NORTHERN CAPE DEPARTMENT OF EDUCATION

NOORDKAAP DEPARTEMENT VAN ONDERWYS
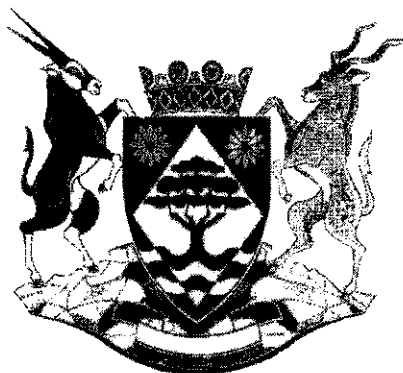
TRIAL EXAMINATION

PROEFEKSAMEN

GRADE 12
GRAAD 12

PHYSICAL SCIENCES: PHYSICS (P1)

FISIESE WETENSKAPPE: FISIKA (V1)

SEPTEMBER 2015
MEMORANDUM

MARKS/ PUNTE: 150

This memorandum consists of 20 pages
Hierdie memorandum bestaan uit 20 bladsye

GENERAL GUIDELINES / *ALGEMENE RIGLYNE*

1.   CALCULATIONS/ BEREKENINGE

1.1   **Marks will be awarded for**: correct formula, correct substitution, correct answer with unit.
Punte sal toegeken word vir: korrekte formule, korrekte substitusie, korrekte antwoord met eenheid.

1.2   **No marks** will be awarded if an **incorrect or inappropriate formula is used**, even though there may be relevant symbols and applicable substitutions.
*Geen punte sal toegeken word waar 'n **verkeerde of ontoepaslike formule gebruik** word nie, selfs al is daar relevante simbole en relevante substitusies.*

1.3   When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.
*Wanneer 'n fout gedurende **substitusie in 'n korrekte formule** begaan word, sal 'n punt vir die korrekte formule en vir korrekte substitusies toegeken word, maar **geen verdere punte** sal toegeken word nie*

1.4   If **no formula** is given, but **all substitutions are correct**, a candidate will **forfeit one mark**.
*Indien **geen formule** gegee is nie, maar **al die substitusies is korrek, verloor die kandidaat een punt.***

1.5   **No penalisation if zero substitutions are omitted** in calculations where **correct formula / principle is given correctly**.
*Geen penalisering indien **nulwaardes nie getoon** word nie in berekeninge waar die **formule/beginsel korrek gegee is nie**.*

1.6   Mathematical manipulations and change of subject of appropriate formulae carry no marks, but if a candidate starts off with the correct formula and then changes the subject of the formula incorrectly, marks will be awarded for the formula and the correct substitutions. The mark for the incorrect numerical answer is forfeited.
Wiskundige manipulasies en verandering van die onderwerp van toepaslike formules tel geen punte nie, maar indien 'n kandidaat met die korrekte formule begin en dan die onderwerp van die formule verkeerd verander, sal punte vir die formule en korrekte substitusies toegeken word. Die punt vir die verkeerde numeriese antwoord word verbeur.

1.7   Marks are only awarded for a formula if a **calculation has been attempted**. i.e. substitutions have been made or a numerical answer given.
*Punte word slegs vir 'n formule toegeken indien **'n poging tot 'n berekening aangewend is**, d.w.s. substitusies is gedoen of 'n numeriese antwoord is gegee.*

1.8   Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.
Punte kan slegs toegeken word vir substitusies wanneer waardes in formule ingestel is en nie vir waardes wat voor 'n berekening gelys is nie.

1.9   All calculations, when not specified in the question, must be done to two decimal places.
       Alle berekenings, wanneer nie in die vraag gespesifiseer word nie, moet tot 'n minimum van twee desimale plekke gedoen word.

2.   UNITS/ EENHEDE

2.1   Candidates will only be penalised once for the repeated use of an incorrect unit **within a question or sub-question**.
       Kandidate sal slegs een keer gepenaliseer word vir die herhaaldelike gebruik van 'n verkeerde eenheid in 'n vraag.

2.2   Units are only required in the final answer to a calculation.
       Eenhede word slegs in die finale antwoord op 'n vraag verlang.

2.3   Marks are only awarded for an answer and not for a unit *per se*. Candidates will therefore forfeit the mark allocated for the answer in each of the following situations:
       - Correct answer + wrong unit
       - Wrong answer + correct unit
       - Correct answer + no unit
       Punte word slegs vir 'n antwoord en nie vir 'n eenheid per se toegeken nie. Kandidate sal derhalwe die punt vir die antwoord in die volgende gevalle verbeur:
       - Korrekte antwoord + verkeerde eenheid
       - Verkeerde antwoord + korrekte eenheid
       - Korrekte antwoord + geen eenheid

2.4   SI units must be used except in certain cases, e.g. $V \cdot m^{-1}$ instead of $N \cdot C^{-1}$, and $cm \cdot s^{-1}$ or $km \cdot h^{-1}$ instead of $m \cdot s^{-1}$ where the question warrants this.
       SI-eenhede moet gebruik word, behalwe in sekere gevalle, bv. $V \cdot m^{-1}$ in plaas van $N \cdot C^{-1}$, en $cm \cdot s^{-1}$ of $km \cdot h^{-1}$ in plaas van $m \cdot s^{-1}$ waar die vraag dit regverdig.

3.   GENERAL/ ALGEMEEN

3.1   If one answer or calculation is required, but two given by the candidate, only the first one will be marked, irrespective of which one is correct. If two answers are required, only the first two will be marked, etc.
       Indien een antwoord of berekening verlang word, maar twee word deur die kandidaat gegee, sal slegs die eerste een nagesien word, ongeag watter een korrek is. Indien twee antwoorde verlang word, sal slegs die eerste twee nagesien word, ens.

3.2   For marking purposes, alternative symbols (s,u,t, etc.) will also be accepted.
       Vir nasiendoeleindes sal alternatiewe simbole (s, u, t, ens.) ook aanvaar word.

3.3   Separate compound units with a multiplication dot, not a full stop, for example, $m \cdot s^{-1}$. For marking purposes $m.s^{-1}$ and m/s will also be accepted.
       Skei saamgestelde eenhede met 'n vermenigvuldigpunt en nie met 'n punt nie, byvoorbeeld, $m \cdot s^{-1}$. Vir nasiendoeleindes sal $m.s^{-1}$ en m/s ook aanvaar word.

