education
Department of Education
FREE STATE PROVINCE

PREPARATORY EXAMINATION

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2022

MARKS: 150

TIME: 3 HOURS

This question paper consists of 14 pages and 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 10 questions. Answer ALL 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 subquestions, 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 where applicable.
10. Give brief motivations, discussions, et cetera where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTION

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

1.1 A block is at rest on a table. Which ONE of the following best describes the normal force acting in this situation?

A Force of the block on the table.
B Force of the table on the block.
C Force of the table on the earth.
D Force of the block on the earth. (2)

1.2 An object moving at a constant velocity has momentum *p* and kinetic energy *E*. What will the kinetic energy of the object be if its momentum is changed to *2p* while its mass remains constant?

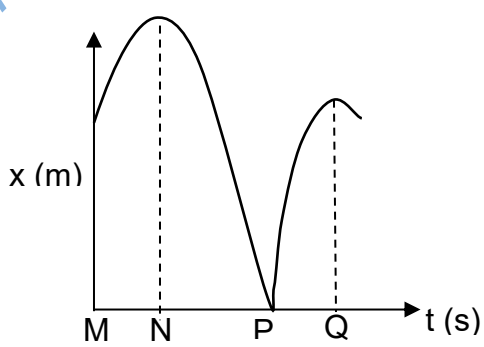
A $\frac{1}{4}$ E

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

C 2 E

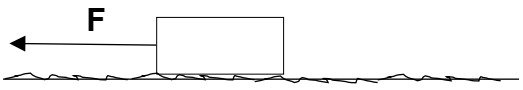
D 4 E (2)

1.3 The position-time graph below shows the motion of a ball that is thrown vertically UPWARDS. It bounces off the ground. At what time during its motion does the ball have the most kinetic energy?



A M
B N
C Q
D P (2)

1.4 A block being pulled by force **F** and moving to the left on a rough horizontal surface, is slowing down.



The directions of the resultant force and the acceleration are:

	DIRECTION OF THE RESULTANT FORCE	DIRECTION OF THE ACCELERATION
A	to the right	to the left
B	to the right	to the right
C	to the left	to the left
D	to the left	to the right

(2)

1.5 Which ONE of the following units is equivalent to the watt?

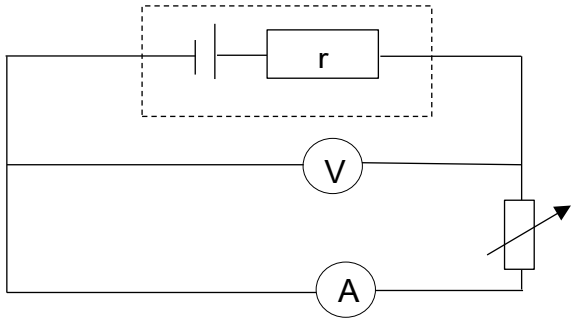
A $A \cdot \Omega$

B $A \cdot V^{-1}$

C $A \cdot V$

D $A \cdot \Omega^2$ (2)

1.6 A variable resistor is included in the circuit below.



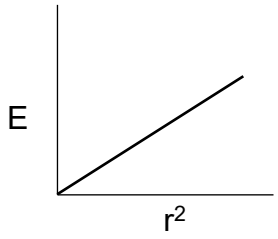
The resistance of the variable resistor is decreased. Which ONE of the following combinations of changes will occur in the ammeter and voltmeter readings?

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

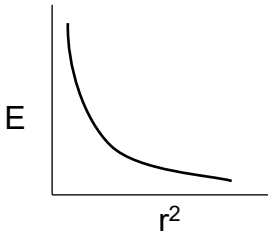
(2)

1.7 Which of the following graphs best represents the relationship between the electric field **E** caused by a point charge at a point and the distance **r** of that point from the point charge?

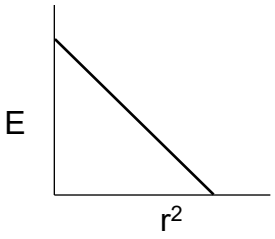
A



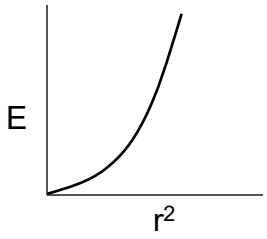
B



C

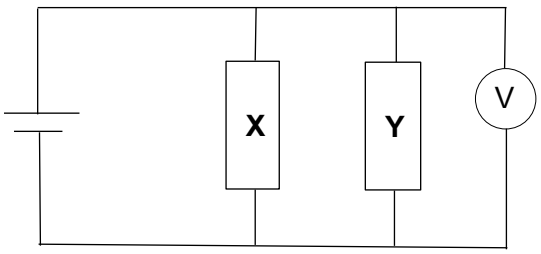


D



(2)

1.8 In the circuit below the resistance of **X** is R, and that of **Y** is 2R.



If the power dissipated by **Y** is P, then the power dissipated by **X** will be …

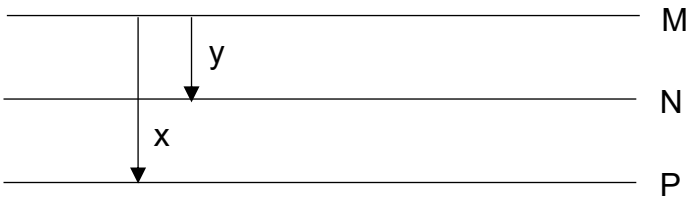
A $\frac{1}{4}$ P

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

C 2 P

D 4 P (2)

1.9 The diagram shows three energy levels (M, N and P) in an atom.



The energy related to the photon ejected due to transition **x** is DOUBLE that of the photon ejected during transition **y**.

The wavelength of the photon ejected due to transition **x** is λ. The wavelength of the photon ejected due to transition **y** will be …

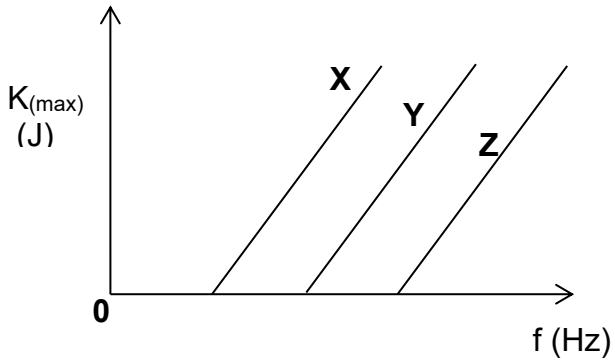
A $\frac{1}{3}\lambda$

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

C 2λ

D 3λ (2)

1.10 The graph below shows three different results (**X**, **Y** and **Z**) of an experiment involving the photoelectric effect.



Which ONE of the following best explains the lines X, Y and Z on the graph?

A The same metal, with a different threshold frequency is used.

B The same metal, with the same threshold frequency is used.

