LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE/GRAAD 12

PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V 1)

MEMORANDUM

SEPTEMBER 2020

MARKS/PUNTE: 150

These marking guidelines consists of 15 pages.

Hierdie nasienriglyne bestaan uit 15 bladsye

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QUESTION / *VRAAG* 1

1.1 B ✓✓ (2)

1.2 C ✓✓ (2)

1.3 D ✓✓ (2)

1.4 A ✓✓ (2)

1.5 B ✓✓ (2)

1.6 C ✓✓ (2)

1.7 B ✓✓ (2)

1.8 D ✓✓ (2)

1.9 C ✓✓ (2)

1.10 A ✓✓ (2)
[20]

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QUESTION/ *VRAAG* 2

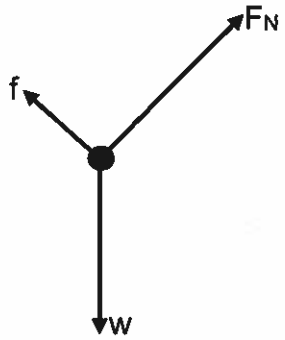
2.1 The rate of change of velocity/ *Tempo waarteen snelheid verander*✓✓
OR/OF:
The change in velocity per unit time/ *verandering in snelheid per eenheidtyd*✓✓ (2)

2.2

Marking criteria/ *Nasienriglyn:*
-1 mark for each key word/ phrase omitted in the correct context *-1 punt vir elke sleutelwoord/frase uitgelaat in die korrekte konteks*

When a (non-zero) resultant/net force acts on an object, the object will accelerate in the direction of the force with an acceleration that is directly proportional to the force✓ and inversely proportional to the mass of the object.✓ /
Wanneer 'n (nie-nul) resultante/netto krag uitgeoefen word op 'n voorwerp, sal die voorwerp versnel in die rigting van die krag met 'n versnelling wat direk eweredig is aan die krag en omgekeerd eweredig aan die massa van die voorwerp. (2)

2.3



	Accept the following symbols/Names :
F_N	N/Normal force/*Normaalkrag*
f	F_k/f_k/frictional force/kinetic frictional force *F_k/f_k /wrywingskrag/kinetiese wrywingskrag*
w	F_g/mg/weight/gravitational force/$F_{\text{earth on skier}}$ *F_g/mg/gewig/gravitasiekrag/$F_{\text{aarde op skier}}$*

Notes:
- Mark is awarded for label and arrow / *punte word toegeken vir byskrif en pylpunt*
- Do not penalise for length of arrows/ *moenie vir die lengte van die pyl penaliseer nie*
- Deduct 1 mark for any additional force / *trek 1 punt af vir enige ander krag*
- If forces do not make contact with dot: max. $:\frac{2}{3}$ *indien kragte nie kontak mak met kol nie max.* $:\frac{2}{3}$
- If arrows missing: max. $\frac{2}{3}$: / *indien pylpunte nie daar nie max.* $: \frac{2}{3}$

(3)

2.4.1 Take downhill as positive / *Neem afwaarts as positief*

$F_{g\parallel} = mg\sin\theta$
$F_{g\perp} = mg\cos\theta$

$F_{net,y} = 0$
$F_N + (-F_{g\perp}) = 0$
$\therefore F_N - mg\sin\theta = 0$
$\therefore F_N = mg\sin\theta$
$F_{net,x} = ma_x$
$mg\sin\theta + (-\mu_k F_N) = ma$ } Any one/*enige een*✓
$g\sin\theta - \mu_k mg\cos\theta = a$
$(9,8)(\sin30°)$✓ $- (0,10)(9,8)(\cos30°)$✓ $= a$
$\therefore a = 4,0513\ m\cdot s^{-1}$✓,downhill/ *afwaarts*✓

(5)

2.4.2 $v_f = v_i + a\Delta t$✓
$= 0 + (4,0513)(6,0)$ ✓
$= 24,3078\ m\cdot s^{-1}$✓

(3)
[15]

QUESTION/ *VRAAG* 3

3.1.1 An object upon which the only force acting is the force of gravity/gravitational force. ✓✓
'n Voorwerp waarop die enigste krag wat daarop inwerk swaartekrag/ gravitasiekrag is. ✓✓ (2)

