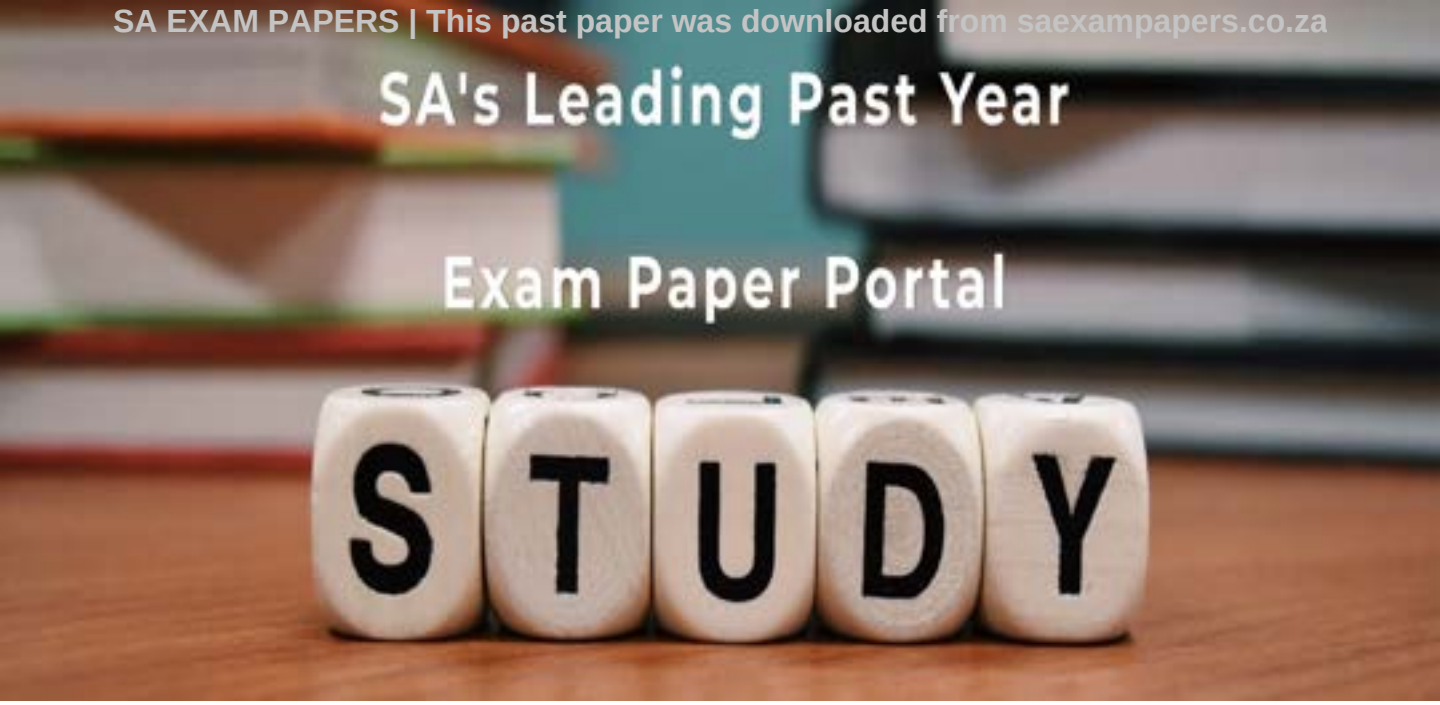

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GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

