education
Department of Education
FREE STATE PROVINCE

PREPARATORY EXAMINATION

GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

This question paper consists of 17 pages and 3 information 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 sub-questions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable pocket 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 QUESTIONS

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 Newton's second law of motion can be expressed as F_{net} = ma. This equation consists of …

A one vector quantity and two scalar quantities.

B two vector quantities and one scalar quantity.

C three vector quantities.

D three scalar quantities. (2)

1.2 The acceleration due to gravity on Earth is *g*. What is the acceleration due to gravity on a planet which has double the mass of the Earth and half the radius of the Earth?

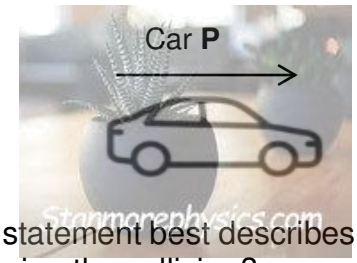
A ½ g

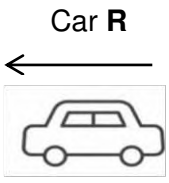
B 2 g

C 4 g

D 8 g (2)

1.3 Two cars **P** and **R** are travelling in opposite directions as shown in the diagram below. Car **R** has a greater mass than car **P** and it is moving at a higher speed. The two cars collide head-on.





Which statement best describes the magnitude of the forces experienced by the cars during the collision?

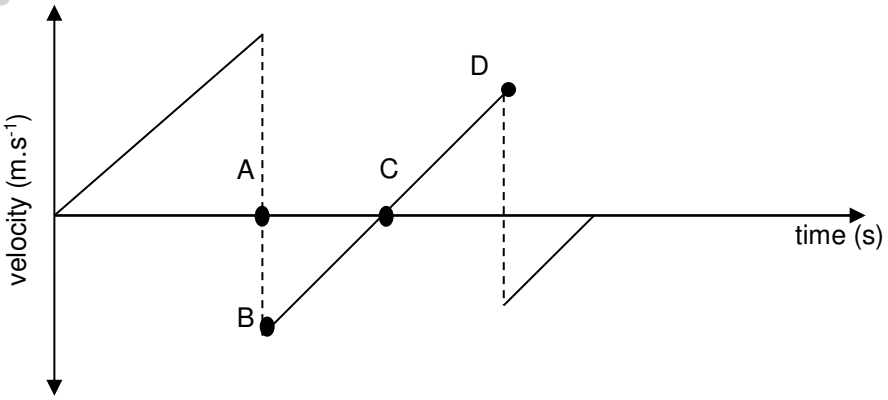
A Both cars experience equal force.

B Car **R** experiences greater force.

C Car **P** experiences greater forces.

D A force depends on the ratio of the cars' masses. (2)

1.4 A ball is dropped vertically downwards and bounces off the ground. The velocity versus time graph, not drawn to scale, represents the motion of the ball. Ignore the effect of air friction.



At which point labelled on the graph, does the ball reach its maximum height after the first bounce?

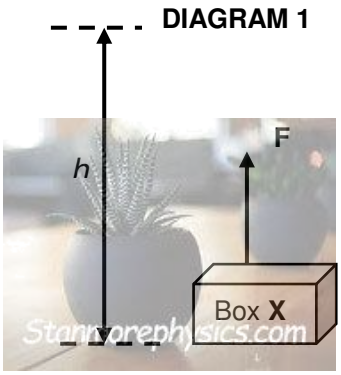
A A

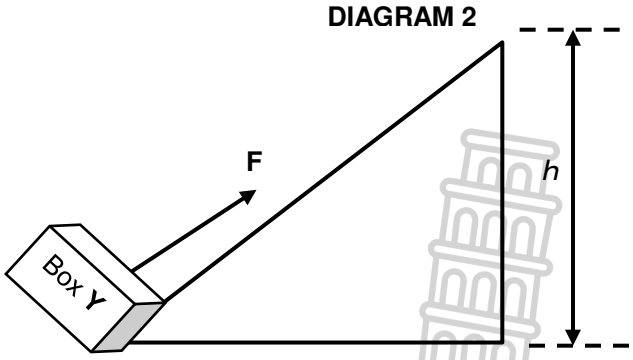
B B

C C

D D (2)

1.5 Two boxes, **X** and **Y**, of the same masses are lifted up with a constant velocity through a vertical height *h* and pulled up a frictionless surface by the same force **F** as shown in Diagram **1** and Diagram **2** below respectively.





Which ONE of the statements is CORRECT?

	ΔE_P of the boxes	Amount of work done by F
A	Is the same for both boxes	Is the same for both boxes
B	Is the same for both boxes	Box **y** is more than box **x**
C	Box **y** is less than box **x**	Box **y** is less than box **x**
D	Box **y** is more than box **x**	Box **y** is more than box **x**

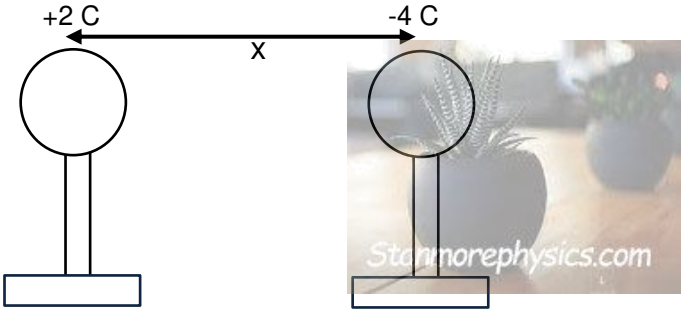
(2)

1.6 A police car with its siren on, moves at a constant speed towards a stationary observer. Which ONE of the following describes how the observed frequency and pitch differ from that of the sound source?

	Frequency	Pitch
A	Higher	Lower
B	Lower	Higher
C	Higher	Higher
D	Lower	Lower

(2)

1.7 Two small identical metal spheres on insulated stands, carry charges of +2 C and -4 C respectively. Each sphere experiences a force **F.** When they are distance *x* apart, they are brought together to touch and then separated to half the original distance. The magnitude of the electrostatic force which the spheres exert on each other in terms of **F** is …



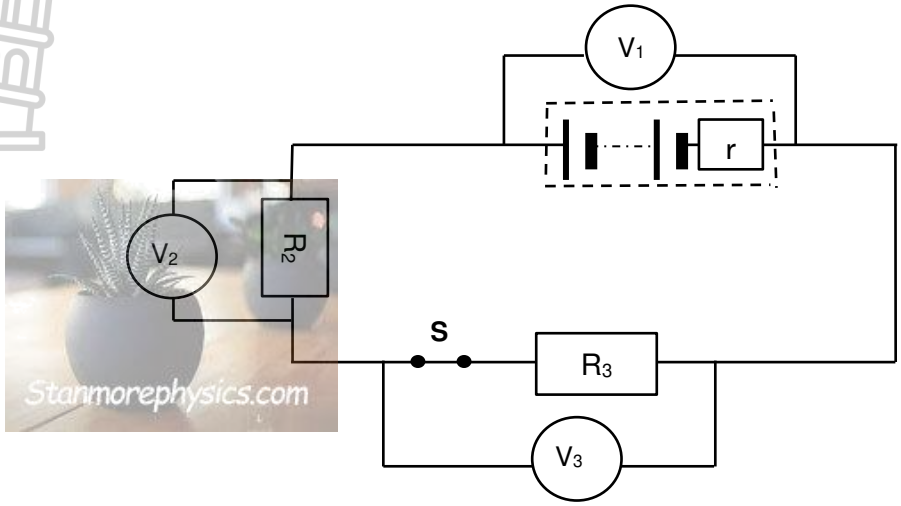
A ¼ **F**.

B ½ **F**.

C 2 **F**.

D 4 **F**. (2)

1.8 In the circuit diagram shown below, voltmeters **V_1**, **V_2** and **V_3** have very high resistance. The battery has an internal resistance, and the switch **S** and connecting wires have negligible resistance.

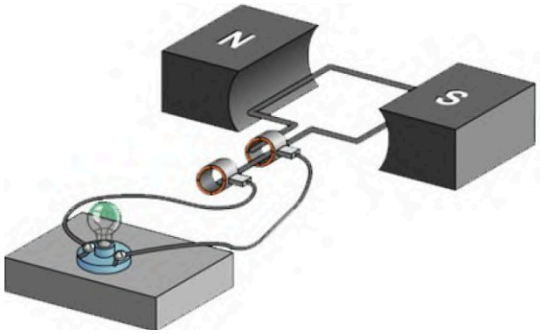


Switch **S** is now open. How will the readings of voltmeters **V_1** and **V_2** be affected?