3.1.2 Equal to g ✓/ *Gelyk aan g* ✓ (1)

3.1.3 Equal to g ✓/ *Gelyk aan g* ✓ (1)

3.1.4 $v_f^2 = v_i^2 + 2a\Delta y$ ✓

$= (20)^2 + 2(-9,8)(-10)$ ✓

$= 596$

$\therefore v_f = \pm 24, 413$

$v_f = -24, 413\ m\cdot s^{-1}$

The velocity is 24, 413 $m\cdot s^{-1}$ (downwards) ✓

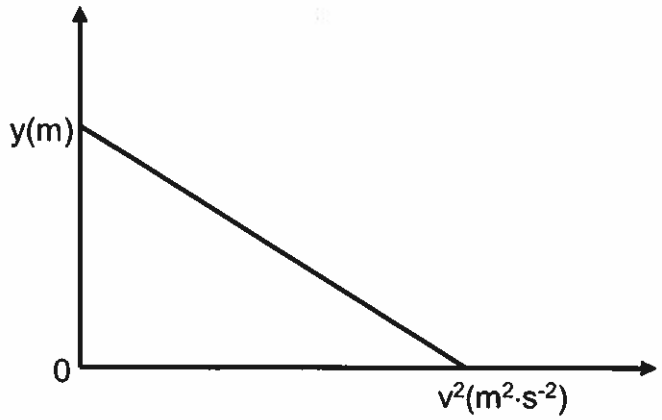
Die snelheid is 24,413 $m\cdot s^{-1}$ (afwaarts) ✓ (3)

3.1.5 $v_f = v_i + a\Delta t$ ✓

$-24, 413 = 20 + (-9,8)\Delta t$ ✓

$\therefore t = 4. 532\ s$ ✓ (3)

3.2.1



Marking criteria/ *Nasienriglyn*:

- correct graph (Everything correct) ✓✓
  Korrekte grafiek (Alles korrek) ✓✓ (2)

3.2.2 $v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = 0^2 + 2a\Delta y$
$\frac{v_f^2}{2a} = \Delta y$ ✓

Slope/*helling*, m = $\frac{\Delta y}{\Delta V^2}$

$= \frac{\frac{v_f^2}{2a} - 0}{0 - V^2}$ ✓ ✓

$= \frac{\frac{v_f^2}{2a}}{-V^2}$

$= (\frac{v_f^2}{2a}) - (\frac{1}{-V^2})$

$= -\frac{1}{2a}$

$= -\frac{1}{2(9.8)}$

$= -0,05102\ \mathbf{s^2 \cdot m^{-1}}$ ✓ (4)

[16]

QUESTION/ *VRAAG* 4

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

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

4.2.1 $F_{net} \cdot \Delta t = mv_f - mv_i$ or/*of* $p_f - p_i$ ✓

$\therefore (65)(t_1 - 0)$ ✓ $= 0,95 - 0$ ✓

$\therefore t_1 = 0,015$ s ✓ (2)

4.2.2 Between $t = t_1$ and $t = 0,25$ s, there is a decrease in momentum.✓ Therefore, the velocity of the ball decreases✓ which implies that there is a force opposing the motion of the ball (i.e. friction)

Tussen $t = t_1$ en $t = 0,25$ s, is daar 'n afname in momentum. ✓*Daarom verminder die snelheid van die bal* ✓*wat impliseer dat daar 'n krag is wat die beweging van die bal teenstaan (d.w.s. wrywing)* (2)

4.2.3 **Take to the right as positive/ *Neem regs as positief*:**

$\sum p_i = \sum p_f$

$p_{Ai} + p_{Bi} = p_{Af} + p_{Bf}$ ✓

$0,77 + 0 = 0,16 + p_{Bf}$

$\therefore p_{Bf} = 0,61$ kg·m·s^{-1}

But/*maar* $p = mv$ ✓

$\therefore 0,61 = (0,30)v$ ✓

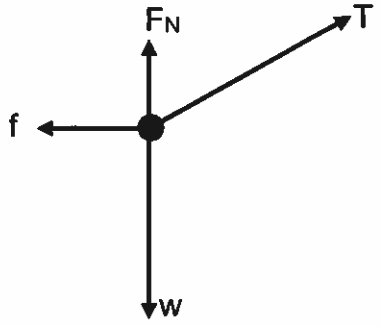
$v = 2,03333$ m·s^{-1}, (to the right/ na regs).✓ (4)

