



## NATIONAL SENIOR CERTIFICATE

**GRADE 12**

**SEPTEMBER 2021**

**PHYSICAL SCIENCES P1**

Stanmorephysics.com

**MARKS:** 150

**TIME:** 3 hours

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This question paper consists of 19 pages, including 3 data sheets.

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**INSTRUCTIONS AND INFORMATION**

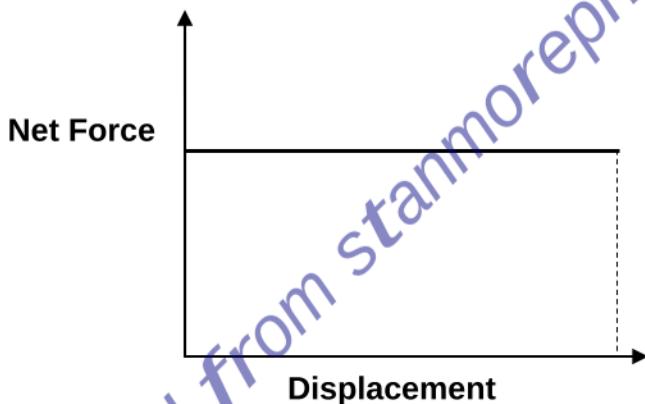
1. Write your full NAME and SURNAME in the appropriate space on the ANSWER BOOK.
2. The question paper consists of TEN questions. Answer ALL the questions.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question 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. Show ALL formulae and substitutions in ALL calculations.
9. Round off your FINAL numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions, etc. where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 E.

- 1.1 The impulse delivered by a net force acting on an object is equal to the ...
- A initial momentum of the object.
  - B final momentum of the object.
  - C change in momentum of the object.
  - D rate of change in momentum of the object. (2)

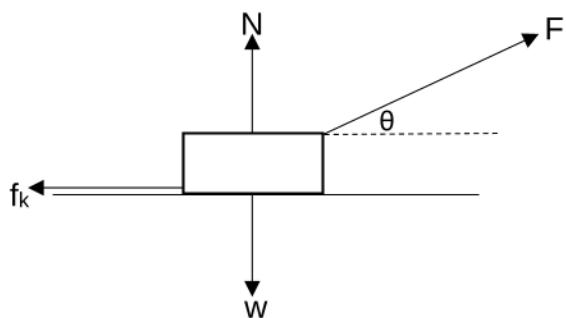
- 1.2 The graph below represents the relationship between the net force exerted on an object and the displacement it undergoes. The force and displacement are in the same direction.



Which ONE of the following statements can be deduced from the graph?

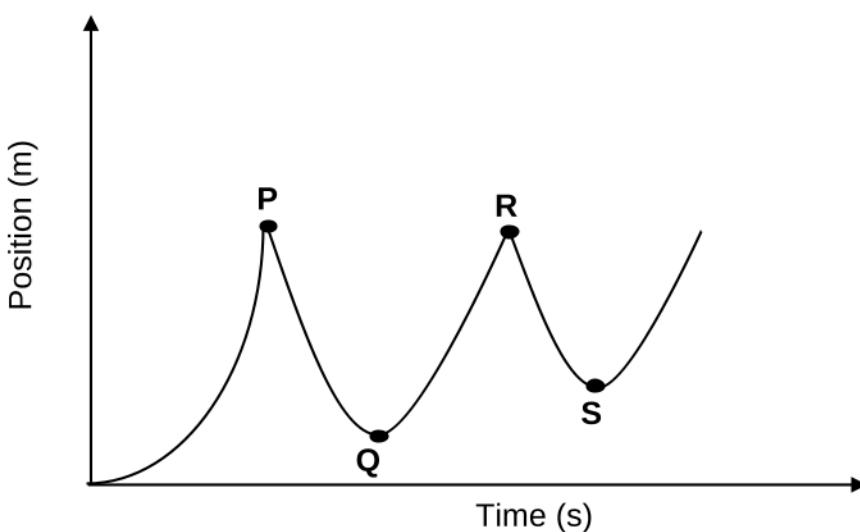
- A The area between the graph and the displacement axis represents the net work done by the force.
- B The area between the graph and the displacement axis represents the power dissipated by the force.
- C The gradient of the graph represents the change in kinetic energy of the object.
- D The gradient of the graph represents the work done by the force. (2)

- 1.3 The diagram below shows all the forces acting on an object being pulled to the right by a force  $F$  acting at an angle  $\theta$  to the horizontal.



Which ONE of the following expressions can be used to determine the magnitude of the kinetic frictional force ( $f_k$ ) acting on the object?

- A  $\mu(w + F\sin\theta)$
  - B  $\mu(w - F\sin\theta)$
  - C  $\mu(N - w)$
  - D  $\mu w$
- (2)
- 1.4 The position-time graph below represents the motion of a ball from the instant it is released from rest from a certain height above the floor and bounces off the floor a number of times. Ignore the effects of air resistance.



Which point (P, Q, R or S) on the graph represents the position-time coordinates of the maximum height reached by the ball after the SECOND bounce?

- A P
  - B Q
  - C R
  - D S
- (2)

- 1.5 The kinetic energy of a car moving at velocity  $v$  is  $K$ . The velocity of the car changes to  $2v$ . What is the new kinetic energy of the car?

A  $\frac{1}{4}K$

B  $\frac{1}{2}K$

C  $2K$

D  $4K$

(2)

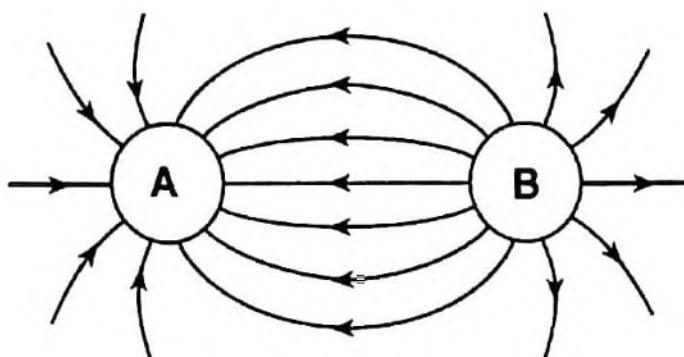
- 1.6 A sound source approaches a stationary observer at constant velocity.

Which ONE of the following describes how the observed frequency and wavelength differ from that of the sound source?

	<b>Observed wavelength</b>	<b>Observed frequency</b>
A	Greater than	Greater than
B	Less than	Less than
C	Less than	Greater than
D	Greater than	Less than

(2)

- 1.7 The electric field pattern between two charged spheres, **A** and **B**, is shown below.



Which ONE of the following statements regarding the charge on spheres **A** and **B** is CORRECT?

A Sphere **A** is negatively charged, and sphere **B** is positively charged.

B Sphere **A** is positively charged, and sphere **B** is negatively charged.

C Spheres **A** and **B** are both positively charged.

D Spheres **A** and **B** are both negatively charged.

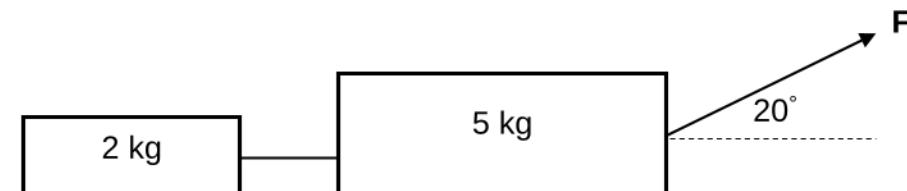
(2)

- 1.8 The SI unit of measurement of the RATE OF FLOW OF CHARGE in a conductor is ...
- A watt.
  - B volt.
  - C ampere.
  - D coulomb.
- (2)
- 1.9 Which ONE of the following changes to the design of an AC generator will increase its maximum emf output?
- A Change the polarity of the magnets
  - B Use larger slip rings
  - C Use larger brushes
  - D Increase the number of turns on the coil
- (2)
- 1.10 A line emission spectrum is formed when ...
- A electrons in the ground state move to a higher energy state.
  - B electrons in the higher energy state move to a lower energy state.
  - C white light passes through a cold gas.
  - D white light passes through a triangular prism.
- (2)  
**[20]**

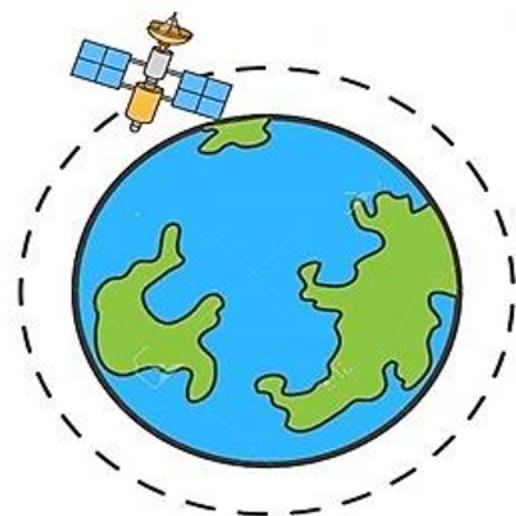
**QUESTION 2**

- 2.1 Two blocks of masses 2 kg and 5 kg are connected by means of a light inextensible string. The blocks are pulled along a rough horizontal surface by a force,  $\mathbf{F}$ . The force makes an angle of  $20^\circ$  with the horizontal. Refer to the diagram below.