	V_1	**V_2**
A	No change	Increase
B	No change	Decrease
C	Increase	Decrease
D	Increase	Increase

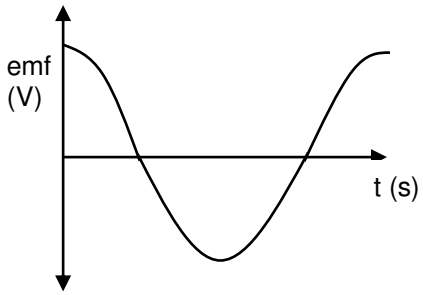
(2)

1.9 The diagram below represents a simple generator which is rotated clockwise.

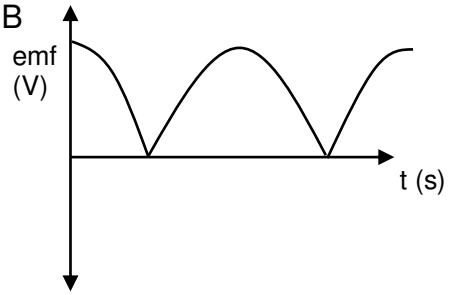


Which ONE of the following graphs represents the induced emf versus time for one full rotation of the coil, starting from the horizontal position as shown above?

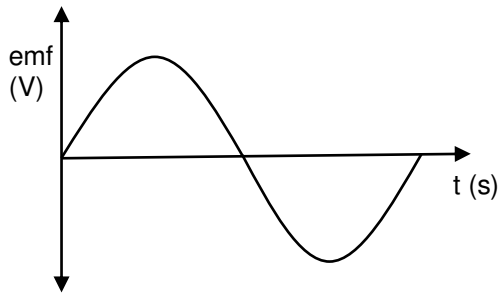
A



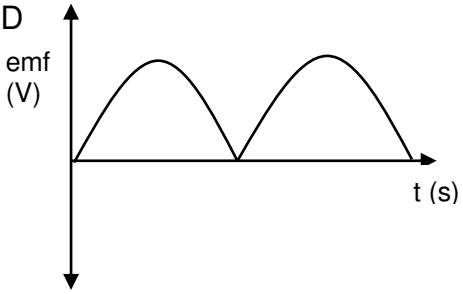
B



C



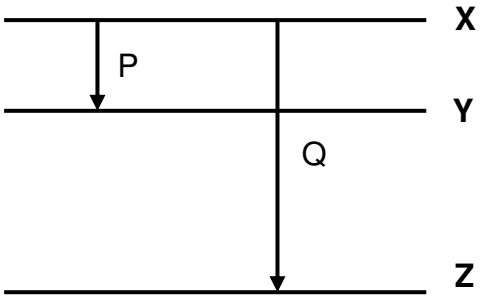
D



(2)

1.10 The diagram below represents 3 energy levels **X**, **Y** and **Z** in a certain atom. The energy difference between levels **Y** and **Z** is twice the energy difference between levels **X** and **Y**. The wavelength of a photon emitted as a result of transition **P** from level **X** to **Y** is λ.

What is the wavelength of the photon emitted during transition **Q**, from level **X** to **Z**?



A 2λ

B 3λ

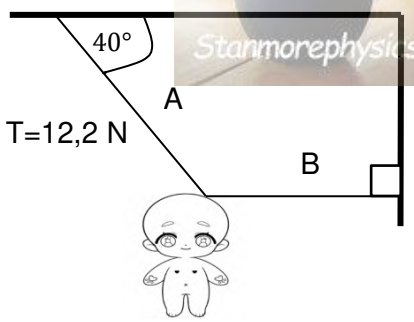
C $\frac{1}{2}\lambda$

D $\frac{1}{3}\lambda$ (2)

[20]

QUESTION 2

2.1 A doll is suspended by two light inextensible strings from the ceiling in the corner of a room. String **A** makes an angle of 40° with the ceiling and string **B** makes an angle of 90° with the wall. The tension in string **A** is 12,2 N.



2.1.1 State Newton's First Law of Motion in words. (2)

2.1.2 Calculate the magnitude of the vertical component of the tension in string **A**. (2)

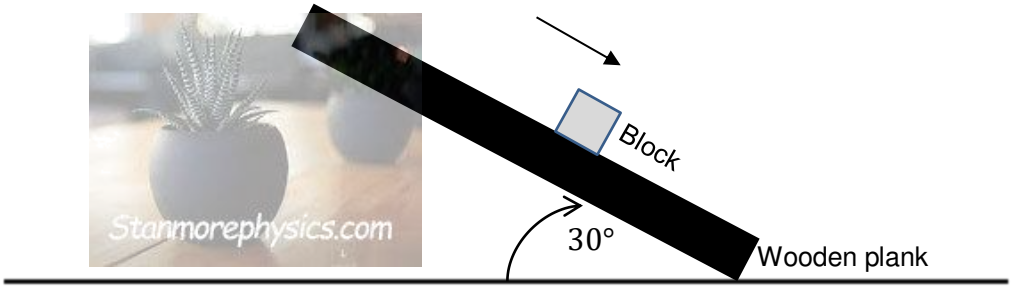
2.1.3 Calculate the mass of the doll. (3)

2.2 A learner wants to determine the coefficients of both static and kinetic frictional force between a flat wooden plank and a block. He places a block of mass m on the wooden plank that lies on the flat horizontal surface as shown on the diagram below.

He then gradually raises one end of the plank. When the wooden plank reaches an angle of 30° with the horizontal, the block starts to slip and then slides 2,5 m down the plank for 4 seconds at constant acceleration.

Before

After



2.2.1 Define *static frictional force* in words. (2)

2.2.2 Draw a free-body diagram and identify all the forces acting on the block just before it slides down the wooden plank. (3)

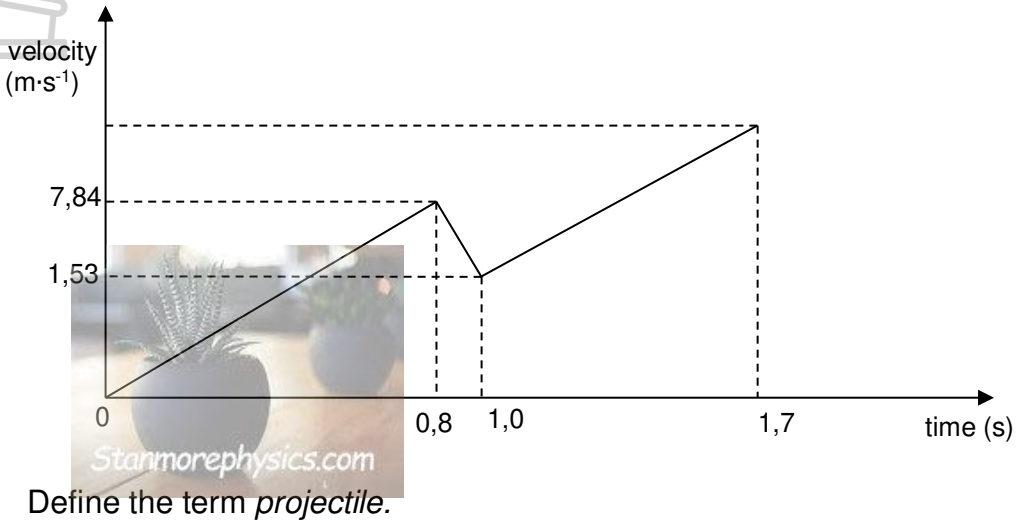
2.2.3 Calculate the coefficient of static friction between the plank and the block before the plank is tilted. (4)

2.2.4 Calculate the coefficient of kinetic friction between the block and the plank. (5)

2.2.5 Draw a labelled graph showing the relationship between the force applied and frictional force. (3)
[24]

QUESTION 3

A ball of mass 175 g falls from a tree and breaks the glass roof of a wooden cabin directly below it. The ball continues to fall freely until it hits the ground. The velocity-time graph below represents the motion of the ball from when it left the tree until it hit the ground.



