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)

NOVEMBER 2019

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 13 pages./
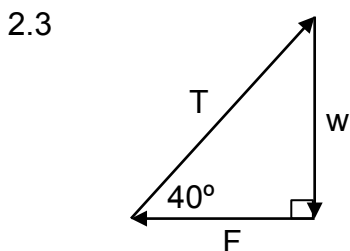*Hierdie nasienriglyne bestaan uit 13 bladsye.*

QUESTION 1/*VRAAG 1*

1.1   B ✓✓   (2)

1.2   C ✓✓   (2)

1.3   A ✓✓   (2)

1.4   B ✓✓   (2)

1.5   B ✓✓   (2)

1.6   C ✓✓   (2)

1.7   D ✓✓   (2)

1.8   B ✓✓   (2)

1.9   A ✓✓   (2)

1.10   D ✓✓   (2)

[20]

QUESTION 2/*VRAAG 2*

2.1 F_{net} = 0/Object in equilibrium/Resultant is zero ✓✓
F_{net} = *0/Voorwerp in ewewig/Resultant is nul.*   (2)

2.2   w = mg
= (15)(9,8) ✓
= 147 N ✓   (2)

2.3

Accepted Labels/*Aanvaarbare byskrifte*		Mark/*Punt*
w	weight/F_g/F *gewig/gravitasiekrag/swaartekrag*	✓
F	Applied force/F/$F_{A/}$*Toegepaste krag*	✓
T	Tension/T/*Spanning*	✓
	Any angle correctly shown (40° or 50° or 90°) *Enige hoek korrek aangedui (40° of 50° of 90°)*	✓
	Triangle not closed/*Driehoek nie geslote* nie: *Max./maks.* $\frac{3}{4}$	

(4)

2.4   **POSITIVE MARKING FROM QUESTION 2.2.**
POSITIEWE NASIEN VANAF VRAAG 2.2.

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
$T = \dfrac{w}{\sin 40°}$	$T = \dfrac{w}{\cos 50°}$
$= \dfrac{147}{\sin 40°}$ ✓	$= \dfrac{147}{\cos 50°}$ ✓
= 228,69 N ✓	= 228,69 N ✓

(2)

2.5   The two forces act on the same object (the billboard). ✓
(For the Newton's third law, the forces act on different objects.)

Die twee kragte werk op dieselfde voorwerp (die bord) in.
(Vir Newton se derde wet moet die kragte op verskillende voorwerpe inwerk.)   (1)
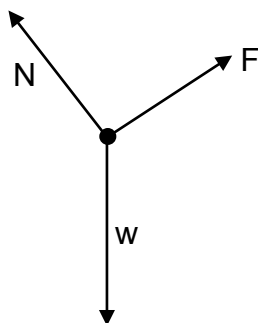
[11]

QUESTION 3/*VRAAG 3*

3.1
Marking guidelines/*Nasienriglyne*
If any of the underlined key words/phrases are omitted: minus 1 mark *Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt*

A <u>body will remain in its state of rest</u> or motion at constant velocity <u>unless a non-zero resultant</u>/net force <u>acts on it</u>. ✓✓
'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid volhard tensy 'n nie-nul resulterende/netto krag daarop inwerk.   (2)

3.2

Accepted Labels/*Aanvaarbare byskrifte*		
w	weight/F_G/F_g *gewig/gravitasiekrag/swaartekrag*	✓
N	Normal force/F_N/*Normaalkrag*/F_N	✓
F	Force applied/ F /F_A/*Toegepaste krag*	✓
Any additional forces/E*nige addisionele kragte: Max./maks.* $\frac{2}{3}$		
If arrows do NOT touch object/*Indien pyle NIE voorwerp raak* *NIE:* *Max./maks.* $\frac{2}{3}$		

(3)

3.3.
3.3 $F_{g\perp}$ = mgcos θ ✓
              = (4)(9,8)cos 30° ✓
              = 33,95 N ✓   (3)

3.3.2 F_{net} = ma   ⎤ ✓ Any one/*Enige een*
             F - $Fg_{//}$ = 0   ⎦
             F - (4)(9,8)sin 30° = 0 ✓
               = 19,6 N ✓   (3)

3.4
3.4.1 $F_{net} = ma$
$F - f_k - Fg_{//} = ma$ ⎱ ✓ Any one/*Enige een*

$\underline{25 - f_k - 4(9,8)\sin 30^o}$ ✓ = 4(0,2) ✓
$f_k = 4,6 \text{ N}$ ✓   (4)