The 2 kg and 5 kg blocks experience kinetic frictional forces of 10 N and 15 N respectively.



- 2.1.1 State Newton's Second Law of motion in words. (2)
- 2.1.2 Draw a labelled free-body diagram for the 5 kg block. (5)
- 2.1.3 Calculate the magnitude of force  $\mathbf{F}$  that must be applied at an angle of  $20^\circ$  to the horizontal to make the two blocks accelerate at  $2 \text{ m.s}^{-2}$  to the right. (5)
- 2.2 The earth exerts a force of 1 842,50 N to keep a satellite of mass 200 kg in orbit around the earth as shown in the diagram below.



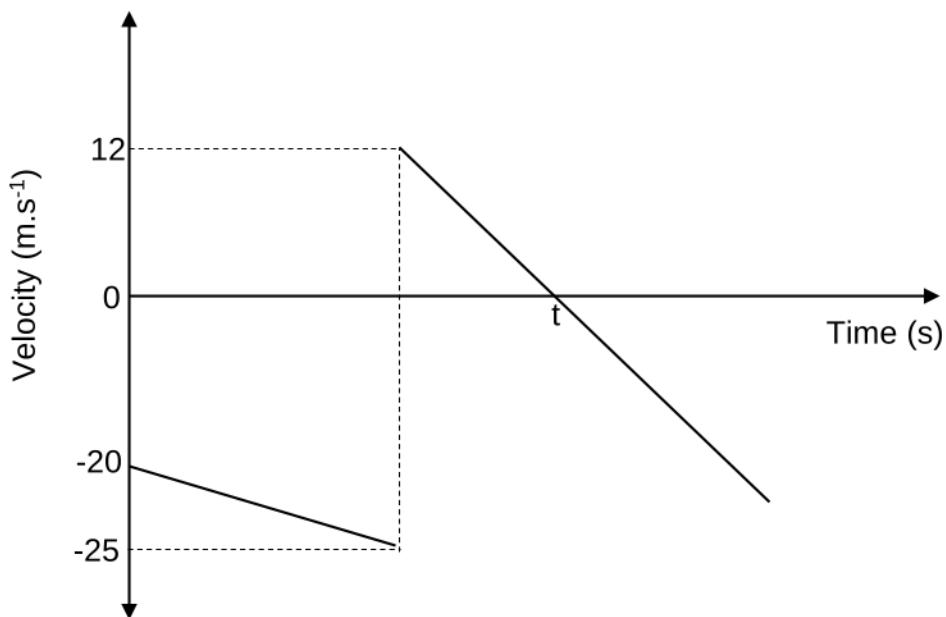
Calculate the distance, above the EARTH'S SURFACE at which the satellite orbits the earth.

(5)  
[17]

**QUESTION 3**

The velocity versus time graph below shows the motion of a ball thrown **vertically downwards** from the top of a building and bouncing off the floor as it hits the ground.

Ignore the effects of air friction. TAKE UPWARD MOTION AS POSITIVE.



3.1 Using EQUATIONS OF MOTION ONLY, calculate the:

3.1.1 Height from which the ball is thrown (3)

3.1.2 Time  $t$  on the graph (5)

3.1.3 Magnitude of the displacement of the ball from the moment it is thrown until time  $t$  (4)

3.2 Sketch a position versus time graph for the motion of the ball from the moment it is thrown until it reaches its maximum height after the bounce.  
USE THE GROUND AS THE ZERO POSITION.

Indicate the following on the graph:

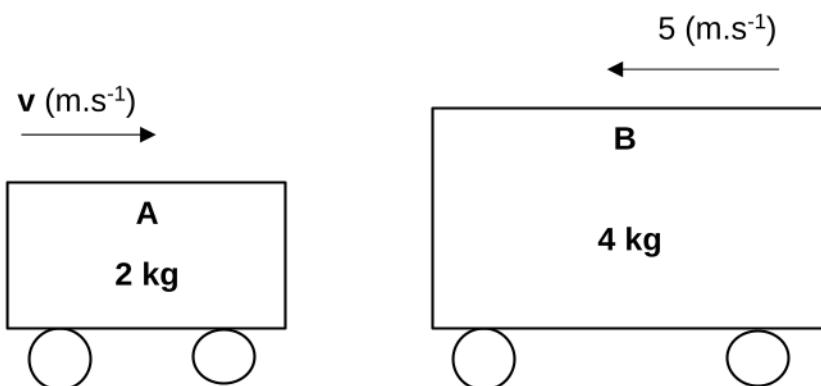
- The height from which the ball is thrown
- Time  $t$

(3)  
[15]

**QUESTION 4**

The diagram below shows trolley A of mass 2 kg travelling at a velocity of  $v \text{ m}\cdot\text{s}^{-1}$  east on a straight horizontal surface colliding head-on with trolley B of mass 4 kg travelling at a velocity of  $5 \text{ m}\cdot\text{s}^{-1}$  west.

After the collision, the two trolleys stick together and move at a velocity of  $1,67 \text{ m}\cdot\text{s}^{-1}$  west. The collision lasted for 0,01 s. Ignore the effects of friction.



4.1 State the principle of conservation of linear momentum in words. (2)

4.2 Calculate the:

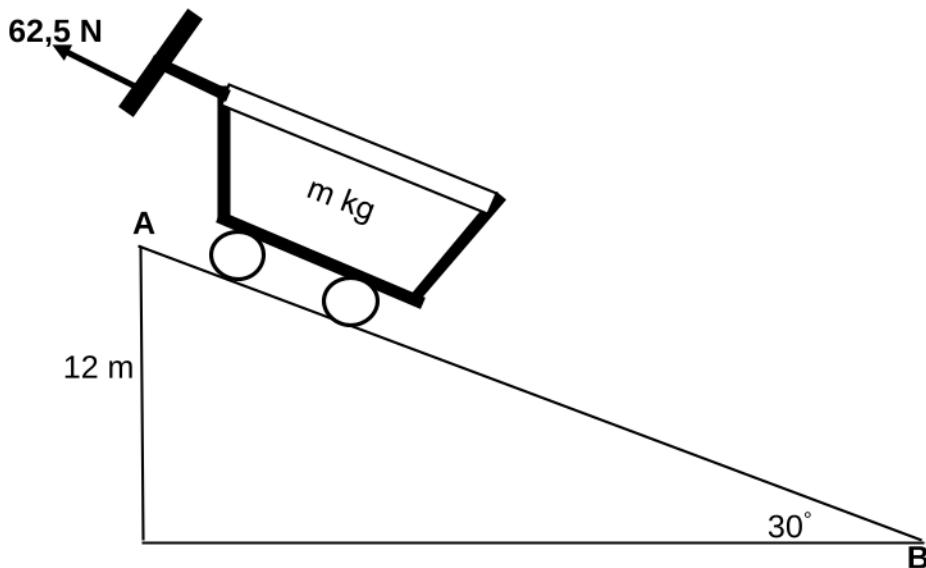
4.2.1 Magnitude of the velocity  $v$  of the trolley A before it collided with trolley B (4)

4.2.2 Force that trolley B exerts on trolley A (4)  
[10]

**QUESTION 5**

A force of 62,5 N is applied to a trolley of mass  $m$  kg parallel to the inclined surface as shown to keep it moving down an inclined surface at a CONSTANT VELOCITY. The vertical height of the inclined surface is 12 m. Refer to the diagram below.

A kinetic frictional force of 35,5 N acts on the trolley as it moves down the inclined surface.



- 5.1 Write down the name of the conservative force acting on the trolley. (1)
- 5.2 Calculate the work done by the frictional force on the trolley. (4)
- 5.3 Write down the change in kinetic energy when the trolley reaches the bottom of the inclined surface. (1)
- 5.4 Use the work-energy theorem to calculate the mass,  $m$ , of the trolley. (5)  
**[11]**

**QUESTION 6**

6.1 A stationary sound detector placed at a certain point records 520 sound waves per second from a moving sound source which emits sound waves of frequency 480 Hz.

6.1.1 Write down the frequency of the sound waves that the detector records in Hz. (1)

6.1.2 Define the phenomenon which explains the change in frequency observed. (2)

6.1.3 Is the sound source moving TOWARDS or AWAY from the observer? Give a reason for your answer. (2)

6.1.4 Calculate the velocity at which the sound source is moving. Take velocity of sound as  $343 \text{ m}\cdot\text{s}^{-1}$ . (5)

6.1.5 How would the wavelength of the sound wave produced by the sound source change if the frequency of the sound waves become higher than 480 Hz?

