education

Department of Education
FREE STATE PROVINCE

CONTROL TEST / *KONTROLETOETS*

GRADE 11 / *GRAAD 11*

PHYSICAL SCIENCES
FISIESE WETENSKAPPE

MEMORANDUM

NOVEMBER 2021

MARKS: 150

TIME: 3 HOURS

This memorandum consists of 12 pages.
Hierdie memorandum bestaan uit 12 bladsye.

QUESTION 1

1.1 A ✓✓

1.2 D ✓✓

1.3 A ✓✓

1.4 B ✓✓

1.5 D ✓✓

1.6 C ✓✓

1.7 C ✓✓

1.8 D ✓✓

1.9 D ✓✓

1.10 A ✓✓ **[10 × 2]**

General marking guideline for definitions
Algemene nasienriglyn vir definisies:

If any one of the underlined key phrases in the **correct context** is omitted, deduct one mark.
Indien enige van die onderstreepte sleutelfrases in die korrekte konteks uitgelaat is, trek een punt af.

QUESTION 2 / *VRAAG 2*

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

2.2

One x-component correct (magnitude x correct trig ratio): ✓
Een x-komponent korrek (grootte x korrekte trigverhou):

Two other x-components correct (magnitude x correct trig ratio): ✓
Twee ander x-komponente korrek (grootte x korrekte trigverhou):

One y-component correct (magnitude x correct trig ratio): ✓
Een y-komponent korrek (grootte x korrekte trigverhou):

Two other y-components correct (magnitude x correct trig ratio): ✓
Twee ander y-komponente korrek (grootte x korrekte trigverhou):

X:		
$F_{1x} = F_1\sin\theta$ $= 60\sin 15°$ $= 15{,}53$ N	$F_{2x} = F_2\cos\theta$ $= 70\cos 30°$ $= 60{,}62$ N	$F_{3x} = F_3\cos\theta$ $= 90\cos 60°$ = 45 N
$F_{Rx} = F_{1x} + F_{2x} + F_{3x}$ = 15,53 N+ 60,62 N – 45 N = 31,15 N		

Y:		
$F_{1y} = F_1\sin\theta$ $= 60\cos 15°$ = 57,95 N	$F_{2y} = F_2\cos\theta$ $= 70\sin 30°$ = 35 N	$F_{3y} = F_3\cos\theta$ $= 90\sin 60°$ = 77,94 N
$F_{Rx} = F_1y + F_2y + F_3y$ = 57,95 N+ 35 N – 77,94 N = 15,01 N up		

$$F_R = \sqrt{(31{,}15)^2 + (15{,}01)^2}$$ ✓
= 34,58 N

Direction

$\theta = tan^{-1}\left(\frac{15{,}01}{31{,}15}\right)$✓ = 25 ,73°✓	$\theta = sin^{-1}\left(\frac{15{,}01}{34{,}58}\right)$ = 25,73°	$\theta = cos^{-1}\left(\frac{31{,}15}{34{,}58}\right)$ = 25,73

(7)
[9]

QUESTION 3 / *VRAAG 3*

3.1 F_{net} = 0 / (Vector) sum of the forces is zero. ✓
(Vektor)som van die kragte is nul. (1)

3.2.1 $F_{R(V)} = FQ_V + FP_V$
$= Qsin\,30° + Psin\,60°$
$= 50\,sin30°$ ✓ $+ 25sin60°$ ✓
$= 46{,}65\,N$ ✓ (3)

3.2.2 **POSITIVE MARKING FROM 3.2.1. / *POSITIEWE NASIEN VANAF 3.2.1.***

w = mg ✓
46,65 =m(9,8) ✓
m = 4,76 kg ✓ (3)

