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PHYSICAL SCIENCES: PHYSICS (FIRST PAPER) (10841)

FISIESE WETENSKAPPE: FISIKA (EERSTE VRAESTEL) (10841)

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GAUTENG DEPARTMENT OF EDUCATION
GAUTENGSE DEPARTEMENT VAN ONDERWYS
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PHYSICAL SCIENCES: PHYSICS /
FISIESE WETENSKAPPE: FISIKA
(First Paper)
(Eerste Vraestel)

MEMORANDUM

QUESTION / VRAAG 1

- 1.1 A ✓✓
- 1.2 C ✓✓
- 1.3 C ✓✓
- 1.4 B ✓✓
- 1.5 A ✓✓
- 1.6 C ✓✓
- 1.7 B ✓✓
- 1.8 B ✓✓
- 1.9 B ✓✓
- 1.10 D ✓✓

[20]

QUESTION / VRAAG 2

Down is positive for the entire question.

Neem af as positief vir die hele vraag.

- 2.1 Velocity with which the tennis ball strikes the balcony:

Snelheid waarmee die tennisbal die balkon tref:

Option / Opsie 1

Option / Opsie 2

$$\begin{aligned}
 v_f^2 &= v_i^2 + 2a\Delta y \quad \checkmark \\
 v_f &= \sqrt{0 + 2 \times 9,8 \times 12} \quad \checkmark \\
 &= 15,336 \text{ m} \cdot \text{s}^{-1} \\
 &= 15,34 \text{ m} \cdot \text{s}^{-1} \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 E_{m(\text{top / bo})} &= E_{m(\text{balcony / balkon})} \\
 \frac{1}{2}mv^2 + mgh &= \frac{1}{2}mv^2 + mgh \quad \checkmark \\
 \frac{1}{2}v^2 + 0 &= 0 + gh \\
 \frac{1}{2}v^2 &= 9,8 \times 12 \quad \checkmark \\
 v &= 15,34 \text{ m} \cdot \text{s}^{-1} \quad \checkmark
 \end{aligned}$$

(3)

2.2.1 Energy that the ball has at bouncing / *Energie wat die bal het wanneer dit bons*

$$E_{k1} = \frac{1}{2} m v_f^2 = 0,5 \times 0,12 \times 15,336^2 \checkmark = 14,112 \text{ J} \checkmark$$

(2)

POSITIVE MARKING FROM 2.2.1 / POSITIEWE NASIEN VANAF 2.2.1

2.2.2 Energy left on ball after bouncing / *Energie oor op die bal na die bons*

$$E_{k2} = (14,112 - 2) \checkmark = 12,112 \text{ J}$$

(tick is for subtraction)/ (punt is vir die aftrekking)

Option 1

Initial velocity after bouncing /
Aanvanklike snelheid na die bons

$$\frac{1}{2} m v^2 = 12,112$$

$$v = \sqrt{\frac{2 \times 12,112}{0,12}} \checkmark$$

$$= 14,208 \text{ m} \cdot \text{s}^{-1}$$

$$\underline{v = 14,21 \text{ m} \cdot \text{s}^{-1}}$$

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 = (-14,21)^2 + 2(9,8) \Delta y \checkmark$$

$$\Delta y = -10,30 \text{ m} \checkmark$$

Option 2

Relative to the balcony

$$E_m = E_{pi} + E_{ki} = E_{pf} + E_{kf}$$

$$0 + 12,112 = mgh + 0$$

$$12,112 = 0,12(-9,8)h$$

$$h = 0,30 \text{ m}$$

(6)

