GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2015

MEMORANDUM

SUBJECT: PHYSICAL SCIENCES: PHYSICS P1 (10841)

FISIESE WETENSKAPPE: FISIKA V1 (10841)

GAUTENG DEPARTMENT OF EDUCATION

PREPARATORY EXAMINATION – 2015

PHYSICAL SCIENCES: PHYSICS/
FISIESE WETENSKAPPE: FISIKA
(First Paper/*Eerste Vraestel*)

MEMORANDUM

QUESTION 1/*VRAAG 1*

1.1	A ✓✓	(2)
1.2	A ✓✓	(2)
1.3	B ✓✓	(2)
1.4	A ✓✓	(2)
1.5	B ✓✓	(2)
1.6	C ✓✓	(2)
1.7	A ✓✓	(2)
1.8	C ✓✓	(2)
1.9	D ✓✓	(2)
1.10	A ✓✓	(2)

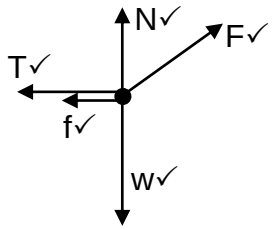
[20]

QUESTION 2/*VRAAG 2*

2.1 The net force acting on an object is equal to the rate of change in the momentum of the object. ✓✓
Die netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering in momentum vir die voorwerp. ✓✓
OR/*OF*
When a <u>resultant/net force</u> acts on an object, the object will accelerate in the direction of the force at an <u>acceleration directly proportional to the force</u> ✓and <u>inversely proportional to the mass</u> of the object. / ✓
Wanneer 'n <u>resultante/netto krag</u> op 'n voorwerp inwerk sal die voorwerp in die rigting van die krag versnel met 'n <u>versnelling direk eweredig aan die krag</u> ✓ en <u>omgekeerd eweredig aan die massa</u>.✓ (2)

2.2 **Accepted Labels/*Aanvaarde benoemings***

w	F_g/F_w/force of Earth on block/weight/49 N/mg/gravitational force *F_g/F_w/krag van Aarde op blok/gewig/49 N/mg/gravitasiekrag*
N	F_N/normal *F_N/normaal*
f	Friction/F_f *Wrywing/F_f*
T	Tension/Force in string/F_T *Spanning/Trekkrag (van die tou)/ F_T*
F	F_{app}/15 N *F_{toeg}/15 N*



Note/*Nota*
One mark for correct arrow **and** label.
If **any** other forces shown max. $\frac{4}{5}$

*Een punt vir die korrekte pyl **en** benaming*
*Indien **enige** ander krag getoon word maks.* $\frac{4}{5}$

(5)

2.3

$f_k = \mu_k N$ ✓

$f_k = (0{,}35)(49 - 15\sin 30°)$ ✓

$f_k = 14{,}53\,N$ ✓

(3)

2.4 **OPTION 1/*OPSIE 1***

Right positive:
Regs positief:
For/*Vir* 5 kg

$$F_{net} = ma \quad \checkmark$$
$$F\cos\theta - T - f = m(2,2)$$
$$\underline{15\cos 30° - T - 14,53} \checkmark = 5(2,2) \checkmark$$
$$T = 14,53 - 15\cos 30° + 11$$
$$T = 12,54\,N$$

Upward positive:
Opwaarts positief:
For/*Vir* B

$$F_{net} = ma$$
$$12,54 - F_G = m(2,2)$$
$$\underline{12,54 - 9,8m} \checkmark = m(2,2)$$
$$12,54 = 12m$$
$$m = 1,05\,kg \checkmark$$

OPTION 2/*OPSIE 2*

Upward positive:
Opwaarts positief:
For/*Vir* B

$$F_{net} = ma \checkmark$$
$$T - F_G = m(2,2) \checkmark$$
$$\underline{T - 9,8m} \checkmark = m(2,2)$$
$$T = 12m \quad (A)$$

