basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

NOVEMBER 2018

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/*PUNTE*: 150

These marking guidelines consist of 29 pages.
Hierdie nasien riglyne bestaan uit 29 bladsye.

QUESTION 1/*VRAAG 1*

1.1 C /D✓✓ (2)

1.2 C ✓✓ (2)

1.3 C ✓✓ (2)

1.4 B ✓✓ (2)

1.5 B ✓✓ (2)

1.6 A ✓✓ (2)

1.7 A ✓✓ (2)

1.8 D ✓✓ (2)

1.9 D ✓✓ (2)

1.10 C ✓✓ (2)

[20]

QUESTION 2/*VRAAG 2*

2.1

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

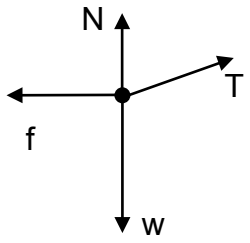
OR/*OF*
The (non-zero) resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force. ✓✓ (2 or 0)
Die (nie-nul) netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum.

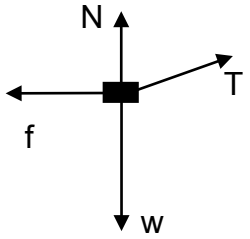
ACCEPT/*AANVAAR*
Acceleration is directly proportional to the net force and inversely proportional to the mass of the object.
Versnelling direk eweredig is aan die netto krag en omgekeerd eweredig aan die massa van die voorwerp.

NOTE/*LET WEL*
If any of the underlined key words in the **correct context** is omitted deduct 1 mark.
*Indien enige van die onderstreepte sleutel woorde in die **korrekte konte**ks uitgelaat is, trek 1 punt af.*

(2)

2.2





Notes/*Aantekeninge*
- Mark is awarded for label and arrow
  Punt word toegeken vir byskrif en pyltjie
- Do not penalise for length of arrows
  Moenie vir die lengte van die pyltjies penaliseer nie.
- If T is not shown but $T_{||}$ and $T\perp$ are shown, give 1 mark for both
  Indien T nie aangetoon is nie maat $T_{||}$ en $T\perp$ is getoon. Ken 1 punt toe vir beide.
- If force(s) do not make contact with body/*Indien krag(te) nie met die voorwerp kontak maak nie:* Max/*Maks:* $\frac{3}{4}$
- Deduct 1 mark for any additional force /*Trek 1 punt af vir enige addisionele krag*

(4)

	Accept the following symbols /*Aanvaar die volgende simbole.*
N	F_N; Normal;Normal force /*Normaal; Normaalkrag* ✓
f	F_f / f_k / frictional force/*wrywingskag*/kinetic frictional force/ *kinetiese wrywingskrag*✓
w	F_g; mg; Weight;$F_{Earth\ on\ block}$;Fw / G*ewig* ;Gravitational force / *Gravitasiekrag*/ 78,4 N✓
T	Tension/*Spanning*; F_T /F_A, F /16,96 N ✓

2.3.1 The 2/8 kg block /system is accelerating/*Die 2/8 kg blok / sisteem is besig om te versnel* ✓

OR/*OF*
The acceleration is not zero / a ≠ 0 ($m \cdot s^{-2}$) / a = 1,32 $m.s^{-2}$ / *Die versnelling is nie nul nie* ✓

OR/*OF*
Velocity is /increasing/changing/not constant/*Snelheid neem toe/ verander/is nie konstant nie* ✓

OR/*OF*
F_{net} is not equal to zero /F_{net} *is nie gelyk aan nul nie* / F_{net} ≠ 0 (N) ✓

OR/*OF*
The acceleration is changing / *Die versnelling verander* ✓

Accept/Aanvaar
An unbalanced force is acting on it / *'n Ongebalanseerde krag werk in op die liggaam* ✓ (1)

2.3.2 **For 2 kg/*Vir die 2 kg massa***

F_{net} = ma
mg -T= ma } ✓ 1 mark for any / *1 punt vir*
(2)(9,8) – T = 2(1,32) ✓
T = 16,96 N ✓

F_{net} = ma
mg + T = ma
(2)(-9,8) + T = 2(-1,32) ✓
T = 16,96 N ✓ (3)

2.3.3 **POSITIVE MARKING FROM 2.3.2/*POSITIEWE NASIEN VANAF 2.3.2***

F_{net} = ma
$T\cos15^o$ - f = ma } ✓

$T_x = T\cos15^o$
= 16,96 $\cos15^o$
= 16,38 N (16,382 N)

16,382 – f ✓ = (8)(1,32) ✓
f = 5,82 N (to the left/*na links*) ✓

OR/*OF*

$F_{net} = ma$
$T\cos15^o + f = ma$ ✓

$T_x = T\cos15^o$
$= 16{,}96\cos15^o$
$= 16{,}38$ N (16,382 N)

$-16{,}382 + f$ ✓ = $(8)(-1{,}32)$ ✓
$f = 5{,}82$ N (to the left/*na links*) ✓ (4)

2.4 **ANY ONE/*ENIGE EEN***
Normal force changes/decreases ✓/*Normaalkrag verander/neem af*
The angle (between string and horizontal) changes/increases. /*Die hoek (tussen die toutjie en die horisontaal) verander/neem toe*
The vertical component of the tension changes/increases/*Die vertikale komponent van die spanning verander / neem toe.* (1)

2.5 Yes✓/*Ja*
The frictional force (coefficient of friction) depends on the nature of the surfaces in contact. ✓
Die wrywingskrag (wrywingskoëffisiënt) is afhanklik van die aard van die oppervlaktes in kontak met mekaar.

ACCEPT/*AANVAAR*
The nature of the surface changes / μ_k changes
Die aard van die oppervlakte verander / μ_k *verander* (2)

[17]

QUESTION 3/*VRAAG 3*

3.1

Downwards/*Afwaarts* ✓

The only force acting on the object is the gravitational force/weight which acts downwards.✓/*Die enigste krag wat op die voorwerp inwerk is die gravitasiekrag/gewig wat afwaarts inwerk.*

ACCEPT/*AANVAAR*:
The only force acting is gravitational/weight.✓/*Die enigste krag wat inwerk is gravitasie/gewig*

OR/*OF*
Gravitational force/weight acts downwards.✓/*Gravitasiekrag/gewig werk afwaarts*

OR/*OF*
The ball is in free-fall / *Die bal in vry-val* ✓

OR/OF
(Gravitational) acceleration is downwards/(*Gravitasionele) versnelling is afwaarts* (2)

3.2

OPTION 1/*OPSIE 1*
Upward positive/*Opwaarts positief*
$v_f = v_i + a\Delta t$ ✓
$0 = 7,5 + (-9,8)\Delta t$ ✓
$\Delta t = 0,77$ s ✓

