basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 11

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

EXEMPLAR/*MODEL* 2013

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 11 pages.
Hierdie memorandum bestaan uit 11 bladsye.

QUESTION 1/*VRAAG 1*

1.1 C ✓✓ (2)

1.2 A ✓✓ (2)

1.3 C ✓✓ (2)

1.4 A ✓✓ (2)

1.5 C ✓✓ (2)

1.6 B ✓✓ (2)

1.7 A ✓✓ (2)

1.8 D ✓✓ (2)

1.9 D ✓✓ (2)

1.10 B ✓✓ (2)
[20]

QUESTION 2/*VRAAG 2*

2.1 A single force ✓
having the same effect as all other forces acting together. ✓

'n Enkele krag ✓
wat dieselfde effek het as al die ander kragte tesame. ✓ (2)

2.2
2.2.1 Magnitude of P/*Grootte van P* = $\sqrt{2^2 + 4^2}$
= 4,47 (force units/*krageenhede)* ✓✓ (2)

2.2.2 $\tan\theta = \frac{-1}{-3}$ ∴ θ = 18,43° ✓
Direction/*Rigting*: 270° - 18,43° ✓ = 251,57° ✓

OR/*OF*

$\tan\theta = \frac{-3}{-1}$ ∴ θ = 71,57° ✓
Direction/*Rigting*: 71,57° + 180° ✓ = 251,57° ✓ (3)

2.3 $R_x = P_x + Q_x$
$= 2 + (-3)$
$= -1$ (force units/*krageenhede*) ✓
$R_y = P_y + Q_y$
$= 4 + (-1)$
$= 3$ (force units/*krageenhede*) ✓

$R = \sqrt{R_x^2 + R_y^2}$
$= \sqrt{(-1)^2 + 3^2}$
$= 3{,}16$ (force units/*krageenhede*) ✓ (3)

2.4 $\tan\theta = \frac{3}{-1}$ ✓ ∴ θ = -71,57°
Direction/*Rigting*: 270° + 71,57° = 341,57° ✓

OR/*OF*

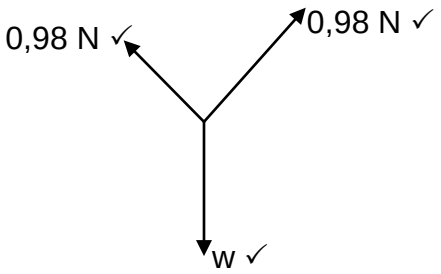
$\tan\theta = \frac{-1}{3}$ ✓ ∴ θ = -18,43°
Direction/*Rigting*: 360° - 18,43° = 341,57° ✓ (2)
[12]

QUESTION 3/*VRAAG 3*

3.1 The resultant of the forces is zero./*Die resultant van die kragte is nul.*✓ (1)

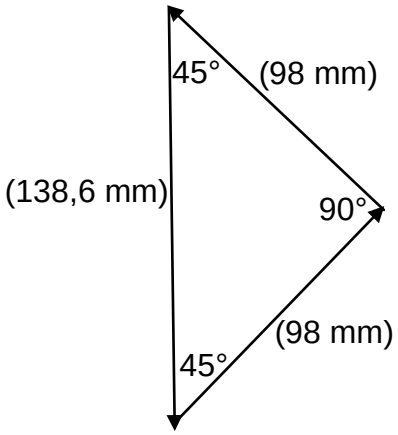
3.2 Parallax error/Error in marking the position of the strings (because the observer's eye and the strings are not in a line perpendicular to the plane of the paper). ✓
Parallaksfout/Fout in die merk van die posisie van die toutjies (omdat die waarnemer se oog en die toutjies nie in lyn loodreg tot die vlak van die papier is nie). ✓ (1)

3.3



(3)

3.4 **CONSTRUCTION AND MEASUREMENT / *KONSTRUKSIE EN METING***



Marking criteria for scale drawing: ***Kriteria vir nasien van skaaltekening:***	
A vector of 98 mm at 45° with vertical. *'n Vektor van 98 mm teen 45° met vertikaal.*	✓
Another vector of 98 mm at 90° to first vector. *'n Ander vektor van 98 mm teen 90° met eerste vektor.*	✓
A third vector drawn from head of one vector to tail of the other./*Derde vektor geteken van kop van een vektor na stert van ander.*	✓
Length of vertical vector in range of 137–139 mm. *Lengte van vertikale vektor in gebied 137–139 mm.*	✓
All vectors represented as arrows. *Alle vektore as pyltjies voorgestel.*	✓
The unknown weight given in range 1,37–1,39 N. *Die onbekende gewig gegee in gebied 1,37–1,39 N.*	✓