4. **POSITIVE MARKING/POSITIEWE NASIEN**

Positive marking regarding calculations will be followed in the following cases:
Positiewe nasien met betrekking tot berekenings sal in die volgende gevalle geld:

4.1 **Sub-question to sub-question:** When a certain variable is calculated in one sub-question (e.g. 3.1) and needs to be substituted in another (3.2 or 3.3), e.g. if the answer for 3.1 is incorrect and is substituted correctly in 3.2 or 3.3, **full marks** are to be awarded for the subsequent sub-questions.
Subvraag na subvraag: Wanneer 'n sekere veranderlike in een subvraag (bv. 3.1) bereken word en dan in 'n ander vervang moet word (3.2 of 3.3), bv. indien die antwoord vir 3.1 verkeerd is en word korrek in 3.2 of 3.3 vervang, word volpunte vir die daaropvolgende subvraag toegeken.

4.2 **A multi-step question in a sub-question:** If the candidate has to calculate, for example, current in the first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer will be forfeited.
'n Vraag met veelvuldige stappe in 'n subvraag: Indien 'n kandidaat byvoorbeeld, die stroom verkeerd bereken in 'n eerste stap as gevolg van 'n substitusiefout, verloor die kandidaat die punt vir die substitusie sowel as die finale antwoord.

4.5 Normally an incorrect answer cannot be correctly motivated if based on a conceptual mistake. If the candidate is therefore required to motivate in question 3.2 the answer given to question 3.1, and 3.1 is incorrect, no marks can be awarded for question 3.2. However, if the answer for e.g. 3.1. is based on a calculation, the motivation for the incorrect answer in 3.2 could be considered.
'n Verkeerde antwoord, indien dit op 'n konsepsuele fout gebaseer is, kan normaalweg nie korrek gemotiveer word nie. Indien 'n kandidaat gevra word om in VRAAG 3.2 die antwoord op VRAAG 3.1 te motiveer en 3.1 is verkeerd, kan geen punte vir VRAAG 3.2 toegeken word nie. Indien die antwoord op bv. 3.1 egter op 'n berekening gebaseer is, kan die motivering vir die verkeerde antwoord in 3.2 oorweeg word.
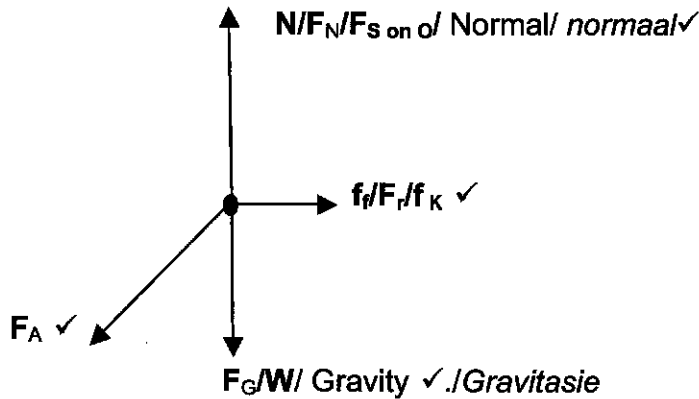
QUESTION 1/ *VRAAG 1*

1.1   B ✓✓   (2)

1.2   C ✓✓   (2)

1.3   D ✓✓   (2)

1.4   A ✓✓   (2)

1.5   B ✓✓   (2)
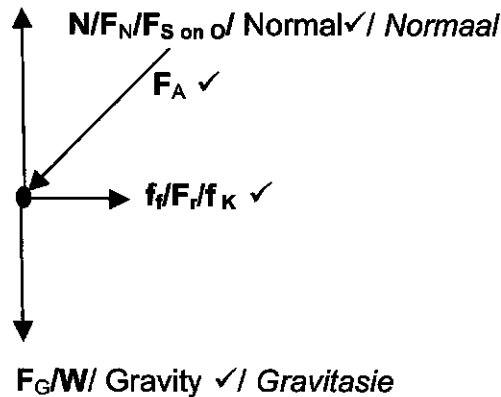
1.6   A ✓✓   (2)

1.7   B ✓✓   (2)

1.8   D ✓✓   (2)

1.9   C ✓✓   (2)

1.10   B ✓✓   (2)
[20]

QUESTION 2/ VRAAG 2

2.1   Normal force is the force or component of a force which a surface exerts on
       an object with which it is in contact, ✓and which is perpendicular to the
       surface. ✓
       Normaalkrag is die krag of komponent van 'n krag wat 'n oppervlak op 'n   (2)
       voorwerp waarmee dit in kontak is, uitoefen en wat loodreg op die oppervlak is.

2.2

N/F_N/$F_{S \text{ on o}}$/ Normal/ *normaal*✓

f_f/F_r/f_K ✓

F_A ✓

F_G/W/ Gravity ✓./*Gravitasie*

ACCEPT/ AANVAAR

N/F_N/$F_{S \text{ on o}}$/ Normal✓/ *Normaal*

F_A ✓

f_f/F_r/f_K ✓

F_G/W/ Gravity ✓/ *Gravitasie*   (4)

2.3   **OPTION 1/ OPSIE 1**

$\sum \vec{F}_y = \vec{0}$ OR/*OF* $F_{net} = 0$ } ✓ Any one/*Enige een*

N+(-mg-$F_A$sin35⁰=0
N= mg+$F_A$sin35⁰

N= 215,16 +97,51✓

$f_k = \mu_k N$ ✓

$f_k = 212.91 N$ ✓

OPTION 2 / OPSIE 2

$f_k = \mu_k N$ ✓

$f_k = \mu_k (mg + F_v)$
$f_k = \mu_k (mg + F \sin 35^0)$ } ✓ Any one/ *Enige een*

                                                                          (4)

$$f_k = \underline{0.68\ (22 \times 9.8 + 170 \times \sin 35^0)}\checkmark$$
$$= 212.91\,N\checkmark$$