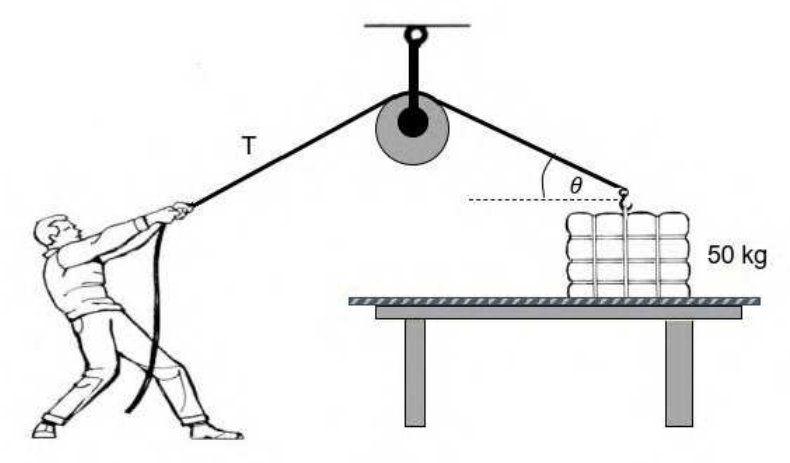
C Different metals, all with the same threshold frequencies are used.

D Different metals, all with different threshold frequencies are used. (2)

[20]

QUESTION 2

A man applies a constant pulling force to move a heavy parcel of mass 50 kg horizontally using a light inextensible rope which passes over a light frictionless pulley, as shown in the diagram below. The parcel stays at rest. The magnitude of the maximum static frictional force experienced by the parcel is 120 N and the coefficient of maximum static friction for the two surfaces is 0,34.



2.1 Draw a labelled free-body diagram showing ALL forces exerted on the parcel. (4)

2.2 Define the term *frictional force* in words. (2)

2.3 Calculate the magnitude of the vertical component of the tension in the rope. (4)

2.4 Determine the magnitude of the tension in the rope (**T**). (4)

2.5 The man now increases the magnitude of his pulling force. Under the action of this new constant force, the parcel begins to slide horizontally along the table.

How will the magnitude of the following forces change as the parcel begins to slide across the table surface?

Choose from INCREASES, DECREASES or REMAINS THE SAME**.**

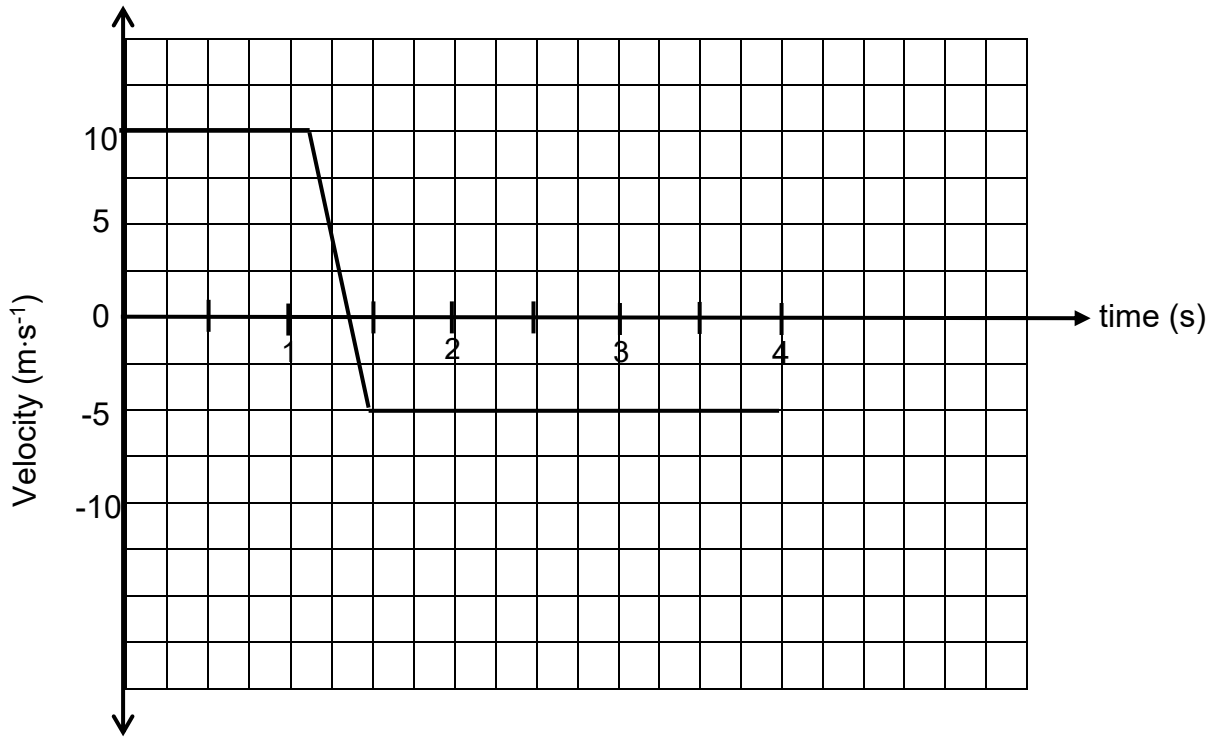
2.5.1 The normal force (1)

2.5.2 The frictional force (1)

[16]

QUESTION 3

Car **P**, mass **m**, is initially travelling eastwards when it collides with another car **Q** of mass 1,7 **m** which is travelling westwards at 15 $m \cdot s^{-1}$. Ignore the rotation effects of the wheels and friction. The graph below shows how the velocity of car **P** changes with time. Take the initial motion of car **P** as positive.



3.1 Define the term *impulse* in words. (2)

3.2 Calculate the velocity of car **Q** after the collision. (5)

3.3 It is observed that the kinetic energy of the system DECREASES by 175000 J after the collision.

3.3.1 Is the collision ELASTIC or INELASTIC? (1)

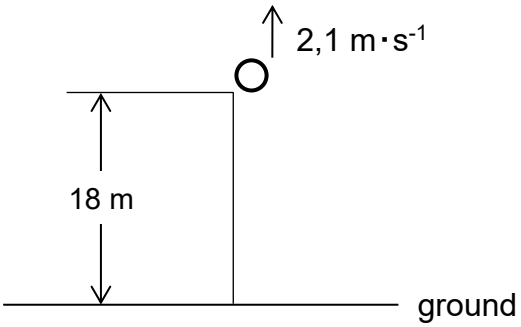
3.3.2 Calculate mass *m*. (5)

3.3.3 USING THE GRAPH, calculate the magnitude of the net force exerted on car **P** during the collision. (4)

[17]

QUESTION 4

A ball is thrown vertically UPWARDS from the top of a building 18 m above the ground with a speed of 2,1 $m \cdot s^{-1}$. Ignore air resistance.



4.1 Explain what is meant by the term *projectile*. (2)

4.2 Write down the magnitude and direction of the acceleration of the ball when it reaches its maximum height. (2)

4.3 Calculate the speed at which the ball strikes the ground. (3)

4.4 Calculate the height above the ground reached by the ball 1,6 s after it is thrown vertically upward. (4)

On reaching the ground, the ball bounces ELASTICALLY from the ground with negligible contact time.