Parallel down positive:
Ewewydig af positief:
For/*Vir* 5 kg

$$F_{net} = ma$$
$$F\cos\theta - T - f = m(2,2)$$
$$\underline{15\cos 30° - T - 14,53} \checkmark = 5(2,2)$$
$$T = 14,85 - 15\cos 30° + 11$$
$$T = 12,54\,N \quad (B)$$

Set/*stel* (A) = (B)

$$12m = 12,54$$
$$m = 1,05\,kg \quad \checkmark$$

(5)
[15]

QUESTION 3/*VRAAG 3*

3.1 $9{,}8\ m{\cdot}s^{-2}$ ✓ downward/to the centre of the earth ✓
9,8 m·s^{-2} ✓afwaarts / na die middelpunt van die aarde ✓ (2)

3.2 Once/one time ✓
Een keer ✓ (1)

3.3 Upward ✓
Opwaarts✓ (1)

3.4 **OPTION 1/ *OPSIE 1***
Upward positive:
***Opwaarts positief*:**

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$-3{,}2^2$✓$= 6^2 + 2(-9{,}8)\Delta y$ ✓
$\Delta y = 1{,}31\ m$ ✓

OPTION 2 / *OPSIE 2*
Upward positive:
***Opwaarts positief*:**
From t_1 to t_2 / *Vanaf t_1 na t_2*

$v_f = v_i + a\Delta t$
$-3{,}2 = 6 + (-9{,}8)\Delta t$ ✓
$\Delta t = 0{,}94\ s$

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$\Delta y = (6)(0{,}94) + \frac{1}{2}(-9{,}8)(0{,}94)^2$ ✓
$\Delta y = 1{,}31\ m$ ✓

OPTION 3 / *OPSIE 3*
Upward positive:
***Opwaarts positief*:**

$v_f = v_i + a\Delta t$
$-3{,}2 = 6 + (-9{,}8)\Delta t$ ✓
$\Delta t = 0{,}94\ s$

$\Delta y = \frac{v_f + v_i}{2}\Delta t$ ✓
$\Delta y = \frac{-3.2 + 6}{2}(0{,}94)$ ✓
$\Delta y = 1{,}31\ m$ ✓

OPTION 4 / *OPSIE 4*
Upward negative:
***Opwaarts negatief*:**

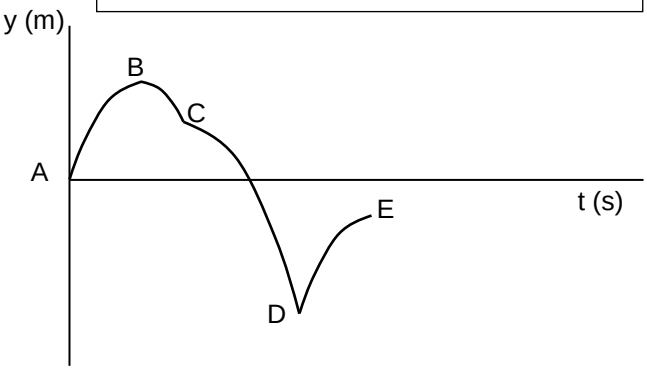
All the options 1 to 3 with all the applicable signs changed. Maximum ¾

Al die opsies 1 tot 3 met die toepaslike tekens omgekeerd. Maksimum ¾

(4)