2.4 POSITIVE MARKING FROM 2.3 /POSITIEWE NASIEN VANAF 2.3
OPTION 1/ OPSIE 1

$\vec{F}_{net} = \vec{F}_h + \vec{f}_k$ OR/OF $F_{net} = F_h - f_k$ OR/OF $F_{net} = F\cos 35^0 - f_f$

$F_{net} = 170\cos 35^0 - 212.91\checkmark$

$\vec{F}_{net} = -73.65\ N$ OR/OF $\vec{F}_{net} = 73.65\ N$ backwards$\checkmark$/ terugwaarts

The net force is in the opposite direction of motion/ since the net force is in opposite direction of motion, the mower accelerates backwards.$\checkmark$
Die netto krag is in die teenoorgestelde rigting van die beweging/ aangesien die netto krag in die teenoorgestelde rigting van beweging is, versnel die grassnyer terugwaarts

OPTION 2/ OPSIE 2

$F_x = F\cos 35$ $\checkmark$

$F_x = 170\cos 35$ $= 139.25$ N$\checkmark$

$F_x < f_f$

Under these circumstances the lawn mower will be accelerating in a backward direction/It will slow down in a forward direction. $\checkmark$ (3)   **[13]**
Onder hierdie omstandighede sal die grassnyer in 'n terugwaartse rigting versnel/ Dit sal stadiger beweeg in 'n voorwaartse rigting.

QUESTION 3/ VRAAG 3

3.1   *Impulse* is the product of the force (resultant/net force) acting on an object and   (2)
the time the force (resultant/net force) acts on the object.
Impuls is die produk van die krag (resultante/ netto krag) wat op 'n voorwerp inwerk en die tyd wat die krag (resultante/ netto krag) op die voorwerp inwerk.

3.2   Impulse *(J)=Δp*
Impulse *(J)* $= m(\vec{v}_f - \vec{v}_i)$ $\checkmark$ Anyone/ *Enige een*
Impulse *(J)* $= 0.43(-25 - 20)\checkmark$
Impulse *(J)* $= -19.35\ N \cdot s$ $\checkmark$ (3)
OR/OF
Impulse *(J)* $= 19.35\ N \cdot s$ $\checkmark$ in opposite direction.

3.3 $\vec{F}\Delta t = \Delta\vec{p}\checkmark$ OR/OF FΔt= Δp
$(300)\Delta t = 19.35\ \checkmark$ (3)
$\Delta t = 0.065$ s $\checkmark$ OR/OF $\Delta t = 0.07$ s

3.4   Inelastic$\checkmark$/Onelasties
Mass is constant but speed changes /Kinetic energy is not conserved.$\checkmark$ (2)
Massa is konstant maar spoed verander/Kinetiese energie bly nie behoue nie   **[10]**

QUESTION 4/VRAAG 4

4.1 Projectile is an object upon which the only force acting is the force of gravity.
Projektiel is 'n voorwerp waarop slegs gravitasiekrag inwerk. (2)

4.2   9,8 m·s^{-2} ✓downwards✓/ *afwaarts (theoretical)* (2)
OR/OF
9,6 m·s^{-2} ✓downwards✓ (actual)

4.3   **OPTION 1/ OPSIE 1**

$$\overrightarrow{\Delta y} = \overrightarrow{v_i}\Delta + \frac{1}{2}\overrightarrow{g}(\Delta t)^2 ✓ \text{ OR/OF} \quad \Delta y = v_i\Delta t + \frac{1}{2}g(\Delta t)^2$$

$$\Delta y = 9{,}8(4{,}08)✓ + \frac{1}{2}(-9{,}8)(4{,}08)^2✓$$

Δy= - 41,58 m ✓

OR/ *OF*
Δy= 41,58 m downwards ✓/ *afwaarts*

OPTION 2/OPSIE 2

$$\overrightarrow{\Delta y} = \overrightarrow{v_i}\Delta + \frac{1}{2}\overrightarrow{g}(\Delta t)^2 ✓ \text{ OR/OF} \quad \Delta y = v_i\Delta + \frac{1}{2}g(\Delta t)^2$$

$$\Delta y = -9{,}8(2.04)✓ + \frac{1}{2}(-9{,}8)(2{,}04)^2✓$$

Δy= - 41,58 m ✓

OR/ *OF*
Δy= 41,58 m downwards ✓/*afwaarts*

OPTION 3/ OPSIE 3

$$\Delta y = \frac{(v_i + v_f)}{2}\Delta t ✓$$

$$\Delta y = \frac{(9{,}8 + (-30{,}18)}{2}✓ \ (4{,}08)✓$$

Δy= - 41,58 m ✓
OR/ *OF*
Δy= 41,58 m downwards ✓/*afwaarts*

OPTION 4/ OPSIE 4

$$\Delta y = \frac{(v_i + v_f)}{2}\Delta t ✓$$

$$\Delta y = \frac{(-9{,}8) + (-30{,}18)}{2} ✓ \ (2{,}04)✓$$

Δy= - 40,78 m ✓
OR/ *OF*
Δy= 40,78 m downwards ✓/ *afwaarts*

OPTION 5/ OPSIE 5
Δy= Area₍trapezium₎

$$\Delta y = area = \frac{(a+b)}{2}h$$

$$\Delta y = \frac{(-9,8)+(-30,18)}{2}\checkmark(4,08-2,04)\checkmark$$

Δy= - 40,78 m ✓
OR OF
Δy= 40,78 m downwards ✓/afwaarts

OPTION 6/ OPSIE 6
Area= Area₍Δ1₎ + Area₍Δ2₎

$$\Delta y = area = \frac{1}{2}b_1h_1 + \frac{1}{2}b_2h_2$$

$$\Delta y = \frac{1}{2}9,8(1,02)\checkmark + \frac{1}{2}(-30,18)(3,06)\checkmark$$

