LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

PREPARATORY 2025

MARKING GUIDELINE/ MERK RIGLYNE

ERRATA

MARKS: 150

These marking guidelines consist of 12 pages

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QUESTION/VRAAG 1

1.1 D✓✓

1.2 B✓✓

1.3 A✓✓

1.4 A✓✓

1.5 D ✓✓

1.6 A ✓✓

1.7 C ✓✓

1.8 A✓✓

1.9 B ✓✓

1.10 B ✓✓

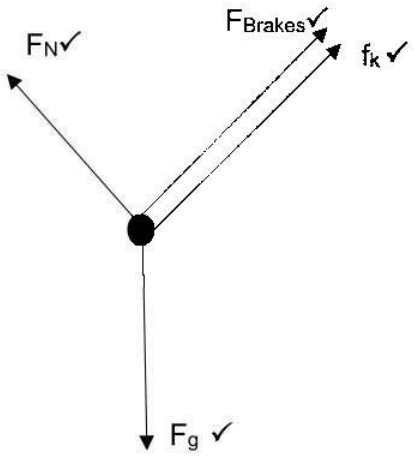
(2 x 10 =20)

QUESTION/VRAAG 2

2.1 When a (non-zero) net force acts on an object, the object will accelerate in the direction of the (net) force at an acceleration that is directly proportional to the (net) force and inversely proportional to the mass of the object.✓✓

Wanneer 'n (nie-nul) resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag teen 'n versnelling direk eweredig aan die (netto)krag en omgekeerd eweredig aan die massa van die voorwerp.✓✓ (2)

2.2



ACCEPTED SYMBOLS/AANVAARDE SIMBOLE		
F_N	Normal force/N /$F_{surface\ on\ truck}$	*Normaalkrag/ N/$F_{oppervlak\ op\ trok}$*
f_k	Kinetic friction / friction /Frictional force	*Kinetiese wrywing/wrywing/wrywingskrag*
F_g	w, weight/Gravitational force/ $F_{earth\ on\ truck}$	*Gewing/Gravitasiekrag/ $F_{aarde\ op\ die\ trok}$*
F_{Brakes}	Force of Brakes/ F_A/Applied force	F_{remme} */ Krag van remme/* F_T*/ Toegepaste krag*
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.		*Notas:* • *Punt toegeken vir pyl en pylpunt* • *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.*
		(4)

2.3.1 F_{gll} = $mg\sin\theta$ (no mark for formula)
= (40 000)(9,8)(sin 33º ✓
= 213 498,50 N ✓ (213 498,5017 N) (2)

2.3.2 W = $F\Delta x\cos\theta$ ✓
= (10 000)(400)(cos180º) ✓
= - 4,0 x 10^6 J ✓ (- 4 000 000 J) (3)

2.4.1 POSTIVE MARKING FROM 2.3.1

The speed of the truck is calculated from the motion of A to B. The pre-amble clearly states that the brakes were still functional during this motion.

$$F_{net} = ma$$

$$F_{gll} - F_{Brakes} - f_k = ma$$

$$mg\sin\theta - 10000 - \mu_k mg\cos\theta = ma$$

40000(9,8)(sin33º) – 10000 – (0,42)(40000)(9,8)cos33º✓ = 40000a✓

OR

213 498,50 – 10000 – (0,42)(40000)(9,8)cos33 ✓ = 40000a ✓

a = 1,64 m·s^{-2} (downhill)
(Range: 1,63549 – 1,64) (5)

$v_f^2 = v_i^2 + 2a\Delta y$ ✓ **Carry over**
= $(5,4)^2 + 2(1,64)(400)$ ✓
v_f = 36,62 m·s^{-1} (downhill/down the incline) ✓ (Range: 36,5726-36.62)
(*af teen helling/afwaarts*)

2.4.2 The product of the resultant/net force acting on an object and the time the net force acts on the object. ✓✓

Die produk van die resulterende/netto krag wat op 'n voorwerp inwerk en die tyd wat die netto krag op die voorwerp inwerk ✓✓ (2)

2.4.3 **POSITIVE MARKING FROM QUESTION 2.4.1**

The only horizontal force present, is the friction caused by the gravel. Therefore friction is seen as the net force.