3.4.2   **POSITIVE MARKING FROM QUESTION 3.3.1 and 3.4.1.**
POSITIEWE NASIEN VANAF VRAAG 3.3.1 en 3.4.1.
$f_k = \mu_k N$ ✓
$4,6 = \mu_k(33,95)$ ✓
$\mu_k = 0,135$ ✓   (3)

3.5
3.5.1   Same in magnitude ✓ and same in direction ✓
Dieselfde grootte en dieselfde rigting   (2)

3.5.2   Increasse in magnitude ✓ and opposite direction ✓
Toeneem in grootte en teenoorgestelde rigting   (2)

3.5.3   Same in magnitude ✓ and opposite direction ✓
Dieselfde grootte en teenoorgestelde rigting   (2)
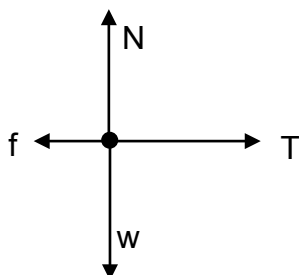   **[24]**

QUESTION 4/*VRAAG 4*

4.1

> **Marking guidelines/*Nasienriglyne*__
> If any of the underlined key words/phrases are omitted: minus 1 mark
> *Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt*

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

4.2

(4)

Accepted Labels/*Aanvaarbare byskrifte*	
w	weight/F_g/*gewig/gravitasiekrag/swaartekrag*	✓
N	Normal force/F_N/*Normaalkrag*/F_N	✓
T	Tension/*Spanning*	✓
f	Friction/F_f/*Wrywing*	✓
Any additional force/*Enige addisionele krag: Max./maks.* $^3/_4$	
If arrows do NOT touch object/*Indien pyle NIE voorwerp raak NIE: Max./maks.* $^3/_4$	

(4)

4.3

6 kg block/*blok:*
F_{net} = ma ✓
T - f_k = ma
<u>T - 24</u> ✓ = 6a ✓
T = 6a + 24 ....(1)

3 kg block/*blok:*
F_{net} = ma
F_g - T = ma
<u>(3)(9,8) - T</u> ✓ = 3a ....(2)

Substitute (1) into (2)/*Vervang (1) in (2):*
29,4 - (6a + 24) = 3a ✓
a = 0,6 m·s^{-2} ✓

> **Marking guidelines/*Nasienriglyne*__
> - Formule/*Formule:* F_{net} = ma ✓
> - T – F_k = T – 24 ✓
> - F_g - T = 3(9,8) – T ✓
> - 3a **OR/*OF*** 6a ✓
> - Equating two equations or substitute one into the other/*Stel twee vergelykings gelyk aan mekaar of vervang die een in die ander.* ✓
> - Final answer/*Finale antwoord*: 0,6 m·s^{-2} ✓

(6)

4.4   The velocity changes with 0,6 m·s^{-1} during every second. ✓✓
Die snelheid verander met 0,6 m·s^{-1} gedurende elke sekonde   (2)

[14]

QUESTION 5/*VRAAG 5*

5.1   g is <u>directly proportional</u> to $\dfrac{M}{R^2}$. ✓

g <u>is direk eweredig</u> aan $\dfrac{M}{R^2}$. (1)

5.2   Any two points from the graph can be used for example:
Enige twee punte vanaf die grafiek kan gebruik word byvoorbeeld:

Gradient = $\dfrac{9-0 ✓}{1{,}35 \times 10^{11}-0 ✓}$

= 6,67 x 10^{-11} ✓

OR/*OF*

Gradient = $\dfrac{10-0}{1{,}5 \times 10^{11}-0}$

= 6,67 x 10^{-11}

OR/*OF*

Gradient = $\dfrac{20-0}{3 \times 10^{11}}$

= 6,67 x 10^{-11} (3)

5.3   G / Gravitational constant ✓
G / Gravitasie konstante (1)

5.4   1,35 x 10^{11} (kg·m^{-2}) ✓✓
Range/*Gebied*: 1,34 – 1,36 x 10^{11} (kg·m^{-2}) (2)

5.5   **POSITIVE MARKING FROM QUESTION 5.4.**
POSITIEWE NASIEN VANAF VRAAG 5.4.