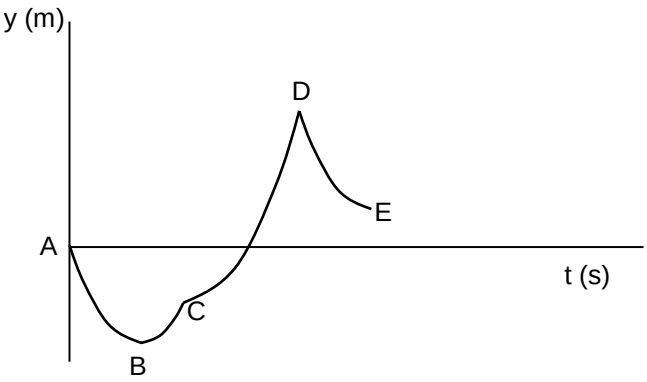
3.5

Upward positive/*Opwaarts positief*



Criteria for graph/*Kriteria vir grafiek:*	Marks/ *Punte*
Parabolic shape from A to C *Paraboliese vorm van A tot C*	✓
Shape from C to D *Vorm van C tot D*	✓
Shape from D to E *Vorm van D tot E*	✓
Combination of negative parabola *Kombinasie van negatiewe parabole*	✓
A starts at zero *A begin vanaf nul*	✓

Downward positive/*Afwaarts positief*



Note/*Nota*

if no/incorrect labels on axis: max. $\frac{4}{5}$

as geen/verkeerde benamings vir asse dan: maks. $\frac{4}{5}$

(5)
[13]

QUESTION 4/*VRAAG 4*

4.1 Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓and inversely proportional to the square of the distance between their centres.✓
Elke voorwerp in die heelal trek elke ander voorwerp aan met 'n krag wat direk eweredig is aan die produk van hul massas ✓en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul middelpunte. ✓ (2)

4.2
$$F_G = \frac{Gm_1m_2}{d^2} \quad \checkmark$$
$$5{,}71\times10^{15} \overset{\checkmark}{=} \frac{(6{,}67\times10^{-11})(6{,}39\times10^{23}\overset{\checkmark}{)}(1{,}08\times10^{16}\overset{\checkmark}{)}}{d^2}$$
$$d^2 = 8{,}06\times10^{13}$$
$$d = 8{,}98\times10^{6}\ \text{m} \quad \checkmark$$
$$\therefore h = 8{,}98\times10^{6} - 3390\times10^{3}$$
$$h = 5{,}59\times10^{6}\ \text{m} \quad \checkmark$$
(6)
[8]

QUESTION 5/*VRAAG 5*

5.1 The total linear momentum of a closed system remains constant (is conserved). ✓✓
Die totale lineêre momentum in 'n geslote stelsel bly konstant (bly behoue). ✓✓
OR/*OF*
In a closed/isolated system the total momentum before collision is equal to the total momentum after collison. ✓✓
In 'n geslote/geïsoleerde sisteem is die totale momentum voor 'n botsing gelyk aan die totale momentum na 'n botsing. ✓✓ (2)

5.2 **OPTION 1/ *OPSIE 1***
East positive:
Oos *positief*:

$\Sigma p_i = \Sigma p_f \quad \checkmark$

$m_{1+2}v_i = m_1v_{1f} + m_2v_{2f}$

$(54+1{,}5)\,(0{,}08) \overset{\checkmark}{=} 54v_{1f} + 1{,}5(10{,}2)\ \checkmark$

$v_{1f} = -0{,}2\ \text{m}\cdot\text{s}^{-1}$

$v_{1f} = 0{,}2\ \text{m}\cdot\text{s}^{-1}$ west/wes ✓

OPTION 2/ *OPSIE 2*
West positive:
***Wes positief*:**

$\Sigma p_i = \Sigma p_f \quad \checkmark$

$m_{1+2}v_i = m_1v_{1f} + m_2v_{2f}$

$(54+1{,}5)(-0{,}08) \overset{\checkmark}{=} 54v_{1f} + 1{,}5(-10{,}2)\ \checkmark$

$v_{1f} = 0{,}2\ \text{m}\cdot\text{s}^{-1}$ west/wes ✓

(4)

5.3 **OPTION 1 / *OPSIE 1***
East positive:
***Oos positief*:**

$F_{net}\Delta t = mv_f - mv_i$ ✓
$F_{net}(1,2) = (1,5)(10,2) - (1,5)(0,08)$ ✓
$F_{net} = 12,65\,\text{N east / oos}$ ✓

