Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2022

PHYSICAL SCIENCES P1 (PHYSICS)

MARKS: **150**

TIME: **3 hours**

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

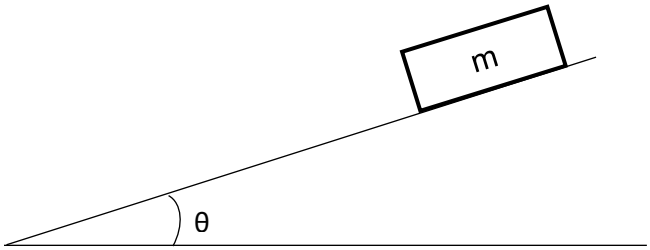
INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME in the appropriate space 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 between two sub-questions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, etc. where required.
10. You are advised to use the attached DATA SHEETS.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 An object of mass **m** moves down an incline at a constant velocity as shown in the diagram below.



Which ONE of the following expressions represents the magnitude of frictional force acting on the object?

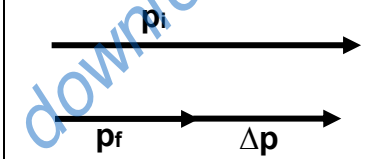
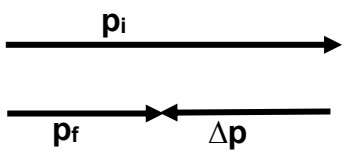
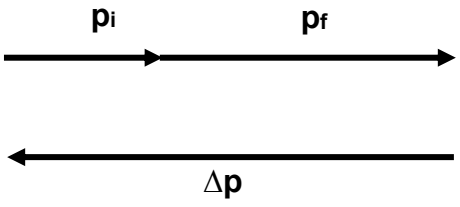
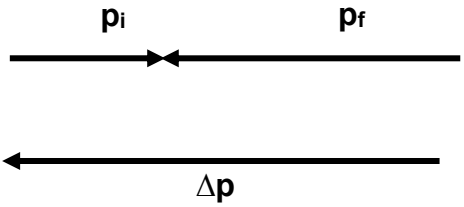
A mg cos θ

B mg sin θ

C mg tan θ

D tan θ (2)

1.2 A car of mass **m** is travelling at a constant velocity and has a momentum **p**. The driver notices an object ahead of him and applies the brakes so that the momentum of the car changes to ½**p.** Which ONE of the diagrams below correctly shows the relationship between $\mathbf{p}_i$, $\mathbf{p}_f$ and $\Delta\mathbf{p}$?

A 	B 
C 	D 

(2)

1.3 A hot air balloon is moving upwards at a constant velocity **v**. A stone is dropped from the hot air balloon. What is the velocity of the stone at the instant it is dropped from the balloon?

A Zero

B **v** downwards

C **v** upwards

D 2**v** downwards (2)

1.4 An object is thrown vertically upwards from **R**, passes point **Q** and reaches a maximum height at point **P**. Ignore the effects of air friction.

Which ONE of the following is correct as the object moves from point **R** to point **Q**?

A Total mechanical energy has increased.

B The total kinetic energy at point **P** is zero.

C The decrease in kinetic energy is equal to the increase in potential energy.

D The average work done on the object is equal to zero. (2)

1.5 The net work done by a constant force **F** that acts on an object to increase its velocity from **0** to **v** is **W**.

The net work done by the same force on the object to increase its velocity from **v** to **2v** is …

A ⅓ W.

B ½ W.

C 2 W.

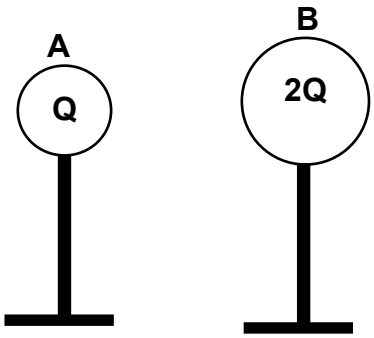
D 3 W. (2)

1.6 Astronomers observed that a light from distant star undergoes a red shift. Which ONE of the following combinations regarding the observed wavelength and frequency correctly explains this shift?

	OBSERVED WAVELENGTH	OBSERVED FREQUENCY
A	Increases	Decreases
B	Decreases	Decreases
C	Decreases	Increases
D	Increases	Increases

(2)

1.7 Two charged spheres, **A** and **B**, carrying charges **Q** and **2Q** respectively, are placed on insulating stands as shown in the diagram below. Sphere **A** exerts a force of **F** on sphere **B**. What is the magnitude of the force exerted by sphere **B** on sphere **A**?



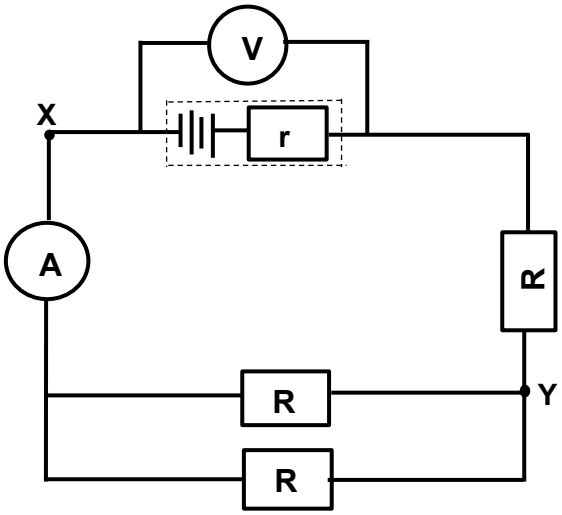
A 4**F**

B 2**F**

C **F**

D ½**F** (2)

1.8 A battery with internal resistance **r** is connected into a circuit as shown in the diagram below.

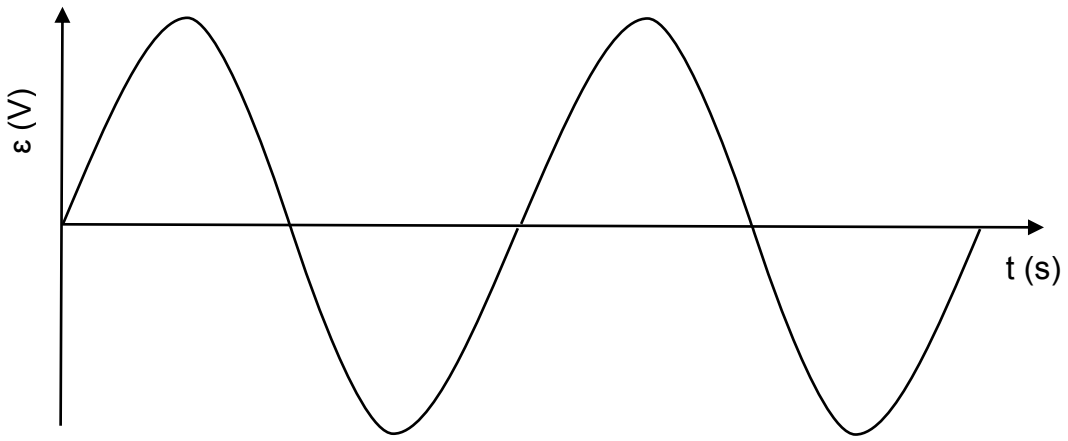


A conducting wire of negligible resistance is now connected into the circuit across points **X** and **Y**. Which combinations below correctly shows the changes to the readings on the voltmeter and ammeter?

