education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE 12/*GRAAD 12*

PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)

SEPTEMBER 2026

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 148

These marking guideline consist of 18 pages.
Hierdie nasienriglyne bestaan uit 18 bladsye.

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QUESTION/*VRAAG 1*

1.1	C	✓✓	(2)
1.2	D	✓✓	(2)
1.3	B	✓✓	(2)
1.4	A	✓✓	(2)
1.5	B	✓✓	(2)
1.6	D	✓✓	(2)
1.7		Removed/*Verwyder*	
1.8	D	✓✓	(2)
1.9	C	✓✓	(2)
1.10	A	✓✓	(2)
			[18]

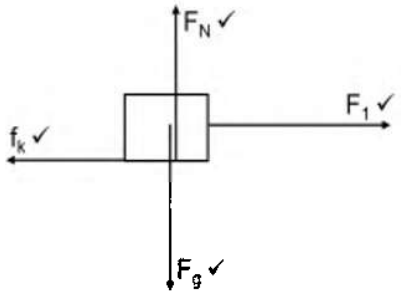
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QUESTION/*VRAAG* 2

2.1 The sum of two or more vectors. ✓✓/ *Die vektorsom van twee of meer vektore.*
OR/*OF*
A single vector having the same effect as two or more vectors together.
'n Enkele vektor wat dieselfde effek het as twee of meer vektore tesame.
(2 or/*of* 0) (2)

2.2 0 (N) ✓ (1)

2.3



Accepted labels/Aanvaarde benoemings	
F_N	N/normal force/*normaalkrag*
F_1	F/Fapp/applied force/F_A/*toegepaste krag*
F_g	F_w/w/gravitational force/weight/*gravitasiekrag/gewig*
f_k	f/f_f/(kinetic) friction/*(kinetiese) wrywing*

***Notes/Aantekeninge*:**
- Mark awarded for label and arrow and the origin of the force./*Punt toegeken vir benoeming en pyltjie en die oorsprong van die krag.*
- 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 addisionele krag(te)*: Max/*Maks* ¾
- If everything correct, but no arrows/*Indien alles korrek, maar geen pyltjies*: Max/*Maks* ¾
- If free body diagram drawn/In*dien vryliggaamdiagram geteken*: Max/*Maks* ¾
- If force/s do not originate from point of application/*Indien kragte nie aangedui is vanaf punt waar dit toegepas word nie:* Max/*Maks* ¾

(4)

2.4 3 $m \cdot s^{-1}$ ✓ (1)

2.5

$F_{net} = ma$

$F - f_f = ma$

$\underline{65 - f_f = 7,65 \times 0,37}$ ✓

$f_f = 62,1695$ N ✓ Both/*Albei*

$f_k = \mu_k F_N / \mu mg / \mu_k N$

$\underline{62,1695 = \mu \times (7,65 \times 9,8)}$ ✓

$\mu = 0,83$ ✓ (4)

2.6 DECREASE/*AFNEEM* ✓

- A greater kinetic frictional coefficient increases the frictional force/*'n Groter kinetiese wrywingskoëffisiënt verhoog die wrywingskrag*✓
- Increase in friction reduces the net force/*Toename in wrywing verlaag die nettokrag* ✓
- The net force is directly proportional to acceleration/*Die nettokrag is direk eweredig aan versnelling*/F_{net} α a ✓ (4)

[16]

QUESTION/*VRAAG* 3

3.1

Marking criteria/*Nasienkriteria*

If any of the underlined key words/phrases in the correct context is omitted deduct 1 mark/*Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.*

If gravity/gravitation without force is used ½
Indien gravitasie sonder krag gebruik word ½

An object which has been given an initial velocity and then moves under the influence of the gravitational force only.✓✓
'n Voorwerp waaraan 'n beginsnelheid gegee is en wat dan slegs onder die invloed van die gravitasiekrag beweeg. (2)

3.2.1

Marking criteria/*Nasienkriteria*

- Below the top of the building/*Onder die bopunt van die gebou*
- Formula with Δy/*Formule met Δy*
- Correct substitution into formula/*Korrekte vervanging in formule*
- Correct final answer/*Korrekte finale antwoord*: 45,92 (m)

NOTE for 3.2.1: If energy principles used ($^2/_4$) for "below" and final answer.