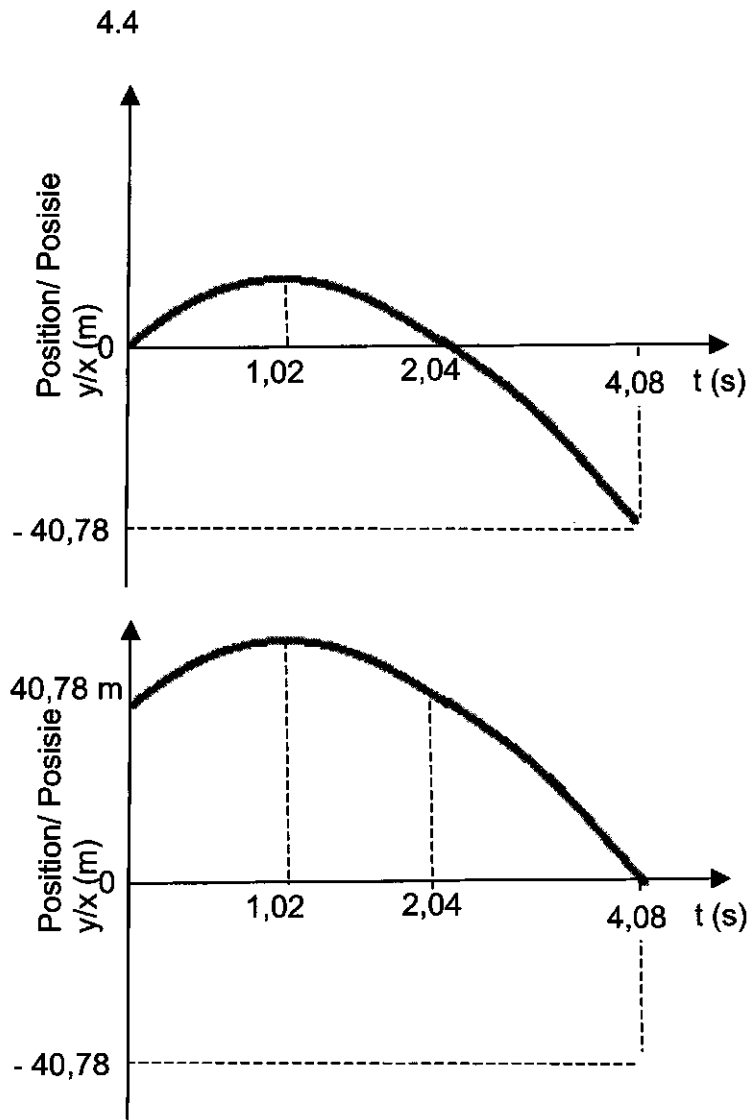Δy=- 41,17 m ✓

OR/ OF
Δy= 41,17 m downwards ✓/ afwaarts

(4)

OPTION 7/ OPSIE 7

$$\Delta y = ab + \frac{1}{2}bh$$

$$\Delta y = -9,8(2,04)\checkmark + \frac{1}{2}(2,04)(-20,38)\checkmark$$

Δy=- 40,78 m ✓

OR/ OF
Δy=40,78 m downwards ✓/afwaarts

4.4

CRITERIA/ *KRITERIA*	MARKS/*PUNTE*
Graph starting from zero OR 40,78 m/*Grafiek begin by nul OF 40,78m*	✓
Correct shape/ *korrekte vorm*	✓
Position for maximum height (4,9 m or/ *of* 5 m) at 1,02 s Posisie vir maksimum hoogte (4,9 m or/ *of* 5 m) by 1,02 s	✓
Final position/ *Finale posisie* (-40.4 m or 40 m) at/ *by* 4,08 s	✓

(4)

[12]

QUESTION 5/ VRAAG 5

5.1. The total linear momentum of an isolated/a closed system✓ remains constant (is conserved). ✓
   Die totale linêre momentum van 'n geïsoleerde/ geslote sisteem bly konstant (bly behoue)

   OR/ *OF*
   In an isolated system✓ the total linear momentum of a system before a collision/interaction is equal to the total linear momentum of the system after the collision. ✓
   In 'n geïsoleerde sisteem is die totale liniêre momentum van 'n sisteem voor 'n botsing/ interaksie gelyk aan die totale liniêre momentum van die sisteem na die botsing

   OR/ *OF*
   If the impulse of the external forces acting on a system is zero✓ the total linear momentum of the system does not change/remains constant. ✓
   As die impuls van die eksterne kragte, wat op 'n sisteem inwerk, gelyk is aan nul sal die totale liniêre momentum van die sisteem nie verander nie/ konstant bly.

   OR/ *OF*
   If there is no external net force acting on a system of particles✓, the total linear momentum of the system is conserved. ✓
   As daar geen eksterne netto krag op 'n sisteem van partikels inwerk nie bly die totale liniêre momentum van die sisteem behoue.   (2)

5.2 $\sum \vec{p}_{before/voor} = \sum \vec{p}_{after/na}$
   OR/OF   } ✓ Anyone/ *Enige een*
   $\sum p_{before/voor} = \sum p_{after/na}$

   $m_1 v_{1(before/voor)} + m_2 v_{2(before/voor)} = (m_1 + m_2) v_{syst/sist}$

   $(6 \times 8) + (5 \times 0)✓ = (6+5) v_{syst/sist}$ ✓

   $v = 4{,}36 \ m{\cdot}s^{-1}$ to the right ✓/ na regs   (4)

5.3. POSITIVE MARKING FROM QUESTION 5.2
POSITIEWE NASIEN VANAF VRAAG 5.2

OPTION 1/*OPSIE 1*
   $W_{nc} = \Delta E_M$ } ✓ Any one/ *Enige een*

11   Please turn over

$$W_{nc} = \Delta E_K + \Delta E_P$$

$$f_f \Delta x \cos 180^0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + \Delta E_P$$

$$\mu_K N \Delta x \cos 180^0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + \Delta E_P \left.\right\}$$ ✓ Any one/ *Enige een*

$$\mu_K mg \Delta x \cos 180^0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + \Delta E_P$$

$$\underline{\mu_K (11 \times 9,8 \times 2 \times (-1)}✓ = \underline{\frac{1}{2}11(1,5)^2 - \frac{1}{2}11(4,36)^2 ✓ + 0}$$

$\mu_k = 0,43$✓

OPTION 2/*OPSIE 2*

$$\left.\begin{array}{l} W_{net} = \Delta E_K \\ W_{net} = E_{Kf} - E_K \end{array}\right\}$$ ✓ Any one/ *Enige een*

$$f_f \Delta x \cos 180^0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$\mu_K N \Delta x \cos 180^0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \left.\right\}$$ ✓ Any one/ *Enige een*

$$\mu_K mg \Delta x \cos 180^0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$\underline{\mu_K (11 \times 9,8 \times 2 \times (-1)}✓ = \underline{\frac{1}{2}11(1,5)^2 - \frac{1}{2}11(4,36)} ✓$$