[12]

QUESTION/ *VRAAG* 5

5.1 Non-conservation force✓ / *Nie-konserwatiewe krag*✓ (1)

5.2



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w	F_g/mg/weight/gravitational force/$F_{\text{earth on skier}}$ *F_g/mg/gewig/gravitasiekrag/$F_{\text{aarde op skier}}$*
T	F_T/Tension/F_g /F *F_T/Spanning/F_g /F*

Notes:
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- If arrows missing: max. : $\frac{3}{4}$ / *indien pylpunte nie daar nie max. :*$\frac{3}{4}$

(4)

5.3 The net/total work done on an object is equal to the change in object's kinetic energy.

Die netto/totale arbeid wat op 'n voorwerp verrig word, is gelyk aan die verandering in die voorwerp se kinetiese energie.

OR/OF:

The work done on an object by a net/resultant force is equal to the change in object's kinetic energy.

Die arbeid wat op 'n voorwerp deur 'n netto/resultante krag verrig word, is gelyk aan die verandering in die voorwerp se kinetiese energie.

Notes/ Let wel:
if only of the underlined keywords/phrases in the correct context is omitted deduct 1 mark.
Indien slegs die onderstreepte sleutelwoorde/frases in die korrekte konteks weggelaat word, trek 1 punt af. (2)

5.4 **Option 1/ Opsie 1:**

$W_{net} = F_{net} \cdot \Delta x$
$= (F_{Ax} - f)\Delta x$
$= (100\cos 60° - 20)(5)$
$= 150$ J

But,*maar* $W_{net} = \Delta E_k$
$= \frac{1}{2}m(v_f^2 - v_i^2)$
$150 = \frac{1}{2}(20)(v_f^2 - 0^2)$
$150 = 10v_f^2$
$v_f^2 = 15$
$\therefore v_f = 3{,}87\ m \cdot s^{-1}$
$\therefore p = mv$
$= (20)(3{,}87)$
$= 77, 46\ kg \cdot m \cdot s^{-1}$, Eastwards/ *Ooswaarts*

Option 2/ Opsie 2:

$W_{net} = \Delta E_k$
$W_f + W_w + W_N + W_F = \frac{1}{2}m(v_f^2 - v_i^2)$
$F \cdot \Delta x \cdot \cos\theta + 0 + 0 + F \cdot \Delta x \cdot \cos\beta = \frac{1}{2}m(v_f^2 - v_i^2)$
$(20)(5)(\cos 180°) + (100)(5)(\cos 60°) = \frac{1}{2}(20)(v_f^2 - 0^2)$
$\therefore -100 + 250 = 10v_f^2$
$150 = 10v_f^2$
$v_f^2 = 15$
$\therefore v_f = 3{,}87\ m \cdot s^{-1}$
$\therefore p = mv$
$= (20)(3{,}87)$
$= 77, 46\ kg \cdot m \cdot s^{-1}$, Eastwards/ *Ooswaarts*

(5)
[12]

QUESTION/ *VRAAG* 6

6.1 The (apparent) change in frequency (or pitch) of the sound source and the listener have different velocities relative to the medium of sound propagation.✓✓
Die (skynbare) verandering in frekwensie (of toonhoogte) van die klank bron(golf) waargeneem deur 'n luisteraar ,omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word,het.

OR:

An (apparent) change is observed/detected frequency (pitch) as a result of the relative motion between a source and a n observer (a listener) ✓✓
'n (skynbare) verandering in frekwensie (toonhoogte) as 'n gevolg van die relatiewe beweging tussen 'n bron en 'n waarnemer ('n luisteraar) (2)

6.2.1 $v = f_s\lambda$
$340 = f_s(0{,}25)$ ✓
$\therefore f_s = 1\,360$ Hz

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

$$1\,480 \checkmark = \left(\frac{340 + 0}{340 - v_s}\right)\checkmark(1\,360)\checkmark$$

$$\frac{37}{34} = \frac{340}{340 - v_s}$$
$\therefore 12\,580 - 37 \cdot v_s = 11\,560$
$\therefore v_s = 27{,}568\ m \cdot s^{-1}$ ✓ (6)