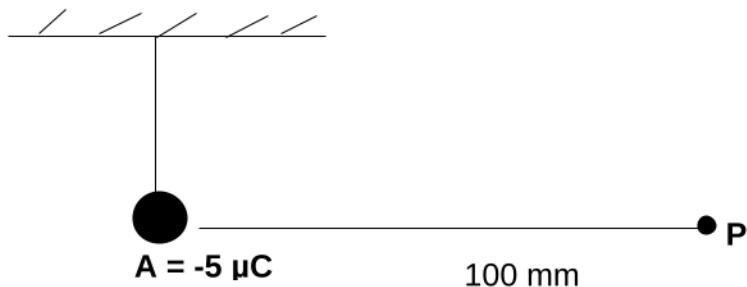
Write down only INCREASES, DECREASES or STAYS THE SAME. Explain your answer using the wave equation. (2)

6.2 The spectral lines from a distant star are observed to be red shifted. Explain the underlined term. (2)

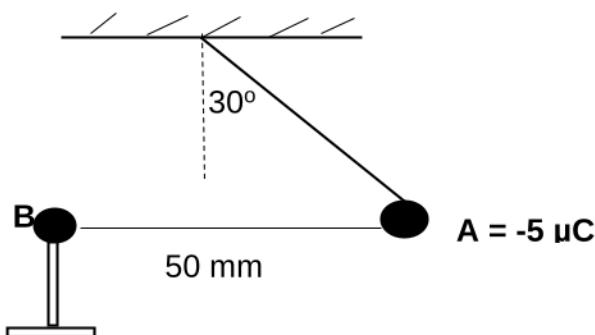
6.3 Write down ONE application of the Doppler effect in the field of medicine. (1)  
[15]

**QUESTION 7**

- 7.1 A small sphere **A** carrying a charge of  $-5 \mu\text{C}$  hangs vertically from a ceiling by means of an inextensible string. Point **P** is 100 mm to the right of sphere **A** as shown on the **Diagram 1** below.

**DIAGRAM 1**

- 7.1.1 Did charged sphere **A** LOSE or GAIN electrons to acquire a charge of  $-5 \mu\text{C}$ ? (1)
- 7.1.2 Calculate the number of electrons lost or gained by charged sphere **A**, to acquire a charge of  $-5 \mu\text{C}$ . (3)
- 7.1.3 Calculate the electric field at point **P**, due to charged sphere **A**. (5)
- 7.2 An identical sphere **B** carrying an unknown charge placed on an insulated stand is brought closer to sphere **A**. Charged sphere **A** swings to the right and comes to rest so that the string makes an angle of  $30^\circ$  with the vertical and the tension in the string is 25 N. The distance between the two charged spheres is 50 mm as shown on **Diagram 2** below.

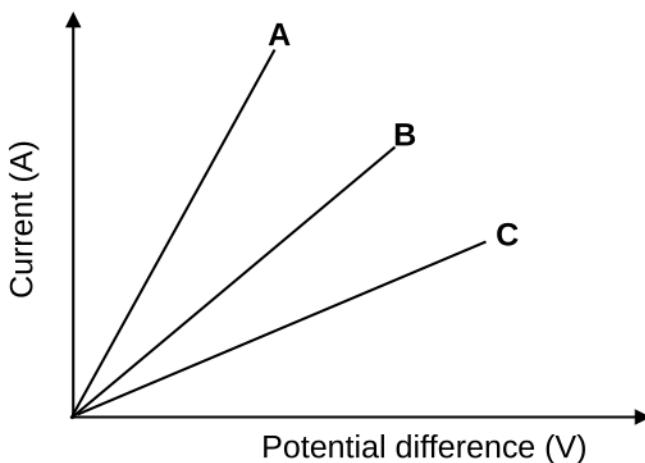
**DIAGRAM 2**

- 7.2.1 Is the charge on sphere **B** POSITIVE or NEGATIVE? Give a reason for your answer. (2)
- 7.2.2 Calculate the magnitude of the charge on sphere **B**. (6)
- [17]

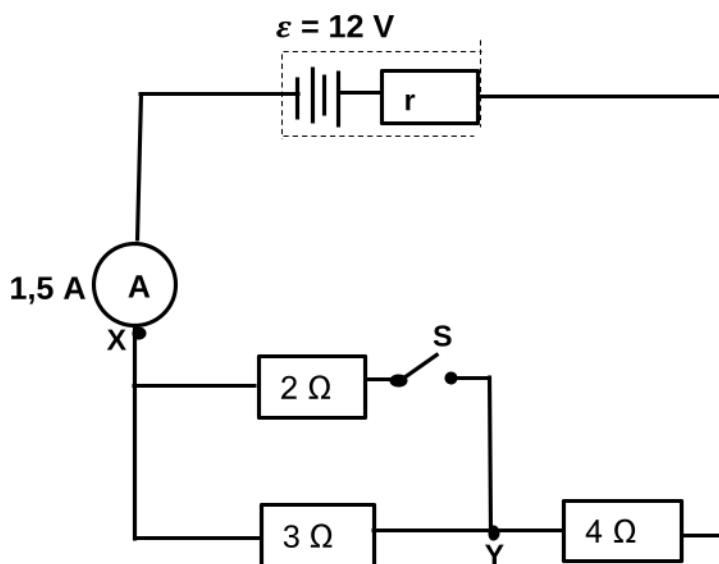
### QUESTION 8

- 8.1 A group of Grade 12 learners want to determine an efficient conductor which can be used as the heating coil for a kettle that they are constructing for their Eskom Expo project.

They connected each of the three conductors (**A**, **B** and **C**) in a circuit and measured the current passing through the conductor and the potential difference across the conductors. Their results are as shown on the graph below.



- 8.1.1 Name any TWO variables that must be kept constant for a fair investigation. (2)
- 8.1.2 Write down the physical quantity represented by the gradient of each graph. (1)
- 8.1.3 Which ONE of the conductors is efficient enough to be used as a heating coil in a kettle? Give a reason for your answer. (2)
- 8.2 The circuit diagram below represents a combination of resistors in series and parallel. The battery has an emf of 12 V and an unknown internal resistance  $r$ .



With switch **S** OPEN, the reading on ammeter **A** is 1,5 A. Calculate the:

8.2.1 Total resistance of the circuit (3)

8.2.2 Internal resistance of the battery (4)

8.2.3 Energy dissipated by the  $3\ \Omega$  resistor in 3 minutes (3)

8.3 Switch **S** is now CLOSED.

How will EACH of the following be affected? Write down only INCREASES, DECREASES or REMAINS THE SAME.

8.3.1 The total resistance of the circuit. (1)

8.3.2 The reading on ammeter **A**. (1)

8.4 A conducting wire of negligible resistance is now connected between points **X** and **Y** as shown on the diagram above. What effect will this have on the temperature of the battery?

Write down only INCREASES, DECREASES or REMAINS THE SAME. Explain your answer. (3)

[20]

### QUESTION 9

AC generators at coal-fired power stations supply most of the electrical energy needed in our country.

- 9.1 State the energy conversion that takes place when this generator is in operation. (2)
- 9.2 State ONE structural difference between an AC generator and a DC generator. (1)
- 9.3 Draw a sketch graph of potential difference versus time for this AC generator. Clearly label the axes and indicate  $V_{\max}$  on the potential difference axis. (2)

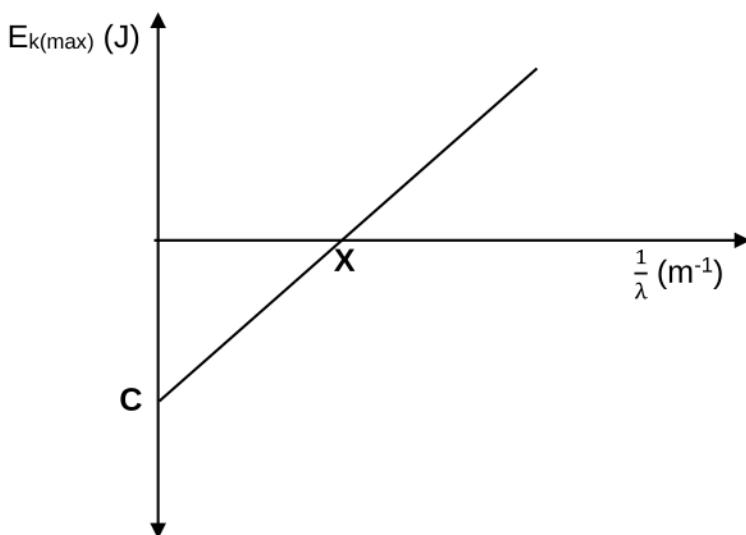
An electric appliance is rated 2 000 W, 230 V. The appliance is connected to an alternating current power source.

Calculate the:

- 9.4 Maximum current ( $I_{\max}$ ) produced by the generator (4)
- 9.5 Peak voltage ( $V_{\max}$ ) output of the generator (3)  
[12]

**QUESTION 10**

A group of learners conducted an experiment to determine the relationship between the inverse of wavelength ( $\frac{1}{\lambda}$ ) of incident photons on a metal and the maximum kinetic energy ( $E_{k(\max)}$ ) of emitted photoelectrons from the metal plate surface. They presented their results as shown on the graph below.



- 10.1 Which physical quantity is represented by the letter **C** (the intercept on the vertical axis) on the graph? Use a suitable equation to explain the answer. (3)
- 10.2 Light photons of frequency of  $6,16 \times 10^{14}$  Hz are incident on a metal plate and photoelectrons are released with maximum kinetic energy of  $5,6 \times 10^{-20}$  J.  
Calculate the magnitude of the physical quantity represented by the letter **X** on the graph. (5)
- 10.3 The brightness of the incident light is now increased. What effect will this change have on the following? (Write down only INCREASES, DECREASES or REMAINS THE SAME.)