3.1 Define the term *projectile.* (2)

3.2 Calculate the distance the ball fell from the instant that it left the tree until it hit the glass roof at 0,8 s. (4)

3.3 For how long was the ball in contact with the glass roof? (1)

3.4 Calculate the average net force acting on the ball while it was in contact with the glass roof. (4)

3.5 Calculate the speed the ball reached when it hit the ground. (3)

3.6 How does the magnitude of the force exerted by the ball on the glass roof compare to that of the force exerted by the glass roof on the ball? (1)

3.7 Name the Physics law used in QUESTION 3.6 to support the answer. (1)

[16]

QUESTION 4

A 4,5 kg skateboard is pushed to the left at a constant speed of 3 m·s^{-1} on a horizontal flat surface. A boy of mass 45 kg runs to the right at a speed of 1,5 m·s^{-1} and jumps onto the skateboard.

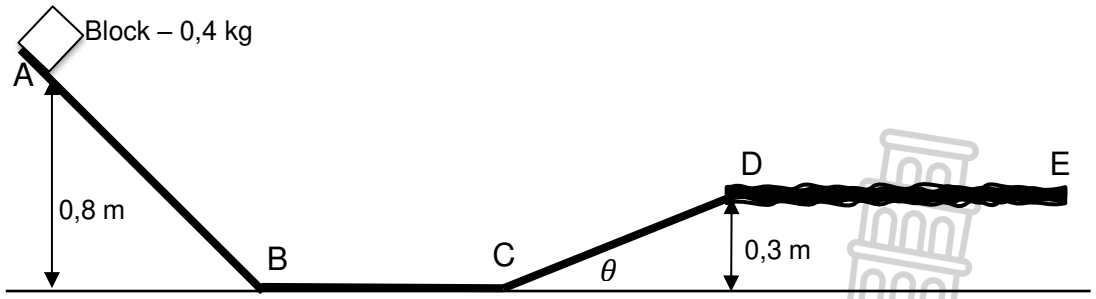
4.1 State the law of conservation of linear momentum. (2)

4.2 Calculate the velocity of the boy and the skateboard immediately after he lands on the skateboard. (4)
[6]

QUESTION 5

A small block of mass 0,4 kg is released from rest at point **A**, which is 0,8 m vertically above the ground. It takes the block 3 s to slide down from point **A** to **E** where it comes to rest. The length of the track from **A** to **E** is 8,1 m. Point **D** is 0,3 m vertically above the ground.

The surface of points **A** to **D** is frictionless. Points **D** to **E** have a rough surface. Ignore the effect of air resistance.



5.1 State the principle of conservation of mechanical energy. (2)

5.2 Is the kinetic energy at point **B** the same as that at point **C**? Write only YES or NO. (1)

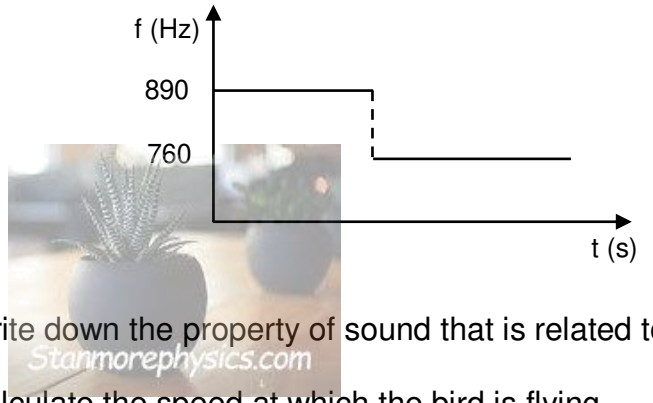
5.3 Give a reason for the answer to QUESTION 5.2. (1)

5.4 Use the energy principles to calculate the speed of the block as it reaches point **D**. (4)

5.5 The distance between **D** and **E** is 3 m. Use energy principles to calculate the magnitude of the frictional force acting on the block between point **D** and **E**. (4)
[12]

QUESTION 6

A bird flies directly towards the stationary birdwatcher at constant velocity. The birdwatcher, with a detector, registers sound waves at a frequency of 890 Hz as the bird approaches him. After passing him, and moving away at the same speed, sound waves of frequency 760 Hz are registered. Assume that the speed of sound in air is 343 $m \cdot s^{-1}$.



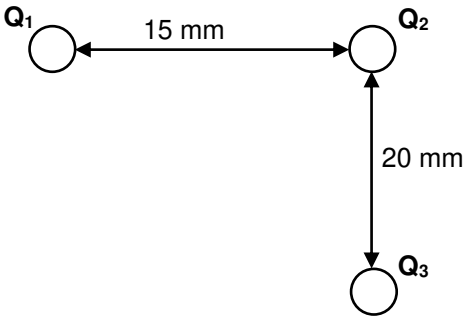
6.1 Write down the property of sound that is related to the pitch. (1)

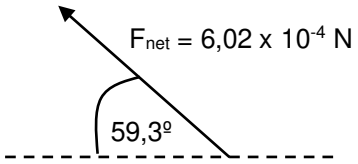
6.2 Calculate the speed at which the bird is flying. (6)

6.3 Calculate the frequency of sound emitted by the bird. (2)
[9]

QUESTION 7

7.1 Three point charges Q_1, Q_2 and Q_3 are arranged in space as shown in the diagram below. The magnitudes of Q_1 and Q_3 are unknown and the charge on Q_2 is +4 nC. The magnitude of Q_3 is three times bigger than that of Q_1. The distance between Q_1 and Q_2 is 15 mm and that between Q_2 and Q_3 is 20 mm. The charge Q_2 experiences the net electrostatic force of 6,02 x 10^{-4} N at 59,3º with the horizontal. The net force diagram below shows the electrostatic forces that Q_1 and Q_3 exert on Q_2.





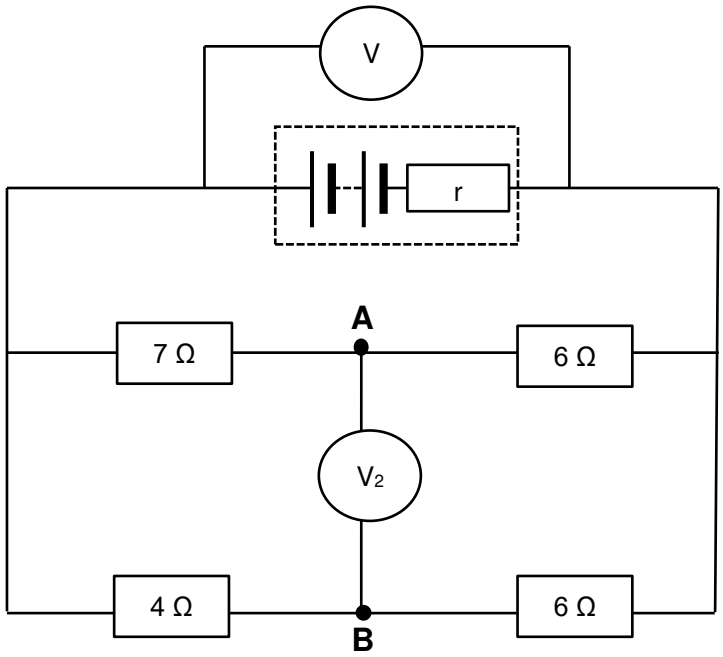
7.1.1 State Coulomb's law in words. (2)

7.1.2 In which direction does Q_2 exert a force on Q_1 and Q_3?
Write only LEFT or RIGHT and UPWARDS or DOWNWARDS. (2)

7.1.3 Calculate the magnitude of charges Q_1 and Q_3. (6)
[10]

QUESTION 8

8.1 In the circuit diagram shown below, the battery has an emf of 15 V. The internal resistance of the battery is 0,45 Ω. Voltmeter V_2 with a very high resistance is placed between point **A** and **B**.



