education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

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

FEBRUARY/MARCH/*FEBRUARIE/MAART* 2010

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 18 pages.
Hierdie memorandum bestaan uit 18 bladsye.

SECTION A/*AFDELING A*

QUESTION 1/*VRAAG 1*

1.1	Power / *drywing* ✓	[12.2.1]	(1)
1.2	Monochromatic / *monochromaties* ✓✓	[12.2.1]	(1)
1.3	Potential difference / *potensiaalverskil* ✓	[12.2.1]	(1)
1.4	Electromagnetic induction / *elektromagnetiese induksie* ✓ OR/*OF* Faraday's law / *Faraday se wet*	[12.2.1]	(1)
1.5	Metastable (state) / *metastabiele (toestand)* ✓✓	[12.2.1]	(1)
			[5]

QUESTION 2/*VRAAG 2*

2.1	.. equal to the net force. / ... *gelyk aan die netto krag.* ✓✓ OR/*OF* The change in momentum is equal to ... / *Die verandering in momentum is gelyk aan ...*	[12.2.2]	(2)
2.2	...remains constant. / ... bly constant. ✓✓	[12.2.2]	(2)
2.3	The light/bright/blue/ lines in the interference pattern ... / Die ligte/helder/ blou lyne in die interferensiepatroon ... ✓✓ OR/*OF* ... are the result of destructive interference. / ... is die gevolg van destruktiewe interferensie.	[12.2.2]	(2)
2.4	... are electromagnetic waves. / ... *is elektromagnetiese golwe.* ✓✓	[12.2.3]	(2)
2.5	... line spectrum. / *lynspektrum.* ✓✓ ... line emission spectrum. / *lynemissiespektrum.* ... line absorption spectrum. / *lynabsorpsiespektrum.*	[12.2.3]	(2)
			[10]

QUESTION 3/*VRAAG 3*

3.1	B ✓✓	[12.1.2]	(2)
3.2	C ✓✓	[12.2.2]	(2)
3.3	A ✓✓	[12.1.2]	(2)
3.4	C ✓✓	[12.2.2]	(2)
3.5	D ✓✓	[12.1.2]	(2)
			[10]

TOTAL SECTION A/*TOTAAL AFDELING A*: 25

SECTION B/*AFDELING B*

QUESTION 4/*VRAAG 4*

4.1 The total linear momentum in an isolated system is conserved. ✓✓ or stays constant or stays the same
Die totale liniêre momentum in'n geslote sisteem bly behoue.
OR/*OF*
If no net external force acts on a system of particles, the total linear momentum of the system cannot change. / *Indien geen netto eksterne krag op'n sisteem van deeltjies inwerk nie, kan die totale liniêre momentum nie verander nie.*
Total mom before "is equal to total mom after collision in closed system"

Only/*Slegs* 2/2 or/*of* 0/2

[12.2.1] (2)

4.2 $(U + K)_{bottom} = (U + K)_{top}$ ✓

$0 + \frac{1}{2}(m_1 + m_2)v^2 = mgh + 0$

$\frac{1}{2}(0,015 + 5)(v_f^2)$ ✓ $= (0,015 + 5)(9,8)(0,15)$ ✓

$\therefore v_f = 1,71\ m\cdot s^{-1}$

Other formulae / *Ander formules:*
$E_{mech(i)} = E_{mech(f)}$
$(E_p + E_k)_i = (E_p + E_k)_f$
$(E_p + E_k)_{bottom} = (E_p + E_k)_{top}$
$(U + K)_{bottom} = (U + K)_{top}$
$mgh_i + \frac{1}{2}mv_i^2 = mgh_f + \frac{1}{2}mv_f^2$

[12.2.3] (3)

4.3 $p_t(before/voor) = p_t(after/na)$ ✓
$m_1v_{i1} + m_2v_{i2} = (m_1 + m_2)v_f$
$(0,015)v_{i1} + 0$ ✓ $= (0,015 + 5)(1,71)$ ✓
$\therefore v_{i1} = \cancel{238,7}\ m\cdot s^{-1}$ ✓
$= 571,71\ m\cdot s^{-1}$