Downward positive/*Afwaarts positief*
$v_f = v_i + a\Delta t$ ✓
$0 = -7,5 + (9,8)\Delta t$ ✓
$\Delta t = 0,77$ s ✓

OPTION 2/*OPSIE 2*
Upward positive
Opwaarts positief
At highest point v_f is zero
By hoogste punt is v_f nul
$v_f^2 = v_i^2 + 2a\Delta y$
$0 = (7,5)^2 + (2)(-9,8)\Delta y$
$\Delta y = 2,87$ (2,869) m

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$2,87 = \frac{7,5 + 0}{2}\ \Delta t$ ✓

$\Delta t = 0,77$ s✓

OPTION 2/OPSIE 2
Downward positive
Afwaarts positief
At highest point v_f is zero
By hoogste punt is v_f nul
$v_f^2 = v_i^2 + 2a\Delta y$
$0 = (-7,5)^2 + (2)(9,8)\Delta y$
$\Delta y = -2,87$ (-2,869) m

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$-2,87 = \frac{-7,5 + 0}{2}\ \Delta t$ ✓

$\Delta t = 0,77$ s✓

OPTION 3/*OPSIE 3* **Upward positive** ***Opwaarts positief***	**OPTION 3/OPSIE 3** **Downward positive** ***Afwaarts positief***
$F_{net}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $(-9,8)\Delta t = 0 - 7,5$ ✓ $\therefore \Delta t = 0,76531$ s (0,77 s) ✓	$F_{net}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $(9,8)\Delta t = 0 - (-7,5)$ ✓ $\therefore \Delta t = 0,76531$ s (0,77 s)✓

OPTION 4/*OPSIE 4* **Upward positive** ***Opwaarts positief***	**OPTION 4/*OPSIE 4*** **Downward positive** ***Afwaarts positief***
(Top to Bottom / *Bo na onder*) $v_f = v_i + a\Delta t$ ✓ $-7,5 = 0 + (-9,8)\Delta t$ ✓ $\therefore \Delta t = 0,76531$ s (0,77 s) ✓	(Top to Bottom /*Bo na onder*) $v_f = v_i + \Delta t$ ✓ $7,5 = 0 + (9,8)\Delta t$✓ $\therefore \Delta t = 0,76531$ s (0,77 s) ✓

OPTION 5/*OPSIE 5* **Upward positive** ***Opwaarts positief***	**OPTION 5/*OPSIE 5*** **Downward positive** ***Afwaarts positief***
(Top to Bottom/ *Bo na onder*) $v_f^2 = v_i^2 + 2a\Delta y$ $(7,5)^2 = (0)^2 + 2(-9,8)\Delta y$ $\Delta y = -2,87$ m $\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓ $-2,87 = (0)\Delta t + ½ (-9,8)(\Delta t)^2$ ✓ $\Delta t = 0,765$ s ✓	(Top to Bottom / *Bo na onder*) $v_f^2 = v_i^2 + 2a\Delta y$ $(7,5)^2 = (0)^2 + 2(9,8)\Delta y$ $\Delta y = 2,87$ m $\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓ $2,87 = (0)\Delta t + ½ (9,8)\Delta t^2$ ✓ $\Delta t = 0,765$ s ✓

(3)

NOTES for marking QUESTION 3.3 ***AANTEKENINGE vir merk van VRAAG 3.3***	
Formula mark/*Formule punt*	✓
Substitution mark /*Vervangingspunt*	✓✓
Mark for height/distance / *Punt vir hoogte/afstand*	✓
Mark for comparison/*Punt vir vergelyking*	✓
Mark for conclusion/*Punt vir gevolgtrekking*	✓

3.3

OPTION 1/*OPSIE 1*

Upward positive/*Opwaarts positief*

At highest point v_f is zero/*By hoogste punt is v_f nul*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

0✓ = $(7,5)^2$ + (2)(-9,8)Δy ✓

Δy = 2,87 (2,869) m✓

This is higher than height needed to reach point **T** (2,1 m)✓therefore the ball will pass point **T**.✓

*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) te bereik dus sal die bal punt **T** verbygaan.*

Downward positive/*Afwaarts positief*

At highest point v_f is zero/*By hoogste punt is v_f nul*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

0✓ = $(-7,5)^2$ + (2)(9,8)Δy✓

Δy = - 2,87 (-2,869) m✓

This is higher than height needed to reach point **T** (2,1 m)✓therefore the ball will pass the target. ✓

*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) te bereik dus sal die bal punt **T** verbygaan.*

OPTION 2/*OPSIE 2* (POSITIVE MARKING FROM 3.2)

Upward positive/*Opwaarts positief*

$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓

$\Delta y = (7,5)(0,77)$ ✓ + ½ $(-9,8)(0,77)^2$✓

Δy = 2,87 m (2,86 m)✓

This is higher than height needed to reach point **T** (2,1 m)✓therefore the ball will pass point **T**. ✓

*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) te bereik dus sal die bal punt **T** verbygaan.*

Downward positive/*Afwaarts positief*

$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓

$\Delta y = (-7,5)(0,77)$ ✓ + ½ $(9,8)(0,77)^2$✓

Δy = -2,87 m (2,869 m)✓

This is higher than the height needed to reach point **T** (2,1 m)✓therefore the ball will pass point **T**. ✓

*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) te bereik dus sal die bal punt **T** verbygaan.*

OPTION 3/*OPSIE 3*

$(E_{mech})_{Top/Bo} = (E_{mech})_{Ground/Grond}$
$(E_P + E_K)_{Top} = (E_P + E_K)_{Bottom/Onder}$
$(mgh + ½ mv^2)_{Top/Bo} = (mgh + ½ mv^2)_{Bottom/Onder}$

1 mark for any
1 punt vir enige

$(9,8)(h) + 0$ ✓$= \underline{0 + (½)(7,5)^2}$ ✓
h = 2,87 m (2,869 m)✓

This is higher than height needed to pass the target (2,1 m)✓<u>therefore the ball will pass the target</u>.✓
*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) verby te gaan dus sal die bal punt **T** verbygaan.*

OPTION 4/*OPSIE 4*

$W_{net} = \Delta E_K$
$mg\Delta x\cos\theta = ½ mv_f^2 - ½ mv_i^2$ ✓
$\underline{(9,8)\Delta x\cos 180^o}$✓ $= \underline{0 - ½(7,5)^2}$✓
Δx = 2,87 m (2,869 m)✓

This is higher than point height needed to pass point **T** (2,1 m)✓<u>therefore the ball will pass point **T**</u>. ✓
*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) verby te gaan dus sal die bal punt **T** verbygaan.*

