basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

PHYSICAL SCIENCES P1
FISIESE WETENSKAPPE V1

PHYSICS/*FISIKA*

2015

MEMORANDUM

MARKS: 150
PUNTE: 150

This memorandum consists of 22 pages.
Hierdie memorandum bestaan uit 22 bladsye.

QUESTION 1/*VRAAG 1*

1.1 D ✓✓ (2)

1.2 B ✓✓ (2)

1.3 B ✓✓ (2)

1.4 C ✓✓ (2)

1.5 C ✓✓ (2)

1.6 A ✓✓ (2)

1.7 B ✓✓ (2)

1.8 C✓✓ (2)

1.9 D ✓✓ (2)

1.10 C ✓✓ (2)

[20]

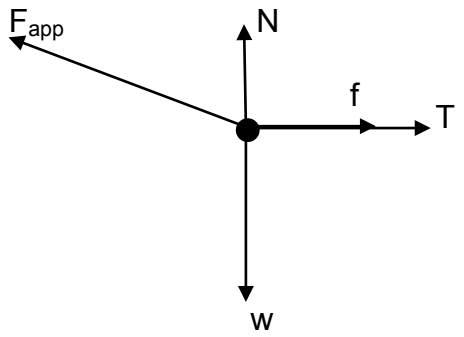
QUESTION 2/*VRAAG 2*

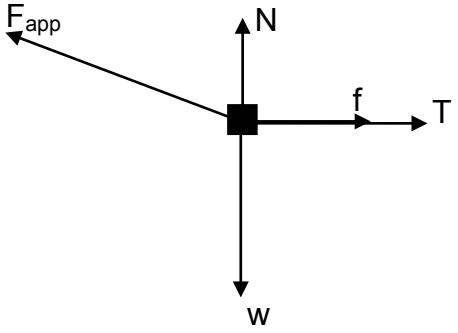
2.1

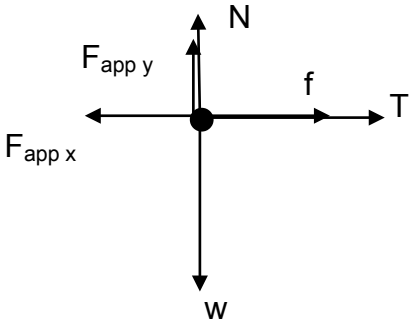
Accepted labels/*Aanvaarde benoemings*		
w	✓	F_g / F_w / weight / mg / gravitational force *F_g / F_w / gewig / mg / gravitasiekrag*
T	✓	F_T / tension F_T / *spanning*
F	✓	F_a / F_{60} / 60 N / $F_{applied}$ / F_t / $F_{toegepas}$
N	✓	F_N
f	✓	F_f

(5)

Accept / *Aanvaar*







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* $\frac{4}{5}$
- If force(s) do not make contact with body/*Indien krag(te) nie met die voorwerp kontak maak nie:* Max/*Maks:* $\frac{4}{5}$

2.2.1

$F_{60y} = F_{60}\sin\theta$ ✓
$F_{60y} = 60\sin10^o$
$= 10{,}42$ N✓

OR/*OF*

$F_{60Y} = F_{60}\cos\theta$ ✓
$F_{60y} = 60\cos80^o$

(2)

2.2.2

$F_{60x} = F_{60}\cos\theta$ ✓
$F_{60x} = 60\cos10^o =$
$= 59{,}09$ N✓

OR/*OF*

$F_{60x} = F_{60}\sin\theta$ ✓
$F_{60x} = 60\sin80^o$

(2)

2.3 When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an acceleration directly proportional to the force ✓ and inversely proportional to the mass of the object.✓
Wanneer 'n 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 krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/*OF*
The net force acting on an object is equal to the rate of change of momentum.
Die netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum. (2)

2.4

POSITIVE MARKING FROM 2.2 ***POSITIEWE NASIEN VANAF 2.2***	**OR/OF**
$N = mg - F_{60y}$ $N = \{5(9,8) - 10,42\}$ ✓ $= 38,58$ N✓	$F_y + N = w$ $N = w - F_y = mg - F_y$ ✓ $[(5)(9,8) - 10,42]$ $= 38,58$ N✓

(2)

2.5 **POSITIVE MARKING FROM 2.2.2 and 2.4**
POSITIEWE NASIEN VANAF 2.2,2 en 2.4

$F_{net} = ma$
$T - m_2g = m_2a$ ✓

$T - 2(9,8) = 2a.$
$T - 19,6$ ✓$= 2a$……(1)

$F_{60x} - (f + T) = m_8a$
$60\cos10^o - (f + T) = 5a.$ ✓
$60\cos10^o - [(\mu_k N)$ ✓ $+T)] = 5a..$
$59,09 - (0,5 \times 38,58) - T$ ✓$= 5a$