OPTION 2 / *OPSIE 2*
West positive:
***Wes positief*:**
$F_{net}\Delta t = mv_f - mv_i$ ✓
$F_{net}(1,2) = (1,5)(-10,2) - (1,5)(-0,08)$ ✓
$F_{net} = -12,65\,\text{N}$
$\therefore F_{net} = 12,65\,\text{N east / oos}$ ✓

OPTION 3 / *OPSIE 3*
East positive:
***Oos positief*:**
$v_f = v_i + a\Delta t$
$10,2 = 0,08 + a(1,2)$
$a = 8,43\,\text{m}\cdot\text{s}^{-2}$

$F_{net} = ma$ ✓
$F_{net} = 1,5(8,43)$ ✓
$F_{net} = 12,65\,\text{N east / oos}$ ✓

OPTION 3 / *OPSIE 3*
West positive:
***Wes positief*:**
$v_f = v_i + a\Delta t$
$-10,2 = -0,08 + a(1,2)$
$a = -8,43\,\text{m}\cdot\text{s}^{-2}$

$F_{net} = ma$ ✓
$F_{net} = 1,5(-8,43)$ ✓
$F_{net} = -12,65\,\text{N}$
$F_{net} = 12,65\,\text{N east / oos}$ ✓

(3)
[9]

QUESTION 6/*VRAAG 6*

6.1 A force for which the net work done in any closed path is dependent on the path the object travelled. ✓✓
OR/*OF*
'n Krag waarvoor die netto arbeid verrig langs enige geslote pad onafhanklik is van die roete geneem ✓✓
OR/*OF*
The net work done by the non-conservative force / frictional force depends on the path the object travelled ✓✓ /
Die netto arbeid verrig deur 'n nie-konserwatiewe krag / wrywingskrag is onafhanklik van die roete geneem ✓✓
OR/*OF*
The mechanical energy is not constant ✓✓for a non-conservative force /
Die meganiese energie is nie konstant ✓✓vir 'n nie-konserwatiewe krag nie (2)

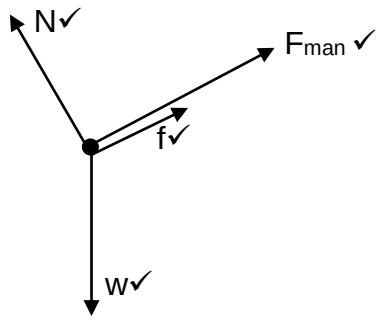
6.2 $f_k = \mu_k N$ } Any one/*enige een* ✓
$f_k = \mu_k F_{g\perp}$ }
$f_k = 0{,}22 \times (86 \times 9{,}8) \times \cos 25°$ ✓
$f_k = \underline{168{,}04\,N}$ (2)

6.3 <u>The net/total work done</u> ✓ on an object is <u>equal to the change in the object's kinetic energy</u>. ✓ OR The work done on an object by a resultant/net force is equal to the change in the object's kinetic energy.

<u>Die netto/totale arbeid</u> ✓ wat op 'n voorwerp verrig word, <u>is gelyk aan die verandering in die kinetiese energie van die voorwerp</u>. ✓ OF Die arbeid verrig op 'n voorwerp deur 'n resultante/netto krag is gelyk aan die verandering in die kinetiese energie van die voorwerp. (2)

6.4 **Accepted Labels/*Aanvaarde benoemings***

w	F_g/F_w/force of Earth on block/weight/842,8 N/mg/gravitational force *F_g/F_w/krag van Aarde op blok/gewig/842,8 N/mg/gravitasiekrag*
N	F_N/normal *F_N/normaal*
f	Friction/F_f *Wrywing/F_f*
F	F_{app}/15 N *F_{toeg}/15 N*



(4)