2.3 Height of balcony above the ground / *Hoogte van die balkon bokant die grond*

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

$$= (-14,208 \times 3,16) + (\frac{1}{2} \times 9,8 \times 3,16^2) \checkmark$$

$$= 3,999 \text{ m}$$

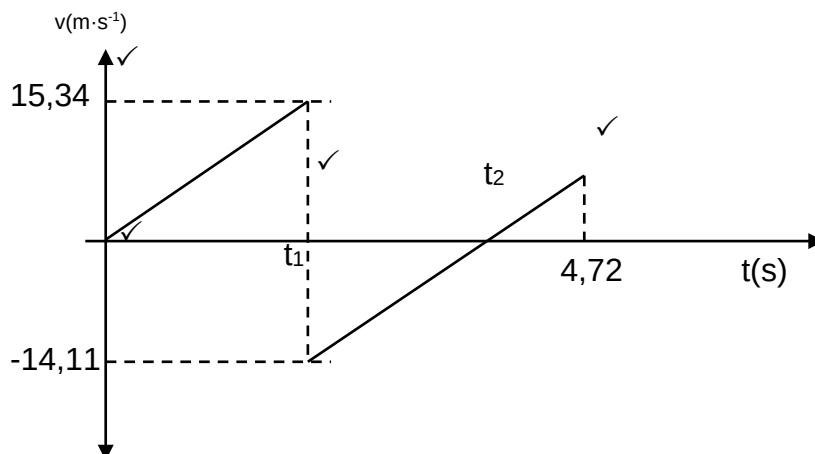
$$= 4,03 \text{ m} \checkmark$$

Balcony is 4,03 m above the ground. / *Balkon is 4,03 m bokant die grond.*

(3)

2.4 Mark if following is shown / *Merk indien die volgende gewys word:*

- Velocity ball hits the balcony $\checkmark$ / *snelheid waarmee bal die balkon tref*
- Velocity ball leaves balcony $\checkmark$ / *snelheid waarmee die bal die balkon verlaat*
- Time of flight of ball to reach balcony (t_1) $\checkmark$ / *tyd wat bal neem om balkon te bereik*
- Time ball reaches max height after bounce (t_2) $\checkmark$ / *tyd wat bal neem om maks hoogte te bereik na die bons*

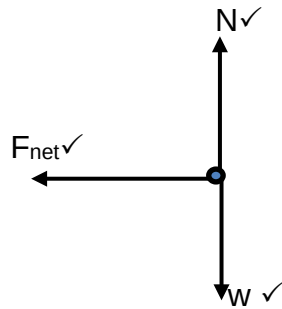


(4)

[17]

QUESTION / VRAAG 3

3.1



(3)

$$3.2 \quad 120 \text{ kmh}^{-1} = \frac{120 \times 1000}{3600} = 33,33 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

(1)

3.3 **Work-energy theorem:** The net work done on an object is equal to the change in the objects kinetic energy. $\checkmark\checkmark$

Arbeid energie beginsel: Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie.

(2)

$$3.4 \quad 3.4.1 \quad W_{\text{net}} = E_{\text{kf}} - E_{\text{ki}} \quad \checkmark$$

$$= 0 - \frac{1}{2} mv^2$$

$$= 0 - \frac{1}{2} (1000) \times 33,33^2 \quad \checkmark$$

$$= -555\,444,45 \text{ J}$$

$$F_{\text{net}} \Delta x \cos \theta = 555\,444,45 \quad \checkmark$$

$$F_{\text{net}} (0,8) \cos 180^\circ \quad \checkmark = 555\,444,45$$

$$F_{\text{net}} = -694\,305,56 \text{ N}$$

$$F_{\text{net}} = 694\,305,56 \text{ N to the left} \quad \checkmark / \text{ away from the}$$

wall/opposite direction of initial motion

Na links / weg van die muur / teenoorgestelde rigting van die aanvanklike beweging

(5)

$$3.4.2 \quad \text{Time lapse / Tydperk} \quad F_{\text{net}} \Delta t = \Delta p = m(v_f - v_i) \quad \checkmark$$

$$\Delta t = \frac{1\,000(0 - 33,33)}{-694\,305,56} \quad \checkmark\checkmark$$

$$= 0,05 \text{ s} \quad \checkmark$$

(4)

3.4.3

- Crumpling increases stopping time $\checkmark$ / *frommeling vergroot stop-tyd*
- thus reducing F_{net} $\checkmark$ / *dus verminder F_{net}*
- $F_{\text{net}} = \frac{\Delta p}{\Delta t} \quad \checkmark$

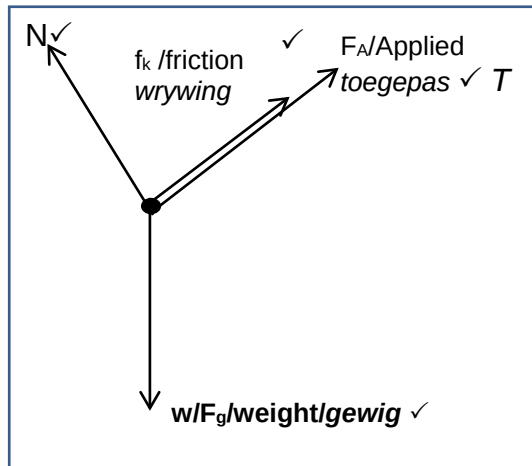
(3)