OR/*OF* $60 \sin 80^o - [f + T) = 5a$

$39,8 - T = 5a$.....(2)
$a = 2,886\ ms^{-2}$

$T - 19,6 = 2\ (2,886)$ ✓
$T = 25,37$ N✓

OR/*OF*
From equation/*Uit vergelyking* (2)
$T = 25,37$ N

NOTE: 1 mark for either $\mu_k N$ or substitution./
LET WEL: 1 punt vir $\mu_k N$ óf *vervanging.*

OR/*OF*
$T - 19,6 = 2a$ ……..(1) x 5
$59,09 - 19,29 - T = 5a$ ……(2) x 2

$7T - 177,6 = 0$✓
$T = 25,37$ N ✓ (7)

2.5

NOTES: ACCEPT FOR 5 MARKS
NOTAS: AANVAAR VIR 5 PUNTE

Fnet = ma✓ OR/*OF*
$\underline{F_{60x} - (f+m_2g) = (m_5 + m_2)a}$

$60\cos10^o - \underline{(\mu_k N)}$ ✓ $\underline{+ (2)(9,8)} = 7a$
$59,09 - \underline{[(0,5 \times 38,58) + 19,6]}$ ✓ $= 7a$
$a = 2,886\ ms^{-2}$

$T - m_2g = m_2a$
$T - 2(9,8) = 2(2,886)$ ✓
$T = 25,37\ N$✓

$\underline{F_{60x} - (f + T) = m_8a}$
$60\cos10^o - (f + T) = 5a.$
$60\cos10^o - [(\mu_k N) + T)] = 5a..$
$\underline{59,09 - (0,5 \times 38,58) - T = 5(2,886)}$ ✓
$T = 25,37\ N$✓

[20]

QUESTION 3/*VRAAG 3*

3.1 $5,88\ m\cdot s^{-1}$✓ (1)

3.2

Notes/*Aantekeninge*
Accept/*Aanvaar*
g or/*of* a
$\Delta x = v_i\Delta t + ½\ a\Delta t^2$✓
$s = ut + ½\ at^2$
$v = u + at$

If/Indien:
$g = 10\ m\cdot s^{-2}$ (deduct only 1 mark for the whole question)
Different convention i.e. upward negative: (deduct only 1 mark for the whole question

3.2

POSITIVE MARKING FROM 3.1
POSITIEWE NASIEN VANAF 3.1

OPTION 1/*OPSIE 1*
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$\underline{(-19,6)^2 = (5,88)^2 + 2(-9,8)\ \Delta y}$ ✓
$\Delta y = -17,84m$
Height above ground/*hoogte bo grond* = 17,84 m ✓ (3)

POSITIVE MARKING FROM 3.1
POSITIEWE NASIEN VANAF 3.1

OPTION 2/*OPSIE 2*
Area between graph and t-axis for 2,6 s
Oppervlakte tussen grafiek en t-as vir 2,6 s

$\Delta y = ½\ bh + ½\ bh$
$= ½\ (0,6)(5,88)$✓$+ ½(2,6 - 0,6)(-19,6)$✓
$= -17,84\ m$
∴Height above ground/*Hoogte bo grond* = 17,84 m ✓ (3)

POSITIVE MARKING FROM 3.1
POSITIEWE NASIEN VANAF 3.1

OPTION 3/*OPSIE 3*
By symmetry ball returns to A at 1,2s downward and v = -5,88 m·s^{-1}
Volgens simmetrie keer bal terug na A by 1,2s afwaarts en v = -5,88 m·s^{-1}

Δy = Area of trapezium / *Oppervlakte van trapesium*
= ½(sum of parallel sides / *som van parallelle sye*)(h) ✓ /
= ½{(-5,88) +(-19,6)} (2,6 - 1,2) ✓ = - 17,84m
∴Height above ground/*Hoogte bo grond* = 17,84 m ✓ (3)

POSITIVE MARKING FROM 3.1
POSITIEWE NASIEN VANAF 3.1

OPTION 4/*OPSIE 4*
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$\Delta y = \left(\frac{5,88 + (-19,6)}{2}\right)(2,6)$ ✓ = - 17,836 m
∴Height above ground/*Hoogte bo grond* =17,84 m ✓ (3)

POSITIVE MARKING FROM 3.1
POSITIEWE NASIEN VANAF 3.1

OPTION 5/*OPSIE 5*
$\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓
Δy = (5,88)(2,6) + ½(-9,8)(2,6)^2 ✓
= 15,288 – 33,124 = -17,836
∴Height above ground/*Hoogte bo grond* = 17,84 m ✓ (3)

POSITIVE MARKING FROM 3.1
POSITIEWE NASIEN VANAF 3.1

OPTION 6/*OPSIE 6*
From point of release to max height
Vanaf punt van vrylating tot maksimum hoogte

$v_f^2 = v_i^2 + 2a\Delta y$ ✓ for either formula/*vir enige van die formules*
$(0)^2 = (5,88)^2 + 2(-9,8)\,\Delta y$ ✓ for substitions in both equations/
vir vervanging in beide vergelykings
Δy = 1,76 m up