6.5 **OPTION 1 / *OPSIE 1***
Parallel to the plane down is positive
Ewewydig aan die vlak af is positief

$$v_f^2 = v_i^2 + 2a\Delta x$$
$$v_f^2 - v_i^2 = 2(1,54)(0,9) \quad \checkmark$$
$$v_f^2 - v_i^2 = 2,772$$

$$W_{net} = \Delta E_K \quad \checkmark$$
$$W_{man} + W_{grav} + W_f = \tfrac{1}{2}m(v_f^2 - v_i^2)$$
$$W_{man} + (86 \times 9,8)\sin 25°(0,9)\cos 0° + 168,04(0,9)\cos 180° \quad \checkmark = \tfrac{1}{2}(86)(2,772) \quad \checkmark$$
$$W_{man} + 320,56 - 151,236 = 119,196$$
$$W_{man} = -50,13 \text{ J} \quad \checkmark$$

OPTION 2 / *OPSIE 2*
Parallel to the plane up is positive
Ewewydig aan die vlak op is positief

$$v_f^2 = v_i^2 + 2a\Delta x$$
$$v_f^2 - v_i^2 = 2(-1,54)(-0,9) \quad \checkmark$$
$$v_f^2 - v_i^2 = 2,772$$

$$W_{net} = \Delta E_K \quad \checkmark$$
$$W_{man} + W_{grav} + W_f = \tfrac{1}{2}m(v_f^2 - v_i^2)$$
$$W_{man} + (86 \times 9,8)\sin 25°(0,9)\cos 0° + 168,04(0,9)\cos 180° \quad \checkmark = \tfrac{1}{2}(86)(2,772) \quad \checkmark$$
$$W_{man} + 320,56 - 151,236 = 119,196$$
$$W_{man} = -50,13 \text{ J} \quad \checkmark$$

OPTION 3 / *OPSIE 3*
Parallel to the plane up is positive
Ewewydig aan die vlak op is positief

$$F_{net} = ma$$
$$F_{man} - F_G\sin\theta + f = ma$$
$$F_{man} - (86 \times 9,8)\sin 25° + 168,04 = 86(-1,54) \quad \checkmark$$
$$F_{man} = 356,18 - 168,04 - 132,44$$
$$F_{man} = 55,7 \text{ N}$$

$$W_{man} = F_{man}\Delta x\cos\theta \quad \checkmark$$
$$W_{man} = (55,7) \quad \checkmark (0,9)\cos 180° \quad \checkmark$$
$$W_{man} = -50,13 \text{ J} \quad \checkmark$$

OPTION 4 / *OPSIE 4*
Parallel to the plane down is positive
Ewewydig aan die vlak af is positief

$$F_{net} = ma$$
$$-F_{man} + F_G\sin\theta + f = ma$$
$$-F_{man} + (86 \times 9{,}8)\sin 25° - 168{,}04 = 86(1{,}54) \quad \checkmark$$
$$F_{man} = -356{,}18 + 168{,}04 + 132{,}44$$
$$F_{man} = -55{,}7 \text{ N}$$

$W_{man} = F_{man}\Delta x\cos\theta$ ✓
$W_{man} = (55{,}7)$ ✓ $\underline{(0{,}9)\cos 180°}$ ✓
$W_{man} = -50{,}13 \text{ J}$ ✓

(5)
[15]

QUESTION 7/*VRAAG 7*

7.1 The 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.✓ ✓

Die verandering in die frekwensie(of toonhoogte) van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede het relatief to die medium van voortplanting. ✓ ✓ (2)

7.2 **OPTION 1 / *OPSIE 1***

$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓ OR/*OF* $f_L = \frac{v}{v - v_s} f_s$

$f_L = \left(\frac{335}{335 - 25} \right)$ ✓ 430 ✓

$f_L = 464{,}68\,\text{Hz}$

$\lambda = \frac{v}{f}$ ✓

$\lambda = \frac{335}{464{,}68}$ ✓

$\lambda = 0{,}72\,\text{m}$ ✓

OPTION 2 / *OPSIE 2*

$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓ OR/*OF* $f_L = \frac{v}{v - v_s} f_s$

$\frac{v}{\lambda_L}$ ✓ $= \left(\frac{335}{335 - 25} \right)$ ✓ 430 ✓

$\frac{335}{\lambda_L}$ ✓ $= \left(\frac{335}{335 - 25} \right) 430$

$\lambda = 0{,}72\,\text{m}$ ✓ (6)

7.3 THE SAME; ✓ The relative velocity of the train driver and the train is zero✓. There will therefore not be an observed change ✓ in the frequency heard by the driver.

