**NATIONAL
SENIOR CERTIFICATE**

GRADE/*GRAAD* 12

SEPTEMBER 2016

**PHYSICAL SCIENCES P1
FISIESE WETENSKAPPE V1
MEMORANDUM**

**MARKS/
PUNTE:** 150

GENERAL GUIDELINES/*ALGEMENE RIGLYNE*

1 CALCULATIONS/*BEREKENINGE*

1.1 **Marks will be awarded for**: correct formula, correct substitution, correct answer with unit.
Punte sal toegeken word vir: *korrekte formule, korrekte substitusie, korrekte antwoord met eenheid.*

1.2 **No marks** will be awarded if an **incorrect or inappropriate formula is used**, even though there are many relevant symbols and applicable substitutions.
*Geen punte sal toegeken word waar 'n **verkeerde of ontoepaslike formule gebruik** word nie, selfs al is daar relevante simbole en relevante substitusies.*

1.3 When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.
*Wanneer 'n fout gedurende **substitusie in 'n korrekte formule** begaan word, sal 'n punt vir die korrekte formule en vir korrekte substitusies toegeken word, maar **geen verdere punte** sal toegeken word nie.*

1.4 If **no formula** is given, but **all substitutions are correct**, a candidate will **forfeit one mark.**
*Indien **geen formule** gegee is nie, maar **al die substitusies is korrek, verloor** die kandidaat **een punt**.*

1.5 **No penalisation** if **zero substitutions are omitted** in calculations where **correct formula**/**principle** is correctly given.
*Geen penalisering indien **nulwaardes nie getoon** word nie in berekeninge waar die **formule/beginsel korrek gegee is nie**.*

1.6 Mathematical manipulations and change of subject of appropriate formulae carry no marks, but if a candidate starts off with the correct formula and then changes the subject of the formula incorrectly, marks will be awarded for the formula and correct substitutions. The mark for the incorrect numerical answer is forfeited.
Wiskundige manipulasies en verandering van die onderwerp van toepaslike formules tel geen punte nie, maar indien 'n kandidaat met die korrekte formule begin en dan die onderwerp van die formule verkeerde verander, sal die punte vir die formule en korrekte substitusies toegeken word. Die punt vir die verkeerde numeriese antwoord word verbeur.

1.7 Marks are only awarded for a formula if a **calculation has been attempted**, i.e. substitutions have been made or a numerical answer given.
Punte word slegs vir 'n formule toegeken indien 'n poging tot 'n berekening aangewend is, d.w.s. substitusies is gedoen of 'n numeriese antwoord is gegee.

1.8 Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.
Punte kan slegs toegeken word vir substitusies wanneer waardes in formule ingestel word en nie vir waardes wat voor 'n berekening gelys is nie.

1.9   All calculations, when not specified in the question, must be done to a minimum of two decimal places.
Alle berekenings, wanneer nie in die vraag gespesifiseer word nie, moet tot 'n minimum van twee desimale plekke gedoen word.

1.10   If a final answer to a calculation is correct, full marks will not automatically be awarded. Markers will always ensure that the correct/appropriate formula is used and that workings, including substitutions, are correct.
Indien 'n finale antwoord van 'n berekening korrek is, sal volpunte nie outomaties toegeken word nie. Nasieners sal altyd verseker dat die korrekte/toepaslike formule gebruik word en dat bewerkings, insluitende substitusies korrek is.

1.11   Questions where a series of calculations have to be made (e.g. a circuit diagram question) do not necessarily always have to follow the same order. FULL MARKS will be awarded provided it is a valid solution to the problem. However, any calculation that will not bring the candidate closer to the answer than the original data, will no count any marks.
Vrae waar 'n reeks berekeninge gedoen moet word (bv. 'n stroombaan-diagramvraag) hoef nie noodwendig dieselfde volgorde te hê nie. VOLPUNTE sal toegeken word op voorwaarde dat dit 'n geldige oplossing vir die probleem is. Enige berekening wat egter nie die kandidaat nader aan die antwoord as die oorspronklike data bring nie, sal geen punte tel nie.