  - 10.3.1 The gradient of the graph. Explain your answer. (2)
  - 10.3.2 The maximum kinetic energy of the released photoelectrons.  
Draw a graph of the relationship between brightness of incident photons and maximum kinetic energy of photoelectrons to explain your answer. (3)

[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	$9,8 \text{ m}\cdot\text{s}^{-2}$
Universal gravitational constant / Universele gravitasiekonstante	G	$6,67 \times 10^{-11} \text{ N}\cdot\text{m}^2\cdot\text{kg}^{-2}$
Speed of light in a vacuum / Spoed van lig in 'n vakuum	c	$3,0 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
Planck's constant / Planck se konstante	h	$6,63 \times 10^{-34} \text{ J}\cdot\text{s}$
Coulomb's constant / Coulomb se konstante	k	$9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$
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 earth / Massa op aarde	M	$5,98 \times 10^{24} \text{ kg}$
Radius of earth / Radius van aarde	$R_E$	$6,38 \times 10^3 \text{ km}$

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

**FORCE/KRAG**

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$W = mg$
$F = \frac{G m_1 m_2}{d^2}$	$g = G \frac{M}{d^2}$

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

$W = F \Delta x \cos \theta$	$U = mgh$ or/of $E_P = mgh$
$K = \frac{1}{2} mv^2$ or/of $E_k = \frac{1}{2} mv^2$	$W_{net} = \Delta K$ 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 $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = F v_{ave}$	

**ELECTROSTATICS/ELEKTROSTATIKA**

$F = \frac{k Q_1 Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{V}{d}$	$E = \frac{F}{q}$
$V = \frac{W}{q}$	$n = \frac{Q}{q_e}$

**ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE**

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

**ALTERNATING CURRENT/WISSELSTROOM**

$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}}$ / $I_{\text{wgk}} = \frac{I_{\text{maks}}}{\sqrt{2}}$	$P_{\text{average}} = V_{\text{rms}} I_{\text{rms}}$ / $P_{\text{gemiddeld}} = V_{\text{wgk}} I_{\text{wgk}}$
$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$ / $V_{\text{wgk}} = \frac{V_{\text{maks}}}{\sqrt{2}}$	$P_{\text{average}} = I_{\text{rms}}^2 R$ / $P_{\text{gemiddeld}} = I_{\text{wgk}}^2 R$

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

$v = f \lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/of $E = h \frac{c}{\lambda}$
$E = W_o + E_k$ where/waar $E = hf$ and/en $W_0 = hf_0$ and/en $E_k = \frac{1}{2}mv^2$ or/of $K_{\text{max}} = \frac{1}{2}mv_{\text{max}}^2$	



**NATIONAL  
SENIOR CERTIFICATE/  
NASIONALE SENIOR  
SERTIFIKAAT**

**GRADE/GRAAD 12**

**SEPTEMBER 2021**

**PHYSICAL SCIENCES P1/  
FISIESE WETENSKAPPE V1  
MARKING GUIDELINE/NASIENRIGLYN**

**MARKS/PUNTE:** 150

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This marking guideline consists of 17 pages./  
*Hierdie nasienriglyn bestaan uit 17 bladsye.*

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**GENERAL GUIDELINES/ALGEMENE RIGLYNE****1. CALCULATIONS/BEREKENINGE**

- 1.1 **Marks will be awarded for:** correct formula, correct substitution, correct answer with unit.  
**Punte sal toegeken word vir:** korrekte formule, korrekte substitusie, korrekte antwoord met eenheid.
- 1.2 **No marks** will be awarded if an **incorrect or inappropriate formula is used**, even though there are many relevant symbols and applicable substitutions.  
**Geen punte** sal toegeken word waar 'n **verkeerde of ontoepaslike formule gebruik** word nie, selfs al is daar relevante simbole en relevante substitusies.
- 1.3 When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.  
*Wanneer 'n fout gedurende **substitusie in 'n korrekte formule** begaan word, sal 'n punt vir die korrekte formule en vir korrekte substitusies toegeken word, maar **geen verdere punte** sal toegeken word nie.*
- 1.4 If **no formula** is given, but **all substitutions are correct**, a candidate will forfeit one mark.  
*Indien **geen formule** gegee is nie, maar **al die substitusies is korrek**, verloor die kandidaat **een punt**.*
- 1.5 No penalisation if **zero substitutions are omitted** in calculations where **correct formula/principle** is correctly given.  
*Geen penalisering indien **nulwaardes nie getoon** word nie in berekening waar die **formule/beginsel korrek gegee is nie**.*
- 1.6 Mathematical manipulations and change of subject of appropriate formulae carry no marks, but if a candidate starts off with the correct formula and then changes the subject of the formula incorrectly, marks will be awarded for the formula and correct substitutions. The mark for the incorrect numerical answer is forfeited.  
*Wiskundige manipulasies en verandering van die onderwerp van toepaslike formules tel geen punte nie, maar indien 'n kandidaat met die korrekte formule begin en dan die onderwerp van die formule verkeerd verander, sal die punte vir die formule en korrekte substitusies toegeken word. Die punt vir die verkeerde numeriese antwoord word verbeur.*
- 1.7 Marks are only awarded for a formula if a **calculation has been attempted**, i.e. substitutions have been made or a numerical answer given.  
*Punte word slegs vir 'n formule toegeken indien 'n **poging tot berekening aangewend** is, d.w.s. substitusies is gedoen of 'n numeriese antwoord is gegee.*

- 1.8 Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.  
*Punte kan slegs toegeken word vir substitusies wanneer waardes in formules ingestel word en nie vir waardes wat voor 'n berekening gelys is nie.*
- 1.9 All calculations, when not specified in the question, must be done to a minimum of two decimal places.  
*Alle berekenings, wanneer nie in die vraag gespesifieer word nie, moet tot 'n minimum van twee desimale plekke gedoen word.*
- 1.10 If a final answer to a calculation is correct, full marks will not automatically be awarded. Markers will always ensure that the correct/appropriate formula is used and that workings, including substitutions, are correct.  
*Indien 'n finale antwoord van 'n berekening korrek is, sal volpunte nie automaties toegeken word nie. Nasieners sal altyd verseker dat die korrekte/toepaslike formule gebruik word en dat bewerkings, insluitende substitusies korrek is.*
- 1.11 Questions where a series of calculations have to be made (e.g. a circuit diagram question) do not necessarily always have to follow the same order. FULL MARKS will be awarded provided it is a valid solution to the problem. However, any calculation that will not bring the candidate closer to the answer than the original data, will not count any marks.  
*Vrae waar 'n reeks berekeninge gedoen moet word (bv. 'n stroombaan-diagramvraag) hoef nie noodwendig dieselfde volgorde te hê nie.*  
*VOLPUNTE sal toegeken word op voorwaarde dat dit 'n geldige oplossing vir die probleem is. Enige berekening wat egter nie die kandidaat nader aan die antwoord as die oorspronklike data bring nie, sal geen punte tel nie.*

## 2. UNITS/EENHEDE

- 2.1 Candidates will only be penalised once for the repeated use of an incorrect unit **within a question**.  
*Kandidate sal slegs een keer gepenaliseer word vir die herhaalde gebruik van 'n verkeerde eenheid **in 'n vraag**.*
- 2.2 Units are only required in the final answer to a calculation.  
*Eenhede word slegs in die finale antwoord op 'n vraag verlang.*
- 2.3 Marks are only awarded for an answer, and not for a unit *per se*. Candidates will therefore forfeit the mark allocated for the answer in each of the following situations:
  - Correct answer + wrong unit
  - Wrong answer + correct unit
  - Correct answer + no unit*Punte sal slegs vir 'n antwoord en nie vir 'n eenheid per se toegeken word nie. Kandidate sal die punt vir die antwoord in die volgende gevalle verbeur:*
  - Korrekte antwoord + verkeerde eenheid
  - Verkeerde antwoord + korrekte eenheid
  - Korrekte antwoord + geen eenheid

- 2.4 SI units must be used except in certain cases, e.g.  $V \cdot m^{-1}$  instead of  $N \cdot C^{-1}$ , and  $cm \cdot s^{-1}$  or  $km \cdot h^{-1}$  instead of  $m \cdot s^{-1}$  where the question warrants this.  
*SI-eenhede moet gebruik word, behalwe in sekere gevalle, bv.  $V \cdot m^{-1}$  in plaas van  $N \cdot C^{-1}$ , en  $cm \cdot s^{-1}$  of  $km \cdot h^{-1}$  in plaas van  $m \cdot s^{-1}$  waar die vraag dit regverdig.*

### 3. GENERAL/ALGEMEEN

- 3.1 If one answer or calculation is required, but two are given by the candidate, only the first one will be marked, irrespective of which one is correct. If two answers are required, only the first two will be marked, etc.  
*Indien een antwoord of berekening verlang word, maar twee word deur die kandidaat gegee, sal slegs die eerste een nagesien word, ongeag watter een korrek is. Indien twee antwoorde verlang word, sal slegs die eerste twee nagesien word, ens.*
- 3.2 For marking purposes, alternative symbols (s, u, t, etc.) will also be accepted.  
*Vir nasiendoeleindes sal alternatiewe simbole (s, u, t, ens.) ook aanvaar word.*
- 3.3 Separate compound units with a multiplication dot, not a full stop, for example,  $m \cdot s^{-1}$ .  
For marking purposes,  $m \cdot s^{-1}$  and  $m/s$  will also be accepted.  
*Skei saamgestelde eenhede met 'n vermenigvuldigingspunt en nie met 'n punt nie, byvoorbeeld  $m \cdot s^{-1}$ . Vir nasiendoeleindes sal  $m \cdot s^{-1}$  en  $m/s$  ook aanvaar word.*

### 4. POSITIVE MARKING/POSITIEWE NASIEN

Positive marking regarding calculations will be followed in the following cases:  
*Positiewe nasien met betrekking tot berekeninge sal in die volgende gevalle geld:*

- 4.1 **Sub-question to sub-question:** When a certain variable is calculated in one sub-question (e.g. 3.1) and needs to be substituted in another (3.2 or 3.3), e.g. if the answer for 3.1 is incorrect and is substituted correctly in 3.2 or 3.3, **full marks** are to be awarded for the subsequent sub-questions.  
**Subvraag na subvraag:** Wanneer 'n sekere veranderlike in een subvraag (bv. 3.1) bereken word en dan in 'n ander vervang moet word (3.2 of 3.3), bv. indien die antwoord vir 3.1 verkeerd is en word korrek in 3.2 of 3.3 vervang, word **volpunte** vir die daaropvolgende subvraag toegeken.
- 4.2 **A multistep question of a sub-question:** If the candidate has to calculate, for example, current in die first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer will be forfeited.  
**'n Vraag met veelvuldige stappe in 'n subvraag:** Indien 'n kandidaat bv. die stroom verkeerd bereken in 'n eerste stap as gevolg van 'n substitusiefout, verloor die kandidaat die punt vir die substitusie sowel as die finale antwoord.

