education
Lefapha la Thuto la Bokone Bophirima
Noordwes Departement van Onderwys
North West Department of Education
NORTH WEST PROVINCE

NATIONAL
SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2022

MARKS: 150

TIME: 3 hours

This question paper consists of 20 pages and 3 data sheets

Please turn over

INSTRUCTIONS AND INFORMATION

1.   Write your name on the ANSWER BOOK.

2.   This question paper consists of TEN 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 open between sub questions, e.g. 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, etc. where required.

12.   Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are given as possible answers to the following questions. Each question has only one correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g.1.11 E.

1.1 Which ONE of the following is a conservative force?

    A   Frictional force

    B   An applied force

    C   Gravitational force

    D   Tension in a rope   (2)

1.2 An object with mass **m** moves with a constant velocity. It undergoes a displacement **fx** in **t** seconds in the presence of a frictional force **F**. How much power is required to keep the body in motion at this constant velocity?

    A $\dfrac{fx}{t}$

    B $\dfrac{Fx}{2}$

    C $\dfrac{F(fx)2}{t}$

    D $F\left(\dfrac{fx}{t}\right)$ (2)

1.3 Two forces, each of magnitude 300 N are simultaneously applied to a crate at rest on a frictionless horizontal surface as shown in the diagram below.

Work will be done by the net force on the crate and the crate will...

   A   accelerate to the left

   B   be lifted off the surface

   C   accelerate to the right

   D   remain rest   (2)

1.4 A stone falls freely from rest from a certain height. Which one of the following quantities could be represented on the y-axis of the graph?
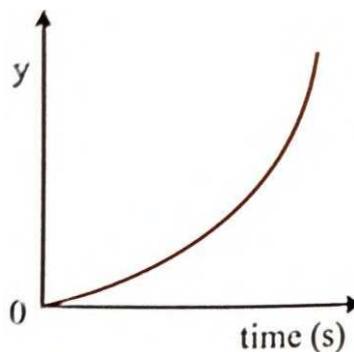
   A   Velocity

   B   Acceleration

   C   Momentum

   D   Position   (2)

1.5 The ball is released from rest at point **A**, h meters above the ground. It slides down and up on a smooth frictionless track ABC. See the diagram below.
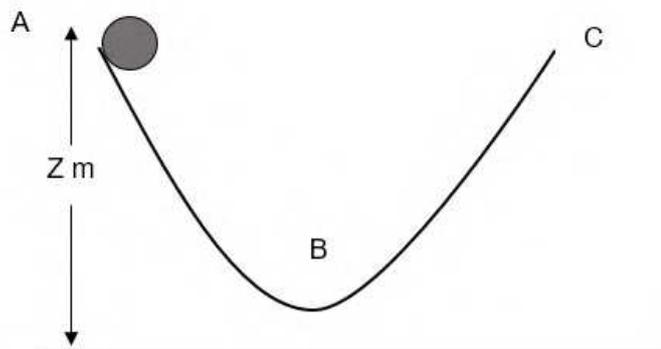
As the ball slides on the track ABC, it will …

A   have maximum kinetic energy and zero potential energy at B

B   roll up to a height of 'z' m on the opposite slope at C

C   lose mechanical energy as it rolls up the opposite slope towards point C

D   experience a gain in kinetic energy which is equal to its potential energy at C   (2)

1.6 A source of sound moves away from a stationery observer. The frequency of the sound detected by the observer is different from the source frequency because:

A   the volume of the sound decrease as the source moves away from the observer

B   the speed of sound becomes smaller

C   the wave fronts received by the observer are further apart than the wave front from the source

D   the wave fronts received by the observer are closer than the wave front from the source   (2)
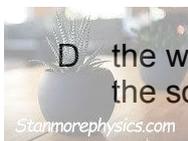
1.7 Two oppositely charged spheres P and Q carry charges of +3 C and -3 C respectively. An object is placed at point Y as indicated in the diagram below.
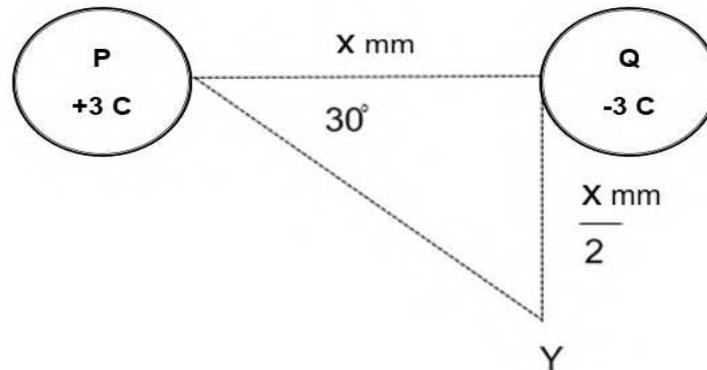
The vector diagram representing the net electric field at point **Y** is:

        A   B   C   D

(2)
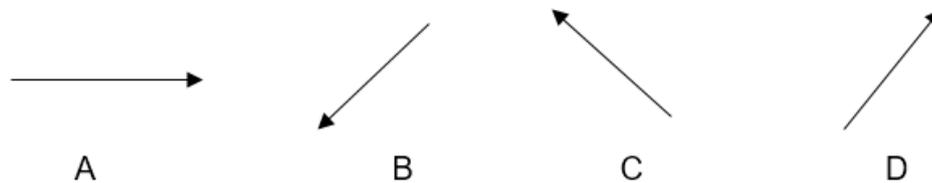
1.8 The diagram below represents part of a circuit. The potential difference across **P** and **Q** is V
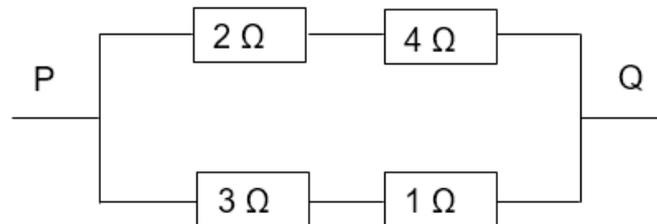
Which ONE of the following gives the current through the 3 Ω resistor?

A $\dfrac{V}{4}$

B $\dfrac{V}{6}$

C $\dfrac{V}{2}$

D $\dfrac{V}{3}$

(2)

NSC

1.9 A multi plug enables us to plug many appliances in at the same time so they can function simultaneously. If a multi plug adaptor connected in parallel is overloaded with too many appliances, a trip switch cuts off the electrical supply.

Which ONE of the following statements best explains the situation?

A   The effective resistance increases and the current becomes too high

B   More current is required that can be supplied

C   The effective resistance decreases, resulting in a larger current being drawn

D   The current is divided among all the appliances and is not enough for them all to operate   (2)

1.10 Fluorescent lights are used for signage, advertising and coloured lighting. The fluorescent tubes consists of mainly argon, neon or krypton gas ...

The type of spectrum formed by these types of lights is…

A   an absorption spectrum

B   a line emission spectrum

C   continuous spectrum

D   a transmission spectrum   (2)
                                                                              [20]

Please turn over

QUESTION 2 (Start on a new page)

Elephants are being transported from Kruger National Park to Eastern Cape. They are loaded into crates that are pulled up an inclined plane on frictionless rollers.