From max height to ground/*Vir maksimum hoogte bo grond*

$v_f^2 = v_i^2 + 2a\Delta y$
$(-19,6)^2 = 0 + 2(-9,8)\,\Delta y$
∴Δy = - 19,6 (down/*afwaarts*)
∴Height above ground/*hoogte bo grond* = 19,6 -1,76 (3)

= 17,84 m ✓

NOTE: For substitions in both equations/***LET WEL:*** *Vir vervangings in beide vergelykings*: (5,88)(0,6) + ½(-9,8)(0,6)^2 ✓ = 1,77 m upward/*opwaarts*

OPTION 7/*OPSIE 7*

From point of release to max height/*Vanaf punt van vrylating tot maks hoogte*

$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓ for either formula/*vir enige van die formules*

From max height to ground/*Vanaf maks hoogte bo grond*

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

= 0 + ½(-9,8)(2)^2 ✓ = -19,6 m (down/*afwaarts*)

Height above ground/*hoogte bo grond*

= 19,6 -1,77=17,83 m ✓ (3)

POSITIVE MARKING FROM 3.1
POSITIEWE NASIEN VANAF 3.1

NOTE: For substitions in both equations/***LET WEL:*** *Vir vervangings in beide vergelykings*: (5,88)(0,6) + ½(-9,8)(0,6)^2 ✓ = 1,77 m up/*opwaarts*

OPTION 8/*OPSIE 8*

From point of release to max height/*Vanaf punt van vrylating tot maks hoogte*

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓for either formula/*vir enige van die formules*

From max height to ground/*Vanaf maks hoogte bo grond*

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

$\Delta y = \frac{0 + 19,6}{2}$ (2) ✓

= -19,6

Height above ground/*Hoogte bo grond* = 19,6 -1,76

= 17,84 m ✓ (3)

POSITIVE MARKING FROM 3.1
POSITIEWE NASIEN VANAF 3.1

NOTE/*LET WEL*:

1. For substitions in both equations/*Vir vervanging in beide vergelykings:*

$\Delta y = \left(\frac{5,88 + 0}{2}\right)(0,6)$ ✓= 1,76 m upwards/*opwaarts*

2. The steps can be swopped for options 6,7,8/*Vir opsie 6,7,8 kan stappe omgeruil word.*

3.3

OPTION 1/*OPSIE 1*

$t_p = \left(\frac{3,2 - 2,6}{2}\right) + 2,6$ ✓

Time at / *Tyd by* P (t_p) = 2,9 s ✓ (2)

OPTION 2/*OPSIE 2*

Gradient/*Gradiënt* = -9,8

$\frac{\Delta y}{\Delta t} = -9,8$

$\frac{0 - 2,94}{\Delta t} = -9,8$ ✓

$\Delta t = 0,3s$

Time at P (t_p) / *Tyd by P (t_p)* = (2,6 + 0,3) = 2,9 s ✓ (2)

OPTION 3/*OPSIE 3*

$v_f = v_i + a\Delta t$

$0 = 2,94 + (-9,8)\Delta t$ ✓

$\Delta t = 0,3s$

$\therefore t_p = 2,6 + 0,3 = 2,9s$ ✓ (2)

3.4

POSITIVE MARKING FROM 3.3
POSITEWE NASIEN VANAF 3.3
OPTION 1/*OPSIE 1*

Δy = area under graph / *oppervlakte onder die grafiek* ✓

$= \frac{1}{2}(0,3)(2,94)$ ✓

= 0,44 m ✓ (3)

OPTION 2/*OPSIE 2*

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

$\Delta y = \frac{2,94 + 0}{2}(0,3)$ ✓

= 0,44 m ✓ (3)

OPTION 3/*OPSIE 3*

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

$= (2,94)(0,3) + \frac{1}{2}(-9,8)(0,3)^2$ ✓

= 0,44 m ✓ (3)

OPTION 4/*OPSIE 4*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0 = 2,94^2 + 2(-9,8)\Delta y$ ✓

$\Delta y = 0,44m$ ✓ (3)

3.5 **POSITIVE MARKING FROM 3.1, 3.2, 3.3 AND 3.4**
POSITIEWE NASIEN VANAF 3.1, 3.2, 3.3 EN 3.4

for/*vir* t =2,9 s t_p = 2,9 s
distance travelled by balloon since ball was dropped
afstand deur ballon gereis vandat bal laat val is

$\Delta y = v\Delta t$
$= (5,88)(2,9)$ ✓
$= 17,05$ m

height of balloon when ball was dropped/*hoogte van ballon toe bal laat val is* = 17,84 m

Height of balloon after 2,9 s/*Hoogte van ballon na 2,9 s* = (17.05 + 17,84) ✓
= 34,89 m

maximum height of ball above ground/*maksimum hoogte van bal bo grond* = 0,44 m

∴distance between balloon and ball/*afstand tussen ballon en bal* = (34,89 ✓– 0,44) = 34,45 m ✓ (4)
[13]