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
$\dfrac{M}{R^2}$ = 1,35 x 10^{11}	g = $\dfrac{GM}{R^2}$
$\dfrac{M}{(2{,}54 \times 10^7)^2}$ = 1,35 x 10^{11} ✓	9 = $\dfrac{6{,}67 \times 10^{11}M}{(2{,}54 \times 10^7)^2}$ ✓
M = 8,71 × 10^{25} kg ✓ (8,7097 × 10^{25} kg)	M = 8,71 × 10^{25} kg ✓ (8,705 × 10^{25} kg)

(2)

[9]

QUESTION 6/*VRAAG 6*

6.1

> **Marking guidelines/*Nasienriglyne***
> If any of the underlined key words/phrases are omitted: minus 1 mark
> *Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt*

The angle between the normal to a surface and the refracted light ray. ✓✓
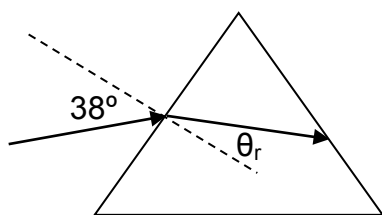*Die hoek tussen die normaal op die oppervlak en die gebreekte ligstraal.* (2)

6.2 $n_i \sin \theta_i = n_r \sin \theta_r$ ✓
      $1 \sin 38^\circ = 1,5 \sin \theta_r$ ✓
       $\theta_r = 24,23^\circ$ ✓   (3)

6.3

> **Marking criteria/*Nasienriglyne*:**
> - Light ray bends towards normal. ✓
>   *Ligstraal breek na normal toe.*
> - Angle of refraction correctly shown. ✓
>   *Brekingshoek korrek aangetoon.*

(2)

6.4 $n_i \sin \theta_i = n_r \sin \theta r$
      $1,5 \sin 36^\circ = n_r \sin 41^\circ$ ✓
      $n_r = 1,34$ ✓   (2)

6.5   Smaller than ✓
      Kleiner as   (1)

6.6   <u>For a constant speed</u> of light, c, ✓
      the <u>refractive index is inversely proportional to the speed</u> of light in the medium (v). ✓
      Therefore, the higher the refractive index, the lower the speed (v).

      <u>*Vir 'n konstante spoed*</u> *van lig, c,*
      is die <u>brekingsindeks omgekeerd eweredig aan die spoed</u> van lig in die medium (v).
      Dus, hoe groeter die brekingsindeks, hoe kleiner die spoed (v).   (2)

6.7   The angle of incidence when the angle of refraction is 90°. ✓✓
      Die invalshoek wanneer die brekingshoek gelyk is aan 90°.   (2)

6.8   Total internal reflection occurs ✓
      because the light ray passes from an optical denser to less dense medium ✓
      and the angle of incidence is greater than the critical angle. ✓
      Totale interne weerkaatsing vind plaas
      omdat die ligstraal van 'n opties meer dig na minder digte medium beweeg
      en die invalshoek is groter as die grenshoek.   (3)

[17]

QUESTION 7/*VRAAG 7*

7.1

> **Marking guidelines/*Nasienriglyne***
> If any of the underlined key words/phrases are omitted: minus 1 mark
> *Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is:*
> *minus 1 punt*

A wave front is an <u>imaginary line joining the points</u> on a wave that are <u>in phase.</u> ✓✓
'n Golffront is 'n <u>denkbeeldige lyn wat punte</u> op 'n golf, <u>wat in</u> fase is, verbind.   (2)

7.2   Wave nature ✓
Golfgeaardheid   (1)

7.3.1   Slit width ✓
Spleetwydte   (1)

7.3.2   Colour of light/Wavelength of light ✓
Kleur van lig/Golflengte van lig   (1)

7.4   Wavelength increases from blue to red light. ✓

(Degree of) diffraction α $\dfrac{\lambda}{w}$ ✓

For the same slit width, ✓
degree of diffraction increases with wavelength. ✓

Golflengte neem toe van blou na rooi lig.