4.5 Sketch the velocity-time graph for the complete motion of the ball until it reaches its maximum height after rebounding.

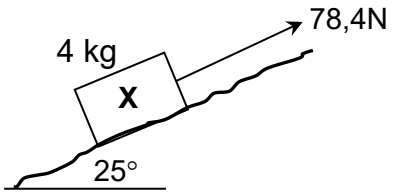
Show the following on the graph:

- The velocity of the ball when thrown upwards
- The velocity of the ball when reaching the ground (3)

[14]

QUESTION 5

Block **X** of mass 4 kg is initially at rest at the bottom of an incline, which makes an angle of 25º with the horizontal. A 78,4 N force, acting parallel to the incline, pulls block X up the incline. Block X experiences a constant frictional force of 13 N.



5.1 Define the term *conservative force* in words and give an example of such a force acting on block X. (3)

5.2 Draw a free body diagram indicating all the forces parallel to the incline, acting on the block. (3)

5.3 Using energy principles only, calculate the speed of block **X** after it has moved 3 m up the incline. (5)
[11]

QUESTION 6

An ambulance moves away from an accident scene at a constant speed. Its siren produces sound waves with a frequency of 890 Hz. A person standing at the accident scene measures a change of 89 Hz in the frequency of the sound produced by the siren as it moves away.

6.1 NAME and DESCRIBED the phenomenon above. (3)

6.2 If the speed of sound in air is 340 $m \cdot s^{-1}$, calculate the speed of the ambulance. (5)

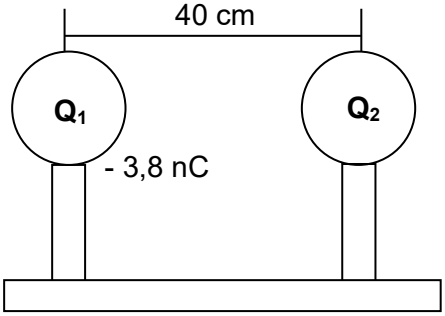
6.3 How will the frequency measured by the person be affected if the speed of the ambulance increases?

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

6.4 State ONE use of the Doppler-flow meter in the medical field. (1)
[10]

QUESTION 7

7.1 Two identical charged metal spheres Q_1 and Q_2 are placed on insulated stands with their centres 40 cm apart. The charge on Q_1 is -3,8 nC. The electrostatic force of attraction between the two spheres is 8,54 x 10^{-7} N.

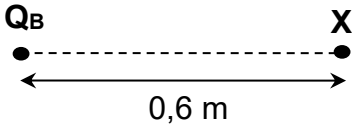


7.1.1 State *Coloumb's law* in words. (2)

7.1.2 Calculate the charge on Q_2. (3)

7.1.3 The two spheres are now brought into contact with each other and then separated. Calculate the new charge on EACH sphere. (2)

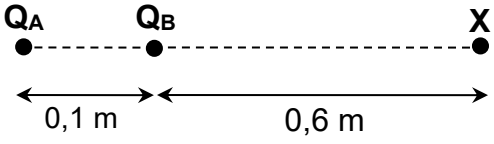
7.2 Point **X** is 0,6 m to the right of charge Q_B which has a charge of +2 x 10^{-6} C, as shown in the diagram below.



7.2.1 Draw the electric field pattern due to Q_B. (2)

7.2.2 Calculate the magnitude of the electric field due to Q_B at point **X**. (3)

A second charge, Q_A of magnitude +6 x 10^{-6} C, is now placed 0,1 m to the left of charge Q_B, as shown in the diagram below.



7.2.3 Calculate the magnitude of the net electric field experienced at point **X**. (3)

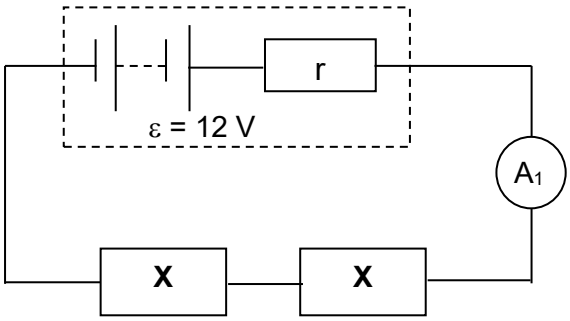
7.2.4 Calculate the magnitude of the net electrostatic force that an electron would experience if it is placed at point **X**. (3)

[18]

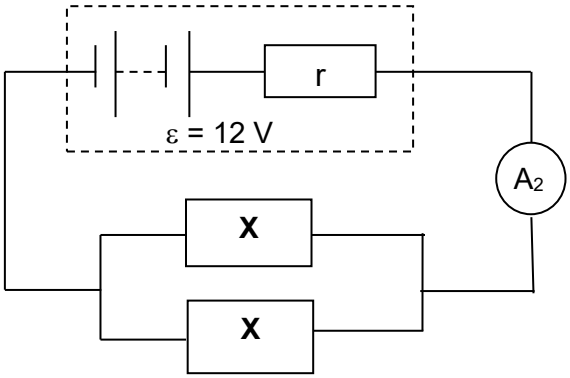
QUESTION 8

The diagrams below show circuits **1** and **2** with identical batteries (emf 12 V and internal resistance r). The battery in each circuit is connected to two identical resistors, each with resistance X. Ammeters A_1 and A_2 and the conducting wires have negligible resistance.

CIRCUIT 1



CIRCUIT 2



8.1 State *Ohm's law* in words. (2)

8.2 Show that the total external resistance in circuit **1** is FOUR times that in circuit **2**. (3)

8.3 How would the lost volts in circuit **1** compare to that in circuit **2**?

Choose from GREATER THAN, LESS THAN or THE SAME AS.

Give a reason for the answer. (2)

8.4 The ammeter reading in circuit **2** is 1,5 A, and the internal resistance is 2Ω.

8.4.1 Calculate the value of **X**. (4)

8.4.2 Calculate the ammeter reading in circuit **1**. (2)

8.5 How will the power dissipated by a resistor in circuit **2,** compare to the power dissipated by a resistor in circuit **1**?

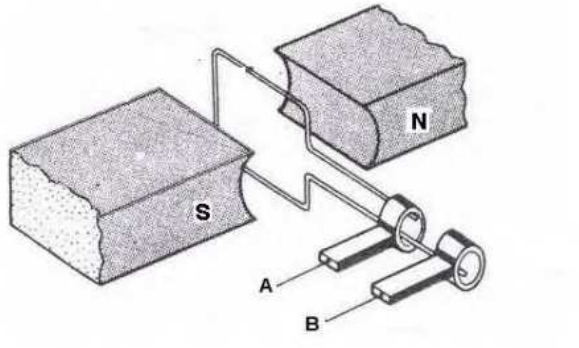
Choose from BIGGER THAN, SMALLER THAN or THE SAME.