8.1.1 State Ohm's law in words. (2)

Calculate the:

8.1.2 Equivalent resistance of the external circuit (4)

8.1.3 Total current flowing through the circuit (3)

8.1.4 Reading on V_2 (7)

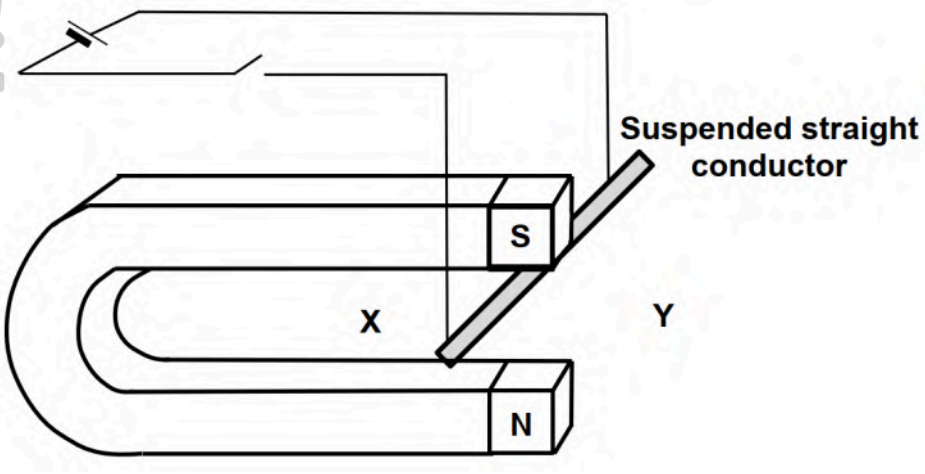
8.2 4 Ω and 6 Ω resistors alongside point **B** are removed. How will this change affect the **V** reading?
Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

8.3 Explain the answer to QUESTION 8.2. (2)

8.4 The cost of energy is R2,55 per 1 kWh. How many 60 W light bulbs can you have on for 8 hours per day if your budget for lighting is R250 per month? Assume that an average month has 30 days. (5)
[24]

QUESTION 9

9.1 The diagram below shows a straight conductor connected to a battery and suspended between the poles of a permanent magnet so that it is perpendicular to the magnet. The conductor is free to move.



9.1.1 The switch is closed. Will the conductor move towards **X** or **Y**? (1)

9.1.2 Write down ONE change that could be made to the set-up, so that the conductor will move in the opposite direction. (1)

9.1.3 Identify TWO changes that could be made to increase the emf through the conductor. (2)

9.2 An AC generator, producing a maximum voltage of 460 V, is connected to a heater of resistance 40 Ω.

9.2.1 Define the *root mean square potential difference*. (2)

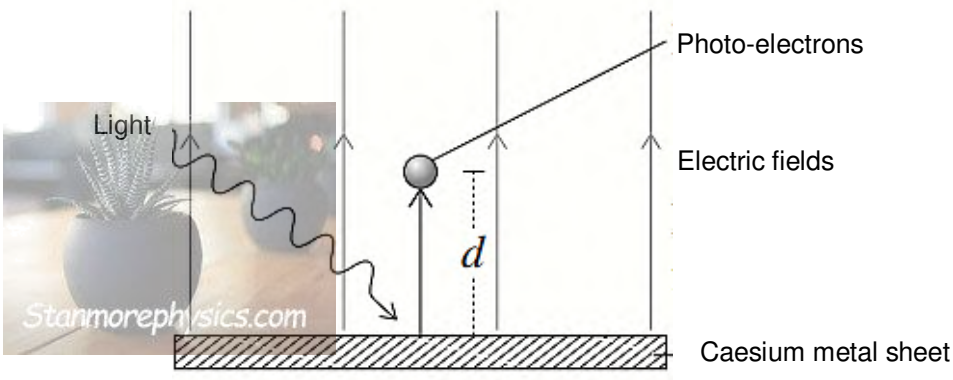
9.2.2 Write down the TWO structural differences between the AC generator and the DC generator. (2)

9.2.3 Calculate the root mean square value of the voltage. (3)

9.2.4 Calculate the root mean square value of the current in the heater. (4)
[15]

QUESTION 10

A caesium metal sheet has a wavelength of 400 nm and a work function of $3,36 \times 10^{-19}$ J. The uniform electric field of 4,6 $N.C^{-1}$ is perpendicular to the sheet. The photo-electrons travel a distance *d* to the anode as shown below.



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

10.2 Show that the maximum kinetic energy of an emitted photo-electron is $1,61 \times 10^{-19}$ J. (3)

10.3 How will the maximum kinetic energy of the ejected photo-electron calculated in QUESTION 10.2 change when the intensity of the incident light increases? Write only INCREASES, DECREASES or REMAINS THE SAME. (1)

10.4 Calculate the change in momentum carried by the photo-electron to travel from the surface of the metal to distance *d*. (4)

10.5 Calculate the maximum distance *d*. (4)
[14]

TOTAL: 150

DATA FOR PHYSICALSCIENCES 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 $m \cdot s^{-2}$
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* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	

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

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

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

ALTERNATING CURRENT/*WISSELSTROOM*

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

education

Department of Education
FREE STATE PROVINCE

PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN

GRADE/*GRAAD* 12

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

MARKING GUIDELINE
NASIENRIGLYNE

This marking guideline consists of 19 pages.
Hierdie nasienriglyne bestaan uit 19 bladsye.

QUESTION/*VRAAG* 1

1.1 B ✓✓
1.2 D ✓✓
1.3 A ✓✓
1.4 C ✓✓
1.5 A ✓✓
1.6 C ✓✓
1.7 B ✓✓
1.8 C ✓✓
1.9 A ✓✓
1.10 D ✓✓

[10 x 2 = 20]

QUESTION/*VRAAG* 2

2.1.1

Marking criteria/*Nasienkriteria*:
If any of the underlined keywords/phrases in the **correct context** is omitted, deduct 1 mark.
*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** weggelaat word, trek 1 punt af.*

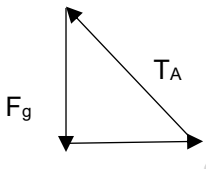
A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it. ✓✓
'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid bly, tensy 'n nie-nul resulterende/nettokrag daarop inwerk. (2)

2.1.2 $T_A = 12{,}2 \sin 40$ ✓
$= 7{,}84$ N ✓ (2)

2.1.3 **POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 2.1.2**

$F_g = T_A$
$= 7{,}84$ N

$F_g = mg$ ✓
$7{,}84 = m\,(9{,}8)$ ✓
$m = 0{,}8$ kg ✓



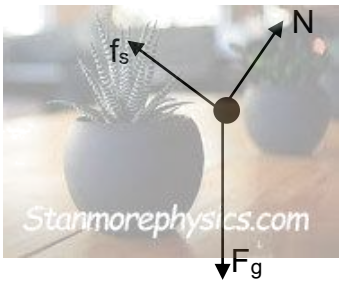
(3)

2.2.1

Marking criteria/*Nasienkriteria*:
If any of the underlined keywords/phrases in the **correct context** is omitted, deduct 1 mark. *Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** weggelaat word, trek 1 punt af.*

The force acting parallel to a surface and opposes the tendency of motion of a stationary object relative to the surface.✓✓
Die krag wat parallel met 'n oppervlak inwerk en die neiging van beweging van 'n stilstaande voorwerp relatief tot die oppervlak. (2)

2.2.2



	Acceptable labels/*Aanvaarde byskrifte*
N	F_N / $F_{normal/normaal}$ / Normal force/*Normaalkrag*
F_g	Weight/*gewig* / w / mg / $F_{gravitation/gravitasie}$
f_s	static friction/*statiese wrywing*

Notes/*Nota*:
- Mark is awarded for label and arrow.
- Do not penalise for the lengths of vectors.
- If arrows do not touch the dot: Max ($^2/_3$)
- Any additional force(s): Max ($^2/_3$)
- No arrows drawn with correct labels: Max ($^2/_3$)

- *Punt word toegeken vir byskrift en pyl.*
- *Moenie penaliseer vir die lengtes van vektore nie.*
- *As pyle nie aan die punt raak nie: Maks ($^2/_3$)*
- *Enige bykomende krag(te): Maks ($^2/_3$)*
- *Geen pyle met korrekte byskrifte nie: Maks ($^2/_3$)*

(3)

2.2.3

Marking criteria/*Nasienkriteria*:

- Any correct formula for/*Enige korrekte formule vir* F_{net} ✓
- Correct substitution for/*Korrekte substitusie vir* $F_{g//}$ ✓
- Correct substitution for/*Korrekte substitusie vir* f_s ✓
- Correct final answer./*Korrekte finale antwoord*. ✓