NOTE: ONLY THE IMPULSE-MOMENTUM THEORY METHOD IS ALLOWED (4)

$F_{net}\Delta t = \Delta p$ ✓

$F_{net}(2,5)$ ✓ $= 40\ 000(0 - 36,62)$ ✓

$F_{net} = 585\ 161,71$N (range: 585 161,71 – 585 920 N) ✓

2.4.4 **POSITIVE MARKING FROM QUESTIONS 2.4.1 , 2.4.3**

OPTION 1

$W = f\Delta x\cos\theta$ ✓

$= 585\ 161,71\ (55)\ \cos 180$ ✓

$= -3,22 \times 10^7$ J ✓

OPTION 2 (OPTIONS 2 and 3 Provides a different answer)

$W_{nc} = \Delta E_p + \Delta E_k$ ✓

$\therefore W_f = 0 + \frac{½\ (40\ 000)(0)^2 - ½\ (40\ 000)(36,62)^2}{}$ ✓

$= -2,675 \times 10^7$ N (Range: $=2,675 \times 10^7 - 2,68 \times 10^7$ N) ✓

OPTION 3

$W_{net} = \Delta E_k$ ✓

$= \frac{½\ (40\ 000)(0)^2 - ½\ (40\ 000)(36,62)^2}{}$ ✓

$= -2,675 \times 10^7$ N (Range: $=2,675 \times 10^7 - 2,68 \times 10^7$ N) ✓

(3)

[25]

QUESTION/ VRAAG 3

3.1 An object that has an initial velocity and moves under the influence of the gravitational force only. ✓✓ (2)

'n Voorwerp met 'n aanvangsnelheid wat slegs onder die invloed van die gravitasiekrag beweeg.✓✓

3.2 $v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0 = v_i^2 + 2(9{,}8)(-7)$ ✓

$\underline{v_i = 11{,}71\ m \cdot s^{-1}\ upward}$ ✓ (3)

3.3 **POSITIVE MARKING FROM QUESTION 3.2**

$v_f = v_i + at$ ✓

v_f = (-11,71) +9,8(2,83) ✓ (3)

= <u>16,02 m·s^{-1} downward</u> ✓

3.4 **POSITIVE MARKING FROM QUESTION 3.3**

NOTE: Candidate may not show calculation, but is credited if it was calculated and substituted

75 % of 16,02= 12,015 m·s^{-1}✓

Carry over mark – if initial value calculated incorrectly, candidate gets mark for substituting correctly but not further. (5)

$v_f = v_i + a\Delta t$ ✓

14,93✓ = -12,015 + 9,8 ·Δt✓

Δt = 2,7495 s ✓ (Range: 2,7495 – 2,75)

3.5 **POSITIVE MARKING 3.2,3.3,3.4**

OPTION 1:

AB:

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

= (-11,71)(2,83) + ½ (9,8)(2,83)² ✓

= 6,10 m (6,10431 m)

BC:

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

= (-12,015)(2,749) + ½ (9,8)(2,749)² ✓

= 4,00 m

OPTION 2:

AB

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$(16,02)^2 = (-11,71)^2 + 2(9,8)\Delta y$✓

Δy = 6,0977m

BC

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$(14,93)^2 = (-12,015)^2 + 2(9,8)\Delta y$✓

Δy = 4,00m

(5)

OPTION 3

AB

$\Delta y_{AB} = \left(\frac{v_f + v_i}{2}\right) \Delta t$ ✓

$\Delta y_{AB} = \left(\frac{-16,02 + 11,71}{2}\right) (2,83)$ ✓

Δy = -6,09865

BC:

$\Delta y_{AB} = \left(\frac{v_f + v_i}{2}\right) \Delta t$

$\Delta y_{AB} = \left(\frac{-14,93 + 12,015}{2}\right) (2,749)$ ✓

Δy = -4,015

Total height: 6,09865 + 4,015 = 10,11 m ✓ ✓

[18]

MARKING CRITERIA:

- One mark for either formula present to calc Δy for AB or BC
- Substitution to calc AB
- Substitution to calc BC
- Addition of AB + BC
- Final answer

QUESTION/VRAAG 4

Afrikaans and English papers differ in mass of objects:

Afrikaans = 85 kg

English = 85 g

NOTE: Mass conversions is imperative. Penalise when conversion is not done correctly.