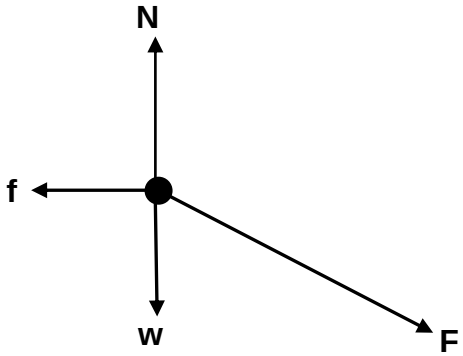
[7]

QUESTION 4 / *VRAAG 4*

4.1 A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it. ✓✓ **(2 or 0)**

'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid volhard tensy 'n nie-nul resulterende/netto krag daarop inwerk. (2)

4.2



Marking criteria / *Nasienriglyne*

✓	N / F_N / Normal /Normal force *Normaal / Normaalkrag*
✓	f / f_k / friction / frictional force / kinetic friction *wrywing / wrywingskrag / kinetiese wrywing*
✓	w / F_g / weight *gewig*
✓	F / $F_{applied}$ / Force / Force applied *$F_{toegepas}$ / Krag / Toegepaste krag*

(4)

4.3.1

$F_{net} = ma$
$F_H + (-f) = ma$
$F\cos\theta + (-\mu_k N) = ma$
$F\cos\theta + (-\mu_k (F_V + w)) = ma$
$F\cos\theta + (-\mu_k (F\sin\theta + mg)) = ma$ } Any ✓

$\underline{F\cos 30^0}$ ✓ $- \underline{0{,}3}$ ✓ $(\underline{F\sin 30^0 + 60 \times 9{,}8}$ ✓ $) = \underline{0}$ ✓

$F\cos 30^0 - 0{,}3\,F\sin 30^0 - 0{,}3 \times 60 \times 9{,}8 = 0$

$F(\cos 30^0 - 0{,}3 \sin 30^0) = 0{,}3 \times 60 \times 9{,}8$

$F = 246{,}36$ N ✓ (6)

4.3.2 **POSITIVE MARKING FROM 4.3.1. / *POSITIEWE NASIEN VANAF 4.3.1.***

$f_K = \mu_k N$✓
$= 0,3(246,36 \sin 30° + 60 \times 9,8)$ ✓
$= 213,354$ N✓ (3)

4.4

Increases ✓	Toeneem
Normal force decreases. ✓	Normaalkrag word kleiner.
f decreases; constant μ_k.✓	f neem af; konstante μ_k.
F_{net} (hor)increases. ✓	F_{net} (hor) neem toe. (4)

[19]

QUESTION 5 / *VRAAG 5*

5.1.1 Normal force ✓ *Normaalkrag* (1)

5.1.2 Force of table on Earth ✓ Krag van tafel op Aarde (1)

5.1.3 Non-contact (forces) ✓ Nie-kontak(kragte) (1)

5.2.1 Each particle in the universe attracts every other particle with a gravitational force that is directly proportional to the product of their masses✓ and inversely proportional to the square of the distance between them/their centres.✓

Elke deeltjie in die heelal trek elke ander deeltjie aan met 'n gravitasiekrag wat direk eweredig aan die produk van hulle massas en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle middelpunte is. (2)

5.2.2

On Earth / *Op Aarde*
w = mg ✓
= 65 x 9,8 ✓
= 637 N

On mountain / *Op berg*

OPTION 1 / *OPSIE 1*

$F_g = G\frac{m_1 m_2}{d^2}$ ✓
$= \frac{6,67 \times 10^{-11}\,(5,98 \times 10^{24})(65)}{(5\,895 + 6,38 \times 10^{6})^2}$ ✓✓
= 635,765 N

OPTION 2 / *OPSIE 2*

$g = G\frac{M}{d^2}$ ✓
$= \frac{6,67 \times 10^{-11}(5,98 \times 10^{24})}{(5\,895 + 6,38 \times 10^{6})^2}$ ✓
$= 9,78\ m \cdot s^{-2}$
$F_g = mg = (9,87)(65) = 635,765\ N$ ✓