2 UNITS/*EENHEDE*

2.1   Candidates will only be penalised once for the repeated use of an incorrect unit **within a question**.
*Kandidate sal slegs een keer gepenaliseer word vir die herhaaldelike gebruik van 'n verkeerde eenheid **in 'n vraag**.*

2.2   Units are only required in the final answer to a calculation.
Eenhede word slegs in die finale antwoord op 'n vraag verlang.

2.3   Marks are only awarded for an answer, and not for a unit *per se*. Candidates will therefore forfeit the mark allocated for the answer in each of the following situations:
- Correct answer + wrong unit
- Wrong answer + correct unit
- Correct answer + no unit

Punte sal slegs vir 'n antwoord en nie vir 'n eenheid per se toegeken word nie. Kandidate sal die punt vir die antwoord in die volgende gevalle verbeur:
- *Korrekte antwoord + verkeerde eenheid*
- *Verkeerde antwoord + korrekte eenheid*
- *Korrekte antwoord + geen eenheid*

2.4   SI units must be used except in certain cases, e.g. $V \cdot m^{-1}$ instead of $N \cdot C^{-1}$, and $cm \cdot s^{-1}$ or $km \cdot h^{-1}$ instead of $m \cdot s^{-1}$ where the question warrants this.
SI eenhede moet gebruik word, behalwe in sekere gevalle, bv. $V \cdot m^{-1}$ in plaas van $N \cdot C^{-1}$, en $cm \cdot s^{-1}$ of $km \cdot h^{-1}$ in plaas van $m \cdot s^{-1}$ waar die vraag dit regverdig.

3 **GENERAL/***ALGEMEEN*

3.1   If one answer or calculation is required, but two are given by the candidate, only the first one will be marked, irrespective of which one is correct. If two answers are required, only the first two will be marked, etc.
Indien een antwoord of berekening verlang word, maar twee word deur die kandidaat gegee, sal slegs die eerste een nagesien word, ongeag watter een korrek is. Indien twee antwoorde verlang word, sal slegs die eerste twee nagesien word, ens.

3.2   For marking purposes, alternative symbols (s, u, t etc) will also be accepted.
Vir nasiendoeleindes sal alternatiewe simbole (s, u, t, ens.) ook aanvaar word.

3.3   Separate compound units with a multiplication dot, no a full stop, for example, $m \cdot s^{-1}$. For marking purposes, $m \cdot s^{-1}$ and m/s will also be accepted.
Skei saamgestelde eenhede met 'n vermenigvuldigingspunt en nie met 'n punt nie, byvoorbeeld $m \cdot s^{-1}$. Vir nasiendoeleindes sal $m \cdot s^{-1}$ en m/s ook aanvaar word.

4 **POSITIVE MARKING/***POSITIEWE NASIEN*

Positive marking regarding calculations will be followed in the following cases:
Positiewe nasien met betrekking tot berekeninge sal in die volgende gevalle geld:

4.1   **Subquestion to subquestion**: When a certain variable is calculated in one subquestion (e.g. 3.1) and needs to be substituted in another (3.2 of 3.3), e.g. if the answer for 3.1 is incorrect and is substituted correctly in 3.2 or 3.3, **full marks** are to be awarded for the subsequent subquestions.
Subvraag na subvraag: *Wanneer 'n sekere veranderlike in een subvraag (bv. 3.1) bereken word en dan in 'n ander vervang moet word (3.2 of 3.3), bv. indien die antwoord vir 3.1 verkeerd is en word korrek in 3.2 of 3.3 vervang, word **volpunte** vir die daaropvolgende subvraag toegeken.*

4.2   **A multistep question in a subquestion**: If the candidate has to calculate, for example, current in die first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer will be forfeited.
*'n **Vraag met veelvuldige stappe in 'n subvraag**: Indien 'n kandidaat bv. die stroom verkeerd bereken in 'n eerste stap as gevolg van 'n substitusiefout, verloor die kandidaat die punt vir die substitusie sowel as die finale antwoord.*