JUNE 2025

FINAL AND AMENDE MARKING GUIDELINE/
FINALE EN AANGEPASTE MERK RIGLYNE

MARKS: 150

These marking guidelines consist of 9 pages

QUESTION 1

1.1 A✓✓

1.2 C✓✓

1.3 A✓✓

1.4 D✓✓

1.5 B ✓✓

1.6 B ✓✓

1.7 C ✓✓

1.8 B ✓✓

1.9 A ✓✓

1.10 D ✓✓

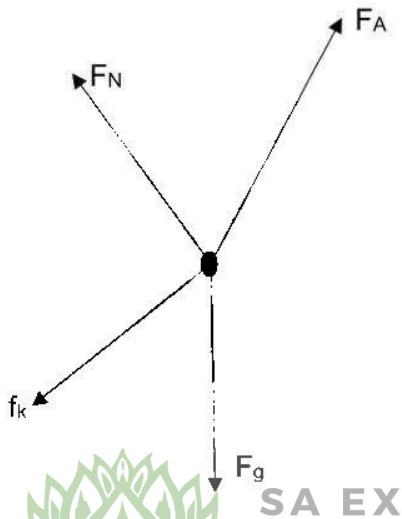
(2 x 10 =20)

QUESTION/VRAAG 2

2.1 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 Voorwerp sal in 'n toestand van rus of konstante bewegin bly tot 'n nie-sero resultante krag daarop inwerk. ✓✓ **(2)**

2.2



ACCEPTED SYMBOLS/AANVAARDE SIMBOLE		
F_N	Normal force/N /$F_{surface\ on\ box}$	*Normaalkrag/ N/$F_{oppervlak\ op\ krat}$*
f_k	Kinetic friction / friction /Frictional force	*Kinetiese wrywing/wrywing/wrywingskrag*
F_g	w, weight/Gravitational force/ $F_{earth\ on\ box}$	*Gewing/Gravitasiekrag/ $F_{aarde\ op\ die\ voorwerp}$*
F_A/F	Applied force /Tention/T	*F_T/ FToegepaste krag/Spanningskrag*
Notes: • Mark awarded for label and arrow • Do not penalize for length of arrows • Any additional force/s: -1 • If force(s) do not make contact with the body: -1 mark • -1 mark if all arrowheads are omitted but correctly labelled. **(4)**		*Notas:* • *Punt toegeken vir pyl en pylpunt* • *Moenie lengte van pyle penaliseer nie* • *Addisionele krag/te:-1* • *As kragte nie kontak maak met kol nie: -1* • *-1 punt as alle kragte teenwoordig is en benoem maar geen pylpunte nie.*

2.3.1 **OPTION 1**

$F_{net} = 0$

$F_{net} = ma$ ✓ Any one/ Enige een

$F_{Ax} - f_k - mg\sin\theta = 0$

$3f_k\cos28^0$✓ $- f_k - (48 + 4,3)(9,8)\sin15^0$ ✓ $= 0$ ✓

$f_k = 80,45$ N✓

(This value is checked and correct)

NOTES:

Formula for N1/N2
Substitution of zero
Substitution for F_{Ax}
Substitution for F_{gII}
Answer = 80,45 N

OPTION 2

$f_k = N\mu_k$ ✓

$= \mu_k(mg\cos\theta_1 - F_T \sin\theta_2)$

$= 0,22$✓ $(48 + 4,3)(9,8)\cos15$ ✓ $- 3f_k\sin28$✓)

$= 83,15$N ✓

NOTES:

Formula for f_k
Substitution of 0,22
Substitution for F_{Ax}
Substitution for F_{gII}
Answer = 83,15 N

2.3.2 **POSITIVE MARKING FROM QUESTION 2.3.1**

Tension in the rope is the applied force/ *Spanning in die tou is die toegepaste krag*