OPTION/*OPSIE* 1

+ DOWNWARDS/*OPWAARTS*

$F_{net} = ma$
$F_{g//} - f_s = ma$ ✓any one/*enige een*
$(mg\sin\theta) - (\mu_S \cdot mg\cos\theta) = 0$
$[m(9{,}8)\sin 30°]✓ - [(\mu_S)(m)(9{,}8)(\cos 30°)]✓ = 0$
$4{,}9\ m - 8{,}49\ m(\mu_S) = 0$
$\mu_S = 0{,}58$✓

OPTION/*OPSIE* 2

+ UPWARDS/*OPWAARTS*

$F_{net} = ma$
$-F_{g//} + f_s = ma$ ✓any one/*enige een*
$-(mg\sin\theta) + (\mu_S \cdot mg\cos\theta) = 0$
$[-m(9{,}8)\sin 30°]✓ + [(\mu_S)(m)(9{,}8)(\cos 30°)]✓ = 0$
$-4{,}9\ m + 8{,}49\ m(\mu_S) = 0$
$\mu_S = 0{,}58$✓

(4)

2.2.4

Marking criteria/*Nasienkriteria*:

- Correct formula for calculating a/*Korrekte formule vir berekening van* a✓
- Correct substitution for the whole substitution ✓
- Correct formula for calculating/*Korrekte formule vir berekening* van F_{net} ✓
- Correct substitution for/*Korrekte substitusie vir* $F_{g//}$ and/*en* f_k ✓
- Correct final answer./*Korrekte finale antwoord*. ✓

OPTION/*OPSIE* 1

+ DOWNWARDS/*AFWAARTS*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$\underline{2{,}5 = (0)(4) + \frac{1}{2}(a)(4^2)}$ ✓
$a = 0{,}3125\ m\cdot s^{-2}$

$F_{net} = ma$
$F_{g//} - f_k = ma$ ✓any one/ *enige een*
$(mg\sin\theta) - (\mu_k \cdot mg\cos\theta) = ma$
$\underline{[m(9{,}8)\sin 30°] - [(\mu_k)(m)(9{,}8)(\cos 30°)] = m(0{,}3125)}$ ✓
$4{,}9\ m - 8{,}49\ m(\mu_k) = 0{,}3125m$
$\mu_k = 0{,}54$✓

OPTION/*OPSIE* 2

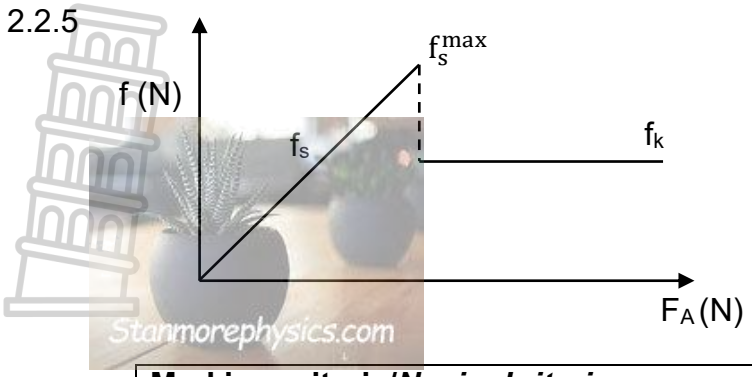
+ UPWARDS/*OPWAARTS*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$\underline{-2{,}5 = (0)(4) + \frac{1}{2}(-a)(4^2)}$ ✓
$a = 0{,}3125\ m\cdot s^{-2}$

$F_{net} = ma$
$-F_{g//} + f_k = ma$ ✓ any one/ *enige een*
$-(mg\sin\theta) + (\mu_k \cdot mg\cos\theta) = ma$
$\underline{[-m(9{,}8)\sin 30°] + [(\mu_k)(m)(9{,}8)(\cos 30°)] = m(0{,}3125)}$ ✓
$-4{,}9\ m + 8{,}49\ m(\mu_k) = 0{,}3125m$
$\mu_k = 0{,}54$✓

(5)

2.2.5



Marking criteria/*Nasienkriteria*	
Showing f_s, $f_{s(max)}$ and f_k/*Toon* f_s, $f_{s(maks)}$ *en* f_k	✓
Correct labels of f and F_A/*Korrekte byskrifte f and* F_A	✓
• Correct shape./*Korrekte vorm.* • f_s straight line from origin./ f_s *reguit lyn vanaf oorspring.* • f_k lower and parallel to x-axis./f_k *laer en parallel aan x-as.*	✓

(3)
[24]

QUESTION/*VRAAG* 3

3.1

Marking criteria/*Nasienkriteria*: If any of the underlined keywords/phrases in the **correct context** is omitted, deduct 1 mark. *Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks weggelaat word, trek 1 punt af.*

An object which has been given an initial velocity and then it moves under the influence of the gravitational force only. ✓✓
'n Voorwerp wat 'n beginsnelheid gegee is en dan beweeg dit slegs onder die invloed van die gravitasiekrag. (2)

3.2

Marking criteria/*Nasienkriteria*:	
• Any correct answer leading to the distance at which the ball strikes the glass roof. ✓ *Enige korrekte antwoord wat lei tot die afstand waarteen die bal die glasdak tref.* • Correct substitution of/*Korrekte substitusie vir* v_f. ✓ • Correct substitution into/ *Korrekte substitusie in* $v_i + 2a\Delta y$. ✓ • Correct final answer./*Korrekte finale antwoord.* ✓	
OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
+ DOWNWARDS/*AFWAARTS*	**+ UPWARDS/*OPWAARTS***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(7{,}84^2)$✓ $= 0^2 + 2(9{,}8)\Delta y$✓ $\Delta y = 3{,}14$ m✓	$v_f^2 = v_i^2 + 2a\Delta y$✓ $(7{,}84^2)$✓ $= 0^2 + 2(-9{,}8)\Delta y$✓ $\Delta y = -3{,}14$ m $\Delta y = 3{,}14$ m✓

OPTION/*OPSIE* 3	**OPTION/*OPSIE* 4**
+ DOWNWARDS/*AFWAARTS*	**+ UPWARDS/*OPWAARTS***
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $\Delta y = (0)(0{,}8)$✓ $+ \frac{1}{2}(9{,}8)(0{,}8)^2$✓ $\Delta y = 3{,}14$ m✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $\Delta y = (0)(0{,}8)$✓ $+ \frac{1}{2}(-9{,}8)(0{,}8)^2$ ✓ $\Delta y = -3{,}14$ m $\Delta y = 3{,}14$ m✓
OPTION/*OPSIE* 5	**OPTION/*OPSIE* 6**
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$✓ $\Delta y = \left(\frac{0 + 7{,}84}{2}\right)$✓$0{,}8$✓ $\Delta y = 3{,}14$ m✓	Distance = area under the graph✓ *Afstand =oppervlakte onder die grafiek* $= \frac{1}{2}bh$ $= (\frac{1}{2})(0{,}8)$✓ $(7{,}84)$ ✓ $= 3{,}14$ m✓

(4)

3.3 0,2 s ✓ (1)

3.4

Marking criteria/*Nasienkriteria*:
- Any correct answer leading to the F_{net} at which the ball strikes the glass roof. ✓
  Enige korrekte antwoord wat lei na die F_{net} waarteen die bal die glasdak tref.
- Correct substitution of/*Korrekte substitusie van* $v_f + v_i$. ✓
- Correct substitution into/*Korrekte substitusie in* Δt. ✓
- Correct final answer./*Korrekte finale antwoord.* ✓

OPTION/*OPSIE* 1	**OPTION/ 2**
$F_{net} \cdot \Delta t = \Delta p$ $F_{net} = m\left(\frac{v_f - v_i}{\Delta t}\right)$ ✓ Any one/*Enige een* $F_{net} = 0{,}175\left(\frac{1{,}53 - 7{,}84}{0{,}2}\right)$✓ $F_{net} = -5{,}52$ N $F_{net} = 5{,}52$ N upwards/*opwaarts*✓	$v_{f=} v_i + a\Delta t$ $1{,}53 = 7{,}84 + a(0{,}2)$✓ $a = -31{,}55\ m \cdot s^{-2}$ $F_{net} = ma$✓ $= (0{,}175)(-31{,}55)$✓ $F_{net} = -5{,}52$ N $F_{net} = 5{,}52$ N upwards/*opwaarts* ✓

