education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE/*GRAAD* 12

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

MEMORANDUM

FEBRUARY/*FEBRUARIE*/MARCH/*MAART* 2009

MARKS/*PUNTE*: 150

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

Learning Outcomes and Assessment Standards ***Leeruitkomste en Assesseringstandaarde***		
LO1/*LU1*	**LO2/*LU2***	**LO3/*LU3***
AS 12.1.1: Design, plan and conduct a scientific inquiry to collect data systematically with regard to accuracy, reliability and the need to control variables. *Ontwerp, beplan en voer 'n wetenskaplike ondersoek uit om data te versamel ten opsigte van akkuraatheid, betroubaarheid en die kontroleer van veranderlikes.* **AS 12.1.2:** Seek patterns and trends, represent them in different forms, explain the trends, use scientific reasoning to draw and evaluate conclusions, and formulate generalisations. *Soek patrone en tendense, stel dit in verskillende vorms voor, verduidelik tendense, gebruik wetenskaplike beredenering om gevolgtrekkings te maak en te evalueer, en formuleer veralgemenings.* **AS 12.1.3:** Select and use appropriate problem-solving strategies to solve (unseen) problems. *Kies en gebruik geskikte probleemoplossingsstrategieë om (ongesiene) probleme op te los.*	**AS 12.2.1:** Define, discuss and explain prescribed scientific knowledge. *Definieer, bespreek en verduidelik voorgeskrewe wetenskaplike kennis.* **AS 12.2.2** Express and explain prescribed scientific principles, theories, models and laws by indicating the relationship between different facts and concepts in own words. *Verduidelik en druk voorgeskrewe wetenskaplike beginsels, teorieë, modelle en wette uit deur die verwantskap tussen verskillende feite konsepte in eie woorde aan te dui.* **AS 12.2.3:** Apply scientific knowledge in everyday life contexts. *Pas wetenskaplike kennis in kontekste van die alledaagse lewe toe.*	**AS 12.3.2:** Research case studies and present ethical and moral arguments from different perspectives to indicate the impact (pros and cons) of different scientific and technological applications. *Vors gevallestudies na en lewer etiese en morele argumente uit verskillende perspektiewe om die impak (voordele en nadele) van verskillende wetenskaplike en tegnologiese toepassings aan te dui.* **AS 12.3.3:** Evaluate the impact of scientific and technological research and indicate the contribution to the management, utilisation and development of resources to ensure sustainability continentally and globally. *Evalueer die impak van wetenskaplike en tegnologiese navorsing en dui die bydrae tot diebestuur, benutting en ontwikkeling van bronne aan om volhoubaarheid kontinentaal en globaal te verseker.*

SECTION A/*AFDELING A*

QUESTION 1/*VRAAG 1*

1.1 Gravitational force/*gravitasiekrag* ✓
or/*of*
weight/*gewig* [12.2.1] (1)

1.2 Energy/*energie* ✓ [12.2.1] (1)

1.3 Diffraction/*diffraksie* ✓ [12.2.1] (1)

1.4 Coulomb's law/*Coulomb se wet* ✓ [12.2.1] (1)

1.5 Gamma rays/*Gammastrale* ✓ [12.2.1] (1)
[5]

QUESTION 2/*VRAAG 2*

2.1 E✓ [12.2.1] (1)

2.2 D✓ [12.2.1] (1)

2.3 B✓ [12.2.1] (1)

2.4 G✓ [12.2.1] (1)

2.5 C✓ [12.2.1] (1)
[5]

QUESTION 3/*VRAAG 3*

3.1 False/Onwaar ✓
… the force applied by the child is too small to overcome the inertia of the crate/frictional forces.
… *die krag uitgeoefen deur die kind is te klein om die traagheid van die krat/wrywingskragte te oorkom.*✓

OR/OF

… the net force on the crate is zero. ✓
…die nettokrag op die krat is nul. ✓ [12.2.3] (2)

3.2 True/*Waar* ✓✓ [12.2.2] (2)

3.3 False/*Onwaar* ✓
…frequency of the source remains the same …✓
… frekwensie van die bron bly dieselfde …✓ [12.2.2] (2)

3.4 False/*Onwaar*✓
directly proportional to the potential difference across its ends✓/ *direk eweredig aan die potensiaalverskil en omgekeerd eweredig aan die weerstand* [12.2.2] (2)