DIESELFDE ✓ Die relatiewe snelheid van die treindrywer ten opsigte van die trein is nul. ✓ Daar sal dus nie 'n verandering in die waargenome frekwensie ✓ soos gehoor deur die treindrywer wees nie. (3)

[11]

QUESTION 8/*VRAAG 8*

8.1 Negative OR – ✓ The direction of E_1 on the diagram is to the left ✓which is opposite to that of E_2 which indicates the field for a positive charge. ✓

Negatief of – ✓ Die rigting van E_1 in die diagram is na links ✓ wat in die teenoorgestelde rigting is as E_2 wat die veld vir 'n positiewe lading is. ✓ (3)

8.2 **POSITIVE MARKING FROM QUESTION 8.1**
POSITIEWE NASIEN VANAF VRAAG 8.1
Option 1/*Opsie 1*

$$E_{net} = E_2 - E_1$$
$$\therefore E_1 = E_2 + E_{net}$$

} Any one/*enige een* ✓

$$\frac{kQ_1}{r^2} = \frac{kQ_2}{r^2} + E_{net}$$ ✓

$$\frac{(9\times10^9)Q_1}{(0,6)^2} = \frac{(9\times10^9)(12\times10^{-9})}{(0,3)^2} + 1600$$ ✓ ✓ ✓

$$2,5\times10^{10}Q_1 = 1200 + 1600$$
$$Q_1 = 1,12\times10^{-7}\,C$$ ✓

8.3 **Option 2/*Opsie 2***

$$E_2 = \frac{kQ_2}{r^2}$$ ✓

$$E_2 = \frac{(9\times10^9)(12\times10^{-9})}{(0,3)^2}$$ ✓ ✓

$E_2 = 1200\,N\cdot C^{-1}$ to the right / *na regs*

$$E_{net} = E_2 - E_1$$
$$\therefore E_1 = E_2 + E_{net}$$

} Any one/*enige een*✓

$E_1 = 1200 + 1600$ ✓

$E_1 = 2000\ N\cdot C^{-1}$ to the left/na links

$$E_1 = \frac{kQ_1}{r^2}$$

$$2000 = \frac{(9\times10^9)Q_1}{(0,6)^2}$$ ✓

$Q_1 = 1,12\times10^{-7}\,C$ ✓ (7)

8.3

$E = \frac{F}{Q}$ ✓

$F = (1{,}6 \times 10^{-19}) \checkmark (1600)$ ✓

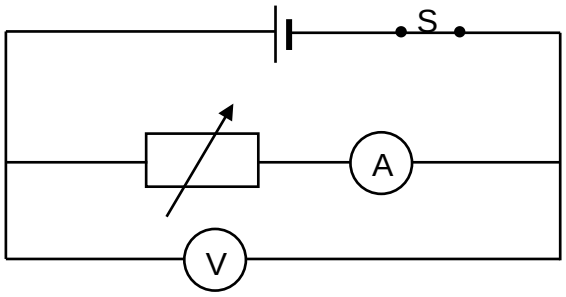
$F = \underline{2{,}56 \times 10^{-16}\ \text{N to the right / na regs}}$ ✓

(4)
[15]

QUESTION 9 / *VRAAG 9*

9.1 **Independent variable/*Onafhanklike veranderlike:***
Total current in the circuit ✓
Totale stroom(sterkte) in die stroombaan✓ (1)

9.2



Cell; switch rheostat correctly drawn and placed in series *Sel, skakelaar en reostaat korrek geteken en in serie met mekaar.*	✓
Ammeter in series with rheostat. *Ammeter in serie met die reostaat.*	✓
Voltmeter in parallel with the rheostat and ammeter or cell. *Voltmeter in parallel met die reostaat en die ammeter of sel.*	✓