4.1 $E_M = E_p + E_k$ ✓ Any one

$= mgh + ½ mv^2$

$= (85 \times 10^{-3})(9,8)(0,7) + \frac{1}{2}(85 \times 10^{-3})(0)^2$ ✓

$= 0,5831$ J ✓

AFRIKAANS:

$= (85)(9,8)(0,7) + \frac{1}{2}(85)(0)^2$

$= 583,1$ J

(3)

4.2 **POSTIVE MARKING FROM 4.1**

OPTION 1

$E_{Mtop} = E_{Mbottom}$ ✓ any one

$= E_p + ½ mv^2$

$0,5831 = 0 + \frac{1}{2}(85 \times 10^{-3})v^2$ ✓

$v = 3,70$ m·s^{-1} right ✓ (3,7041 m·s^{-1})

AFRIKAANS:

$583,1 = 0 + \frac{1}{2}(85)v^2$

$v = 3.70$ m·s^{-1}

OPTION 2:

$W_{net} = \Delta E_k + \Delta E_p$ ✓

$0 = (mgh_{bottom} - mgh_{top}) + (½ mv^2 - ½ mv^2)$

$0 = [0-(85 \times 10^{-3})(9,8)(0,7)] + [½ (85 \times 10^{-3})v^2 - 0]$ ✓

$v = 3,70$ m·s^{-1} right ✓

(3)

4.3 The total linear momentum of an isolated system remains constant/is conserved. ✓✓

Die totale lineêre momentum van 'n geïsoleerde sisteem bly konstant/ bly behoue ✓✓

(2)

4.4 POSITIVE MARKING 4.2

$\Sigma p_i = \Sigma p_f$ ✓any one

$mv_A + mv_B = mv_A + mv_B$ (4)

$(85 \times 10^{-3})(3,7)$ ✓$+0 = 0 + 85 \times 10^{-3} v_f$✓

$v_f = 3,7\ m \cdot s^{-1}$ Right ✓

AFRIKAANS:

$\Sigma p_i = \Sigma p_f$ ✓any one

$mv_A + mv_B = mv_A + mv_B$

$(85)(3,7)$ ✓$+0 = 0 + (85)v_f$✓

$v_f = 3,7\ m \cdot s^{-1}$right ✓

OPTION 2:

$\Delta p_A = -\Delta p_B$ ✓

$[0 - (85 \times 10^{-3})(3,7)] = -[(85 \times 10^{-3})(v_B)-0]$ ✓

$V_b = 3,7\ m.s^{-1}$ Right✓

4.5 0,7m ✓ **Same value as A started** (1)

[13]

QUESTION/VRAAG 5

5.1 The total mechanical energy (sum of gravitational potential energy and kinetic energy) in an isolated system remains constant. ✓✓

Die totale meganiese energie (som van gravitasie- potensiële energie en kinetiese energie) in 'n geïsoleerde sisteem bly konstant. ✓✓ (2)

5.2 **OPTION 1**

$E_{MA} = E_{MB}$

$(E_p + E_k)_A = (E_p + E_k)_B$ } Any ✓

$\underline{(4410)(9,8)(23) + \left(\frac{1}{2}\right)(4410)(18)^2}$ ✓ $= \underline{(4410)(9,8)(37) + \left(\frac{1}{2}\right)(4410)v^2}$ ✓

$v_B = 7,04\ m{\cdot}s^{-1}$ ✓ $(7,04273\ m{\cdot}s^{-1})$ (4)

OPTION 2

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

$0 = [(4410)(9,8)(37) - (4410)(9,8)(23)] + [\left(\frac{1}{2}\right)(4410)(18)^2 - \left(\frac{1}{2}\right)(4410)v^2]$ ✓

$v = 7,04\ m.s^{-1}$

5.3.1 **POSITIVE MARKING from 5.2**

OPTION 1

$W_{nc} = \Delta E_P + \Delta E_k$ ✓

$= \underline{(4410)(9,8)(1,5 - 37)}$ ✓ $+ \underline{\left(\frac{1}{2}\right)(4410)(25^2 - 7,04273^2)}$ ✓ (4)