The diagram below shows a crate with an elephant being held stationery on the ramp by means of a rope parallel to the ramp. The angle of inclination is 15˚ and the tension of the rope is 5000 N.
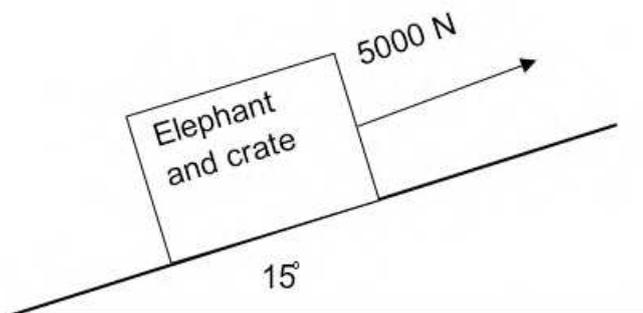
2.1 Draw a labelled free-body diagram of all the forces acting on the elephant and crate. (consider crate and elephant as one object) (3)

2.2 The crate has a mass of 800 kg. Determine the mass of the elephant. (4)

2.3 The crate is now being pulled up the ramp at CONSTANT ACCELERATION.

    2.3.1 What effect does it have on the net force acting on the elephant and the crate?
        Choose from INCREASE, DECREASE OR REMAINS SAME. (1)

    2.3.2 Explain your answer in QUESTION 2.3.1 (1)

2.4 In another experiment, learners investigated the forces acting on an object on an inclined plane. The object had a gravitational force of 98 N. The ratio of the NORMAL force to that of parallel component force was **7:4**
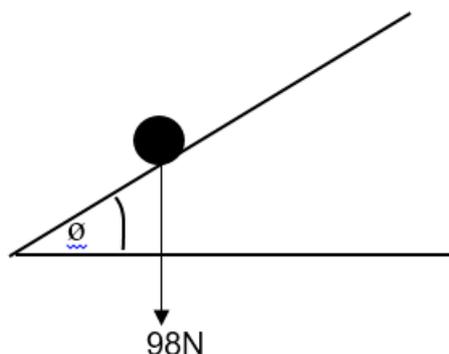

2.4.1 Define *normal force* in words. (2)

2.4.2 Calculate the angle of inclination Ø of the ramp (3)

[14]

QUESTION 3 (Start on a new page)

Nomsa is standing on the ground floor of a building. She throws a pencil case vertically towards Mekwe, who is standing on the balcony of the first floor of the building, with an initial velocity, **v**.

Mekwe fails to catch the pencil case as it moves upwards but catches it on its way back. Ignore the effects of air friction.

The position time graph below, not drawn to scale, represents the motion of the pencil case when it was thrown up till it reaches Mekwe's hand. Choose **upwards** as positive.
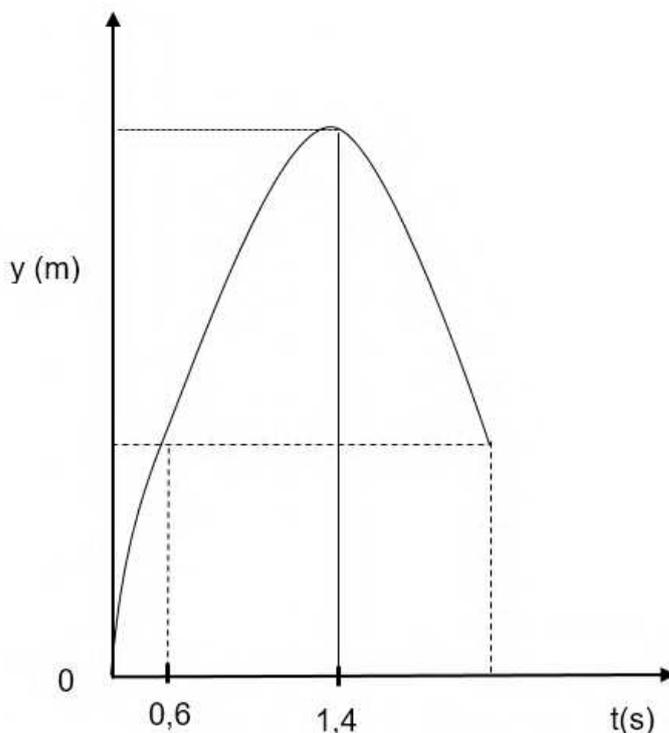
3.1   Define the term *free fall*.   (2)

3.2   Use the graph and determine the:

    3.2.1   Time in which pencil case's velocity is 0 m·s^{-1} (1)

    3.2.2   Acceleration of the pencil case at 1,4 s?   (2)

    3.2.3   Time it takes for the pencil case to reach Mekwe's hand from the
                moment Nomsa threw it upwards.   (2)

3.3   Use equations of motion and information from the graph to calculate the:

      3.3.1   Initial velocity **v** of the pencil case.   (3)

      3.3.2   Height of the pencil case above the ground when Mekwe caught it.   (3)

3.4   Draw an acceleration-time graph for the entire motion of the pencil case. Indicate the value of acceleration and time on the graph.   (2)

3.5   What does the area under the acceleration time graph represents?   (1)

[16]

QUESTION 4 (Start on a new page)

Tim is playing snooker and positions his cue so that the white ball is lined up with the black ball. A 0,6 kg white ball moving at a velocity 0,5 m·s⁻¹ collides with a stationery black ball of mass 0,8 kg. On contact, the black ball exerts a force of 1,2 N on the white ball.
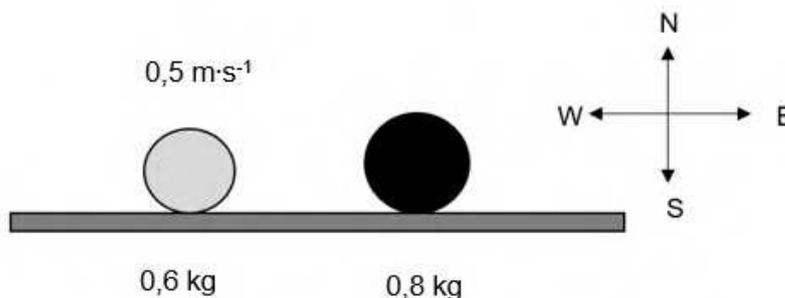
4.1 State Newton's Second Law of motion *in terms of momentum.* (2)

4.2 If the change in momentum of the white ball is -0,24 kg·m·s⁻¹, calculate the time that the white ball is in contact with the black ball. (3)

4.3 Calculate the velocity of the white ball after the collision. (3)

4.4 On being struck, the black ball moves forward towards the bumper cushion on the sides of the snooker table and collided elastically with the bumper cushion. After collision, the kinetic energy of the black ball is 0,042 J. Calculate its velocity. (3)

[11]

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QUESTION 5 (Start on a new page)

Vickey a 75 kg learner, jumps off a bridge 60 m above the ground. She has a bungee cord tied to her ankles. She falls 25 m before the bungee cord begins to stretch, slowing down her fall. The cord stretches 20 m, before the jumper come to rest. Ignore air friction.
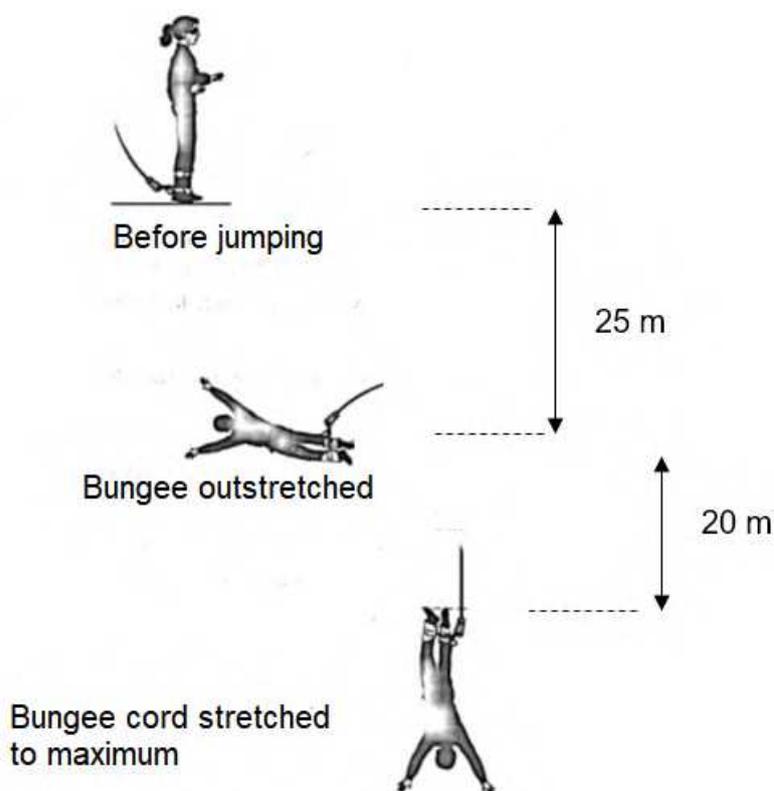
5.1 Write down the *work-energy theorem* in words. (2)