NOTA vir 3.2.1: *Indien energiebeginsels gebruik ($^2/_4$) vir "onder" en finale antwoord.*

Below the top of the building/*Onder die bopunt van die gebou*. ✓

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*
(note: v_f and v_i can be switched/*nota: v_f en v_i kan omgeruil word*)

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**	**OPTION/*OPSIE* 3**
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$0^2 = 30^2 + 2(-9,8)\Delta y$ ✓	$0 = 30 + (-9,8)(\Delta t)$	$0 = 30 + (-9,8)(\Delta t)$
$\Delta y = 45,92$ (m) ✓	$t = 3,06$ s	$t = 3,06$ s
	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓	$\Delta y = \frac{v_i + v_f}{2} \times \Delta t$ ✓
	$= 30(3,06) + \frac{1}{2}(-9,8)(3,06^2)$ ✓	$\Delta y = \boxed{\frac{0 + 30}{2} 3,06}$ ✓
	$\Delta y = 45,92$ (m) ✓	$\Delta y = 45,92$ (m) ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF*

OPTION/*OPSIE* 4	**OPTION/*OPSIE* 5**	**OPTION/*OPSIE* 6**
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$0^2 = -30^2 + 2(9,8)\Delta y$ ✓	$0 = -30 + (-9,8)(\Delta t)$	$0 = -30 + (-9,8)(\Delta t)$
$\Delta y = -45,92$	$t = 3,06$ s	$t = 3,06$ s
$\Delta y = 45,92$ (m) ✓	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓	$\Delta y = \frac{v_i + v_f}{2} = \Delta t$ ✓
	$= -30(3,06) + \frac{1}{2}(9,8)(3,06^2)$ ✓	$\Delta y = \boxed{\frac{0 + (-30)}{2} 3,06}$ ✓
	$\Delta y = -45,92$	$\Delta y = -45,92$
	$\Delta y = 45,92$ (m) ✓	$\Delta y = 45,92$ (m) ✓ (4)

3.2.2

POSITIVE MARKING FROM 3.2.1/*POSITIEWE NASIEN VANAF 3.2.1*
(award marks if calculated in 3.2.1/*ken punte toe indien bereken in 3.2.1*)

Marking criteria/*Nasienkriteria*

- Formula with Δt/*Formule met* Δt
- Correct substitution into formula/*Korrekte vervanging in formule*
- Correct final answer/*Korrekte finale antwoord*: 3,06 (s)

NOTE for 3.2.2: If energy principles used ($^1/_3$) for final answer.
NOTA vir 3.2.2: *Indien energiebeginsels gebruik* ($^1/_3$) *vir finale antwoord.*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**	**OPTION/*OPSIE* 3**
$v_f = v_i + a\Delta t$ ✓	$\Delta y = \frac{v_i + v_f}{2} \times \Delta t$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$0 = 30 + (-9{,}8)(\Delta t)$ ✓	$45{,}92 = \frac{v_i + 30}{2}\Delta t$ ✓	$45{,}92 = 30(t) + \frac{1}{2}(-9{,}8)(\Delta t)^2$ ✓
$t = 3{,}06$ (s) ✓	$t = 3{,}06$ (s) ✓	$t = 3{,}06$ (s) ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF*

OPTION/*OPSIE* 4	**OPTION/*OPSIE* 5**	**OPTION/*OPSIE* 6**
$v_f = v_i + a\Delta t$ ✓	$\Delta y = \frac{v_i + v_f}{2} \times \Delta t$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$0 = -30 + (9{,}8)(\Delta t)$ ✓	$-45{,}92 = \frac{v_i + (-30)}{2}\Delta t$ ✓	$-45{,}92 = -30(t) + \frac{1}{2}(9{,}8)(\Delta t)^2$ ✓
$t = 3{,}06$ (s) ✓	$t = 3{,}06$ (s) ✓	$t = 3{,}06$ (s) ✓