## 5. NEGATIVE MARKING/NEGATIEWE NASIEN

Normally an incorrect answer cannot be correctly motivated if based on a conceptual mistake. If the candidate is therefore required to motivate in QUESTION 3.2 the answer given in QUESTION 3.1, and QUESTION 3.1 is incorrect, no marks can be awarded for QUESTION 3.2. However, if the answer for e.g. QUESTION 3.1 is based on a calculation, the motivation for the incorrect answer could be considered. *'n Verkeerde antwoord, indien dit op 'n konsepsuele fout gebaseer is, kan normaalweg nie korrek gemotiveer word nie. Indien 'n kandidaat gevra word om in VRAAG 3.2 die antwoord op VRAAG 3.1 te motiveer en VRAAG 3.1 is verkeerd, kan geen punte vir VRAAG 3.2 toegeken word nie. Indien die antwoord op bv. VRAAG 3.1 egter op 'n berekening gebaseer is, kan die motivering vir die verkeerde antwoord in VRAAG 3.2 oorweeg word.*

**QUESTION/VRAAG 1: MULTIPLE-CHOICE QUESTIONS/  
MEERVOUDIGEKEUSE-VRAE**

- 1.1 C ✓✓ (2)  
1.2 A ✓✓ (2)  
1.3 B ✓✓ (2)  
1.4 D ✓✓ (2)  
1.5 D ✓✓ (2)  
1.6 C ✓✓ (2)  
1.7 A ✓✓ (2)  
1.8 C ✓✓ (2)  
1.9 D ✓✓ (2)  
1.10 B ✓✓ (2)  
**[20]**

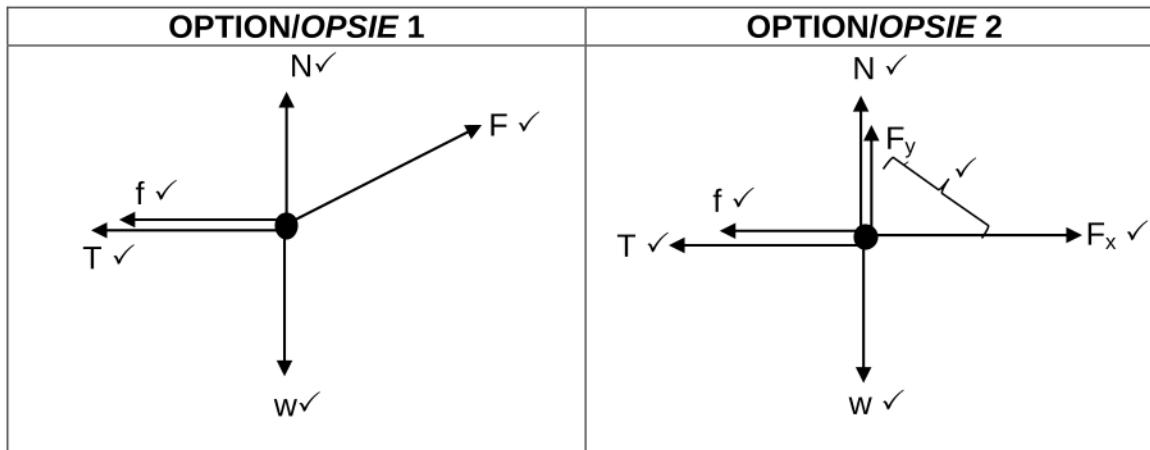
**QUESTION/VRAAG 2**

- 2.1.1 When a (non-zero) resultant/net force acts on an object, it accelerates in the direction of the force. The acceleration is directly proportional to the force and inversely proportional to the mass of the object. ✓✓

*Indien 'n (nie-nul) resultante/netto krag op 'n voorwerp inwerk, versnel dit in die rigting van die krag. Die versnelling is direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp. ✓✓*

(2)

- 2.1.2



(5)

**Accept the following symbols./Aanvaar die volgende simbole:**

N ✓	$F_N$ /Normal/Normaal/Normal force/Normaal krag
f ✓	$F_f$ / $f_k$ / $f_r$ / frictional force/wrywingskrag/kinetic frictional force / kinetiese wrywingskrag
w ✓	$F_g$ , $mg$ /weight/ $F_{\text{Earth on block}}$ /49 N/gravitational force/gewig/ $F_{\text{aarde op blok}}$ /gravitasiekrag
T ✓	Tension / Spanning / $F_T$ / $F_s$
$F_{\text{applied/toegepas}}$ ✓	F / $F_A$ / Applied force / Toegepaste krag

Marks awarded for arrow and label/Punte toegeken vir pyltjie en byskrif.

Do not penalise for length of arrows since drawing is not drawn to scale.

*Moenie penaliseer vir pyltjie-lengtes nie (diagram is nie volgens skaal nie).*

Any other additional force(s)/Enige addisionele krag(te)  $\frac{3}{4}$

If force(s) do not make contact with body. Max./Maks.  $\frac{3}{4}$

*Indien krag(te) nie kontak maak met voorwerp nie.*

2.1.3	<b>OPTION/OPSIE 1 (To the right is positive) (Na regs positief)</b>	<b>OPTION/OPSIE 2 (To the right is negative) (Na regs negatief)</b>
	$F_{net} = ma$ $T - f = ma$ $F \cos \theta - T - f = ma$ $\underline{T - 10 = 2(2)} \checkmark$ $T = 14 \text{ N}$ $F \cos \theta - T - f = ma$ $F \cos 20^\circ - 14 - 15 \checkmark = 5(2) \checkmark$ $F = 41,50 \text{ N } \checkmark$	$F_{net} = ma$ $f - T = -ma$ $T + f - F \cos \theta = -ma$ $\underline{10 - T = 2(-2)} \checkmark$ $T = 14 \text{ N}$ $T + f - F \cos \theta = -ma$ $14 + 15 - F \cos 20^\circ \checkmark = 5(-2) \checkmark$ $F = 41,50 \text{ N } \checkmark$

(5)

2.2  $F = \frac{Gm_1 m_2}{d^2} \checkmark$   
 $1\ 842,50 \checkmark = \frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(200)}{d^2} \checkmark$   
 $d = 6\ 579\ 982,80 \text{ m}$

distance above earth surface/afstand bo die aardoppervlak =  
 $6\ 579\ 982,80 - 6,38 \times 10^6 \checkmark$   
 $= 199\ 982,80 \text{ m } (1,9998280 \times 10^5 \text{ m} / 2,00 \times 10^5 \text{ m}) \checkmark$

(5)

[17]

### QUESTION/VRAAG 3

#### 3.1.1 **OPTION/OPSIE 1**

<b>UPWARDS POSITIVE OPWAARTS POSITIEF</b>	<b>UPWARDS NEGATIVE OPWAARTS NEGATIEF</b>
$v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $(-25)^2 = (-20)^2 + 2(-9,8) \Delta y \checkmark$ $\Delta y = -11,48$ $\Delta y = 11,48 \text{ m } \checkmark$	$v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $(25)^2 = (20)^2 + 2(9,8) \Delta y \checkmark$ $\Delta y = 11,48 \text{ m } \checkmark$

#### OPTION/OPSIE 2

<b>UPWARDS POSITIVE OPWAARTS POSITIEF</b>	<b>UPWARDS NEGATIVE OPWAARTS NEGATIEF</b>
$v_f = v_i + a\Delta t$ $-25 = -20 + (-9,8)(\Delta t)$ $\Delta t = 0,51 \text{ s}$ $\Delta y = v_i \Delta t + \frac{1}{2}g\Delta t^2 \checkmark$ $\Delta y = (-20)(0,51) + \frac{1}{2}(-9,8)(0,51)^2 \checkmark$ $\Delta y = -11,47$ $\Delta y = 11,47 \text{ m } \checkmark$	$v_f = v_i + a\Delta t$ $25 = 20 + (9,8)(\Delta t)$ $\Delta t = 0,51 \text{ s}$ $\Delta y = v_i \Delta t + \frac{1}{2}g\Delta t^2 \checkmark$ $\Delta y = (20)(0,51) + \frac{1}{2}(9,8)(0,51)^2 \checkmark$ $\Delta y = 11,47 \text{ m } \checkmark$