5.2 Using energy principles calculate the kinetic energy of the jumper when she has fallen 25 m. (4)

5.3 Calculate the work done by the cord to bring her to rest. (3)

5.4 How much energy is transferred from the jumper to the cord? (1)

5.5 Calculate the average force exerted by the cord on the jumper if the cord stretches for 20 m before she comes to rest. (4)

[14]

QUESTION 6 (Start on a new page)

Scientists studying the social interaction of dolphins in captivity connected an underwater sound recorder to an oscilloscope and immersed it in the dolphin tank at an aquarium.

They recorded the sound waves emitted by the dolphins as they approached the microphone. The waves they recorded on the oscilloscope are represented below:
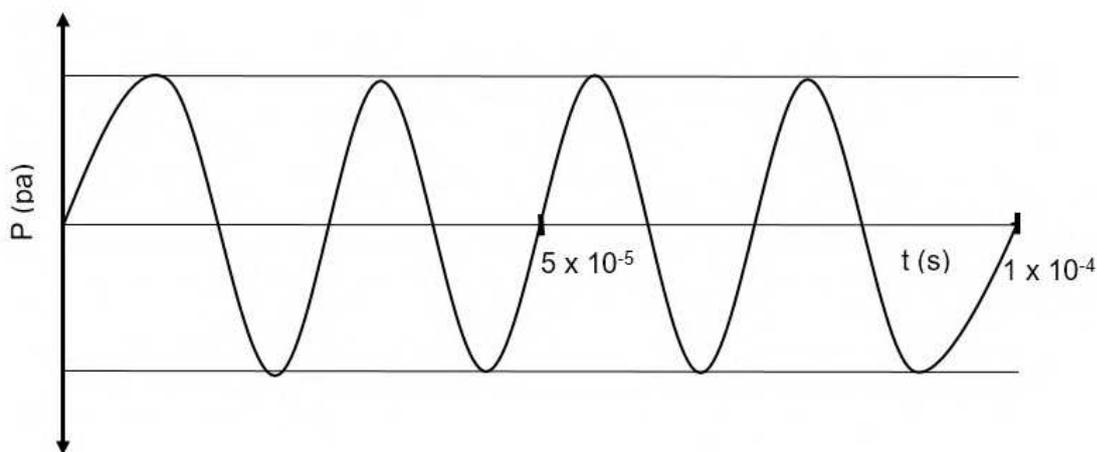
6.1 State the *Doppler effect* in words. (2)

6.2 The average frequency of the social vocalisations of these dolphins is 38 kHz. Show by calculation that the frequency recorded is 2 kHz higher than the actual frequency. (2)

6.3 Explain why the recorded frequency is higher than the actual frequency. (2)

6.4 Calculate the speed at which the dolphins are approaching the recorder. The speed of sound in water is 1500 m·s^{-1}. (5)

6.5 Astronomers have used *Doppler effect* to conclude that galaxies are moving away from the Earth. Write a reason to support their conclusion. (2)

[13]

NSC

QUESTION 7 (Start on a new page)

Two small identical metal spheres, X and Y, each with a mass of 0,9 g hang from the same fixed point from threads of equal length. When the spheres receive equal charges, they repel each other and come to rest with their centres 40 mm apart and the threads making an angle of 45° with the vertical.
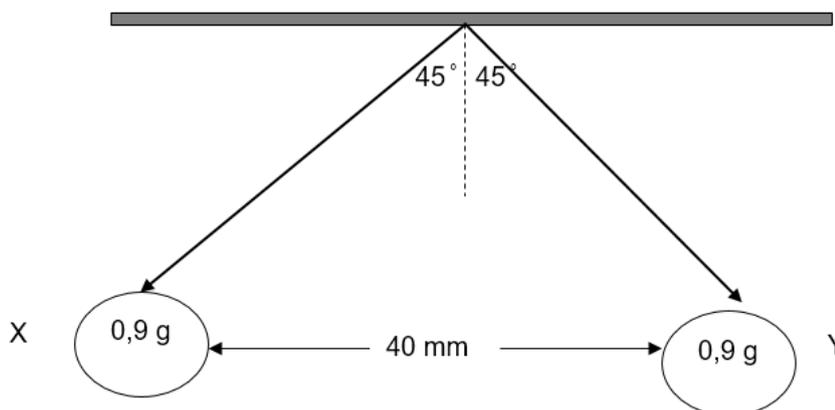
7.1   State *Coulomb's law* in words.   (2)

7.2   Draw a force diagram to show all the forces acting on Y.   (3)

7.3   Calculate the:

    7.3.1   Magnitude and direction of electrostatic force that X exerts on Y.   (3)

    7.3.2   Charge on each sphere.   (3)

7.4   Three charged particles A, B and C are arranged in a line as shown in the diagram.
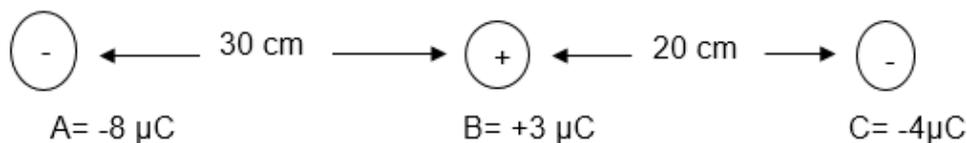
    7.4.1   Calculate the magnitude and direction of net electrostatic force on particle C due to the other two charges.   (3)

[14]

NSC

QUESTION 8 (Start on a new page)

Three identical unknown resistors each of resistance R are connected in circuit to a battery of emf 24 V and unknown internal resistance '**r**'. An ammeter registers a current of 3 A and voltmeter V_1 reads 21 V when the switch '**S**' is closed.
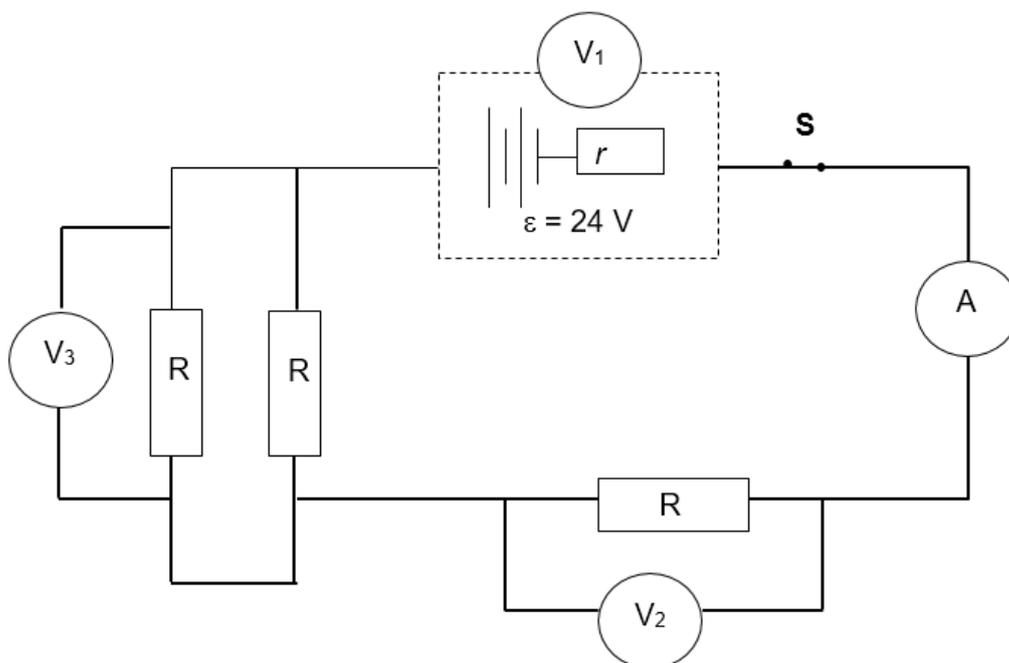
8.1 Explain the term *internal resistance*. (2)