5 **NEGATIVE MARKING/***NEGATIEWE NASIEN*

Normally an incorrect answer cannot be correctly motivated if based on a conceptual mistake. If the candidate is therefore required to motivate in QUESTION 3.2 the answer given in QUESTION 3.1, and 3.1 is incorrect, no marks can be awarded for QUESTION 3.2. However, if the answer for e.g. 3.1 is based on a calculation, the motivation for the incorrect answer could be considered.
'n Verkeerde antwoord, indien dit op 'n konsepsuele fout gebaseer is, kan normaalweg nie korrek gemotiveer word nie. Indien 'n kandidaat gevra word om in VRAAG 3.2 die antwoord op VRAAG 3.1 te motiveer en 3.1 is verkeerd, kan geen punte vir VRAAG 3.2 toegeken word nie. Indien die antwoord op bv. 3.1 egter op 'n berekening gebaseer is, kan die motivering vir die verkeerde antwoord in 3.2 oorweeg word.

QUESTION/*VRAAG* 1

1.1	C ✓✓	(2)
1.2	D ✓✓	(2)
1.3	C ✓✓	(2)
1.4	C ✓✓	(2)
1.5	B ✓✓	(2)
1.6	B ✓✓	(2)
1.7	A ✓✓	(2)
1.8	C ✓✓	(2)
1.9	D ✓✓	(2)
1.10	B ✓✓	(2)

[20]

QUESTION/*VRAAG 2*

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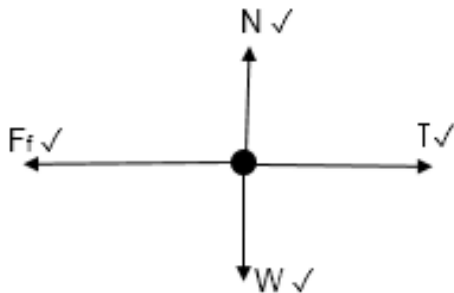
Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag teen <u>'n versnelling direk eweredig aan die krag</u> en <u>omgekeerde eweredig aan die massa</u> van die voorwerp.

OR/*OF*

The net force acting on an object is equal to the rate of change of momentum✓✓ of the object (in direction of the force).   (2 or 0)

Die netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering in momentum van die voorwerp (in die rigting van die krag). (2 of 0)   (2)

2.2

Accepted labels/Aanvaarde byskrifte	
N	F_N/ F_{normal}/Normal
	F_N/ $F_{normaal}$ /Normaal
T	F_T/Tension
	F/Spanning
w	F_g /F_w/weight/mg/gravitational force
	F_g /F_w/gewig/mg/gravitasiekrag
F_f	f/ friction
	f/wrywing

> **Notes/Aantekeninge:**
> - Mark awarded for <u>label and arrow</u>/
>   *Punt toegeken vir <u>byskrif en pyltjie</u>*
> - Do not penalize for length of arrows since drawing is not to scale/
>   *Moenie vir lengte van die pyltjie penaliseer nie aangesien die tekeninge nie volgens skaal is nie*
> - Any other additional force(s)/
>   *Enige addisionele krag(te)*   (-1 mark/*punt*)
> - If force(s) do not make contact with the body/
>   *Indien krag(te) nie met voorwerp kontak maak ni*e   (-1 mark/*punt*)
> - If arrows are omitted but correctly labelled/
>   *Indien pyltjies weggelaat is maar korrek benoem.*   (-1 mark/*punt*)   (4)

2.3 **On/*Op 6 kg:***

F_{net} = ma ⎤ ✓
F_g + (-T) = ma ⎦

(6 × 9,8) ✓ – T = 6 × a
   58,8 – T   = 6a
              T = 58,8 – 6a   (1)

On/*Op 4 kg*:

  F_{net} = ma ⎤
(-f) + T = ma ⎦   ✓ any one/*enige een*

(-32,53) ✓ + T =   4 × a
          T = 32,53 + 4a   (2)

 (1) - (2):   0 = (58,8 – 6a) – (32,53 + 4a) ✓
                     a = 2,63 m·s^{-2} ✓   (6)

2.4 **Positive marking from QUESTION 2.3/**
Positiewe nasien vanaf VRAAG 2.3:

    f_k = μ_k N ⎤✓ any one/*enige een*
    f_k = μ_k mg ⎦

32,53 = μ_k × 4 × 9,8 ✓
    μ_k = 0,83 ✓   (3)

2.5 DECREASE ✓
At an angle of 30° the tension force will have a component in the vertical direction ✓and the block will be slightly lifted up. The normal will decrease and friction is directly proportional normal. ✓
NEEM AF.
Teen 'n hoek van 30° het die spanningskrag 'n vertikale komponent en die blok sal effens gelig wees. Die normaal sal afneem en wrywing id direk eweredig aan die normaal.   (3)

[18]

QUESTION/*VRAAG* 3

3.1   0 m·s^{-1} ✓   (1)

3.2   g = 9,8 m/s^2 ✓ downwards/*afwaarts* ✓   (2)

3.3   3.3.1

OPTION/*OPSIE* 1 (downward positive/*afwaarts positief*)	**OPTION/*OPSIE* 2 (upwards positive/*opwaarts positief*)**
v_f = v_i + g∆t ✓	v_f^2 = v_i^2 + g∆t ✓
0 = (-18) + 9,8∆t ✓	0 = (18)^2 + (-9,8)∆t ✓
∆t = 1,84 s ✓	∆t = 1,84 s ✓

                                                                              (3)

        3.3.2

OPTION/*OPSIE* 1 Downwards is positive *Afwaarts positief*	**OPTION/*OPSIE* 2 Upwards is positive *Opwaarts positief***
v_f^2 = v_i^2 + 2a∆y ✓	v_f^2 = v_i^2 + 2a∆y ✓
v_f^2 = (-18)^2 +2 × (9,8)(-5) ✓	v_f^2 = (18)^2 +2 × (-9,8)(5) ✓
v_f^2 = 226	v_f^2 = 226
v_f = 15,033 m·s^{-1} downward /afwaarts ✓	v_f = 15,033 m·s^{-1} downward *Iafwaarts*✓

                                                                              (3)

3.3.3   **Downwards is positive**   **Upwards is positive**
          (*Afwaarts is positief)*   **(*Opwaarts is positief)***

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓	$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
$\underline{-5}$ ✓ $= \underline{-18 \Delta t + \frac{1}{2}(9,8)(\Delta t)^2}$ ✓	$\underline{5}$ ✓ $= \underline{18 \Delta t + \frac{1}{2}(-9,8)(\Delta t)^2}$ ✓
$-5 = -18\Delta t + 4,9(\Delta t)^2$	$5 = 18\Delta t - 4,9(\Delta t)^2$
$\Delta t = 3,37s$ or/*of* $\Delta t = 0,30s$	$\Delta t = 3,37s$ or/*of* $\Delta t = 0,30s$
$\therefore \Delta t = 3,37s$ ✓	$\therefore \Delta t = 3,37s$ ✓