6.2.2 $$f_L = \left(\frac{v \pm v_L}{v \pm v_s}\right)f_s \checkmark$$
$$= \left(\frac{340 - 0}{340 + 27{,}568}\right)\checkmark(1\,360)\checkmark$$
$= 1\,257{,}999$ Hz ✓ (4)

6.3 The spectral lines (light) from the star are shifted towards the lower frequency✓✓
Die spektrale lyne (lig) van die ster word na die laer frekwensie verskuif (2)
[14]

QUESTION/ *VRAAG 7*

7.1.1 A region in which an electric charge experiences a force ✓✓
'n Gebied waarin 'n elektriese lading 'n krag ervaar (2)

7.1.2 Electric field ✓ / *Elektriese veld*✓ (1)

7.1.3 The electrostatic force(F) experienced by the charge is directly proportional to the electric field(E) in which charge is placed ✓
Die elektrostatiese krag (F) ervaar deur die lading is direk eweredig aan die elektriese veld (E) waarin die lading geplaas word (1)

7.1.4 (Electric) charge ✓/ (*Elektriese) lading*✓ (1)

7.1.5 Gradient/ *gradiënt*, $m = \frac{\Delta F}{\Delta E}$

$= \frac{(20-5)\times10^{-8}}{(4-1)\times10^{3}}$ ✓ ✓

$= 5 \times 10^{-11}$ ✓ (3)

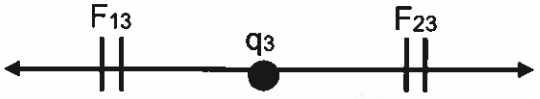
7.1.6 $q = 5 \times 10^{-11}$ C ✓ (1)

7.1.7 $n = \frac{Q}{q_e}$ ✓

$= \frac{5\times10^{-11}}{1,6\times10^{-19}}$ ✓

= 312500000 electrons/ *elektrone* **or/of** ($3,125 \times 10^{8}$) electrons/*elektrone* ✓ (3)

7.2 $F = \frac{KQ_1Q_2}{r^2}$ ✓



$F_{net,\ (on\ q3)} = 0$

$F_{(q1\ on\ q3)} = F_{(q2\ on\ q3)}$ — Any one/*enige een* ✓

$\frac{KQ_1Q_2}{r^2} = \frac{KQ_1Q_2}{r_1^{\,2}}$

$\frac{(9\times10^{9})(q_1)\,(5\times10^{-9})}{(0,02)^2}$ ✓ $= \frac{(9\times10^{9})(2\times10^{-9})\,(5\times10^{-9})}{(0,035)^2}$ ✓

$\frac{(q_1)}{(0,02)^2} = \frac{(2\times10^{-9})}{(0,035)^2}$

$\therefore q_1 = 6,531 \times 10^{-10}$ C

$\therefore q_1 = +6,531 \times 10^{-10}$ C ✓✓ (6)

[18]

QUESTION/ *VRAAG* 8

8.1.1 The opposing offered to the flow of charge in the battery.✓✓
Die weerstand wat gebied word teen die vloei van lading in 'n battery. (2)

8.1.2 $R = 2(0,5)$
$= 1,00\ \Omega$ ✓ (1)

8.1.3 $R_p = \frac{R_1R_2}{R_1+R_2}$ **OR/OF:** $R_p = \frac{1}{(\frac{1}{R_1}+\frac{1}{R_2})}$ **OR/OF:** $\frac{1}{R_p} = \frac{1}{R_1}$

$= \frac{(4)(6)}{(4)+(6)}$
$= 2,4\ \Omega$
$\therefore R_{ext} = 2,4 + 3$ ✓
$= 5,4\ \Omega$

$R = \frac{V}{I}$
$5,4 = \frac{10,8}{I}$ ✓
$I = 2A$

$\varepsilon = I(R_{ext} + r)$ ✓
$= 2(5,4 + 1)$ ✓
$= 12,8\ V$ ✓ (5)

8.1.4 Less than ✓*/Minder as*
• R_{total} increases ✓ *R_{totaal} verhoog*
$\therefore I_{circuit}$ increases $\therefore$ *$I_{stroombaan}$ verhoog* (2)

8.2 Brightness is determined by/ *helderheid word bepaal deur*
$P = I^2R$ or $P = \frac{V^2}{R}$ or $P = VI$ **(Any one/ enige een ✓)**

In the diagram A the <u>same current</u>✓ flows through **X** and **Y**, $P_x > P_y$; but $P = I^2R$
$\therefore$ <u>$R_x > R_y$</u> ✓if $P_x > P_y$ and I is the same

In diagram B: <u>$V_x = V_y$</u> ✓and $R_x > R_y$, thus $I_x < I_y$, but $P = \frac{V^2}{R}$ or $P = VI$,
Thus $P_x < P_y$
Therefore the brightness of bulb **X** is <u>LESS THAN</u>✓ that of bulb **Y**.