8.2 Write down a mathematical expression/formula which relates the voltmeter readings of V_2 and V_3. (1)

8.3 What will be the reading on V_2 and V_3? (2)

8.4 Calculate the:

    8.4.1 Internal resistance of the battery. (4)

    8.4.2 Resistance of the resistor **R**. (3)
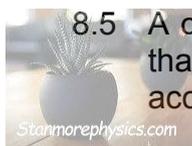
8.5 A car lamp is marked '12 V, 60 W'. Calculate the quantity of electric charge that passes through any point in the lamp in 2 minutes when operating according to the above mentioned specifications. (4)
[16]

QUESTION 9 (Start on a new page)

The diagram given below is a schematic representation of an AC generator.
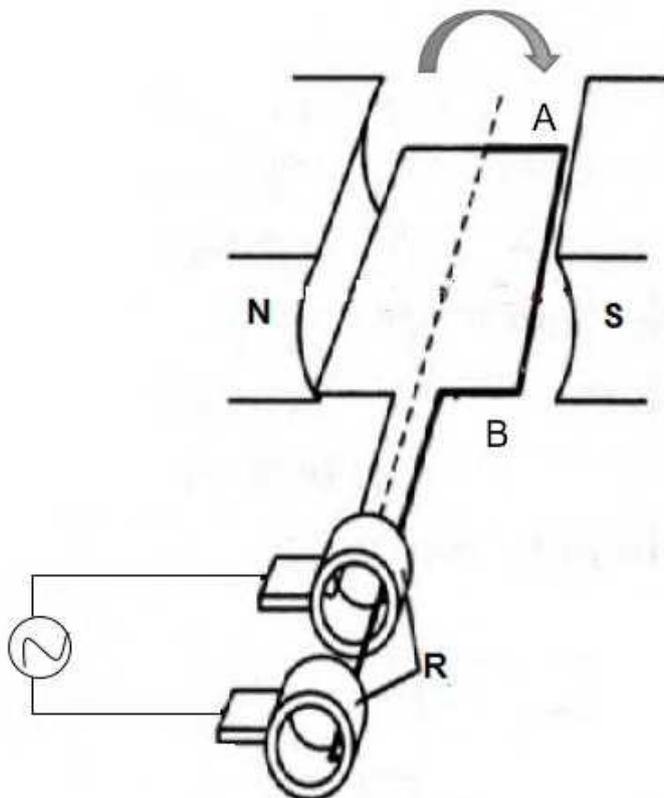
9.1 Write down the:

    9.1.1   Name of the part labelled 'R'.   (1)

    9.1.2   Function of part labelled 'R'.   (2)

9.2   State ONE principle on which an AC generator works.   (2)

9.3   If the armature is rotated in the direction as indicated in the diagram, which way will the current flow in the armature?

    Choose from **A to B** or **B to A**   (1)

9.4   What effect does changing the polarity of the magnets have on the output voltage?

    Choose from INCREASES, DECREASES OR REMAINS THE SAME.   (1)

9.5   What is the position of the coil, relative to the magnetic field, when the output voltage is at a minimum?   (2)

9.6 The graph shows the potential delivered by an AC source to a light bulb which is dissipating 15 W.
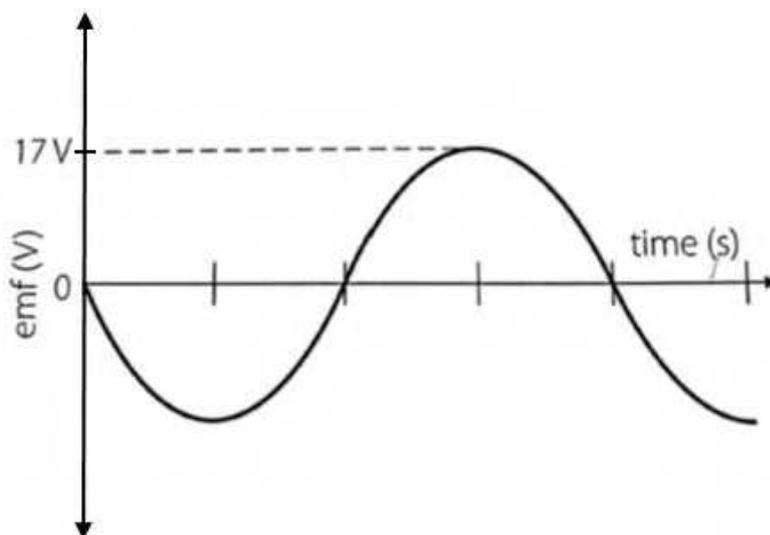
9.6.1 What DC voltage would have to be supplied to keep the bulb burning at the same brightness? (3)

9.6.2 What is the peak current through the bulb while it is connected to the AC source? (4)

9.6.3 Draw a graph of current versus time for the same time period as the above graph. Indicate the values of I_{max} and I_{rms} on the graph. (2)

[19]

QUESTION 10 (Start on a new page)

When ultraviolet light shines on the surface of an electrode of a photoelectric cell, electrons are ejected. The velocity of the ejected electrons is measured against the frequency.

The graph below represents the results obtained.
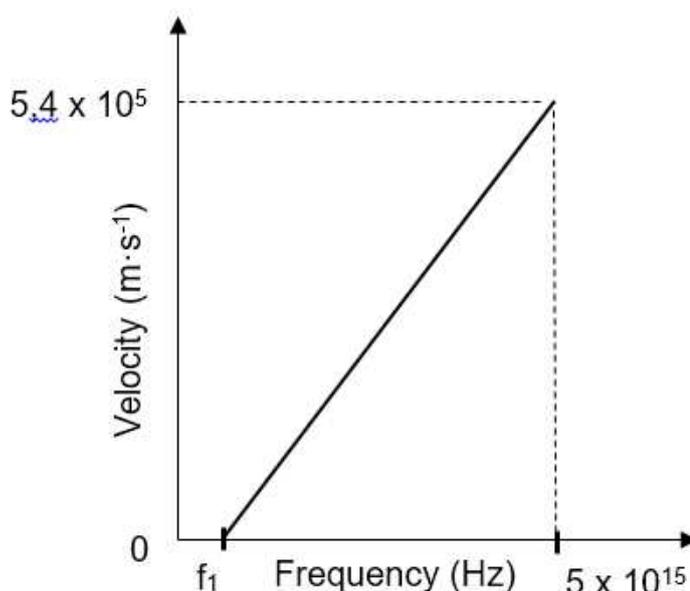
10.1   Name the physical quantity represented by **'f₁'** on the graph?   (1)

10.2   Use the information from the graph to calculate the value of **f₁**   (5)

10.3   A grade 12 learner has a calculator that is powered by a photoelectric cell. The photoelectric cell consists of two conductive plates that are connected in a circuit as shown below. The lower plate consists of selenium.
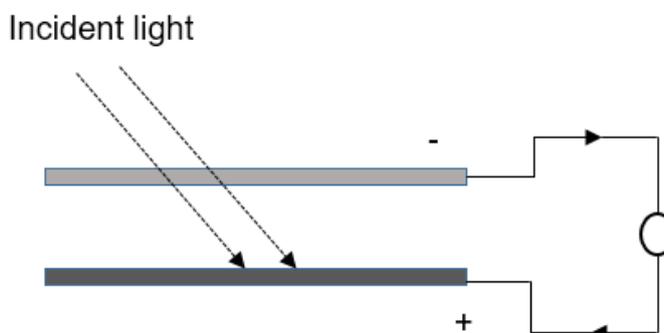
      10.3.1   Define the term *work function* in words.   (2)

A learner shone a blue light on the photoelectric cell and found that the calculator did not work. He finds that the calculator works in day light.