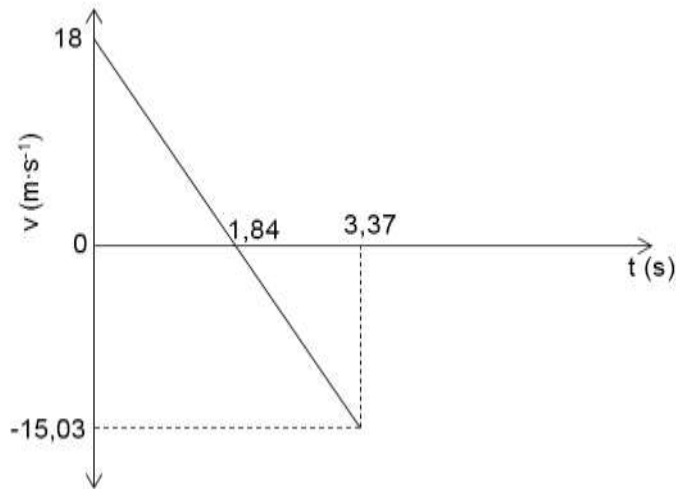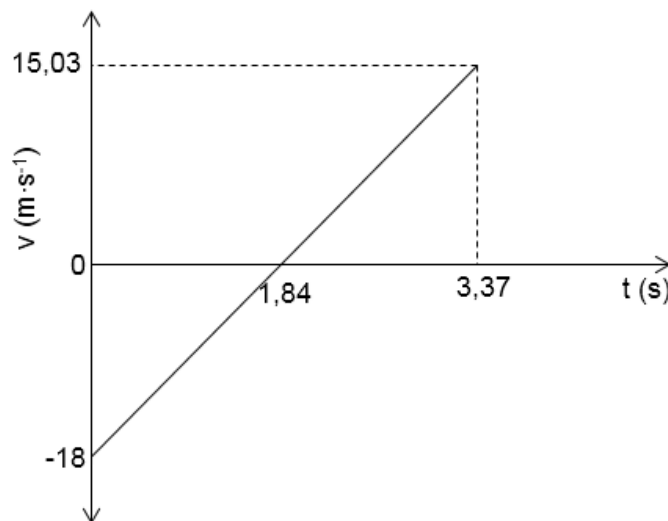| **OPTION/*OPSIE* 3**	**OPTION/*OPSIE* 4**
Time taken to reach maximum height from the ground./ *Tyd om maksimum hoogte bo grond te bereik*	Time taken to reach maximum height from the ground./ *Tyd om maksimum hoogte te bereik bo grond te bereik*
$v_f = v_i + g\Delta t$ $0 = -18 + 9,8\Delta t$ $\therefore \Delta t = 1,84$ s✓	$v_f = v_i + g\Delta t$ $0 = 18 + -9,8\Delta t$ $\therefore \Delta t = 1,84$ s ✓
From the maximum height to the top of the building/ *Vanaf maksimum hoogte tot bopunt van gebou*	From the max height to the top of the building/ *Vanaf maksimum hoogte tot bopunt van gebou*
$v_f = v_i + a\Delta t$ $15,03$ ✓ $= 0 + 9,8\Delta t$ $\therefore \Delta t = 1,53$ s✓	$v_f = v_i + a\Delta t$ $-15,03$✓ $= 0 + -9,8\Delta t$ $\therefore \Delta t = 1,53$ s✓
The total time from the point from the ground to the top of the building: *Totale tyd vanaf grond tot bopunt van gebou*	The total time from the point from the ground to the top of the building: *Totale tyd vanaf grond tot bopunt van gebou*
$\Delta t_{total} = 1,84 + 1,53 = 3,37$ s ✓	$\Delta t_{total} = 1,84 + 1,53 = 3,37$ s ✓

(4)

3.4

OPTION/*OPSIE 1*   Velocity vs. time graph (Upwards is positive) *Snelheid vs. tyd grafiek (Opwaarts positief)*

OPTION/*OPSIE 2*   Velocity vs. time graph (Downwards is positive) *Snelheid vs. tyd grafiek (Afwaarts positief)*

Criteria to mark the graph/*Kriteria vir merk van grafiek*	**Marks/Punte**
Correct shape (straight line)/*Korrekte vorm (reguitlyn)*	✓
Graph starts at v = 18 m·s⁻¹/-18 m·s⁻¹ and t = 0 s *Grafiek begin by v = 18 m·s⁻¹/-18 m·s⁻¹ en t = 0 s*	✓
Graph cuts t-axis at 1,84 s at v = 0 m·s⁻¹ *Grafiek sny t-as by 1,84 s by v = 0 m·s⁻¹*	✓
Graph shows the ball bouncing with v = -15 m·s⁻¹/15,03 m·s⁻¹ at t = 3,37 s *Grafiek toon die bal bons met v = -15 m·s⁻¹/15,03 m·s⁻¹ by t = 3,37 s*	✓