Any one as formula / *Enige een as formule:*
$\Sigma p_{before/voor} = \Sigma p_{after/na}$
$p_t(before) = p_t(after)$
$m_1v_{i1} + m_2v_{i2} = m_1v_{f1} + m_2v_{f2}$
$m_1v_{i1} + m_2v_{i2} = (m_1 + m_2)v_f$
Accept symbols v and u
Accept / *Aanvaar:* $p_{before} = p_{after}$
$p_i = p_f$

[12.2.3] (4)

4.4 According to Newton's third law, If definition given ✓✓ (using object A ; object B)
the gun will exert a force on the bullet ✓
and the bullet will exert an equal but opposite force on the gun. ✓
The force of the gun on the officer pushes him slightly backwards. ✓

Volgens Newton se derde wet
oefen die geweer 'n krag op die koeël uit ✓
en die koeël oefen 'n gelyke, maar teenoorgestelde krag op die geweer uit. ✓
Die krag van die geweer op die polisieman druk hom effens terugwaarts. ✓

[12.2.3] (3)
[12]

QUESTION 5/*VRAAG 5*

5.1 Velocity after / *snelheid na* 30 m:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= 0 + 2(9,8)(50 - 20)$ ✓
$v_f = 24,25\ m{\cdot}s^{-1}$ ✓

Accept / *Aanvaar:*
$v^2 = u^2 + 2as$/$v = u + at$/$s = ut + ½at^2$
A mixture of the two allowed formulae is not accepted. / *'n Mengsel van die twee erkende formules word nie aanvaar nie.*

OR/*OF*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$30 = (0)\Delta t + ½(9,8)\ \Delta t^2$
$\therefore\ \Delta t = 2,47$ s
$v_f = v_i + a\Delta t = 0 + (9,8)(2,47)$ ✓ $= 24,25\ m{\cdot}s^{-1}$ ✓ [12.2.3] (3)

5.2 Velocity after a further / *snelheid na 'n verdere* 18,2 m:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= 24,25^2 + 2(9,8)(20 - 1,8)$ ✓
$\therefore v_f = 30,74\ m{\cdot}s^{-1}$

$v_f = v_i + a\Delta t$ ✓
$30,74 = 24,25 + 9,8t$ ✓
$\therefore t = 0,66$ s ✓

Accept / *Aanvaar:*
$v^2 = u^2 + 2as$/ $v = u + at$
A mixture of the two allowed formulae is not accepted.
'n Mengsel van die twee erkende formules word nie aanvaar nie.

(He will not be struck) – reaction time is shorter than the time for the brick to reach his head. ✓ *Hy sal nie getref word nie – reaksietyd is korter as die tyd wat dit die baksteen neem om sy kop te bereik.* ✓

OR/*OF*

Distance fallen in 0,4 s / *Afstand geval in 0,4 s*:
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= (24,25)(0,4) + ½(9,8)(0,4)^2$ ✓ $= 10,45$ m✓

Distance above head of supervisor after 0,4 s / *Afstand bo kop van toesighouer na 0,4 s*: $20 - 1,8 - 10,45 = 7,75$ m✓✓
He will not be struck – the brick is still 7,75 m above his head./*Hy sal nie getref word nie – die baksteen is steeds 7,75 m bokant sy kop.* ✓ [12.1.3] (6)

[9]

QUESTION 6/*VRAAG 6*

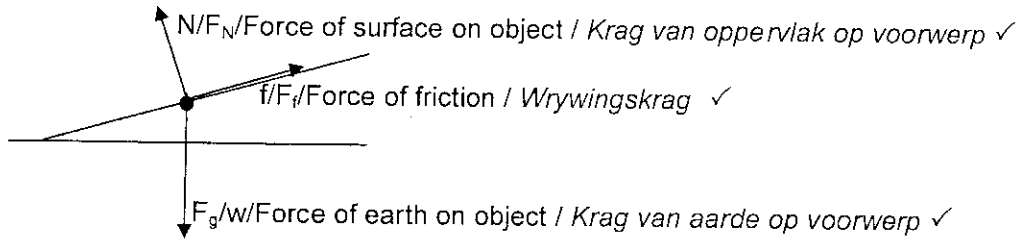
6.1 The net work done on an object is equal to the change in the object's kinetic energy. ✓✓
Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp.