(3)

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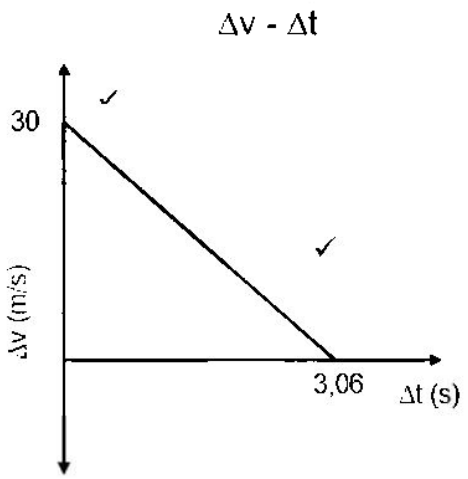
3.3

POSITIVE MARKING FROM 3.2.1 AND 3.2.2
POSITIEWE NASIEN VANAF 3.2.1 EN 3.2.2

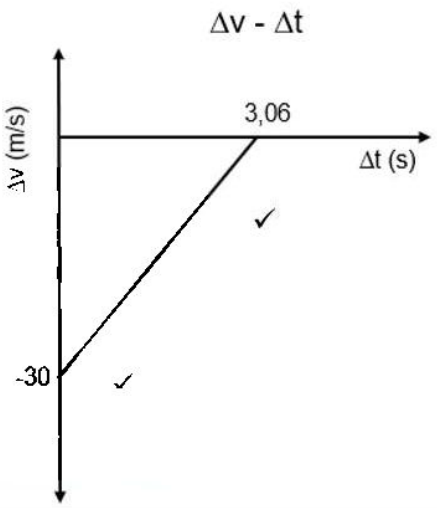
Marking criteria/*Nasienkriteria*

- Initial velocity of 30 m·s^{-1} for the ball/A*anvanklike snelheid van 30 m·s^{-1} vir die bal*
- Correct shape and graph stops at time of 3,06 s/*Korrekte vorm en grafiek eindig by tyd 3,06 s*

OPTION/*OPSIE* 1
(UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF*)



OPTION/*OPSIE* 2
(DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF*)



(2)

3.4

Marking criteria/*Nasienkriteria*

- Formula that leads to the final answer/*Formule wat lei tot die antwoord*
- Correct substitution into formula/*Korrekte vervanging in formule*
- Subtraction of the initial velocity (30 m·s^{-1})/*Aftrek van die aanvanklike snelheid (30 m·s^{-1})*
- Correct final answer/*Korrekte finale antwoord*: 1,30 m · s^{-1}

OPTION/*OPSIE* 1
(UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF*)

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0^2 = \underline{v_i^2 + 2(-9,8)50}$ ✓

$v_i = 31,30495168$ m·s^{-1}

$v_i = \underline{31,30495168 - 30}$ ✓

$v_i = 1,30$ m·s^{-1} ✓

OPTION/*OPSIE* 2
(DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF*)

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0^2 = \underline{v_i^2 + 2(9,8)50}$ ✓

$v_i = 31,30495168$ m·s^{-1}

$v_i = \underline{31,30495168 - 30}$ ✓

$v_i = 1,30$ m·s^{-1} ✓

(4)

[15]

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QUESTION/*VRAAG* 4

4.1 A system on which the net external force is zero. ✓✓*I'n Sisteem waarop die netto eksterne krag nul is.*
OR/*OF*
A system that excludes external forces that originate outside the colliding bodies./*'n Sisteem wat eksterne kragte wat buite die botsende voorwerpe ontstaan, uitsluit.* **(2 or/*of* 0)** (2)