Mass/*Massa* = 141 g ✓
(Accept answers in range/*Aanvaar antwoorde in gebied:* 139 g–142 g)

OR / *OF*
CALCULATION / *BEREKENING*

$\sum F_y = 0$✓
(0,98) ✓sin45°✓ + (0,98) ✓sin45° ✓= m(9,8) ✓
m = 141,42 g ✓ (7)
[12]

QUESTION 4/*VRAAG 4*

4.1 When a resultant force acts on an object, the object accelerates in the direction of the force. This acceleration is directly proportional to the force ✓ and inversely proportional to the mass of the object. ✓
Indien 'n resulterende krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Hierdie versnelling is direk eweredig aan die resulterende krag ✓ en omgekeerd eweredig aan die massa van die voorwerp. ✓ (2)

4.2
4.2.1 $f_k = \mu_k N$ ✓
= (0,13)(1)(9,8) ✓
= 1,27 N ✓ (3)

4.2.2 For the 2 kg mass (to the right/downwards as positive):
Vir die 2 kg-massa (na regs/afwaarts as positief):
$F_{net} = ma$ ✓
$w + F_T = ma$
$(2)(9,8) + F_T = 2a$ ✓
$F_T = 2a - 19,6$

For the 1 kg mass (to the right as positive):
Vir die 1 kg-massa (na regs as positief):
$F_{net} = ma$
$F_T + f = ma$
$-(2a - 19,6)$ ✓ $+ (-1,27) = 1a$ ✓ $F_T(1\text{ kg}) = -F_T(2\text{ kg})$
$\therefore a = 6,11\ m\cdot s^{-2}$ ✓ (5)

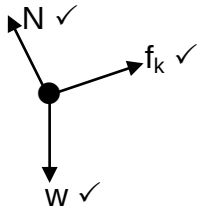
4.3 Zero acceleration ✓
F_{net} on the 1 kg mass is zero. ✓
According to Newton's second law of motion, its acceleration will be zero. ✓
According to Newton's first law of motion, it will continue to move at constant velocity (until it reaches the edge of the surface). ✓

Nul versnelling ✓
F_{net} op die 1 kg-massa is nul. ✓
Volgens Newton se tweede bewegingswet, is sy versnelling nul. ✓
Volgens Newton se eerste bewegingswet, sal dit teen konstante snelheid beweeg (tot aan die einde van die oppervlak). ✓ (4) **[14]**

QUESTION 5/*VRAAG 5*

5.1 $N = w_{\perp} = mg\cos\theta$ ✓
$= (60)(9,8)\cos 15°$
$= 567,96$ N ✓ (2)

5.2



Accepted Labels/*Aanvaarde byskrifte*	
w	F_g/F_w/force of Earth on skier/weight/588 N/mg/gravitational force *F_g/F_w/krag van Aarde op skiër/gewig/588 N/mg/gravitasiekrag*
N	F_N/normal/567,96 N *F_N/normaal/567,96 N*
f_k	Frictional force / F_f *Wrywingskrag / F_f*

(3)

5.3 $v_f^2 = v_i^2 + 2a\Delta x$ ✓
$15^2 = 0^2 + 2a(75)$ ✓
$\therefore a = 1{,}5\ m\cdot s^{-2}$
$F_{net} = ma$ ✓
$w_{//} + f = ma$
$mg\sin\theta + f = ma$
$(60)(9{,}8)\sin 15°$✓ $+ f_k = (60)(1{,}5)$ ✓
$\therefore f = -62{,}19$ N
$\therefore$ f = 62,19 N ✓ up the incline/*opwaarts teen skuinsvlak* ✓ (7)
[12]

QUESTION 6/*VRAAG 6*

6.1 Any two objects in the universe attract each other ✓
with a force directly proportional to the product of their masses and ✓
inversely proportional to the square of the distance between their centres. ✓

Enige twee voorwerpe in die heelal trek mekaar aan ✓
met 'n krag wat direk eweredig is aan die produk van hul massas en ✓
omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte. ✓ (3)