Only/*Slegs* 2/2 or/*of* 0/2

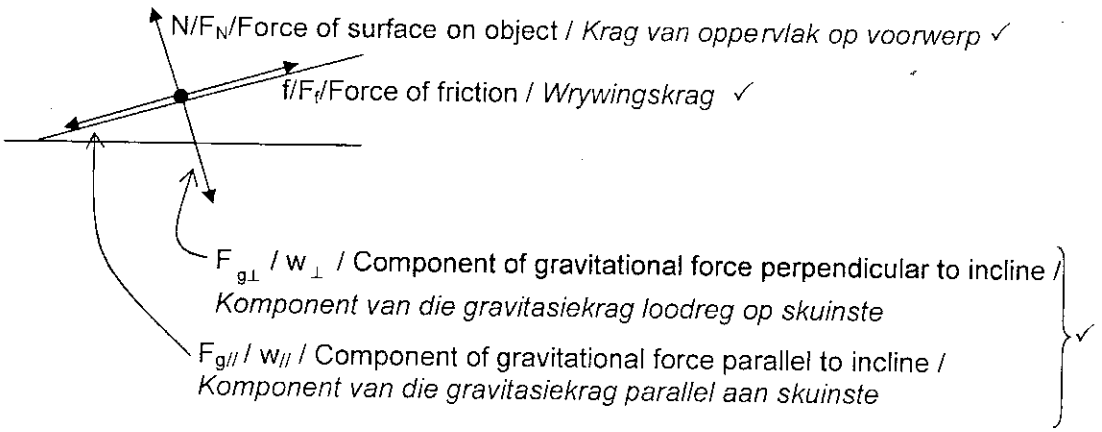
OR/*OF*
The work done on an object by a net force is equal to the change in the object's kinetic energy. / *Die arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in kinetiese energie van die voorwerp.*

[12.2.1] (2)

6.2



OR/*OF*



[12.1.2] (3)

6.3.1 $v_f^2 = v_i^2 + 2a\Delta x$ ✓
$= (0)^2 + (2)(2)(10)$ ✓
$= 40\ m^2 \cdot s^{-2}$ or $v = 6,32$

$E_{kf} = \frac{1}{2}mv_f^2$ ✓ or $E_{kf} = \frac{1}{2}mv^2$
$= \frac{1}{2}(60)(40)$ ✓ $= \frac{1}{2}(60)(6,32)^2$
$= 1\ 200$ J ✓ $= 1199,27$ J

E_{kf} ok to omit f

Accept/*Aanvaar:*
E_k / K
$v^2 = u^2 + 2as$ / $s = ut + \frac{1}{2}at^2$ / $v = u + at$
A mixture of the two allowed formulae is not accepted. / *'n Mengsel van die twee erkende formules word nie aanvaar nie.*

OR/*OF*

$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$10 = (0)\Delta t\ \frac{1}{2}(2)\ \Delta t^2$
$\therefore \Delta t = 3,16$ s

$v_f = v_i + a\Delta t = 0 + (2)(3,16)$ ✓ $= 6,32\ m \cdot s^{-1}$

$E_{kf} = \frac{1}{2}mv_f^2$ ✓
$= \frac{1}{2}(60)(6,32)^2$ ✓
$= 1\ 200$ J ✓

[12.1.3] (5)

6.3.2 $W_g = W_{g//}\Delta x\cos\theta$ ✓ or $W_g = F_{g//}\Delta x\cos\theta$
$= mg\sin 25°$ ✓ $(10)(\cos 0°)$ ✓
$= (60)(9,8)\sin 25°10(1)$
$= 2\ 485$ J ✓