QUESTION 4/*VRAAG 4*

4.1 A collision in which both total momentum and total kinetic energy are conserved. ✓✓(2 or/*of* 0)
'n Botsing waarin beide totale momentum en totale kinetiese energie behoue bly

Accept/*Aanvaar*
(Total)kinetic energy is conserved ✓✓
(Totale) kinetiese energie bly behoue

Accept/*Aanvaar*
$\sum K_i = \sum K_f$ ✓✓

(2)

4.2 **OPTION 1/*OPSIE 1***
For ball A / *Vir bal A*
$(E_{mech/meg})_{top/bo} = (E_{mech/meg})_{bottom/onder}$
$(E_K + E_P)_{top/bo} = (E_K + E_P)_{bottom/onder}$
Any one / *Enige een* ✓
$(½\ mv^2 + mgh)_{top/bo} = (½\ mv^2 + mgh)_{bottom/onder}$
$½\ (0,2)(0)^2 + (0,2)(9,8)(0,2)_{top/bo} = E_k + m(9,8)(0)_{bottom/onder}$ ✓
$E_k = 0,39$ J ✓

OPTION 2/*OPSIE 2*
$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$0 = mg(h_f - h_i) + ½m(v_f^2 - v_i^2)$
$0 = (0,2)(9,8)(0,2 - 0) + ½mv_f^2 - ½\ (0,2)(0)^2$✓
$\therefore E_k = 0,39$ J ✓ (3)

4.3 **POSITIVE MARKING FROM QUESTION 4.2**
POSITIEWE NASIEN VANAF VRAAG 4.2

$\Sigma E_{Kbefore} = \Sigma E_{Kafter}$
$E_{KiA} + E_{KiB} = E_{KfA} + E_{KfB}$
$E_{KiA} + E_{KiB} = \frac{1}{2} m_A v_{fA}^2 + E_{KfB}$
✓Any one /*Enige een*
$\underline{0,39 + 0}$✓ = ½ $\underline{(0,2)v_{fA}^2 + 0,12}$ ✓
v_{fA} = 1,64 m·s^{-1}✓ (Accept/*Aanvaar* 1,65 m·s^{-1}) (4)

4.4 **POSITIVE MARKING FROM QUESTION 4.2**
POSITIEWE NASIEN VANAF VRAAG 4.2

$E_{Kbefore/voor} = \frac{1}{2} m_A v_{iA}^2$
0,39 = ½ (0,2) v_{iA}^2✓
v_{iA} = 1,98 m·s^{-1}
Impulse/*Impuls* = m($v_f - v_i$)
Impulse/*Impuls* = m($v_{iA} - v_{fA}$)
✓Any one /*Enige een*
= 0,2(-1,64) ✓- (0,2)(1,98)✓
= 0,72 N·s ✓ (accept/*aanvaar*: 0,73 N·s) (5)
(accept/*aanvaar* kg·m·s^{-1} as unit /*eenheid*) **[14]**

QUESTION 5/*VRAAG 5*

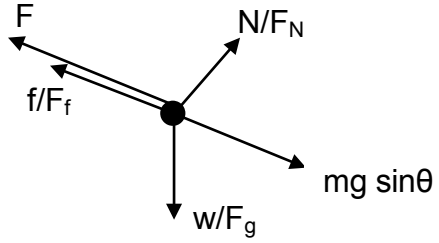
5.1 If the work done in moving an object between two points depends on the path taken (then the force applied is non-conservative) ✓✓(2 or/*of* 0).
Indien die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, afhanklik is van die pad wat gevolg word, (is die krag wat toegepas word, nie-konserwatief) (2)

5.2.1 No/*Nee* ✓ (1)

5.2.2 Since there is no acceleration, the net force is zero ✓hence net work done (which is $F_{net}\Delta x \cos\theta$) must be zero. ✓
Omdat daar geen versnelling is nie, is die netto krag nul. Dus moet die netto arbeid verrig (wat $F_{net}\Delta x \cos\theta$ is) nul wees.

OR/*OF*
$W_{net} = \Delta K$.
Since it is moving with constant velocity ✓*Omdat dit teen konstante snelheid beweeg*
$\Delta K = 0 \therefore W_{net} = 0$✓ (2)

5.3
$F_{//} - (f + F) = 0$✓
OR/*OF*
$F = mg\sin\theta - f_k$
OR/*OF*
$F = mg\sin\theta - 266$
$F = [100(9,8)\sin 25^o]$✓ – 266✓
414,167- 266
F = 148,17 N✓



(4)

NOTE/*LET WEL*
No mark for diagram */ Geen punt vir diagram nie*
1 mark for use of any of the three formulae / *1 punt vir gebruik van enige drie van die formules*

5.4

OPTION 1/*OPSIE 1*

1 mark for any of the three/
1 punt vir enige van die drie

$W = F\Delta x \cos\theta$
$W_{net} = W_f + W_g + W_N$
$W_{net} = f_k \Delta x \cos 180^o$ ✓ $+ mg\sin\theta \Delta x \cos 0^o + 0$
$= (266)(3)(-1)$ ✓$+ [100(9,8) \sin 25^o (3)(1)]$✓ $+ 0$
$= -444,5$ J
$W_{net} = \Delta E_K / \Delta K = ½ m(v_f^2 - v_i^2)$ ✓
$444,5 = ½ (100)(v_f^2 - 0)$ ✓
$v_f = 2,98 \text{ m·s}^{-1}$✓ (6)