6.2 $F = \frac{Gm_1m_2}{r^2}$ ✓

5 000 ✓$= \frac{(6{,}67\times10^{-11})(5{,}98\times10^{24})(615)}{r^2}$ ✓
$\therefore r = 7{,}0 \times 10^6$ m
Height /*Hoogte* = $7{,}0 \times 10^6 - 6{,}38 \times 10^6$ ✓ $= 6{,}2432 \times 10^5$ m = 624,32 km ✓ (5)

6.3 $F = \frac{Gm_1m_2}{r^2}$

$\therefore F = \frac{Gm_1 2m_2}{(2r)^2} = \frac{1}{2}\frac{Gm_1m_2}{r^2} = \frac{1}{2}(5\ 000) =$ 2 500 N ✓✓ (2)
[10]

QUESTION 7/*VRAAG 7*

7.1 The ratio of sin i to sin r is constant. ✓✓
Die verhouding van sin i tot sin r is konstant. (2)

7.2 1,4,2,3,6,5 ✓✓ (2 or/*of* 0) (2)

7.3 To ensure that the position of the glass block remains the same/glass block does not shift. ✓
Om te verseker dat die posisie van die glasblok dieselfde bly/die glasblok nie skuif nie. (1)

7.4
7.4.1 Gradient/*Gradiënt* = $\frac{\Delta \sin i}{\Delta \sin r}$ ✓
= $\frac{0,6 - 0}{0,4 - 0}$ ✓
= 1,5 ✓

Note/*Let Wel*
Accept values from/*aanvaar waardes vanaf* 1,44 to/*tot* 1,5.

(4)

7.4.2 The refractive index of glass✓
Die brekingsindeks van glas. (1)
[10]

QUESTION 8/*VRAAG 8*

8.1 $n_1 \sin\theta_1 = n_2 \sin\theta_2$ ✓
$(1,44)\sin 30° ✓ = (1)\sin\theta_2 ✓$
$\theta_a = 46,05°$ ✓ (4)

8.2 The glass block is optically more dense than air. ✓
When light passes from an optically dense into an optically less dense medium, it bends away from the normal. ✓
Die glasblok is opties digter as lug.
Wanneer lig van 'n optiese digter medium na 'n opties minder digte medium beweeg, buig dit weg van die normaal af. (2)

8.3 Increases/*Neem toe* ✓ (1)

8.4 The angle of incidence in the optically denser medium for which the angle of refraction in the optically less medium is 90°. ✓✓
Die invalshoek in die opties digter medium waarvoor die brekingshoek in die opties minder digte medium 90° is.

OR/*OF*
The angle of incidence in the optically denser medium beyond which the light/wave will be totally internally reflected. ✓✓
Die invalshoek in die opties digter medium waarbo die lig/golf totale interne weerkaatsing ondervind. (2)

8.5 Total internal reflection/*Totale interne weerkaatsing* ✓ (1)

8.6 Optical fibres for communication/in endoscopes. ✓
Optiese vesels vir kommunikasie/in endoskope. ✓

OR/*OF*
Binoculars/*Verkykers*

OR/*OF*
Periscopes/Periskope (1)
[11]

QUESTION 9/*VRAAG 9*

9.1 The bending/spreading of waves as they pass through a narrow opening or around corners/obstacles.✓✓
Die buiging/spreiding van golwe wanneer hulle 'n smal opening of om hoeke/versperrings beweeg. (2)

9.2

9.2.1 Greater than/*Groter as* ✓ (1)

9.2.2 Dimmer than/*Dowwer as* ✓ (1)

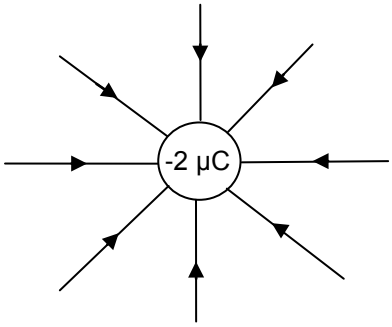
9.2.3 Greater than/*Groter as* ✓ (1)

9.2.4 Every point on a wave front acts as a source of new wavelets that move forward with the same speed as the wave. ✓✓
Elke punt op 'n golffront wat dien as 'n bron van nuwe golwe wat voortbeweeg teen dieselfde spoed as die golf. (2)
[7]