OPTION 5/*OPSIE 5*

Upward positive/*Opwaarts positief*

If the highest point is y_f then $\Delta y = (y_f - y_{1,6})$ At highest point v_f is zero
Indien die hoogste punt y_f is, dan is $\Delta y = (y_f - y_{1,6})$. *By hoogste punt is v_f* nul
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
0✓ $= [\underline{(7,5)^2 + (2)(-9,8)}(y_f - 1,6)]$✓
y_f = 4,47 (4,469) m✓

Yes ✓✓
OR/*OF*
This point (4,47m) is higher than point **T** ✓✓ (or even the required height of 2,1 m) therefore the ball will pass point **T**.
Ja ✓✓
*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) te bereik dus sal die bal punt **T** verbygaan.*

Downward positive/*Afwaarts positief*

If the highest point is y_f then $\Delta y = (y_f - y_{1,6})$ At highest point v_f is zero
Indien die hoogste punt y_f is, dan is $\Delta y = (y_f - y_{1,6})$. *By hoogste punt is v_f* nul
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
0✓ $= [\underline{(-7,5)^2 + (2)(9,8)}\{y_f - (-1,6)\}]$ ✓
y_f = -4,47 (-4,469) m✓
height is/*hoogte is* 4,47 m.
This point (4,47 m) is higher than point **T**✓✓ (or even the required height of 2,1 m) <u>therefore the ball will pass point **T**</u>.
*Hierdie punt (4,47 m) is hoer as punt **T** (of selfs die benodigde hoogte van 2,1 m) dus sal die bal punt **T** verbygaan.*

OPTION 6/*OPSIE 6* (POSITIVE MARKING FROM 3.2)

Upward positive/*Opwaarts positief*

If the highest point is y_f then $\Delta y = (y_f - y_{1,6})$ At highest point v_f is zero
Indien die hoogste punt y_f is, dan is $\Delta y = (y_f - y_{1,6})$. By hoogste punt is v_f nul

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$(y_f - 1,6) = (7,5)(0,77)$ ✓ + ½ $(-9,8)(0,77)^2$ ✓
y_f = 4,47 m (4,469 m) ✓

This point (4,47m) is higher than point **T** ✓✓ (or even the required height of 2,1 m) therefore the ball will pass point **T**.
*Hierdie punt (4,47 m) is hoer as punt **T** (of selfs die benodigde hoogte van 2,1 m) dus sal die bal punt **T** verbygaan.*

Downward positive/*Afwaarts positief*

If the highest point is y_f then $\Delta y = (y_f - y_{1,6})$ At highest point v_f is zero
Indien die hoogste punt y_f is, dan is $\Delta y = (y_f - y_{1,6})$. By hoogste punt is v_f nul

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$\{y_f - (-1,6)\} = (-7,5)(0,765)$ ✓ + ½ $(9,8)(0,765)^2$ ✓
y_f = -4,47 m (-4,469 m) ✓

This point (4,47m) is higher than point T✓✓ (or even the required height of (2,1m) therefore the ball will pass point **T.**
*Hierdie punt (4,47 m) is hoer as punt **T** (of selfs die benodigde hoogte van 2,1 m) dus sal die bal punt **T** verbygaan.*

OPTION 7/*OPSIE 7* (POSITIVE MARKING FROM 3.2)

Upward positive/*Opwaarts positief*

$$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t \quad ✓$$
$$= \left(\frac{0 + 7,5}{2}\right)(0,77) \quad ✓✓$$
= 2,89 m ✓

This is higher than height needed to pass the target (2,1 m) ✓ therefore the ball will pass the target. ✓
Dit is hoer as die hoogte benodig om die teiken verby te gaan (2,1 m) dus sal die bal die teiken verbygaan.

OPTION 7/*OPSIE 7* (POSITIVE MARKING FROM 3.2

Downward positive/*Afwaarts positief*

$$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t \quad ✓$$
$$= \frac{0 - 7,5}{2}\ (0,77) \quad ✓✓$$
= -2,89 m ✓

Height /*Hoogte* is 2,89m
This is higher than height needed to pass the target (2,1 m) ✓ therefore the ball will pass the target. ✓
Dit is hoer as die hoogte benodig om die teiken verby te gaan (2,1 m) dus sal die bal die teiken verbygaan.

OPTION 8/*OPSIE 8*

Upward positive/*Opwaarts positief*

At highest point v_f is zero/*By hoogste punt is v_f nul*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

0✓ $= v_i^2 - (2)(9,8)(2,1)$ ✓

$v_i = 6,42\ m\cdot s^{-1}$ ✓

This is the actual velocity needed to reach the target.

The given velocity is greater than the actual velocity needed. ✓

The ball will pass the target. ✓

Dit is die werklike snelheid benodig is om die teiken te bereik

Die gegewe snelheid is groter as die werklike snelheid benodig

Die bal sal die teiken verbygaan.

Downward positive/*Afwaarts positief*

At highest point v_f is zero

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

0✓ $= v_i^2 + (2)(9,8)(-2,1)$ ✓

$v_i = 6,42\ m\cdot s^{-1}$ ✓

This is the actual velocity needed to pass the target.

The given velocity is greater than the actual velocity needed. ✓

The ball will reach the target. ✓

Dit is die werklike snelheid benodig is om die teiken te verby te gaan.

Die gegewe snelheid is groter as die werklike snelheid benodig

Die bal sal die teiken verbygaan.

OPTION 9/*OPSIE 9*

$W_{nc} = \Delta E_p + \Delta E_k$ ✓

$0 = mgh_f - mgh_i + \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$

0 ✓$= \underline{(9,8)h_f} - (9,8)(1,6) + \frac{1}{2}\underline{(0)^2} - \frac{1}{2}\underline{(7,5)^2}$✓

$0 = (9,8)h_f - 43,805$

$\therefore h_f = 4,47\ m$ ✓

$\therefore$ The ball will pass point **T** ✓✓

*Die bal sal punt **T** verbygaan.*

OPTION 10/*OPSIE 10*
POSITIVE MARKING FROM 3.2 / POSITIEWE NASIEN VANAF 3.2
Upward positive/*Opwaarts positief*
Δt(max. height/*maks. hoogte*) = 0,77 s
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
2,1✓ = (7,5)Δt + ½ (-9,8)Δt^2 ✓
∴ Δt = 0,36 s ✓
∴ Δt (max height/*maks.hoogte*, 0,77 s) > Δt (to pass point **T**/ om **T** *verby te gaan,* 0,36 s) ✓
∴ The ball passed point **T** ✓
*Die bal het punt **T** verbygegaan.*
Downward positive/*Afwaarts positief*
Δt (max height) = 0,77 s
$\Delta y = v_i\Delta t + \frac{1}{2} a \Delta t^2$ ✓
2,1✓= (7,5)Δt + ½ (-9,8)Δt^2 ✓
∴ Δt = 0,36 s✓
∴ Δt (max height, 0,77 s) > Δt (to reach point T, 0,36 s) ✓
∴ The ball passed point **T** ✓
*Die bal het punt **T** verbygegaan*