3.5 True/*Waar* ✓✓ [12.2.3] (2)
[10]

QUESTION 4/*VRAAG 4*

4.1 D ✓✓✓ [12.2.3] (3)

4.2 C ✓✓✓ [12.1.3] (3)

4.3 C ✓✓✓ [12.2.3] (3)

4.4 D ✓✓✓ [12.2.3] (3)

4.5 B ✓✓✓ [12.2.3] (3)
[15]

TOTAL SECTION A: 35
***TOTAAL AFDELING A:* 35**

SECTION B/*AFDELING B*

QUESTION 5/*VRAAG 5*

5.1 $v_f^2 = v_i^2 + 2a\Delta x$ ✓
$v_f^2 = (0)^2 + 2(-9,8)(25)$✓
$v_f = -22,13$ or $22,13$ m·s^{-1} down/*afwaarts*✓

OR/OF

E_t(top/*bo*) = E_t(bottom/*onder*)
$E_p + E_k = E_p + E_k$
$mgh + 0 = 0 + \frac{1}{2}mv_f^2$ ✓
$(0,3)(9,8)(25) + 0 = 0 + \frac{1}{2}(0,3)v_f^2$ ✓
$v_f = 22,13$ m·s^{-1} downward/*afwaarts*✓ [12.2.3] (3)

5.2 Consider upward motion as positive:/ *Beskou opwaartse beweging as positief:*
$v_f^2 = v_i^2 + 2a\Delta x$ ✓
$0 = v_i^2 + 2(-9,8)(6)^2$ ✓
$v_i = 10,84$ m·s^{-1} ✓

Impulse/*Impuls* = Δp ✓
= [(0,3)(10,84) – (0,3)(- 22,13)]✓
= + 9,89 N·s ✓ i.e. 9,89 N·s upward/*opwaarts*✓

OR/OF

Consider upward motion as negative:/*Beskou opwaartse beweging as negatief*
$v_f^2 = v_i^2 + 2a\Delta x$ ✓
$0 = v_i^2 + 2(9,8)(-6)^2$ ✓
$v_i = -10,84$ m·s^{-1} ✓

Impulse/*Impuls* = Δp ✓
= [(0,3)(- 10,84) – (0,3)(22,13)]✓
= - 9,89 N·s✓ i.e. 9,89 N·s upward/*opwaarts* ✓

OR/OF

E_t(top/*bo*) = E_t(bottom/*onder*)
$E_p + E_k = E_p + E_k$
$mgh + 0 = 0 + \frac{1}{2}mv_f^2$ ✓
$(0,3)(9,8)(6) + 0 = 0 + \frac{1}{2}(0,3)v_f^2$ ✓
$v_f = 10,84$ m·s^{-1} upward/*opwaarts*✓

Impulse/*Impuls* = Δp ✓
= [(0,3)(10,84) – (0,3)(- 22,13)]✓
= + 9,89 N·s ✓ i.e. 9,89 N·s upward/*opwaarts*✓ [12.1.3] (7)

5.3 Take upward as positive:/*Neem opwaarts as positief:*

$F_{net}\Delta t = \Delta p$✓

$F_{net} = \frac{\Delta p}{\Delta t} = \frac{+9,89}{0,9}$ ✓ =+ 10,99 N✓i.e.10,99 N (11 N) upward/*opwaarts*

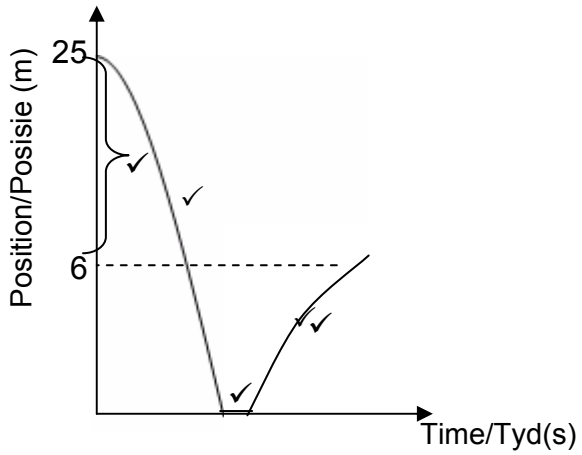
Take upward as negative:/*Neem opwaarts as negatief:*

$F_{net}\Delta t = \Delta p$✓

$F_{net} = \frac{\Delta p}{\Delta t} = \frac{-9,89}{0,9}$ ✓ = - 10,99 N ✓i.e. 10,99 N (11 N)

upward/*opwaarts* [12.2.3] (3)

