPHERE **T** or from SPHERE **T** to SPHERE **P**?

Give a reason for your answer. (3)
[16]

QUESTION 4 (Start on a new page.)

In the circuit diagram below, the 24 V battery and conducting wires have negligible resistance.



4.1 Define the term *voltage*. (2)

4.2 Switch **S** is now CLOSED.

4.2.1 Calculate the total resistance of the circuit. (4)

4.2.2 If 4 A of current passes through the 2 Ω resistor, determine the amount of charge passing through it in 2 minutes. (3)

4.3 If the potential difference across the 2 Ω resistor is 6 V, deduce the potential difference across the parallel combination of resistors in the circuit. Support your answer by means of a calculation. (3)

[12]

QUESTION 5 (Start on a new page.)

The table below represents the electromagnetic spectrum, showing:

Lowest frequency → Highest frequency						
Radio waves	**A**	Infrared	**B**	**C**	X-rays	**D**

5.1 Define the term *photon*. (2)

5.2 Identify the type of electromagnetic waves represented by **A** – **D**. (4)

5.3 Give ONE medical use of X-rays . (1)

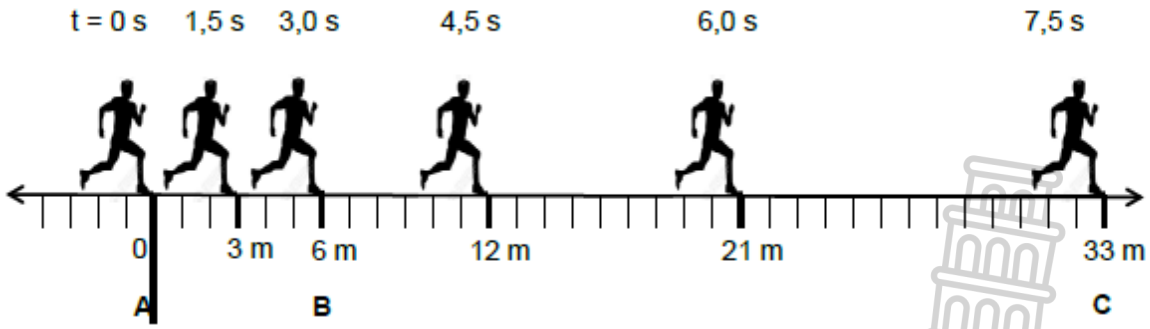
5.4 Which has a greater penetrating ability, radio waves or infrared rays? Give a reason to support your answer. (3)

5.5 Calculate the energy of a photon of microwaves with a frequency of $3,2 \times 10^{10}$ Hz. (3)

[13]

QUESTION 6 (Start on a new page.)

The diagram below show the positions of an athlete during a training session over a period of 7,5 s. Positions **A**, **B** and **C** are on a straight line.



6.1 Define the term *displacement*. (2)

6.2 Consider the motion of the athlete between position **A** and **B**. Is the athlete SLOWING DOWN, SPEEDING UP or MOVING AT CONSTANT VELOCITY? Give a reason for your answer. (2)

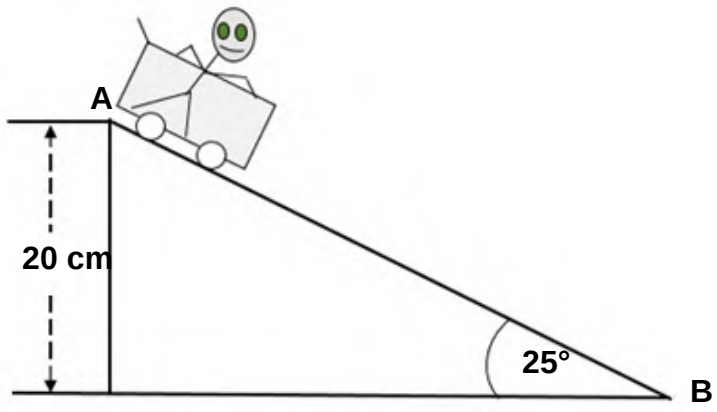
6.3 Calculate the displacement of the athlete in the last 3 s. (3)

6.4 By means of a calculation, show that the magnitude of the athlete's velocity in the last 1,5 s is 8 ms^{-1}. (3)

[10]

QUESTION 7 (Start on a new page.)

A 30 kg boy sits in a trolley with a mass 15 kg which rests at the top of the 25° inclined plane. The trolley begins to free wheel down the frictionless inclined plane.



7.1 Define the term *gravitational potential energy*. (2)

7.2 Prove with necessary calculations that the mechanical energy of the system at point **A** is 88,2 J. (4)

7.3 Calculate the velocity of the boy and trolley system upon reaching point **B**. (5)

7.4 Name and explain the energy principle you used in QUESTION 7.3 above. (3)

7.5 Determine the length of the ramp **A** – **B.** (3)
[17]

TOTAL SECTION B: 80

TOTAL: 100

DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10
VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	G	9,8 $m \cdot s^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	C	3,0 x 10^{8} $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	H	6,63 x 10^{-34} J·s
Charge on electron *Lading op elektron*	E	-1,6 x 10^{-19} C
Electron mass *Elektronmassa*	m_e	9,11 x 10^{-31} kg