(3)

9.3 $\text{gradient} = \frac{\Delta y}{\Delta x}$

$\text{gradient} = \frac{10-8}{0-1}$ ✓

$\text{gradient} = -2$ ✓

$\therefore r = 2\,\Omega$ ✓

Accept any legitimate coordinates taken from the graph
Aanvaar antwoorde enige geldige koördinate afgelees vanaf die grafiek

(3)

9.4 GREATER THAN; ✓
GROTER AS ✓ (1)
[8]

QUESTION 10/*VRAAG 10*

10.1.1 $R_T = R_1 + R_2$ ✓
$R_T = 3,7 + 3,4$
$R_T = 7,1\ \Omega$ ✓ (2)

10.1.2 $\varepsilon = IR + Ir$ ✓
$20 = I(7,1 + 1)$ ✓
$I = 2,47\ A$ ✓ (3)

10.2 INCREASES; ✓ When the <u>total resistance decreases</u> ✓; the total current increases when <u>emf and internal resistance stay the same</u>. ✓
NEEM TOE; ✓Wanneer die <u>totale weerstand afneem</u>, ✓ sal die totale stroom toeneem as die <u>EMK en die interne weerstand dieselfde bly</u>. ✓ (3)

10.3 **<u>Option 1/*Opsie 1:*</u>**

$\varepsilon = IR + Ir$
$20 = (2,31)R_4 + (2,31)(1)$ ✓
$R_4 = 7,66\ \Omega$

$V = IR$
$V = (2,31)(7,66)$
$V = 17,69\ V$

$P = \frac{V^2}{R}$ ✓
$P = \frac{17,69^2}{7,66}$ ✓
$P = 40,86\ W$ ✓

<u>Option 2/*Opsie 2*:</u>

$\varepsilon = IR + Ir$
$20 = (2,31)R_4 + (2,31)(1)$ ✓
$R_4 = 7,66\ \Omega$

$P = I^2R$ ✓
$P = 2,31^2(7,66)$ ✓
$P = 40,87\ W$ ✓

Accept answers between
Aanvaar antwoorde tussen
40,86 W en 40,88 W

(4)
[12]

QUESTION 11/*VRAAG 11*

11.1 AC; ✓ The magnetic field changes continuously ✓ which causes the current through the globe to alternate direction.✓
WS; ✓ Die magneetveld word kontinu omgekeer ✓ wat veroorsaak dat die stroom deur die gloeilamp van rigting verander. ✓ (3)

11.2 The globe will light up/glow/burn. ✓
Die gloeilamp sal brand/ gloei. ✓ (1)

11.3 The strength of the magnetic field/magnetic flux linking with the copper coil changes continuously. ✓ This causes an induced emf in the copper coil. ✓ A current is able to flow through the globe because the coil is part of that circuit.✓
Die sterkte van die magneetveld/magnetiese fluks wat met die koperspoel skakel verander voortdurend. ✓Dit veroorsaak 'n geïnduseerde EMK in die koperspoel. ✓ 'n Stroom kan deur die gloeilamp vloei omdat die spoel deel vorm van daardie stroombaan. ✓ (3)

11.4
- Increase the speed/tempo at which the wheel/crank is turned.
- Increase the number or turns on the coil
- Use a stronger magnet ✓✓ [any two]

- *Verhoog die tempo waarteen die wiel/kruk gedraai word.*
- *Vermeerder die aantal windings op die spoel*
- *Gebruik 'n sterker magneet* ✓✓ [enige twee] (2)

11.5 **Option 1/*Opsie 1:***

$P_{ave} = V_{rms} I_{rms}$ ✓
$6 = (12) I_{rms}$ ✓
$I_{rms} = 0{,}5\ A$

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓
$0{,}5 = \frac{I_{max}}{\sqrt{2}}$
$I_{max} = 0{,}707\ A$ ✓