5.4



Checklist/*Kontrolelys* Criteria for graph/*Kriteria vir grafiek*	Marks/ *Punte*
Maximum original height indicated as 25 m and height of 2nd bounce as 6 m *Maksimum oorspronklike hoogte aangedui as 25 m en hoogte van tweede hop as 6 m*	✓
Correct shape between 25 m and 0 m *Korrekte vorm tussen 25 m en 0 m*	✓
Graph on x-axis between first reaching the floor and 2nd bounce *Grafiek op x-as wanneer dit die vloer tref en die 2de hop*	✓
Correct shape between 0 m and 6 m. *Korrekte vorm van grafiek tussen 0 m en 6 m.*	✓

[12.1.2] (4)

5.5 Smaller ✓

Contact time for softer ball is longer ✓than for rigid ball

According to $F_{net}\Delta t = \Delta p$, the force exerted by floor on softer ball is smaller than on the rigid ball. ✓.

Kleiner

Kontak tyd vir sagter bal is langer ✓ *as vir stewige bal*

Volgens $F_{net}\Delta t = \Delta p$, is die krag deur die vloer op sagter bal uitgeoefen kleiner as die op die stewige bal. ✓. [12.3.2] (3)

[20]

QUESTION 6/*VRAAG 6*

6.1.1 $W_{net} = \Delta E_p + \Delta E_k$ ✓
$\therefore W_{net} = (mgh_f - mgh_i) + (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2)$
$\therefore 7 \times 10^5$ ✓ $- 8,5 \times 10^4$ ✓ $= 10\,000(9,8)(h_f - 0)$ ✓ $+ 0$ ✓
$\therefore 6,15 \times 10^5 = 10\,000(9,8)h_f$
$\therefore h_f = 6,28$ m ✓

OR/*OF*

Useful work done = gain in Ep ✓ = mgh ✓
Bruikbare arbeid verrig = wins aan Ep ✓ = mgh ✓
$\therefore 7 \times 10^5$ ✓ $- 8,5 \times 10^4$ ✓ $= 10\,000(9,8)h$ ✓
$\therefore 6,15 \times 10^5 = 10\,000(9,8)h_f$
$\therefore h = 6,28$ m ✓ [12.1.3] (6)

6.1.2 $W = F\Delta x \cos\theta$ ✓
$\therefore 7 \times 10^5 = F(23)(1)$ ✓
$\therefore F = 3,04 \times 10^4$ N ✓

$P = Fv$ ✓
$= (3,04 \times 10^4)(\frac{20\,000}{60 \times 60})$ ✓
$= 1,6 \times 10^5$ W ✓ [12.1.3] (6)

6.2 Any TWO/*Enige TWEE:*
Surface must provide sufficient friction like sand ✓
Must be long enough for vehicle to stop. ✓
Oppervlak moet genoeg wrywing lewer soos sand ✓
Moet lank genoeg wees om die voertuig tot stilstand te bring✓ [12.3.2] (2) **[14]**

QUESTION 7/*VRAAG 7*

7.1 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

$= (\frac{1500 \pm 0}{1500 - 20})$ ✓(250×10^3) ✓

$= 253,38 \times 10^3$ Hz (253,38 kHz) ✓ [12.2.3] (4)

7.2 Remains the same ✓
The detected frequency is independent of the distance between the source and observer. ✓
Bly dieselfde ✓
Die waargenome frekwensie is onafhanklik van die afstand tussen die bron en die waarnemer✓ [12.2.2] (2) **[6]**

QUESTION 8/*VRAAG 8*

8.1.1 D: cyan ✓/*siaan*✓
E: yellow ✓/*geel* ✓
F: magenta ✓/ *magenta*✓ [12.2.3] (3)

8.1.2 All other colours can be obtained by mixing of these three colours ✓✓ /
Al die ander kleure kan verkry word deur hierdie drie kleure te meng✓✓ [12.2.1] (2)

8.2.1 Green ✓/*Groen* ✓ [12.2.3] (1)

8.2.2 The yellow filter transmits red and green ✓and absorbs blue light. ✓
The cyan filter transmits the green light ✓and absorbs the red light. ✓
Die geel filter laat rooi en groen lig deur✓ *en absorbeer blou lig*✓
Die siaanfilter laat groen lig deur ✓*en absorbeer rooi lig*✓ [12.2.3] (4)

8.2.3 Red ✓/*rooi* ✓ [12.2.3] (1)
[11]

QUESTION 9/*VRAAG 9*

9.1 Each point on the wavefront acts as a source of spherical secondary waves or wavelets travelling away from source. ✓✓
Elke punt of die golffront dien as 'n bron van sferiese sekondêre golwe of golfies wat weg vanaf die bron beweeg ✓✓ [12.2.1] (2)