$\mu_k = 0,43$✓   (5)

5.4.1 POSITIVE MARKING FROM QUESTION 5.3
POSITIEWE NASIEN VANAF VRAAG 5.3

$$\left.\begin{array}{l} \sum \vec{F}_{net} = m\vec{a} \ /\text{F}_{net}=\text{ma} \\ \vec{f}_f + \vec{F}_g + \vec{N} = m\vec{a} \\ -f_f - F_g = ma \\ -\mu N - F_g = ma \end{array}\right\}$$ ✓ Any one / *Enige een*

$$\left.\begin{array}{l} -\mu mg\cos 30^0 - mg\sin 30^0 = ma \\ -\mu g\cos 30^0 - g\sin 30^0 = a \end{array}\right\}$$ ✓ Any one / *Enige een*

$$-(0,43 \times 11 \times 9,8 \times \cos 30^0)✓ - (11 \times 9,8 \times \sin 30^0 ✓ = 11a$$

$$v_f^2 = v_i^2 + 2a\Delta x ✓$$

$$0^2 = (1,5)^2 + 2(-8.55)\Delta x ✓$$

$\Delta x = d = 0,26$ m✓

OR/OF

$$\sum \vec{F}_{net} = m\vec{a} \ / F_{net} = ma$$

$$\vec{f}_f + \vec{F}_g + \vec{N} = m\vec{a}$$

$$-f_f - F_g = ma$$

$$-\mu N - F_g = ma$$

✓ Any one / Enige een

$$-\mu mg\cos 30^0 - mg\sin 30^0 = ma$$

$$-\mu g\cos 30^0 - g\sin 30^0 = a$$

✓ Any one / Enige een

$$-(0,43 \times 9,8 \times \cos 30^0)\checkmark - (9,8 \times \sin 30^0 \checkmark = a$$

$$a = -8,55 \ \text{m·s}^{-2}$$

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

$$0^2 = (1,5)^2 + 2(-8.55)\Delta x \checkmark$$

$$\Delta x = d = 0,26 \ \text{m}\checkmark$$

5.4.2 Increases ✓*Toeneem*

Aceleration of the system of blocks decreases✓.
Versnelling van die bloksisteem neem af

(7)

(2)
[20]

QUESTION 6/ VRAAG 6

6.1 The Doppler effect is the change in frequency (pitch) of sound detected by a listener✓ because the sound source and the listener have different velocities (relative to the medium of sound propagation). ✓
Die Doppler-effek is die verandering in frekwensie (toonhoogte) van klank soos waargeneem deur die luisteraar omdat die klankbron en die luisteraar verskillende snelhede besit (relatief tot die medium wat die klank voortbring)
OR/ *OF*
The Doppler effect is the change in the observed frequency of a wave✓ when the source or the detector moves relative to the transmitting medium. ✓
Die Doppler-effek is die verandering in die waargenome frekwensie van "n golf wanneer die bron of die waarnemer beweeg relatief tot die medium wat die klank dra.   (2)

6.2   **OPTION 1/OPSIE 1**

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

$$1\,000 ✓ = \left(\frac{340}{340 - v_s}\right) ✓ (930) ✓$$

$V_s = 23,80 \text{ m·s}^{-1} ✓$

OPTION 2/ OPSIE 2

$$f_L = \left(\frac{v}{v - v_S}\right) f_S ✓$$

$$1\,000 ✓ = \left(\frac{340}{340 - v_s}\right) ✓ (930) ✓$$

$V_s = 23,80 \text{ m·s}^{-1} ✓$

OPTION 3/ OPSIE 3

$$f_L = \frac{f_s}{1 \pm \dfrac{V_s}{v}} ✓ \qquad OR \qquad f_L = \frac{f_s}{1 - \dfrac{V_s}{v}}$$

$$✓\,1000 = \frac{930\ ✓}{1 - \dfrac{V_s}{340}\ ✓}$$

$V_s = 23,80 \text{ m·s}^{-1} ✓$ (5)

6.3. Increases✓/*Toeneem*   (2)
The compressions behind the ambulance are further apart than when it was approaching✓.
Die verdunnings agter die ambulans is verder van mekaar as die verdigtings toe die ambulans die luisteraar nader.

6.4.1. The stars are moving away ✓
Die sterre beweeg weg van die aarde
The spectral lines in the diagrams are shifted towards the red end/red shifted).✓
Die spektrumlyne in die diagramme het verskuif na die rooi ent/rooi verskuiwing.   (2)

6.4.2. The Universe is expanding.✓　　　　　　　　　　　　　　　　(1)
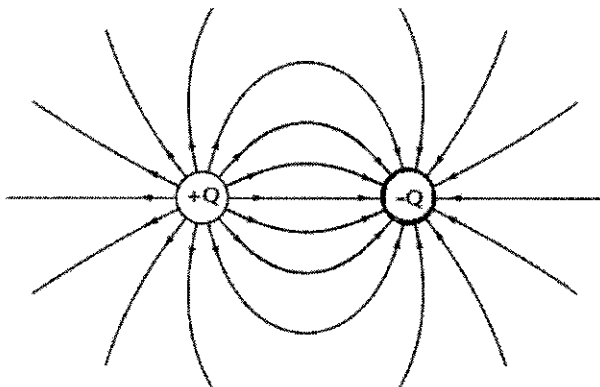　　　　*Die heelal is besig om uit te sit.*　　　　　　　　　　　　　　**[12]**

QUESTION 7/ VRAAG 7

7.1　The electric field at a point is the (electrostatic) force experienced per unit
　　　positive charge at this point. ✓✓
　　　Die elektriese veld by 'n punt is die (elektrostatiese) krag wat 'n positiewe　　(2)
　　　eenheidslading by daardie punt ondervind.