OR/*OF*

$W_g = W_{g//}\Delta x\cos\theta$ ✓
$= mgh\cos 0°$
$= (60)(9,8)$ ✓ $(10)\sin 25°(1)$ ✓
$= 2\ 485$ J ✓

OR/*OF*

$W_g = -\Delta U$ ✓
$= -(0 - mgh)$ ✓
$= -(0 - (60)(9,8)(10)\sin 25°$ ✓
$= 2\ 485$ J ✓

[12.2.3] (4)

6.3.3

OPTION 1/*OPSIE 1:*

$W_{net} = \Delta E_k$ ✓

$W_{g(parallel\ to\ slope/parallel\ aan\ helling)} + W_f = \Delta E_k$ ✓

$2\,485 + W_f = 1\,200$ ✓

$W_f = -\ 1\,285$ J ✓ (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)

Marking rule 1.6
Nasienreël 1.6

positive marking value from 6.3.2

OPTION 2/*OPSIE 2:*

$W_{net} = W_g + W_f$ ✓

$ma\Delta x = W_g + W_f$

$(60)(2)(10)$ ✓ $= 2\,485$ ✓ $+ W_f$

$\therefore W_f = -\ 1\,285$ J ✓ (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)

Marking rule 1.6
Nasienreël 1.6

OPTION 3/*OPSIE 3*:

$W_{(applied/toegepas)} = \Delta E_k + \Delta E_p - W_f$

$0 = (\frac{1}{2}m v_f^2 - 0) + (0 - mgh) - W_f$ **Max./*Maks.*:** $^3/_4$

$0 = \frac{1}{2}m v_f^2 - mgh - W_f$ ✓

$0 = 1\,200 - 2\,485 - W_f$ ✓

$\therefore W_f = -1\,285$ J ✓

$W_{appl/toegep} = \Delta U + \Delta K + W_f$ $^0/_4$

Marking rule 1.6
Nasienreël 1.6

pos marking from 6.3.1

OPTION 4 / *OPSIE 4*:

$(U + K)_i + W_f = (U + K)_f$ **Max./*Maks.*:** $^3/_4$

$mgh + 0 + W_f = 0 + \frac{1}{2}m v_f^2$ ✓

$2\,485 + W_f = 1\,200$ ✓

$W_f = -\ 1\,285$ J✓ (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)

$(U + K)_i - W_f = (U + K)_f$ $^0/_4$

Marking rule 1.6
Nasienreël 1.6

OPTION 5/*OPSIE 5:*

$W_{nc} = \Delta E_k + \Delta E_p$ ✓

$= (\frac{1}{2}m v_f^2 - 0) + (0 - mgh)$

$= \frac{1}{2}m v_f^2 - mgh$ ✓

$= 1\,200 - 2\,485$ ✓

$\therefore W_{nc} = W_f = -1\,285$ J ✓ (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)

Marking rule 1.6
Nasienreël 1.6

(4)

[12.2.3]

6.3.3

OPTION 1/*OPSIE 1*
$W_f = F_f \Delta x \cos\theta$ ✓
$-1\,285 = f(10)\cos 180°$ ✓
$F_f = 128{,}5$ N ✓

OPTION 2/*OPSIE 2*
$F_{net} = F_{g(\text{parallel to slope/parallel aan helling})} - F_f$ ✓
$ma = mg\sin 25° - F_f$
$(60)(2) = (60)(9{,}8)\sin 25° - F_f$ ✓
$F_f = 128{,}5$ N ✓

[12.2.3] (3)
[21]

QUESTION 7/*VRAAG 7*

7.1 Doppler effect / *Doppler-effek* ✓ [12.2.1] (1)

7.2 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓ / $f_L = \frac{v}{v + v_s} f_s$

$\frac{90}{100} f_s$ ✓ $= (\frac{340}{340 + v_s})$ ✓f_s ✓ $\quad (f_L = \frac{90}{100} f_s)$