OPTION 2/*OPSIE 2*
$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$f\Delta x\cos\theta$ ✓$= (mgh_f - mgh_i) + (½ mv_f^2 - ½ mv_i^2)$
$266\Delta x \cos 180^o$ ✓ $= (0 - mg\sin 25^o \Delta x \cos 0^o) + (½ mv_f^2 - 0)$
$266(3)(-1) = [-100(9,8) \sin 25^o (3)(1)]$ ✓ $-½ (100)(v_f^2 - 0)$✓
$v_f = 2,98 \text{ m·s}^{-1}$✓ (6)

OPTION 3/*OPSIE 3*
POSITIVE MARKING FROM QUESTION 5.3
POSITIEWE NASIEN VANAF VRAAG 5.3
$W_{net} = \Delta E_k$ ✓
$F_{net}\Delta x\cos\theta$ ✓$= ½ m(v_f^2 - v_i^2)$
$(148,17)$✓$(3)\cos 0^0$✓ $= ½ (100)(v_f^2 - 0^2)$
$444,51 = 50v_f^2$ ✓
$v_f = 2,98 \text{ m·s}^{-1}$ ✓ (6)

OPTION 4/*OPSIE 4*
POSITIVE MARKING FROM QUESTION 5.3
POSITIEWE NASIEN VANAF VRAAG 5.3
$F_{net} = ma$ ✓
$148,17$✓ $= 100a$ ✓
$a = 1,48 \text{ m·s}^{-2}$

$v_f^2 = v_i^2 + 2a\Delta x$ ✓
$= 2(1,48)(3)$ ✓
$v_f = 2,98 \text{ m·s}^{-1}$ ✓ (6)

OPTION 5/*OPSIE 5*
POSITIVE MARKING FROM QUESTION 5.3
POSITIEWE NASIEN VANAF VRAAG 5.3

$F_{net} = ma$ ✓
148,17✓ =100a✓
$a = 1{,}48\ m\cdot s^{-2}$

$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$3 = 0 + \frac{1}{2}(1{,}48)\Delta t^2$ ✓
$\Delta t = 2{,}01\ s$

$v_f = v_i + a\Delta t$
$= 0 + (1{,}48)(2{,}01)$✓
$v_f = 2{,}97\ m\cdot s^{-1}$✓ (6)

OPTION 6/*OPSIE 6*
POSITIVE MARKING FROM QUESTION 5.3
POSITIEWE NASIEN VANAF VRAAG 5.3

$F_{net} = ma$ ✓
148,17✓ =100a ✓
$a = 1{,}48\ m\cdot s^{-2}$

$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$3 = 0 + \frac{1}{2}(1{,}48)\Delta t^2$ ✓
$\Delta t = 2{,}01\ s$

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$3 = \left(\frac{0 + v_f}{2}\right)(2{,}01)$
$v_f = 2{,}99\ m\cdot s^{-1}$✓ (6)
[15]

QUESTION 6/*VRAAG 6*

6.1 It is the (apparent) 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.✓
Dit is die (skynbare) 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*
An (apparent) change in observed/detected frequency (pitch), (wavelength) ✓ 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)

6.2

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

$825 \overset{\checkmark}{=} \frac{v}{v - v_s}(800)$ ✓

$(1{,}03125)(v - 10)$ ✓ $= v$

$\therefore v = 330\ m{\cdot}s^{-1}$ ✓

Notes/*Aantekeninge*:
The following values are obtained using other points
Die volgende waardes is verkry deur ander punte te gebruik

v_s ($m{\cdot}s^{-1}$)	Frequencies	v ($m{\cdot}s^{-1}$)
v_s = 20	850	310
v_s = 20	845	375,56
vs =30	880	330
40	910	331

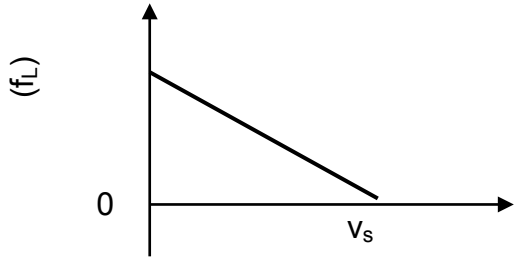
Any other Doppler formula, e.g.
Enige ander Doppler-formule, bv:

$f_L = \frac{v - v_L}{v - v_s}$ - Max./*Maks* $\frac{3}{4}$

Marking rule 1.5: No penalisation if zero substitutions are omitted.
Nasienreël 1.5: Geen penalisering indien nulvervangings uitgelaat is nie.