TABLE 2: FORMULAE/*TABEL 2: FORMULES*
MOTION/*BEWEGING*

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

WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

$U = mgh$ or/*of* $E_P = mgh$	$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$v = f\lambda$	$T = \frac{1}{f}$
$E = hf$ or/*of* $E = h\frac{c}{\lambda}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$Q = I\,\Delta t$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$
$R_s = R_1 + R_2 + \ldots$	$V = \frac{W}{Q}$

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GRADE 10

MARKING GUIDELINES

PHYSICAL SCIENCES (PHYSICS) (PAPER 1)

7 pages

SECTION A

QUESTION 1

1.1	A	(2)
1.2	A	(2)
1.3	A	(2)
1.4	D	(2)
1.5	B	(2)
1.6	A	(2)
1.7	C	(2)
1.8	A	(2)
1.9	B	(2)
1.10	C	(2)

[20]

TOTAL SECTION A: 20

SECTION B

QUESTION 2

2.1 The algebraic sum of two disturbances that occupy the same space at the same time. (2)

2.2 2.2.1 Wavelength (1)

2.2.2 Trough (1)

2.2.3 Crest (1)

2.2.4 Amplitude (1)

2.3 2.3.1 B and D
A and F (2)

2.3.2 D and C
C and F (2)

2.4 0,02 m (2)

[12]

QUESTION 3

3.1 Net charge of an isolated system remains constant during any physical process. ✓✓ (2)

3.2 $Q = Q_P + Q_T$ ✓

$= (-4 \times 10^{-9}) + (+6 \times 10^{-9})$ ✓

$= +2 \times 10^{-9}$ C ✓ (3)

3.3.1 $Q_{New} = \frac{Q_p + Q_T}{2}$ ✓

$= \frac{-4 \times 10^{-9} + 6 \times 10^{-9}}{2}$ ✓

$= +1 \times 10^{-9}$ C ✓ (3)

3.3.2 Every charge in the universe consists of the integer multiple of the electron charge. ✓✓ (2)

3.3.3 $Q = n.q_e$ ✓

$2 \times 10^{-9} = n.(16 \times 10^{-19})$ ✓

$\therefore n = 1.25 \times 10^{10}$ electrons ✓ (3)

3.3.4 From P to T ✓

- Sphere P, has excess ✓ number of electrons ✓
  OR
- Sphere T, has deficit ✓number of electrons ✓ (3)

[16]

QUESTION 4

4.1 Voltage is the amount of work done per unit charge. ✓✓
OR
Difference in electric potential between two points in a circuit. ✓✓ (2)

4.2 4.2.1 $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓

$\frac{1}{R_P} = \frac{1}{24} + \frac{1}{8}$ ✓

$\therefore R_P = 6\ \Omega$

$R_{TOT} = R_S + R_P$

$= 2 + 6$ ✓

$= 8\ \Omega$ ✓ (4)

4.2.2 $I = \frac{Q}{\Delta t}$ ✓

$4 = \frac{Q}{(2 \times 60)}$ ✓

$\therefore Q = 480$ C ✓ (3)

4.3 $V_{TOT} = V_{2\Omega} + V_P$ ✓

$24 = 6 + V_P$ ✓

$\therefore V_P = 18$ V ✓ (3)

[12]

QUESTION 5

5.1 Photon – A quantum of light/electromagnetic radiation with energy proportional to frequency. ✓✓ (2)

5.2 A – Microwave oven ✓
B – Visible light ✓
C – Ultraviolet light ✓
D – Gamma rays ✓ (4)

5.3 To examine for broken/fractured bones. (1)

5.4 Infrared
– It has highest frequency ✓, thus greater energy. E α *F* ✓ from E = h.F (3)

5.5 $E = h.F$

$= 6,63 \times 10^{-10} \times 3,2 \times 10^{10}$ ✓

$= 2,12 \times 10^{-23}$ J ✓ (3)

[13]

QUESTION 6

6.1 Displacement is the change in position measured as the difference between final and initial points on a straight line. ✓✓ (2)

6.2 Moving at a constant velocity.

– Same distance is covered in the same time. (2)

6.3 $\Delta x = 33 - 12$ ✓

$= 21$ m ✓, East. ✓ (3)

6.4 $v = \frac{\Delta x}{\Delta t}$ ✓

$= \frac{(33-21)}{7.5-6}$ ✓

$= 8 m.s^{-1}$ ✓ (3)

[10]

QUESTION 7

7.1 Energy that an object has as a result of its height/position above the surface of the earth. ✓✓ (2)

7.2 $EM_A = E_P + E_K$ ✓

$= m.g.h + 0$

$= (45)(9,8)(0,2)$ ✓ $+ 0$ ✓

$= 88,2$ J ✓ (4)

7.3 **POSITIVE MARKING FROM 7.2**

$EM_A = EM_B$ ✓

$88,2$ ✓ $= \frac{1}{2}mv^2 + 0$ ✓

$88,2 = \frac{1}{2}(45)v^2$ ✓ $+ 0$ ✓

$\therefore v = \sqrt{\frac{88.2}{22.5}}$

$= 1,98 m.s^{-1}$ (5)

7.4 Conservation of mechanical energy.

Total mechanical energy of an isolated system ✓ remains constant or is conserved. ✓ (3)

7.5 Sin 25° = $\frac{20}{AB}$ ✓

∴ AB = $\frac{20}{Sin25^{o}}$ ✓

= 47,32 cm ✓ or 0,4732 m ✓ (3)

[17]

TOTAL SECTION B: 80

TOTAL MARKS: 100