	VOLTMETER READING	AMMETER READING
A	Increases	Increases
B	Increases	Decreases
C	Decreases	Decreases
D	Decreases	Increases

(2)

1.9 The graph below represents the emf generated versus time for an alternating current (ac) generator.



The speed of rotation of the generator's coil is now DOUBLED. What happens to the emf and the period of one cycle?

	EMF	PERIOD
A	Doubles	Doubles
B	Doubles	Halves
C	Halves	Doubles
D	Halves	Halves

(2)

1.10 The photoelectric effect provides evidence of the fact that:

A Positive charges can be emitted from metal surfaces.

B Light is an electromagnetic wave.

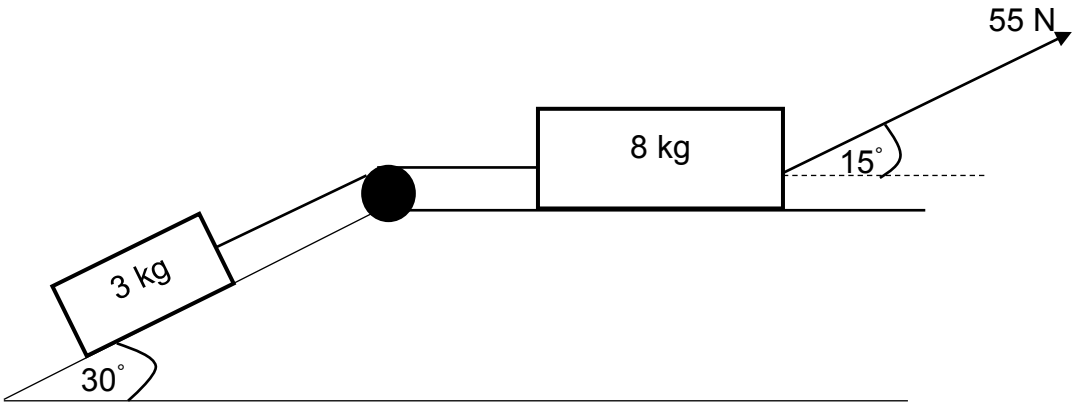
C Light has a wave nature.

D Light has a particle nature. (2)

[20]

QUESTION 2 (Start on a new page.)

Two blocks of masses 3 kg and 8 kg respectively are connected by means of a light, inextensible string as shown in the diagram below. The string moves over a frictionless pulley and the 3 kg block is placed on a plane that is inclined at an angle of 30° to the horizontal.
A force of 55 N, which makes an angle of 15° with the horizontal, is applied to the 8 kg block to move the system of blocks to the right.
The 3 kg block experiences a constant frictional force of 5 N. The coefficient of kinetic friction between the 8 kg block and the surface is 0,16.



2.1 State Newton's Second Law of motion in words. (2)

2.2 Draw a labelled free-body diagram of all forces acting on the 8 kg block. (5)

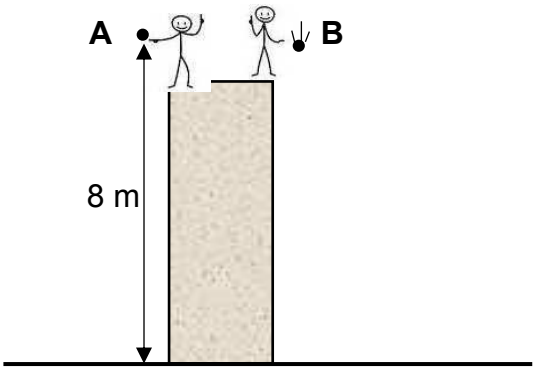
2.3 Calculate the:

2.3.1 Kinetic frictional force that the 8 kg block experiences (4)

2.3.2 Tension in the string connecting the two blocks (6)
[17]

QUESTION 3 (Start on a new page.)

A learner drops a ball **A** from a height of 8 m. After 0,6 s, another learner throws a second ball **B** downwards from the same height. Both balls **A** and **B**, hit the ground at the same time. Ignore the effects of friction.



3.1 Define the term *free fall*. (2)

3.2 Calculate the speed at which:

3.2.1 Ball **A** hits the ground (3)

3.2.2 Ball **B** was thrown downwards (5)

Ball **A** bounces off the ground to a maximum height of 6,5 m above the ground.

3.3 Calculate the velocity of ball **A** as it bounces off the ground. (4)

3.4 Sketch a velocity versus time graph for the motion of ball **A** from the moment it was dropped until it reaches its maximum height after the bounce.

Indicate the following on the graph:

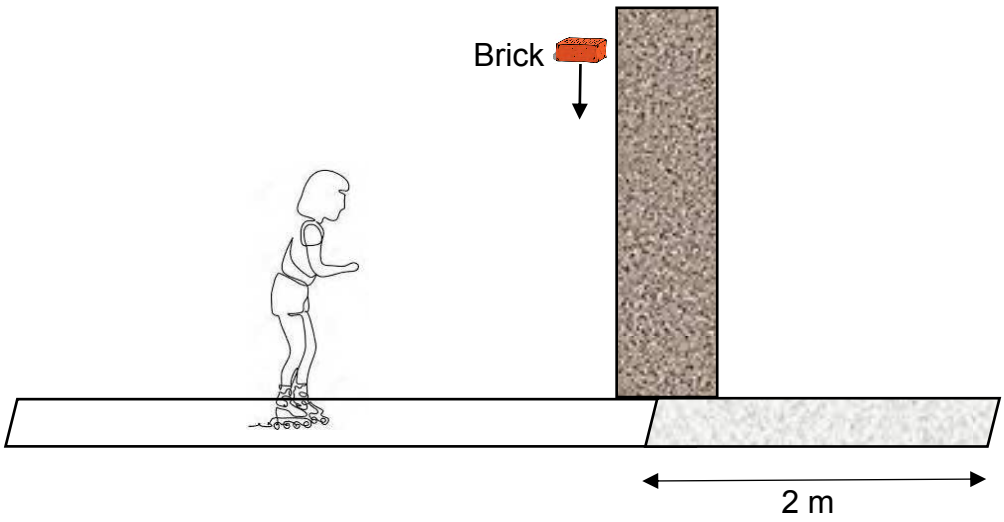
- The velocity with which ball **A** hits the ground
- The velocity with which the ball bounces off the ground (3)

[17]

QUESTION 4 (Start on a new page.)

A girl on roller skates, of combined mass 52 kg, moves horizontally at a certain constant velocity. She catches a brick of mass 5 kg which is thrown vertically downwards from the top of a high wall. The girl continues to move in a straight line at a speed of 2,4 $m \cdot s^{-1}$ after catching the brick.

Ignore the effects of friction.



4.1 Write down the horizontal speed of the brick just before the girl catches it. (1)

4.2 Calculate the girl's speed just before she catches the brick. (4)

The girl-brick combination, moving at 2,4 $m \cdot s^{-1}$ moves onto a rough surface. She comes to rest after moving 2 m along the rough surface.

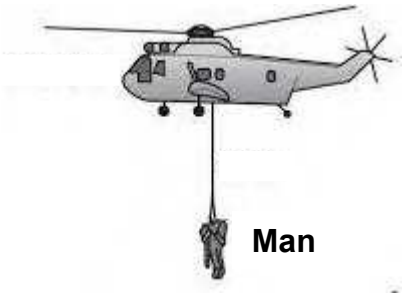
4.3 Write down a pair of action-reaction forces acting while the girl catches the brick. (2)

4.4 Calculate the magnitude of the net force exerted by the rough surface to bring the girl-brick combination to a stop after 2 m. (5)

[12]

QUESTION 5 (Start on a new page.)