Explain the answer. (3)

[16]

QUESTION 9

The simplified diagram below shows a generator.



9.1 Is the above a **DC** or an **AC** generator? (1)

9.2 Name the principle on which this generator works. (1)

9.3 State the energy conversion that takes place in this generator. (2)

9.4 The maximum emf generated is 15 V. Draw a graph to illustrate how the induced emf changes with time for one complete rotation of the coil, starting from the position of the coil indicated in the diagram above. Label the axis and indicate the given data. (3)

9.5 The specifications of an electric drill are as follows:

2 100 W; 240 V

9.5.1 Define *rms for an alternating voltage*. (2)

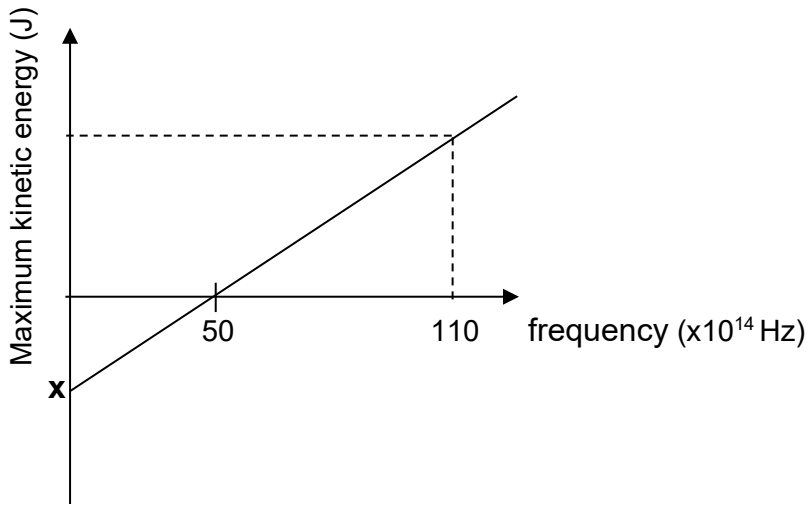
9.5.2 What is the rms voltage for this drill? (1)

9.5.3 Calculate the maximum current value of the current that can flow through the drill. (4)

[14]

QUESTION 10

Different frequencies of light are shone onto the surface of a metal cathode of a photoelectric cell. The graph below shows the relationship between the maximum kinetic energy of the photoelectrons and the frequency of the incident light.



10.1 Define the term *work function* in words. (2)

10.2 Give a reason why no photo-electrons are released when light of 45×10^{14} Hz is used. (2)

10.3 Which quantity can be determined from the gradient of the graph? (1)

10.4 Calculate the magnitude of **x.** (3)

10.5 Light of frequency 110×10^{14} Hz is shone onto the metal cathode.

10.5.1 Calculate the speed of the ejected electrons. (4)

10.5.2 What effect will an increase in the intensity of the light have on the maximum speed of the ejected electrons?

Choose from INCREASES, DECREASES or STAYS THE SAME.

Explain the answer. (2)

[14]

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

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ 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*

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

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

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

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* $E = h\frac{c}{\lambda}$
$E = W_o + E_{k(max/maks)}$ or/*of* $E = W_o + K_{max/maks}$ where/*waar* $E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_{k(max/maks)} = \frac{1}{2}mv^2_{max/maks}$ or/*of* $K_{(max/maks)} = \frac{1}{2}mv^2_{max/maks}$	

ELECTROSTATICS/*ELEKTROSTATIKA*

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

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 = VI Δt 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*

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

education

Department of Education
FREE STATE PROVINCE

PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN

GRADE/*GRAAD* 12

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

SEPTEMBER 2022

MARKS/*PUNTE*: 150

MARKING GUIDELINES
NASIENRIGLYNE

This marking guideline consists of 17 pages.
Hierdie nasienriglyne bestaan uit 17 bladsye.

QUESTION/*VRAAG* 1

1.1 B ✓✓ (2)

1.2 D ✓✓ (2)

1.3 D ✓✓ (2)

1.4 C ✓✓ (2)

1.5 C ✓✓ (2)

1.6 B ✓✓ (2)

1.7 B ✓✓ (2)

1.8 C ✓✓ (2)

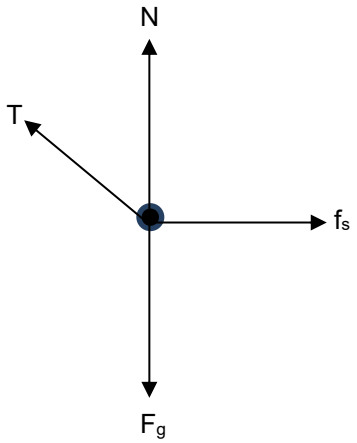
1.9 C ✓✓ (2)

1.10 D ✓✓ (2)

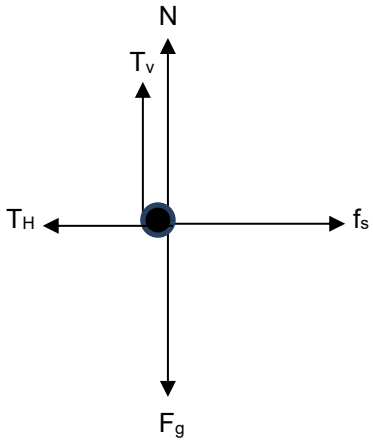
[20]

QUESTION/*VRAAG* 2

2.1



ACCEPT/*AANVAAR*



(4)

Accept the following symbols/*Aanvaar die volgende simbole*		
T	F_T/Force on the rope/$F_{Applied}$ *F_T/Krag op die tou/$T_{oegepas}$*	✓
F_g	w/F_w/weight/*gewig*	✓
N	F_N/Normal/Normal force *F_N/Normaal/Normaalkrag*	✓
f_s	Friction/frictional force/static frictional force/120N *Wrywing/wrywingskrag/statiese wrywingskrag/120N*	✓

NOTE/*LET WEL*:

- Mark awarded for label and arrow/*Punt toegeken vir benoeming en pyl*
- Do not penalise for length of arrow since drawing is not to scale. *Moenie penaliseer vir lengte van pyl nie, aangesien tekening nie volgens skaal is nie.*
- Any additional force(s)/*Enige addisionele krag/te* $\frac{3}{4}$
- If force(s) do not make contact with body $\frac{3}{4}$
  Indien krag(te) nie met liggaam kontak maak nie
- No labels/*Geen benoeming* $\frac{0}{4}$

Marking criteria/*Nasienkriteria:*
If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase
Indien enige van die onderstreepte sleutelwoorde/-frases in die korrekte konteks weggelaat word:
- 1 punt per woord/frase

2.2 The force that opposes the motion of an object and which acts parallel to the surface. ✓✓

Die krag wat die beweging van 'n voorwerp teenstaan en wat parallel op die oppervlak inwerk. (2)