Any other formula / *Enige ander formule* 0/5

$v_s = 37{,}78\ m{\cdot}s^{-1}$ ✓ [12.1.3] (5)
[6]

QUESTION 8/*VRAAG 8*

8.1.1 Additive / *additief* ✓ [12.2.1] (1)

8.1.2 X: yellow / *geel* ✓
Y: magenta ✓
Z: cyan / *siaan* ✓ [12.2.3] (3)

8.1.3 P: red / *rooi* ✓
Q: blue / *blou* ✓ [12.2.3] (2)

8.2 Green plants will reflect green light ✓and very little light will be available ✓for (photosynthesis) food production in the plant.

Groen plante weerkaats groen lig ✓ *en baie min lig is beskikbaar* ✓ *vir (fotosintese) produksie van voedsel in die plante.* [12.3.2] (2)
[8]

QUESTION 9/*VRAAG 9*

9.1 Wave nature / *Golfaard* ✓
OR/*OF*
Light has wave properties. / *Lig het golfeienskappe.* [12.2.1] (1)

9.2 Wavefronts from the slit arrive at point P out of phase and interfere destructively. ✓✓
Goffronte vanaf die spleet kom uit fase by punt P aan en ondergaan destruktiewe interferensie. ✓✓
OR/OF
A crest meets a trough at P and destructive interference takes place. ✓✓ / 'n *Kruin ontmoet 'n trog by P en destruktiewe interferensie vind plaas.* [12.2.3] (2)

9.3 ✓

$$\sin\theta = \frac{m\lambda}{a} \checkmark = \frac{(1)(600\times10^{-9})}{3{,}2\times10^{-5}\checkmark} \therefore \theta = 1{,}07°$$

$$\tan\theta = \frac{OP}{Q}$$

$$\therefore \tan 1{,}07° = \frac{2{,}5\times10^{-2}}{Q} \checkmark$$

$\therefore$ Q = 1,34 m ✓ [12.1.3] (5)

9.4.1 Smaller than / *Kleiner as* ✓ [12.2.2] (1)

9.4.2 If OP increases:

$\sin\theta$ increases ✓ OR degree of diffraction increases

$\sin\theta \ \alpha \ \frac{1}{a}$ ✓ (and thus *a* decreases)

Indien OP toeneem:
$\sin\theta$ *neem toe* ✓ *OF mate van diffraksie vermeerder*

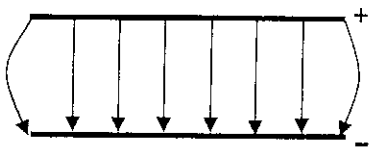
$\sin\theta \ \alpha \ \frac{1}{a}$ ✓*(en dus neem* a *af)* [12.2.2] (2)

[11]

QUESTION 10/*VRAAG 10*

10.1 Dielectric / Diëlektrikum ✓
Distance between plates / Afstand tussen plate ✓ [12.2.1] (2)

10.2.1



Checklist / *Kontrolelys*	Mark / *Punt*
Evenly spaced field lines. / *Eweredig gespasieerde veldlyne.*	✓
Direction of field lines from positive to negative. / *Rigting van veldlyne vanaf positief na negatief.*	✓
Field lines curved at the ends. / *Veldlyne gekrom by die ente.*	✓

NOTE: If charges on plates not indicated, maximum $\frac{2}{3}$ (no mark for direction)
LET WEL: Indien ladings op plate nie aangedui is nie, maksimum $\frac{2}{3}$ *(geen punt vir rigting)*

[12.1.2] (3)

10.2.2 $C = \frac{\varepsilon_0 A}{d}$ ✓ $= \frac{(8{,}85\times10^{-12})(2\times10^{-2})(10\times10^{-2})}{0{,}2\times10^{-3}}$ ✓ ✓

$= 8{,}85 \times 10^{-11}$ F ✓

(5)
[12.1.3] **[9]**

QUESTION 11/*VRAAG 11*

11.1 The current through a conductor is directly proportional to the potential difference across its ends at constant temperature. ✓✓

