DEPARTMENT OF EDUCATION

DEPARTEMENT VAN ONDERWYS

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PROVINCIAL PREPARATORY EXAMINATION/ PROVINSIALE VOORBEREIDINGSEKSAMEN

GRADE/GRAAD 12

PHYSICAL SCIENCES P1: PHYSICS/ FISIESE WETENSKAPPE V1: FISIKA

MARKING GUIDELINES/NASIENRIGLYNE

SEPTEMBER 2019

MARKS/PUNTE: 150

TIME/TYD: 3 hours/uur

This memorandum consist of 26 pages./
Hierdie memorandum bestaan uit 26 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 D ✓✓ (2)
1.3 A ✓✓ (2)
1.4 A ✓✓ (2)
1.5 C ✓✓ (2)
1.6 D ✓✓ (2)
1.7 B ✓✓ (2)
1.8 C ✓✓ (2)
1.9 A ✓✓ (2)
1.10 D ✓✓ (2)
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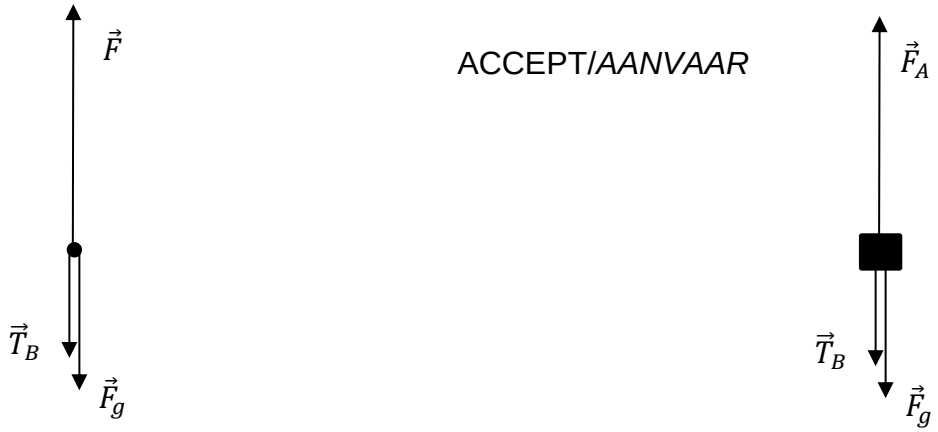
QUESTION 2/*VRAAG 2*

2.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force and the acceleration is directly proportional to the force✓ and inversely proportional to the mass of the object. ✓
Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag teen 'n versnelling direk eweredig aan die krag✓ en omgekeerd eweredig aan die massa van die voorwerp. ✓
(2)

2.2



Accepted labels/*Aanvaarde benoemings*		
F	F_{app} / F_A/applied force (accept T/tension) $F_{toegepas}$ / F_T/toegepaste krag/(aanvaar T/spanning)	✓
F_g	w/F_w/weight/mg/gravitational force *w/F_w/gewig/mg/gravitasiekrag*	✓
T	F_T/Tension/*Spanning*	✓

Notes/*Aantekeninge*

- Marks awarded for label and arrow./*Punt toegeken vir benoeming en pyltjie.*
- Do not penalise for length of arrows since drawing is not to scale./*Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie.*
- Any other additional force(s)./*Enige ander ekstra krag(te). Max/Maks* $\frac{2}{3}$
- If force(s) do not make contact with body./Indien krag(te) nie met die voorwerp kontak maak nie: *Max/Maks* $\frac{2}{3}$
- Do not penalise if vector notation is not used./*Moenie penaliseer indien vektor notasie nie gebruik is nie.*

(3)

2.3.1 $\sum \vec{F}_y = \vec{0}$
$\vec{N}+\vec{F}_g = \vec{0}$
$N-F_g = 0$
$N=mg$

✓Any one/*Enige een*

$N=4,0 \times 9,8$✓
N=39, 20 N✓
Note/*Aantekening*: Do not penalise if vectors notation is not used./*Moenie penaliseer indien vektore notasie nie gebruik word nie.* (3)

2.3.2 **OPTION 1/*OPSIE 1***
$\sum \vec{F}=m\vec{a}$✓ **OR/*OF*** $\vec{F}_{net}=m\vec{a}$ **OR/*OF*** $\mathbf{F}_{net}=m\mathbf{a}$
Direction of motion as positive/*Rigting van beweging as positief*
Block A/*Blok A*
$\vec{T}+\vec{f}_k = m_A\vec{a}$ **OR/*OF*** $\mathbf{T}+\mathbf{f}_k = m_A\mathbf{a}$
$T-f_k = m_Aa$
$T-11,76 = 4a$ (1)

✓Any one/*Enige een*

Block B/*Blok B*:
$\vec{T}+\vec{F}_g+\vec{F} = m_B\vec{a}$ **OR/*OF*** $\mathbf{T}+\mathbf{F}_g+\mathbf{F} = m_B\mathbf{a}$
$-T-F_{g(B)}+F = m_Ba$
$-T-m_Bg+F = m_Ba$
$-T-(8)(9,8)+96 = 8a$
$-T-78,4+96 = 8a$
$-T+17,6 = 8a$ (2)

✓Any one/*Enige een*

Solving (1) and (2)/*Los (1) en (2) op:*
$T-11,76-T-(8)(9,8)+96=4a+8a$
$T-11,76-T-78,4+96=12a$
$a=0,49\ m\cdot s^{-2}$

✓Any one/*Enige een*

$T-11,76 = 4(0,49)$ ✓ **OR/*OF*** $-T-78,4+96 = 8(0,49)$
$T = 13,72$ N✓ **OR/*OF*** $T = 13,68$ N✓ **OR/*OF*** $T = 13,71$ N✓

OPTION 2/*OPSIE 2*

$\sum \vec{F}=m\vec{a}$✓ **OR/*OF*** $\vec{F}_{net}=m\vec{a}$ **OR/*OF*** $\mathbf{F}_{net}=m\mathbf{a}$

Direction of motion as negative/*Rigting van beweging as negatief*

Block A/*Blok A*:

$\vec{T}+\vec{f}_k= m_A\vec{a}$ **OR/*OF*** $\mathbf{T}+\mathbf{f}_k= m_A\mathbf{a}$

$-T+f_k= m_Aa$

$-T+11,76= 4a$ (1)

✓Any one/*Enige een*

Block B/*Blok B*:

$\vec{T}+\vec{F}_{g(B)}+\vec{F}= m_A\vec{a}$ **OR/*OF*** $\mathbf{T}+\mathbf{F}_{g(B)}+\mathbf{F}= m_B\mathbf{a}$

$T+F_g-F= m_Ba$

$T+m_Bg-F= m_Ba$

$T+(8)(9,8)-96=8a$

$T+78,4-96= 8a$ (2)

$T-17,6= 8a$

✓Any one/*Enige een*

Solving 1 and 2/*Los 1 en 2 op:*

$-T+11,76+T+(8)(9,8)-96=4a+8a$

$-T+11,76+T+78,4-96=12a$

$a=-0,49\ m\cdot s^{-2}$

✓Any one/*Enige een*

$-T+11,76= 4(-0,49)$ ✓ **OR/*OF*** $+T+78,4-96= 8(-0,49)$

$T= 13,72$ N✓

OPTION 3/*OPSIE 3*

$\sum \vec{F}=m\vec{a}$✓ **OR/*OF*** $\vec{F}_{net}=m\vec{a}$ **OR/*OF*** $\mathbf{F}_{net}=m\mathbf{a}$