[18]

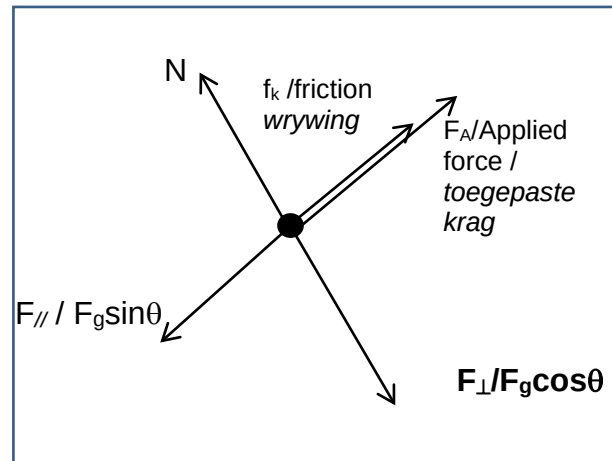
QUESTION / VRAAG 4

4.1

Option 1 / Opsie 1



Option 2 / Opsie 2



(4)

Accepted labels/Aanvaarde benoemings	
w	F_g/F_w /weight/mg/gravitational force F_g/F_w /gewig/mg/gravitasiekrag
f	F_{friction}/F_f /friction/ f_k F_{wrywing}/F_w /wrywing/ f_k
N	F_N/F_{normal} /normal force F_N/F_{normaal} /normaalkrag
	Deduct 1 mark for any additional force. / Trek een punt af vir enige ekstra krag
	Mark is given for both arrow and label. / Punt word toegeken vir beide 'n pyl en byskrif.

4.2 0 N ✓

Box slides at constant velocity / $\Delta E_k = 0$ / acceleration = 0 ✓
 Boks gly teen konstante snelheid / versnelling = 0

(2)

4.3 A non-conservative force is that force for which the work done in moving an object between two points depends on the path taken.
 'n Nie-konserwatiewe krag is daardie krag waarvan die arbeid verrig afhang van die padlengte gevolg tussen twee punte.

(2)

$$4.4 \quad \theta = \sin^{-1} \frac{12}{6} \checkmark = 11,537^\circ$$

Option 1 / Opsie 1

$$W_{\text{nett}} = \Delta E_k \checkmark$$

$$W_A + W_f + W_N + W_{\perp} + W_{\parallel} = 0 \checkmark$$

$$W_A + F_f \Delta x \cos 180 + 0 + 0 + 100 \times 9,8 \sin 11,537^\circ \times 6 \cos 0^\circ = 0$$

$$W_A + 60 \times 6 \cos 180^\circ + 100 \times 9,8 \sin 11,537^\circ \times 6 \cos 0^\circ = 0$$

$$W_A = -816 \text{ J}$$

$$\underline{\text{Work done by man} = 816 \text{ J} \checkmark}$$

Arbeid verrig deur man

Option 2 / Opsie 2

$$F_{\text{nett}} = F_A + f + F_{\parallel} + N + F_{\perp}$$

$$= F_A + f + F_{\parallel}$$

$$0 = F_A - 60 + 100 \times 9,8 \times \sin 11,537^\circ$$

$$= F_A + 136$$

$$F_A = -136 \text{ N}$$

$$\therefore W_A = F_A \times \Delta x$$

$$= -136 \times 6$$

$$= -816 \text{ J}$$

$$\therefore \underline{\text{work done by man is } 816 \text{ J} \checkmark}$$

Arbeid verrig deur man

Option 3 / Opsie 3

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

$$W_{\text{man}} + W_f = 0 + mg(h_f - h_i)$$

$$W_{\text{man}} + 60 \times 6 \times (-1) = 100 \times 9,8 (0 - 1,2)$$

$$W_{\text{man}} = -1176 + 360$$

$$= -816 \text{ J}$$

$$\therefore \underline{\text{work done by man is } 816 \text{ J}}$$

Arbeid verrig deur man

(6)

$$4.5 \quad W_A = F \Delta x \cos \theta \quad \checkmark \quad = -816$$

$$= F \times \underline{6 \cos 180} \quad \checkmark \quad = -816 \quad \checkmark$$

$$F_A = 136 \text{ N}$$

Magnitude of force applied by man is 136 N. ✓
Grootte van krag toegepas deur man is 136 N