$F_A = 3f_k$ ✓ **(Ratio)**

$F_A = 3✓(80,45)✓$

$F_A = 241,35$ N✓

OR

$F_A = 3f_k$ ✓ **(Ratio)**

$F_A = 3✓(83,15)✓$

$F_A = 249,4557$

$F_A = 249,46$ N ✓

Range: 241,35 – 249,46 N

OPTION 2

$F_{net} = F_x - F_{g\parallel} - f_k$ ✓

$0 = F_A\cos 28 - 52,3(9,8)\sin 15✓ - 80,45$ ✓

$F_A = 241,36$ N✓

OR

$F_{net} = F_x - F_{g\parallel} - f_k$ ✓

$0 = F_A\cos 28 - 52,3(9,8)\sin 15✓ - 83,15$ ✓

$F_A = 244,41$ N✓

Range: 241,36 – 244,47 N

OPTION 3

$F_A^2 = F_x^2 + F_y^2$ ✓

$= (3f_k\cos 28)^2 + (3f_k\sin 28)^2$ ✓

$= (3(80,45)\cos 28)^2 + (3(80,45)\sin 28)^2$ ✓

$= (213,21)^2 + (113,36)^2$

$F_A = 241,47$ N ✓ **(4)**

2.3.3 **(POSITIVE MARKING FROM QUESTION 2.3.1 and 2.3.2**

OPTION 1

$f_k = N\mu_k$✓

$80,45 = N\ (0,22)$ ✓

$N = 365,68$ N ✓

377,95 N

OR

$f_k = N\mu_k$✓

$83,15 = N\ (0,22)$ ✓

$N = 377,95$ N ✓

OPTION 2:

$F_{net} = 0$

$N = F_{g\perp} - F_y$ ✓ **Any One**

$= mg\cos\theta_1 - F_A \sin\theta_2$

$= \underline{(48 + 4,3)(9,8)(\cos 15) - 241,35 \sin 28}$ ✓

$= 381,76866$

$= 381,77\ N$ ✓

(3)

2.4 Rate at which work **is done/** Rate **at** which energy is expended/transferred ✓✓

Tempo waarteen arbeid verrig word/ Tempo waarteen energie oorgedra word. ✓✓

(2 OR 0) **(2)**

2.5 (**POSITIVE MARKING FROM QUESTION 2.3.2) check alternative answers from 2.3.2**

$W = F\Delta x \cos\theta$

$= \underline{241,35(5)(\cos 28^\circ)}$ ✓

$= 1065,497\ J$

Range: 1065,497 - 1101,43 J

OR

calculate F_x

$W_{Fx} = F_x \Delta x \cos\theta$

$= \underline{(241,35\cos 28)(5)(\cos 0)}$ ✓

$= 1065,497\ J$

Range: 1065,50 – 1079,01 J

$P = \frac{W}{t}$ ✓ ✓

$= \frac{1065,497}{3,2}$ ✓

$= 332,9678$

$= 332,97\ W$ ✓

Carry over mark. Correctly substituting the value calculated for work in the power formula. But then the final (wrong) answer is not awarded a mark.

Range: 332,97- 344,20 W **(5)**

OPTION 3:

Speed = $\frac{\Delta x}{\Delta t} = \frac{5}{3,2\checkmark}$ = 1,5625 m.s^{-1}

Carry over mark. Correctly substituting speed in power formula

$P_{ave} = F_{Ax} v_{ave}$ ✓ (F_A from 2.3.2 Range: 241,35 – 249,49 N

= (241,35cos 28) ✓ (1,5625) ✓

= 332,97 W ✓ **(Range: 332,97 - 344,20W)**

QUESTION 3

3.1 In an isolated system, the total linear momentum is conserved/ remains constant. ✓✓
In 'n geïsoleerde sisteem sal die totale lineêre momentum behoue bly/constant bly. ✓✓ **(2 or 0)** **(2)**

3.2 $\sum p_i = \sum p_f$
$mv_i = mv_N + mv_{FT}$ ✓ Anyone/ *Enige een*

$(90000 + m_{FT})4500\checkmark = (90000)(11000)\checkmark + m_f(-3045)\checkmark$

$m_{FT} = 77\,534,79$ kg✓

OPTION 2

$\Delta p_N = -\Delta p_{FT}$ ✓

$m(v_f - v_i) = -m(v_f - v_i)$

9000 (11000✓ – 4500✓) = -m(4500- (-3045) ✓

m = 7753,48 kg ✓ **(5)**

3.3 **POSITIVE MARKING FROM 3.2**

$E_{ki} = \frac{1}{2}mv^2$ ✓Any one/ *Enige een*

$= \frac{1}{2}(90000 + 77534,79)(4500)^2$ ✓

$= 1,696 \times 10^{12}$J

$E_{kf} = \frac{1}{2}mv^2 + \frac{1}{2}mv^2$

$= \frac{1}{2}(90000)(11000)^2 + \frac{1}{2}(77534,79)(3045)^2$✓

$= 5,8 \times 10^{12}$J

$E_{ki} \neq E_{kf}$✓

Decoupling is not elastic✓ / *Ontkoppeling is onelasties* **(5)**

QUESTION 4

4.1 3 m·s^{-1} ,downwards✓/*afwaarts* **(1)**

4.2 **NOTE: Allow positive marking from 4.1**
IF SIGN CONVENTION IS NOT FOLLOWED: (-1)