Direction of motion as positive / *Rigting van beweging as positief*

Block A/*Blok A*:

$\vec{T}+\vec{f}_k= m_A\vec{a}$ **OR/*OF*** $\mathbf{T}+\mathbf{f}_k= m_A\mathbf{a}$

$T-f_k= m_Aa$

$T-11,76= 4a$

$a=\frac{T-11,76}{4}$ (1)

✓Any one/*Enige een*

Block B/*Blok B*:

$\vec{T}+\vec{F}_g+\vec{F}= m_B\vec{a}$ **OR/*OF*** $\boldsymbol{T}+\boldsymbol{F}_g+\boldsymbol{F}_A= m_B\boldsymbol{a}$

$-T-F_{g(B)}+F= m_Ba$

$-T-m_Bg+F= m_Ba$

$-T-(8)(9,8)+96= 8a$

$-T-78,4+96= 8a$ (2)

✓Any one/*Enige een*

Substitute (1) into (2)/*Vervang (1) in (2):*

$(-T-78,4+96)$✓$= 8\left(\frac{T-11,76}{4}\right)$ ✓

$T= 13,71$ N✓

OPTION 4/*OPSIE 4*

$\sum \vec{F}=m\vec{a}$✓ **OR/*OF*** $\vec{F}_{net}=m\vec{a}$ OR/*OF* $\mathbf{F}_{net}=m\mathbf{a}$

Direction of motion as negative/*Rigting van beweging as negatief*

Block A/*Blok A*:

$\vec{T}+\vec{f}_k= m_A\vec{a}$ **OR/*OF*** $\mathbf{T}+\mathbf{f}_k= m_A\mathbf{a}$

$-T+f_k= m_Aa$

$-T+11,76= 4a$

$a=\frac{-T+11,76}{4}$ (1)

✓Any one/*Enige een*

Block B/*Blok B*:

$\vec{T}+\vec{F}_g+\vec{F}= m_B\vec{a}$ **OR/*OF*** $\mathbf{T}+\mathbf{F}_g+\mathbf{F}= m_B\mathbf{a}$

$+T+F_{g(B)}-F= m_Ba$

$+T+m_Bg-F= m_Ba$

$+T+(8)9,8)-96= 8a$

$+T+78,4-96= 8a$ (2)

✓Any one/*Enige een*

Substitute (1) into (2)/*Vervang (1) in (2):*

$(+T+78,4-96)$✓$= 8\left(\frac{-T+11,76}{4}\right)$ ✓

$T= 13,71$ N✓

Note/*Aantekening*: Do not penalise if vector notation is not used./*Moenie penaliseer indien vektornotasie nie gebruik is nie.* (6)

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QUESTION 3/*VRAAG 3*

3.1 A projectile is an object upon which the only force acting is the force of gravity. ✓✓

'n Projektiel is 'n voorwerp waarop die enigste krag wat daarop inwerk, die gravitasiekrag is. (2)

3.2.1 **OPTION 1/*OPSIE 1***

Positive downwards/*Positief afwaarts*:

$\vec{v}_f=\vec{v}_i+\vec{a}\Delta t$✓ **OR/*OF*** $\mathbf{v_f=v_i+a}\Delta t$

$245=0+9,8\Delta t$✓

$\Delta t=25$ s✓

OPTION 2/*OPSIE 2*

Positive upwards/ *Positief opwaarts*:

$\vec{v}_f=\vec{v}_i+\vec{a}\Delta t$✓ **OR/*OF*** $\mathbf{v_f=v_i+a}\Delta t$

$-245=0-9,8\Delta t$✓

$\Delta t=25$ s✓

OPTION 3/*OPSIE 3*

Positive downwards/*Positief afwaarts*:

$\vec{v}_f^2= \vec{v}_i^2+2\vec{a}\Delta\vec{y}$

$(245)^2= 0^2+2(9,8)\Delta y$

$\Delta\vec{y}=+ 3062,5$ m

$\Delta\vec{y}=\left(\frac{\vec{v}_i+\vec{v}_f}{2}\right)\Delta t$✓

$3062,5=\left(\frac{0+245}{2}\right)\Delta t$✓

$\Delta t=25$ s✓

OPTION 4/*OPSIE 4*
Positive upwards/*Positief opwaarts*:

$\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\Delta\vec{y}$
$(-245)^2 = 0^2 + 2(-9,8)\Delta y$
$\Delta\vec{y} = -3062,5$ m
$\Delta\vec{y} = \left(\frac{\vec{v}_i+\vec{v}_f}{2}\right)\Delta t$ ✓
$-3062,5 = \left(\frac{0-245}{2}\right)\Delta t$ ✓
$\Delta t = 25$ s ✓

OPTION 5/*OPSIE 5*
Positive downwards/*Positief afwaarts:*
$\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\Delta\vec{y}$
$(245)^2 = 0^2 + 2(9,8)\Delta\vec{y}$
$\Delta\vec{y} = +3062,5$ m
$\Delta\vec{y} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2$ ✓
$3062,5 = (0\times t) + \frac{1}{2}(9,8)\Delta t^2$ ✓
$\Delta t = 25$ s ✓

OPTION 6/*OPSIE 6*
Positive upwards/*Positief opwaarts*:

$\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\Delta\vec{y}$
$(-245)^2 = 0^2 + 2(-9,8)\Delta y$
$\Delta\vec{y} = -3062,5$ m
$\Delta\vec{y} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2$ ✓
$-3062,5 = (0\times t) + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$\Delta t = 25$ s ✓

Note/*Aantekening*: Do not penalise if vector notation is not used./*Moenie penaliseer indien vektornotasie nie gebruik is nie.* (3)

3.2.2 **POSITIVE MARKING FROM 3.2.1/*POSITIEWE NASIEN VANAF 3.2.1***
OPTION 1/*OPSIE 1*
Positive downwards/*Positief afwaarts*:
$\Delta\vec{y} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2$ **OR/*OF*** $\Delta\mathbf{y} = \mathbf{v}_i\Delta t + \frac{1}{2}\mathbf{a}\Delta t^2$
$\vec{v}_{iA}\Delta t_A + \frac{1}{2}\vec{a}\Delta t_A^2 = \vec{v}_{iB}\Delta t_B + \frac{1}{2}\vec{a}\Delta t_B^2$

✓Any one/*Enige een*

$0(25) + \frac{1}{2}(+9,8)(25)^2$ ✓$= \vec{v}_{iB}(20) + \frac{1}{2}(+9,8)(20)^2$ ✓
$\vec{v}_{iB} = 55,13$ m·s^{-1}downwards/*afwaarts* ✓***OR/OF*** $\vec{v}_{iB} = +55,13$ m·s^{-1}

OPTION 2/*OPSIE 2*

Positive upwards/*Positief opwaarts*:

$\Delta\vec{y}=\vec{v}_i\Delta t+\frac{1}{2}\vec{a}\Delta t^2$ **OR/*OF*** $\Delta\mathbf{y}=\mathbf{v}_i\Delta t+\frac{1}{2}\mathbf{a}\Delta t^2$

$\vec{v}_{iA}\Delta t_A+\frac{1}{2}\vec{a}\Delta t_A^2=\vec{v}_{iB}\Delta t_B+\frac{1}{2}\vec{a}\Delta t_B^2$