Option 2/*Opsie 2:*

$P_{ave} = \frac{V_{rms}^2}{R}$ ✓
$6 = \frac{(12)^2}{R}$ ✓
$R = 24\ \Omega$

$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓
$12 = \frac{V_{max}}{\sqrt{2}}$
$V_{max} = 16{,}97\ V$

$I_{max} = \frac{V_{max}}{R}$
$I_{max} = \frac{16{,}97}{24}$
$I_{max} = 0{,}707\ A$ ✓

(4)
[13]

QUESTION 12/*VRAAG 12*

12.1 Workfunction is the minimum energy of a photon ✓needed to set an electron free from the surface of a metal✓ /
Werksfunksie is die minimum energie wat 'n foton ✓moet hê om 'n elektron vry te stel uit die oppervlak van 'n metaal.✓ (2)

12.2 The wavelength is then inversely proportional to the maximum kinetic energy ✓ $(\lambda\alpha\frac{1}{E_{k\,max}})$.

Wavelength is inversely proportional to the frequency $(\lambda\alpha\frac{1}{f})$ of the radiation. ✓
The frequency is directly proportional to the maximum kinetic energy$(f\alpha E_{k\,max})$. ✓ if the cathode remains the same. ✓

Die golflengte is omgekeerd eweredig aan die maksimum kinetiese energie✓ $(\lambda\alpha\frac{1}{E_{k\,max}})$

Die golflengte is omgekeerd eweredig aan die frekwensie✓ $(\lambda\alpha\frac{1}{f})$*van die straling.*

Die frekwensie is direk eweredig aan die maksimum kinetiese energie✓ $(f\alpha E_{k\,max})$ *mits die katode dieselfde bly*. ✓

(4)

12.3 STAYS THE SAME
BLY DIESELFDE

(1)

12.4 **Option 1/*Opsie 1*:**

$$E = W_0 + E_K$$
$$\frac{hc}{\lambda} = \frac{hc}{\lambda_0} + \tfrac{1}{2}mv_{max}^{\ 2}$$
✓ Any one/*Enige een*

$$\frac{(6{,}63\times10^{-34})(3\times10^{8})}{160\times10^{-9}} \checkmark = \frac{(6{,}63\times10^{-34})(3\times10^{8})}{255\times10^{-9}} \checkmark + \tfrac{1}{2}(9{,}11\times10^{-31}) \checkmark v_{max}^{\ 2}$$
$$1{,}24\times10^{-18} = 7{,}8\times10^{-19} + 4{,}555\times10^{-31}v_{max}^{\ 2}$$
$$v_{max}^{\ 2} = 1.009\times10^{12}$$
$$v_{max} = 1{,}01\times10^{6}\ m\cdot s^{-1} \checkmark$$

Option 2/*Opsie 2*:

$$E = \frac{hc}{\lambda}$$
$$E = \frac{(6{,}63\times10^{-34})(3\times10^{8})}{160\times10^{-9}} \checkmark$$
$$E = 1{,}24\times10^{-18}\ J$$

$$W_0 = hf_0$$
$$W_0 = \frac{(6{,}63\times10^{-34})(3\times10^{8})}{255\times10^{-9}} \checkmark$$
$$W_0 = 7{,}8\times10^{-19}\ J$$

$$E_K = \tfrac{1}{2}mv^2$$
$$E - W_0 \checkmark = \tfrac{1}{2}(9{,}11\times10^{-31})v_{max}^{\ 2} \checkmark$$
$$1{,}24\times10^{-18} - 7{,}8\times10^{-19} = \tfrac{1}{2}(9{,}11\times10^{-31})v_{max}^{\ 2}$$
$$v_{max}^{\ 2} = 1.009\times10^{12}$$
$$v_{max} = 1{,}01\times10^{6}\ m\cdot s^{-1} \checkmark$$

(5)
[12]

GRAND TOTAL/*GROOTTOTAAL*: 150