<b>OPTION/OPSIE 3</b>	
<b>UPWARDS POSITIVE OPWAARTS POSITIEF</b>	<b>UPWARDS NEGATIVE OPWAARTS NEGATIEF</b>
$v_f = v_i + a\Delta t$ $-25 = -20 + (-9,8)(\Delta t)$ $\Delta t = 0,51 \text{ s}$ $\Delta y = \frac{v_f + v_i}{2} \Delta t \checkmark$ $\Delta y = \frac{-25 + (-20)}{2} \times 0,51 \checkmark$ $\Delta y = -11,48 \text{ m}$ $\Delta y = 11,48 \text{ m } \checkmark$	$v_f = v_i + a\Delta t$ $25 = 20 + (9,8)(\Delta t)$ $\Delta t = 0,51 \text{ s}$ $\Delta y = \frac{v_f + v_i}{2} \Delta t \checkmark$ $\Delta y = \frac{25 + 20}{2} \times 0,51 \checkmark$ $\Delta y = 11,48 \text{ m } \checkmark$

**OPTION/OPSIE 4 (ACCEPT/AANVAAR)**

<b>UPWARDS POSITIVE OPWAARTS POSITIEF</b>	<b>UPWARDS NEGATIVE OPWAARTS NEGATIEF</b>
$v_f = v_i + a\Delta t$ $-25 = -20 + (-9,8)(\Delta t)$ $\Delta t = 0,51 \text{ s}$ $\Delta y = lb + \frac{1}{2}bh \checkmark$ $\Delta y = 20 \times 0,51 + \frac{1}{2}(5)0,51 \checkmark$ $\Delta y = 11,48 \text{ m } \checkmark$	$v_f = v_i + a\Delta t$ $25 = 20 + (-9,8)(\Delta t)$ $\Delta t = 0,51 \text{ s}$ $\Delta y = lb + \frac{1}{2}bh \checkmark$ $\Delta y = 20 \times 0,51 + \frac{1}{2}(5)0,51 \checkmark$ $\Delta y = 11,48 \text{ m } \checkmark$

(3)

3.1.2

<b>UPWARDS POSITIVE OPWAARTS POSITIEF</b>	<b>UPWARDS NEGATIVE OPWAARTS NEGATIEF</b>
$v_f = v_i + a\Delta t \checkmark$ $-25 = -20 + (-9,8)(\Delta t) \checkmark$ $\Delta t = 0,51 \text{ s}$ (time to reach to ground) <i>(tyd om die grond te bereik)</i> $v_f = v_i + a\Delta t$ $0 = 12 + (-9,8)(\Delta t) \checkmark$ $\Delta t = 1,22 \text{ s}$ (time to reach maximum height) <i>(tyd om maks hoogte te bereik)</i> $t = 1,22 + 0,51 \checkmark$ $t = 1,73 \text{ s } \checkmark$	$v_f = v_i + a\Delta t \checkmark$ $25 = 20 + (-9,8)(\Delta t) \checkmark$ $\Delta t = 0,51 \text{ s}$ (time to reach to ground) <i>(tyd om die grond te bereik)</i> $v_f = v_i + a\Delta t$ $0 = -12 + (9,8)(\Delta t) \checkmark$ $\Delta t = 1,22 \text{ s}$ (time to reach maximum height) <i>(tyd om maks hoogte te bereik)</i> $t = 1,22 + 0,51 \checkmark$ $t = 1,73 \text{ s } \checkmark$

(5)

3.1.3

<b>OPTION/OPSIE 1</b>	
<b>Positive marking from 3.1.1/Positiewe merk vanaf 3.1.1</b>	
<b>UPWARDS POSITIVE OPWAARTS POSITIEF</b>	<b>UPWARDS NEGATIVE OPWAARTS NEGATIEF</b>
$v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $0^2 = 12^2 + 2(-9,8) \Delta y \checkmark$ $\Delta y = 7,35 \text{ m}$ Displacement = <u>-11,48</u> + 7,35 $\checkmark$ Verplasing = -4,13 = 4,13 m (downwards/afwaarts) $\checkmark$	$v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $0^2 = -12^2 + 2(9,8) \Delta y \checkmark$ $\Delta y = -7,35 \text{ m}$ Displacement = <u>11,48</u> + (-7,35) $\checkmark$ Verplasing = 4,13 m (downwards/afwaarts) $\checkmark$

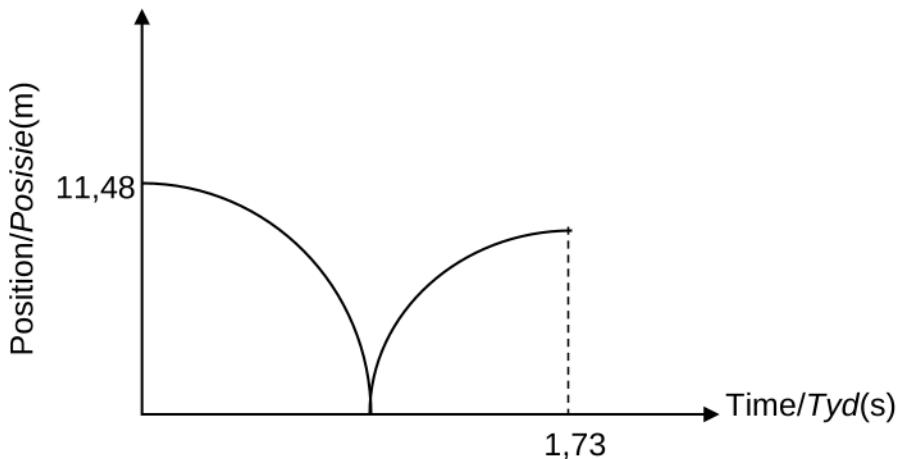
<b>OPTION/OPSIE 2</b>	
<b>Positive marking from 3.1.1/Positiewe merk vanaf 3.1.1</b>	
<b>UPWARDS POSITIVE OPWAARTS POSITIEF</b>	<b>UPWARDS NEGATIVE OPWAARTS NEGATIEF</b>
$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$0 = 12 + (-9,8)(\Delta t)$	$0 = -12 + (9,8)(\Delta t)$
$\Delta t = 1,22 \text{ s}$	$\Delta t = 1,22 \text{ s}$
$\Delta y = v_i \Delta t + \frac{1}{2}a\Delta t^2 \checkmark$	$\Delta y = v_i \Delta t + \frac{1}{2}a\Delta t^2 \checkmark$
$\Delta y = 12 \times 1,22 + \frac{1}{2}(-9,8)(1,22)^2 \checkmark$	$\Delta y = (-12)(1,22) + \frac{1}{2}(9,8)(1,22)^2 \checkmark$
$\Delta y = 7,35 \text{ m}$	$\Delta y = -7,35$
Displacement = <u>- 11,48</u> + 7,35 $\checkmark$	Displacement = <u>11,48</u> + (- 7,35) $\checkmark$
Verplasing = - 4,13	Verplasing = 4,13 m
$= 4,13 \text{ m}$	(downwards/afwaarts) $\checkmark$
(downwards/afwaarts) $\checkmark$	

<b>OPTION/OPSIE 3</b>	
<b>Positive marking from 3.1.1 / Positiewe merk vanaf 3.1.1</b>	
<b>UPWARDS POSITIVE OPWAARTS POSITIEF</b>	<b>UPWARDS NEGATIVE OPWAARTS NEGATIEF</b>
$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$0 = 12 + (-9,8)(\Delta t)$	$0 = -12 + (9,8)(\Delta t)$
$\Delta t = 1,22 \text{ s}$	$\Delta t = 1,22 \text{ s}$
$\Delta y = \frac{v_f + v_i}{2} \Delta t \checkmark$	$\Delta y = \frac{v_f + v_i}{2} \Delta t \checkmark$
$\Delta y = \frac{0 + (12)}{2} \times 1,22 \checkmark$	$\Delta y = \frac{0 + (-12)}{2} \times 1,22 \checkmark$
$\Delta y = 7,32 \text{ m}$	$\Delta y = -7,32 \text{ m}$
Displacement = <u>- 11,48</u> + 7,32 $\checkmark$	Displacement = <u>11,48</u> + (- 7,32) $\checkmark$
Verplasing = - 4,16	Verplasing = 4,16 m
$= 4,16 \text{ m}$	(downwards/afwaarts) $\checkmark$
(downwards/afwaarts) $\checkmark$	

<b>OPTION/OPSIE 4</b>	
<b>Positive marking from 3.1.1 / Positiewe merk vanaf 3.1.1</b>	
<b>UPWARDS POSITIVE OPWAARTS POSITIEF</b>	<b>UPWARDS NEGATIVE OPWAARTS NEGATIEF</b>
$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$0 = 12 + (-9,8)\Delta t$	$0 = -12 + (9,8)\Delta t$
$\Delta t = 1,22 \text{ s}$	$\Delta t = 1,22 \text{ s}$
Area/oppervlakte = $\frac{1}{2}bh \checkmark$	Area/oppervlakte = $\frac{1}{2}bh \checkmark$
$= \frac{1}{2}(1,22)(12) \checkmark$	$= \frac{1}{2}(1,22)(-12) \checkmark$
$= 7,32 \text{ m}$	$= -7,32 \text{ m}$
Displacement = <u>- 11,48</u> + 7,32 $\checkmark$	Displacement = <u>11,48</u> + (- 7,32) $\checkmark$
Verplasing = - 4,16	Verplasing = 4,16 m
$= 4,16 \text{ m}$ (downwards/afwaarts) $\checkmark$	(downwards/afwaarts) $\checkmark$