OPTION/*OPSIE* 3	**OPTION/*OPSIE* 4**
$v_{f=}v_i + a\Delta t$ $1{,}53 = 7{,}84 + a(0{,}2)$ $a = -31{,}55\ m \cdot s^{-2}$ $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta x = (7{,}84)(0{,}2) + \frac{1}{2}(-31{,}55)(0{,}2^2)$✓ $\Delta x = -0{,}937$ m $W_{net} = \Delta E_K$✓ $F_{net}\Delta x cos\ \theta = \frac{1}{2}m(v_f^2 - v_i^2)$ $F_{net}(-0{,}937)cos\ 0^\circ$ $= \frac{1}{2}(0{,}175)(1{,}53^2$ $- 7{,}84^2)$✓ $F_{net} = 5{,}52$ N upwards/*opwaarts* ✓	$F_{net} \cdot \Delta t = \Delta p$ $F_{net} \cdot \Delta t = m(v_f - v_i)$ ✓ Any one/ *Enige een* $F_{net}(0{,}2)$✓ $= 0{,}175(1{,}53 - 7{,}84$✓$)$ $F_{net} = -5{,}52$ N $F_{net} = 5{,}52$ N upwards/*opwaarts*✓

(4)

3.5

Marking criteria/*Nasienkriteria*:

- Any correct answer leading to the speed at which the ball strikes the ground. ✓/*Enige korrekte antwoord wat lei tot die spoed waarteen die bal die grond tref.*
- Correct substitution of/*Korrekte substitusie van* v_i. ✓
- Correct substitution to calculate./*Korrekte substitusie om* v_f *te bereken.* ✓
- Correct final answer./*Korrekte finale antwoord*. ✓

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
+ DOWNWARDS/*AFWAARTS*	**+ UPWARDS/*OPWAARTS***
$v_f = v_i + a\Delta t$ $v_f = (1{,}53)$✓ $+ (9{,}8)(0{,}7)$✓ $v_f = 8{,}39\ m \cdot s^{-1}$✓	$v_f = v_i + a\Delta t$ $v_f = (-1{,}53)$✓ $+ (-9{,}8)(0{,}7)$✓ $v_f = -8{,}39\ m \cdot s^{-1}$ $v_f = 8{,}39\ m \cdot s^{-1}$✓
OPTION/*OPSIE* 3	**OPTION/*OPSIE* 4**
+ DOWNWARDS/*AFWAARTS*	**+ UPWARDS/*OPWAARTS***
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta y = (1{,}53)(0{,}7) + \frac{1}{2}(9{,}8)(0{,}7^2)$ ✓ $\Delta y = 3{,}472$ m $v_f^2 = v_i^2 + 2a\Delta y$ $v_f^2 = (1{,}53)^2 + 2(9{,}8)(3{,}472)$ ✓ $v_f = 8{,}39\ m \cdot s^{-1}$✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta y = (-1{,}53)(0{,}7) + \frac{1}{2}(-9{,}8)(0{,}7^2)$ ✓ $\Delta y = -3{,}472$ m $v_f^2 = v_i^2 + 2a\Delta y$ $v_f^2 = (-1{,}53)^2 + 2(-9{,}8)(-3{,}472)$ ✓ $v_f = -8{,}39\ m \cdot s^{-1}$ $v_f = 8{,}39\ m \cdot s^{-1}$✓

(3)

3.6 Equal/*Gelyk* ✓ (1)

3.7 Newton's third law of motion/*Newton se derde bewegingswet* ✓ (1)

[16]

QUESTION/*VRAAG* 4

4.1 The total linear momentum in an isolated system is conserved. ✓✓
Die totale lineêre momentum in 'n geïsoleerde sisteem bly behoue.
(2 or/*of* 0) (2)

4.2

Marking criteria/*Nasienkriteria*:
- Any correct formula for conservation of momentum./*Enige korrekte formule vir behoud van momentum.*
- Correct substitutions./*Korrekte substitusie.* ✓✓
- Correct final answer./*Korrekte finale antwoord*. ✓

POSITIVE TO THE RIGHT/*POSITIEF NA REGS*

$$\left.\begin{aligned}\sum p_i &= \sum p_f \\ m_t v_{it} + m_s v_{is} &= (m_t + m_s)v_f\end{aligned}\right\} \checkmark \text{any one/}\textit{enige een}$$

$$\underline{(45)(1,5) + (5)(-3)} \checkmark = \underline{(45 + 5)\, v_f} \checkmark$$

$$v_f = 1{,}05 \text{ m·s}^{-1} \text{ right/}\textit{regs} \checkmark$$

POSITIVE TO THE LEFT/*POSITIEF NA LINKS*

$$\left.\begin{aligned}\sum p_i &= \sum p_f \\ m_t v_{it} + m_s v_{is} &= (m_t + m_s)v_f\end{aligned}\right\} \checkmark \text{Any one/}\textit{Enige een}$$

$$\underline{(45)(-1,5) + (5)(3)} \checkmark = \underline{(45 + 5)\, v_f} \checkmark$$

$$v_f = -1{,}05 \text{ m·s}^{-1}$$

$$v_f = 1{,}05 \text{ m·s}^{-1} \text{ right/}\textit{regs} \checkmark$$

(4)
[6]

QUESTION/*VRAAG* 5

5.1 The total mechanical energy in an isolated system is conserved. ✓✓
Die totale meganiese energie in 'n geïsoleerde stelsel bly behoue.
(2 or/*of 0)* (2)

5.2 Yes/*Ja* ✓ (1)

5.3 No friction/Resultant force is zero and thus no loss in energy. ✓
Geen wrywing/Resulterende krag is nul en dus geen verlies aan energie nie.

OR/*OF*

Only conservative forces are present./*Slegs konserwatiewe kragte is teenwoordig.*

OR/*OF*

Mechanical energy is conserved./*Meganiese energie bly behoue.* (1)

5.4

Marking criteria/*Nasienkriteria*:
- Any correct formula for energy./*Enige korrekte formule vir energie.* ✓
- Correct substitutions./*Korrekte substitusies.* ✓✓
- Correct final answer./*Korrekte finale antwoord.* ✓

OPTION/*OPSIE* 1

$\sum E_{M(A)} = \sum E_{M(D)}$
$(E_K + E_P)_A = (E_K + E_P)_B$
$(½mv^2 + mgh)_A = (½mv^2 + mgh)_B$ ✓ any one/*enige een*
$0 + (0,4 \times 9,8 \times 0,8)$✓ $= (½ \times 0,4 \times v^2) + (0,4 \times 9,8 \times 0,3)$✓
$v_f = 3,13\ m \cdot s^{-1}$✓

OPTION/*OPSIE* 2

$W_{nc} = \Delta K + \Delta U$
$0 = ½m(v_f^2 - v_i^2) + mg(h_f - h_i)$ ✓ any one/*enige een*
$0 = ½(0,4)(v_f^2 - 0)$✓ $+ (0,4)(9,8)[0,3 - 0,8]$✓
$v_f = 3,13\ m \cdot s^{-1}$✓

OPTION/*OPSIE* 3

$W_{net} = \Delta E_K$
$W_{net} = ½m(v_f^2 - v_i^2)$
$mg\Delta y\cos\theta = ½m(v_f^2 - v_i^2)$ ✓ any one/ *enige een*
$(0,4)(9,8)(0,5)\cos 0°$✓ $= ½(0,4)(v_f^2 - 0)$✓
$v_f = 3,13\ m \cdot s^{-1}$✓

(4)

5.5 **POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 5.4**

Marking criteria/*Nasienkriteria*:
- Correct formula for work./*Korrekte formule vir arbeid.* ✓
- Correct substitutions./*Korrekte substitusies.* ✓✓
- Correct final answer./*Korrekte finale antwoord*. ✓

OPTION/*OPSIE* 1

$W_{net} = \Delta E_K$
$W_{net} = {}^1/_2 mv_f^2 - {}^1/_2 mv_i^2$ ✓ any one/*enige een*
$f(3)\cos 180°$✓ $= (0) - {}^1/_2 (0,4)(3,13)^2$ ✓
$f = 0,65$ N✓

OPTION/*OPSIE* 2

$W_{nc} = \Delta E_K + \Delta E_p$
$W_{net} = ½m(v_f^2 - v_i^2) + mg(h_f - h_i)$ ✓ any one/*enige een*
$f(3)\cos 180°$✓ $= ½(0,4)(0 - 3,13^2) + (0,4)(9,8)(0,3 - 0,3)$✓
$f = 0,65$ N✓

(4)
[12]