7.2

<u>Criteria for marking</u>
Shape of field lines✓
Direction of field lines. ✓
Nasienkriteria
Vorm van die veldlyne
Rigting van die veldlyne

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(2)

7.3　**OPTION 1/ *OPSIE1***

$$E_{2\mu C} = \frac{kQ}{r^2} ✓$$

$$E_{2\mu C} = \frac{(9x10^9)(2x10^{-6})}{(0,5)^2} ✓$$

$E_{2\mu C}$ = 7.20x10⁴ N·C⁻¹right / regs

$$E_{-2\mu C} = \frac{kQ}{r^2}$$

$$E_{-2\mu C} = \frac{kQ}{r^2} = \frac{(9x10^9)(2x10^{-6})}{(0,5)^2} ✓$$

$E_{-2\mu C}$ = 7,2×10⁴ N·C⁻¹right / regs

$\vec{E}_{net} = \vec{E}_{2\mu C} + \vec{E}_{-2\mu C}$ ⎫
Positive to the right　　　　⎬ ✓ Anyone / Enige een
$E_{net} = E_{2\mu C} + E_{2\mu C}$ ⎭

E_{netto} = 7.2x10⁴ + 7,2×10⁴ ✓

= +14,4×10⁴ $N \cdot C^{-1}$ ✓

OR/ *OF*

= 14,4×10⁴ $N \cdot C^{-1}$ *right / regs* ✓

OPTION 2/ *OPSIE 2*

$$E_{2\mu C} = \frac{kQ}{r^2} \checkmark$$

$$E_{2\mu C} = \frac{(9x10^9)(2x10^{-6})}{(0,5)^2} \checkmark$$

$E_{2\mu C} = 7.20x10^4 N \cdot C^{-1} \text{right / regs}$

$$E_{-2\mu C} = \frac{kQ}{r^2}$$

$$E_{-2\mu C} = \frac{kQ}{r^2} = \frac{(9x10^9)(2x10^{-6})}{(0,5)^2} \checkmark$$

$E_{-2\mu C} = 14,4 \times 10^4 \ N \cdot C^{-1} \text{right / regs}$

$\vec{E}_{net} = \vec{E}_{2\mu C} + \vec{E}_{-2\mu C}$

Positive to the left $\Big\}$ $\checkmark$ Any one/ E*nige een*

$E_{net} = -E_{2\mu C} + (-E_{2\mu C})$

$E_{netto} = -7.2x10^4 - 7,2x10^4 \checkmark$

$= -14,4 \times 10^4 \ N \cdot C^{-1} \checkmark$

OR/*OF*

$= 14,4 \times 10^4 \ N \cdot C^{-1} right / regs \checkmark$

OPTION 3/*OPSIE 3*

$$E_{2\mu C} = \frac{kQ}{r^2} \checkmark$$

$$E_{2\mu C} = \frac{(9x10^9)(2x10^{-6})}{(0,5)^2} \checkmark$$

$E_{2\mu C} = 7.20 \times 10^4 \ N \cdot C^{-1} right / regs$

$E_{2\mu C} = E_{-2\mu C} = 7.20x10^4 N \cdot C^{-1} \text{right / regs} \checkmark$

$\vec{E}_{net} = \vec{E}_{2\mu C} + \vec{E}_{-2\mu C}$

Positive to the right $\Big\}$ $\checkmark$ Any one/ E*nige een*

$E_{net} = E_{2\mu C} + E_{2\mu C}$

$E_{netto} = 2 \times (7.2x10^4) \checkmark$

$= +14,4 \times 10^4 \ N \cdot C^{-1} \checkmark$

OR/*OF*

$= 14,4 \times 10^4 \ N \cdot C^{-1} right / regs \checkmark$

OPTION 4/ OPSIE 4

$E_{2\mu C} = \dfrac{kQ}{r^2}$ ✓

$E_{2\mu C} = \dfrac{(9x10^9)(2x10^{-6})}{(0,5)^2}$ ✓

$E_{2\mu C} = 7.20x10^4 N \cdot C^{-1}$ right / regs

$E_{2\mu C} = E_{-2\mu C} = 7.20x10^4 N \cdot C^{-1}$ right / regs ✓

$\vec{E}_{net} = \vec{E}_{2\mu C} + \vec{E}_{-2\mu C}$ ⎤
Positive to the left ⎬ ✓ Any one / Enige een
$E_{net} = -E_{2\mu C} + (-E_{2\mu C})$ ⎦

$E_{netto} = -7.2x10^4 - 7,2x10^4$ ✓

$= -14,4 \times 10^4 N \cdot C^{-1}$ ✓

OR/OF

$= 14,4 \times 10^4 N \cdot C^{-1}$ right / regs ✓   (6)

7.4   **OPSION 1/OPSIE 1**

$\vec{F}_{net} = \vec{F}_{13} + \vec{F}_{23}$ ✓   OR/OF

$F_{net} = \dfrac{KQ_1Q_3}{r_{13}^2} - \dfrac{KQ_2Q_3}{r_{23}^2}$ ⎫

$0 = \dfrac{KQ_1Q_3}{r_{13}^2} - \dfrac{KQ_2Q_3}{r_{23}^2}$ ⎬ ✓ Any one / Enige een

$\dfrac{KQ_1Q_3}{r_{13}^2} = \dfrac{KQ_2Q_3}{r_{23}^2}$

$\dfrac{Q_1}{r_{13}^2} = \dfrac{Q_2}{r_{23}^2}$ ⎭

$\dfrac{2\times10^{-6}}{x^2}$ ✓ $= \dfrac{6\times10^{-6}}{(1-x)^2}$ ✓

$\dfrac{2}{x^2} = \dfrac{6}{(1-x)^2}$

$4x^2 + 4x - 2 = 0$ OR/OF

$\dfrac{\sqrt{2}}{x} = \dfrac{\sqrt{6}}{(1-x)}$

+2 μC.   P   + 6 μC
● $\vec{F}_{2Q_3}$ $\vec{F}_{6Q_3}$ ●
   x
|← 1,0 m →|

OR/OF
$2(1-x)^2 = 6x^2$
$2(x^2-2x+1) = 6x^2$
$2x^2-4x+2 = 6x^2$
$2x^2-2x+1=0$

$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \dfrac{-2 \pm \sqrt{2^2 - 4\times2\times(-1)}}{2(2)}$