OPTION 11/*OPSIE 11*
Upward positive/*Opwaarts positief*
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓
(3,7 – 1,6)✓ = 7,5 Δt + ½ (- 9,8) Δt^2 ✓
Δt = 0,375 s ✓
The time to pass point **T** is less than time to reach maximum height ✓. Ball will pass point **T**.✓
*Die tyd om punt **T** verby te gaan, is minder as tyd om maksimum hoogte te bereik.. Bal sal punt **T** verbygaan*

Downward positive/*Afwaarts positief*
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓
(3,7 – 1,6)✓ = -7,5 Δt + ½ (9,8) Δt^2 ✓
Δt = 0,375 s ✓
The time to reach point **T** is less than time to reach maximum height ✓. Ball will pass point **T**.✓
*Die tyd om punt **T** verby te gaan, is minder as tyd om maksimum hoogte te bereik.. Bal sal punt **T** verbygaan*

OPTION 12/*OPSIE 12*

Upward positive/*Opwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$v_f^2 = (7,5)^2$ ✓$+ 2(-9,8)(2,1)$ ✓

$v_f = 3,88\ m\cdot s^{-1}$ ✓

Velocity at **T** is $3,88\ m\cdot s^{-1}$ therefore the ball still moving towards its maximum height ✓✓

*Snelheid by **T** is 3,88 $\cdot m\cdot s^{-1}$ dus beweeg die bal steeds opwaarts na maksimum hoogte*

Downward positive/*Afwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

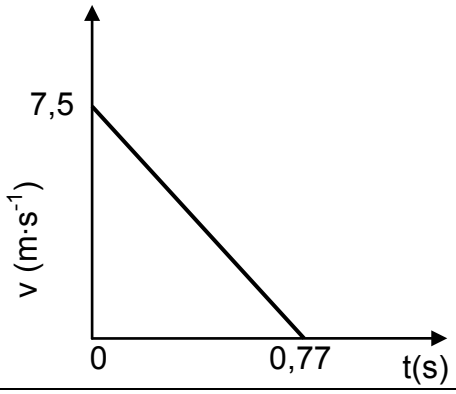
$v_f^2 = (-7,5)^2$ ✓$+ 2(9,8)(-2,1)$✓

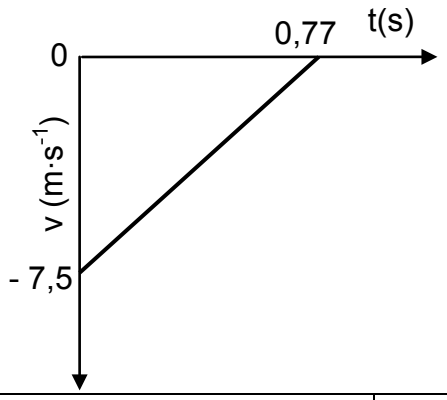
$v_f = -3,88\ m\cdot s^{-1}$✓

Velocity at **T** is $-3,88\ m\cdot s^{-1}$ therefore the ball is still moving towards its maximum height ✓✓

*Snelheid by **T** is -3,88 $\cdot m\cdot s^{-1}$ dus beweeg die bal steeds opwaarts na maksimum hoogte* (6)

3.4 **POSITIVE MARKING FROM 3.2 / *POSITIEWE NASIEN VANAF 3.2***





Notes/*Notas*:	
Initial velocity and time for final velocity shown *Beginsnelheid en tyd vir finale snelheid aangedui.*	✓
Correct straight line (including orientation) drawn *Korrekte reguitlyn (insluitend oriëntasie) geteken.*	✓

(2)
[13]

QUESTION 4/*VRAAG 4*

4.1 Momentum is the product of the mass of an object and its velocity ✓✓
Momentum is die produk van die massa van 'n voorwerp en sy snelheid.
[NOTE/LET WEL: 2 or/of 0] (2)

4.2 To the left/*Na links* ✓
Newton's third law/*Newton se derde wet* ✓

ACCEPT/*AANVAAR*:
Principle of conservation of linear momentum / law of action-reaction
Beginsel van behoud van lineêre momentum/wet van aksie-reaksie
Newton's third law **and** Newton's second law/*Newton se derde wet **en** Newton se tweede wet* (2)

NOTE: For QUESTION 4.3 and 4.4 motion to the right has been taken as positive. Candidates may use the opposite direction.
LET WEL: Vir VRAAG 4.3 en 4.4 word beweging na regs as positief geneem. Kandidate mag die teenoorgestelde rigting gebruik.

4.3

OPTION 1/*OPSIE 1*
$\sum p_i = \sum p_f$ ✓
$m_1v_{1i} + m_2v_{2i} = m_1v_{2f} + m_2v_{2f}$
mass of girl is m / *massa van meisie is m*

Allocate mark if 0 is substituted on left hand side/*Ken punt toe indien 0 aan linkerkant vervang is.*

$\{(m + 2)(0)\} + \{8(0)\}$✓ = $\{(m + 2)(-0,6)\}$✓ + (8)(4)✓
m = 51,33 kg ✓

N**OTE**: Penalise only once for the incorrect sign of the 0,6.
LET WEL: *Penaliseer slegs eenmaal die die inkorrekte teken van 0,6*

OPTION 2/*OPSIE 2*
$\sum p_i = \sum p_f$ ✓
$m_1v_{1i} + m_2v_{2i} = m_1v_{2f} + m_2v_{2f}$
$0 = m_1v_{1f} + m_2v_{2f}$
0✓ = (8)(4)✓+ m_2(-0,6) ✓
∴ m_2 = 53,33 kg
∴ m_{girl} = 53,33 – 2
∴ m_{girl} = 51,33 kg ✓

OPTION 3/*OPSIE 3*
$\Delta p_{girl} = -\Delta p_{parcel}$ ✓
$m(v_f – v_i) = -m(v_f – v_i)$
(m + 2)(-0,6 - 0) ✓ = – 8(4 – 0) ✓
m = 51,33 kg ✓

(5)

4.4

POSITIVE MARKING FROM 4.3/*POSITIEWE NASIEN VANAF 4.3*
Impulse = $\Delta p = m(v_f – v_i)$ ✓
= (51,33 + 2)(-0,6 – 0) ✓
= -32 N·s / kg·m·s^{-1}
Magnitude of impulse/*Grootte van die impuls* is 32 N·s /32 kg·m·s^{-1} ✓
OR/*OF*
Impulse = $\Delta p_{parcel/pakket} = m(v_f – v_i)$ ✓
Δp = (8)(4 – 0) ✓ = 32 kg m·s^{-1}
∴$\Delta p_{girl/meisie}$ = 32 kg m·s^{-1}✓

(3)

4.5

POSITIVE MARKING FROM 4.4 /*POSITIEWE NASIEN VANAF 4.4*
32 kg·m·s^{-1} / N·s ✓ to the right/opposite direction /*na regs /teenoorgestelde rigting*✓

(2)
[14]

QUESTION 5/*VRAAG 5*

5.1 A force is non-conservative if the work it does on an object which is moving between two points depends on the path taken.✓✓
'n Krag is nie-konserwatief indien die arbeid wat dit verrig op 'n voorwerp wat tussen twee punte beweeg van die pad afhang.
OR/*OF*
A force is non-conservative if the work it does on an object depends on the path taken.✓✓
'n Krag is nie-konserwatief indien die arbeid wat dit verrig afhang van die pad wat dit neem.