= - 265 482,1011 J ✓ (- 265 397,33 J)

OPTION 2

Calculate $E_{mechanical}$ at points B and C

$E_{MC} = E_p + E_k$

$E_{MC} = \frac{1}{2}mv^2 + mgh$ ✓(Formula at either MC or MB)

$= \frac{1}{2}(4410 \text{ x } 25^2) + (4410 \text{ x } 9,8 \text{ x } 1,5)$ ✓

= 1 442 952 J

$E_{MB} = \frac{1}{2}(4410 \text{ x} 7,04^2) + (4410 \text{ x } 9,8 \text{ x } 37)$ ✓

=1 708 349,328 J

$W_{fk} = E_{MC} - E_{MB}$

= 1 442 952 – 1 708 349,328

= - 265 397,328 J ✓

5.3.2 NO ✓

Friction is present / The external net force is not equal to zero

There is a non-conservative force acting. ✓

Nee✓

Wrywing (is teenwoordig)/Die eksterne netto krag is nie nul nie

Daar is 'n nie-konservatiewe krag teenwoordig ✓ (2)

[12]

QUESTION/VRAAG 6

6.1 Doppler Effect

Doppler Effek ✓ (1)

6.2 $f_L = \left(\frac{v \pm v_L}{v \pm v_S}\right) f_S$ ✓

$2428{,}57 ✓ = \left(\frac{340}{340 - v_S}\right) 1000$ ✓

v_s = 200,00 m·s^{-1} ✓ (199,9999176 m·s^{-1})

(4)

6.3 DECREASES✓

The wavelengths are longer. ✓

ACCEPT: Waves are stretched out/Wave crests are farther apart/wavelength increase ✓

$f = \frac{1}{\lambda}$

VERLAAG ✓ (2)

Die golflengtes is langer ✓

AANVAAR:*Golwe is uitgerek/Golffronte is verder uit mekaar ✓*

6.4 Ultrasound
Detection of blood clots
Detection of heart problems Any ✓
Fetal blood flow
Blood flow in the heart/organs

Ultraklank
Bloedklonte
Hart probleme
Fetale bloed vloei
Bloed vloei in hart/organe

(1)
[8]

QUESTION/VRAAG 7

7.1 The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point ✓✓

Die elektrostatiese krag wat per eenheid positiewe lading wat by daardie punt geplaas is, ondervind word. ✓✓

(2)

7.2.1 $E = \frac{F}{q}$ ✓

$= \frac{3{,}5 \times 10^{-6}}{6{,}2 \times 10^{-9}}$ ✓

$= 564{,}516\ N \cdot C^{-1}$ Right ✓

(3)

7.2.2 Take to the right as positive:

OPTION 1

$E = \frac{kQ_R}{r^2}$ Use of formula ✓

$E_{net} = \frac{kQ}{r^2} + \frac{kQ}{r^2}$ Substitution of any one ✓

0 ✓ $= \frac{(9x10^9)Q_R}{(x)^2} - \frac{(9x10^9)(6{,}2x10^{-9})}{(2x)^2}$

SIMPLIFY BY MULTIPLYING WITH x^2 THROUGHOUT

$0 = (9x10^9)Q_R - \frac{(9x10^9)(6{,}2x10^9)}{4}$

$Q_R = 1{,}55 \times 10^{-9} C$ ✓

OPTION 2

$E = \frac{kQ_R}{r^2}$ Use of formula ✓

$E_{T\ at\ P} = E_{R\ at\ P}$ ✓

$\frac{(9x10^9)Q_R}{(x)^2} = \frac{(9x10^9)(6,2x10^{-9})}{(2x)^2}$ Substitution of any one ✓

$Q_R = 1,55 \times 10^{-9} C$ ✓

(4)

NOTE: Consider to the left as positive also.