4.2.1

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
(left as negative/*links as negatief*)	**(left as positive/*links as positief*)**
$p = mv$ ✓	$p = mv$ ✓
$= \underline{12,5 \times (-1,8)}$ ✓	$= \underline{12,5 \times (1,8)}$ ✓
$= -22,5\ kg{\cdot}m{\cdot}s^{-1}$	$= 22,5\ kg{\cdot}m{\cdot}s^{-1}$ ✓ left ✓/*links*
$= 22,5\ kg{\cdot}m{\cdot}s^{-1}$ ✓ left ✓/*links*	

(4)

4.2.2

Marking criteria/*Nasienkriteria*
- Formula/*Formule*: $mv_i = mv_{f1} + mv_{f2}$
- Correct substitution into formula/*Korrekte vervanging in formule*
- Formula/*Formule*: $½\ mv_i^2 = ½\ mv_{f1}^2 + ½\ mv_{f2}^2$
- Correct substitution into formula/*Korrekte vervanging in formule*
- Substitution of 1 into 2/*Vervanging van 1 in 2*
- Correct final answer/*Korrekte finale antwoord*: $1,8\ m{\cdot}s^{-1}$

POSITIVE MARKING FROM 4.2.1/*POSITIEWE NASIEN VANAF 4.2.1*

$mv_i = mv_{f1} + mv_{f2}$ ✓

$\underline{(25 \times v_i) = (-22,5) + (12,5 \times v_{f2})}$ ✓

$25v_i = -22,5 + 12,5\ v_{f2}$

$2v_i + 1,8 = v_{f2}$ …1

$½\ mv_i^2 = ½\ mv_{f1}^2 + ½\ mv_{f2}^2$ ✓

$\underline{½\ 25v_i^2 = ½\ 12,5(1,8)^2 + ½\ 12,5v_{f2}^2}$ ✓

$12,5v_i^2 = 20,25 + 6,25v_{f2}^2$

$2v_i^2 = 3,24 + v_{f2}^2$ … 2

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

$\underline{2v_i^2 = 3,24 + (2v_i + 1,8)^2}$ ✓

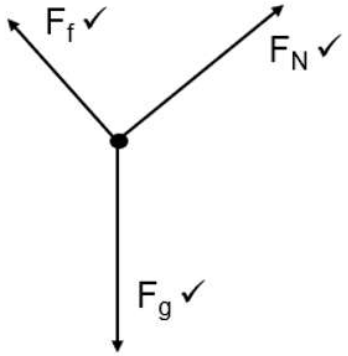
$v_i = 1,8\ m{\cdot}s^{-1}$ ✓

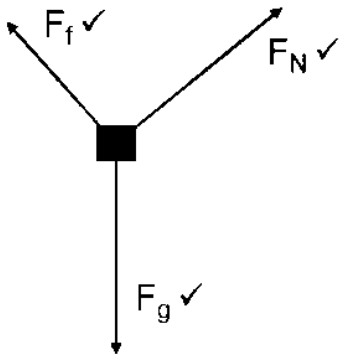
(6)
[12]

QUESTION/*VRAAG* 5

5.1 The net work done on an object is equal to the change in the object's kinetic energy.✓✓/*Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp.* **(2 or/*of* 0)** (2)

5.2 Accept force diagram/*Aanvaar kragtediagram:*





Accepted labels/Aanvaarde benoemings	
F_N	N/normal force/n*ormaalkrag*
F_g	Fw/w/gravitational force/weight/*gravitasiekrag/gewig*
F_f	f/f_k/(kinetic) friction/*(kinetiese) wrywing*

***Notes/Aantekeninge*:**

- Mark 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 addisionele krag(te)*: Max/*Maks* ⅔
- If everything correct, but no arrows/*Indien alles korrek, maar geen pyltjies*: Max/*Maks* ⅔
- If force(s) do not make contact with the dot/*Indien krag(te) nie met die kolletjie kontak maak nie*: Max/*Maks* ⅔

(3)

5.3.1

Marking criteria/*Nasienkriteria*

- Formula/*Formule*
- Correct substitution into left of formula/*Korrekte vervanging in linkerkant van formule*
- Correct substitution into right of formula/*Korrekte vervanging in regterkant van formule*
- Correct final answer/*Korrekte finale antwoord*: 8,48 m·s^{-1}