OR/*OF*
A force is non-conservative if the work it does in moving an object around a closed path is non-zero ✓✓
'n Krag is nie-konserwatief indien die arbeid wat dit verrig om 'n voorwerp op 'n geslote pad te beweeg nie-nul is. (2)

NOTE/*LET WEL*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark. If the word work is omitted 0 marks
*Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af. Indien die woord arbeid uitgelaat is 0 punte.*

5.2 No/*Nee* ✓ (1)

5.3

OPTION 1/ *OPSIE 1*

$P = \frac{W}{\Delta t}$ ✓

$= \frac{4{,}8\times10^{6}}{(90)}$ ✓

$= 53\,333{,}33$ W

$= 5{,}33 \times 10^{4}$ W (53,33 kW) ✓

OPTION 2/*OPSIE 2*

$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$

$= \left(\frac{0 + 25}{2}\right)(90)$

$= 1\,125$ m

$W_F = F\Delta x\cos\theta$

$4{,}80 \times 10^{6} = F(1\,125)\cos0^{o}$

$F = 4\,266{,}667$ N

$P_{ave} = Fv_{ave}$ ✓

$= (4\,266{,}667)(12{,}5)$ ✓

$= 53\,333,33$ W ✓ (3)

5.4 The net/total work done on an object is equal to the change in the object's kinetic energy✓✓
Die netto/totale arbeid verrig op 'n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie.
OR/*OF*
The work done on an object by a net force ✓is equal to the change in the object's kinetic energy. ✓
Die arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie. (2)

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

5.5

OPTION 1/*OPSIE 1*

$W_{net} = \Delta K$✓
$W_w + W_f + W_F = ½ mv_f^2 - ½ mv_i^2$
$mg\Delta x\cos\theta + W_f + W_F = ½ mv_f^2 - ½ mv_i^2$
$(1\ 500)(9,8)200\cos180^o$✓ + $W_f + 4,8 \times 10^6$ ✓= ½ $(1\ 500)(25^2 – 0)$ ✓
$-2\ 940\ 000 + W_f + 4,8 \times 10^6 = 468\ 750$
$W_f = -1\ 391\ 250$ J
$= -1,39 \times 10^6$ J✓

OR/OF

$W_{net} = \Delta K$✓
$W_w + W_f + W_F = ½ mv_f^2 - ½ mv_i^2$
$-\Delta Ep + W_f + W_F = ½ mv_f^2 - ½ mv_i^2$
$-(1\ 500)(9,8)(200 – 0)$✓ + $W_f + 4,8 \times 10^6$ ✓= ½ $(1\ 500)(25^2 – 0)$ ✓
$-2\ 940\ 000 + W_f + 4,8 \times 10^6 = 468\ 750$
$W_f = -1\ 391\ 250$ J
$= -1,39 \times 10^6$ J ✓ (5)

NOTE/*LET WEL*
0 can be omitted in above substitutions.
0 kan in bogenoemde vervangings weggelaat word.

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = ½ mv_f^2 - ½ mv_i^2 + mgh_f - mgh_i$ ✓
$= ½ m (v_f^2 - v_i^2) + mg(h_f - h_i)$
$W_{nc} = ½ mv_f^2 + mgh_f - ½ mv_i^2 - mgh_i$

1 mark for any of these/
1 punt vir enige van hierdie

$W_f + W_F = ½ mv_f^2 - ½ mv_i^2 + mgh_f - mgh_i$
$W_f + 4,8 \times 10^6$ ✓$= [½ (1\ 500)(25)^2 + -0]$ ✓$+[(1\ 500)(9,8)(200) - 0]$✓
$W_f = - 1,39 \times 10^6$ J $(-1,40 \times 10^6$J)✓

OR/*OF*

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = ½ mv_f^2 - ½ mv_i^2 + mgh_f - mgh_i$ ✓
$= ½ m (v_f^2 - v_i^2) + mg(h_f - h_i)$
$W_{nc} = ½ mv_f^2 + mgh_f - ½ mv_i^2 - mgh_i$

1 mark for any of these/
1 punt vir enige van hierdie

$W_f + 4,8 \times 10^6$ ✓$= [½ (1500)(25)^2$ ✓$+ (1500)(9,8)(200)$✓$] - [0 + 0]$
$W_f = - 4,8 \times 10^6 + 3,4 \times 10^6$
$= - 1,39 \times 10^6$ J $(-1,40 \times 10^6$J)✓

(5)

ACCEPT THE FOLLOWING FOR: /*AANVAAR DIE VOLGENDE VIR* : $(3/5)$

POSITIVE MARKING FROM 5.3/*POSITIEWE NASIEN VANAF 5.3*

$v_f = v_i + a\Delta t$
$25 = 0 + a(90)$
$a = 0,277\ldots m \cdot s^{-2}$

$F_{net} = ma$
$=(1\ 500)(0,2777\ldots) = 416,66\ldots$ N

$F + (w_{||}) + (-f_k) = 416,666\ldots$
$4\ 266,6667 – 1\ 500(9,8)\sin\theta - f_k = 416,666\ldots$
$f_k = 1\ 236,6667$ N

$W_f = f_k \Delta x \cos\theta$ ✓
$= (1\ 236,6667)(1\ 125)(\cos 180°)$✓
$= - 1\ 391\ 250$ J ✓

(5)
[13]

QUESTION 6/*VRAAG 6*

6.1 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. ✓✓
Die verandering in frekwensie (of toonhoogte) (golflengte) van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klank voortplanting het.