Use the information given below and answer the questions that follow:

Frequency of blue light	Frequency of ultraviolet light	Work function of selenium
$3,32 \times 10^{14}$ Hz	$1,54 \times 10^{16}$ Hz	$9,44 \times 10^{-19}$ J

10.3.2   Calculate threshold frequency of selenium?   (3)

10.3.3   Write a reason why does the photoelectric cell work in day light and not in blue light.   (2)

[13]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9{,}8 \ \text{m·s}^{-2}$
Universal gravitational constant *Universele gravitasiekonstant*	G	$6{,}67 \times 10^{-11} \ \text{N·m}^2\text{·kg}^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3{,}0 \times 10^8 \ \text{m·s}^{-1}$
Planck's constant *Planck se konstante*	h	$6{,}63 \times 10^{-34} \ \text{J·s}$
Coulomb's constant *Coulomb se konstante*	k	$9{,}0 \times 10^9 \ \text{N·m}^2\text{·C}^{-2}$
Charge on electron *Lading op elektron*	e	$1{,}6 \times 10^{-19} \ \text{C}$
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31} \ \text{kg}$
Mass of the Earth *Massa van die Aarde*	M	$5{,}98 \times 10^{24} \ \text{kg}$
Radius of the Earth *Radius van die Aarde*	R_E	$6{,}38 \times 10^6 \ \text{m}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{\,max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G\dfrac{m_1 m_2}{d^2}$ or/*of* $F = G\dfrac{m_1 m_2}{r^2}$	$g = G\dfrac{M}{d^2}$ or/*of* $g = G\dfrac{M}{r^2}$

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

$W = F\Delta x \cos\theta$	$U = mgh$ or/*of* $E_P = mgh$
$K = \dfrac{1}{2}mv^2$ or/*of* $E_k = \dfrac{1}{2}mv^2$	$W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \dfrac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	

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

$v = f\,\lambda$	$T = \dfrac{1}{f}$
$f_L = \dfrac{v \pm v_L}{v \pm v_s}f_s$ $f_L = \dfrac{v \pm v_L}{v \pm v_b}f_b$	$E = hf$ or/*of* $E = h\dfrac{c}{\lambda}$
$E = W_o + E_{k(max)}$ or/*of* $E = W_o + K_{max}$ where/*waar* $E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_{k(max)} = \dfrac{1}{2}mv_{max}^2$ or/*of* $K_{max} = \dfrac{1}{2}mv_{max}^2$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \dfrac{kQ_1Q_2}{r^2}$	$E = \dfrac{kQ}{r^2}$
$V = \dfrac{W}{q}$	$E = \dfrac{F}{q}$
$n = \dfrac{Q}{e}$ or/*of* $n = \dfrac{Q}{q_e}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \dfrac{V}{I}$	emf $(\varepsilon) = I(R + r)$ emk $(\varepsilon) = I(R + r)$
$R_s = R_1 + R_2 + ...$ $\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + ...$	$q = I\,\Delta t$
$W = Vq$ $W = VI\,\Delta t$ $W = I^2R\,\Delta t$ $W = \dfrac{V^2\Delta t}{R}$	$P = \dfrac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \dfrac{V^2}{R}$

ALTERNATING CURRENT/*WISSELSTROOM*

$I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \dfrac{I_{maks}}{\sqrt{2}}$ $V_{rms} = \dfrac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \dfrac{V_{maks}}{\sqrt{2}}$	$P_{ave} = V_{rms}I_{rms}$ / $P_{gemiddeld} = V_{wgk}I_{wgk}$ $P_{ave} = I_{rms}^2R$ / $P_{gemiddeld} = I_{wgk}^2R$ $P_{ave} = \dfrac{V_{rms}^2}{R}$ / $P_{gemiddeld} = \dfrac{V_{wgk}^2}{R}$

education

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NORTH WEST PROVINCE

NATIONAL SENIOR CERTIFICATE/
NASIONALE SENIOR SERTIFIKAAT

GRADE/GRAAD 12

PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)

SEPTEMBER 2022

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/ *PUNTE*: 150

These marking guidelines consist of 16 pages including the cognitive table/
Hierdie nasienriglyne bestaan uit 16 bladsye wat die kognitiewe tabel insluit.

QUESTION 1/VRAAG 1

1.1   C   ✓✓   (2)

1.2   D   ✓✓   (2)

1.3   A   ✓✓   (2)

1.4   D   ✓✓   (2)

1.5   B   ✓✓   (2)

1.6   C   ✓✓   (2)

1.7   D   ✓✓   (2)

1.8   A   ✓✓   (2)

1.9   C   ✓✓   (2)

1.10   B   ✓✓   (2)

[20]

QUESTION 2 /VRAAG 2

2.1
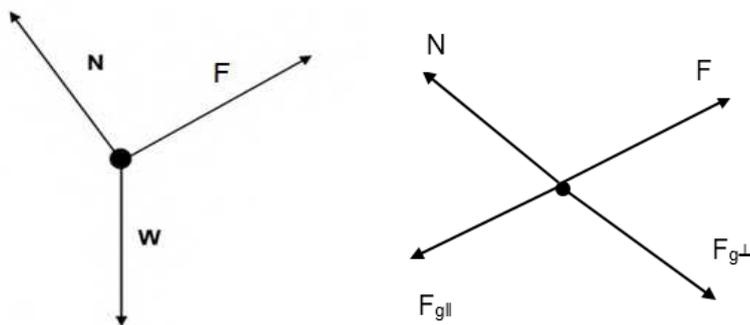
Accept the following symbols	
N ✓	F_N/Normal/Normal force *Normaal/Normaalkrag*
F ✓	F_A/Applied force force/ 5000 N F_A/*Toegepaste krag*/ 5000 N
w ✓OR $F_{g\parallel}$ and $F_{g\perp}$	F_g/mg/weight/ gravitational force F_g/mg/*gewig/ gravitasiekrag*

(3)

2.2 $F_{g\parallel}$ = w sinθ ✓
5000 = w sin 15 º ✓
w = 19318,52 N
M_E = (19318,52) – 800 ✓
        9,8
     = 1171,28 kg ✓ (4)

2.3.1 Increases/*Verhoog*. ✓ (1)

2.3.2 Crate is moving at constant acceleration/*Die krat beweeg teen `n konstante versnelling*✓ (1)

2.4.1 The force or the component of a force which a surface exerts on an object with which it is in contact, and which is perpendicular to the surface.
/Die krag of die komponent van die krag wat `n voorwerp op `n oppervlakte uitoefen waarmee dit in kontak is, en wat loodreg op die oppervlakte is. ✓✓
(2 or/*of 0*) (2)

2.4.2 $F_{g\parallel}$ = w sinθ
       = (98) (sinθ)
     $F_{g\perp}$ = w cosθ
       = (98) (cosθ)
     7 $F_{g\parallel}$ = 4 $F_{g\perp}$ ✓
     7 (98) (sinθ) = 4 (98) (cosθ) ✓
     tanθ = 0,5714
      θ   = 25,53 º ✓

Note: By using tanθ - 2/3 marks
Nota**: **Gebruik van tanθ - 2/3 punte

tan θ = $\frac{4}{7}$ ✓

θ   = 25,53 º ✓   (3)
         [14]