OPTION/*OPSIE* 1

$$W_{net} = \Delta E_K \checkmark$$

$$F_{net}\Delta x\cos\theta = \Delta E_K$$

$$(0,4 \times 9,8 \sin 31° - 0,22)8\cos 0° \checkmark = \tfrac{1}{2}(0,4)v_f^2 - 0 \checkmark$$

$$v_f = 8,48 \text{ m·s}^{-1} \checkmark$$

OPTION/*OPSIE* 2

$$h_A = 8\sin 31°$$

$$= 4,1203 \text{ m}$$

$$W_{nc}/W_{nk} = \Delta E_k + \Delta E_p \checkmark$$

$$f\Delta x\cos\theta = \tfrac{1}{2} mv_f^2 - \tfrac{1}{2} mv_i^2 + mgh_f + mgh_i$$

$$0,22 \times 8\cos 180° \checkmark = \tfrac{1}{2}\, 0,4v_f^2 - 0 + 0 - (0,4 \times 9,8 \times 4,1203) \checkmark$$

$$v_f = 8,48 \text{ m·s}^{-1} \checkmark$$

(4)

5.3.2

POSITIVE MARKING FROM 5.3.1/*POSITIEWE NASIEN VANAF 5.3.1*

Marking criteria/*Nasienkriteria*

- Formula/*Formule*: $mgh_i + \tfrac{1}{2} mv_i^2 = mgh_f + \tfrac{1}{2} mv_f^2$
- Correct substitution into formula/*Korrekte vervanging in formule*
- Correct final answer/*Korrekte finale antwoord*: 3,67 m
- If equations of motion used/*Indien bewegingsvergelykings gebruik*: Max $^1/_3$ for final answer/*Maks* $^1/_3$ *vir finale antwoord*

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

$$0 + \tfrac{1}{2}\, 0,4(8,48)^2 = (0,4 \times 9,8 \times h) + 0 \checkmark$$

$$h = 3,67 \text{ m} \checkmark$$

(3)

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5.4

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2** **POSITIVE MARKING FROM 5.3.1** ***POSITIEWE NASIEN VANAF 5.3.1***
$W = F\cos\theta\Delta x$ ✓ $= \underline{0{,}22\cos 180^\circ \times 8}$ ✓ $= -1{,}76$ J✓	$h_A = 8\sin 31^\circ$ $= 4{,}12$ m $W_{nc}/W_{nk} = \Delta E_K + \Delta E_P$ ✓ $= (\frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2) + (mgh_B - mgh_A)$ $= \underline{(\frac{1}{2} 0{,}4 \times 8{,}48^2 - 0) + (0 - 0{,}4 \times 9{,}8 \times 4{,}12)}$✓ $= -1{,}77$ J ✓ (Range/*Gebied*: -1,76 to/*tot* -1,77 J)

(3)
[15]

QUESTION/*VRAAG* 6

6.1.1

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the correct context is omitted deduct 1 mark/*Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.*

The change in frequency (or pitch) of the sound detected by the listener, because the sound source and the listener have different velocities relative to the medium of sound propagation.✓✓

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 frequency of sound detected by the listener due to relative motion between the source and the listener.

Die verandering in frekwensie van die klank waargeneem deur 'n luisteraar as gevolg van die relatiewe beweging tussen die klankbron en die luisteraar. (2)

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6.1.2

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**	**OPTION/*OPSIE* 3**
$v = \frac{\Delta x}{\Delta t}$ $= \frac{5}{0,5}$ ✓ $= 10\ m{\cdot}s^{-1}$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $5 = v_i(0,5) + 0$ ✓ $v_i = 10\ m{\cdot}s^{-1}$ ✓	$\Delta y = \frac{v_i + v_f}{2}\Delta t$ $5 = \frac{2v}{2}\ 0,5$ ✓ $v = 10\ m{\cdot}s^{-1}$ ✓

(2)

6.1.3 **POSITIVE MARKING FROM 6.1.2/*POSITIEWE NASIEN VANAF 6.2.1***

$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓ or/*of* $f_L = \frac{v + v_L}{v} f_s$