9.2 Each point on the initial plane wavefront entering the slit acts as a source of secondary wavelets. ✓ The wavelets propagate in all directions ✓ beyond the slit causing the wave to spread into regions beyond those in line with the slit. ✓
Elke punt op die aanvanklike vlakgolffront wat die spleet binnegaan dien as 'n bron van sekondêre golfies. ✓ *Die golfies word in alle rigtings* ✓*aan die anderkant van die spleet propageer wat veroorsaak dat die golf in gebiede verder as dié in lyn met die van die spleet, sprei* ✓ [12.2.3] (3)

9.3 $\sin\theta = m\frac{\lambda}{a}$ ✓ ∴ $\sin 15° = 1 \times \frac{650 \times 10^{-9}}{a}$ ✓ ∴ $a = 2{,}7 \times 10^{-6}$ m ✓ [12.2.3] (3)
[8]

QUESTION 10/*VRAAG 10*

10.1 $C = \frac{\varepsilon_o A}{d}$ ✓ $= \frac{(8{,}85 \times 10^{-12})(40 \times 10^{-4})}{(0{,}01)}$ ✓ = 3,54 x 10^{-12} F

Q = CV✓
= (3,54 x 10^{-12})(12) ✓
= 4,25 x 10^{-11} C✓ [12.1.3] (5)

10.2 half ✓
Half the area will store half the amount of charge OR C α A ✓
and C α Q, thus C is halved ✓
Helfte✓
Helfte die oppervlak (area) sal die helfte van die aantal lading stoor OF
C α A ✓ en C α Q, dus is C halveer ✓ [12.2.2] (3)

10.3 net charge = 0 C ✓/ *netto lading = 0 C* ✓ [12.2.3] (1)

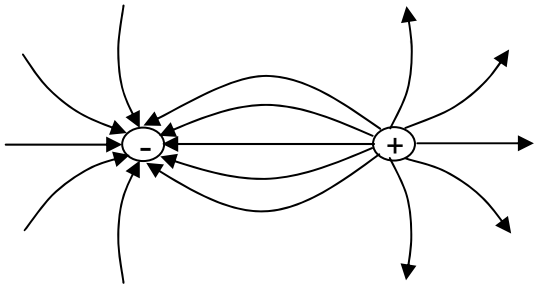
10.4 Discharges almost instantly to deliver flash light ✓/ *Ontlaai amper onmiddellik om 'n flits te lewer*✓ [12.3.2] (1)

[10]

QUESTION 11/*VRAAG 11*

11.1 (Electric) Force experienced per (positive) charge placed at the point.✓✓
(Elektriese) Krag ondervind per (positiewe) lading geplaas by die punt✓✓ [12.2.1] (2)

11.2



Checklist/*Kontrolelys* Criteria for electric field/*Kriteria vir elektriese veld*	Marks/ *Punte*
Direction *Rigting*	✓
Shape *Vorm*	✓
Field lines not touching each other or entering the spheres *Veldlyne raak nie mekaar nie of wat die sfere binnegaan*	✓

[12.1.2] (3)

11.3 Electric field at P due to Q_1:/*Elektriese veld by P as gevolg van* Q_1

$E = \frac{kQ}{r^2}$ ✓ $= \frac{9\times10^{9}\times14\times10^{-6}}{1^2}$ ✓= 1,26 x 10^5 N·C^{-1} to the left/*na links*

Electric field at P due to Q_2: *Elektriese veld by P as gevolg van* Q_2

$E = \frac{kQ}{r^2} = \frac{9\times10^{9}\times20\times10^{-6}}{2^2}$ ✓= 4,5 x 10^4 N·C^{-1} to the left/*na links*

E_{net} = 1,26 x 10^5 + 4,5 x 10^4 N·C^{-1} ✓= 1,71 x 10^5 N·C^{-1} to the left/*na links*✓

[12.1.3] (5)
[10]

QUESTION 12/*VRAAG 12*

12.1 $\frac{1}{R_e} = \frac{1}{r_1} + \frac{1}{r_2} = \frac{1}{9}$ ✓ + $\frac{1}{23}$ ✓
R = 6,47 Ω ✓

R_{tot} = 6,47 + 2 + 0,2 = 8,67 Ω ✓

$I = \frac{V}{R} = \frac{12}{8,67}$ ✓ = 1,41 A✓

[12.1.3] (6)

12.2 Decreases ✓/*Afneem*

Effective resistance of circuit decreases ✓ (No current through 15 Ω and 8 Ω resistances)
Current increases ✓
Ir (lost volts) increases ✓
$V_{external}$ decreases

