education

Department of Education
FREE STATE PROVINCE

PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN

GRADE/*GRAAD* 12

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



SEPTEMBER 2024

MARKS/*PUNTE*: 150

MARKING GUIDELINE
NASIENRIGLYNE

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

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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.*

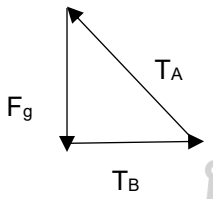
A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it. ✓✓
'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid bly, tensy 'n nie-nul resulterende/nettokrag daarop inwerk. (2)

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)

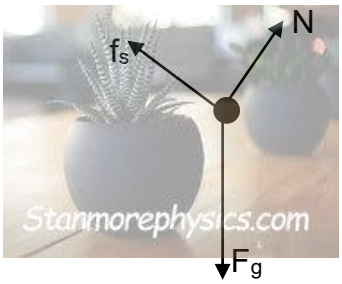
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2.2.1

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*
$(mgsin\theta) - (\mu_S \cdot mgcos\theta) = 0$
$[m(9,8)sin30°]✓ - [(\mu_S)(m)(9,8)(cos30°)]✓ = 0$
$4,9\ m - 8,49\ m(\mu_S) = 0$
$\mu_S = 0,58✓$

OPTION/*OPSIE* 2

+ UPWARDS/*OPWAARTS*

$F_{net} = ma$
$-F_{g//} + f_s = ma$ ✓any one/*enige een*
$-(mgsin\theta) + (\mu_S \cdot mgcos\theta) = 0$
$[-m(9,8)sin30°]✓ + [(\mu_S)(m)(9,8)(cos30°)]✓ = 0$
$-4,9\ m + 8,49\ m(\mu_S) = 0$
$\mu_S = 0,58✓$

(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*

$\Delta y = v_i\Delta t + ½a\Delta t^2$✓
$\underline{2{,}5 = (0)(4) + ½(a)(4^2)}$ ✓
$a = 0{,}3125\ m\cdot s^{-2}$

$F_{net} = ma$
$F_{g//} - f_k = ma$ ✓any one/ *enige een*
$(mgsin\theta) - (\mu_k \cdot mgcos\theta) = ma$
$\underline{[m(9{,}8)sin30°] - [(\mu_k)(m)(9{,}8)(cos30°)] = m(0{,}3125)}$ ✓
$4{,}9\ m - 8{,}49\ m(\mu_k) = 0{,}3125m$
$\mu_k = 0{,}54$✓

OPTION/*OPSIE* 2

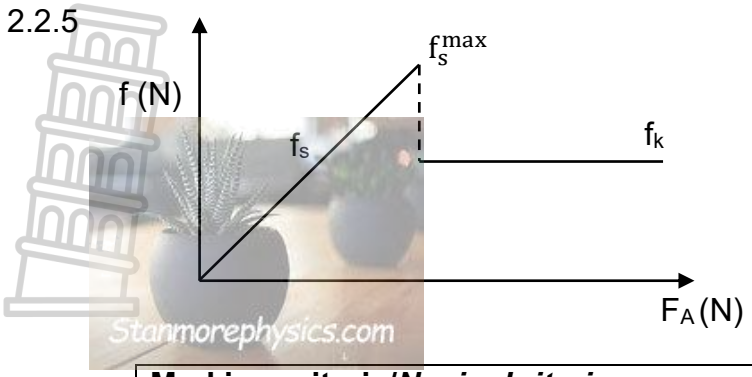
+ UPWARDS/*OPWAARTS*

$\Delta y = v_i\Delta t + ½a\Delta t^2$✓
$-2{,}5 = (0)(4) + ½(-a)(4^2)$ ✓
$a = 0{,}3125\ m\cdot s^{-2}$

$F_{net} = ma$
$-F_{g//} + f_k = ma$ ✓ any one/ *enige een*
$-(mgsin\theta) + (\mu_k \cdot mgcos\theta) = ma$
$\underline{[-m(9{,}8)sin30°] + [(\mu_k)(m)(9{,}8)(cos30°)] = m(0{,}3125)}$ ✓
$-4{,}9\ m + 8{,}49\ m(\mu_k) = 0{,}3125m$
$\mu_k = 0{,}54$✓

(5)

2.2.5



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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 <u>object</u> which has been given <u>an initial velocity</u> and then it moves <u>under the influence of the gravitational force only</u>. ✓✓
'n <u>Voorwerp</u> wat <u>'n beginsnelheid</u> gegee is en dan beweeg dit <u>slegs onder die invloed van die gravitasiekrag</u>. (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***
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\underline{\Delta y = (1{,}53)(0{,}7) + \frac{1}{2}(9{,}8)(0{,}7^2)}$ ✓ $\Delta y = 3{,}472$ m $v_f^2 = v_i^2 + 2a\Delta y$ $\underline{v_f^2 = (1{,}53)^2 + 2(9{,}8)(3{,}472)}$ ✓ $v_f = 8{,}39\ m \cdot s^{-1}$✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\underline{\Delta y = (-1{,}53)(0{,}7) + \frac{1}{2}(-9{,}8)(0{,}7^2)}$ ✓ $\Delta y = -3{,}472$ m $v_f^2 = v_i^2 + 2a\Delta y$ $\underline{v_f^2 = (-1{,}53)^2 + 2(-9{,}8)(-3{,}472)}$ ✓ $v_f = -8{,}39\ m \cdot s^{-1}$ $v_f = 8{,}39\ m \cdot s^{-1}$✓

(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*
$0 + (0,4 \text{ x } 9,8 \text{ x } 0,8)$✓ $= (½ \text{ x } 0,4 \text{ x } v^2) + (0,4 \text{ x } 9,8 \text{ x } 0,3)$✓
$v_f = 3,13 \text{ m} \cdot s^{-1}$✓

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*
$0 = ½(0,4)(v_f^2 - 0)$✓ $+ (0,4)(9,8)[0,3 - 0,8]$✓
$v_f = 3,13 \text{ m} \cdot s^{-1}$✓

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*
$(0,4)(9,8)(0,5)\cos 0°$✓ $= ½(0,4)(v_f^2 - 0)$✓
$v_f = 3,13 \text{ m} \cdot s^{-1}$✓

(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*
$f(3)\cos 180°$✓ $= (0) - {}^1/_2 (0,4)(3,13)^2$ ✓
$f = 0,65 \text{ N}$✓

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*
$f(3)\cos 180°$✓ $= ½(0,4)(0 - 3,13^2) + (0,4)(9,8)(0,3 - 0,3)$✓
$f = 0,65 \text{ N}$✓

(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*

$890 ✓ = \frac{343}{343 - V_S} f_S$ ✓

$890(343 - v_S) = 343 f_S$ ..... (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*

$760 ✓ = \frac{343}{343 + V_S} f_S$ ✓

$760(343 + v_S) = 343 f_S$..... (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

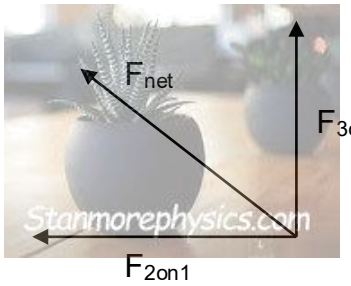
7.1.1

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 $E_K = ½mv^2$
$1{,}61 \times 10^{-19} = ½(1{,}6 \times 10^{-19})\ v^2$✓
$v = 1{,}42\ m \cdot s^{-1}$

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

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