2.3

$$F_{net} = ma$$
$$T_V + N - F_g = 0 \quad \checkmark$$
$$T_V + \left(\frac{120}{0,34}\right)^{\checkmark} - (50 \times 9,8) = 0^{\checkmark}$$
$$T_V = 137,06\ N \checkmark$$

OPTION 2/*OPSIE 2*

$$T_v + \frac{f}{\mu_s} = Fg \checkmark$$
$$T_v + \frac{120}{0,34} \checkmark = 50(9,8) \checkmark$$
$$T_v = 137,06\ N \checkmark$$

(4)

2.4 **POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 2.3**

$$T_H + f_s = ma$$
$$T_H - 120 = 0 \checkmark$$
$$T_H = 120\ N$$

$$T = \sqrt{T_V^2 + T_H^2}$$
$$= \sqrt{(137,06)^2 \checkmark + (120)^2} \checkmark$$
$$= 182,17\ N \checkmark$$

(4)

2.5.1 Decreases/*Afneem* ✓ (1)

2.5.2 Decreases/*Afneem* ✓ (1)
[16]

QUESTION/*VRAAG* 3

3.1 The product of the resultant/net force acting on an object and the time the resultant/net force acts on the object. ✓✓ **(2/0)**

Die produk van die resulterende/netto krag wat op 'n voorwerp inwerk en die tyd wat die resulterende/netto krag op die voorwerp inwerk. (2)

3.2 **OPTION/*OPSIE* 1**

Motion to the east / *Beweeg na oos* (+)

$\Sigma p_i = \Sigma p_f$
$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$ } Any/Enige ✓

$m(10) + 1{,}7m(-15)$ ✓ $= m(-5) + 1{,}7mv_f$ ✓

$v_f = -6{,}18\ m\cdot s^{-1}$

$= 6{,}18\ m\cdot s^{-1}$ ✓ west / forward ✓
wes / vorentoe (5)

OPTION/*OPSIE* 2
Motion to the east/ *Beweeg na oos* (-)

$\Sigma p_i = \Sigma p_f$
$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$ } Any/*Enige* ✓

$m(-10) + 1{,}7m(15)$ ✓ $= m(5) + 1{,}7mv_f$ ✓

$v_f = +6{,}18\ m\cdot s^{-1}$

$= 6{,}18\ m\cdot s^{-1}$ ✓ west / forward ✓
wes / vorentoe

OPTION/*OPSIE* 3
Motion to the east / *Beweeg na oos* (+)

$\Delta p_1 = -\Delta p_2$
$m_1(v_{f1} - v_{i1}) = -m_2(v_{f2} - v_{i2})$ } Any / Enige ✓

$m(-5\ -10)$ ✓ $= -1{,}7m(v_{f2} - (-15))$ ✓

$v_f = -6{,}18\ m\cdot s^{-1}$

$= 6{,}18\ m\cdot s^{-1}$ ✓ west / forward ✓
wes / vorentoe

OPTION/*OPSIE* 4
Motion to the east / *Beweeg na oos* (-)

$\Delta p_1 = -\Delta p_2$
$m_1(v_{f1} - v_{i1}) = -m_2(v_{f2} - v_{i2})$ } Any / Enige ✓

$m(5 + 10)$ ✓ $= -1{,}7m(v_{f2} - (+15))$ ✓

$v_f = +6{,}18\ m\cdot s^{-1}$

$= 6{,}18\ m\cdot s^{-1}$ ✓ west / forward ✓
wes / vorentoe

3.3.1 Inelastic/*Onelasties* ✓ (1)

3.3.2 **POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 3.2**

$\Delta K = K_f - k_i$
$\sum K_i = \sum K_f + \text{energy lost/}energie\ verloor$
$\frac{1}{2}m_P v_{Pi}^2 \rightleftarrows + \frac{1}{2}m_Q v_{Qi}^2 = \frac{1}{2}m_P v_{Pf}^2 + \frac{1}{2}m_Q v_{Qf}^2 + 175000\ J$ } Any/*Enige* ✓

$\frac{1}{2}m\ (10^2) + \frac{1}{2}(1{,}7m)\ (15^2)$ ✓ $= \frac{1}{2}m\ (5^2) + \frac{1}{2}(1{,}7\ m)(6{,}18)^2$ ✓ $+ 175000$ ✓
$m = 881{,}54\ kg$ ✓ (5)

3.3.3 **POSITIVE MARKING 3.2 AND 3.3.2**
POSITIEWE NASIEN 3.2 EN 3.3.2

Note: Force on car **P** is exerted by car **Q**.
Let wel: *Krag op motor **P** word deur motor **Q** uitgeoefen.*

(Newton's third law of motion/*Newton se derde bewegingswet)*

$F_{net/netto}\Delta t = \Delta p$
$F_{net/netto} = \frac{\Delta p}{\Delta t}$
$= \frac{m(v_f - v_i)}{\Delta t}$ } Any ✓

$= \frac{881{,}54(-5-10)}{1{,}75-1{,}25}$ ✓ ✓
$= -26\ 446{,}20$
$F_{net} = 26\ 446{,}20\ N$ ✓

ACCEPT/*AANVAAR*

$F_{net/netto}\Delta t = \Delta p$
$F_{net/netto} = \frac{\Delta p}{\Delta t}$
$= \frac{m(v_f - v_i)}{\Delta t}$ } Any ✓

$= \frac{1498{,}62(-6{,}18-(-15))}{1{,}75-1{,}25}$ ✓ ✓
$= 26\ 425{,}66\ N$
$F_{net/} = 26\ 425{,}66\ N$ ✓

(4)
[17]

QUESTION/*VRAAG* 4

4.1 An object (which has been given an initial velocity and) on which the only force acting is the gravitational force/weight. ✓✓ **(2/0)**

'n Voorwerp (wat 'n beginsnelheid gegee is en) waarop die enigste krag wat daarop inwerk, die gravitasiekrag/gewig is. (2)

4.2 9,8 m·s^{-2} ✓ Downwards/*Afwaarts* ✓ (2)

4.3 **OPTION/*OPSIE* 1**

Upwards as positive
Opwaarts as positief

$v_f^2 = v_i^2 + 2g\Delta y$ ✓
$= (2,1)^2 + 2(-9,8)(-18)$ ✓
$= 357,21$
$v_f = 18,9\ m\cdot s^{-1}$ ✓

OPTION/*OPSIE* 2

Upwards as negative
Opwaarts as negatief

$v_f^2 = v_i^2 + 2g\Delta y$ ✓
$= (-2,1)^2 + 2(9,8)(18)$ ✓
$= 357,21$
$v_f = 18,9\ m\cdot s^{-1}$ ✓

(3)

OPTION/*OPSIE* 3

Down as positive

$v_f^2 = v_i^2 + 2g\Delta y$ ✓
$= (2,1)^2 + 2(9,8)(1,8)$ ✓
$= 357,21$
$v_f = 18,9\ m\cdot s^{-1}$ ✓