(4)

## 3.2 Positive marking from 3.1.1 and 3.1.2 / Positiewe merk vanaf 3.1.1 en 3.1.2



CRITERIA FOR MARKING/MERK KRITERIA	
Correct shape/Korrekte vorm	✓
Height indicated/Hoogte aangedui (11,48 m)	✓
Time t indicated/Tyd t aangedui (1,73 s)	✓

(3)  
[15]

## QUESTION/VRAAG 4

- 4.1 In an isolated system total linear momentum is conserved. ✓✓  
*Die totale lineêre momentum bly behoue in 'n geïsoleerde/geslote sisteem.* (2)
- 4.2.1  $\sum p_i = \sum p_f$   
 $m_A v_{iA} + m_B v_{iB} = (m_A + m_B) v_f$  } Any one/Enige een ✓  
 $(2 \times v_{iA}) + (4 \times -5) \checkmark = (2+4)(-1,67) \checkmark$   
 $v_{iA} = 4,99 \text{ m.s}^{-1}$  (East/Ooswaarts) ✓ (4)

4.2.2	POSITIVE MARKING FROM 4.2.1/Positiewe merk vanaf 4.2.1	POSITIVE MARKING FROM 4.2.1/Positiewe merk vanaf 4.2.1
	<b>OPTION/OPSIE 1</b> $F_{net} \cdot \Delta t = \Delta p$ $F_{net} \cdot \Delta t = m(v_f - v_i)$ } Any one Any one $F_{net} \cdot 0,01 \checkmark = 2 (-1,67 - 4,99) \checkmark$ $F_{net} = -1 332 \text{ N}$ $F_{net} = \underline{1 332 \text{ N west/left/Wes/links}} \checkmark$	<b>OPTION/OPSIE 2</b> $F_{net} \cdot \Delta t = \Delta p$ $F_{net} \cdot \Delta t = m(v_f - v_i)$ } Any one Any one $F_{net} \cdot 0,01 \checkmark = 2 [1,67 - (-4,99)] \checkmark$ $F_{net} = -1 332 \text{ N}$ $F_{net} = \underline{1 332 \text{ N west/left/Wes/links}} \checkmark$

OPTION/OPSIE 3	OPTION/OPSIE 4
$F_{\text{net}} = ma$ $F_{\text{net}} = m \left( \frac{v_f - v_i}{\Delta t} \right)$ $F_{\text{net}} = 2 \times \left( \frac{-1,67 - 4,99}{0,01} \right) \checkmark$ $F_{\text{net}} = -1 332$ $F_{\text{net}} = \underline{1 332 \text{ N west/left/Wes/links}} \checkmark$	$F_{\text{net}} = ma$ $F_{\text{net}} = m \left( \frac{v_f - v_i}{\Delta t} \right)$ $F_{\text{net}} = 2 \times \left( \frac{1,67 - (-4,99)}{0,01} \right) \checkmark$ $F_{\text{net}} = \underline{1 332 \text{ N west/left/Wes/links}} \checkmark$

OPTION 5/OPSIE 5	OPTION 6/OPSIE 5
$F_{\text{net}} \cdot \Delta t = \Delta p$ $F_{\text{net}} \cdot \Delta t = m(v_f - v_i)$ $F_{\text{net}}(0,01) \checkmark = 4(-1,67 - -5) \checkmark$ $F_{\text{net}} = 1 332$ $F_{AB} = -F_{BA}$ $F_{\text{net(BA)}} = \underline{1 332 \text{ N west/left}} \checkmark$	$F_{\text{net}} \cdot \Delta t = \Delta p$ $F_{\text{net}} \cdot \Delta t = m(v_f - v_i)$ $F_{\text{net}}(0,01) \checkmark = 4(1,67 - 5) \checkmark$ $F_{\text{net}} = -1 332$ $F_{AB} = -F_{BA}$ $F_{\text{net(BA)}} = \underline{1 332 \text{ N west/left}} \checkmark$

(4)  
[10]

## QUESTION/VRAAG 5

- 5.1 Gravitational force / Gravitasiekrag  $\checkmark$  (1)
- 5.2  $\Delta x = \frac{12}{\sin 30^\circ} \checkmark = 24 \text{ m}$   
 $W_f = f \cdot \Delta x \cos \theta \checkmark$   
 $W_f = 35,5 \times 24 \cos 180^\circ \checkmark$   
 $W_f = -852 \text{ J} \checkmark$  (4)
- 5.3 Zero/0 J  $\checkmark$  (1)

## 5.4 Positive marking from 5.2/Positiewe merk vanaf 5.2

## OPTION/OPSIE 1

$$\begin{aligned} W_{\text{net}} &= \Delta E_k \\ W_f + W_F + W_{Fg} &= \Delta E_k \\ f x \Delta x \cos \theta + F \Delta x \cos \theta + mg(h_2 - h_1) &= \Delta E_k \\ -852 \checkmark + (62,5 \times 24 \cos 180^\circ) \checkmark + m(9,8)(12-0) \checkmark &= 0 \\ m = 20 \text{ kg} \checkmark \end{aligned} \quad \left. \right\} \text{Any one/Enige een } \checkmark$$

## OPTION/OPSIE 2

$$\begin{aligned} W_{nc} &= \Delta E_p + \Delta E_k \\ W_f + W_F &= \Delta E_p + \Delta E_k \\ f \Delta x \cos \theta + F \Delta x \cos \theta &= mg(h_2 - h_1) + \Delta E_k \\ -852 \checkmark + (62,5)(24) \cos 180^\circ \checkmark &= m(9,8)(0 - 12) \checkmark + 0 \\ m = 20 \text{ kg} \checkmark \end{aligned} \quad \left. \right\} \text{Any one/Enige een } \checkmark$$

## OPTION 3/OPSIE 3

$$\begin{aligned} W_{\text{net}} &= \Delta E_k \\ W_f + W_F + W_w &= \Delta E_k \\ f \Delta x \cos \theta + F \Delta x \cos \theta + mg \Delta x \cos \theta &= \Delta E_k \\ -852 \checkmark + (62,5)(24) \cos 180^\circ \checkmark + m(9,8)(24) \cos 60^\circ \checkmark &= 0 \\ m = 20 \text{ kg} \checkmark \end{aligned} \quad \left. \right\} \text{Any one/Enige een } \checkmark$$

(5)  
[11]

## QUESTION/VRAAG 6

6.1.1 520 Hz / 520 waves per second (waves.s<sup>-1</sup>)/golwe per sekondes (golwe.s<sup>-1</sup>)  $\checkmark$  (1)6.1.2 The change in frequency  $\checkmark$  (or pitch) observed/detected by a listener because the listener and the sound source have different velocities relative to the medium of sound propagation.  $\checkmark$ *Die verandering in frekwensie  $\checkmark$  (of toonhoogte) waargeneem deur 'n luisteraar want die luisteraar en die klankbron het verskillende snelhede relatief tot die medium wat klank voortplant.  $\checkmark$* 

## OR/OF

*The (apparent) changed in observed/detected frequency (pitch) as a result of relative motion between the sound source and the listener.  $\checkmark \checkmark$* *Die waarskynlike verandering in die waargenome frekwensie (toonhoogte) as gevolg van die relatiewe beweging tussen die klankbron en die luisteraar.  $\checkmark \checkmark$*  (2)6.1.3 TOWARDS  $\checkmark$  Detected frequency is higher than the source frequency  $\checkmark$   
NA.  $\checkmark$  Waargenome frekwensie is hoër as die bron se frekwensie  $\checkmark$  (2)6.1.4  $f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark$   
 $520 \checkmark = \frac{343}{343 - v_s} \checkmark (480) \checkmark$   
 $v_s = 26,38 \text{ m} \cdot \text{s}^{-1} \checkmark$  (5)

## 6.1.5 Decreases/Neem af ✓

For a constant velocity/speed of sound, if the frequency increases,  $\lambda$  decreases. ✓  
*Vir 'n konstante snelheid/spoed van klank, indien die frekwensie toeneem, neem  $\lambda$  af.*

**OR/OF**

$$\lambda \propto \frac{1}{f} \text{ at constant velocity/speed/by konstante snelheid/spoed} \checkmark$$

**OR/OF**

$$f \propto \frac{1}{\lambda} \text{ at constant velocity/speed/by konstante snelheid/spoed} \checkmark$$

(2)

## 6.2 Light from the star is shifted towards longer wavelength (towards the red end of the spectrum) ✓ which indicated that the star is moving away from the earth. ✓

*Lig van die ster skuif na 'n langer golflengte (na die rooi kant van die spektrum) ✓ wat aandui dat die ster wegbeweeg van die aarde af. ✓*

(2)

6.3 Used to measure the direction and speed of blood flow in arteries and veins. ✓  
*Word gebruik om die rigting en spoed waarteen bloed in are en slagare vloeい, te meet.***OR/OF**

Used to measure the heartbeat of a foetus in the womb.