✓Any one/*Enige een*

$0(25)+\frac{1}{2}(-9{,}8)(25)^2$✓$=\vec{v}_{iB}(20)+\frac{1}{2}(-9{,}8)(20)^2$✓

$\vec{v}_{iB}$=55,13 m·s^{-1}downwards/*afwaarts*✓ **OR/OF** $\vec{v}_{iB}$=-55,13 m·s^{-1}

OPTION 3/*OPSIE 3*

Positive downwards/*Positief afwaarts*:

$\Delta\vec{y}=\vec{v}_i\Delta t+\frac{1}{2}\vec{a}\Delta t^2$ ✓**OR/*OF*** $\Delta\mathbf{y}=\mathbf{v}_i\Delta t+\frac{1}{2}\mathbf{a}\Delta t^2$

$\Delta\vec{y}_A=0(25)+\frac{1}{2}(+9{,}8)(25)^2$✓

$\Delta\vec{y}_A=+3062{,}5\ m$

$+3062{,}5=\ \vec{v}_{iB}(20)+\frac{1}{2}(+9{,}8)(20)^2$✓

$\vec{v}_{iB}$=55,13 m·s^{-1}downwards/*afwaarts* ✓**OR/*OF*** $\vec{v}_{iB}$=+55,13 m·s^{-1}

OPTION 4/*OPSIE 4*

Positive upwards/*Positief opwaarts*:

$\Delta\vec{y}=\vec{v}_i\Delta t+\frac{1}{2}\vec{a}\Delta t^2$ ✓**OR/*OF*** $\Delta\mathbf{y}=\mathbf{v}_i\Delta t+\frac{1}{2}\mathbf{a}\Delta t^2$

$\Delta\vec{y}_A=0(25)+\frac{1}{2}(-9{,}8)(25)^2$✓

$\Delta\vec{y}_A$=-3062,5 m

-3062,5= $\vec{v}_{iB}(20)+\frac{1}{2}(-9{,}8)(20)^2$✓

$\vec{v}_{iB}$=55,13 m·s^{-1}downwards/*afwaarts* ✓**OR/*OF*** $\vec{v}_{iB}$=-55,13 m·s^{-1}

OPTION 5/*OPSIE 5*

Positive downwards/Positief afwaarts:

$\Delta\vec{y}=\vec{v}_i\Delta t+\frac{1}{2}\vec{a}\Delta t^2$ **OR/*OF*** $\Delta\mathbf{y}=\mathbf{v}_i\Delta t+\frac{1}{2}\mathbf{a}\Delta t^2$

$\left(\frac{\vec{v}_i+\vec{v}_f}{2}\right)\Delta t=\vec{v}_{iB}\Delta t_B+\frac{1}{2}\vec{a}\Delta t_B^2$

✓Any one/*Enige een*

$\left(\frac{0+245}{2}\right)(25)$✓$=\vec{v}_{iB}(20)+\frac{1}{2}(+9{,}8)(20)^2$✓

$\vec{v}_{iB}$=55,13 m·s^{-1}downwards/*afwaarts* ✓**OR/*OF*** $\vec{v}_{iB}$=+55,13 m·s^{-1}

OPTION 6/*OPSIE 6*

Positive upwards/Positief opwaarts:

$\Delta\vec{y}=\vec{v}_i\Delta t+\frac{1}{2}\vec{a}\Delta t^2$ **OR/*OF*** $\Delta\mathbf{y}=\mathbf{v}_i\Delta t+\frac{1}{2}\mathbf{a}\Delta t^2$

$\left(\frac{\vec{v}_i+\vec{v}_f}{2}\right)\Delta t=\vec{v}_{iB}\Delta t_B+\frac{1}{2}\vec{a}\Delta t_B^2$

✓Any one/*Enige een*

$\left(\frac{0-245}{2}\right)(25)$✓$=\vec{v}_{iB}(20)+\frac{1}{2}(-9{,}8)(20)^2$✓

$\vec{v}_{iB}$=55,13 m·s^{-1}downwards/afwaarts✓ **OR/OF** $\vec{v}_{iB}$=-55,13 m·s^{-1}

OPTION 7/*OPSIE 7*

Positive downwards/*Positief afwaarts*:

$\Delta\vec{y}=\vec{v}_i\Delta t+\frac{1}{2}\vec{a}\Delta t^2$ **OR/*OF*** $\Delta\mathbf{y}=\mathbf{v}_i\Delta t+\frac{1}{2}\mathbf{a}\Delta t^2$

$\frac{\vec{v}_f^{\,2}-\vec{v}_i^{\,2}}{2a}=\vec{v}_{iB}\Delta t_B+\frac{1}{2}\vec{a}\Delta t_B^2$

$\frac{(245)^2-0^2}{2(9,8)}$ ✓$=\vec{v}_{iB}(20)+\frac{1}{2}(+9,8)(20)^2$✓

$\vec{v}_{iB}$=55,13 m·s^{-1}downwards/*afwaarts* ✓***OR/OF*** $\vec{v}_{iB}$=+55,13 m·s^{-1}

✓Any one/*Enige een*

OPTION 8/*OPSIE 8*

Positive upwards/*Positief opwaarts*:

$\Delta\vec{y}=\vec{v}_i\Delta t+\frac{1}{2}\vec{a}\Delta t^2$ **OR/*OF*** $\Delta\mathbf{y}=\mathbf{v}_i\Delta t+\frac{1}{2}\mathbf{a}\Delta t^2$

$\frac{\vec{v}_f^{\,2}-\vec{v}_i^{\,2}}{2a}=\vec{v}_{iB}\Delta t_B+\frac{1}{2}\vec{a}\Delta t_B^2$

$\frac{(-245)^2-0^2}{2(-9,8)}$ ✓$=\vec{v}_{iB}(20)+\frac{1}{2}(-9,8)(20)^2$ ✓

✓Any one/*Enige een*

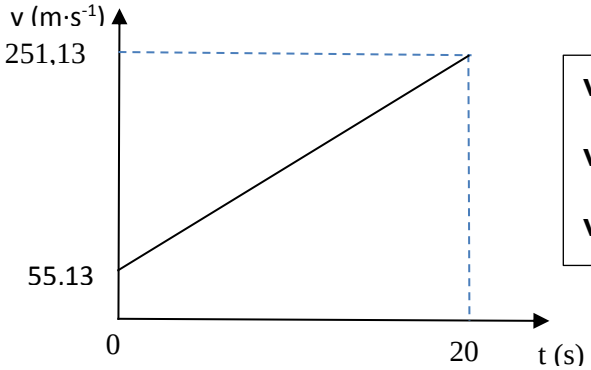
$\vec{v}_{iB}$=55,13 m·s^{-1}downwards/*afwaarts*✓ **OR/*OF*** $\vec{v}_{iB}$=-55,13 m·s^{-1} (4)

Note/Aantekening: Do not penalise if vector notation is not used./*Moenie penaliseer indien vektorenotasie nie gebruik is nie.*

3.3 **POSITIVE MARKING FROM 3.2.2/*POSITIEWE NASIEN VANAF 3.2.2***

OPTION 1/ *OPSIE 1*

Positive downwards/*Positief afwaarts*:



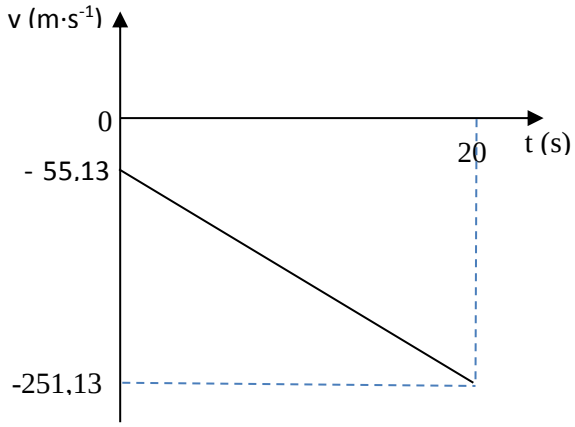
$v_f=v_i+a\Delta t$

$v_f=55,13+9,8$(20)

$v_f=$ 251,13 m·s^{-1}

OPTION 2/*OPSIE 2*

Positive upwards/*Positief opwaarts*:



$v_f=v_i+a\Delta t$

$v_f=-55,13-9,8(20)$

$v_f=-251,13\ m\cdot s^{-1}$

Criteria for marking the graph/ *Kriteria vir die nasien van die grafiek.*	**Marks/ *Punte***
Initial velocity/*Aanvanklike snelheid*	✓
Final velocity/*Finale snelheid*	✓
Time taken for object **B** to reach object **A**/*Tyd geneem deur voorwerp **B** om voorwerp **A** te bereik.*	✓
Correct shape/*Korrekte vorm.*	✓

(4)
[13]

QUESTION 4/*VRAAG 4*

4.1 *Impulse* is the product of the (resultant/net) force acting on an object and the time the (resultant/net) force acts on the object. ✓✓ (2 or 0)

Impuls is die produk van die (resultante/netto) krag wat op 'n voorwerp uitgeoefen word en die tyd wat die (resultante/netto) krag op die voorwerp uitgeoefen word.✓✓ (2 of) (2)

4.2 3 000 N✓ (1)

4.3 Impulse (of the force)/*Impuls (van die krag)*✓ (1)

4.4 **OPTION 1/*OPSIE 1***

$\vec{J}=\Delta\vec{p}$ ***OR/OF*** $\vec{I}=\Delta\vec{p}$ ***OR/OF*** Impulse/Impuls$=\Delta p$
$\vec{J}=m(\vec{v}_f-\vec{v}_{fi})$ ***OR/OF*** $\vec{J}=m\vec{v}_f-m\vec{v}_{fi}$
$\vec{I}=\frac{1}{2}F_{max}\Delta t$) ***OR/OF*** $\vec{I}=m\vec{v}_f-m\vec{v}_{fi}$
Impulse$=m(v_f-v_{fi})$ ***OR/OF*** Impulse/Impuls$=m\vec{v}_f-m\vec{v}_{fi}$
$\frac{1}{2}F_{max}\Delta t=m(\vec{v}_f-\vec{v}_{fi}$ **OR/*OF*** $\frac{1}{2}F_{max}\Delta t=m\vec{v}_f-m\vec{v}_{fi}$

✓Any one/Enige een

Positive towards the bat/*Positief na die kolf toe:*
$\frac{1}{2}(-3000)\left(6\times10^{-3}\right)$✓$= 0,16\vec{v}_f-(0,16)(+20)$✓
$\vec{v}_f=-36,25\ m\cdot s^{-1}$
$v_f=36,25\ m\cdot s^{-1}$✓

OPTION 2/*OPSIE 2*

$\vec{J}=\Delta\vec{p}$ ***OR/OF*** $\vec{I}=\Delta\vec{p}$ ***OR/OF*** Impulse=Δp
$\vec{J}=m(\vec{v}_f-\vec{v}_{fi})$ ***OR/OF*** $\vec{J}=m\vec{v}_f-m\vec{v}_{fi}$
$\vec{I}=\frac{1}{2}F_{max}\Delta t$) ***OR/OF*** $\vec{I}=m\vec{v}_f-m\vec{v}_{fi}$
Impulse=$m(v_f-v_{fi})$ ***OR/OF*** Impulse=$m\vec{v}_f-m\vec{v}_{fi}$
$\frac{1}{2}F_{max}\Delta t=m(\vec{v}_f-\vec{v}_{fi}$ **OR/*OF*** $\frac{1}{2}F_{max}\Delta t=m\vec{v}_f-m\vec{v}_{fi}$

✓Any one/*Enige een*

Negative towards the bat/*Negatief na die kolf toe*:
$\frac{1}{2}(+3000)\left(6\times10^{-3}\right)$ ✓= $0,16\vec{v}_f-(0,16)(-20)$ ✓
$\vec{v}_f=-36,25\ m\cdot s^{-1}$
$v_f=36,25\ m\cdot s^{-1}$ ✓

OPTION 3/*OPSIE 3*

I=FΔt **OR/*OF*** J=FΔt **OR/*OF*** I=$\frac{1}{2}F_{max}\Delta t$ **OR/*OF*** J=$\frac{1}{2}F_{max}\Delta t$
OR/*OF* Impulse/Impuls=FΔt *OR/OF* Impulse/Impuls=$\frac{1}{2}F_{max}\Delta t$
Positive towards the bat/*Positief na die kolf toe:*
$I=\frac{1}{2}(-3000)(6\times10^{-3})$ ✓
I=-9,00 N·s
I=Δp= -9,00 kg·m·s^{-1}
$\Delta\vec{p}=m(\vec{v}_f-\vec{v}_{fi})$ *OR/OF* $\Delta\vec{p}=m\vec{v}_f-m\vec{v}_{fi}$
$-9=0,16\vec{v}_f-(0,16)(+20)$ ✓
$\vec{v}_f=-36,25\ m\cdot s^{-1}$
$v_f=36,25\ m\cdot s^{-1}$ ✓

✓Both/*Beide*

OPTION 4/*OPSIE 4*

I=$F_{ave}\Delta t$ **OR/*OF*** J=$F_{ave}\Delta t$ **OR/*OF*** I=$\frac{1}{2}F_{max}\Delta t$ **OR/*OF*** J=$\frac{1}{2}F_{max}\Delta t$
OR/*OF* Impulse/Impuls=FΔt ***OR/OF*** Impulse/Impuls=$\frac{1}{2}F_{max}\Delta t$
Negative towards the bat/*Negatief na die kolf toe:*
$I=\frac{1}{2}(+3000)(6\times10^{-3})$ ✓
I=+9,00 N·s
I=Δp = +9,00 kg·m·s^{-1}
$\Delta\vec{p}=m(\vec{v}_f-\vec{v}_{fi})$ ***OR/OF*** $\Delta\vec{p}=m\vec{v}_f-m\vec{v}_{fi}$
$+9=0,16\vec{v}_f-(0,16)(-20)$ ✓
$\vec{v}_f=+36,25\ m\cdot s^{-1}$
$v_f=36,25\ m\cdot s^{-1}$ ✓

✓ Both/*Beide*

(4)

4.5 The cricket fielder pulls his arms towards his body to lengthen the time✓ while catching the ball. This will reduce the force ✓acted upon him by the ball and therefore reduces the chances of getting hurt. $F_{net} = \frac{\Delta p}{\Delta t}$ as Δp is constant✓. By increasing time, the net force will decrease.
Die krieketspeler trek sy arms na sy liggaam toe om die tyd te verleng ✓ terwyl hy die bal vang. Dit sal die krag verminder ✓wat die bal op die speller uitoefen en dus die kanse verminder dat die speler seer kry. $F_{net} = \frac{\Delta p}{\Delta t}$ *Δp is konstant. ✓Deur die tyd te verleng, sal die netto krag afneem*.
OR/*OF*
For a constant Δp, ✓ pulling his arms towards his body lengthens the contact time,✓ thus reducing the force on his hands. ✓
Vir 'n konstante Δp,✓ as hy sy arms na sy liggaam trek, verleng die kontaktyd,✓dus verminder die krag op sy hande.✓