7.2.3 **POSITIVE MARKING FROM 7.2.2**

OPTION 1

$F = \frac{kQ_1Q_2}{r^2}$ ✓

$3,5 \times 10^{-6} = \frac{(9x10^9)(6,2x10^{-9})(1,55x10^{-9})}{r^2}$ ✓

r = 0,157 – 0,1572

$3x$ = 0.1572 ✓ (Division with 3)

x = 0,052 m ✓ (0,0524 m)

OPTION 2

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

$E = \frac{(9x10^9)(1,5x10^{-9}}{(3x)^2}$

X = 0,0157 m

(4)

7.3 **POSITIVE MARKING FROM 7.2.2**

R to T ✓

(NOTE: Wrong calculation in QUESTION 7.2.2 giving $Q_R > Q_T$: T to R)

(1)

7.4 **POSITIVE MARKING FROM 7.2.2**

$$Q_{new} = \frac{(1{,}55x10^{-9}) + (6{,}2x10^{-9})}{2}$$ ✓

(2)

$Q_{new} = 3{,}875\ x10^{-9}C$ ✓ (3,88 x 10^{-9}C) **[16]**

QUESTION/VRAAG 8

8.1 It is the maximum energy provided by a battery per unit charge passing through it. ✓✓

Dit is die maksimum energie wat 'n battery lewer per eenheidslading wat daardeur vloei. (2)

8.2 **OPTION 1**

$V_{internal} = Ir$ ✓

$12 - 11{,}3 = I(0{,}5)$

OR

$0{,}7 = I(0{,}5)$ ✓

$I = 1{,}4\ A$ ✓

OPTION 2

$\varepsilon = V_{external} + V_{internal}$ ✓

$12 = 11{,}3 + I(0{,}5)$ ✓

$I = 1{,}40\ A$ ✓

(3)

8.3 INCREASE ✓

TOENEEM (1)

8.4 S_2 causes a parallel circuit:

R_{total} decreases ✓

I_{total} increases since $I \propto \frac{1}{R}$ ✓

OR:

I is inversely proportional to R. Therefore, as R_{total} decrease, I_{total} will increase. ✓✓

S_2 veroorsaak dat die stroombaan verander in parallel skakeling:

R_{totaal} neem af ✓

I_{totaal} neem toe want $I \propto \frac{1}{R}$ ✓

OF:

I is omgekeerd eweredig aan R. Daarom, wanneer R_{totaal} afneem, sal I_{totaal} toeneem. ✓✓

(2)

8.5 **OPTION 1**

$\varepsilon = I(R + r)$

$\varepsilon = V_{external} + Ir$

$12 = 11{,}10 + I(0{,}5)$ ✓

$I = 1{,}8\ A$

Carry over mark✓

$V_p = IR_p$

$11{,}10 = 1{,}8\ R_p$

$R_p = 6{,}17\ \Omega\ (6{,}1667\ \Omega)$

✓Formula for R_p

$\frac{1}{R_p} = \frac{1}{R_4} + \frac{1}{R_s}$

$\frac{1}{6{,}17} = \frac{1}{x} + \frac{1}{3x}$ ✓

$x = 8{,}23\ \Omega$ ✓ (8,2267 Ω

OR

$\frac{1}{R_P} = \frac{R_4 + (R1 + 2 + 3)}{R_4 x R_s}$ ✓

$\frac{1}{6{,}17} = \frac{x + 3x}{3x^2}$ ✓

$3x = 24{,}6667$

$X = 8{,}222\Omega$✓

OPTION 2

$V_{internal} = Ir$

$0{,}9 = I(0{,}5)$ ✓

$I_T = 1{,}8\ A$

Carry over mark✓

$\varepsilon = I(R + r)$

$12 = 1{,}8(R + 0{,}5)$

$R = 6{,}1667$

OPTION 3

Calculate R_4 in the initial circuit,

$V = IR_4$ ✓

$11{,}3$ ✓$= I(1{,}4)$ ✓

$R_4 = 8{,}07\Omega$ ✓

$R_2 = R_4$✓ (5)

8.6 **POSITIVIE MARKING**

OPTION 1

$V = IR$ ✓
$11{,}10 = I(24{,}6801)$
$I = 0{,}4498\ A$ ✓

R_s = 24,68 (8,2267 x 3) ✓

OPTION 2

Ratio's:

1,8 x $\frac{1}{4}$ ✓✓ = 0,45 A ✓

(3)