Difference/*Verskil* = 637 - 635,765 ✓
= 1,23 N ✓

(7)

[12]

QUESTION 6 / *VRAAG 6*

6.1.1 The magnitude of the electrostatic force exerted by two-point charges (Q1 and Q2) on each other is directly proportional to the product of the magnitudes of the charges✓ and inversely proportional to the square of the distance (r) between them. ✓

Die grootte van die elektrostatiese krag wat deur twee puntladings (Q1 en Q2) op mekaar uitgeoefen word, is direk eweredig aan die produk van die grootte van die ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle. (2)

6.1.2
$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$
$$= \frac{(9 \times 10^9)(20 \times 10^{-6})(40 \times 10^{-6})}{(50 \times 10^{-2})^2} \checkmark$$
$$= 28{,}8 \text{ N} \checkmark$$
(4)

6.2
$$E_y = \frac{kQ}{r^2} \checkmark$$
$$= \frac{(9 \times 10^9)(40 \times 10^{-6})}{(20 \times 10^{-2})^2} \checkmark$$
$$= 9 \times 10^6 \text{ N.C}^{-1}$$

$$E_x = \frac{kQ}{r^2}$$
$$= \frac{(9 \times 10^9)(20 \times 10^{-6})}{(50 \times 10^{-2})^2} \checkmark$$
$$= 7{,}2 \times 10^5 \text{ N.C}^{-1}$$
$$E_{net} = \sqrt{E(x)^2 + E(y)^2} \checkmark$$
$$= \sqrt{(7{,}2 \times 10^5)^2 + (9 \times 10^6)^2} \checkmark$$
$$= 9{,}03 \times 10^6 \text{ N.C}^{-1} \checkmark$$
(6)
[12]

QUESTION 7 / *VRAAG 7*

7.1.1. Right (hand) ✓ Regter(hand) (1)

7.1.2 **X** ✓✓ (2)

7.2.1 There is relative motion between the solenoid and the magnet. ✓✓
Daar is relatiewe beweging tussen die solenoïed en die magneet. (2)

7.2.2 Right hand (rule) ✓ Regterhand(reël) (1)

7.2.3 The magnitude of the induced emf across the ends of a conductor is directly proportional to the rate of change in magnetic flux linkage with the conductor. ✓✓

Die grootte van die geïnduseerde emk oor die ente van 'n geleier is direk eweredig aan die tempo van verandering van die magnetiese vloedkoppeling met die geleier. (2)

7.2.4 Use a stronger magnet. ✓
Move the magnet faster in and out of the solenoid. ✓
Increase the number of turns on the solenoid.✓

Gebruik 'n sterker magneet.
Beweeg die magneet vinniger in en uit die solenoïed.
Vermeerder die aantal windings op die solenoïed. (3)

[11]

QUESTION 8 / *VRAAG 8*

8.1

OPTION 1 / *OPSIE 1*

Cost = Energy × tariff
= P × Δt × tariff ✓
$= \frac{3500}{1000}$ ✓× 4 × R 1,20✓
= R16,80 ✓

OPTION 2 / *OPSIE 2*

$P = \frac{W}{\Delta t}$ ✓
$3500 = \frac{W}{4}$ ✓
$\therefore W = 1400\ Wh$
$= 14\ kWh$
$Cost = 14 \times 1{,}20$ ✓
= R16,80 ✓

(4)

8.2.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature.✓✓ **(2 or 0)**

Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur. (2)

8.2.2 V = IR ✓
12 = I (6 + 2) ✓
I = 1,5 A✓ (3)

8.2.3 V = IR
V = 1,5 × 6 ✓
= 9 V ✓ (2)

8.3 Let/Laat A_2 (I_2) = y
∴ A_1 (I_1) = 3y
$V_{6\Omega} = I_{6\Omega}(R_{6\Omega})$
= 6(3y - y)✓
= 12y✓

$V_{6\Omega} = V_p = V_R$
V = IR
12y = yR✓
∴ R = 12Ω ✓

(4)