QUESTION 6

6.1 Frequency/*Frekwensie* ✓ (1)

6.2

OPTION/*OPSIE* 1

Approaches/*Benaderings*:

$$f_L = \frac{V \pm V_L}{V \pm V_S} f_S$$
$$\mathbf{f_L = \frac{V}{V - V_S} f_S}$$

✓ any one/*enige een*

$$890 ✓ = \frac{343}{343 - V_S} f_S \ ✓$$
$$890(343 - v_S) = 343 f_S \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (1)$$

Moves Away/*Beweeg weg*:

$$f_L = \frac{V \pm V_L}{V \pm V_S} f_S$$
$$\mathbf{f_L = \frac{V}{V + V_S} f_S}$$

any one/*enige een*

$$760 ✓ = \frac{343}{343 + V_S} f_S \ ✓$$
$$760(343 + v_S) = 343 f_S \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (2)$$

(1) - (2):

$$(305270 - 890 v_S) - (260680 + 760 v_S) = 0$$
$$v_S = 27{,}02 \text{ m} \cdot \text{s}^{-1} ✓$$

(1) and/*en* (2) both/*beide* = 343 f_s

$$890(343 - v_S) = 760(343 + v_S)$$
$$v_S = 27{,}02 \text{ m} \cdot \text{s}^{-1} ✓$$

(6)

6.3 **POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 6.2**

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$305270 - 890(27{,}02) = 343 f_S$ ✓ $f_S = 819{,}89$ Hz ✓	$260680 + 760(27{,}02) = 343 f_S$ ✓ $f_S = 819{,}89$ Hz ✓

(2)
[9]

QUESTION/*VRAAG 7*

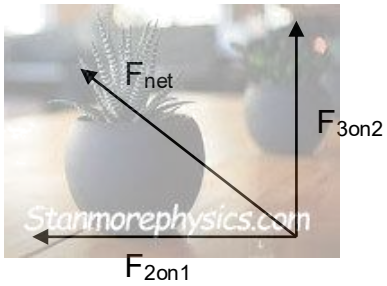
7.1.1

Marking Criteria/*Nasienkriteria*:
If any of the underlined keywords/phrases in the **correct context** is omitted, deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** weggelaat word, trek 1 punt af.*

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

7.1.2 Q_1 on Q_2 is left./*Q_1 op Q_2 is links.* ✓
Q_3 on Q_2 is upwards./*Q_3 op Q_2 opwaarts.* ✓ (2)

7.1.3



Marking criteria/*Nasienkriteria*:
- Correct calculation of/*Korrekte berekening van* F_{12} /F_{32}✓
- Correct formula for Coulomb's law./*Korrekte formule van Coulom se wet* .✓
- Correct substitution of/*Korrekte substitusie van* F_{12} / F_{32}✓
- Correct calculation for/*Korrekte berekening van* F_{12} / F_{32}✓
- Correct calculation for/ *Korrekte berekening van* Q_1✓
- Correct calculation for/ *Korrekte berekening van* Q_3✓

OPTION/*OPSIE* 1

$$F_{2on1} = F_{net}\cos 56°$$
$$= 6{,}02 \times 10^{-4}\cos 59{,}3°\checkmark$$
$$= 3{,}07 \times 10^{-4}\text{N}$$

$$F_{2on1} = \frac{kQ_1Q_2}{r^2}\checkmark$$
$$3{,}07 \times 10^{-4}\checkmark = \frac{(9\times10^{9})Q_1(4\times10^{-9})}{(0{,}015)^2}\checkmark$$
$$Q_1 = 1{,}92 \times 10^{-9}C\checkmark$$
$$\therefore Q_3 = 3\,(1{,}92 \times 10^{-9})$$
$$= 5{,}76 \times 10^{-9}\text{ C}\checkmark$$

OPTION/*OPSIE* 2

$F_{3on2} = F_{net} \sin 56°$
$= 6{,}02 \times 10^{-4} \sin 59{,}3°$✓
$= 5{,}18 \times 10^{-4}\text{N}$

$F_{3on2} = \frac{kQ_3Q_2}{r^2}$ ✓

$5{,}18 \times 10^{-4}$✓ $= \frac{(9\times10^{9})Q_3(4\times10^{-9})}{(0{,}02)^2}$✓

$Q_3 = 5{,}76 \times 10^{-9}\text{C}$✓

$\therefore Q_1 = {}^{1}/_{3}\ (5{,}76 \times 10^{-9})$
$= 1{,}92 \times 10^{-9}\ \text{C}$✓

OPTION/*OPSIE* 3

Marking criteria/*Nasienkriteria*:

- Correct formula for/*Korrekte formule vir* F_{net} ✓
- Correct substitution of/*Korrekte substitusie van* F_{net} ✓
- Correct substitution of/*Korrekte substitusie van* F_{12} ✓
- Correct substitution of/*Korrekte substitusie van* F_{32}✓
- Correct calculation for/*Korrekte berekening van* Q_1✓
- Correct calculation for/*Korrekte berekening van* Q_3✓

$F_{net}^{\ 2} = (F_{12})^2 + (F_{32})^2$
$F_{net}^{\ 2} = \left(\frac{kQ_1Q_2}{r^2}\right)^2 + \left(\frac{kQ_3Q_2}{r^2}\right)^2$ ✓ any one/*enige een*

$(6{,}02 \times 10^{-4})^2$✓ $= \left(\frac{(9 \times 10^9)Q_1(4 \times 10^{-9})}{(0{,}015)^2}\right)^2$ ✓ $+ \left(\frac{(9 \times 10^9)3Q_3(4 \times 10^{-9})}{(0{,}02)^2}\right)$✓ ^{2}

$Q_1 = 1{,}92 \times 10^{-9}C$✓

$\therefore Q_3 = 3\ (1{,}92 \times 10^{-9})$
$= 5{,}76 \times 10^{-9}\ \text{C}$✓

(6)
[10]

QUESTION/*VRAAG* 8

8.1.1

Marking criteria/*Nasienkriteria*: If any of the underlined keywords/phrases in the **correct context** is omitted, deduct 1 mark. *Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks weggelaat word, trek 1 punt af.*

The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature. ✓✓
Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur.

OR/*OF*

The ratio of potential difference to current is constant provided the temperature remains the same.
Die verhouding van potensiaalverskil tot stroom is konstant mits die temperatuur dieselfde bly. (2)

8.1.2

OPTION/*OPSIE 1* 1	**OPTION 2/*OPSIE 2***
$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ $= \frac{1}{7+6}$ ✓ $+ \frac{1}{4+6}$ ✓ $R_P = 5{,}65\ \Omega$✓	$R_P = \frac{R_1 \times R_2}{R_1 + R_2}$ ✓ $= \frac{13\times10}{13+10}$ ✓✓ $R_P = 5{,}65\ \Omega$✓

(4)

8.1.3 **POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 8.2**

OPTION/*OPSIE 1* 1	**OPTION 2/*OPSIE 2***
$\mathcal{E} = I(R_{ext} + r_{int})$ ✓ $15 = I(5{,}65 + 0{,}45)$ ✓ $I = 2{,}46\ A$✓	$R_T = \frac{V_T}{I}$ ✓ $(5{,}65 + 0{,}45) = \frac{15}{I}$ ✓ $I = 2{,}46\ A$✓

(3)

8.1.4 POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 8.3

Marking criteria/*Nasienkriteria*:

- Correct formula for calculating V_{int} /V_{ext}/*Korrekte formule vir berekening* V_{int} /V_{ext}
- *Correct substitution/Korrekte substutisie* ✓
- Correct calculation for V_{ext}/*Korrekte berekening vir* V_{ext} ✓
- Correct substitution of $I_{7\Omega\ \&\ 6\Omega}$/*Korrekte substutisie van* $I_{7\Omega\ \&\ 6\Omega}$ ✓
- Correct substitution of $I_{4\Omega\ \&\ 6}$/ *Korrekte substutisie van* $I_{4\Omega\ \&\ 6}$ ✓
- Correct calculation for V_A/*Korrekte berekening vir* V_A ✓
- Correct calculation for V_B/*Korrekte berekening vir* V_B ✓
- Correct calculation for V_2/*Korrekte berekening vir* V_2 ✓