A rescue helicopter lifts a man of mass 75 kg, initially at rest, vertically upwards by means of a light inextensible massless cable as shown in the diagram below. While the man is lifted to a height of 12 m, the average tension in the cable is 3 600 N. A constant downward air resistance of 1 540 N is exerted on the man while he is being lifted.



5.1 State the work-energy theorem in words. (2)

5.2 Draw a free body diagram of all forces acting on the man as he is lifted upwards. (3)

5.3 Name a non-conservative force acting on the man while he is being lifted. (1)

5.4 Calculate the work done on the man by the gravitational force while he is being lifted. (3)

5.5 Use ONLY energy principles to calculate the speed of the man at 12 m above the ground. (5)
[14]

QUESTION 6 (Start on a new page.)

An ambulance, with its siren emitting sound of a certain constant frequency, approaches an accident scene at a constant velocity. A stationary sound detector at the accident scene records a frequency that is 2% higher than the actual frequency of the siren.

6.1 State the Doppler effect in words. (2)

6.2 Explain why the detector records a higher frequency. (2)

6.3 Calculate the speed of the ambulance.

Take velocity of sound as 343 $m.s^{-1}$. (5)

6.4 The frequency of the sound emitted by the siren is 720 Hz. Calculate the wavelength of the siren's sound. (3)

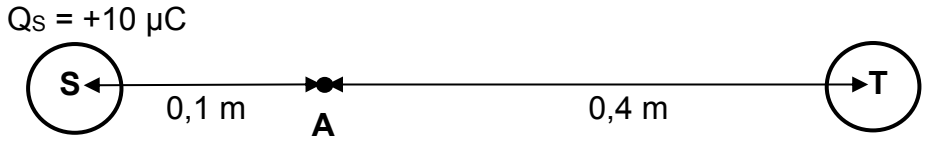
6.5 State ONE use of a Doppler flowmeter. (1)
[13]

QUESTION 7 (Start on a new page.)

7.1 Define the *electric field at a point* in words. (2)

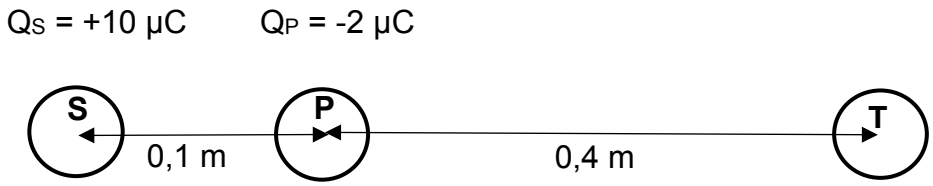
7.2 Draw the resultant electric field pattern due to two-point charges with identical positive charges. (3)

Two identical spheres, **S** and **T,** are placed with their centres 0,5 m apart. Point **A** is 0,1 m to the right of sphere **S**, as shown in the diagram below. The charge on sphere **S** is +10 µC while sphere **T** carries an unknown positive charge of similar magnitude.



7.3 The net electric field strength at point **A** is 4,70 x 10^6 N.C^{-1} to the left. Calculate the unknown charge on sphere **T**. (6)

A third sphere **P** carrying a charge of -2 µC is now placed at point **A** as shown in the diagram below.

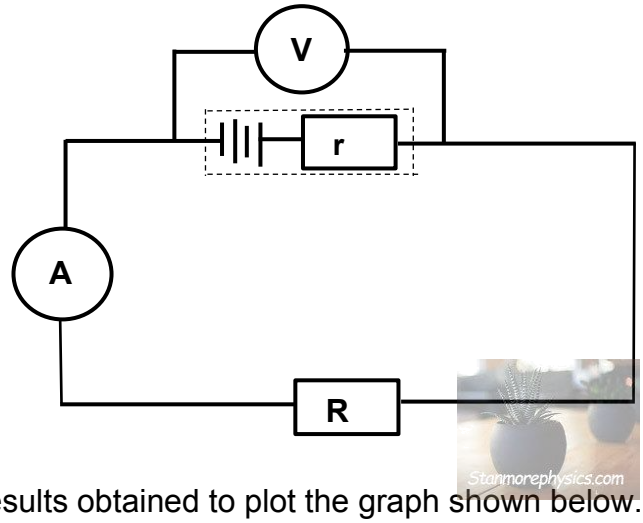


7.4 Calculate the NET electrostatic force exerted on sphere **P** due to charged spheres **S** and **T**. (4)

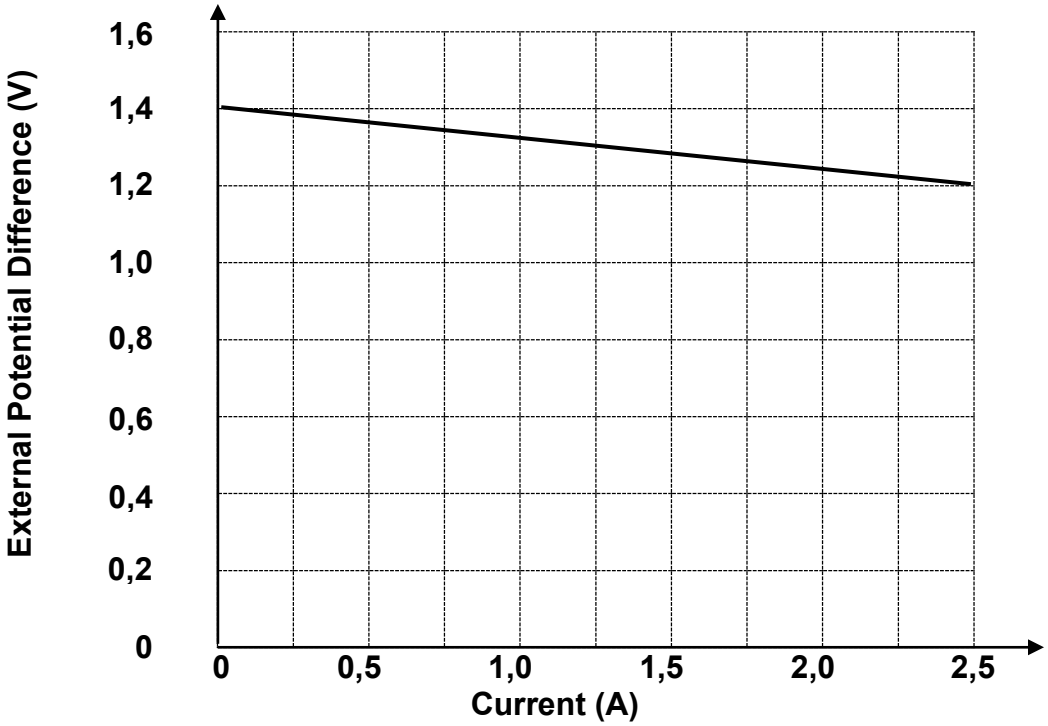
[15]

QUESTION 8 (Start on a new page.)

8.1 A learner sets up a circuit to determine the emf and internal resistance of a battery.



She uses the results obtained to plot the graph shown below.