x = 0,37 m from charge/ vanaf lading 2 μC ✓

OR/OF

x= 0,63 m from charge/ *vanaf lading* 6µC✓

OPSION 2/OPSIE 2

$\vec{F}_{net} = Q_3 \vec{E}_{net12}$ ✓

$F_{net} = Q_3 \left(\dfrac{KQ_1}{r_{13}^2} - \dfrac{KQ_2}{r_{23}^2} \right)$

$0 = \dfrac{KQ_1 Q_3}{r_{13}^2} - \dfrac{KQ_2 Q_3}{r_{23}^2}$

$\dfrac{KQ_1 Q_3}{r_{13}^2} = \dfrac{KQ_2 Q_3}{r_{23}^2}$
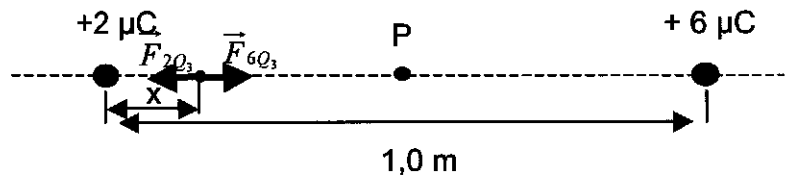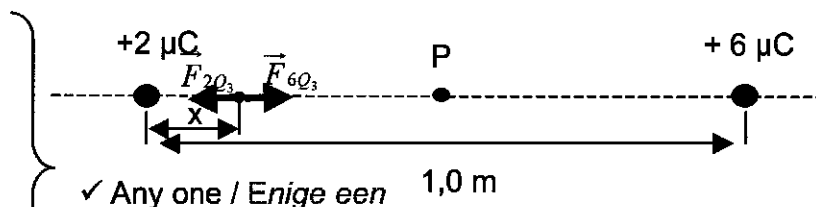
$\dfrac{Q_1}{r_{13}^2} = \dfrac{Q_2}{r_{23}^2}$

$\dfrac{2 \times 10^{-6}}{x^2}$ ✓ $= \dfrac{6 \times 10^{-6}}{(1-x)^2}$ ✓

$\dfrac{2}{x^2} = \dfrac{6}{(1-x)^2}$

$4x^2 + 4x - 2 = 0$ OR/OF

$\dfrac{\sqrt{2}}{x} = \dfrac{\sqrt{6}}{(1-x)}$

+2 µC   P   + 6 µC

✓ Any one / E*nige een*   1,0 m

OR/OF
$2(1-x)^2 = 6x^2$
$2(x^2-2x+1) = 6x^2$
$2x^2 - 4x + 2 = 6x^2$
$2x^2 - 2x + 1 = 0$

$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \dfrac{-2 \pm \sqrt{2^2 - 4 \times 2 \times (-1)}}{2(2)}$

x = 0,37 m from charge/ *vanaf lading* 2 µC ✓

OR/*OF*   (6)
x= 0,63 m from charge/ *vanaf lading* 6µC✓   [16]

QUESTION 8/ VRAAG 8

8.1   When current flows through a voltage source (battery/generator) a resistance to current flow arises✓ due to the resistance of the materials (chemicals/conductors) from which the source is made.✓
Wanneer stroom deur 'n volt-kragbron (battery/generator) vloei, ontstaan 'n weerstand teen stroomvloei as gevolg van die weerstand van die materiaal (chemikaleë/ geleiers) waarvan die bron gemaak is.

OR/*OF*   (2)

Internal resistance is the resistance offered to the electron flow✓ by the electrolyte/medium of the cell/generator. ✓
Interne weerstand is die weerstand gebied teen die vloei van elektrone deur die elektroliet/ medium van die sel/ generator.
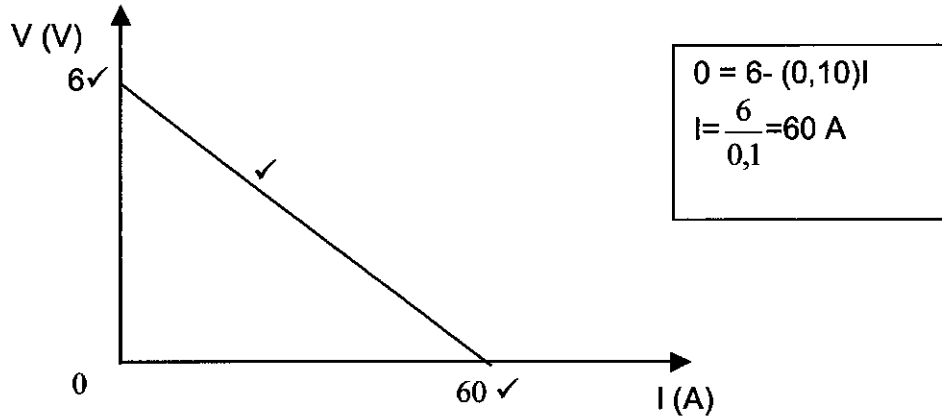
8. 2 $\varepsilon = V_{ext} + Ir$✓

$6 = V_{ext} + I(0,10)$

$V_{ext} = 6 - (0,10)I$ ✓

(2)

8.3

$$0 = 6 - (0,10)I$$

$$I = \frac{6}{0,1} = 60 \text{ A}$$

(3)

8.4

8.4.1 OPTION 1/ *OPSIE 1*

$W_4 = I^2R\Delta t$ ✓ $= 40$

$I^2(4)\Delta t = 40$ ✓

$W_R = (\frac{10}{\Delta t})R\Delta t = 60$ ✓

$R = 6 \ \Omega$ ✓

OPTION 2/ *OPSIE 2*

$W = I^2R\Delta t$ ✓

$$\frac{W_4}{W_R} = \frac{I^2 R_4 \Delta t}{I^2 R \ \Delta t^2}$$

$$\frac{40}{60} ✓ = \frac{I^2(4)\Delta t}{I^2 R \ \Delta t} ✓$$

$R = 6 \ \Omega$ ✓

(4)

8.4.2   POSITIVE MARKING FROM QUESTION 8.4.1
POSITIEWE NASIEN VANAF VRAAG 8.4.1

(3)