OPTION/*OPSIE* 4

Down as negative

$v_f^2 = v_i^2 + 2g\Delta y$ ✓
$= (-2,1)^2 + 2(-9,8)(-1,8)$ ✓
$= 357,21$
$v_f = 18,9\ m\cdot s^{-1}$ ✓

(3)

4.4

OPTION/*OPSIE* 1

$\Delta y = v_i \Delta t + \frac{1}{2} g \Delta t$ ✓

$= (2{,}1)(1{,}6) + \frac{1}{2}(-9{,}8)(1{,}6)^2$ ✓

$= -9{,}184$

$\text{Height/} = 18 - 9{,}184$ ✓

$\textit{Hoogte} = 8{,}816 \text{ m}$ ✓

OPTION/*OPSIE* 2

Time/*Tyd* = 1,6 – 0,43
= 1,17 s

$\Delta y = v_i + \frac{1}{2} g \Delta t^2$ ✓

$= -2{,}1(1{,}17) + \frac{1}{2}(-9{,}8)(1{,}17)^2$ ✓

$= 9{,}16$

$Height/= 18, -9{,}16$

$\textit{Hoogte} = 8{,}83\ m$ ✓ ✓

OPTION/*OPSIE* 3

Time/*Tyd* = 1,6 – 0,21
= 1,38 s ✓

$\Delta y = v_i + \frac{1}{2} g \Delta t^2$ ✓

$= 0(1{,}38) + \frac{1}{2}(9{,}8)(1{,}38)^2$ ✓

$= 9{,}33$ ✓

$Height/= 18{,}107 - 9{,}33$

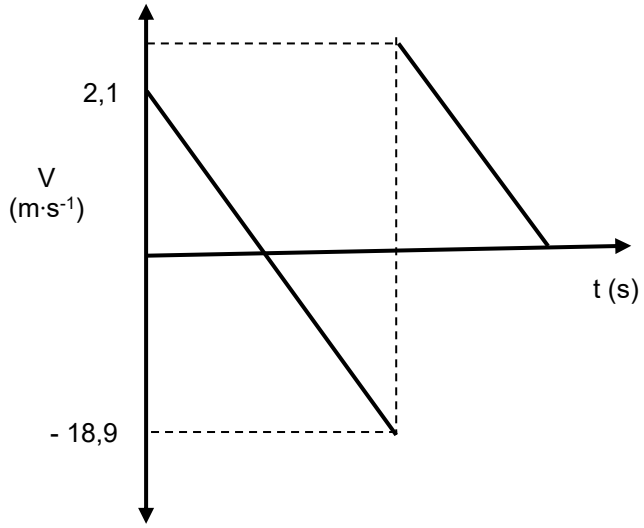
$\textit{Hoogte} = 8{,}78\ m$

(4)

Range: 8,78 m – 8,83 m

4.5 **OPTION/*OPSIE* 1**

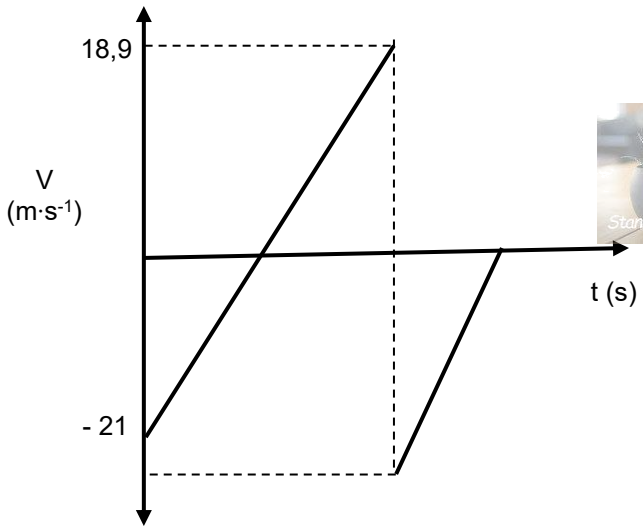
Upwards motion as positive/*Opwaartse beweging as positief*



NOTES/*AANTEKENINGE*:	
✓	Correct graph with lines parallel *Korrekte grafiek met parallelle lyne*
✓	Two velocities indicated *Twee snelhede aangedui*
✓	Velocity of rebound higher than initial velocity *Terugbonssnelheid hoër as aanvanklike snelheid*

OPTION/*OPSIE* 2

Downwards motion as positive/*Afwaartse beweging as positief*



NOTES/*AANTEKENINGE*:	
✓	Correct graph with lines parallel *Korrekte grafiek met parallelle lyne*
✓	Two velocities indicated *Twee snelhede aangedui*
✓	Velocity of rebound higher than initial velocity *Terugbonssnelheid hoër as aanvanklike snelheid*

(3)
[14]

QUESTION/*VRAAG* 5

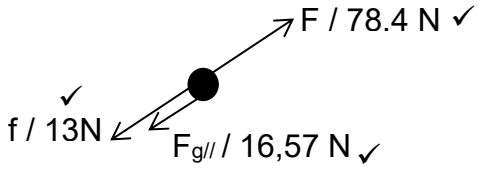
5.1 A force for which the work done in moving an object between two points, is independent of the path taken. ✓✓

Weight/gravitational force ✓

'n Krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, onafhanklik is van die pad wat geneem word.

Gewig/gravitasiekrag (3)

5.2



(3)

5.3

OPTION/*OPSIE* 1

$W_{net/netto} = \Delta K$

$W_{Fg//} + W_f + W_{FA} = \frac{1}{2}m(v_f^2 - v_i^2)$ ✓

$4(9{,}8)\sin 25°(3)\cos 180° + 13(3)\cos 180° + (78{,}4)(3)\cos 0° = \frac{1}{2}(4)v^2 - 0$ ✓ ✓ ✓

$v = 8{,}56\ m \cdot s^{-1}$ ✓

OPTION/*OPSIE* 2

$W_{nc} = \Delta K + \Delta U$

$W_f + W_{FA} = \frac{1}{2}m(v_f^2 + v_i^2) + mg(h_f - h_i)$ ✓

$13(3)\cos 180° + (78{,}4)(3)\cos 0° = \left[\frac{1}{2}(4)v^2 - 0\right] + [4(9{,}8)(3)\sin 25° - 0]$ ✓ ✓

$v = 8{,}56\ m \cdot s^{-1}$ ✓

OPTION/*OPSIE* 3

$$\sin 25^\circ = \frac{h}{3}$$
$$\therefore h_f = 3\sin 25^\circ$$

$W_{net/netto} = \Delta K$

$W_f + W_{Fg} + W_{FA} = \frac{1}{2}m(v_f^2 - v_i^2)$

$f\Delta x\cos\theta + F_g\Delta y\cos\theta + F_A\Delta x\cos\theta = \frac{1}{2}m[v_f^2 - v_i^2]$

Any/*Enige* ✓

$13(3)\cos 180°$ ✓ $+ 4(9{,}8)(3\sin 25°)\cos 180°$ ✓ $+ 78{,}4(1{,}8)\cos 0° = \frac{1}{2}(4)[v_f^2 - 0]$ ✓