(Mate van) diffraksie α $\dfrac{\lambda}{w}$

Vir dieselfde spleetwydte,
sal mate van diffraksie toeneem met langer golflengte.   (4)

7.5   Increases ✓
(Degree of) diffraction is inversely proportional to slit width ✓
Afneem
(Mate van) diffraksie is omgekeerd eweredig aan spleetwydte   (2)

[11]

QUESTION 8/*VRAAG 8*

8.1
> **Marking guidelines/*Nasienriglyne***
> If any of the underlined key words/phrases are omitted: minus 1 mark
> *Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt*

The magnitude of the <u>electrostatic force</u> exerted by two point charges on each other is <u>directly proportional to the product of the magnitudes of the charges</u> ✓and <u>inversely proportional to the square of the distance between them</u>. ✓

Die grootte van die <u>elektrostatiese krag</u> wat deur twee puntladings op mekaar uitgeoefen word, is <u>direk eweredig aan die produk van die grootte van die ladings</u> en <u>omgekeerd eweredig aan die kwadraat van die afstand tussen hulle</u>. (2)

8.2
$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$
$$= \frac{(9 \times 10^9)(4{,}2 \times 10^{-6})(6{,}8 \times 10^{-6})}{(0{,}3)^2} \checkmark$$
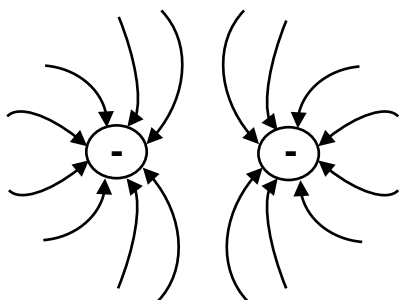$$= 2{,}86 \text{ N } \checkmark$$ (3)

8.3
$$Q = \frac{Q_1 + Q_2}{2}$$
$$= \frac{4{,}2 \times 10^{-6} + (-6{,}8 \times 10^{-6})}{2} \checkmark$$
$$= -1{,}3 \times 10^{-6} \text{ C } \checkmark$$ (2)

8.4

Criteria for marking/*Nasienkriteria*	
Charges correctly indicated *Ladings korrek aangedui*	✓
Shape of the field *Vorm van veld*	✓
Direction of the field *Rigting van veld*	✓

> **NOTE/LET WEL:**
> IF lines don't touch charges or lines cross etc.
> INDIEN l*yne nir doe ladings raak nie of lyne kruis ens.*   Max./maks. $\frac{2}{3}$

(3)

8.5   **POSITIVE MARKING FROM QUESTION 8.4.**
        POSITIEWE NASIEN VANAF VRAAG 8.4.

$E = \dfrac{kQ}{r^2}$ ✓

$\quad = \dfrac{(9\times10^9)(1,3\times10^{-6})}{0,4^2}$ ✓

$\quad = 73125 \text{ N·C}^{-1}$ right

$E = \dfrac{(9\times10^9)(1,3\times10^{-6})}{0,1^2}$ ✓

$\quad = 1170000 \text{ N·C}^{-1}$ right

$E_{net} = 73\ 125 + 1\ 170\ 000$ ✓
$\quad\quad = 1\ 243\ 125 \text{ N·C}^{-1}$ ✓   (5)
                                                                       [15]

QUESTION 9/*VRAAG 9*

9.1   Faraday's law of electromagnetic induction ✓
        Faraday se wet van elektromagnetiese induksie   (1)

9.2.1 $\Delta\Phi = \Delta BA\cos\theta$ ✓
        $= (2,8\times10^{-3})(2,5)(\cos 90^\circ - \cos 0^\circ)$ ✓
        $= -0,007 \text{ Wb}$ ✓   (3)

9.2.2   **POSITIVE MARKING FROM QUESTION 9.2.1.**
        POSITIEWE NASIEN VANAF VRAAG 9.2.1.

$\varepsilon = -\dfrac{N\Delta\phi}{\Delta t}$ ✓

$3,5 = -\dfrac{200(-0,007)}{\Delta t}$ ✓

$\Delta t = 0,4 \text{ s}$ ✓   (3)

9.3   Emf will be halve/two times smaller ✓
        Emf is directly proportional to number of windings ✓

        Emk sal die helfte wees/twee keer kleiner
        Emk is direk eweredig aan die aantal windings   (2)
                                                                       [9]

QUESTION 10/*VRAAG 10*

10.1

> **Marking guidelines/*Nasienriglyne***
> If any of the underlined key words/phrases are omitted: minus 1 mark
> *Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt*

The <u>potential difference</u> across a conductor is <u>directly proportional to the current</u> in the conductor <u>at constant temperature</u>. ✓✓
Die <u>potensiaalverskil</u> oor die ente van 'n geleier is <u>direk eweredig aan die stroom</u> in die geleier <u>by konstante temperatuur</u>. (2)