QUESTION 3/ VRAAG 3

3.1   Motion during which the only force acting on an object is the force of gravity.
       Beweging waar die enigste krag wat op die voorwerp inwerk gravitasiekrag
       is. ✓✓ **(2 or/of 0)**   (2)

3.2.1   1,4 s ✓   (1)

3.2.2   9,8 m·s^{-2} ✓ downwards ✓/ *afwaarts* ✓   (2)

3.2.3   1,4 + 0,8 = 2,2 s ✓✓   (2)

3.3.1 $v_f = v_i + a\Delta t$ ✓
         $0 = v_i + (-9,8)(1,4)$ ✓
         $v_i = 13,72$ m·s^{-1} ✓   (3)

3.3.2   **POSITIVE MARKING FROM QUESTION 3.3.1 and 3.2.3/**
         POSITIEWE NASIEN VANAF 3.3.1 and 3.2.3
         $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
         $\Delta y = (13,72)(2,2) + \frac{1}{2}(-9,8)(2,2^2)$ ✓
             $= 6,47$ m ✓   (3)

3.4   **POSITIVE MARKING FROM QUESTION 3.2.3**
         POSITIEWE NASIEN VANAF 3.2.3
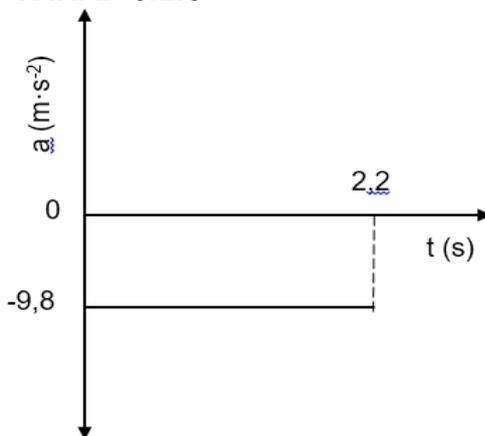
Marking Criteria
- Labelling -9,8 and 2,2 on the graph ✓
- Shape and graph lies below x axis ✓

Nasien kriteria
- *Toon -9,8 en 2,2 op die grafiek* ✓
- *Vorm van grafiek en grafiek lê onder die x-as* ✓   (2)

3.5   Change in the velocity ✓
         Verandering is die snelheid ✓   (1)

                                                                                                   [16]

QUESTION 4 / VRAAG 4

4.1 The net force acting on an object is equal to rate of change of momentum of the object✓✓
Die netto krag wat op `n voorwerp inwerk is gelyk aan die verandering in die momentum van die voorwerp✓✓
(2 or/of 0) (2)

4.2 $F_{net} \Delta t = \Delta P$ ✓
$(-1,2)(\Delta t) = (-0,24)$ ✓
$\Delta t = 0,2$ s ✓ (3)

4.3 **OPTION 1**
$\underline{F_{net} \Delta t = \Delta P = m(v_f - v_i)}$✓
$\underline{(-1,2)(0,2) = 0,6 (v_f - 0,5)}$ ✓
$v_f = 0,1$ m·s⁻¹ towards east ✓

OPTION 2
$\Delta P = m(v_f - v_i)$✓
$\underline{(-0,24) = 0,6 (v_f - 0,5)}$ ✓
$v_f = 0,1$ m·s⁻¹ towards east ✓ (3)

4.4 $E_{kbefore} = E_kafter$ ⎤ any one / *enige een*✓
$E_k = \frac{1}{2} mv^2$ ⎦
$\underline{0,042 = \frac{1}{2} (0,8)(v_f)^2}$ ✓
$v_f = 0,32$ m·s⁻¹.✓ (3)

[11]

QUESTION 5 / VRAAG 5

5.1 The net/total work done on an object is equal to the change in the object's kinetic energy. ✓✓
/ Die netto werk verrig op `n voorwerp is gelyk aan sy verandering in kinetiese energie.
OR
The work done on an object by a resultant/net force is equal to the change in the objects kinetic energy. ✓✓
/ Die werk verrig op `n voorwerp deur `n netto/resultante krag is gelyk aan sy verandering in kinetiese energie. (2)

5.2 $W_{nc} = \Delta E_K + \Delta E_p$ ⎤
$W_{nc} = (E_{Kf} - E_{Ki}) + (E_{pf} - E_{pi})$ ⎦ any one / enige een ✓

    0 ✓ $= \underline{(E_{Kf} - 0) + (0 - (75)(9,8)(25))}$ ✓
    $E_{Kf} = 18375$ J ✓

(4)

5.3 **POSITIVE MARKING FROM QUESTION 5.2**
POSITIEWE NASIEN VANAF 5.2
$W_{nc} = \Delta E_K + \Delta E_p$
$W_{nc} = (E_{Kf} - E_{Ki}) + (E_{pf} - E_{pi})$
    $= \underline{(0-18375)}$ ✓ $+ \underline{(0 - (75)(9,8)(20)}$ ✓
    $= (- 18375) + (-14700)$
    $= - 33075$ J ✓

(3)

5.4 33075 J ✓ (1)

5.5 **POSITIVE MARKING FROM QUESTION 5.3**
POSITIEWE NASIEN VANAF 5.3
$W_{nc} = F\Delta x \cos\theta$ ✓
$- 33075$ ✓ $= F_T \times 20 \cos 180°$ ✓
$F_T = 1653,75$ N ✓

(4)
[14]

QUESTION 6 / VRAAG 6

6.1 <u>The change in frequency (or pitch)</u> ✓ of the sound detected by a listener <u>because the sound source and the listener have different velocities relative to the medium of sound propagation.</u> / *<u>Die verandering in die frekwensie (toonhoogte)</u> van die waargenome klank deur <u>die luisteraar agv die klankbron en die luisteraar wat verskillende snelhede relatief tot mekaar het.</u>*
OR/*OF*
An (apparent) <u>change in</u> (observed/detected) <u>frequency</u> (pitch),✓ as a result of <u>the relative motion between a source and an observer</u> ✓ (listener).
'n (Skynbare) <u>verandering in</u>(waargenome) <u>frekwensie</u> ✓ (toonhoogte), as gevolg van die <u>relatiewe beweging tussen die bron en 'n</u> <u>waarnemer/luisteraar.</u> ✓ (2)

6.2

OPTION 1	**OPTION 2**
$f_{(recorded)}$ = $\dfrac{(4)}{(1 \times 10^{-4})}$ ✓	$f_{(recorded)}$ = $\dfrac{(2)}{(5 \times 10^{-5})}$ ✓
= 40000 Hz	= 40000 Hz
= 40 kHz	= 40 kHz
40-38 = 2 kHz ✓	40-38 = 2 kHz ✓

(2)

6.3 When the dolphin is moving towards the recorder, there is a compression of the wave fronts, ✓ more waves are arriving per second. ✓
Wanneer die dolfyn na die klankopnemer beweeg vind `n kompressie van golffronte plaas ✓ en meer golwe arriveer per sekonde ✓ (2)

6.4 **OPTION 1 / OPSIE 1**

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad ✓$$

$40000✓ = \dfrac{(1500+0)}{(1500-v_s)}$ ✓ 38000 ✓

$V_s = 71{,}43 \text{ m·s}^{-1}$ ✓ (5)

6.5 The light coming from the distant planet observed from the Earth has <u>a lower frequency and therefore a longer wavelength.</u> ✓
Therefore <u>it is shifted towards the red end of the spectrum.</u> ✓
Die lig vanaf verafgeleë planete wat observeer word van die aarde het `n laer frekwensie en langer golflengte ✓, daarom vind `n verskuiwing na die rooi gedeelte van die speltrum plaas ✓ (2)

[13]