(4)
[18]

QUESTION / VRAAG 5

- 5.1 All charge is made up of multiples of a basic charge that has a value of $1,6 \times 10^{-19} \text{ C}$ ✓
Alle ladings word opgemaak uit veelvulde van 'n basiese lading wat die waarde het van $1,6 \times 10^{-19} \text{ C}$. (1)

5.2 5.2.1 New charge / nuwe lading $= \frac{Q_A + Q_B}{2}$

$$= \frac{9 \times 10^{-6} - 3 \times 10^{-6}}{2} \quad \checkmark$$

$$= +3 \mu\text{C} \quad \checkmark$$

(2)

- 5.2.2 For sphere A: from $+9 \mu\text{C}$ to $+3 \mu\text{C}$ is a loss of $6 \mu\text{C}$ ✓
 For sphere B: from $-3 \mu\text{C}$ to $+3 \mu\text{C}$ is a gain of $6 \mu\text{C}$
Vir sfeer A vanaf $+9 \mu\text{C}$ tot $+3 \mu\text{C}$ is 'n verlies van $6 \mu\text{C}$
Vir sfeer B vanaf $-3 \mu\text{C}$ tot $+3 \mu\text{C}$ is 'n toename van $6 \mu\text{C}$

electrons transferred / elektrone oorgedra

$$= \frac{(-)Q_{\text{lost/gained / verlies / wins}}}{e^-}$$

$$= \frac{(-)6 \times 10^{-6}}{(-)1,6 \times 10^{-19}} \quad \checkmark$$

$$= 3,75 \times 10^{13} \quad \checkmark \quad \text{electrons (Answer must be positive.)}$$

Elektrone (Antwoord moet positief wees.) (3)

- 5.2.3 B to A ✓ / B tot A (1)

- 5.3 Coulomb's Law: The force between two charges is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between the charges. ✓
Coulomb se Wet: die krag tussen twee ladings is direk eweredig aan die produkte van hul ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen die ladings. (2)

5.4 $F_A = \frac{kQ_2Q_3}{r_{2,3}^2} = \frac{9 \times 10^9 \times 9 \times 10^{-6} \times 3 \times 10^{-6}}{0,02^2} \quad \checkmark$

$$= 607,5 \text{ N, attractive} \quad \checkmark$$

(3)

$$\begin{aligned}
 5.5 \quad E_{\text{net}} &= E_{\text{QA at x}} + E_{\text{QB at x}} \\
 &= \frac{kQ}{r_A^2} + \frac{kQ_B}{r_B^2} \checkmark \\
 &= \frac{9 \times 10^9 \times 9 \times 10^{-6}}{(0,04)^2} \checkmark + \frac{9 \times 10^9 \times 3 \times 10^{-6}}{0,16^2} \checkmark \\
 &= 50\,625\,000 + 1\,054\,687,5 \\
 &= \underline{5,168 \times 10^7 \text{ NC}^{-1}} \checkmark
 \end{aligned}$$

(4)
[16]**QUESTION / VRAAG 6**

6.1 6.1.1 It is the apparent change in frequency of a source when there is relative motion between the source and the observer. ✓✓

Die verandering in frekwensie (of toonhoogte) van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word, het.

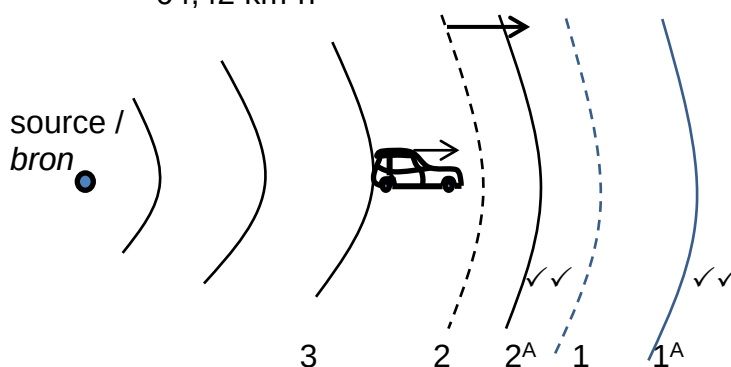
(2)

$$6.1.2 \quad f_L = \left(\frac{v \pm v_L}{v \pm v_s} \right) f_s \checkmark$$

$$\begin{aligned}
 v_L &= (v + v_s) \frac{f_L}{f_s} \\
 &= (340 + 0) \checkmark \times \left[\frac{360}{340} \right] \checkmark \\
 &= 17,90 \text{ ms}^{-1} \\
 &= 17,895 \times \left[\frac{3600}{1000} \right] \checkmark \\
 &= 64,42 \text{ km} \cdot \text{h}^{-1} \checkmark
 \end{aligned}$$

(5)

6.2



Since the driver is moving in the same direction as the waves, the wavefronts will pass him at delayed intervals, thus making the wavelengths longer hence hearing a lower frequency.