(3)
[11]

QUESTION 5/*VRAAG 5*

5.1 The total linear momentum of a closed (isolated) system remains constant (is conserved). ✓✓ (2 or 0)
Die totale lineêre momentum in 'n geslote (geïsoleerde) sisteem bly konstant (bly behoue).✓✓ (2 of 0)

OR/*OF*
In an isolated system, the total linear momentum before collision is equal to the total linear momentum after collision ✓✓ (2 or 0)
In 'n geïsoleerde sisteem is die totale lineêre momentum voor botsing gelyk aan die totale lineêre momentum na botsing.✓✓ (2 of 0)

NOTE/LET WEL: *(If key words "isolated" and "total" missing (-1 mark for each)./Indien sleutelwoords "geïsoleer" en "totaal" uitgelaat is (-1 punt vir elk).* (2)

5.2 A collision is elastic when both total linear momentum and total kinetic energy are conserved (in the system).✓✓
'n Botsing is elasties wanneer beide totale lineêre momentum en totale kinetiese energie behoue bly (in die sisteem). ✓✓ (2)

5.3 **OPSION 1/*OPSIE 1***

$\sum \vec{p}_{after/na} - \sum \vec{p}_{(before/voor)} = 0$

$\sum \vec{p}_{(before/voor)} = \sum \vec{p}_{(after/na)}$

$m\vec{v}_{ball(bef/voor)} + M\vec{v}_{obj(bef/voor)} = (m)\vec{v}_{ball(after/na)} + M\vec{v}_{obj(aft/na)}$

✓Any one/*Enige een*

positive to the right/*na regs is positief*:

$(0,1)(+10)+(4)(0)$✓ $= (0,1)(0)+(4)\vec{v}_{object(after)}$✓

$\vec{v}_{obj(after/na)} = +0,25 \text{ m·s}^{-1}$

$v_{obj(after/na)} = 0,25 \text{ m·s}^{-1}$✓

OPSION 2/*OPSIE 2*

$\sum \vec{p}_{after/na} - \sum \vec{p}_{(before/voor)} = 0$

$\sum \vec{p}_{(before/voor)} = \sum \vec{p}_{(after/na)}$

$m\vec{v}_{ball(bef/voor} + M\vec{v}_{obj(bef/voor} = (m)\vec{v}_{ball(after/na)} + M\vec{v}_{obj(after/na)}$

✓Any one/*Enig een*

negative to the right/ *na regs is negatief*:

$\underline{(0,1)(-10) + (4)(0)}$ ✓ = ✓$\underline{(0,1)(0) + (4)\vec{v}_{obj(after/na)}}$

$\vec{v}_{obj(after/na)} = -0,25$ m·s^{-1}

$v_{obj(after/na)} = 0,25$ m·s^{-1}✓ (4)

5.4 **POSITIVE MARKING FROM 5.3/*POSITIEWE NASIEN VANAF 5.3.***

$\sum E_{ki} = \sum E_{kf}$

$\frac{mv_i^2}{2} + \frac{Mv_i^2}{2} = \frac{mv_f^2}{2} + \frac{Mv_f^2}{2}$

✓Any one/*Enige een*

$\frac{0,1\times10^2}{2} + \frac{4\times0^2}{2}$ ✓ = $\frac{0,1v_f^2}{2} + \frac{4(0,25)^2}{2}$ ✓

$v_{ball(final)} = 9,87$ m·s^{-1}

$E_{Mi} = E_{Mf}$

$E_{Ki} + E_{Pi} = E_{Kf} + E_{Pf}$

$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$

✓Any one/*Enige een*

$\left(\frac{1}{2}(0,10)(9,87)^2 + (0,10)(9,8)(0) = \frac{1}{2}(0,10)(0)^2 + (0,10)(9,8)h_f\right)$ ✓

$h_f = 4,97$ m✓ (6)

5.5 **POSITIVE MARKING FROM 5.3/*POSITIEWE NASIEN VANAF 5.3.***

OPTION 1/*OPSIE 1*

$W_{net}=\Delta E_K$

$f_k\ \Delta x\ \cos\theta=E_{Kf}-E_{Ki}$

$f_k\ \Delta x\ \cos\theta=\frac{1}{2}mv_f^2-\frac{1}{2}mv_i^2$

✓Any one/*Enig een*

$\left[(4,8)\Delta x\ \cos 180^o\right]\checkmark=\left(\frac{1}{2}(4)(0)^2-\frac{1}{2}(4)(0,25)^2\right)\checkmark$

$\Delta x = 0,03\ \text{m}\checkmark$

OPTION 2/*OPSIE 2*

$W_{nc}=\Delta E_M$

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

$f_k\ \Delta x\ \cos\theta=(E_{Kf}-E_{Ki})+(E_{Pf}-E_{Pi})$

$f_k\ \Delta x\ \cos\theta=\left(\frac{1}{2}mv_f^2-\frac{1}{2}mv_i^2\right)+(mgh_f-mgh_i)$

✓Any one/*Enig een*

$\left[(4,8)\Delta x\ \cos 180^o\right]\checkmark=\left(\frac{1}{2}(4)(0)^2-\frac{1}{2}(4)(0,25)^2+(4)(9,8)(0)-(4)(9,8)(0)\right)\checkmark$

$\Delta x = 0,03\ \text{m}\checkmark$

(4)
[18]

QUESTION 6/*VRAAG 6*

6.1 Doppler effect is the change in frequency (or pitch) of the sound detected by a listener ✓because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓
Doppler-effek is 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. ✓
OR/*OF*
The change in the observed frequency ✓when there is relative motion between the source and the observer.✓
Die verandering in die waargenome frekwensie✓as daar relatiewe beweging tussen die klankbron en die luisteraar is. ✓ (2)

6.2 <u>For the same (constant) speed of sound</u>✓ <u>the frequency of sound is inversely proportional to the wave length</u>✓and as the locomotive approaches the listener (girl) the <u>sound waves emitted</u> by the whistle <u>are compresed</u>✓ in front of the locomotive therefore the observed frequency is higher.
Vir <u>dieselfde (konstante) spoed van klank</u>✓ is die <u>frekwensie van klank omgekeerd eweredig aan die golflengte</u>✓ en as die lokomotief die luisteraar nader, word die <u>klankgolwe</u> wat deur die fluit uitgegee word, <u>saamgepers aan</u> ✓ die voorkant van die lokomotief, en is die waargenome frekwensie hoër. (3)

6.3 EQUAL TO/*GELYK AAN*✓
The driver of the locomotive is at rest relative to the source of sound.✓
Die bestuurder van die lokomotief beweeg nie relatief tot van die bron van klank nie.
OR/*OF*
No relative motion between the train driver and locomotive.✓
Geen relatiewe beweging tussen drywer en lokomotief nie. (2)