QUESTION 7 / VRAAG 7

7.1 The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) <u>is directly proportional to the product</u>
of the magnitudes of <u>their charges</u>✓ and inversely proportional to the square of the <u>distance (r) between them</u> ✓
/ Die grootte van die elektrostatiese krag wat deur een puntlading (Q_1) op 'n ander puntlading (Q_2) uitgeoefen word, is <u>direk eweredig aan die</u> produk van die <u>groottes</u> van die ladings ✓en <u>omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle</u> ✓

(2)

7.2
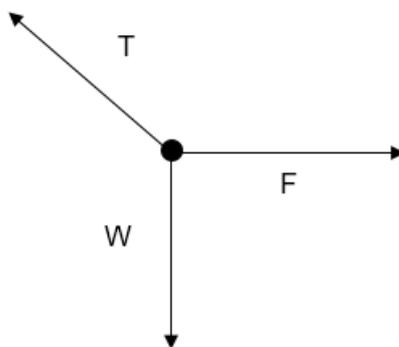
Accept the following symbols	
T ✓	Tension in the spring / Spanning in die tou
F✓	Electrostatic force of repulsion / Elektrostatiese afstotingskrag
w ✓	F_g/mg/weight/$F_{earth\ on\ sphere}$/gravitational force F_g/mg/*gewig*/F aarde op sfeer/*gravitasiekrag force*

(3)

7.3.1 Forces are in equilibrium / *Kragte is in ewewig*
w = mg
  = (0,0009)(9,8) ✓
  = 0,0088 N
tan 45˚ = (F) ✓
_____
(0,0088)

=0,008 N repulsion to the right. / *afstotend na regs*✓

(3)

7.3.2 **POSITIVE MARKING FROM QUESTION 7.1.3**
POSITIEWE NASIEN VANAF 7.1.3

$$F = \frac{kQ_1Q_2}{r^2} \quad \checkmark$$

$$0{,}0088 = \frac{(9x\ 10^9)\,(Q)^2}{(0{,}04)^2} \checkmark$$

$Q = 3{,}8 \times 10^{-8}$ C $\quad\checkmark$ Accept the range 3,8 to 3,9 $\times 10^{-8}$ C

$Q = 3{,}8 \times 10^{-8}$ C $\quad\checkmark$ Aanvaar omvang 3,8 tot 3,9 $\times 10^{-8}$ C (3)
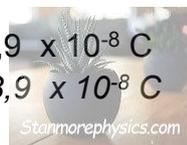
7.4.1
$$F = \frac{kQ_1Q_2}{r^2}$$

'F' at 'C' due to A

$$F_{CA} = \frac{(9{,}0 \times 10^9)\,(4 \times 10^{-6})\,(8 \times 10^{-6})}{0{,}5^2} \checkmark$$

$= 1{,}152$ N to the right / *na regs*

'F' at 'C' due to B

$$F_{CB} = \frac{(9{,}0 \times 10^9)\,(4 \times 10^{-6})\,(3x\ 10^{-6})}{0{,}2^2} \checkmark$$

$= 2{,}7$ N to the left / *na links*

Net electrostatic force at C $= 1{,}152 - 2{,}7 = -1{,}548$ N· to the left $\checkmark$

Netto elektrostatiesekrag by C $= 1{,}152 - 2{,}7 = -1{,}548$ N· na links $\checkmark$ (3)

[14]

QUESTION 8 / VRAAG 8

8.1 Internal resistance is the *resistance found inside the battery due to the movement of charges.* ✓✓

Interne weerstand is die weestand in die battery as gevolg van die beweging van lading (2)

8.2 $V_2 = 2V_3$✓
OR
$V_3 = ½ V_2$ (1)

8.3 $V_1 = V_2 + V_3$
$21 = V_2 + ½ V_2$
$V_2 = 14 V$ ✓
$V_3 = 7 V$ ✓ (2)

8.4.1 $V_{lost} = 24-21$
$= 3 V$ ✓
$V_{lost} = I_r$ ✓
$3 = 3r$ ✓
$r = 1 Ω$ ✓ (4)

8.4.2

OPTION 1	**OPTION 2**
$R= \dfrac{V}{I}$ ✓	$R= \dfrac{V}{I}$ ✓
$V_2 = 14 V$	$V_3 = 7 V$
$14 = 3R$ ✓	$7 = 3R_T$
$R = 4,67 Ω$ ✓	$7 = \dfrac{(3)(R)}{2}$ ✓
	$R = 4,67 Ω$ ✓

(3)

8.5 $P = VI$
$60 = 12 \times I$ ✓
$I = 5 A$
$Q = It$ ✓
$= 5 \times 2 \times 60$ ✓
$= 600 C$ ✓ (4)

[16]

QUESTION 9 / VRAAG 9

9.1.1   Slip rings✓ / *Sleepringe*   (1)

9.1.2   Slip rings keep the armature in contact with the brushes, <u>and thus ensure</u>
        <u>flow of current to the external circuit.</u> ✓✓
        Sleepringe hou die spoel in kontak met die koolstofborsels en verseker die
        vloei van stroom na die eksterne stroombaan ✓✓   (2)

9.2   Induction of an electromotive force by the motion of conductor across a
        magnetic field.
        OR
        Whenever there is a change in the magnetic flux linkage with a conductor an
        emf is induced. ✓✓
        Induksie van 'n elektromotoriese krag deur die beweging van 'n geleier oor 'n
        magnetiese veld.
        OF
        Wanneer daar `n verandering in die magnetiese vloedkoppeling is met `n
        geleier waarin `n emk dan geïnduseer word   (2)

9.3   A to B / A na B✓   (1)

9.4   Remains the same ✓ Bly dieselfde ✓   (1)

9.5   Coil will be parallel to the field✓✓ / *Spoel sal parallel aan die veld wees*   (2)

9.6.1 $V_{rms} = \dfrac{V_{max}}{\sqrt{2}}$ ✓

        $V_{rms} = \dfrac{17}{\sqrt{2}}$ ✓

        $V_{rms} = 12{,}02 \text{ V}$ ✓

        $V_{wgk} = \dfrac{V_{max}}{\sqrt{2}}$

        $V_{wgk} = \dfrac{17}{\sqrt{2}}$

        $V_{wgk} = 12{,}02 \text{ V}$ (3)

9.6.2   **POSITIVE MARKING FROM QUESTION 9.2.1**

$P_{ave} = I_{rms} \times V_{rms}$ ✓
$15 = I_{rms} \times 12,02$ ✓
$I_{rms} = 1,25$ A

$I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$ ✓

$1,25 = \dfrac{I_{max}}{\sqrt{2}}$ ✓

$I_{max} = 1,77$ A ✓

POSITIEWE NASIEN VANAF VRAAG 9.2.1

$P_{gem} = I_{wgk} \times V_{wgk}$ ✓
$15 = I_{wgk} \times 12,02$ ✓
$I_{wgk} = 1,25$ A

$I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$ ✓

$1,25 = \dfrac{I_{max}}{\sqrt{2}}$ ✓

$I_{maks} = 1,77$ A ✓

(5)

9.6.3   **POSITIVE MARKING FROM QUESTION 9.2.2**
POSITIEWE NASIEN VANAF VRAAG 9.2.2
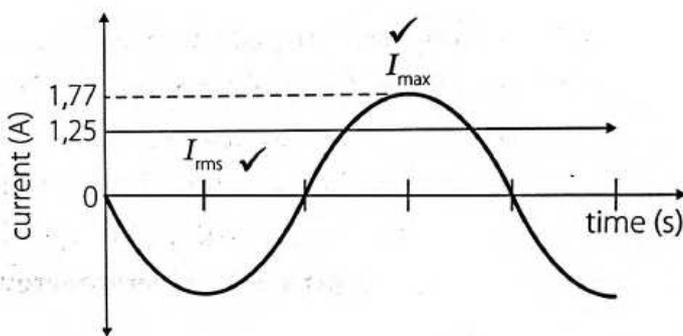
Marking Criteria / Nasien kriteria