8.1 Define the term *emf* of a battery. (2)

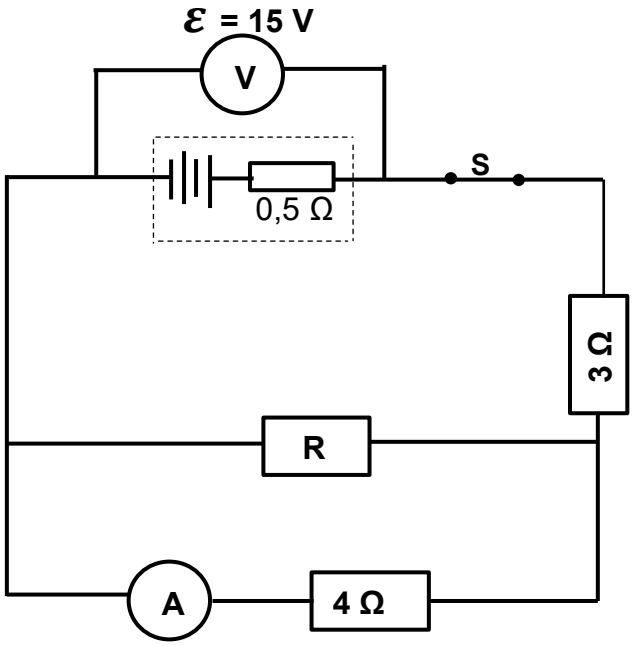
8.2 Use the graph to:

8.2.1 Determine the emf of the battery (1)

8.2.2 Calculate the internal resistance of the battery (3)

8.3 A circuit is connected as shown below. The resistance of **R**, which is connected in parallel with the 4 Ω resistor, is unknown. The battery has an emf of 15 V and an internal resistance of 0,5 Ω.

When switch **S** is closed the voltmeter reads 13,5 V.



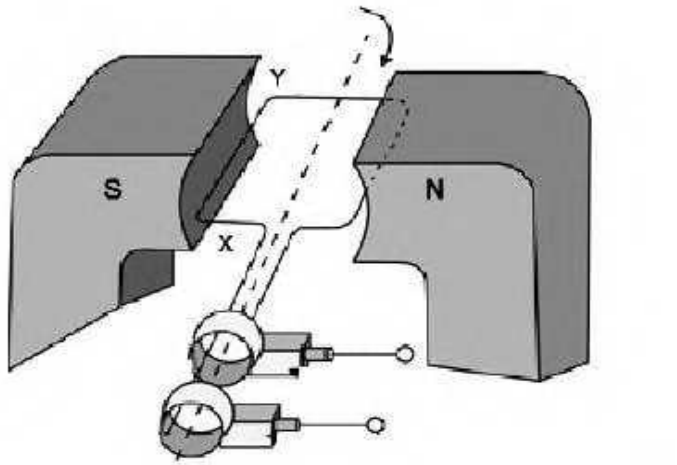
Calculate the:

8.3.1 Reading on ammeter **A** (6)

8.3.2 Resistance of resistor **R** (3)
[15]

QUESTION 9 (Start on a new page.)

9.1 The diagram of a simplified generator is shown below. The coil is rotated clockwise in a uniform magnetic field.



9.1.1 What type of generator is illustrated in the diagram?
Give a reason for your answer. (2)

9.1.2 Determine the direction of the current in segment XY when the coil is in the position shown above.

Only write down **X to Y** OR **Y to X**. (2)

9.2 Eskom supplies electricity to homes at rms voltage of 220 V. A certain electrical appliance dissipates 1 200 W of power when it is plugged in at a home.

9.2.1 Define the term *rms potential difference.* (2)

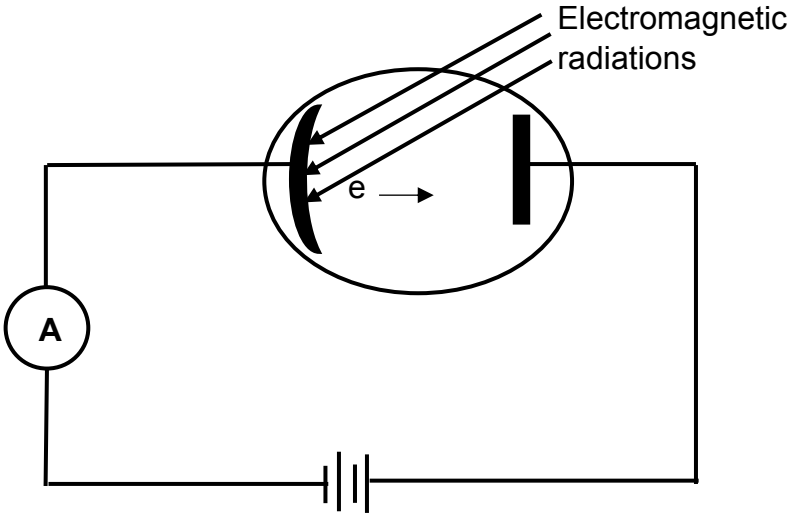
Calculate the:

9.2.2 Resistance of the appliance (3)

9.2.3 Peak (maximum) current that passes through the appliance (5)
[14]

QUESTION 10 (Start on a new page.)

The diagram below shows a photocell that emits electrons when a certain frequency of electromagnetic radiation is incident on the metal plate.



10.1 Describe the *photoelectric effect*. (2)

10.2 Define the term *work function of a metal.* (2)

When radiation of wavelength 555 nm is incident on the metal plate, electrons are released with zero kinetic energy.

10.3 Calculate the work function of this metal. (3)

10.4 The intensity of the incident light is now increased. State how this increase in intensity will affect the reading on the ammeter.

Write down only INCREASES, DECREASES or REMAINS THE SAME.
Give a reason for your answer. (2)

10.5 Another light source shines light onto the same metal and the emitted electron moves away from the metal surface with a velocity of 5×10^6 m.s^{-1}.

Calculate the frequency of this light source. (4)
[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 m•s^{-2}
Universal gravitational constant *Universelegravitasiekonstant*	G	6,67 × 10^{-11} N•m^2•kg^{-2}
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 × 10^8 m•s^{-1}
Planck's constant / *Planck se konstante*	h	6,63 × 10^{-34} J•s
Coulomb's constant / *Coulomb se konstante*	k	9,0 × 10^9 N•m^2•C^{-2}
Charge on electron / *Lading op elektron*	e	-1,6 × 10^{-19} C
Electron mass / *Elektronmassa*	m_e	9,11 × 10^{-31} kg
Mass of earth / *Massa op aarde*	M	5,98 × 10^{24} kg
Radius of earth / *Radius van aarde*	R_E	6,38 × 10^3 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*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1m_2}{d^2}$	$g = G\frac{M}{d^2}$

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* $W_{nc} = \Delta E_K + \Delta E_P$	$P = \frac{W}{\Delta t}$
$P_{av} = Fv$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{V}{d}$	$E = \frac{F}{q}$
$V = \frac{W}{q}$	$n = \frac{Q}{q_e}$

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

$V = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} \cdot f_s$ or/of $f_L = \frac{v \pm v_L}{v \pm v_b} \cdot f_b$	$E = hf$ or/of $E = \frac{hc}{\lambda}$
$E = W_0 + E_{k(max)}$ or $E = W_0 + K_{max}$ where $E = hf$ and $W_0 = hf_0$ and $E_{k(max)} = \frac{1}{2}mv^2_{max}$ / $K_{(max)} = \frac{1}{2}mv^2_{max}$	
$E = W_0 + E_{k(maks)}$ of $E = W_0 + K_{maks}$ waar $E = hf$ en $W_0 = hf_0$ en $E_{k(maks)} = \frac{1}{2}mv^2_{maks}$ / $K_{(maks)} = \frac{1}{2}mv^2_{maks}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	emf (ε) = I(R + r) emk (ε) = I(R + r)
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\Delta t$
W = Vq W = VIΔt 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*

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

Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

SEPTEMBER 2022

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

MARKS/*PUNTE*: 150

This marking guideline consists of 18 pages./
Hierdie nasienriglyn bestaan uit 18 bladsye.