6.4 **OPTION 1/*OPSIE 1***
$f_L = \left(\frac{v \pm v_L}{v \pm v_s}\right) f_s$ ✓ **OR/*OF*** $f_L = \left(\frac{v}{v + v_s}\right) f_s$
$1836✓ = \left(\frac{340}{340 + v_s}\right)✓2000$ ✓
$v_s = 30{,}37 \ m \cdot s^{-1}$✓

OPTION 2/*OPSIE 2*
$f_L = \left(\frac{v \pm v_L}{v \pm v_s}\right) f_s$ ✓ **OR/OF** $f_L = \left(\frac{v}{v - v_s}\right) f_s$
$2196{,}2✓ = \left(\frac{340}{340 - v_s}\right)✓2000$ ✓
$v_s = 30{,}37 \ m \cdot s^{-1}$✓

OPTION 3/*OPSIE 3*
$f_L = \frac{f_s}{1 + \frac{v_s}{v}}$ ✓
$1836✓ = \frac{2000✓}{1 + \frac{v_s}{340}}$ ✓
$v_s = 30{,}37 \ m \cdot s^{-1}$ ✓

OPTION 4/*OPSIE 4*
$f_L = \frac{f_s}{1 + \frac{v_s}{v}}$ ✓
$2196{,}2✓ = \frac{2000✓}{1 - \frac{v_s}{340}}$ ✓
$v_s = 30{,}37 \ m \cdot s^{-1}$ ✓ (5)

6.5 **ANY ONE**✓
- It is used (in flow meters) in medical science to measure:
  - the speed and direction (velocity) of blood flow.
  - movement of the heart of a foetus.
- To find the rate of blood flow (Doppler scanning)
- To see the unborn child (Ultra sound scanning)
- To hear the heart of a foetus (Ultra sound scanning)
- It is used in medical sonography to generate images (and sounds) of flowing blood.
- To detect blood clotting (Doppler ultrasound test)

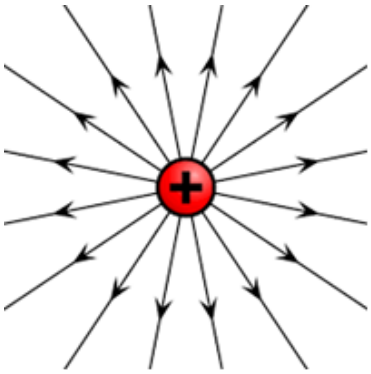
ENIGE EEN

- *Dit word (in vloeimeters) gebruik in mediese wetenskap om die volgende te meet:*
  - Die spoed en rigting (snelheid) van bloedvloei.
  - Beweging van 'n fetus se hart.
- *Om die tempo van bloedvloei te meet (Doppler skandering)*
- *Om 'n ongebore baba te sien (Ultraklankskandering)*
- *Om die hart van 'n fetus te hoor (Ultraklankskandering)*
- *Dit word gebruik in mediese sonografie om beelde (en klanke) te vorm van vloeiende bloed.*
- *Om vorming van bloedklonte op te spoor. (Doppler- ultraklamktoets)*

(1)
[13]

QUESTION 7/*VRAAG 7*

7.1



Shape (radial)/*Vorm (radiaal)*✓

Correct direction/*Korrekte rigting*✓

(2)

7.2 An *electric field* is a region of space in which an electric charge experiences a force✓. The direction of the electric field at a point is the direction that a positive test charge would move if placed at that point.✓
'n Elektriese veld is 'n gebied in die ruimte waarin 'n elektriese lading 'n krag ondervind. Die rigting van die elektriese veld by 'n punt is die rigting waarin 'n positiewe toetslading wat by die punt geplaas is, sal beweeg. (2)

7.3 $Q=ne$✓
$Q=(3{,}125\times10^{10})(1{,}6\times10^{-19})$✓
$Q=+5\times10^{-9}\text{C}$✓ (3)

7.4 **POSITIVE MARKING FROM 7.3/*POSITIEWE NASIEN VANAF 7.3.***
$E=\frac{kQ}{r^2}$✓
$E=\frac{(9{,}0\times10^{9})(5\times10^{-9})}{(0{,}8)^2}$✓
$E=70{,}31\ \text{N}\cdot\text{C}^{-1}$away from the charge/*weg van die lading.*✓ (3)

7.5 GREATER THAN/*GROTER AS*✓

The electric field at a point due to a point charge is inversely proportional to the square of the distance between the point and the charge/($E \propto \frac{1}{r^2}$) ✓

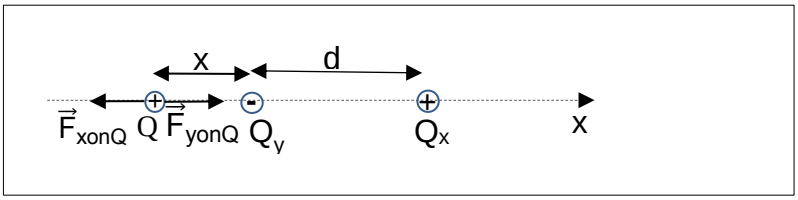
Die elektriese veld by 'n punt as gevolg van 'n puntlading is omgekeerd eweredig aan die kwadraat van die afstand tussen die punt en die lading /($E \propto \frac{1}{r^2}$)

OR/*OF*

The distance from the charge to point **M** is smaller than the distance from the charge to point **P**. ✓

*Die afstand vanaf die lading na punt **M** is kleiner as die afstand vanaf die lading na punt **P**.* (2)

7.6



OPTION 1/*OPSIE 1*

$\vec{F}_{x\text{ on }Q}+\vec{F}_{y\text{ on }Q}=\vec{0}$ **OR/*OF*** $-F_{x\text{ on }Q}+F_{y\text{ on }Q}=0$ **OR/*OF*** $F_{x\text{ on }Q}=F_{y\text{ on }Q}$ ✓Any one/ *Enige een*

$k\frac{Q_xQ}{(d+x)^2}=k\frac{Q_yQ}{x^2}$ **OR/*OF*** $\sqrt{\frac{Q_x}{(d+x)^2}}=\sqrt{\frac{Q_y}{x^2}}$ **OR/*OF*** $\frac{\sqrt{Q_x}}{d+x}=\frac{\sqrt{Q_y}}{x}$

$\frac{\sqrt{\left(5\times10^{-9}\right)}}{0,4+x}$✓$=\frac{\sqrt{\left(4\times10^{-9}\right)}}{x}$✓

x=3,39 m✓

OPTION 2/*OPSIE 2*

$\vec{F}_{x\text{ on }Q}+\vec{F}_{y\text{ on }Q}=\vec{0}$ ✓ **OR/*OF*** $-F_{x\text{ on }Q}+F_{y\text{ on }Q}=0$ **OR/*OF*** $F_{x\text{ on }Q}=F_{yon\ Q}$

$k\frac{Q_xQ}{(d+x)^2}=k\frac{Q_yQ}{x^2}$ **OR/OF** $Q_xx^2=Q_y(d+x)^2$

OR/*OF*

$Q_xx^2=Q_yd^2+2Q_ydx+Q_yx^2$

OR/*OF*

$Q_xx^2-Q_yd^2-2Q_ydx-Q_yx^2=0$

OR/*OF*

$(Q_x-Q_y)x^2-2Q_ydx-Q_yd^2=0$

✓Any one/ *Enige een*

$\left(5\times10^{-9}-4\times10^{-9}\right)x^2$✓ $-2\left(4\times10^{-9}\right)(0,4)x-4\times10^{-9}(0,4)^2=0$✓