$v = 8{,}56\ m\cdot s^{-1}$ ✓

OPTION/*OPSIE* 4

$W_{net/netto} = \frac{1}{2}m(v_f^2 - v_i^2)$

$W_{Fg} + W_f + W_F = \frac{1}{2}m(v_f^2 - v_f^2)$

$mg\Delta x\cos 115° + f\Delta x\cos 180° + F_A\Delta x\cos 0° = \frac{1}{2}m(v_f^2 - v_i^2)$

Any/*Enige* ✓

$4(9{,}8)(3\cos 115°$ ✓ $+ 13(3)\cos 180°$ ✓ $+ 78{,}4(3)\cos 0° = \frac{1}{2}(4)[v_f^2 - 0]$ ✓

$v = 8{,}56\ m\cdot s^{-1}$ ✓

(5)
[11]

QUESTION/*VRAAG* 6

6.1 Doppler effect ✓

It is the (apparent) change in frequency (or pitch) of the sound (detected by a listener) ✓ because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓

Doppler-effek

Dit is die (skynbare) verandering in frekwensie (of toonhoogte) van die klank (bespeur deur 'n luisteraar) omdat die klankbron en die luisteraar verskillende snelhede het relatief tot die medium van klankvoortplanting.

OR/*OF*

An (apparent) change in (observed/detected) frequency (pitch), (wavelength) ✓as a result of the relative motion between a source and an observer ✓(listener).

'n (Skynbare) verandering in (waargenome/bespeurde) frekwensie (toon-hoogte), (golflengte) as gevolg van die relatiewe beweging tussen 'n bron en 'n waarnemer (luisteraar). (3)

6.2

$$f_L = \left(\frac{v \pm v_L}{v \pm v_s}\right) f_s \checkmark$$

$$f_L = \left(\frac{v}{v + v_s}\right) f_s$$

$$\overset{\checkmark}{801} = \left(\frac{340}{340 + v_s}\right)^{\checkmark} \times 890^{\checkmark}$$

$$v_s = 37{,}78 \ \ m \cdot s^{-1} \checkmark$$

(5)

6.3 Decrease/*Afneem* ✓ (1)

6.4 Doppler flow meter is used to determine whether arteries are clogged/ narrowed.✓

Doppler-vloeimeter word gebruik om te bepaal of are verstop/vernou is.

OR/OF

To determine the rate of flow of blood.✓

Om die tempo van bloedvloei te bepaal. (1)
[10]

QUESTION/*VRAAG 7*

7.1.1 The magnitude of the electrostatic force exerted by one point charge on another point charge is directly proportional to the product of the magnitude of the charges✓ and inversely proportional to the square of the distance between them. ✓

Die grootte van die elektrostatiese krag wat deur een puntlading op 'n ander puntlading uitgeoefen word, is direk eweredig aan die produk van die grootte van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. (2)

7.1.2

$$F = \frac{k\,Q_1 Q_2}{r^2} \quad ✓$$

$$8{,}54 \times 10^{-7} = \frac{9 \times 10^9 \times (3{,}8 \times 10^{-9})Q_2}{(40 \times 10^{-2})^2} \quad ✓$$

$$Q_2 = 3{,}995 \times 10^{-9}\ C \quad ✓$$ Accept/*Aanvaar* $Q_2 = 4 \times 10^{-9}$ C (3)

If Q_2 is written as a negative charge, no mark for final answer. Indien Q_2 as *'n negatiewe lading geskryf is, geen punt vir die finale antwoord nie.*

7.1.3 **POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 7.1.2**

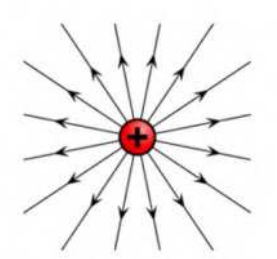
$$Q_{new/nuwe} = \frac{Q_1 + Q_2}{2}$$

$$= \frac{-3{,}8 \times 10^{-9} + 3{,}995 \times 10^{-9}}{2} \quad ✓$$

$$= 9{,}75 \times 10^{-11}\ C \quad ✓ \text{ or } 0{,}0975 \times 10^{-9}\ C$$

Accept/*Aanvaar*: 1×10^{-10} C or $0{,}1 \times 10^{-9}$ C (2)

7.2.1



Marking criteria/*Nasienkriteria:*

Correct direction away from the sphere *Korrekte rigting weg van die sfeer*	✓
Field lines not crossing and radial *Veldlyne kruis nie en radiaal*	✓

(2)

7.2.2 $E_{BX} = \frac{kQ_2}{r^2}$ ✓

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

$= 5 \text{ x } 10^4 \text{ N·C}^{-1}$ ✓ (3)

7.2.3 **POSITIVE MARKING FROM 7.2.2**
***POSITIEWE NASIEN VANAF* 7.2.2**

$E_{AX} = \frac{kQ_2}{r^2}$ ✓

$= \frac{9 \times 10^9 (6 \times 10^{-6})}{(0,7)^2}$ ✓

$= 11,02 \text{ x } 10^4 \text{ N·C}^{-1}$

$E_{net/netto} = E_B + E_A$
$= E_{Bx} + E_{AX}$
$= 5 \times 10^4 + 11,02 \times 10^4$ ✓
$= 1,602 \times 10^5 \text{ N} \cdot \text{C}^{-1}$ ✓ (3)

7.2.4 **POSITIVE MARKING FROM 7.2.3**
***POSITIEWE NASIEN VANAF* 7.2.3**

$F_{net/netto} = qE$ ✓
$= (1,6 \times 10^{-19})(1,6020 \times 10^5$ ✓
$= 2,56 \times 10^{-14} N$ ✓ (3)
[18]

QUESTION/*VRAAG* 8

8.1 The potential difference across a conductor is directly proportional to the current ✓in the conductor, provided the temperature remains constant.✓
Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier mits die temperatuur konstant bly. (2)

8.2

$$R_S = R_1 + R_2$$
$$= X + X$$
$$= 2X \quad ✓$$
$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$= \frac{1}{X} + \frac{1}{X}$$
$$= \frac{2}{X} \quad ✓$$
$$\frac{R_S}{R_P} = \frac{2X}{\frac{2}{X}} ✓$$
$$= 4$$
$$\therefore R_S = 4R_p$$

(3)

8.3 Less than✓
The current in circuit 1 is smaller than the current in circuit 2 ($V_i = Ir$) ✓
V_{intern} (circuit 1) is less than V_{intern} (circuit 2)

Minder/Kleiner as
Die stroom in stroombaan 1 is kleiner as die stroom in stroombaan 2 (Vi = Ir)
V_{intern} (stroombaan 1) is minder as V_{intern} (stroombaan 2) (2)

8.4.1

OPTION/*OPSIE* 1

$$\frac{1}{R_p} = \frac{1}{p_1} + \frac{1}{p_2}$$
$$= \frac{1}{x} + \frac{1}{x}$$
$$= \frac{2}{x}$$
$$\therefore R_p = \frac{x}{2}$$