Aangesien die bestuurder beweeg in dieselfde rigting as die golwe, sal die golffronte verby beweeg teen vertraagde intervalle wat dus maak dat die golflengtes langer word en hy dus 'n laer frekwensie hoor.

(4)

6.3 Speed trap cameras, Doppler flow meter for measuring the speed of blood, ultra sound foetus scan ✓✓

Spoevang kameras, Dopplervloei meter vir die meting van die spoed van bloed, ultraklank fetus skandering

(2)
[13]

QUESTION / VRAAG 7

7.1 7.1.1 Potential difference across R ✓ / *potensiaalverskil oor R* (1)

7.1.2 Current flowing through R ✓ / *stroom vloei deur R* (1)

7.2 $\varepsilon = 2,52 + 0,3r$ ✓i

$-\varepsilon = 0,71 + 1,6r$ ✓ii

$0 = 1,81 - 1,3r$ (add – any other method) / (voeg by – enige ander metode)

$r = 1,39 \Omega$ ✓ (3)

7.3 7.3.1 $2,9 \text{ V}$ ✓✓ (2)

7.3.2 $2,1 \text{ A}$ ✓✓ (2)

7.3.3 Gradient of graph / *gradient van die grafiek*

$= \frac{0 - 2,9}{2,1 - 0}$ ✓ (Accept any viable calculation of gradient.)
(Aanvaar enige sinvolle berekening van gradiënt.)

$= -1,38 \Omega$

$r = 1,38 \Omega$ ✓ (2)

7.4 The graph is an average line through the points/learners drew line of best fit $\therefore$ gives an average value for r , ✓ whilst calculation from individual plots does not take into account instrument reading errors, and any other small errors that arise.

max.

Die grafiek is 'n gemiddelde lyn deur die punte/leerders teken 'n beste paslyn $\therefore$ gee 'n gemiddelde waarde vir r , terwyl berekeninge vanaf individuele punte nie enige instrumentele aflees foute in ag neem nie en enige ander klein foute wat mag opduik.

(1)
[12]

QUESTION / VRAAG 8

8.1 For the parallel network $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{6} + \frac{1}{4} \checkmark R_{//} = 2,4 \Omega$

Option 1/ Opsie 1

$$\begin{aligned} R_{\text{circuit}} &= R_{//} + R_{\text{series}} \checkmark \\ &= 2,4 + 2 + 1 \checkmark \\ &= 5,4 \Omega \end{aligned}$$

$$\begin{aligned} I &= \frac{\varepsilon}{R_{\text{circuit / stroombaan}}} \checkmark \\ I &= \frac{10}{5,4} \checkmark \\ I &= 1,85 \text{ A} \checkmark \end{aligned}$$

Option 2/ Opsie 2

$$\begin{aligned} \varepsilon &= IR_{\text{ext}} + I_c r \checkmark \\ &= I (R_{\text{ext}} + r) \\ 10 \checkmark &= I (2,4 + 2 + 1) \checkmark \\ I &= 1,85 \text{ A} \checkmark \end{aligned}$$

(5)

8.2 For reading of V_1

Option 1/ Opsie 1

$$\begin{aligned} V_1 &= \varepsilon - V_r \\ &= \varepsilon - I_c r \checkmark \\ &= 10 - (1,852 \times 1) \\ &= 8,15 \text{ V} \checkmark \end{aligned}$$

Option 2 / Opsie 2

$$\begin{aligned} R_{\text{ext}} &= R_{//} + R_{\text{series / serie}} \\ &= 2,4 + 2 \\ &= 4,4 \Omega \\ V_1 &= I_{\text{circuit / stroombaan}} \times R_{\text{ext}} \\ &= 1,852 \times 4,4 \\ &= 8,15 \text{ V} \end{aligned}$$

(2)

8.3 Increases $\checkmark$

When switch S is opened, circuit resistance increases leading to a decrease in I. $\checkmark$
Fewer volts lost at "r" $\checkmark$ hence V_1 increases.