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 berekeninge 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 gespesifiseer 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 outomaties 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 herhaaldelike 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, $m•s^{-1}$.
For marking purposes, $m•s^{-1}$ and m/s will also be accepted.
Skei saamgestelde eenhede met 'n vermenigvuldigingspunt en nie met 'n punt nie, byvoorbeeld $m•s^{-1}$. Vir nasiendoeleindes sal $m•s^{-1}$ 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 of 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 the 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 B ✓✓ (2)

1.2 B ✓✓ (2)

1.3 C ✓✓ (2)

1.4 C ✓✓ (2)

1.5 D ✓✓ (2)

1.6 A ✓✓ (2)

1.7 C ✓✓ (2)

1.8 C ✓✓ (2)

1.9 B ✓✓ (2)

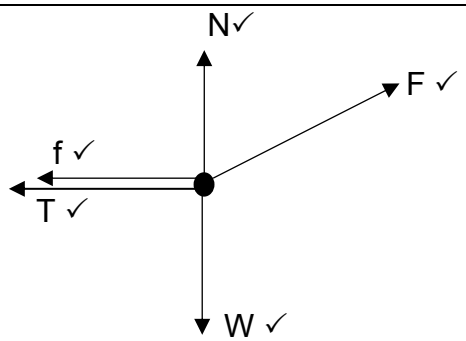
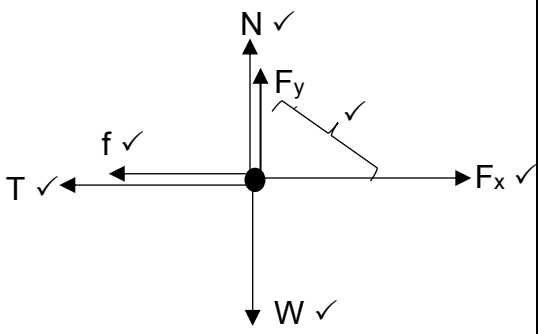
1.10 D ✓✓ (2)
[20]

QUESTION/*VRAAG* 2

2.1 (If any of the underlined key words/phrases in the correct context are omitted: -1 mark per word/phrase)
When a 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 enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 per woord/frase)
Wanneer 'n resulterende/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)

2.2

OPTION 1/*OPSIE* 1	**OPTION 1/*OPSIE* 2**
	

Alternative labels:	***Alternatiewe byskrifte***
W / W_g / F_g	*W / W_g / F_g*
N / F_N / F_{normal}	*N / F_N / $F_{Normaal}$*
f / F_f / $F_{friction}$	*f / F_w / $F_{wrywing}$*
T / F_{string} / F_s	T / F_{tou} / F_T
F / F_{app}	F / $F_{toegepas}$

Marking criteria	***Nasienkriteria***
• Mark awarded for arrow and label. • Do not penalise for length of arrows since drawing not drawn to scale. • Any additional force(s) ¾ • If force(s) do not make. contact with the body – max. ¾.	• Punt word vir byskrif en pyltjie toegeken. • Moenie vir die lengte van die pyltjies penaliseer nie aangesien skets nie volgens skaal geteken is nie. • Enige addisionele krag(te) ¾ • Indien krag(te) nie kontak met die voorwerp maak nie – maks. ¾.

(5)

2.3.1 $f_k = \mu_k N$
$f_k = \mu(mg - F\sin\theta)$ ✓ Any one/*Enige een*
$f_k = [0,16\ (8 \times 9,8 - 55\sin 15^\circ)$ ✓] ✓
$f_k = 10,27$ N ✓ (4)

2.3.2 **Positive marking from QUESTION 2.3.1 / *Positiewe nasien vanaf VRAAG 2.3.1***

3-kg block / *blok*

$F_{net} = ma$
$T - f - F_{//} = ma$
$T - f - mg \sin\theta = ma$
$F\cos\theta - T - f = ma$

Any one ✓
Enige een

$T - 5 - (3 \times 9,8 \times \sin 30^{\circ})$ ✓ $= 3a$

$T - 19,7 = 3a$
$T = 3a + 19,7$… (1)

Any one/ ✓
Enige een

8-kg block / *blok*

$F \cos\theta - T - f = ma$

$[55 \cos 15^{o} - T - 10,27]$ ✓ $= 8a$
$42,8559 - T = 8a$
$42,86 - T = 8a$ … (2)

(1) = (2)
$42,86 - (3a + 19,7) = 8a$
$a = 2,11\ m.s^{-2}$ …(3)

(3) in (1):
$T = 19,7 + 3 \times 2,11$ ✓
$T = 26,03\ N$ ✓

(6)
[17]

QUESTION/*VRAAG* 3

3.1 (If any of the underlined key words/phrases in the correct context are omitted: -1 mark per word/phrase)
Motion of an object upon which the only force acting is the force of gravity. ✓✓
(Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 per woord/frase)
Beweging van 'n voorwerp waarop die enigste krag wat daarop inwerk, die gravitasiekrag is. (2)

3.2.1

UPWARD POSITIVE/ *OPWAARTS POSITIEF*	**UPWARD NEGATIVE/ *OPWAARTS NEGATIEF***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $v_f^2 = 0^2 + 2(-9,8)(-8)$ ✓ $v_f = 12,52\ m.s^{-1}$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $v_f^2 = 0^2 + 2(9,8)(8)$ ✓ $v_f = 12,52\ m.s^{-1}$ ✓

(3)

3.2.2

UPWARD POSITIVE/*OPWAARTS POSITIEF*

$v_f = v_i + a\Delta t$
$-12,52 = 0 + (-9,8)(\Delta t)$ ✓
$\Delta t = 1,28\ s$

$\Delta y = v_i\Delta t + \frac{1}{2}\ a\Delta t^2$ ✓
-8✓$= v_i\ (1,28-0,6) + \frac{1}{2}(-9,8)(1,28-0,6)$ ✓

$-8 = v_i\ (0,68) + \frac{1}{2}(-9,8)(0,68)$

$\therefore v_i = 8,43\ m.s^{-1}$ ✓

UPWARD NEGATIVE/*OPWAARTS NEGATIEF*

$v_f = v_i + a\Delta t$
$12,52 = 0 + (9,8)(\Delta t)$ ✓
$\Delta t = 1,28\ s$
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
8 ✓$= v_i\ (1,28-0,6) + \frac{1}{2}(9,8)(1,28-0,6)^2$ ✓

$8 = v_i\ (0,68) + \frac{1}{2}(9,8)(0,68)^2$

$\therefore\ v_i = 8,43\ m.s^{-1}$ ✓ (5)

3.3

OPTION 1/*OPSIE 1* **UPWARD POSITIVE/ *OPWAARTS POSITIEF***	**UPWARD NEGATIVE/ *OPWAARTS NEGATIEF***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0^2 = v_i^2 + 2(-9,8)(6,5)$ ✓ $v_f = 11,29\ m.s^{-1}$ upwards/*opwaarts* ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0^2 = v_i^2 + 2(9,8)(-6,5)$ ✓ $v_f = 11,29\ m.s^{-1}$ upwards/*opwaarts* ✓