$v_f^2 = v_i^2 + 2a\Delta y$
$= (-3)^2 + 2(-9,8)(-18)$
$v_f = -19,02\ m \cdot s^{-1}$

$v_f = v_i + a\Delta t$ ✓
$19,02$✓ $= 3 + 9,8\Delta t$✓
$\Delta t = 1,63$ s✓

$\Delta y = v_i t + \frac{1}{2}a\Delta t^2$ ✓
-18 ✓ = (-3)t + ½ (-9,8)t² ✓
t = 1,63s ✓

(4)

For the following options, candidate calculated final velocity first:
$v_f^2 = v_i^2 + 2a\Delta$
$= (-3)^2 + 2(-9,8)(-18)$ ✓
v_f = -19,02104

$F_{net}(t\Delta) = m(v_f - v_i)$ ✓
mg.Δt = m(vf -vi)
-9,8 (Δt) = (-19,02104 – (-3)) ✓
Δt = 1,63 s✓

$\Delta y = \left(\frac{v_i+v_f}{2}\right)t$ ✓
$-18 = \left(\frac{-19,02104+(-3)}{2}\right)\Delta t$
Δt = 1,63 s✓

4.3.1 **IF SIGN CONVENTION IS NOT FOLLOWED: (-1)**
Calculate the distance that the crane moves in 1 second at constant velocity:
Bereken die afstand wat die hyskraan in 1 sekonde beweeg teen konstante snelheid:

$\Delta y = v_i\Delta t + \frac{1}{2}a(\Delta t)^2$ ✓
$= 3(1)$ ✓ + 0 (Non-essential zero may be omitted)
$\Delta y = 3m$

Speed = $\frac{distance}{time}$ ✓
Distance = speed x time
= 3(1) ✓
= 3m

$\Delta y = \left(\frac{v_i+v_f}{2}\right)t$ ✓
$= \left(\frac{-3-3}{2}\right)(1)$ ✓
= 3m

C was thrown from: 18 – 3 = 15 m✓ **(3)**

4.3.2 **POSITIVE MARKING 4.2 and 4.3.1**
IF SIGN CONVENTION IS NOT FOLLOWED: (-1)

OPTION 1:

$\Delta y = v_i \Delta t + \frac{1}{2} a(\Delta t)^2$ ✓

$-15 = v_i(0,63) + \frac{1}{2}(-9,8)(0,63)^2$ ✓

$v_i = -20,72 \text{ m.s}^{-1}$

$v_i = 20,72 \text{ m.s}^{-1}$ ✓**downwards** ✓ **Range: 20,519 – 20,72**

OPTION 2:
Use of energy principles:

$E_{mech\ top} = E_{mech\ bottom}$
$E_p + E_{ktop} = E_p + E_{kbottom}$
$mgh + \frac{1}{2}mv^2 = 0\frac{1}{2}mv^2$

Any one ✓

$(9,8)(15) + ½ v_i^2 = ½ (26,74)^2$ ✓

$v_i^2 = 20,519 \text{ m.s}^{-1}$ ✓ **downward** ✓

(4)

4.3.3 **POSITIVE MARKING FROM QUESTION 4.2**
IF SIGN CONVENTION IS NOT FOLLOWED: (-1)

Crane moves at constant velocity for 1,63s./ *Hyskraan beweeg teen konstante snelheid vir 1,63s.*