(5)

6.3 Straight line with negative gradient / frequency decreases (linearly)✓✓
Reguitlyn met negatiewe gradiënt/frekwensie neem af (lineêr)
(2 or/*of* 0)



(2)
[9]

QUESTION 7/*VRAAG 7*

7.1 The (magnitude) of the electrostatic force exerted by one charge on another is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between their centres. ✓
Die (grootte) van die elektrostatiese krag wat een lading op 'n ander uitoefen, is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte. (2)

7.2 $F = k\frac{Q_1Q_2}{r^2}$ ✓

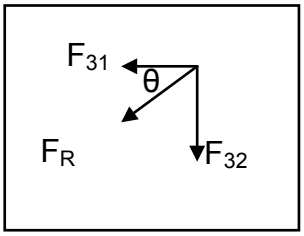
$F_{31} = \frac{(9\times10^{9})(5\times10^{-6})(6\times10^{-6})}{(0,3)^2}$ ✓✓ = 3 N to the left/*na links*

$F_{32} = \frac{(9\times10^{9})(5\times10^{-6})(3\times10^{-6})}{(0,1)^2}$ ✓ = 13,5 N downwards/*afwaarts*

$\mathbf{F_R} = \mathbf{F_{31}} + \mathbf{F_{32}}$

$F_R = \sqrt{(3)^2 + (13,5)^2}$ ✓
= 13,83 N

$\theta = \tan^{-1}\frac{13,5}{3}$ ✓
= 77, 47°



OR/*OF*

$\theta = \tan^{-1}\frac{3}{13,5}$ ✓
= 12,53°

Can use any trigonometric ratio
Kan enige trigonometriese verhouding gebruik

∴ Net force/*Netto krag* = 13,83 N in direction/*rigting* 192,53° / 77,47°✓ (7) **[9]**

NOTE:
The final answer must be given in terms of magnitude and direction
Do not penalise if sketch is not shown
Do not accept directions which include the cardinal points (N, S, E or W)
***LET WEL**:*
Die finale antwoord moet in terme van grootte en rigting gegee word.
Moenie penaliseer as skets nie getoon word nie.
Moenie rigtings aanvaar wat kardinale punte (N, S, O of W) bevat nie

QUESTION 8/*VRAAG 8*

8.1 For object N / *Vir voorwerp N*:

$n = \frac{Q}{q_e}$ ✓

$Q = (5 \times 10^{6})(-1,6 \times 10^{-19})$ ✓

$= -8 \times 10^{-13}$ C ✓

Accept /Aanvaar

Negative / *negatief* ✓ (3)

8.2 **POSITIVE MARKING FROM 8.1** (2)
POSITIEWE NASIEN VANAF 8.1

Charge on / *Lading op* M (Q_M) is $+8 \times 10^{-13}$ C ✓✓ (2 or/*of* 0)

8.3 The electric field at a point is the (electrostatic) force experienced per unit✓ positive charge placed at that point ✓

Die elektriese veld by 'n punt is die (elektrostatiese) krag wat per eenheid✓ positiewe lading wat by daardie punt ✓geplaas word, ervaar word. (2)

8.4 **POSITIVE MARKING FROM 8.1 AND 8.2**
POSITIEWE NASIEN VANAF 8.1 EN 8.2

$E = \frac{kQ}{r^2}$ ✓

$E_{PM} = \frac{(9 \times 10^{9})(8 \times 10^{-13})}{(0,25)^2}$ ✓✓ ← Q from/*vanaf* 8.2

$= 0,12$ N·C^{-1} to the right/*na regs*

$E_{PN} = \frac{(9 \times 10^{9})(8 \times 10^{-13})}{(0,1)^2}$ ✓ ← Q from/*vanaf* 8.1

$= 0,72$ N·C^{-1} to the left/*na links*

$E_{net} = E_{PM} - E_{PN}$ ✓ $= 0,12 - 0,72 = -0,60$ N·C^{-1}

$= 0,60$ N·C^{-1} to the left/*na links* ✓ (6)

[13]

QUESTION 9/*VRAAG 9*

9.1 NEGATIVE✓/*NEGATIEF* (1)

9.2
$I_{2\Omega} = \frac{V}{R}$ ✓
$= \frac{1,36}{(4 + 2)}$ ✓
$= 0,23$ A✓ (Note/*Let wel*: second decimal place/*tweede desimaal* ± 0,01) (3)

9.3

POSITIVE MARKING FROM QUESTION 9.2
POSITIEWE NASIEN VANAF VRAAG 9.2
<u>OPTION 1/*OPSIE 1*</u>

$I_{3\Omega} = \frac{V}{R}$
$= \frac{1,36}{3}$ ✓
$= 0,45$ A (Accept/*Aanvaar* 0,46 A)

$I_T = I_2 + I_3$
$= 0,23 + 0,45$ ✓
$= 0,68$ A (Accept/*Aanvaar* 0,69 A)