*Word gebruik om die hartklop van 'n fetus in die baarmoeder te meet.*

(1)

**[15]****QUESTION/VRAAG 7**

## 7.1.1 GAIN/BYGEKRY ✓

(1)

$$n = \frac{Q}{q_e} \checkmark$$

$$n = \frac{5 \times 10^{-6}}{1,6 \times 10^{-19}} \checkmark$$

$$n = 3,125 \times 10^{13} \text{ (electrons/elektrone)} \checkmark$$

(3)

$$E = \frac{kQ}{r^2} \checkmark$$

$$E = \frac{9 \times 10^9 \times 5 \times 10^{-5}}{0,1^2} \checkmark$$

$$E = 4,5 \times 10^6 \text{ N.C}^{-1} \checkmark \text{ left-links}$$

(5)

## 7.2.1 Negative/Negatief ✓

Like charges repel each other/Gelyksoortige ladings stoot mekaar af. ✓

**OR/OF**

The charges repel each other. If sphere **A** is negative, then sphere **B** must also be negative. ✓

*Die ladings stoot mekaar af. Indien sfeer **A** negatief is, dan moet sfeer **B** ook negatief wees.*

(2)

7.2.2  $F_E = T \sin 30^\circ$

$F_E = 25 \sin 30^\circ \checkmark$

$F_E = 12,5 \text{ N}$

$F_E = \frac{kQ_1 Q_2}{r^2} \checkmark$

$12,5 \checkmark = \frac{(9 \times 10^9)(5 \times 10^{-6})Q}{0,05^2} \checkmark$

$Q = 6,94 \times 10^{-7} \text{ C} \checkmark$

(6)

[17]

## QUESTION/VRAAG 8

8.1.1 Temperature/temperatuur  $\checkmark$

Length of the conductors/Lengte van die geleiers  $\checkmark$

Thickness of the conductors/Dikte van die geleiers

ACCEPT: Type of material

AANVAAR: Tipe materiaal

} (Any two/Enige twee)

(2)

8.1.2 Gradient is the inverse of the resistance.  $\checkmark$  /

Gradiënt is die inverse van die weerstand  $\checkmark$

OR/OF

Gradient =  $\frac{1}{R} \checkmark$

(1)

8.1.3 Conductor C./Geleier C.  $\checkmark$

It has the highest resistance. The higher the resistance of a conductor, the more heat is produced in the conductor if the current is constant.  $\checkmark$

Dit het die hoogste weerstand. Hoe hoër die weerstand, hoe meer hitte geproduseer word in die geleier indien die stroom konstant is.

(2)

8.2.1  $R = \frac{V}{I} \checkmark$

$R = \frac{12}{1,5} \checkmark$

$R = 8 \Omega \checkmark$

(3)

### 8.2.2 OPTION/OPSIE 1

$R_{\text{total}} = R + r \checkmark$

$[8 = (4 + 3) \checkmark + r] \checkmark$

$r = 1 \Omega \checkmark$

### OPTION/OPSIE 2

$\varepsilon = I(R + r) \checkmark$

$12 = 1,5 [(4 + 3) \checkmark + r] \checkmark$

$r = 1 \Omega \checkmark$

(4)

8.2.3  $W = I^2 R \Delta t \checkmark$

$W = (1,5)^2 (3) (180) \checkmark$

$W = 1 215 \text{ J} \checkmark$

(3)

8.3.1 Decrease/Neem af.  $\checkmark$

(1)

8.3.2 Increase/Neem toe.  $\checkmark$

(1)

8.4 Increase/Neem toe. ✓

$R_{ext}$  decreases. Current through battery increases. ✓

$W = I^2r\Delta t$  / Energy transfer to the battery/work done by battery increases. ✓

$R_{eks}$  neem af. Stroom deur die battery neem toe. ✓

$W = I^2r\Delta t$  / Energie oorgedra aan die battery/arbeid verrig deur die battery neem toe. ✓

(3)

[20]

### QUESTION/VRAAG 9

9.1 Mechanical energy to electrical energy.

Meganiese energie na elektriese energie ✓✓

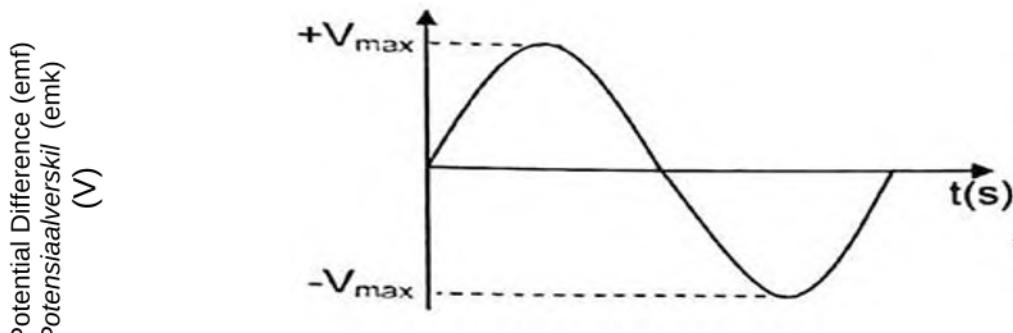
(2)

9.2 AC generator has slip rings and DC generator has a split ring / commutator ✓

WS-generator het sleepringe en GS-generator het 'n splittings / kommutator

(1)

9.3



#### CRITERIA FOR MARKING/MERK KRITERIA

Correct shape/Korrekte vorm	✓
Axes labelled correct/Asse korrek	✓
$V_{max}$ indicated on graph/ $V_{maks}$ aangedui op grafiek	✓

(2)

$$P_{ave} = V_{rms}I_{rms} \quad \checkmark$$

$$2000 = I_{rms} \times 230 \quad \checkmark$$

$$I_{rms} = 8,70 \text{ A}$$

$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

$$8,70 = \frac{I_{max}}{\sqrt{2}} \quad \checkmark$$

$$I_{max} = 12,30 \text{ A} \quad \checkmark$$

$$P_{gem} = V_{wgk}I_{wgk} \quad \checkmark$$

$$2000 = I_{wgk} \times 230 \quad \checkmark$$

$$\therefore I_{wgk} = 8,70 \text{ A}$$

$$I_{wgk} = \frac{I_{max}}{\sqrt{2}}$$

$$8,70 = \frac{I_{max}}{\sqrt{2}} \quad \checkmark$$

$$\therefore I_{maks} = 12,30 \text{ A} \quad \checkmark$$

(4)

9.5

$$V_{rms} = \frac{V_{max}}{\sqrt{2}} \quad \checkmark$$

$$230 = \frac{V_{max}}{\sqrt{2}} \quad \checkmark$$

$$V_{max}/V_{maks} = 325,27 \text{ V} \quad \checkmark$$

(3)

[12]

## QUESTION/VRAAG 10

- 10.1 Work function (of the metal) / Werksfunksie (van die metaal) ✓

$$E_{k(\max)} = \frac{hc}{\lambda} - W_0 \checkmark$$

The intercept on the vertical axis =  $W_0$ .

Die afsnit op die vertikale-as =  $W_0$  ✓

**OR/OF**

$$\frac{hc}{\lambda} = W_0 + E_{k(\max)} \checkmark$$

The intercept on the vertical axis is equal to the  $W_0$ .

Die afsnit op die vertikale-as is gelyk aan die  $W_0$  ✓

(3)

- 10.2  $E = W_0 + E_{k(\max)}$  } Any one/Enige een ✓

$$hf = W_0 + E_{k(\max)}$$

$$hf = hf_0 + E_{k(\max)}$$

$$\underline{6,63 \times 10^{-34} \times 6,16 \times 10^{14}} \checkmark = \underline{6,63 \times 10^{-34}} f_0 \checkmark + \underline{5,6 \times 10^{-20}} \checkmark$$

$$f_0 = 5,32 \times 10^{14} \text{ Hz} \checkmark$$

(5)

- 10.3.1 Remain the same/Bly dieselfde ✓

The gradient is equal to the product of Planck's constant and the speed of light in vacuum which are constants. ✓

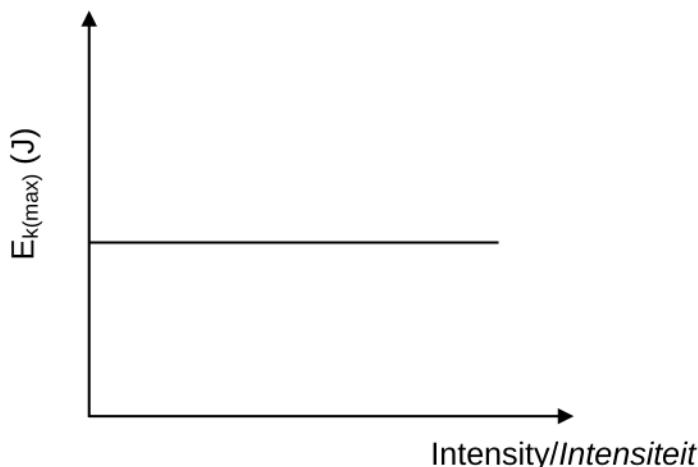
Die gradient is gelyk aan die produk van Planck se konstante en die spoed van lig in 'n vakuum wat konstantes is.

**OR/OF**

Gradient =  $hc$ , which are constants/Gradiënt =  $hc$ , wat konstantes is.

(2)

- 10.3.2 Remains the same/Bly dieselfde ✓



<b>CRITERIA FOR MARKING/MERK KRITERIA</b>	
Axes labelled/Asse benoem	✓
Correct shape/Korrekte vorm	✓

(3)  
[13]

**TOTAL/TOTAAL: 150**