OPTION 2/*OPSIE 2*

UPWARD POSITIVE/*OPWAARTS POSITIEF*

$E_{mech(f)} = E_{mech(i)}$
$(mgh_f + ½mv_f^2) = (mgh_i + ½mv_i^2)$] (Any one/*Enige een*) ✓
$m(-9,8)(6,5) + ½m(0^2) = m(-9,8)(0) + ½m\ v_i^2$ ✓
$v_i = 11,29\ m.s^{-1}$ ✓

UPWARD NEGATIVE/*OPWAARTS NEGATIEF*

$E_{mech(f)} = E_{mech(i)}$
$(mgh_f + ½mv_f^2) = (mgh_i + ½mv_i^2)$] (Any one/*Enige een*) ✓
$m(9,8)(-6,5) + ½m(0^2) = m(9,8)(0) + ½m\ v_i^2$ ✓
$v_i = 11,29\ m.s^{-1}$ ✓

OPTION 3/*OPSIE 3*

UPWARD POSITIVE/*OPWAARTS POSITIEF*

$W_{NC} = \Delta E_K + \Delta E_P$
$0 = (½mv_f^2 - ½mv_i^2) + (mgh_f + mgh_i)$] Any one/*Enige een*) ✓
$0 = (½m + ½m(0^2) = m(-9,8)(6,5) + m(-9,8)\ 0$ ✓
$v_i = 11,29\ m.s^{-1}$ ✓

UPWARD NEGATIVE/*OPWAARTS NEGATIEF*

$W_{NC} = \Delta E_K + \Delta E_P$
$0 = (½mv_f^2 - ½mv_i^2) + (mgh_f + mgh_i)$] Any one/*Enige een*) ✓
$0 = (½m\ 0^2 + ½m(v_i^2) = m(9,8)(-6,5) + m(9,8)\ 0$ ✓
$v_i = 11,29\ m.s^{-1}$ ✓

OPTION 4/*OPSIE 4*

UPWARD POSITIVE/*OPWAARTS POSITIEF*

$W_{NETT} = \Delta E_K$] Any one/*Enige een*)
$F_G.\Delta x.\cos\Theta = (½mv_f^2 – ½mv_i^2)$
$mg.\Delta x.\cos\Theta = (½mv_f^2 – ½mv_i^2)$ ✓
$m(-9,8)(6,5)\cos 180^\circ = ½m(0^2 – v_i^2)$ ✓
$v_i = 11,29\ m.s^{-1}$ ✓

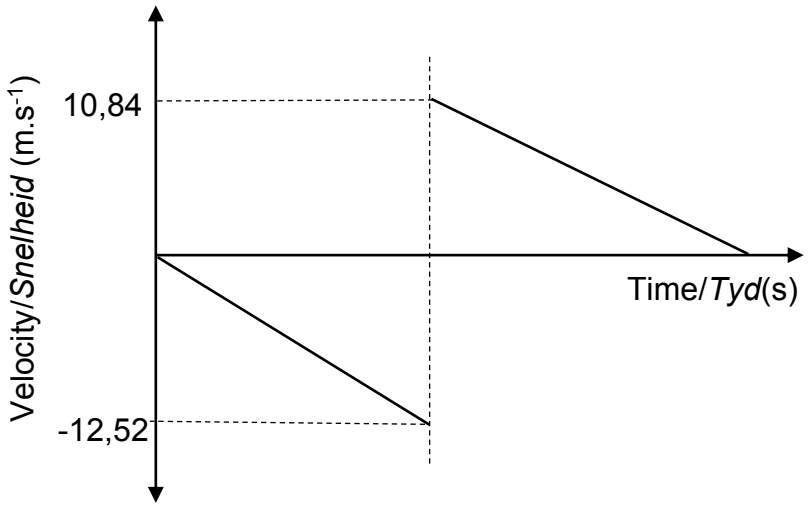
UPWARD NEGATIVE/*OPWAARTS NEGATIEF*

$W_{NETT} = \Delta E_K$] Any one/*Enige een*)
$F_G.\Delta x.\cos\theta = (½mv_f^2 – ½mv_i^2)$
$mg.\Delta x.\cos\theta = (½mv_f^2 – ½mv_i^2)$ ✓
$m(9,8)(-6,5)\cos 180^\circ = ½m(0^2 – v_i^2)$ ✓
$v_i = 11,29\ m.s^{-1}$ ✓

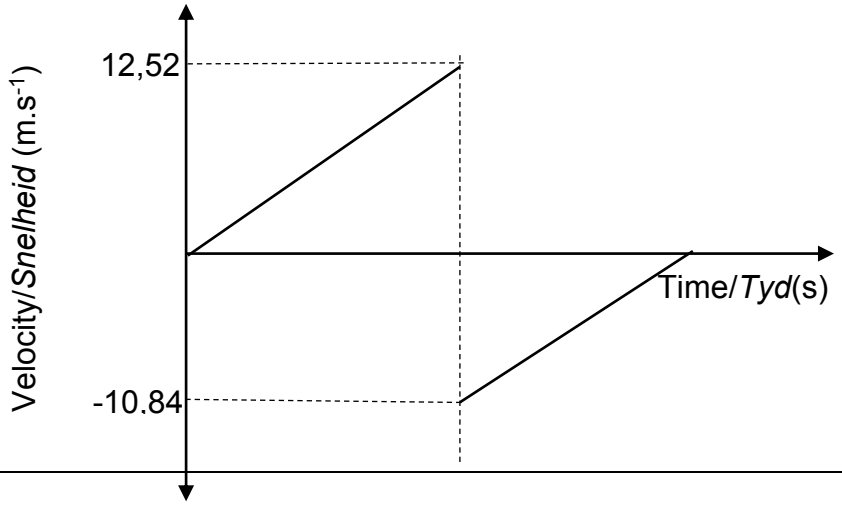
3.4

	MARKING CRITERIA/*NASIENKRITERIA*	
✓	Correct shape (Straight line)	*Korrekte vorm (Reguitlyn)*
✓	Similar gradients	*Dieselfde gradiënte*
✓	Final velocity indicated and bounce off velocity indicated	*Eindsnelheid aangedui en terugbons-snelheid aangedui*

UPWARDS POSITIVE/*OPWAARTS POSITIEF*



DOWNWARDS POSITIVE/*AFWAARTS POSITIEF*



(3)
[17]

QUESTION/*VRAAG 4*

4.1 Zero/*nul* or/ *of* 0 $m.s^{-1}$ ✓ (1)

4.2 $\sum p_i = \sum p_f$
$m_A v_i + m_B v_i = (m_A + m_B)v_f$ } Any one/*Enige een* ✓
$52\ v_{ig} + 5 \times 0$ ✓$= (52 + 5) \times 2,4$ ✓
$v_i = 2,63\ m.s^{-1}$ ✓ (4)

4.3 Force of hands-on brick upwards, ✓ force of brick on hands downwards. ✓
Force of girl on earth/weight of girl downwards, ✓ force of Earth on girl upwards. ✓
Krag van hand op baksteen opwaarts, krag van baksteen op hande afwaarts. Krag van meisie op aarde/gewig van meisie afwaarts, krag van Aarde op die meisie opwaarts. (2)