OR/*OF*

$\left(10^{-9}\right)x^2$✓ $-(3,2\times10^{-9})x+0,64\times10^{-9}=0$✓

OR/*OF*

x^2✓$-3,2x-0,64=0$✓

OR/*OF*

$x=\frac{3,2\pm\sqrt{(3,2)^2-4(1)(-0,64)}}{2}$✓✓ **OR/*OF*** $x=\frac{3,2\pm\sqrt{(3,2)^2+4(1)(0,64)}}{2}$

x = 3,39 m✓

OPTION 3/*OPSIE 3*

$\vec{F}_{net}=\vec{0}$

$\vec{F}_{x\text{ on }Q}+\vec{F}_{y\text{ on }Q}=\vec{0}$ **OR/*OF*** $-F_{x\text{ on }Q}+F_{y\text{ on }Q}=0$ **OR/*OF*** $F_{x\text{ on }Q}=F_{y\text{ on }Q}$

$Q\vec{E}_x+Q\vec{E}_y=\vec{0}$ **OR/*OF*** $-QE_x+QE_y=0$ **OR/*OF*** $QE_x=QE_y$

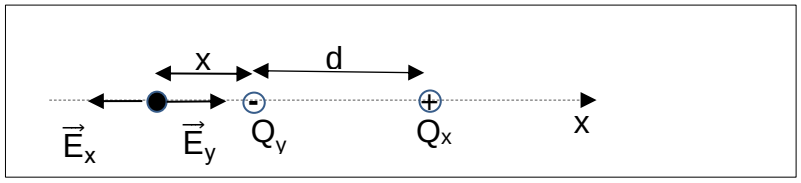
$k\frac{Q_x}{(d+x)^2}=k\frac{Q_y}{x^2}$ **OR/*OF*** $\sqrt{\frac{Q_x}{(d+x)^2}}=\sqrt{\frac{Q_y}{x^2}}$ **OR/*OF*** $\frac{\sqrt{Q_x}}{d+x}=\frac{\sqrt{Q_y}}{x}$

✓Any one/ *Enige een*

$\frac{\sqrt{(5\times10^{-9})}}{0,4+x}$ ✓ $=\frac{\sqrt{(4\times10^{-9})}}{x}$ ✓

x=3,39 m✓

OPTION 4/*OPSIE 4*



$\vec{F}_{net}=\vec{0}$

$\vec{F}_{net}=q\vec{E}_{net}=0$

Therefore/Daarom

$\vec{E}_{net}=\vec{0}$

$\vec{E}_x+\vec{E}_y=\vec{0}$ **OR/*OF*** $-E_x+E_y=0$ **OR/*OF*** $E_x=E_y$

$k\frac{Q_x}{(d+x)^2}=k\frac{Q_y}{x^2}$ **OR/*OF*** $\sqrt{\frac{Q_x}{(d+x)^2}}=\sqrt{\frac{Q_y}{x^2}}$ **OR/*OF*** $\frac{\sqrt{Q_x}}{d+x}=\frac{\sqrt{Q_y}}{x}$

Any one/*Enige een*

$\frac{\sqrt{(5\times10^{-9})}}{0,4+x}$ ✓ $=\frac{\sqrt{(4\times10^{-9})}}{x}$ ✓

x=3,39 m✓

(4)
[16]

QUESTION 8/*VRAAG 8*

8.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature.✓✓ (2 or 0)
Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur. (2 of 0)

OR/*OF*

The current in a conductor is directly proportional to the potential difference across the conductor at constant temperature. ✓✓ (2 or 0)
Die stroom in 'n geleier is direk eweredig aan die potensiaalverskil oor die geleier by konstante temperatuur. (2 of 0) (2)

8.2.1 **OPTION 1/*OPSIE 1***

$R_{234}=R_2+\left(\frac{R_3R_4}{R_3+R_4}\right)$ ✓ $= 10+\left(\frac{10\times10}{10+10}\right)$ ✓$=15\ \Omega$

R_1 and/en R_{234} are/is in parallel

$R_{1234}=\frac{R_1\times R_{234}}{R_1+R_{234}}$ **OR/*OF*** $\frac{1}{R_P}=\frac{1}{R_1}+\frac{1}{R_{p2}}$

$R_{1234}=\frac{15\times15}{15+15}$✓ **OR/*OF*** $\frac{1}{R_{eq}}=\frac{1}{15}+\frac{1}{15}$

$R_{1234}=7,5\ \Omega$

$I=\frac{\varepsilon}{R+r}$✓ **OR/*OF*** (emf/*emk*) $\varepsilon=I(R+r)$

$I=\frac{12}{7,5+0,5}$✓ **OR/*OF*** $12=I(7,5+0,5)$✓

$I=1,5\ A$✓

OPTION 2/*OPSIE 2*

R_3 and/en R_4 are/is in parallel

$\frac{1}{R_P}=\frac{1}{R_1}+\frac{1}{R_2}$

$\frac{1}{R_{34}}=\frac{1}{10}+\frac{1}{10}$

$R_{34}=5\ \Omega$

Any one✓/*Enige een*

R_2 and R_{34} are in series/*R_2 en R_{34} is in serie*

$R_{234}=R_2+R_{34}$

$R_{234}=10+5$

$R_{234}=15\ \Omega$

Any one✓/*Enige een*

R_1 and/en R_{234} are/is in parallel

$\frac{1}{R_P}=\frac{1}{R_1}+\frac{1}{R_{p2}}$

$\frac{1}{R_{eq}}=\frac{1}{15}+\frac{1}{15}$✓

$R_{1234}=7,5\ \Omega$

$I=\frac{\varepsilon}{R+r}$✓ **OR/*OF*** (emf/*emk*) $\varepsilon=I(R+r)$

$I=\frac{12}{7,5+0,5}$✓ **OR/*OF*** $12=I(7,5+0,5)$✓

$I=1,5\ A$✓

OPTION 3/*OPSIE 3*

R_3 and/en R_4 are/is in parallel

$R_{34}=\frac{R_3\times R_4}{R_3+R_4}$

$R_{34}=\frac{10\times10}{10+10}$

Any one✓/*Enige een*

R_{34}= 5 Ω

R_2 and R_{34} are in series/*R_2 en R_{34} is in serie*

$R_{234}= R_2 + R_{34}$

$R_{234}= 10 + 5$

R_{234}= 15 Ω

Any one✓/*Enige een*

R_1 and/en R_{234} are/is in parallel

$R_{1234}=\frac{R_1\times R_{234}}{R_1+R_{234}}$

$R_{1234}=\frac{15\times15}{15+15}$✓

R_{1234}=7,5 Ω

$I=\frac{\varepsilon}{R+r}$✓ **OR/*OF*** (emf/*emk*) ε=I(R+r)

$I=\frac{12}{7,5+0,5}$✓ **OR/*OF*** 12=I(7,5+0,5)✓

I=1,5 A✓

OPTION 4/*OPSIE 4*

$\frac{1}{R_P}=\frac{1}{R_1}+\frac{1}{R_{p2}}$✓

$R_T=R_p=\left(\frac{1}{15}\checkmark+\frac{1}{10+\left(\frac{1}{10}+\frac{1}{10}\right)^{-1}}\checkmark\right)^{-1}$ =7,5 Ω

$I=\frac{\varepsilon}{R+r}$✓ **OR/*OF*** (emf/*emk*) ε=I(R+r)