Only/*Slegs* 2/2 or/*of* 0/2

Die stroom in'n geleier is direk eweredig aan die potetsiaal-verskil oor sy ente by konstante temperatuur. [12.2.1] (2)

11.2 Equal / *gelyk* ✓
2 A divides equally at T (and since I_M = 1 A it follows that I_N = 1 A) ✓
2 A verdeel gelyk by T en omdat I_M = 1 A volg dit dat I_N = 1 A)

OR/*OF*

$I \alpha \frac{1}{R}$, $\therefore R_M = R_N$ [12.2.2] (2)

11.3 emf = IR + Ir ✓ $\therefore$ 17 = 14 + Ir ✓ $\therefore$ Ir = 3 V

$r = \frac{V_{lost}}{I}$ ✓ $= \frac{3}{2}$ ✓ = 1,5 Ω ✓ [12.1.3] (5)

$R = \frac{V}{I}$ (not accepted) but further marks awarded

$R_{int} = \frac{V}{I}$ accepted

$r = \frac{V}{I}$

11.4 $V_N = IR_N$ ✓ = (1)(2) ✓ = 2 V ✓ [12.2.3] (3)

11.5 V_Y = 14 – 2 = 12 V ✓

(need not have Y)

$V_Y = IR_Y$ ✓ $\therefore$ 12 = (2)R_Y ✓
$\therefore R_Y$ = 6 Ω ✓ [12.1.3] (4)
[16]

QUESTION 12/*VRAAG 12*

12.1.1 AC / *WS* – alternating current / *wisselstroom* ✓
A separate slip ring connected to each wire. / *'n Aparte sleepring is aan elke draad geskakel.* ✓ [12.2.1] (2)

12.1.2 Increase in peak (or rms) voltage / *Toename in piekspanning (of wgk-spanning)* ✓
Increase in frequency / *Toename in frekwensie* ✓ [12.2.2] (2)

12.1.3 The plane of the coil is parallel to the magnetic field. ✓
Die vlak van die spoel is parallel aan die magneetveld. [12.2.2] (1)

12.2 Advantage / *Voordeel:*
- Less environmental pollution ✓ (noise, gases, etc.) *Minder omgewingbesoedeling (geraas, gasse, ens.)*
- Fossil fuels are conserved / not used up

Disadvantage / *Nadeel:*
- Will not operate in absence of wind. / *Sal nie in afwesigheid van wind werk nie.* ✓
- Many windmills needed to generate sufficient electricity – unsightly appearance in environment. / *Baie windlaaiers benodig om genoeg elektrisiteit op te wek – is onooglik in omgewing.*

[12.3.2] [12.3.3] (2)
[7]

QUESTION 13/*VRAAG 13*

13.1
$$V_{rms} = \frac{V_{max/maks}}{\sqrt{2}} \checkmark$$
$$\therefore 220 = \frac{V_{max/maks}}{\sqrt{2}} \checkmark$$
$$\therefore V_{max/maks} = 311{,}13 \text{ V} \checkmark$$
[12.2.3] (3)

13.2
$$P_{average/gemid} = \frac{V_{rms}^2}{R} \checkmark$$
$$\therefore 100 = \frac{(220)^2}{R} \checkmark$$
$$\therefore R = 484\ \Omega \checkmark$$
[12.2.3] (3)

13.3 $P_{ave} = V_{rms}I_{rms}$ ✓
$2\,200 = (220)I_{rms}$ ✓
$I_{rms} = 10$ A ✓

The iron draws a current of 10 A. Therefore together with the lights the total current will exceed 10 A ✓and the fuse wire will blow and the current will stop. ✓

Die yster trek'n stroom van 10 A. Dus sal dit, tesame met die ligte,'n groter stroom as 10 A trek en die smeltdraad sal brand en geen stroom sal vloei nie.
[12.3.2] (5)
[11]