[16]

OPTION 3

$V = IR$ ✓
11,10 = I(8,22) ✓
I_{RH} = 1,3504

$I_{Tot} = I_{R1} + I_{R4}$
1,8 = I_{R1} + 1,3596
I_{r1} = 0,45A ✓

Resistors in series are potential dividers:

$\frac{V}{3} = \frac{11{,}1}{3}$ ✓ $= 3{,}7$ V

$I = \frac{V}{R}$ ✓ $= \frac{3{,}7}{8{,}22} = 0{,}45$ A ✓

QUESTION/VRAAG 9

9.1 Mechanical (energy) to Electrical (energy) ✓✓
Meganiese (energie) na Elektriese (energie) (2)

9.2 AC / Alternating ✓
It has slip rings ✓

WS/Wisselstroom ✓
Dit het sleep ringe ✓ (2)

9.3 $T = \frac{1}{f}$

$= \frac{1}{50}$ ✓

= 0,02 s ✓ (2)

9.4.1 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 verbruik/oordra as 'n ekwivalente GS potensiaalverskil. ✓✓

(2)

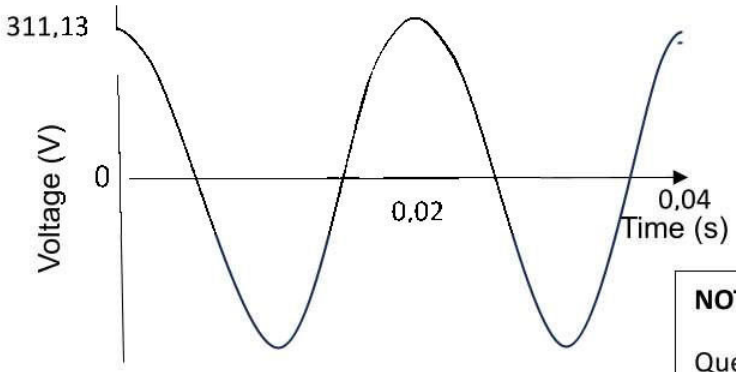
9.4.2 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓

$220(\sqrt{2})$✓ $= V_{max}$

$V_{max} = 311{,}13$ V ✓

(3)

9.5



NOTES:

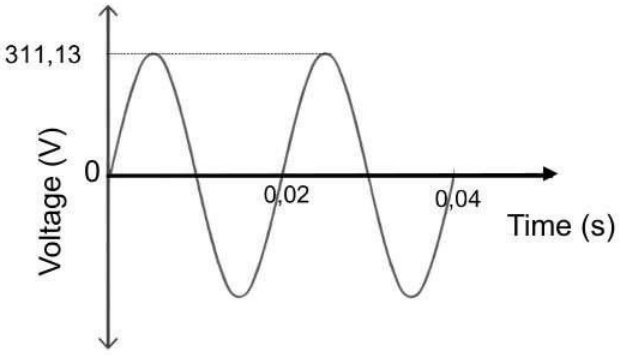
Question does not require 2 cycles to start at the same position as the coil in the diagram.

Period (0,02 s) ✓

V_{max} =311,13 ✓

Correctness: (Shape and 2 full cycles) ✓

ACCEPT, since the instruction does not specify That the graph must start with same orientation As the diagram.



(3)

[14]

QUESTION/VRAAG 10

10.1 The minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓

Die minimum energie benodig om 'n elektron uit die oppervlak van 'n metaal vry te stel ✓✓ (2)

10.2 Photoelectric effect ✓ **and** particle nature of light ✓

Foto-elektriese effek ✓ **en** *deeltjie-aard van lig* ✓ (2)

10.3 $E_{light} = W_o + E_{k(max)}$ ✓ (note that subscript (max) is essential)

$(6{,}63\ x10^{-34})(1x10^{17})$✓ $= (3{,}66\text{x}10^{-19}) + \left(\frac{1}{2}\right)(9{,}11\text{x}10^{-31})v_{max}^2$✓

v_{max} = 1,20 x 10^7 m·s^{-1} ✓ (12 031 243,63 m·s^{-1}) (4)

[8]

GRAND TOTAL/GROOTTOTAAL: 150