[15]

QUESTION 9 / *VRAAG 9*

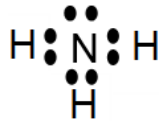
9.1.1 A pair of electrons ✓in the valence shell of an atom that is not shared with another atom. ✓

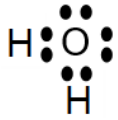
'n Elektronpaar in die valensskil van 'n atoom wat nie met 'n ander atoom gedeel word nie. (2)

9.1.2 NH_3/ammonia/a ✓✓ NH_3/ammoniak (2)

9.1.3 H_2O: Angular/bent ✓ H_2O: Hoekig/Gebuig
NH_3: Trigonal pyramidal ✓ NH_3: Trigonaal piramidaal (2)

9.1.4





NH_3:
3 x shared pairs of electrons ✓
3 x gedeelde elektronpare
1 x lone pair ✓
1 x alleenpaar

NH_3:
2 x shared pairs of electrons ✓
2 x gedeelde elektronpare
2 x lone pairs ✓
2 x alleenpare

(4)

9.2.1 The energy needed to break one mole of its molecules into separate atoms. ✓✓ (**2 or 0**)

Die energie benodig om een mol van sy molekule op te breek in aparte atome. (2)

9.2.2 O_2 has a double bond; OH^- a single bond. ✓
O_2 het 'n dubbelbinding; OH^- 'n enkelbinding.
OR/*OF*
OH^- has a single bond. ✓
OH^- het 'n enkelbinding.
OR/*OF*
A double bond is stronger ✓ than a single bond.
'n Dubbelbinding is sterker as 'n enkelbinding.
OR/*OF*
A single bond is weaker ✓ than a double bond.
'n Enkelbinding is swakker as 'n dubbelbinding.

- Atomic size ✓
- Bond length ✓
- Bond order ✓

(1)

9.3.3 Atomic size ✓ Bond length ✓ Bond order ✓
Atoomgrootte Bindingslengte Bindingsorde (3)
[16]

QUESTION 10 / *VRAAG 10*

10.1 The temperature at which the vapour pressure of a substance equals the atmospheric (external) pressure. ✓✓ (**2 or 0**)

Die temperatuur waarby die dampdruk van 'n stof gelyk is aan atmosferiese druk. (2)

10.2 Gas ✓✓ (2)

10.3.1

Marking criteria / Nasienriglyne

- State London/dispersion/induced dipole forces in **A**. ✓
  Noem London/dispersie/geïnduseerde dipoolkragte in **A**.
- State hydrogen bonds in **B**. ✓
  Noem waterstofbindings in **B**.
- Compare strengths of IMFs. ✓
  Vergelyk sterkte van IMK'e.
- Compare energies required. ✓
  Vergelyk energie benodig.

- There are London/dispersion/induced dipole forces between the molecules of CH_4/compound **A**. ✓
  *Daar is London/dispersie/geïnduseerde dipoolkragte tussen die molekule van CH_4/verbinding **A**.*

- There are hydrogen bonds between the molecules of H_2O/ compound **B**.✓
  *Daar is waterstofbindings tussen die molekule van H_2O/ verbinding **B**.*

- Compound **B**/H_2O has stronger/more intermolecular/Van der Waals forces.✓
  *Verbinding **B**/H_2O het sterkter intermolekulêre/Van der Waalskragte.*

- More energy is needed to overcome/break intermolecular forces in H_2O/compound **B**. ✓
  *Meer energie is nodig om die intermolekulêre kragte in H_2O/verbinding **B** te oorkom/breek.*

Note: Correct alternative arguments accepted as usual.
Nota: Korrekte alternatiewe argumente word aanvaar soos gewoonlik. (4)