OPTION 1/ *OPSIE 1*

$\varepsilon = I(R+r)$ ✓
$6 = I(4+6) + 0,10)$ ✓
$I = 0,59 \text{ A}$ ✓

OPTION 2/ *OPSIE 2*

$\varepsilon = I(R+r)$ ✓
$6 = I(10) + 0,10)$ ✓
$I = 0,59 \text{ A}$ ✓

8.4.3   POSITIVE MARKING FROM QUESTION 8.4.1 and 8.4.2
POSITIEWE NASIEN VANAF VRAAG 8.4.1 en 8.4.2

(3)

OPTION 1/ OPSIE 1   **OPTION 2 /OPSIE 2**

$\varepsilon = V_{ext} + Ir$ ✓ $V = IR_{ext}$ ✓
$6 = V_{ext} + (0,59)(0,10)$ ✓ $= (0,59)(10)$ ✓
$V_{ext} = 5,94$ V ✓ $= 5,9$ V ✓✓

8.5   DECREASE ✓
       Total resistance of the circuit decreases ✓
       Current increases ✓
       $V_{internal\ resistance}$ increases ✓
       V_{ext} (voltmeter reading) decreases ($V_{ext} = \varepsilon - V_{int}$)

       AFNEEM
       Totale weerstand van die stroombaan neem af
       Stroom neem toe
       $V_{interne\ weerstand}$ neem toe
       V_{eks}(voltmeterlesing) neem af ($V_{eks} = \varepsilon - V_{int}$)   (4)
                                                                                                                                                      [21]

QUESTION 9/ VRAAG 9

9.1   DC Generator ✓
       Mechanical energy to electrical energy ✓
       GS Generator
       Meganiese energie na elektriese energie   (2)

9.2   To make the direction of the (induced) current to be the same in every half
       cycle/half turn ✓✓
       *Om die (geïnduseerde) stroom se rigting dieselfde te hou tydens elke
       halfsiklus/ halwe rotasie*
       OR
       To keep the (induced) current unidirectional ✓✓
       Om die (geïnduseerde) stroom in een rigting te laat vloei   (2)

9.3   Graph A ✓
       DC generator becomes an AC generator ✓
       Voltage changes the polarity in every half cycle. ✓
                        OR
       Graph A ✓
       DC generator becomes an AC generator ✓
       The voltage is alternating ✓

                                                                                                                                                      (3)

9.4 $P_{avg/gem} = \dfrac{V^2_{rms/wgk}}{R}$ ✓

$P_{avg/gem} = \dfrac{(\frac{V_{max/maks}}{\sqrt{2}})^2}{R}$

$6 = \dfrac{(\frac{12}{\sqrt{2}})^2}{R}$ ✓

R= 12 Ω

$I_{rms/wgk} = \dfrac{V_{rms/wgk}}{R}$ ✓

$I_{rms/wgk} = \dfrac{(\frac{V_{max/maks}}{\sqrt{2}})^2}{R}$

$= \dfrac{(\frac{12}{\sqrt{2}})^2}{12}$

$I_{rms/wgk}$ = 0,71

$I_{rms\ Total/wgk\ totaal}$ = 2x(0,71) ✓

=1,42 A ✓

$P_{avg/gem} = \dfrac{V^2_{rms/wgk}}{R}$ ✓

$P_{avg} = \dfrac{(\frac{V_{max/maks}}{\sqrt{2}})^2}{R}$

$6 = \dfrac{(\frac{12}{\sqrt{2}})^2}{R}$ ✓

R= 12 Ω

$V_{rms/wgk} = I_{rmsTot/wgk\ tot}\ R_T$ ✓

$\dfrac{V_{rms/wgk}}{\sqrt{2}} = I_{rms\ Total/wgk\ tot} \cdot (\dfrac{R}{2})$

$\dfrac{12}{\sqrt{2}} = I_{rms/wgk} \cdot (\dfrac{12}{2})$ ✓

$I_{rms\ Total/wgk\ tot}$ = 1,42 A ✓

(5)
[12]

QUESTION 10/ VRAAG 10

10.1   What is the relationship between frequency of the incident radiation✓ and the maximum kinetic energy of the ejected electrons? ✓   (2)
Wat is die verwantskap tussen frekwensie van die invallende bestraling en die maksimum kinetiese energie van die vrygestelde elektrone?

10.2
10.2.1   frequency✓/ *frekwensie*   (1)

10.2.2   ANY ONE✓/ *ENIGE EEN*
Threshold frequency/ *drumpel frekwensie*
Work function of the metal/ *werkfunksie van die metaal*
Potential difference/ *potensiaalverskil*
Intensity of the incident radiation/ *intensiteit van die invallende bestraling*   (1)

10.3   As the frequency of the incident radiation increases, the kinetic energy also increases✓✓
Soos die frekwensie van die invallende bestraling toeneem, neem die kinetiese energie ook toe.   (2)

10.4   **OPTION 1/ OPSIE 1**

$$E = W_0 + E_{K\,max/\,maks}$$

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

Any one ✓/Enige een

$$✓\,\frac{hc}{\lambda} = W_0 + E_K$$

$$\frac{(6{,}63 \times 10^{-34})(3 \times 10^8)}{200 \times 10^{-9}}✓ = 8 \times 10^{-19} + E_K✓$$

$E_K = 1{,}95 \times 10^{-19}$ J✓

OPTION 2/ OPSIE 2

$E = W_0 + E_{K\,max/\,maks}$ ✓

$$E = \frac{hc}{\lambda}✓$$

$$E = \frac{(6{,}63 \times 10^{-34})(3 \times 10^8)}{200 \times 10^{-9}}✓$$

$E = 9{,}95 \times 10^{-19}$ J

$9{,}95 \times 10^{-19} = 8 \times 10^{-19} + E_{K\,max/\,maks}$ ✓

$E_K = 1{,}95 \times 10^{-19}$ J✓

(5)

10.5   Remains the same/ No Change. ✓
        Bly dieselfde/ Geen verandering   (2)

        Kinetic energy is independent of intensity of the incident radiation. ✓
        Kinetiese energie is onafhanklik van die intensiteit van die invallende bestraling

106   DECREASES/ *AFNEEM*

                                                                                        (1)
                                                                                        [14]
                                                        TOTAL /TOTAAL: 150