$V_{int/"lost"} = \varepsilon - V_{ext}$ ✓
$= 1,5 - 1,36$ ✓
$= 0,14$ V

$V_{int/"lost"} = Ir$ ✓
$0,14 = (0,68)r$ ✓
$r = 0,21\ \Omega$ ✓ (Accept/*Aanvaar* 0,20 Ω) (7)

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM QUESTION 9.2
POSITIEWE NASIEN VANAF VRAAG 9.2

$I_3 = \frac{V}{R}$
$= \frac{1,36}{3}$ ✓
$= 0,45$ A (Accept/*Aanvaar* 0,46 A)

$I_T = I_2 + I_3$
$= 0,23 + 0,45$ ✓
$= 0,68$ A (Accept/*Aanvaar* 0,69 A)

$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓
$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{3}$ ✓
$R_P = 2\ \Omega$

$\varepsilon = I(R + r)$ ✓
$1,5 = 0,68(2 + r)$ ✓
$r = 0,21\ \Omega$ ✓ (Accept/*Aanvaar* 0,17 Ω) (7)

OPTION 3/*OPSIE 3*

$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓
$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{3}$ ✓
$R_P = 2\ \Omega$

$V = IR$
$1,36$ ✓ $= I(2)$ ✓
$I = 0,68$ A (Accept/*Aanvaar* 0,69 A)

$\varepsilon = I(R+r)$ ✓
$1,5 = 0,68(2 + r)$ ✓
$r = 0,21\ \Omega$ ✓ (Accept/*Aanvaar* 0,17 Ω) (7)

OPTION 4/*OPSIE 4*

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

$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{3}$ ✓

$R_P = 2\ \Omega$

$V = IR$ ✓

$1,36 = I(2)$ ✓

$I = 0,68\ A$

$V_{int} = 1,5 - 1,36$ ✓

$= 0,14\ V$

$Ir = 0,14$

$(0,68)r = 0,14$ ✓

$R = 0,21\ \Omega$✓ (7)

ACCEPT/*AANVAAR*
If the learner wrote I_3 as 0,46 (because resistance is halved) without calculation award marks ✓
Indien die leerder I_3 as 0,46 geskryf het (omdat weerstand gehalveer is) sonder om die berekening te doen, moet punte toegeken word.
$I_T = I_2 + I_3$
$= 0,23 + 0,46 = 0,69$ A✓

$$R_P = \frac{R_1R_2}{R_1 + R_2}\checkmark$$

$$R_P = \frac{(6)(3)}{6+3}\checkmark = 2$$

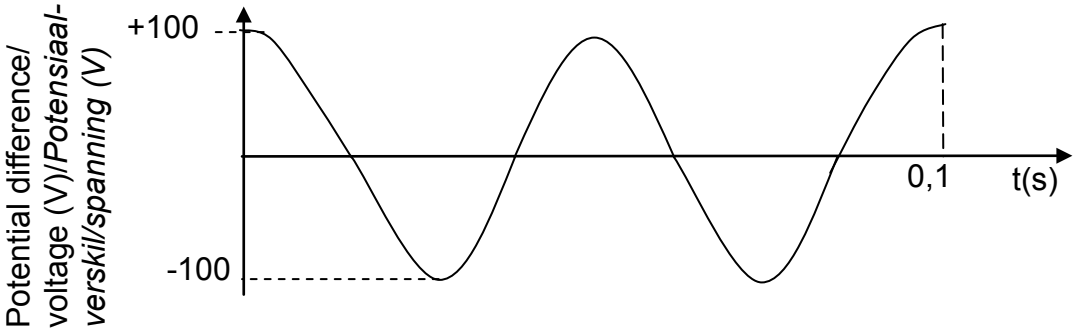
$\varepsilon = I(R + r)$ ✓
$1,5 = 0,69(2 + r)$ ✓
$r = 0,17\ \Omega$ ✓ (7)

9.4 Decrease✓
The effective resistance across the parallel circuit decreases✓
The terminal potential difference **decreases**
The resistance in the ammeter branch remains constant✓ **hence the ammeter reading decreases**
Neem af
Die effektiewe weerstand oor die parallelle kring neemm af.
Die terminaal- potensiaalverskil ***neem af.***
Die weerstand in die parallelle vertakking bly konstant, ***dus sal die ammeterlesing afneem.*** (4) **[15]**