*In diagram A vloei <u>dieselfde stroom</u>✓ deur **X** en **Y**, $P_x > P_y$; maar $P = I^2R$*
$\therefore$ <u>$R_x > R_y$</u> ✓if $P_x > P_y$ en I is dieselfde

In diagram B: <u>$V_x = V_y$</u> ✓en $R_x > R_y$, daarom is $I_x < I_y$, maar $P = \frac{V^2}{R}$ or $P = VI$,
Dus is $P_x < P_y$

Daarom is die helderheid van gloeilamp **X** <u>MINDER AS</u> ✓die van gloeilamp **Y** (5)

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8.3 P = VI

= (120)(15) ✓

= 1,8 kW

Cost = P x t x tarrif (Koste = P x t x tarief)

= (1,8)(90)(0,8) ✓

= R129,60 ✓ (3)

[18]

QUESTION/ *VRAAG* 9

9.1.1 D✓ (1)

9.1.2 B✓ (1)

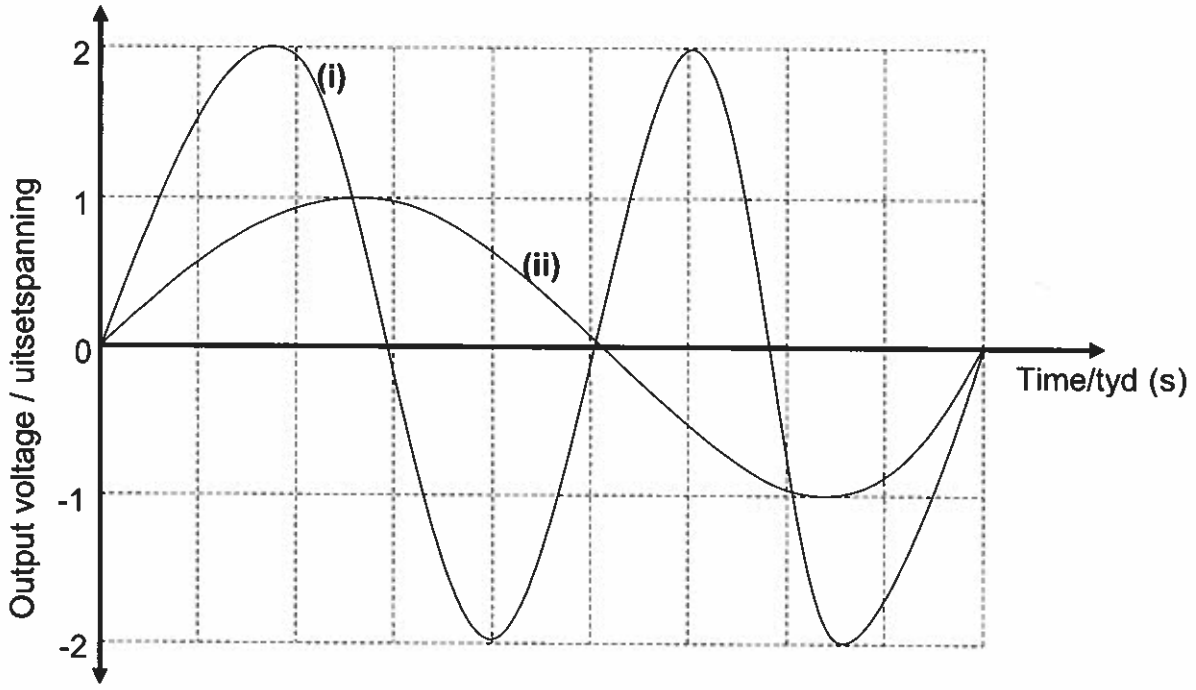
9.1.3 E✓ (1)