OR/*OF*
An (apparent) change in observed/detected frequency (pitch), as a result of the relative motion between a source and an observer ✓✓ (listener).
'n (Skynbare) verandering in waargenome frekwensie (toonhoogte),(golflengte) as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar (2)

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

6.2 Away from/*Weg vanaf* ✓
Observed frequency lower/*Waargenome frekwensie is laer* ✓ (2)

6.3
$v = f\lambda$ ✓
$340 = f\,(0{,}34)$ ✓
$f = 1\,000$ Hz ✓ (3)

6.4 **POSITIVE MARKING FROM 6.3/*POSITIEWE NASIEN VANAF 6.3***

$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓ **OR/*OF*** $f_L = \frac{v - v_L}{v} f_s$

$950 \overset{\checkmark}{=} \left(\frac{340 - v_L}{340 + 0}\right)^{\checkmark} 1\,000$ ✓

$v_L = 17\ m \cdot s^{-1}$

distance/*afstand* x = vΔt
= (17)(10) ✓
= 170 m ✓

OR/*OF*

$f_L = \frac{v - v_L}{v} f_s$ ✓

$950 \overset{\checkmark}{=} \left(\frac{340 - x}{340 + 0}\right)^{\checkmark} (1000)^{\checkmark}$

distance/*afstand* x = 170 m ✓

ACCEPT/*AANVAAR*

$v_L = \Delta f\lambda$ ✓
$= (50)$✓✓$(0{,}34)$✓
$= 17\ m\cdot s^{-1}$

distance/*afstand* $x = v\Delta t$
$= (17)(10)$ ✓
$= 170$ m ✓

(6)

[13]

QUESTION 7/*VRAAG 7*

7.1

$$Q_{net/netto} = \frac{Q_1 + Q_2 + Q_3}{3}$$

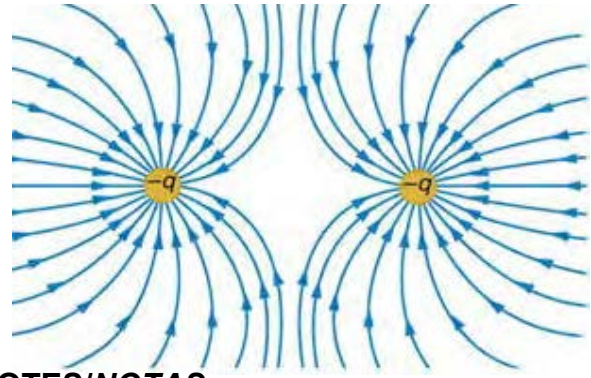
$$-3 \times 10^{-9} = \frac{-15\times10^{-9} + Q + 2\times10^{-9}}{3}$$ ✓

$Q = +4 \times 10^{-9}$ C✓

NOTE/*LET WEL*
✓ for addition of the three correct charges
✓ correct answer

(2)

7.2



NOTES/*NOTAS*
Correct shape /*Korrekte vorm* ✓
Correct direction/*Korrekte rigting* ✓
Lines must not cross and must touch spheres ✓
Lyne moet nie kruis nie en moet die sfere raak

(3)

7.3 The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) <u>is directly proportional to the product of the (magnitudes) of the charges</u> and <u>inversely proportional to the square of the distance (r) between them</u> ✓✓
Die grootte van die elektrostatiese krag uitgeoefen deur een puntlading (Q_1) op 'n ander puntlading (Q_2) <u>is direk eweredig aan die produk van die (groottes) van die ladings en omgekeerde eweredig aam die kwadraat van die afstand (r) tussen hulle.</u>

(2)

NOTE/*LET WEL*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark. If masses used (0/2)
*Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af. Indien massas gebruik word, (0/2)*

7.4

OPTION 1/*OPSIE 1*

$F = \frac{kQ_1Q_2}{r^2}$ ✓

$F_{SP} = \frac{(9\times10^9)(3\times10^{-9})(3\times10^{-9})}{(0,1)^2}$ ✓

= 8,1 x 10^{-6} N downwards/*afwaarts*

$F_{TP} = \frac{(9\times10^9)(3\times10^{-9})(3\times10^{-9})}{(0,3)^2}$ ✓

= 9 x 10^{-7} N left/*links* (0,9 X 10^{-6} N to the left/*na links*

$F_{net}^2 = (F_{SP})^2 + (F_{TP})^2$

$F_{net} = \sqrt{(F_{SP})^2 + (F_{TP})^2}$ ✓ for either

$F_{net} = \sqrt{(8,1\times10^{-6})^2 + (0,9\times10^{-6})^2}$

F_{net} = 8,15 x 10^{-6} N ✓

OPTION 2/*OPSIE 2*

$E_s = \frac{kQ}{r^2}$ ✓

$= \frac{(9\times10^9)(3\times10^{-9})}{(0,1)^2}$

= 2 700 N.C^{-1}

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

$= \frac{(9\times10^9)(3\times10^{-9})}{(0,3)^2}$ ✓ both substitutions *beide vervangings*

= 300 N.C^{-1}

$E_{net} = \sqrt{E_S^2 + E_T^2}$

$= \sqrt{(2700)^2 + (30)^2}$ ✓

= 2 716,62 N.C^{-1}

F = Eq

= (2 716,62)(3 x 10^{-9}) ✓

= 8,15 x 10^{-6} N ✓ (5)

7.5

POSITIVE MARKING FROM 7.4 / *POSITIEWE NASIEN VANAF 7.4*

OPTION 1/*OPSIE 1*

$E = \frac{F}{q}$ ✓

$= \frac{8,15\times10^{-6}}{3\times10^{-9}}$ ✓

= 2,72 x 10^3 N.C^{-1} ✓ (3)

OPTION 2/*OPSIE 2*

$E_s = \frac{kQ}{r^2}$ ✓

$= \frac{(9\times10^{9})(3\times10^{-9})}{(0,1)^2}$ ✓

$= 2\ 700\ N.C^{-1}$

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

$= \frac{(9\times10^{9})(3\times10^{-9})}{(0,3)^2}$ ✓

$= 300\ N.C^{-1}$

$E_{net} = \sqrt{E_S^2 + E_T^2}$

$= \sqrt{(2700)^2 + (30)^2}$

$= 2\ 716,62\ N.C^{-1}$ ✓

NOTE/*LET WEL*
Mark Allocation/*Puntetoekenning*
✓ correct formula/*korrekte formula*
✓ both subsitutions/*beide vervangings*
✓ correct answer/*korrekte antwoord*
If calculation done in 7.4 award full marks for answer written here. / *Indien berekening in 7.4 gedoen is, moet volle punte vir die antwoord wat hier geskryf is, toegeken word.*