$\Delta y = v\Delta t$ ✓
$= (3)(1,63)$ ✓
$= 4,89 \text{ m}$

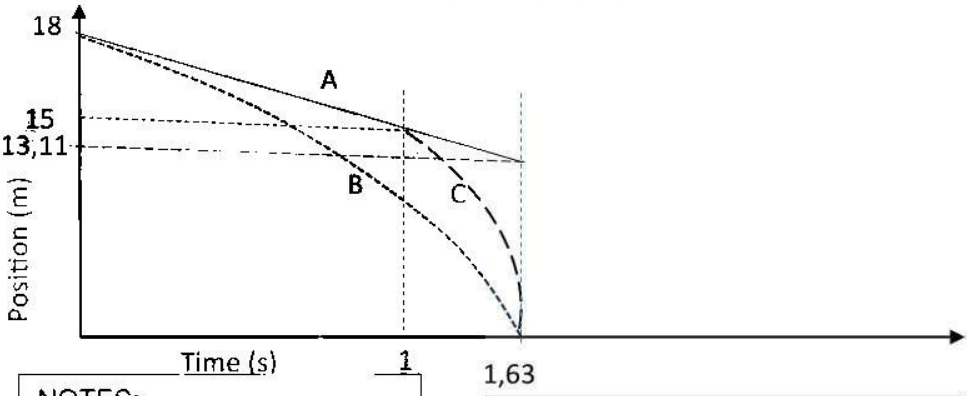
OR

$\Delta y = \left(\frac{v_i + v_f}{2}\right) t$ ✓
$= \left(\frac{-3-3}{2}\right)(1,63)$ ✓
$= 4,89$

Height = 18 –✓ 4,89 (Mark is for subtracting the answer from 18)
= 13,11m✓

(3)

4.4 **POSITIVE MARKING FROM 4.2, 4.3.1, 4.3.2, 4.3.3**



NOTES:
Starting height (AB) ✓
Drop height of C ✓
Throw time of C ✓
Final position of A ✓
B & C hit ground together ✓
Final time for all graphs ✓

NOTAS:
Aanvanklike hoogte (AB) ✓
Gooi/val hoogte van C ✓
Gooi tyd van C ✓
Finale posisie van A ✓
B & C tref grond op dieselfde tyd ✓
Finale tyd vir al drie grafieke ✓

(6)

QUESTION 5

5.1 A system on which the external net force is zero. ✓✓
'n Sisteem waarop die eksterne netto krag nul is ✓✓

(2 or 0) (2)

5.2

Fg✓

* Any additional forces/*Addisionele kragte*: -1
* Allow w / weight /*Aanvaar gewig*

(1)

5.3 $\text{Mechanical Energy}_{\text{Bottom}} = \text{Mechanical Energy}_{\text{Top}}$

Meganiese energie$_{onder}$ = Meganiese energie$_{bo}$

$$(E_p + E_k)_{bottom} = (E_p + E_k)_{top}$$

$$\left(mgh + \frac{1}{2}mv^2\right)_{bottom} = \left(mgh + \frac{1}{2}mv^2\right)_{top}$$

$$W_{nc} = \Delta E_k + \Delta E_p$$

$$W_{net} = \Delta E_k$$

$$0 + \frac{1}{2}(52)(v^2)\checkmark = \frac{(52)(9,8)(0,47)}{v_i}\checkmark + 0$$

$$v_i = 3,04\ m \cdot s^{-1}\ \checkmark$$

Any one ✓

NOTES:
✓ Formula
✓ Subs Ep
✓ Subs Ek
✓ Answer

(4)

5.4 $\Delta p = mv_f - mv_i$ ✓
$\Delta p = m(v_f - v_i)$
$= 52(3,04 - 0)$✓
$= 158,08\ kg \cdot m \cdot s^{-1}$ ✓ upwards✓ *Iopwaarts* **(4)**

5.5 **POSITIVE MARKING FROM 5.4**
158,08 N·s upwards✓ /Opwaarts **(1)**

5.6 $F_{net}\Delta t = \Delta p$

OR/*OF*

$F_{net} = \frac{\Delta p}{\Delta t}$

OR/*OF*

$F_{net}\ \alpha\ \frac{1}{\Delta t}$

Any one✓

AND: momentum remains constant ✓

OR:

If time increase and force decrease✓, the momentum will remain the same✓

As tyd toeneem en krag afneem ✓vir dieselfde verandering in momentum, ✓
(2)
[14]

QUESTION 6

6.1 A force for which work done in moving an object between two points depends on the path taken. ✓✓
'n krag waarvoor die arbeid verrig word om die voorwerp tussen twee punte beweeg afhang van die pad van beweging. ✓✓ **(2 or 0)** **(2)**

6.2 $W_f = f\Delta x\cos\theta$✓
$= (7{,}5)(5)\cos 180°$✓
$= -37{,}5\ \text{J}$✓

(3)

6.3 **POSITIVE MARKING FROM 6.2**

NOTE:
($W_{Fg} = \Delta mgh$)
✓Formula
✓ Subst W_f
✓ Subst ΔE_p
✓ Subst ΔE_k
✓ Final answer

$$W_{nc} = \Delta E_p + \Delta E_k$$
$$W_{net} = \Delta E_k$$
$$W_{Fg} + W_f = \Delta E_k$$

$$W_{nc} = (mgh_f - mgh_i) + \frac{1}{2}m(v_f^2 - v_i^2)$$

-37,5✓ $= (35)(9{,}8)(20 \times 10^{-2} - 2{,}5)$ ✓ + ½ $(35)(v_f^2 - 0{,}3^2)$ ✓

$v_f = 6{,}56\ \text{m}\cdot\text{s}^{-1}$ ✓

NOTE: If equations of motion is used: 0/5

(5)

[10]

QUESTION 7

7.1 Doppler effect ✓
Change in the frequency/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
Verandering in frekwensie/toonhoogte van die waargenome klank agv relatiewe beweging tussen die bron en luisteraar **(3)**

7.2.1 Speed (of car)/Motion (of car) /*Spoed (van die motor)* ✓ **(1)**

7.2.2 (observed) frequency✓ / *(waargenome)frekwensie* **(1)**

7.3 B ✓ **(1)**

7.4 The detected frequency is higher ✓/*Die waargenome frekwensie is hoër* **(1)**

7.5 **NOTE: Allow any value for v. The question should be marked accordingly.**

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

2030✓ $= \left(\frac{340}{340 - v_s}\right)(1700)$ ✓

$v_s = 55{,}27\ m \cdot s^{-1}$✓

$f_L = \left(\frac{v \pm v_L}{v+v_s}\right)$ ✓

2030✓ $= \left(\frac{343}{343 - v_s}\right)(1700)$ ✓

$V_s = 55{,}24\ m \cdot s^{-1}$✓

(4)
[11]

QUESTION 8

8.1 The magnitude of the electrostatic force exerted by one point charge (Q1) on another point charge (Q2) is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them:✓✓*I*
Twee ladings sal 'n elektrostatiese krag uitoefen deur een puntlading op 'n ander is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. **(2)**

8.2

$F_E/F_C/F_{AonB}$ ✓ (Coulombic force)

F_g ✓ **(2)**

8.3

$F = \frac{kQ_1Q_2}{r^2}$ ✓

$(20 \times 10^{-3})(9{,}8)$ ✓ $= \frac{kQ^2}{(25 \times 10^{-3})^2}$ ✓

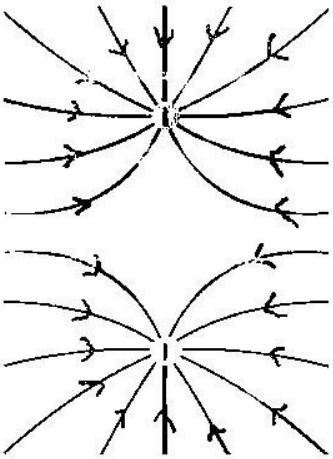
$Q = 1{,}17 \times 10^{-7}C$✓

MARKING CRITERIA:

- Coulomb's Law
- Correct substitution into Fg and F_E
- Equating Fg and F_E
- Final answer (sign not considered)