QUESTION 14/*VRAAG 14*

14.1 Minimum amount of energy needed to remove an electron from the surface of a metal/conducting material. ✓✓

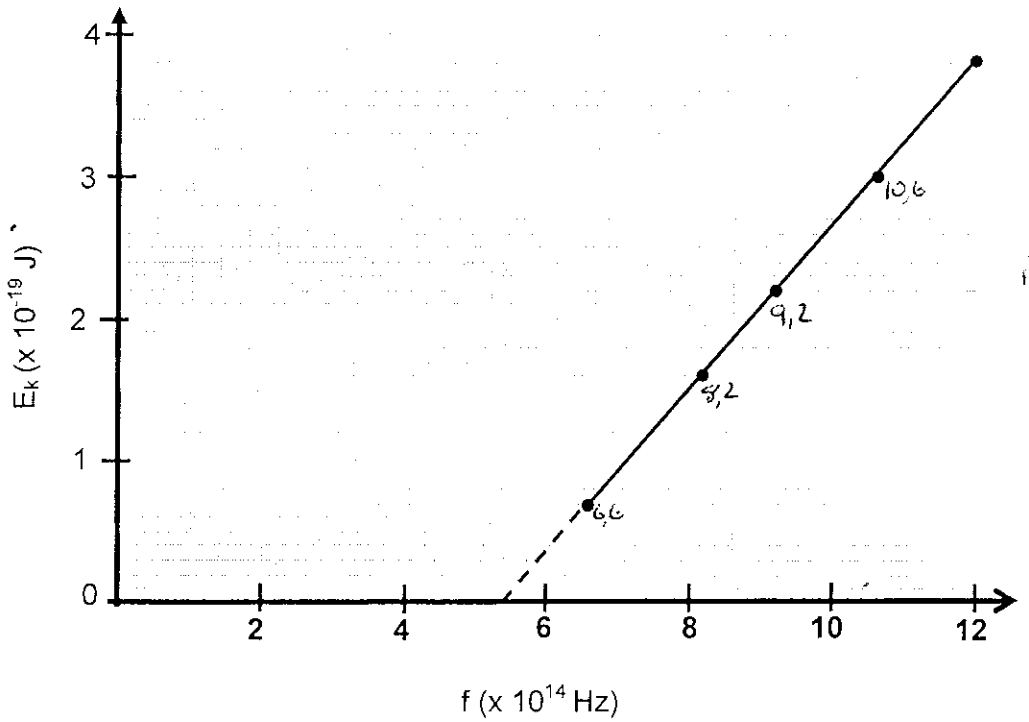
Minimum energie benodig om'n elektron vanaf die oppervlak van'n metaal/geleidende materiaal te verwyder.

Only/*Slegs* $\frac{2}{2}$ or/*of* $\frac{0}{2}$

[12.2.1] (2)

14.2

Graph of kinetic energy versus frequency
Grafiek van kinetiese energie teenoor frekwensie



max $\frac{3}{6}$

Plotting straight from table

Checklist/*Kontrolelys* Criteria for graph / *Kriteria vir grafiek*	Marks / *Punte*
Relevant heading / *Geskikte opskrif*	✓
Axes labelled correctly with units. / *Asse korrek benoem met eenhede.*	✓
Appropriate scale. / *Geskikte skaal.*	✓
Plotting all the points. / *Alle punte gestip.*	✓✓
Line of best fit. / *Beste paslyn getrek.*	✓

[12.1.2] (6)

14.3

14.3.1 $f_o = 5{,}4 \times 10^{14}$ Hz ✓✓ [12.1.2] (2)

14.3.2 Threshold frequency / Drumpelfrekwensie ✓ [12.2.1] (1)

14.3 $W_o = hf_o$ ✓
$= (6{,}63 \times 10^{-34})(5{,}4 \times 10^{14})$ ✓
$= 3{,}58 \times 10^{-19}$ J ✓

[12.1.2] (3)

[14]

TOTAL SECTION B/TOTAAL AFDELING B: 125
GRAND TOTAL/GROOT*TOTAAL*: 150