$\varepsilon = I(R + r)$ ✓
$12 = 1{,}5\left(\frac{X}{2}✓ + 2\right)$ ✓
X= 12Ω ✓

OPTION/*OPSIE* 2

$$R_{Tot} = \frac{V_{Tot}}{I_{Tot}}$$
$$= \frac{12}{1{,}5}$$
$$= 8\ \Omega$$
$$8 = R_{ext} + 2$$
$$R_{ext} = 6\ \Omega$$
$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \quad ✓$$
$$\frac{1}{6}✓ = \frac{1}{X} + \frac{1}{X} \quad ✓$$
$$X = 12\ \Omega \quad ✓$$

(4)

POSITIVE MARKING FROM 8.4.1
POSITIEWE NASIEN VANAF 8.4.1

8.4.2 $\varepsilon = I(R + r)$
$12 = I\ (24\ +\ 2)$✓
I = 0,46 A ✓ (2)

8.5 Bigger than ✓

Voltage across resistor X is bigger than in circuit 2. ✓
∴Using $P = \frac{V^2}{R}$ the power will be bigger ✓

Groter as

Spanning oor weerstand X is groter as in stroombaan 2.
∴Deur $P = \frac{V^2}{R}$ *te gebruik, sal die drywing groter wees* (3)

[16]

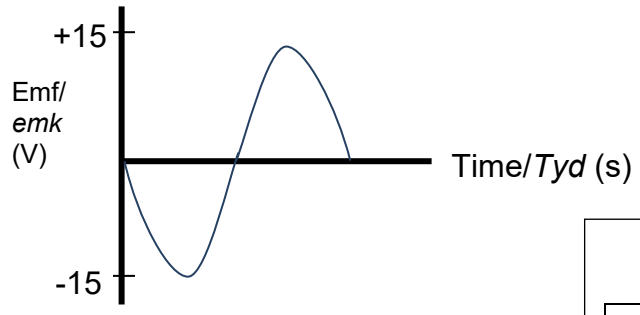
QUESTION/*VRAAG* 9

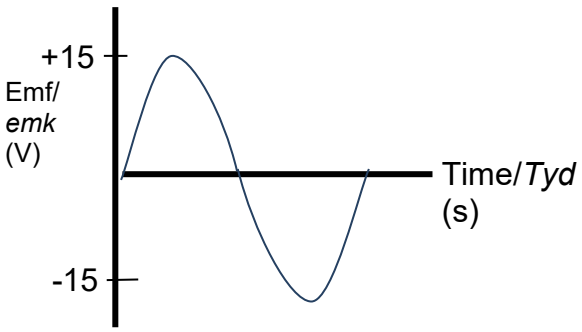
9.1 AC Generators/*WS-Generator* ✓ (1)

9.2 Electromagnetic induction/ *Elektromagnetiese induksie* ✓ (1)

9.3 Mechanical energy to electrical energy./*Meganiese energie na elektriese energie.*✓✓ (2)

9.4





Marking criteria ***Nasienkriteria***	
✓	Correct shape starting from zero *Korrekte vorm vanaf nul*
✓	1 wave drawn *1 golf geteken*
✓	Shows correct labels and minima and maxima *Toon korrekte benoeming; beide minimum en maksimum*

(3)

9.5.1 The rms value of AC is the DC potential difference which dissipates the same amount of energy as AC potential difference. ✓✓
Die wgk-waarde van WS is die GS-potensiaalverskil wat dieselfde hoeveelheid energie as WS-potensiaalverskil verbruik. (2)

9.5.2 240 V ✓ (1)

9.5.3

$P_{ave/gem} = V_{rms/wgk} I_{rms/wgk}$

$2100 = 240 \times I_{rms/wgk}$ ✓

$I_{rms/wgk} = 8{,}75\ A$

$P = \frac{V^2}{R}$

$2100 = \frac{(240)^2}{R}$ ✓

$R = 27{,}43\ \Omega$

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

$240 = \frac{V_{max}}{\sqrt{2}}$

$V_{max} = 339{,}41\ V$

OPTION 1

$I_{rms/wgk} = \frac{I_{max/maks}}{\sqrt{2}}$ ✓

$8{,}75 = \frac{I_{max/maks}}{\sqrt{2}}$ ✓

$I_{max/maks} = 12{,}37\ A$

OPTION/*OPSIE* 2

$R = \frac{V}{I}$ ✓

$27{,}43 = \frac{399{,}41}{I}$ ✓

$I_{max} = 12{,}37\ A$ ✓

OPTION/*OPSIE* 3

$R = \frac{V_{rms/wgk}}{I_{rms/wgk}}$

$27{,}43 = \frac{240}{I_{rms}}$ ✓

$I_{rms} = 8{,}75\ A$

$I_{rms/wgk} = \frac{I_{max/maks}}{\sqrt{2}}$ ✓

$8{,}75 = \frac{I_{max/maks}}{\sqrt{2}}$ ✓

$I_{max/maks} = 12{,}37\ A$ ✓

(4)
[14]

QUESTION/*VRAAG* 10

10.1 The work function of a metal is the minimum energy ✓ that an electron (in the metal) needs to be emitted/ejected from the(metal)surface. ✓

Die werkfunksie/arbeidsfunskie van 'n metaal is die minimum energie benodig om 'n elektron vanaf 'n (metaal) oppervlak vry te stel. (2)

10.2 The frequency of light is less than threshold/cut-off frequency of $50x10^{14}$ Hz.✓✓

Die frekwensie van lig is minder as die drumpel/afsnyfrekwensie van $50x10^{14}$ Hz. (2)

10.3 h / Planck's constant / *h/ Planck se konstante* ✓ (1)

10.4 $x = w_o = hf_o$ ✓
$= 6,63 \times 10^{-34} (50 \times 10^{14})$ ✓
$= 3,315 \times 10^{-18}$J ✓ (1)

10.5.1

$$E = W_0 + K_{max}$$
$$hf = hf_0 + \frac{1}{2}mv_{max}^2$$

Any/*Enige* ✓

$$6,6,3 \times 10^{-34}(110 \times 10^{14}) = 6,63 \times 10^{-34}(50 \times 10^{14}) + \frac{1}{2}(9,11 \times 10^{-31})v_{max}^2$$

$$v_{max} = 2,955 \times 10^6 \, m \cdot s^{-1}$$ ✓ (4)

10.5.2 Stays the same ✓
Intensity only increases the number of photons per unit time/photo-electrons emitted per unit time. ✓
OR
The energy of a photon/emitted photo-electron is not influenced by the intensity of the light.

Bly dieselfde
Intensiteit verhoog net die aantal fotone/foto-elektrone wat vrygestel word per eenheidstyd.
OF
Die energie van 'n foton/vrygestelde foto-elektron word nie deur die intensiteit van die lig beïnvloed nie. (2)
[14]

TOTAL: 150