4.4

OPTION 1/*OPSIE* 1	**OPTION 2/*OPSIE* 2**
$\Delta y = \frac{v_f + v_i}{2} \Delta t$ $2 = \frac{0+(2,4)}{2}$ ✓x Δt $\Delta t = 1,67$ s $F_{net}\Delta t = \Delta p$ $F_{net}\Delta t = m(v_f - v_i)$ } Any one/*Enige een* ✓ $F_{net} \times 1,67 = (52 + 5)$ ✓$(0 - 2,4)$ ✓ $F_{net} = - 81,92$ $F_{net} = 81,92$ N ✓	$v_f^2 = v_i^2 + 2a\Delta y$ $0^2 = 2,4^2 + 2 \times a \times 2$ ✓ $a = -1,44\ m.s^{-2}$ $F_{net} = ma$ ✓ $F_{net} = (52 + 5)$ ✓ $(-1,44)$ ✓ $F_{net} = - 82,08$ $F_{net} = 82,08$ N ✓

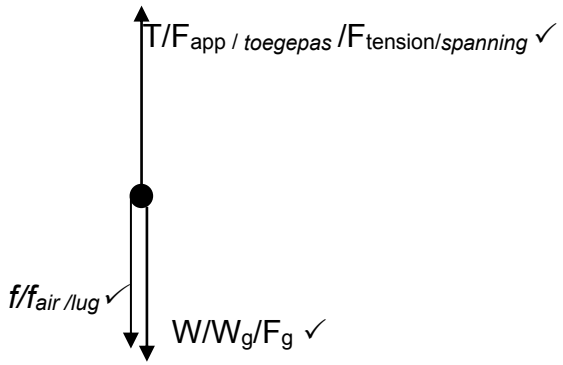
(5)
[12]

QUESTION/*VRAAG* 5

5.1 (If any of the underlined key words/phrases in the correct context are omitted: -1 mark per word/phrase)
The net work done on an object is equal to the change in the object's kinetic energy. ✓✓
The work done on an object by a net force is equal to the change in kinetic energy of the object. ✓✓

(Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 per woord/frase)
Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in die kinetiese energie van die voorwerp.
Die arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in kinetiese energie van die voorwerp. (2)

5.2



(3)

5.3 Tension force (of the rope) / *Spanningskrag (van die tou)*
Air resistance / *Lugweerstand*
} Any one/*Enige een* ✓ (1)

5.4

OPTION 1/*OPSIE* 1
$W_{Fg} = F_g.\Delta x \cos\theta$ ✓ $W_{Fg} = (75 \times 9,8) \times 12 \cos 180^\circ$ ✓ $W_{Fg} = -8\,820$ J ✓

OPTION 1/*OPSIE* 2
$W_{Fg} = -\Delta E_p$ $W_{Fg} = -[mg(h_2 - h_1)]$ $W_{Fg} = -mg\Delta h$ } Any one/*Enige een* ✓ $W_{Fg} = -[75 \times 9,8\ (12 - 0)]$ ✓ $W_{Fg} = -8\,820$ J ✓

(3)

5.5 **Positive marking from QUESTION 5.2/*Positiewe nasien vanaf VRAAG 5.2***

OPTION 1/*OPSIE* 1
$W_{net} = \Delta E_k$ $W_f + W_F + W_{Fg} = \Delta E_k$ $f \times \Delta x \cos\theta + F\Delta x\cos\theta + F_g\Delta x\cos\theta = \Delta E_k$ } Any one/*Enige een* ✓ $1\,540 \times 12\cos 180^\circ$ ✓ + $2\,400 \times 12\cos 0^\circ + (-8\,820)$ ✓ = $\frac{1}{2} \times 75 \times v_f^2 - 0$ ✓ $v_f = 6,32$ m.s^{-1} ✓

OPTION 2/*OPSIE* 2	
$W_{nc} = \Delta E_p + \Delta E_k$ $W_f + W_F = \Delta E_p + \Delta E_k$ $f \times \Delta x \cos\theta + F\Delta x\cos = mg(h_2 - h_1) + \Delta E_k$	Any one/*Enige een* ✓
$\underline{62,5 \times 24 \cos 180^o}$ ✓ $\underline{2\,400 \times 12 \cos 0^o}$ ✓ $= 75 \times 9,8(12 - 0) + \frac{1}{2} \underline{\times 75 \times v_f - 0}$ ✓ $m = 6,32\ m.s^{-1}$ ✓	(5)

[14]

QUESTION/*VRAAG* 6

6.1 (If any of the underlined key words/phrases in the correct context are omitted: -1 mark per word/phrase)
The (apparent) change in frequency observed by a listener because the listener and source of sound have different velocities relative to the medium of sound propagation ✓✓

(Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 per woord/frase)
Die (skynbare) verandering in frekwensie wat deur 'n luisteraar waargeneem word want die luisteraar en die klankbron verskillende snelhede het relatief tot die medium wat die klank veroorsaak.

OR/*OF*

The (apparent) change in frequency observed by a listener due to relative motion between the sound source and the listener. ✓✓

Die (skynbare) verandering in die frekwensie wat 'n luisteraar waarneem as gevolg van relatiewe beweging tussen die klankbron en die luisteraar. (2)

6.2 When the source moves towards a stationary observer, the wave in front of the source is compressed ✓ resulting in a shorter wavelength and a higher frequency ✓ (speed of sound constant).
Wanneer die bron nader aan 'n stilstaande waarnemer beweeg word die golf voor die bron saamgepers wat veroorsaak dat die golflengte korter is en die frekwensie hoër is terwyl die (spoed van klank konstant bly). (2)

6.3 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

$1,02\ f_s$ ✓ $= \frac{343}{343 - v_s}$ ✓ $\times f_s$ ✓

$v_s = 6,73\ m.s^{-1}$ ✓

(Accept any set of values for frequency that indicates that f_L is 2% higher than f_s)
(Aanvaar enige stel waardes vir frekwensie wat aandui dat f_L 2% hoër is as f_s) (5)

6.4 $v = \lambda f$ ✓
$343 = \lambda \times 720$ ✓
$\therefore \lambda = 0,48$ m (0,476 m) ✓ (3)

6.5 Used to measure the direction and speed of blood flow in arteries and veins.
Used to measure the heartbeat of a foetus in the womb. (Any one) ✓

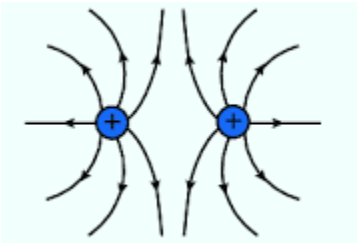
Gebruik om die rigting en spoed van bloedvloei in die are te meet.
Word gebruik om die hartklop van 'n fetus in die baarmoeder te meet.
(Enige een) (1)
[13]

QUESTION/*VRAAG 7*

7.1 (If any of the underlined key words/phrases in the correct context are omitted: -1 mark per word/phrase)
The electrostatic force per unit positive charge placed at the point. ✓✓

(Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 per woord/frase)
Die elektrostatiese krag per eenheid positiewe lading wat by die punt geplaas word. (2)

7.2



Marking criteria /*Nasienkriteria*		
✓	Correct shape	*Korrekte vorm*
✓	Direction of field lines	*Rigting van veldlyne*
✓	Field lines touch surface of point charge and do not cross	*Veldlyne raak oppervlakte van puntlading en kruis nie*

(3)

7.3 $E = \frac{kQ}{r^2}$ ✓

$E_1 = \frac{(9 \times 10^9)(5 \times 10^{-6})}{(0,1)^2}$ ✓

$E_1 = 4,5 \times 10^6$ N.C^{-1} left

$E_2 = \frac{(9 \times 10^9) \times Q}{(0,4)^2}$ ✓ left

$E_{net} = E_1 + E_2$

$4,70 \times 10^6 = 4,5 \times 10^6$ ✓ $+ \frac{(9 \times 10^9) \times Q}{(0,4)^2}$ ✓