7.6.1 Sphere/*Sfeer* P or/*of* T✓ (1)

7.6.2 **SPHERE P/*SFEER P***

$n_e = \frac{Q}{q_e}$ or/*of* $n_e = \frac{Q}{e}$

$= \frac{-15\times10^{-9}}{-1,6\times10^{-19}}$ ✓ $= 9,38 \times 10^{10}$

mass gained/*massa gewin* = $n_e m_e$
m gained /*gewin*= $(9,38 \times 10^{10})(9,11 \times 10^{-31})$✓
$= 8,55 \times 10^{-20}$ kg ✓

SPHERE T/*SFEER T*

$n_e = \frac{Q}{q_e}$ or/*of* $n_e = \frac{Q}{e}$

$= \frac{-5\times10^{-9}}{-1,6\times10^{-19}}$ ✓ $= 3,125 \times 10^{10}$

mass gained/*massa gewin* = $n_e m_e$
m gained /*gewin*= $(3,125 \times 10^{10})(9,11 \times 10^{-31})$✓
$= 2,85 \times 10^{-20}$ kg ✓ (3)

[19]

QUESTION 8/*VRAAG 8*

8.1 The battery supplies 12 J per coulomb/12 J per unit charge. ✓✓
Die battery verskaf 12 J per coulomb lading

OR /*OF*
The potential difference of the battery in an open circuit is 12 V. ✓✓
Die potensiaal verskil van die battery in 'n oop stroombaan is 12 V

OR/*OF*
The battery does 12 J of work per coulomb of charge.✓✓
Die battery verrig 12 J arbeid per coulomb lading

OR/*OF*
Maximum work done by the battery per unit charge is 12 J
Maksimum arbeid verrig deur die battery per eenheidslading is 12 J

OR/*OF*
Maximum energy supplied by the battery per unit charge is 12 J
Maksimum energie verskaf deur die battery per eenheidslading is 12 J

OR/*OF*
The battery supplies 12 J of energy per coulomb/ 12 J of energy per unit charge
Die battery verskaf 12 J energie per coulomb/12 J energie per eenheidslading

OR/*OF*
The greatest potential difference that can be generated by a battery is 12V
Die grootste potensiaalveskil wat deur 'n battery gelewer word, is 12 V

OR/*OF*
The total energy transferred by a battery to a unit electric charge is 12 J
Die totale energie oorgedra deur die battery aan 'n eenheid elektriese lading is 12 J

OR/*OF*
The total amount of electric energy supplied by the battery per coulomb/per unit charge is 12 J
Die totale hoeveelheid elektriese energie verskaf deur die battery per coulomb/per eenheid lading is 12 J (2)

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

8.2.1

OPTION 1/*OPSIE 1*

$V_{lost/verlore}$ = I r ✓
= (2) (0,5)
= 1 V

$V_{ext/eks}$ = Emf/*emk* – $V_{lost/verlore}$
= (12 - 1) ✓
= 11 V✓

OPTION 2/*OPSIE 2*
$\varepsilon = I(R + r)$ ✓
$12 = V_{ext/eks} + (2)(0,5)$ ✓
$V_{ext/eks} = 11$ V✓

OPTION 3/*OPSIE 3*
$\varepsilon = I(R + r)$ ✓
$12 = 2(R + 0,5)$
$R = 5,5\ \Omega$
$V = IR$
$= 2(5,5)$✓
$= 11$ V ✓

(3)

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

OPTION 1/*OPSIE 1*
$R = \frac{V}{I}$
$= \frac{11}{2}$ ✓
$= 5,5\ \Omega$✓

OPTION 2/*OPSIE 2*
0,5:R
1:11 } ✓
$R = 5,5\ \Omega$✓

OPTION 3/*OPSIE 3*
$\frac{1}{0,5} = \frac{11}{R}$ ✓
$R = 5,5\ \Omega$✓

OPTION 4/*OPSIE 4*
$V_{total} = IR_{total}$
$12 = (2)R_{total}$
$R_{total} = 6\ \Omega$
$R = 6 - 0,5$ ✓
$= 5,5\ \Omega$ ✓

OPTION 5/*OPSIE 5*
$\varepsilon = I(R + r)$
$12 = 2(R + 0,5)$ ✓
$R = 5,5\ \Omega$ ✓

(2)

8.3 Decreases /*Neem af* ✓
Total resistance decreases /*Totale weerstand neem af*✓
Current increases/*Stroom neem toe* ✓
"Lost volts" increases, ✓(emf the same)/*"Verlore volts" neem toe, (emk dieselfde)*
External potential difference decreases/*eksterne potensiaal verskil neem af*

OR/*OF*
Decreases /*Neem af* ✓
Total resistance decreases /*Totale weerstand neem af* ✓
Current increases/*Stroom neem toe* ✓
$\varepsilon = V_{ext/eks} + Ir$
Ir increases/*Ir neem toe* ✓
ε is constant/*is konstant*
$\therefore V_{ext/eks}$ decreases/*neem af* (4)
[11]

QUESTION 9/*VRAAG 9*

9.1 Temperature/*Temperatuur* ✓ (1)

9.2.1 *r* = 3 Ω or/*of* 1,5 Ω ✓✓

Accept *for one mark only*: /*Aanvaar vir slegs een punt*
r = -3 Ω ✓ or/of -1,5 Ω (2)

9.2.2 ε = slope (gradient) of the graph/*helling(gradiënt)van die grafiek* ✓

$\varepsilon = \frac{7,5-(-3)}{1,5-0}$ ✓
= 7 V✓

Accept any correct values from the graph
Aanvaar enige korrekte waardes vanaf die grafiek

OR/*OF*
POSITIVE MARKING FROM 9.2.1 / *POSITIEWE NASIEN VANAF 9.2.1*

$R = \frac{\varepsilon}{I} - r$ ✓
$7,5 = 1,5\varepsilon - 3$ ✓
ε = 7 V ✓

Accept any correct values on the line from the graph
Aanvaar enige korrekte waardes op die lyn vanaf die grafiek

OR/OF
ε = I(R + r) ✓
= 0,5(11 + 3) ✓
ε = 7 V ✓ (3)
[6]

QUESTION 10/*VRAAG 10*

10.1.1 Y to/*na* X ✓ (1)

10.1.2 Faraday's Law Electromagnetic Induction ✓
Faraday se wet van Elektromagnetiese Induksie

OR/OF
Electromagnetic induction/Faraday's Law✓
Elektromagnetiese induksie/Faraday se wet (1)

10.1.3 Mechanical (kinetic) energy ✓to electrical energy ✓
Meganiese (kinetiese) energie na elektriese energie (2)

10.2.1 340 V ✓

Accept / Aanvaar
-340 V (1)

10.2.2

POSITIVE MARKING FROM 10.2.1/*POSITIEWE NASIEN VANAF 10.2.1*

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

$= \frac{340}{\sqrt{2}}$ ✓

$V_{rms/wgk}$ = 240,42 V ✓ (3)