9.1.4 A✓ (1)

9.2 From mechanical(kinetic) energy to electrical energy ✓
Van meganiese (kinetiese) energie na elektriese energie✓ (1)

9.3 •Use a stronger magnet.✓/ *gebruik 'n sterker magneet*✓
•Use a coil having a greater number of turns. ✓/ *Gebruik 'n spoel met meer windings*✓ (2)

9.4



Both the frequency and magnitude of the output voltage are proportional to the speed of rotation. Hence, at half the rate of rotation,✓ the frequency and magnitude would be also be halved✓ (as shown in the graph (ii)

Beide die frekwensie en grootte van die uitset spanning is eweredig aan die spoed van rotasie. Dus,teen die helfte van die tempo van rotasie ✓sal die frekwensie en grootte ook gehalveer word ✓(soos aangedui in die grafiek (ii)

Marking criteria:	
• correct shapes of the graph/*korrekte vorm van grafiek*	✓
• Graph (i) amplitude = 2x graph (ii) s amplitudes / *grafiek (i) se amplitude = 2 x grafiek (ii) se amplitude*	✓
• period of graph (ii) = 2x period of graph (i)/ *periode van grafiek (ii) = 2 x periode van grafiek (i)*	✓
• 2 marks for explanation / *2 punte vir verduideliking*	✓✓

(5)

[12]

QUESTION/ *VRAAG* 10

10.1.1 The energy of the photo electrons is not influenced by a change in the intensity of the incident of light.✓

Die energie van die foto-elektrone word nie beïnvloed deur 'n verandering in die intensiteit van die lig nie. ✓ (1)

10.1.2 If threshold frequency (f_0) is exerted, the kinetic energy of the photoelectrons will be directly proportional to the frequency of the incident light

Indien lig met die drumpelfrekwensie (f_0) inval, sal die kinetiese energie van die fotoelektrone direk eweredig wees aan die frekwensie van die invallende lig (2)

10.2 The process whereby electrons are ejected from a metal surface when light of a suitable frequency is incident on that surface.

Die proses waarvolgens elektrone uit 'n metaaloppervlak vrygestel word wanneer lig met die benodigde frekwensie op daardie oppervlak inval.

Marking criteria/Nasienriglyn:
•-1 mark for each key word/ phrase omitted in correct context. *-1 punt vir elke sleutel woord/frase weggelaat in die korrekte konteks*

(2)

10.3 Threshold (cut-off) frequency✓/ *Drumpel(afsny)frekwensie*✓ (1)

10.4 The minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓
Die minimum energie wat 'n elektron in die metaal benodig om vrygestel te word uit die metaaloppervlakte ✓✓

Notes/*Let wel*:
if only of the underlined keywords/phrases in the correct context is omitted deduct 1 mark.
Indien slegs die onderstreepte sleutelwoorde/frases in die korrekte konteks weggelaat word trek 1 punt af.

(2)

10.5 $E = hf$
$= \frac{hc}{\lambda}$ } Any one/ *enige een*✓

$= \frac{(6{,}63 \times 10^{-34})\checkmark\ (3 \times 10^{8})\checkmark}{(600 \times 10^{-9})\checkmark}$

$= 3{,}3 \times 10^{-19}$ J
$\therefore 3{,}3 \times 10^{-19}$ J $< 6{,}2 \times 10^{-19}$ J
Thus/dus $E < W_0$✓
Hence, no electrons ejected/ *geen elektrone vrygestel*

OR:
$W_0 = hf_0$
$6{,}2 \times 10^{-19} = (6{,}63 \times 10^{-34})f_0$
$f_0 = 9{,}35143 \times 10^{14}$ Hz
$E = hf$
$3{,}3 \times 10^{-19} = (6{,}63 \times 10^{-34})f$
$f = 4{,}77376 \times 10^{12}$ Hz
$4{,}77376 \times 10^{14}$ Hz $< 9{,}35143 \times 10^{14}$ Hz
Thus/dus $f < f_0$
Hence, no electrons ejected/ *geen elektrone vrygestel*

OR:
$E = W_0 + E_{k,max}$
$3{,}3 \times 10^{-19} = 6{,}2 \times 10^{-19} + E_{k,max}$
$E_{k,max} = -2{,}9 \times 10^{-19}$ J
Thus/ dus $E_{k,max} < 0$
Hence, no electrons ejected/ *geen elektrone vrygestel*

(5)
[13]

Total/totaal 150

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