10.2   <u>More resistors connected in parallel</u>. ✓
Therefor the <u>effective resistance of the circuit decreases</u>. ✓

<u>Meer resistors verbind in parallel.</u>
Daarom <u>neem die effektiewe weerstand</u> van die stroombaan <u>af.</u> (2)

10.3

10.3.1   Any set of values form the table can be used for example:
Enige stel waardes vanaf die tabel kan gebruik word byvoorbeeld:

$R = \dfrac{V}{I}$ ✓

$ = \dfrac{4,8}{2,4}$ ✓

$ = 2\ \Omega$ ✓ (3)

10.3.2

POSITIVE MARKING FROM QUESTION 10.3.1. *POSITIEWE NASIEN VANAF VRAAG 10.3.1.*		
OPTION 1/*OPSIE 1* Switched 1 closed: *Skakelaar 1 gesluit:* $R_{tot} = 3 + 2$ ✓ $\phantom{R_{tot}} = 5\ \Omega$ $V_{emf} = IR_{tot}$ ✓ $\phantom{V_{emf}} = (2,4)(5)$ ✓ $\phantom{V_{emf}} = 12\ V$ ✓	**OPTION 2/*OPSIE 2*** Switches 1 and 2 closed: *Skakelaar 1 en 2 gesluit:* $\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$ $\phantom{\dfrac{1}{R_p}} = \dfrac{1}{3} + \dfrac{1}{6}$ $R_p = 2\ \Omega$ $R_{tot} = 2 + 2$ ✓ $= 4\ \Omega$ $V_{emf} = IR_{tot}$ ✓ $\phantom{V_{emf}} = (3)(4)$ ✓ $\phantom{V_{emf}} = 12\ V$ ✓	**OPTION 3/*OPSIE 3*** Switches 1, 2 and 3 closed *Skakelaar 1, 2 en 3 gesluit* $\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$ $\phantom{\dfrac{1}{R_p}} = \dfrac{1}{3} + \dfrac{1}{6} + \dfrac{1}{4}$ $R_p = 1,33\ \Omega$ $R_{tot} = 1,33 + 2$ ✓ $= 3,33\ \Omega$ $V_{emf} = IR_{tot}$ ✓ $\phantom{V_{emf}} = (3,6)(3,33)$ ✓ $\phantom{V_{emf}} = 12\ V$ ✓

(4)

10.4   Power is the <u>rate at which work is done</u> or energy is transferred. ✓✓
         Drywing is die <u>tempo waarteen arbeid verrig word</u> of energie oorgedra word.   (2)

10.5

POSITIVE MARKING FROM QUESTION 10.3.1 AND 10.3.2.
POSITIEWE NASIEN VANAF VRAAG 10.3.1 EN 10.3.2.

$V_{\parallel} = V_{emf} - V_{series}$
     $= 12 - 6$ ✓
     $= 6\ V$

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***	**OPTION 3/*OPSIE 3***
$P = \dfrac{V_{\parallel}^2}{R}$ ✓	$I = \dfrac{V}{R}$	$I = \dfrac{V}{R}$
$= \dfrac{6^2}{6}$ ✓	$I = \dfrac{6}{6}$	$I = \dfrac{6}{6}$
$= 6\ W$ ✓	$= 1A$	$= 1A$
	$P = VI$ ✓	$P = I^2R$ ✓
	$= 6(1)$ ✓	$= 1^2(6)$ ✓
	$= 6\ W$ ✓	$= 6\ W$ ✓

     (4)

10.6   Increase/ *Neem toe* ✓   (1)

10.7   (As more resistors are connected in parallel, the effective resistance
         decreases and the current increases.)
         From $P = I^2R$, <u>power is directly proportional to I^2</u> ✓if R (of the bulb) stays
         constant.
         <u>Increase in power increases brightness</u>. ✓

         *(Soos meer resistors in parallel verbind word, neem die effektiewe weerstand
         af en die stroom neem toe.)*
         *Volgens $P = I^2R$ is die <u>drywing direk eweredig aan I^2</u> indien R (van die
         gloeilamp) konstant bly.*
         <u>Toename in drywing verhoog helderheid.</u> ✓   (2)

         [20]

                                                                     TOTAL: 150