Toename

Wanneer skakelaar S oopgemaak word, verhoog die weerstand van die stroombaan wat lei tot 'n afname in I.

Minder verlore volts by r dus sal V_1 vermeerder.

(3)
[10]

QUESTION / VRAAG 9

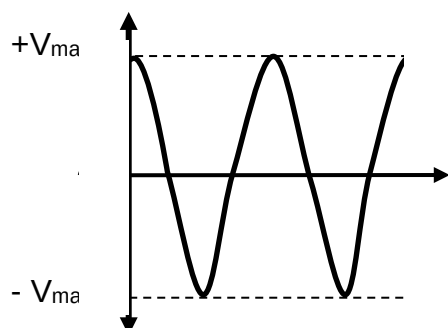
9.1 AC ✓ / WS

Generator has sliprings ✓ / Generator het sleepringe

(2)

9.2

Criteria for marking / Kriteria vir nasien



- Wave starts at $+V_{\max}$ or $-V_{\min}$ ✓
- two cycles shown ✓
- golwe begin by $+V_{maks}$ of $-V_{min}$
- Twee siklusse word gewys

(2)

9.3 a to b ✓ / a tot b

(1)

9.4 9.4.1 It is the DC current which dissipates the same amount of energy as AC. ✓✓
 Dit is die GS wat dieselfde hoeveelheid energie lewer as die WS.

(2)

9.4.2 Option 1

Option 2

$$V_{\text{rms}} = \frac{V_{\text{max / maks}}}{\sqrt{2}} = \frac{6}{\sqrt{2}} \checkmark = 4,243 \text{ V}$$

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark$$

$$= \frac{4,243}{10} \checkmark$$

$$= 0,424 \text{ A} \checkmark$$

$$I_{\text{max}} = \frac{V_{\text{max / maks}}}{R} = \frac{6}{10} = 0,6 \text{ A}$$

$$I_{\text{rms}} = \frac{I_{\text{max / maks}}}{\sqrt{2}}$$

$$= \frac{0,6}{\sqrt{2}}$$

$$= 0,424 \text{ A}$$

(4)

9.4.3

Option 1 / Opsie 1

$$\begin{aligned}
 P_{\text{ave}} &= \frac{I_{\text{max}} V_{\text{max}}}{2} \checkmark \\
 &= \frac{0,6 \times 6}{2} \checkmark \\
 &= 1,8 \text{ W} \checkmark
 \end{aligned}$$

Option 2 / Opsie 2

$$\begin{aligned}
 P_{\text{ave}} &= I_{\text{rms}} V_{\text{rms}} \\
 &= 0,424 \times 4,243 \\
 &= 1,8 \text{ W}
 \end{aligned}$$

Option 3/ Opsie 3

$$\begin{aligned}
 P_{\text{ave}} &= I_{\text{rms}}^2 R \\
 &= 0,424^2 \times 10 \\
 &= 1,8 \text{ W}
 \end{aligned}$$

Option 4 / Opsie 4

$$\begin{aligned}
 P_{\text{ave}} &= V_{\text{rms}}^2 / R \\
 &= \frac{4,24^2}{10} \\
 &= 1,8 \text{ W}
 \end{aligned}$$

(3)
[14]**QUESTION / VRAAG 10**

10.1

$$\Delta E = hf = E_3 - E_1 \checkmark$$

$$\begin{aligned}
 6,63 \times 10^{-34} \checkmark f &= -5,44 \times 10^{-19} \checkmark - (-2,18 \times 10^{-18}) \checkmark \\
 f &= 2,468 \times 10^{15} \text{ Hz} \\
 &= 2,47 \times 10^{15} \text{ Hz} \checkmark
 \end{aligned}$$

(5)

10.2

3 ✓

(1)

10.3.1

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

Die minimum energie wat 'n elektron in die metaal benodig, om vrygestel te word vanuit 'n sekere metaaloppervlakte.

(2)

10.3.2

$$hf = W_0 + \frac{1}{2} mv^2 \checkmark$$

$$6.63 \times 10^{-34} \times 2,468 \times 10^{15} \checkmark = 2 \times 10^{-19} + 0.5 \times 9,11 \times 10^{-31} v^2 \checkmark$$

$$v = 1,78 \times 10^6 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(4)
[12]**TOTAL / TOTAAL : 150**