$I=\frac{12}{7,5+0,5}$✓ **OR/*OF*** 12=I(7,5+0,5)✓

I=1,5 A✓ (6)

8.2.2 **POSITIVE MARKING FROM 8.2.1/*POSITIEWE NASIEN VANAF 8.2.1.***

OPTION 1/*OPSIE 1*

$I_T=I_1+I_2$

$I_1=I_2$

$I_T=2I$

1,5=2I✓

I=0,75 A

$P=I^2R$✓

$P=(0,75)^2 15$✓

P = 8,44 W✓

OPTION 2/*OPSIE 2*

$I_T=I_1+I_2$
$I_1=I_2$
$I_T=2I$
$1,5=2I$✓
$I=0,75$ A
$V=IR$
$V=(0,75)(15)$
$V=11,25$ V
$P=\frac{V^2}{R}$
$P=\frac{(11,25)^2}{R15}$✓
$P=8,44$ W✓

✓ Both/*Beide*

OPTION 3/*OPSIE 3*

$I_T=I_1+I_2$
$I_1=I_2$
$I_T=2I$
$1,5=2I$✓
$I=0,75$ A
$V=IR$
$V=(0,75)(15)$
$V=11,25$ V
$P=VI$
$P=11,25\times0,75$✓
$P=8,44$ W✓

✓ Both/*Beide*

(4)

8.2.3 **POSITIVE MARKING FROM 8.2.1/*POSITIEWE NASIEN VANAF 8.2.1.***

OPTION 1/*OPSIE 1*

$I_2=I_3+I_4$
$I_3=I_4$
$I_2=2I_3$
$0,75=2I$
$I=0,375$ A
$V=IR$✓
$V=(0,375)(10)$✓
$V=3,75$ V✓

OPTION 2/*OPSIE 2*

$I_T=I_1+I_2$
$I_1=I_2$
$I_T=2I$
$1,5=2I$✓
$I_2=I_{34}=0,75$ A
$V=IR$✓
$V=(0,75)(5)$✓
$V=3,75$ V✓

(3)

8.3.1 DECREASES/*AFNEEM* ✓
Emf is constant therefore current is inversely proportional to total resistance. ✓ External resistance increases therefore total resistance increases✓, hence current decreases.
Emk is konstant, daarom is die stroom omgekeerd eweredig aan totale weerstand. Eksterne weerstand neem toe dus neem totale weerstand toe, en stroom neem af. (3)

8.3.2 INCREASES/*TOENEEM* ✓
Total current decreases✓ then less drop in potential (voltage drop) in the internal resistance and emf is constant✓therefore according do $V = \varepsilon - Ir$ terminal potential increases.
Totale stroom neem af, dus minder afname in potensiaal oor die interne weerstand en emk is konstante, en volgens V = ε - Ir sal die terminale potensiaal verhoog. (3)
[21]

QUESTION 9/*VRAAG 9*

9.1 DC generator (dynamo)✓
GS–generator (dinamo) (1)

9.2 Mechanical energy to electrical energy.✓
Meganiese energie na elektriese energie. (1)

9.3 **X** Armature/Anker ✓
OR/*OF*
Coil/spoel (1)

9.4.1 (**Y**) Carbon brushes ensure that the coil is connected to the external circuit.✓
Koolstofborsels verseker dat die spoel aan die eksterne stroombaan verbind is. (1)

9.4.2 *(**Z**) Split ring or commutator ensures that the direction of the current in the external circuit remains the same.* ✓
Splitring of kommutator verseker dat die rigting van die stroom in die eksterne stroombaan dieselfde bly. (1)

9.5.1 $V_{rms/wgk} = \frac{V_{max}}{\sqrt{2}}$✓
$V_{rms/wgk} = \frac{12,73}{\sqrt{2}}$✓
$V_{rms/wgk} = 9,00$ V✓ (3)

9.5.2 **POSITIVE MARKING FROM QUESTION 9.5.1/*POSITIEWE NASIEN VAN VRAE 9.5.1.***

OPTION 1/*OPSIE 1*

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

$=\frac{(9)^2}{25}$✓

$P_{ave/gem}=3,24$ W✓

OPTION 2/*OPSIE 2*

$I_{rms/wgk}=\frac{V_{rms/wgk}}{R}$

$=\frac{9.00}{25}$

$I_{rms/wgk}=0,36$ A

$P_{ave/gem}=V_{rms/wgk}I_{rms/wgk}$✓

$=9,00\times0,36$✓

$P_{ave/gem}=3,24$ W✓

OPTION 3/*OPSIE 3*

$I_{rms/wgk}=\frac{V_{rms/wgk}}{R}$

$=\frac{9.00}{25}$

$I_{rms/wgk}=0,36$ A

$P_{ave/gem}=I^2_{rms/wgk}R$✓

$=(0,36)^2(25)$✓

$P_{ave/gem}=3,24$ W✓

OPTION 4/*OPSIE 4*

$I_{rms/wgk}=\frac{V_{max}}{R\sqrt{2}}$

$=\frac{12,73}{25\sqrt{2}}$

$I_{rms/wgk}=0,36$ A

$P_{ave/gem}=V_{rms/wgk}I_{rms/wgk}$✓

$=9,00\times0,36$✓

$P_{ave/gem}=3,24$ W✓

OPTION 5/*OPSIE 5*

(3)

$I_{rms/wgk} = \frac{V_{max}}{R\sqrt{2}}$

$I_{rms/wgk} = \frac{12,73}{25\sqrt{2}}$

$I_{rms/wgk} = 0,36$ A

$P_{ave/gemiddeld} = I^2_{rms/wgk} R$ ✓

$P_{ave/gemiddeld} = (0,36)^2(25)$ ✓

$P_{ave/gemiddeld} = 3,24$ W ✓

[11]

QUESTIONS 10/*VRAAG 10*

10.1 Photoelectric effect/*foto-elektriese effek*.✓ (1)

10.2 *It establishes the quantum theory* ✓ *and it illustrates the particle nature of light.* ✓
Dit bevestig die kwantumteorie en dit illustreer die deeltjie-aard van lig. (2)

10.3 The work function of a metal is the minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓
Die werkfunksie van 'n metaal is die minimum energie benodig om 'n elektron uit die oppervlak van 'n metaal vry te stel.
(2)

10.4 $E_{kmax} = E - W_o$
$E_{kmax} = \frac{hc}{\lambda} - W_o$
✓Any one/*Enige een*

$E_{kmax} = \frac{6,63\times10^{-34}\times3\times10^{8}}{2\times10^{-7}}$ ✓ $- 6,7 \times 10^{-19}$ ✓

$E_{kmax} = \frac{19,89\times10^{26}}{2\times10^{-7}} - 6,7 \times 10^{-19}$

$E_{kmax} = 9,95 \times 10^{-19}$ J $- 6,7 \times 10^{-19}$ J

$E_{kmax} = 3,25 \times 10^{-19}$ J ✓
(4)

10.5 Increases/*Vermeerder* ✓

With light of higher intensity more photons strikes the metal surface per second✓/*Met lig van hoër intensiteit tref meer fotone die metaaloppervlak per sekonde*

Thus more (photo) electrons are emitted per second, ✓resulting in a bigger current./*Dus word meer (foto-)elektrone per sekonde vrygestel wat 'n hoër stroom tot gevolg het.* (3)

10.6 REMAINS THE SAME/*BLY DIESELFDE*✓. (1)
[13]

TOTAL/TOTAAL: 150