10.2.3

POSITIVE MARKING FROM 10.2.2 / *POSITIEWE NASIEN VANAF 10.2.3*

<u>OPTION 1/*OPSIE 1*</u>

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

$1\,600 = \frac{(240{,}42)^2}{R}$ ✓

R = 36,13 Ω (36,126 Ω) ✓

OR/*OF*
R = 36,12 Ω (36,124 Ω)

<u>OPTION 2/ *OPSIE 2*</u>

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

$1\,600 = \frac{(340)^2}{2R}$ ✓

R = 36,13 Ω (36,125 Ω) ✓

OPTION 3/*OPSIE 3*

$P_{ave/gemid} = V_{rms/wgk} I_{rms/wgk}$

$1600 = (240,416)\ I_{rms/wgk}$

$I_{rms/wgk} = 6,66$ A

$R = \frac{V_{rms}}{I_{rms}}$ ✓

$= \frac{240,416}{6,66}$ ✓

$= 36,1\ \Omega\ (36,09\ \Omega)$ ✓

(Do not penalise if rms is omitted in $R = \frac{V_{rms}}{I_{rms}}$ / *Moenie penaliseer indien wgk uitgelaat is nie.)*

OPTION 4/*OPSIE 4*

$P_{ave/gemid} = \frac{V_{max/maks} I_{max/maks}}{2}$

$1600 = \frac{340 I_{max/maks}}{2}$

$I_{max/maks} = 9,412$ A

$R = \frac{V_{max}}{I_{max}}$ ✓

$= \frac{340}{9,412}$ ✓

$= 36,12\ \Omega$ ✓

(Do not penalise if max is omitted in $R = \frac{V_{max}}{I_{max}}$ / *Moenie penaliseer indien maks uitgelaat*

(3)

[11]

QUESTION 11/*VRAAG 11*

11.1 Work function of a metal is the minimum energy needed to eject an electron from the metal surface ✓✓
Arbeidsfunksie van 'n metaal is die minimum energie benodig om 'n elektron uit die oppervlakte van 'n metaal vry te stel. (2)

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

11.2 Potassium / *Kalium* / K ✓

f_o for potassium is greater than f_o for caesium ✓
f_o vir kalium is groter as f_o vir sesium

OR/*OF*
Work function is directly proportional to threshold frequency ✓
Arbeidsfunksie is direk eweredig aan die drumpel frekwensie

ACCEPT/*AANVAAR*
$W_o = hf_o$
$W_o \ \alpha \ f_o$ (2)

11.3 **OPTION 1/*OPSIE 1***
$c = f\lambda$ ✓
$3 \times 10^8 = f(5,5 \times 10^{-7})$ ✓
$f = 5,45 \times 10^{14}$ Hz
$f_{uv} < f_{o\ of\ K(potassium)}$
∴Ammeter in circuit **B** will not show a reading ✓
∴*Ammeter in stroombaan B sal nie 'n lesing toon nie.*

OPTION 2/*OPSIE 2*

$E = \frac{hc}{\lambda} = \frac{(6{,}63 \times 10^{-34})(3 \times 10^{8})}{5{,}5 \times 10^{-7}}$

$= 3{,}6164 \times 10^{-19}$ J

$W_o = hf_o = (6{,}63 \times 10^{-34})(5{,}55 \times 10^{14}) = 3{,}68 \times 10^{-19}$ J

$W_o > E$ or/*of* $hf_o > hf$

∴The ammeter will not register a current /*ammeter sal nie lesing registreer*✓

Mark allocation / *Puntetoekening*

✓ both correct formulae/*beide korrekte formules*: $E = \frac{hc}{\lambda}$ and $W_o = hf_o$

✓ both substitutions/*beide vervangings*: $\frac{(6{,}63 \times 10^{-34})(3 \times 10^{8})}{5{,}5 \times 10^{-7}}$ and/*en* $(6{,}63 \times 10^{-34})(5{,}55 \times 10^{14})$

✓ correct conclusion

OPTION 3/*OPSIE 3*

$c = f_o\lambda_o$ ✓

$3 \times 10^{8} = (5{,}55 \times 10^{14})\lambda$ ✓

$\lambda_o = 5{,}41 \times 10^{-7}$ m

λ_o (threshold wavelength) < λ (incident wavelength)

λ_o (drumpelgolflengte) < λ (invallende golflengte)

∴ the ammeter will not register a current / *ammeter sal nie lesing registreer* ✓ (3)

11.4 **OPTION 1/*OPSIE 1***

$E = W_0 + E_{k(max)}$

$hf = hf_o + \frac{1}{2}mv^2_{max}$ ✓

$h\frac{c}{\lambda} = h\frac{c}{\lambda_0} + E_{K(max)}$

NOTE: If E_K of the incorrect photocell is calculated, candidate forfeit the mark for the final answer.

***LET WEL**: Indien Ek van verkeerde fotosel bereken is, verbeur kandidaat die punt vir finale antwoord*

$\frac{(6{,}63 \times 10^{-34})(3 \times 10^{8})}{5{,}5 \times 10^{-7}}$ ✓ ✓ = $(6{,}63 \times 10^{-34})(5{,}07 \times 10^{14}) + E_{k(max)}$ ✓

$E_K = 2{,}55 \times 10^{-20}$ J ✓ (Range/*Gebied*: $2{,}52 \times 10^{-20} – 2{,}6 \times 10^{-20}$ J)

OPTION 2/*OPSIE 2*

POSITIVE MARKING FROM 11.3/POSITIEWE NASIEN VANAF 11.3

$E = W_0 + E_{k(max)}$

$hf = hf_o + \frac{1}{2}mv^2_{max}$ ✓

$h\frac{c}{\lambda} = h\frac{c}{\lambda_0} + E_{K(max)}$

NOTE: If E_K of the incorrect photocell is calculated, candidate forfeit the mark for the final answer.
***LET WEL**: Indien Ek van verkeerde fotosel bereken is, verbeur kandidaat die punt vir finale antwoord*

$(6,63 \times 10^{-34})(5,45 \times 10^{14})$ ✓✓ $= \underline{(6,63 \times 10^{-34})(5,07 \times 10^{14})} + \underline{E_{k(max)}}$ ✓

$E_K = 2,52 \times 10^{-20}$ J ✓ (Range/*Gebied*: $2,52 \times 10^{-20} – 2,6 \times 10^{-20}$ J)

(5)

11.5 Remains the same/*Bly dieselfde* ✓ (1)

[13]

TOTAL/*TOTAAL*: 150

ADDENDUM

QUESTION 7.2

Accept the following electric field diagram which would be formed if the effect of the third charge is considered.
Aanvaar die volgende elektrieseveld diagram wat gevorm sal word indien die effek van die derde lading in ag geneem is.