$290 ✓ = \frac{344 + 10}{344 - 0} f_s$ ✓

$f_s = 281,8097$ Hz

$v = \lambda f$ ✓

$344 = \lambda \times 281,8097$ ✓

$\lambda = 1,22$ m✓

(6)

6.2.1 Away/*Weg* or/*of* Towards/*Na*✓ (1)

6.2.2

If away in 6.2.1/*Indien weg in 6.2.1*: the frequency is decreasing as the star is moving/moves towards the side of a longer wavelength.✓/*die frekwensie neem af soos wat die ster beweeg/beweeg na die kant met 'n langer golflengte.* This means that the star red shifted.✓/*Dit beteken 'n rooiverskuiwing het plaasgevind.*

If towards in 6.2.1/*Indien na in 6.2.1*: the frequency is increasing as the star is moving/moves towards the side of a shorter wavelength.✓/*die frekwensie neem toe soos wat die ster beweeg/beweeg na die kant met 'n korter golflengte.*
This means that the star blue shifted.✓/*Dit beteken 'n blouverskuiwing het plaasgevind.*

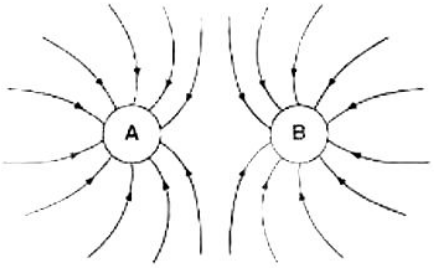
(2)

[13]

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QUESTION/*VRAAG* 7

7.1



Criteria for sketch/*Kriteria vir skets*	Marks/*Punte*
Correct direction of field lines./*Korrekte rigting van veldlyne.*	✓
Correct shape of the electric field lines between charges and on the outside of the charges./*Korrekte vorm van elektrieseveld tussen ladings en die buitekant van die ladings.*	✓
No field lines crossing each other. Field lines must touch the charge, but not go inside the charge./*Geen veldlyne wat mekaar kruis nie. Veldlyne moet die lading raak, maar nie die lading binnegaan nie.*	✓
Note/*Nota*: • If the learner draws a field pattern of two unlike charges: $^0/_3$ • If only one charge is drawn: $^0/_3$ • *Indien leerder 'n elektrieseveld van twee ongelyke ladings teken:* $^0/_3$ • *Indien slegs een lading geteken is:* $^0/_3$	

(3)

7.2

Marking criteria/*Nasienriglyne*
If any of the underlined key words/phrases in the correct context is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.* If mass is used/*Indien massa gebruik is:* $^0/_2$ If force is omitted/*Indien krag uitgelaat is:* $^0/_2$

The magnitude of the electrostatic force exerted by one point charge on another point charge is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance between them.✓✓

Die grootte van die elektrostatiese krag wat deur een puntlading op 'n ander puntlading uitgeoefen word, is direk eweredig aan die produk van die grootte van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.

(2)

7.3

$F = \frac{kQ_1Q_2}{r^2}$ ✓

$12,4 = \frac{9 \times 10^9 \times Q^2}{(5 \times 10^{-3})^2}$ ✓ ✓

$Q = 1,86 \times 10^{-7}$ C ✓ (4)

7.4

POSITIVE MARKING FROM 7.3/*POSITIEWE NASIEN VANAF 7.3*

$n = \frac{Q}{q_e}$ ✓

$= \frac{1,86 \times 10^{-7}}{1,6 \times 10^{-19}}$ ✓

$= 1,16 \times 10^{12}$ (electrons/*elektrone*) ✓ (3)

7.5

Marking criteria/*Nasienkriteria*

- Any one of the formulae/*Enige een van die formules*
- Correct substitution of 7 500/*Korrekte vervanging van 7 500*
- Correct substitution into formula: $\frac{kQ_A}{r^2}$/*Korrekte vervanging in formule:* $\frac{kQ_A}{r^2}$
- Correct substitution into formula: $\frac{kQ_B}{r^2}$ /*Korrekte vervanging in formule:* $\frac{kQ_B}{r^2}$
- Addition/*Optel*
- Correct final answer/*Korrekte finale antwoord*: 0,94 m