10.3.2 • Both compounds **C** and **D** have dipole-dipole forces/are hydrogen halides. ✓
*Beide verbindings **C** en **D** het dipool-dipoolkragte/is waterstofhaliede.*

• Compound **C** has a larger molecular mass/size than compound **D**. ✓
*Verbinding C het 'n groter molekulêre massa/grootte as verbinding **D**.*

• Compound **C**/HI has stronger/more intermolecular/Van der Waals forces. ✓
*Verbinding **C**/HI het sterker/meer intermolekulêre/Van der Waals-kragte.*

• More energy is needed to overcome/break intermolecular forces in **C**/HI ✓
*Meer energie is nodig om die intermolekulêre kragte in **C**/HI te oorkom/te breek.*

Note: Correct alternative arguments accepted as usual.
Nota: Korrekte alternatiewe argumente word aanvaar soos gewoonlik. (4)

10.4 Lower/*Laer* ✓

-

Boiling point of **B** is higher than boiling point of **C**. ✓
*Kookpunt van **B** is hoër as kookpunt van **C**.* (2)
[14]

QUESTION 11 / *VRAAG 11*

11.1 The reactant that is used up first (completely) during a chemical reaction. ✓✓ **(2 or 0)**

Die reaktant wat tydens 'n chemiese reaksie eerste opgebruik word (volledig). (2)

11.2 N_2/nitrogen ✓ It touches the x-axis/it is used up. ✓✓
N_2/stikstof *Dit raak die x-as/dit word opgebruik.* (3)

11.3

Marking criteria / *Nasienriglyne*

- Formula/*Formule* $n = \frac{m}{M}$ ✓
- Substitute 28 g·mol^{-1} in $n = \frac{m}{M}$ ✓
  Vervang
- Use of mole ratio $n(NH_3)$: $n(N_2)$ = 2 : 1 ✓
  Gebruik molverhouding
- Substitute 17 g·mol^{-1} in $n = \frac{m}{M}$ ✓
  Vervang
- Answer: 14,57 g ✓ (14,57-14,62)
  Antwoord

$$n(N_2) = \frac{m}{M} \quad \checkmark$$
$$= \frac{12}{28} \quad \checkmark$$
$$= 0{,}42857\ mol$$

$n(NH_3)$ = 2(0,42857) ✓ = 0,857 mol

$$n(NH_3) = \frac{m}{M}$$
$$0{,}857 = \frac{m}{17} \quad \checkmark$$
$$m = 14{,}57\ g \quad \checkmark$$

(5)

11.4

Marking criteria / *Nasienriglyne*

- $n(H_2) : n(N_2) = 3 : 1$ or/of $n(H_2) : n(NH_3) = 3 : 2$ ✓
- $n = \frac{m}{M}$ ✓
- Substitute 2 g·mol^{-1} in $n = \frac{m}{M}$ ✓
  Vervang
- $m(H_2)_{ini} - m(H_2)_{rea}$ ✓
  Answer = 7,43 g✓
  Antwoord

OPTION 1

$n(H_2) = 3n(N_2)$ ✓
$= 3(0,42857) = 1,2857$ mol

$n(H_2) = \frac{m}{M}$ ✓

$1,2857 = \frac{m}{2}$ ✓

$m = 2,571\ g$

$m(X) = m(H_2)_{ini} - m(H_2)_{rea}$
$= 10 - 2,571$ ✓
$= 7,43$ g ✓

OPTION 2

$n(H_2) = {}^{3}/_{2}\,n(NH_3)$ ✓
$= {}^{3}/_{2}(0,857)$
$= 1,2855$ mol

$n(H_2) = \frac{m}{M}$ ✓

$1,2855 = \frac{m}{2}$ ✓

$m = 2,571\ g$

$m(X) = m(H_2)_{ini} - m(H_2)_{rea}$
$= 10 - 2,571$ ✓
$= 7,43$ g ✓

(5)
[15]

GRAND TOTAL / *GROOTTOTAAL*: 150