(4)

8.4



* All lines curve away (shape)✓*Ialle lyne buig weg (vorm)*
* All arrows point towards the charge (direction of the field lines)✓*IAlle pyle wys na die lading(rigtin van veldlyne)*
* No lines touching/crossing and all make contact with the charges✓ */Geen lyne raak/kruis of maak kontak met die ladings nie*

(3)

8.5

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

$$= \frac{(9 \times 10^9)(1{,}17 \times 10^{-7}) \checkmark}{(25 \times 10^{-3})^2 \checkmark}$$

$$= 1{,}68 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark$$

(4)

QUESTION 9

9.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature. ✓✓ **(2 or 0)**
Die potensiaalverskil oor die punte van 'n geleier is direk eweredig aan die stroom in die geleier mits temperatuur constant bly **(2)**

9.2.1

$$V_{internal} = Ir \checkmark$$

$$1{,}7 = I\,(0{,}7) \checkmark$$

$$I = 2{,}43 \text{ A} \checkmark$$

(3)

9.2.2 **(POSITIVE MARKING FROM QUESTION 9.2.1)**

R_2:

$V = IR \checkmark$

$5 = 2{,}43\,R_2 \checkmark$

$R_2 = 2{,}06\ \Omega$

$R_1 = 2R_2$ ✓

$\therefore R_1 = 4{,}12\Omega$ ✓

(4)

9.2.3 **(POSITIVE MARKING FROM QUESTIONS 9.2.1 AND 9.2.2)**
OPTION 1

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

$$= (2{,}43)(0{,}7 + 2{,}06 + 4{,}12) \checkmark$$

$$\varepsilon = 16{,}72 \text{ V} \checkmark$$

OPTION 2

$I_{R1} = I_{R2}$

$\frac{V_{R1}}{R_1} = \frac{V_2}{R_2}$

$\frac{V_1}{2R_2} = \frac{5}{R_2}$ ✓

$V_1 = 10\ V$

$\varepsilon = 1,7 + 10 + 5$ ✓

$= 16,7\ V$ ✓

(3)

9.3.1 **(POSITIVE MARKING FROM 9.2)**

$\frac{1}{R_p} = \frac{1}{R_3} + \frac{1}{R_2}$

$\frac{1}{R_p} = \frac{1}{15} + \frac{1}{2,06}$ ✓

$R_p = 1,811$

$R_T = R_p + R_1$

$R_T = 1,811 + 4,12$ ✓

$R_T = 5,93\Omega$

$\varepsilon = I(R + r)$ ✓

$16,72 = I(5,93 + 0,7)$ ✓

$I = 2,52\ A$ ✓

MARKING CRITERIA

- Correct substitution into R_p/*Korrekte invervanging*
- Addition of R_p and R_1/*Som van R_p en R_1*
- EMF formula/ *EMK formule*
- Substituting into EMF formula *Invervanging in EMK formule*
- Final answer/*Finale antwoord*

(5)

9.3.2 **(POSITIVE MARKING FROM QUESTION 9.3.1)**

MARKING CRITERIA

- Substituting into Ohm's law/*Invervanging in Ohm se wet*
- Power formula/*Drywing formule*
- Substituting into power formula/*Invervanging in drywing*
- Final answer/*Finale antwoord*

V over R_2:

V= IR
= 2,52(1.811) ✓
= 4,56

$P = \frac{V^2}{R}$ ✓

$P = \frac{4,56^2}{2,06}$ ✓

P = 10,09 W✓

OPTION 2

I in R_2

I = 2,52✓ x $\frac{15}{17,02}$

I = 2,221 A

R = I^2R✓
= $(2,221)^2(2,52)$ ✓
= 10,16 W✓

OPTION 3

I in R_2

I = 2,52✓ x $\frac{15}{17,02}$

I = 2,221 A

P = VI ✓
= (4,56)(2,221) ✓
= 10,127 W ✓

RANGE: 10,09 – 10,16 W **(4)**

[21]

GRAND TOTAL/GROOTTOTAAL: 150