$2 \times 10^5 = \frac{(9 \times 10^9) \times Q}{(0,4)^2}$ ✓

$Q_T = 3,56 \times 10^{-6}$ C ✓ (6)

7.4

OPTION 1/*OPSIE* 1

$E = \frac{F}{q}$ ✓

$4{,}70 \times 10^{6}$ ✓ $= \frac{F}{-2 \times 10^{-6}}$ ✓

$F = -9{,}4$

F = 9,4 N to the right ✓

OPTION 2/*OPSIE 2*

$F_E = \frac{kQ_1Q_2}{r^2}$ ✓

$F1 = \frac{(9 \times 10^{9})(5 \times 10^{-6})(2 \times 10^{-6})}{(0{,}1)^2}$ ✓ right

$F_1 = 9$ N

$F_2 = \frac{(9 \times 10^{9})(3{,}56 \times 10^{-6})(2 \times 10^{-6})}{(0{,}4)^2}$ ✓ right

$F_2 = 0{,}4$

$F_{net} = F_1 + F_2$

$F_{net} = 9 + 0{,}4$ ✓

F_{net} = 9,4 N to the right ✓ (4)

[15]

QUESTION/*VRAAG* 8

8.1 (If any of the underlined key words/phrases in the correct context are omitted: -1 mark per word/phrase)
The total energy per coulomb of charge that a battery can supply. ✓✓

(Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 per woord/frase)
Die totale energie per coulomb lading wat 'n battery kan lewer. (2)

8.2.1 1,4 V ✓ (1)

8.2.2 Gradient/*Gradiënt* = $\frac{\Delta V}{\Delta I} = \frac{1{,}4 - 0}{0 - 2{,}5}$ ✓ = -0,56

Gradient/*Gradiënt* = - r = -0,56 ✓

r = 0,56 Ω ✓ (3)

8.3.1 $V_{int} = \varepsilon - V$
$V_{int} = 15 - 13,5$ ✓
$V_{int} = 1,5$ V
$r = \frac{V}{I}$ ✓
$0,5 = \frac{1,5}{I}$ ✓
I = 3 A
$V_s = IR_s$
$V_s = 3 \times 3$✓ = 9 V
$V_p = 13,5 - 9 = 4,5$ V
$R = \frac{V}{I}$
$4 = \frac{4,5}{I}$ ✓
I = 1,125 A ✓ (6)

8.3.2

OPTION 1/*OPSIE 1*
Positive marking from QUESTION 8.3.1/*Positiewe nasien vanaf VRAAG 8.3.1*
I = 3 – 1,125 ✓ = 1,875 A
$R = \frac{V}{I}$
$R = \frac{4,5}{1,875}$ ✓

R = 2,4 Ω ✓

OPTION 2 / *OPSIE 2*
Positive marking from QUESTION 8.3.1/*Positiewe nasien vanaf VRAAG 8.3.1*
$V_{ext\ /\ eks} = I\ R_{ext\ /\ eks}$
$13,5 = 3 \times R_{ext/\ eks}$
$\therefore R_{ext/eks} = 4,5\ \Omega$ ✓

$R_{ext/eks} = R_p + 3$
$4,5 = R_p + 3$
$\therefore R_p = 1,5\ \Omega = \frac{3}{2}\ \Omega$ ✓

$\frac{1}{R_p} = \frac{1}{R} + \frac{1}{4}$
$\frac{2}{3} = \frac{1}{R} + \frac{1}{4}$
$\therefore R = 2,4\ \Omega$ ✓ (3)

[15]

QUESTION/*VRAAG* 9

9.1 AC generator. ✓ It has slip rings. ✓
WS generator. Dit het sleepringe. (2)

9.2 Y to/*na* X ✓✓ (2)

9.3 9.3.1 The rms potential difference is the AC potential difference which dissipates/produces the same amount of energy as an equivalent DC potential difference. ✓✓
(If any of the underlined key words/phrases in the correct context are omitted: -1 mark per word/phrase)

Die wgk potensiaalverskil is die WS-potensiaalverskil wat dieselfde hoeveelheid energie produseer/opwek as 'n ekwivalente GS-potensiaalverskil.
(Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 per woord/frase). (2)

9.3.2 $P_{average/gem} = \frac{V^2_{rms/wgk}}{R}$ ✓

$1\ 200 = \frac{220^2}{R}$ ✓

$R = 40{,}33\ \Omega$ ✓ (3)

9.3.3 $P_{average/gem} = V_{rms/\ wgk}\ I_{rms/wgk}$ ✓
$1\ 200 = I_{rms/\ wgk} \times 220$ ✓
$I_{rms/wgk} = 5{,}45$ A
$I_{rms/wgk} = \frac{I_{max/maks}}{\sqrt{2}}$ ✓
$5{,}45 = \frac{I_{max/maks}}{\sqrt{2}}$ ✓
$I_{max/maks} = 7{,}71$ A ✓ (5)
[14]

QUESTION/*VRAAG* 10

10.1 (If any of the underlined key words/phrases in the correct context are omitted: -1 mark per word/phrase)
The photo-electric effect is the process where electrons are released from a (metal) surface ✓when light of appropriate frequency is shone on the surface. ✓
(Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 per woord/fase)
Die foto-elektriese effek is die proses waardeur elektrone uit 'n (metaal) oppervlak vrygestel word wanneer lig van geskikte frekwensie invallend op die oppervlak is. (2)

10.2 The minimum energy of light needed to emit (photo) electrons from a metal surface. ✓✓
Die minimum energie van lig wat nodig is om (foto) elektrone uit 'n metaal oppervlakte vry te stel. (2)

10.3

OPTION 1/*OPSIE* 1

$W_0 = \frac{hc}{\lambda_0}$ ✓

$W_0 = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{(555 \times 10^{-9})}$ ✓

$W_0 = 3,58 \times 10^{-19}$ J ✓

OPTION 2/*OPSIE* 2

$E = W_0 + E_{k(max)}$ */(maks)*

$\frac{hc}{\lambda} = W_0 + E_{k(max)}$ */(maks)* } Any one/*Enige een* ✓

$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{(555 \times 10^{-9})} = W_0 + 0$ ✓

$W_0 = 3,58 \times 10^{-19}$ J ✓ (3)

10.4 Increases. ✓ With light of higher intensity more photons strike the metal surface per second. Thus more (photo) electrons are emitted per second, resulting in a bigger current ✓

Neem toe. Indien die lig 'n hoër intensiteit het, sal meer fotone die metaal oppervlate per sekondes tref. Dus word meer (foto) elektrone per sekonde vrygestel wat 'n groter stroom gee. (2)

10.5 $E = W_0 + E_{k(max)}$ */ (maks)*

$hf = W_0 + E_{k(max)}$ */ (maks)*

$hf = W_0 + + \frac{1}{2} mv_{(max/maks)}^2$ } Any one/*Enige een* ✓

$6,63 \times 10^{-34} f$ ✓ $= 3,58 \times 10^{-19}$ ✓ $+ \frac{1}{2} \times 9,11 \times 10^{-31} \times (5 \times 10^6)^2$ ✓

$f = 1,72 \times 10^{16}$ Hz ✓ (4)

[13]

TOTAL/*TOTAAL*: 150