- Labelling I_{max} on the graph / I_{maks} aangedui op die grafiek✓
- Labelling I_{rms} on the graph / I_{wgk} aangedui op die grafiek✓

(2)
[19]

QUESTION 10 / VRAAG 10

10.1   Threshold frequency / *Drumpelfrekwensie*✓   (1)

10.2 $E = W_o + E_{k(max)}$ ⎤ any one / *enige een* ✓
         $E = hf_o + \frac{1}{2}mv^2$ ⎦
         $\underline{(6,63 \times 10^{-34})(5 \times 10^{15})}$ ✓ $= \underline{(6,63 \times 10^{-34})(f_o)}$ ✓ $+ \underline{(\frac{1}{2} \times 9,1 \times 10^{-31})(5 \times 10^5)^2}$✓
         $f_0 = 4,8 \times 10^{15}$ Hz ✓   (5)

10.3.1   The work function of a metal is the minimum energy that an electron needs
         to be emitted from the metal surface ✓✓
         Die werksfunksie van `n metaal is die minimum hoeveelheid energie
         benodig om elektrone uit die oppervlakte van die metaal vry te stel
         (2 or/of 0)   (2)

10.3.2 $W_o = hf_o$ ✓
         $\underline{9,44 \times 10^{-19} = (6,63 \times 10^{-34})(f_o)}$ ✓
         $f_o = 1,42 \times 10^{15}$ Hz ✓   (3)

10.3.3   The frequency of blue light is less than that of threshold frequency of
         selenium,✓and the frequency of ultraviolet light (found in day light) is
         greater than threshold frequency of selenium.✓
         Die frekwensie van blou lig is laer as die drumpelfrekwensie van
         selenium,✓*en die frekwensie van unltraviolet lig (wat in die dag gekry*
         word) is groter as die drumpelfrekwensie van selenium.✓   (2)

         [13]

         TOTAL/*TOTAAL*:   150

SUBJECT: PHYSICAL SCIENCES PAPER 1   **GRADE 12**

ANALYSIS GRID   **SEPTEMBER 2022**

QUESTION	Mark	Cognitive Levels				Topics				TOTAL	Difficulty Levels		
		1	2	3	4	Mechanics ≈ 65 Marks	Waves,Sound & Light ≈ 15 Marks	Electricity & Magnetism 55 Marks	Matter & Materials ≈ 15 Marks		Easy	Moderate	Difficult
1.1	2	2				2				2	2		
1.2	2			2		2				2	2		
1.3	2			2		2				2	2		
1.4	2		2			2				2		2	
1.5	2		2			2				2	2		
1.6	2	2					2			2		2	
1.7	2			2				2		2			2
1.8	2				2			2		2			2
1.9	2			2				2		2	2		
1.10	2	2							2	2		2	
Ques 1	**20**	**6**	**4**	**8**	**2**	**10**	**2**	**6**	**2**	**20**	**10**	**6**	**4**
2.1	3		3			3				3	3		
2.2	4				4	4				4			4
2.3.1	1			1		1				1		1	
2.3.2	1			1		1				1		1	
2.4.1	2	2				2				2	2		
2.4.2	3				3	3				3			3
Ques 2	**14**	**2**	**3**	**2**	**7**	**14**	**0**	**0**	**0**	**14**	**5**	**2**	**7**
3.1	2	2				2				2	2		
3.2.1	1		1			1				1	1		
32.2.	2		2			2				2		2	
3.2.3	2			2		2				2			2
3.3.1	3		3			3				3		3	
3.3.2	3			3		3				3		3	
3.4	2		2			2				2		2	
3.5	1			1		1				1			1
Ques 3	**16**	**2**	**8**	**6**	**0**	**16**	**0**	**0**	**0**	**16**	**3**	**10**	**3**
4.1	2	2				2				2	2		
4.2	3		3			3				3		3	
4.3	3		3			3				3		3	
4.4	3			3		3				3		3	
Ques 4	**11**	**2**	**6**	**3**	**0**	**11**	**0**	**0**	**0**	**11**	**2**	**9**	**0**
5.1	2	2				2				2	2		
5.2	4		4			4				4		4	
5.3	3			3		3				3			3
5.4	1		1			1				1		1	
5.5	4			4		4				4			4
Ques 5	**14**	**2**	**5**	**7**	**0**	**14**	**0**	**0**	**0**	**14**	**2**	**5**	**7**
6.1	2	2					2			2	2		
6.2	2			2			2			2			2
6.3	2		2				2			2		2	
6.4	5		5				5			5		5	
6.5	2			2			2			2	2		
Ques 6	**13**	**2**	**7**	**4**	**0**	**0**	**13**	**0**	**0**	**13**	**4**	**7**	**2**
7.1	2	2						2		2	2		
7.2	3			3				3		3		3	
7.3.1	3			3				3		3			3
7.3.2	3		3					3		3		3	

SUBJECT: PHYSICAL SCIENCES PAPER 1   **GRADE 12**

ANALYSIS GRID   **SEPTEMBER 2022**

QUESTION	Mark	1	2	3	4	Mechanics ≈ 65Marks	Waves, Sound & Light ≈ 15 Marks	Electricity & Magnetism ≈ 55 Marks	Matter & Materials ≈ 15 Marks	TOTAL	Easy	Moderate	Difficult
7.4.1	3				3			3		3		3	
Ques 7	**14**	**2**	**3**	**6**	**3**	**0**	**0**	**14**	**0**	**14**	**2**	**9**	**3**
8.1	2	2						2		2	2		
8.2	1			1				1		1		1	
8.3	2		2					2		2		2	
8.4.1	4			4				4		4			4
8.4.2	3			3				3		3			3
8.5	4		4					4		4		4	
Ques 8	**16**	**2**	**6**	**8**	**0**	**0**	**0**	**16**	**0**	**16**	**2**	**7**	**7**
9.1.1	3			3				3		3	3		
9.1.2	1	1						1		1	1		
9.2	2		2					2		2		2	
9.3	1				1			1		1	1		
9.4	1		1					1		1	1		
9.5	1			1				1		1			1
9.6.1	3			3				3		3		3	
9.6.2	5			5				5		5			5
9.6.3	2			2				2		2	2		
Ques 9	**19**	**1**	**3**	**14**	**1**	**0**	**0**	**19**	**0**	**19**	**8**	**5**	**6**
10.1	1		1						1	1			1
10.2	5		5						5	5			5
10.3.1	2	2							2	2	2		
10.3.2	3			3					3	3	3		
10.3.3	2				2				2	2		2	
Ques 10	**13**	**2**	**6**	**3**	**2**	**0**	**0**	**0**	**13**	**13**	**5**	**2**	**6**
SUMMARY													
QUES 1	20	6	4	8	2	10	2	6	2	20	10	6	4
QUES 2	14	2	3	2	7	14	0	0	0	14	5	2	7
QUES 3	16	2	8	6	0	16	0	0	0	16	3	10	3
QUES 4	11	2	6	3	0	11	0	0	0	11	2	9	0
QUES 5	14	2	5	7	0	14	0	0	0	14	2	5	7
QUES 6	13	2	7	4	0	0	13	0	0	13	4	7	2
QUES 7	14	2	3	6	3	0	0	14	0	14	2	9	3
QUES 8	16	2	6	8	0	0	0	16	0	16	2	7	7
QUES 9	19	1	3	14	1	0	0	19	0	19	8	5	6
QUES 10	13	2	6	3	2	0	0	0	13	13	5	2	6
Total mark	150	23	51	61	15	65	15	55	15	150	43	62	45
Norm mark	150	22,5	52,5	60	15	65	15	55	15	150	45	60	45
Total %	100	15	34	41	10	100	100	100	100	100	29	41	30
Norm %	100	15	35	40	10					0	30	40	30