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

$E_{net} = \frac{kQ_A}{r^2} + \frac{kQ_B}{r^2}$ ✓Anyone/*Enige een*

$7\,500$ ✓ $= \frac{9 \times 10^9 \times 1,86 \times 10^{-7}}{(0,005 + r)^2}$ ✓ ✓ $+ \frac{9 \times 10^9 \times 1,86 \times 10^{-7}}{(r)^2}$ ✓

$r = 0,94$ m ✓ (6)

[18]

QUESTION/*VRAAG* 8

8.1 **ANY ONE:**

- A conductor that does not change its resistance/conductance when temperature changes.✓✓
- V is always directly proportional to I at a constant temperature.✓✓
- A conductor for which the resistance remains constant at constant temperature when voltage or current changes.✓✓

ENIGE EEN:

- *'n Geleier waarvan die weerstand/geleidingsvermoë nie verander wanneer die temperatuur verander nie.*
- *V is altyd direk eweredig aan I by 'n konstante temperatuur.*
- *'n Geleier waarvan die weerstand konstant bly by 'n konstante temperatuur wanneer die potensiaalverskil of die stroom verander.* **(2 or/*of* 0)**

Note/*Nota*: If "obeys Ohms law"/*Indien "gehoorsaam Ohm se wet"*
Max/*Maks ½* (2)

8.2.1

Marking criteria/*Nasienkriteria*

- Any one of the formulae/*Enige een van die formules*
- Addition of 10 Ω and 12 Ω/*Optel van 10 Ω and 12 Ω*
- Correct whole substitution/*Hele substitusie korrek*
- Correct final answer/*Korrekte finale antwoord*: 8,56 Ω m

OPTION/*OPSIE* 1

$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓

$\frac{1}{R_E} = \frac{1}{R_1 + R_2} + \frac{1}{R}$

$\frac{1}{R_E} = \frac{1}{10 + 12}$ ✓ $+ \frac{1}{14}$ ✓

$R_E = 8{,}56\ \Omega$ ✓

OPTION/*OPSIE* 2

$R_p = \frac{R_1 \times R_2}{R_1 + R_2}$ ✓

$= \boxed{\frac{(10+12)\checkmark \times 14}{(10+12)+14}}$ ✓

$R_p = 8{,}56\ \Omega$ ✓

(4)

8.2.2

$V = IR$ ✓

$38 = I \times 22$ ✓

$I = 1{,}73$ A ✓

(3)

8.2.3

OPTION/*OPSIE* 1 **(POSITIVE MARKING FROM 8.2.1/ *POSITIEWE NASIEN VANAF 8.2.1*)**	**OPTION/*OPSIE* 2** **(POSITIVE MARKING FROM 8.2.1 and 8.2.2 *POSITIEWE NASIEN VANAF 8.2.1 en 8.2.2*)**
V = IR 38 = I x 8,56 ✓ I = 4,439 A Emf/*Emk* (ε) = I(R + r) ✓ = 4,439 (8,56 + 1,8) ✓ = 46 V ✓	V = IR 38 = I x 14 I = 2,71 A I_T = 2,71 + 1,73 ✓ I_T = 4,439 A Emf/*Emk* (ε) = I(R + r) ✓ = 4,439 (8,56 + 1,8) ✓ = 46 V ✓

(4)

8.3 Increase/*Toeneem* ✓ (1)

[14]

QUESTION/*VRAAG* 9

9.1 Mechanical to electrical energy./*Meganiese na elektriese energie*. ✓✓ (2)

9.2

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$f = \frac{1}{T}$ $= \frac{1}{0,02}$ ✓✓ = 50 Hz ✓	$f = \frac{\text{number of waves}}{\text{time}}$ /$f = \frac{\textit{aantal golwe}}{\textit{tyd}}$ $= \frac{1,25\ ✓}{0,025\ ✓}$ = 50 Hz ✓