OPTION/*OPSIE* 1

$r = \frac{V_{int}}{I}$ ✓ $0{,}45 = \frac{V_{int}}{2{,}46}$ ✓ $V_{int} = 1{,}11\ V$ $V_T = V_{ext} + V_{int}$ $15 = V_{ext} + 1{,}11$ $V_{ext} = 13{,}89\ V$	$R = \frac{V_{ext}}{I}$ ✓ $5{,}65 = \frac{V_{int}}{2{,}46}$ ✓ $V_{ext} = 13{,}89\ V$
Current through/*Stroom deur* 7Ω & 6Ω $R = \frac{V}{I}$ $13 = \frac{13{,}89}{I}$ ✓ $I = 1{,}07\ A$	**Current through/ *Stroom deur* 4Ω & 6Ω** $R = \frac{V}{I}$ $10 = \frac{13{,}89}{I}$ ✓ $I = 1{,}39\ A$
Potential difference across/ *Potensiaalverskil oor* 7Ω $R_{7\Omega} = \frac{V}{I}$ $7 = \frac{V}{1{,}07}$ ✓ $V = 7{,}49\ V$ $V_A = 13{,}89 - 7{,}49$ $= 6{,}40\ V$	**Potential difference across/ *Potensiaalverskil oor* 4Ω** $R = \frac{V}{I}$ $4 = \frac{V}{1{,}39}$ ✓ $V = 5{,}56\ V$ $V_B = 13{,}89 - 5{,}56$ $= 8{,}33\ V$
$V_2 = V_B - V_A$ $V_2 = 8{,}33 - 6{,}40$ $V_2 = 1{,}93\ V$ ✓	

OPTION/*OPSIE* 2

$$r = \frac{V_{int}}{I} \checkmark$$
$$0{,}45 = \frac{V_{int}}{2{,}46} \checkmark$$
$$V_{int} = 1{,}11\ V$$

$$R = \frac{V_{ext}}{I} \checkmark$$
$$5{,}65 = \frac{V_{int}}{2{,}46} \checkmark$$
$$V_{ext} = 13{,}89\ V$$

Current through/*Stroom deur* 7Ω & 6Ω

$$R = \frac{V}{I}$$
$$13 = \frac{13{,}89}{I} \checkmark$$
$$I = 1{,}07\ A$$

Current through/*Stroom deur* 4Ω & 6Ω

$$R = \frac{V}{I}$$
$$10 = \frac{13{,}89}{I} \checkmark$$
$$I = 1{,}39\ A$$

Potential difference across/ *Potensiaalverskil oor* 6Ω

$$R_{6\Omega} = \frac{V(B)}{I}$$
$$6 = \frac{V}{1{,}39} \checkmark$$
$$V = 8{,}34V$$

Potential difference across/ *Potensiaalverskil oor* 6Ω

$$R = \frac{V(A)}{I}$$
$$6 = \frac{V}{1{,}07} \checkmark$$
$$V = 6{,}42\ V$$

$$V_2 = V_B - V_A$$
$$V_2 = 8{,}34 - 6{,}42 \checkmark$$
$$V_2 = 1{,}92\ V \checkmark$$

(7)

8.2 Increases/*Verhoog* ✓ (1)

8.3 Total resistance increases and total current decreases. ✓
V lost decreases ✓
Totale weerstand neem toe en totale stroom neem af.
V neem af (2)

8.4 $\text{Cost}/Koste = \text{Energy}/Energie \times \text{Tarrif}/Tarief$ ✓
250✓ $= (\text{kW} \times 8 \times 30) \times 2{,}55$ ✓
$250 = 612\ \text{KW}$
$\text{kW} = 0{,}4084967$

$P = 0{,}4084967 \times 1000$
$P = 408{,}4967\ W$

$\text{Number of bulbs}/Aantal\ gloeilampe = \frac{408{,}4967}{60}$ ✓ $= 6\ \text{bulbs}/gloeilampe$ ✓ (5)

[24]

QUESTION/*VRAAG* 9

9.1.1 X ✓ (1)

9.1.2 Change the direction of the magnetic field (turn magnet upside down). ✓
Change the direction of the current (turn the battery around).
Verander die rigting van die magneetveld (draai magneet onderstebo).
Verander die rigting van die stroom (draai die battery om). (1)

9.1.3 **Any ONE/*Enige EEN***
Increase the strength of the magnetic field (use stronger magnet). ✓
Increase the current in the conductor. ✓
Increase the thickness of the magnet to increase the length of the magnetic field.
Verhoog die sterkte van die magneetveld (gebruik sterker magneet).
Verhoog die stroom in die geleier.
Verhoog die dikte van die magneet om die lengte van die magnetiese veld te vergroot. (2)

9.2.1

Marking criteria/*Nasienkriteria*:
If any of the underlined keywords/phrases in the **correct context** is omitted deduct 1 mark.
Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks weggelaat word, trek 1 punt af.

The AC potential difference which dissipates/produces the same amount of energy as an equivalent DC potential difference. ✓✓
Die WS-potensiaalverskil wat dieselfde hoeveelheid energie dissipeer/produseer as 'n ekwivalente GS-potensiaalverskil. (2)

Note: If rms current defined $^{0}/_{2}$
***Let wel**: Indien rms stroom gedefinieer is* $^{0}/_{2}$

9.2.2 AC-slip rings/*WS-sleepringe* ✓
DC- commutator (split ring)/*GS-kommutator (splitring)* ✓ (2)

9.2.3 $V_{rms} = \frac{V_{max/maks}}{\sqrt{2}}$ ✓
$= \frac{460}{\sqrt{2}}$ ✓
$= 325{,}27\ V$ ✓ (3)

9.2.4 **POSITIVE MARKING FROM/*POSITIEWE NASIEN VANAF* 9.2.2**

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$I_{max} = \frac{V_{max}}{R}$ $= \frac{460}{40}$ ✓ $= 11,5\ A$ $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓ $= \frac{11,5}{\sqrt{2}}$ ✓ $= 8,13\ A$ ✓	$R = \frac{V_{rms}}{I_{rms}}$✓ 40✓ $= \frac{325,27}{I_{rms}}$✓ $I_{rms} = 8,13\ A$✓

(4)
[15]

QUESTION/*VRAAG* 10

10.1 The minimum energy that an electron in the metal needs to bemitted from the metal surface. ✓✓
Die minimum energie wat 'n elektron in die metaal nodig het om vanaf die metaaloppervlak vrygestel te word. (2 or/*of* 0) (2)

10.2

Marking criteria/*Nasienkriteria*:
- Correct formula for work/*Korrekte formule vir arbeid* ✓
- Correct substitutions/*Korrekte substitusies* ✓✓
- Correct final answer/*Korrekte finale antwoord* ✓

OPTION/*OPSIE* 1

$E = W_0 + E_K$
$\frac{hc}{\lambda} = W_0 + E_K$
✓any one/*enige een*

$\frac{(6,63 \times 10^{-34})(3 \times 10^{8})}{(400 \times 10^{-9})}$✓ $= (3,36 \times 10^{-19})$✓ $+ E_K$
$E_K = 1,61 \times 10^{-19}\ J$

OPTION/*OPSIE* 2

$E = \frac{hc}{\lambda}$
$= \frac{(6,63 \times 10^{-34})(3 \times 10^{8})}{(400 \times 10^{-9})}$✓
$= 4,97 \times 10^{-4} J$

$E = W_0 + E_K$✓
$4,97 \times 10^{-4} J = (3,36 \times 10^{-19})$✓ $+ E_K$
$E_K = 1,61 \times 10^{-19}\ J$

(3)

10.3 Remains the same/*Bly dieselfde* ✓ (1)

10.4 $E_K = \frac{1}{2}mv^2$
$1{,}61 \times 10^{-19} = \frac{1}{2}(1{,}6 \times 10^{-19})\ v^2$✓
$v = 1{,}42\ m \cdot s^{-1}$

$\Delta p = m\Delta v$✓
$= (1{,}6 \times 10^{-19})(1{,}42 - 0)$ ✓
$= 2{,}27\ kg \cdot m \cdot s^{-1}$✓ (4)

10.5 $W = dEq$✓
$1{,}61 \times 10^{-19}$✓ $= d(4{,}6)(1{,}6 \times 10^{-19})$✓
$d = 0{,}22\ m$✓

$F = Eq$
and/*en* $F = \frac{W}{d}$
$\frac{W}{d} = Eq$ (both $= F$)
$\therefore\ W = dEq$

(4)
[16]

TOTAL/*TOTAAL*: 150