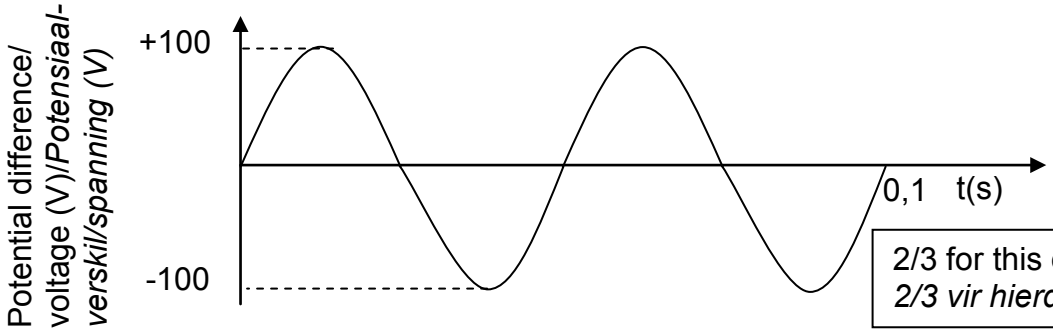
QUESTION 10/*VRAAG10*

10.1.1 Anticlockwise ✓/*Antikloksgewys* (1)

10.1.2



Crieteria for graph/*Kriteria vir grafiek*	**Marks/*Punte***
Two full cycles with correct shape /*Twee vol siklusse met korrekte vorm*	✓
Showing the maximum voltage/*Dui die maksimum spanning aan*	✓
Showing the time 0,1s for two cycles/*Dui die tyd 0,1s vir twee siklusse aan*	✓



2/3 for this drawing/
2/3 vir hierdie skets

Criteria for graph/*Kriteria vir grafiek*	**Marks/*Punte***
Showing the maximum voltage /showing the time of 0,1s for two cycles *Dui die maksimum spanning / tyd van 0,1 s vir twee siklusse aan*	✓
Showing two cycles / *Dui twee siklusse aan*	✓

(3)

10.1.3 Decrease the frequency/ speed of rotation ✓
Verlaag die frekwensie / spoed van rotasie (1)

10.2 $P_{average/gemiddeld} = V_{rms} I_{rms}$ ✓
$\underline{1\,500 = (220)(I_{rms})}$ ✓
$I_{rms} = 6{,}82$ A

$I_{rms} = \frac{I_{max/maks}}{\sqrt{2}}$ ✓
$I_{max/maks} = (\sqrt{2})(6{,}82)$ ✓
$= 9{,}65$ A ✓ (5)

[10]

QUESTION 11/*VRAAG 11*

11.1.1 The particle nature of light ✓/*Die partikelaard /deeltjie-aard van lig.* (1)

11.1.2 Shorter wavelength means higher photon energy ✓
Photon energy is inversely proportional to wavelength ✓ ; $E = \frac{hc}{\lambda}$
For the same metal kinetic energy is proportional to photon energy

Korter golflengte beteken hoër foton energie
Foton energie is omgekeerd ewredig aan golflengte $E = \frac{hc}{\lambda}$
Vir dieselfde metaal is kinetiese energie eweredig aan foton energie

OR/*OF*
Shorter wavelength means higher frequency ✓
Higher frequency means higher photon energy ✓; E = hf
For the same metal kinetic energy is proportional to photon energy
Korter golflengte beteken hoër frekwensie
Hoër frekwensie beteken hoër foton energie; E = hf
Vir dieselfde metaal is kinetiese energie eweredig aan foton energie

Accept / *Aanvaar*
Shorter wavelength ✓✓
Korter golflengte

OR/*OF*
Higher frequency ✓✓
Hoër frekwensie

OR/OF
Higher photon energy ✓✓
Hoër foton nergie (2)

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

$W_0 = h\frac{c}{\lambda_0}$ ✓

$= \frac{(6{,}63 \times 10^{-34})(3 \times 10^8)}{330 \times 10^{-9}}$ ✓ ✓

$W_o = 6{,}03 \times 10^{-19}$ J✓

<u>OPTION2/OPSIE 2</u>

$c = f\lambda$
$3 \times 10^8 = f_o(330 \times 10^{-9})$✓
$f_o = 9{,}09 \times 10^{14}$ Hz

✓ for both equations / *vir beide vergelykings*

$W_o = hf_o$
$= (6{,}63 \times 10^{-34})(9{,}09 \times 10^7)$✓
$= 6{,}03 \times 10^{-19}$ J✓ (4)

11.2.2 **POSITIVE MARKING FROM QUESTION 11.2.1/*POSITIEWE NASIEN VANAF VRAAG 11.2.1***

OPTION 1/*OPSIE 1*

$E = W_o + E_k$
$hf = hf_o + E_k$
$hf = hf_o + ½ mv^2$
$E = W_o + ½ mv^2$
✓ Any one/*Enige een*

$(6,63 \times 10^{-34})(1,2 \times 10^{15})$✓$= (6,03 \times 10^{-19})$✓$+ ½(9,11 \times 10^{-31})v^2$✓
$\therefore$ $v= 6,5 \times 10^5$ m·s^{-1}✓

OPTION 2/*OPSIE 2*

$E_K = E_{light/lig} - W_o$ ✓ Any one/ *Enige een*
$= hf_{light/lig} - hf_o$
$= (6,63 \times 10^{-34})(1,2 \times 10^{15})$ ✓ $- 6,03 \times 10^{-19}$ ✓
$= 1,926 \times 10^{-19}$ J

$E_K = ½ mv^2$
$1,926 \times 10^{-19} = ½ (9,11 \times 10^{-31})v^2$✓
$\therefore v = 6,5 \times 10^5$ m·s^{-1}✓ **(5)**
[12]

TOTAL/*TOTAAL*: 150