(3)

9.3

Marking criteria/*Nasienriglyne*
If any of the underlined key words/phrases in the correct context is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.*

The AC potential difference which dissipates/produces the same amount of energy/heat as an equivalent direct current (DC) potential difference.✓✓/*Die wissel(WS) potensiaalverskil wat dieselfde hoeveelheid energie verbruik/oordra as 'n ekwivalente gelykstroom (GS) potensiaalverskil.* (2)

9.4.1

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

$= \frac{12,4}{\sqrt{2}}$ ✓

= 8,77 A ✓ (3)

9.4.2

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2** **POSITIVE MARKING FROM 9.4.1** ***POSITIEWE NASIEN VANAF 9.4.1***
$P_{ave/gem} = \frac{V_{max/maks} \times I_{max/maks}}{2}$ ✓ 900 ✓ $= \frac{V_{max/maks} \times 12,4}{2}$ ✓ $V_{max/maks}$ = 145,16 V ✓	$P_{ave/gem} = V_{rms/wgk} \times I_{rms/wgk}$ 900 = $V_{rms/wgk}$ x 8,77 ✓ $V_{rms/wgk}$ = 102,62 V $V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}}$ ✓ 102,62 $= \frac{V_{max/maks}}{\sqrt{2}}$ ✓ $V_{max/maks}$ = 145,13 V ✓ (Range/*Gebied*: 145,13 - 145,16 V)

(4)

[14]

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QUESTION/*VRAAG* 10

10.1 A packet of (light) energy. ✓✓*'n Pakkie (lig)energie.* **(2 or/*of* 0)** (2)

10.2.1
$E_{Kmax/maks} = ½ mv_{max/maks}^2$ ✓
$1,1 \times 10^{-12} = ½ 9,11 \times 10^{-31} v_{max/maks}^2$ ✓
$v_{max/maks} = 1,55 \times 10^9 \text{ m·s}^{-1}$ ✓ (3)

10.2.2
OPTION/*OPSIE* 1

$E = W_0 + E_{Kmax/maks}$ ✓

$E = \frac{hc}{\lambda_0} + E_{Kmax/maks}$

$2,1 \times 10^{-12}$ ✓ $= \frac{(6,63 \times 10^{-34}) \times (3 \times 10^8)}{\lambda_0}$ ✓ $+ 1,1 \times 10^{-12}$ ✓

$\lambda_0 = 1,99 \times 10^{-13}$ m ✓

OPTION/*OPSIE* 2

$E = W_0 + E_{Kmax/maks}$

$2,1 \times 10^{-12}$ ✓ $= W_0 + 1,1 \times 10^{-12}$ ✓ both ✓

$W_0 = \frac{hc}{\lambda_0}$

$W_0 = 1 \times 10^{-12}$

$1 \times 10^{-12} = \frac{(6,63 \times 10^{-34}) \times (3 \times 10^8)}{\lambda_0}$ ✓

$\lambda_0 = 1,99 \times 10^{-13}$ m ✓ (5)

10.3 Emission spectrum/*Emissie(spektrum)* ✓
Emission spectra are formed when certain frequencies of electromagnetic radiation are emitted✓due to an atom making a transition from a higher energy state to a lower energy state.✓
Emissiespektra word gevorm wanneer sekere frekwensies van elektromagnetiese strale uitgestraal word as gevolg van 'n atoom wat terug verander van 'n hoë energie na 'n lae energietoestand.
OF/*OR*
Atoms in a hot gas emit light at characteristic frequencies.✓The spectrum observed is a line spectrum with only a few coloured lines of frequencies unique to the type of atom that is producing the emission lines✓
Atome in 'n warm gas straal lig uit teen kenmerkende frekwensies. Die waargenome spektrum is 'n lynspektrum met net 'n paar gekleurde lyne in frekwensies uniek aan die tipe atoom wat die emissielyne produseer. (3)

[13]

TOTAL/TOTAAL: 148

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