Effektiewe weerstand van die stroombaan neem af ✓ (Geen stroom deur die 15 Ω*- en 8* Ω*-weerstande)*
Stroom neem toe ✓
Ir (verlore volts) neem toe ✓
$V_{ekstern}$ *neem af*

[12.2.2] (4)
[10]

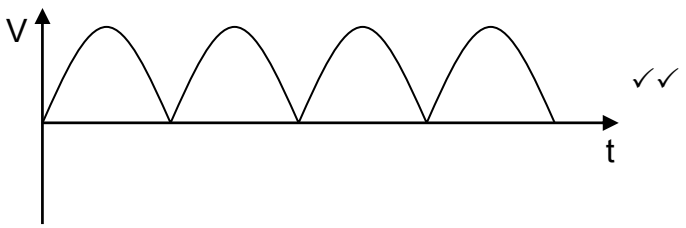
QUESTION 13/*VRAAG 13*

13.1.1 DC ✓ A splitring-commutator ✓ is used to ensure that the current in the loop remains in the same direction through the complete cycle. / *GS✓ / 'n Spitringkommutator✓ word gebruik om te verseker dat die stroom in die spoel in dieselfde rigting bly tydens die volledige siklus.* [12.1.2] (2)

13.1.2 B to A ✓/ *B na A✓* [12.1.2] (1)

13.1.3 Electromagnetic induction ✓/*Elektromagnetiese induksie✓* [12.2.1] (1)

13.1.4



✓✓

[12.1.2] (2)

13.2 When the magnet rotates the changing magnetic flux✓cuts through the windings of the coil ✓and induces a current in the coil. / *Wanneer die magnet roteer sny die veranderende magnetiese vloed ✓deur die windings van die spoel✓ en induseer 'n stroom in die spoel.* [12.2.3] (2)

[8]

QUESTION 14/*VRAAG 14*

14.1.1 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $\therefore V_{max} = 15(\sqrt{2}) = 21{,}21$ V ✓ [12.2.3] (2)

14.1.2 $R_{total} = 8{,}2 + 10{,}4 = 18{,}6\ \Omega$ ✓

$I = \frac{V}{R}$ ✓ $= \frac{15}{18{,}6}$ ✓$= 0{,}81$ A

$P = I^2R$ ✓$= (0{,}81)^2(10{,}4)$ ✓$= 6{,}76$ W ✓ [12.1.3] (6)

14.2
- With alternating current long distance transmission may be at high voltage and low current, less loss in energy and therefore more energy available for use. ✓/ *Met wisselstroom mag langafstand geleiding teen hoë spanning and lae stroom geskied, minder verlies in energie en daarom meer energie vir verbruik beskikbaar.✓*
- AC allows power stations to be relatively remote from users, so users are isolated from environmental affects of the stations. This remote delivery may save energy elsewhere (e.g. goods transport and commuting). ✓/ *WS maak dit moontlik vir kragstasies om relatief afgeleë van verbruikers te wees, sodoende word verbruikers geïsoleer van die omgewingseffekte van die kragstasies. Hierdie afgeleë lewering mag energie elders bespaar (bv. goederevervoer en pendel)* ✓

[12.3.2] (2)

[10]

QUESTION 15/*VRAAG 15*

15.1 Different metals have different ionisation energies/Different metals attract electrons with different forces. ✓
Verskillende metale het verskillende ionisasie energieë / Verskillende metale trek elektrone aan met verskillende kragte✓ [12.2.1] (1)

15.2 $hf = W_0 + \frac{1}{2}mv^2$ ✓ and/*en* $c = f\lambda$ ✓

$$\frac{hc}{\lambda} = W_0 + \frac{1}{2}mv^2$$

$$\frac{(6{,}63 \times 10^{-34})(3 \times 10^{8})}{(2{,}3 \times 10^{-7})} \checkmark = W_o + \tfrac{1}{2}(9{,}11 \times 10^{-31})(4{,}78 \times 10^{5})^2 \checkmark$$

$W_0 = 7{,}58 \times 10^{-19}$ J✓

Metal X is silver ✓/*Metaal X is silwer*✓ [12.1.3] (6)

15.3 (Establish) particle nature of light ✓/(*Bevestig)die deeltjieaard van lig*✓ [12.2.1] (1)
[8]

TOTAL SECTION B/*TOTAAL AFDELING B:* *115*

GRAND TOTAL/*GROOTTOTAAL:* *150*