QUESTION 10/*VRAAG 10*

10.1 The force per unit charge./*Die krag per eenheid lading.*✓✓ (2)

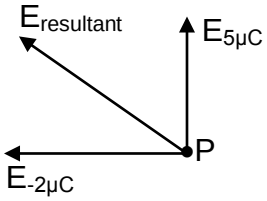
10.2



Marking criteria for electric field lines ***Kriteria vir nasien van elektriese veldlyne***	
Shape of field lines./*Vorm van veldlyne.*	✓
Direction of field lines (towards charge). *Rigting van veldlyne (na lading toe).*	✓

(2)

10.3



$E_{2\mu C} = \frac{kQ}{r^2}$ ✓ $= \frac{(9\times10^{9})(2\times10^{-6})}{(0{,}1)^2}$ ✓

$= 1{,}8 \times 10^{6}$ N·C^{-1} ✓towards the 2 µC charge (as shown)
na 2 µC lading (soos aangedui)

$E_{5\mu C} = \frac{kQ}{r^2} = \frac{(9\times10^{9})(5\times10^{-6})}{(0{,}15)^2}$ ✓

$= 2 \times 10^{6}$ N·C^{-1} ✓away from the 5 µC charge (as shown)
weg vanaf 5 µC lading (soos aangedui)

$E_{resultant} = \sqrt{(1{,}8\times10^{6})^2 + (2\times10^{6})^2}$ ✓$= 2{,}69 \times 10^{6}$ N·C^{-1} ✓ (7)

[11]

QUESTION 11/*VRAAG 11*

11.1 The (magnitude of the) emf induced in a conductor is equal to the rate of change of magnetic flux linkage (through it). ✓✓
Die (grootte van die emk) geïnduseer in 'n geleier is gelyk aan die tempo van verandering van magnetiese vloedkoppeling (daar deur). ✓✓ (2)

11.2
11.2.1 emf/*emk* = $-N\frac{\Delta\phi}{\Delta t}$ ✓

$-15,2$ ✓ $= -(200)\ \frac{\Delta\phi}{3,2\times10^{-2}}$ ✓

$\therefore\ \Delta\phi = 2,43 \times 10^{-3}$ Wb ✓ or/*of* $(2,43 \times 10^{-3}$ V·s) (4)

11.2.2 $\Delta\phi = (B_f - B_i)A\cos\theta$ ✓
$2,432 \times 10^{-2} = (0,42 - 0,22)A\cos0°$ ✓
$\therefore A = 0,012\ m^2$

Area of circle/*Oppervlak van sirkel* = πr^2
$0,012 = \pi r^2$ ✓
$\therefore r = 6,22 \times 10^{-2}$ m ✓ (4)

11.3 15,2 V ✓ (1)
[11]

QUESTION 12/*VRAAG 12*

12.1 Resistance = gradient of graph
12.1.1 *Weerstand = helling van grafiek*

$= \frac{4 - 0}{25\times10^{-3} - 0}$ ✓ ✓
$= 160\ \Omega$ ✓ (3)

12.1.2 Graph at T_1 ✓/*Grafiek by* T_1 ✓
Steeper/larger gradient/*Steiler helling* ✓
∴ R is greater/*R is groter* ✓
∴ Temperature is higher/*Temperatuur is hoër* (3)

12.1.3 V is directly proportional to I at each of the temperatures T_1 and T_2. ✓
V is direk eweredig aan I by elk van die temperature T_1 *en* T_2 (1)

12.1.4 $P = VI$ ✓
$= (2,5)(25 \times 10^{-3})$ ✓
$= 0,06(2)$ W ✓ (3)

12.2

12.2.1 Both switches open:/*Beide skakelaars oop:*

$R = 6\ \Omega + 1\Omega + 2\Omega = 9\ \Omega$ ✓

$R = \frac{V}{I}$ ✓

$9 = \frac{4,5}{I}$ ✓

$\therefore I = 0,5\ A$ ✓ (4)

12.2.2 Both switches closed:/*Beide skakelaars gesluit:*

$V_{6\Omega} = IR = (0,5)(6) = 3\ V$ ✓

$V_{2\Omega} = 4,5 - 3 = 1,5\ V$ ✓

$I_{2\Omega} = \frac{V}{R} = \frac{1,5}{2} = 0,75\ A$ ✓

$I_R = 0,75 - 0,5 = 0,25\ A$ ✓

$R = \frac{V}{I} = \frac{3}{0,25}$ ✓ $= 12\ \Omega$ ✓ (6)

[20]

TOTAL/*TOTAAL*: 150