(4)

[17]

QUESTION/*VRAAG* 4

4.1   The total mechanical energy in an isolated (closed) system ✓ remains
      constant (is conserved). ✓
      *Die totale meganiese energie in 'n geïsoleerde (geslote) sisteem bly konstant
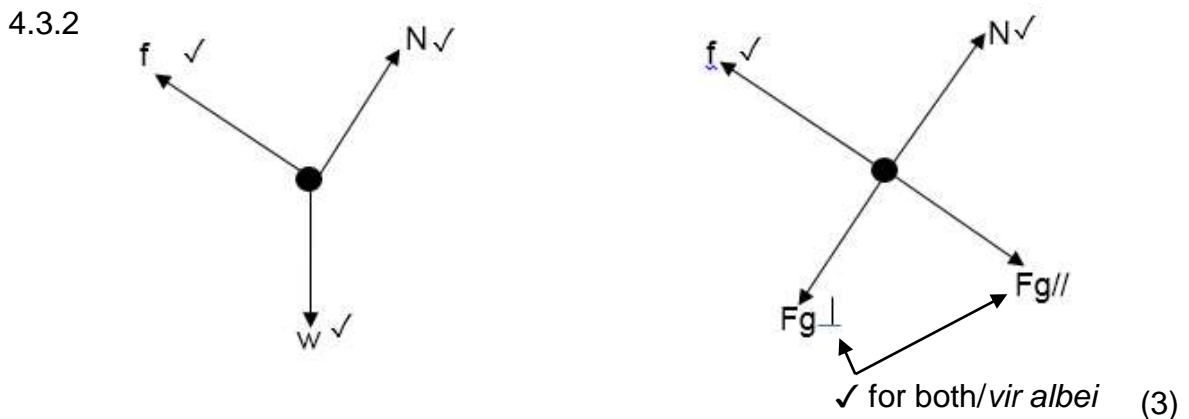   (bly behoue).*

      NOTE/LET WEL
      If total or isolated/closed is omitted (max:1/2)
      Indien totale of geslote(geïsoleeerde) weggelaat is (maks:1/2)   (2)

4.2 E_{mech} at A = E_{mech} at B/E_{meg} *by A =* E_{meg} *by B* ✓
      $(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_B$
      $m(9,8 \times 0,5 + \frac{1}{2} \times 0^2)$ ✓ $= m(9,8 \times 0 + \frac{1}{2} \times v^2)$ ✓
      $\qquad 4,9 = \frac{1}{2}v^2$
      $\qquad\quad v = 3,13 \text{ m·s}^{-1}$ ✓   (4)

4.3   4.3.1   The net/total work done on an object ✓ is equal to the change in the
              object's kinetic energy. ✓
              *Die netto/totale arbeid verrig op 'n voorwerp is gelyk aan die
              verandering in die kinetiese energie van die voorwerp.*
              OR/*OF*
              The work done on an object by a resultant/net force is equal ✓ to the
              change in the object's kinetic energy. ✓
              *Arbeid verrig deur 'n netto krag is gelyk aan die verandering in die
              kinetiese energie van die voorwerp.*   (2)

      4.3.2

      ✓ for both/*vir albei*   (3)

      4.3.3 $W_{net} = \Delta E_K$ ✓
              $W_{net} = 0$
              $W_f + W_{g//} = 0$ ✓
              $f.\Delta x \cdot \cos\theta + mg.\frac{1}{\Delta x}\ \Delta x \cdot\cos\theta = 0$
              $14,7 \cdot \textbf{d} \cdot\cos 180°$ ✓ $+ 3 \times 9,8\,(\frac{1}{d}).$ ✓$\textbf{d}\cos 0° = 0$
              $-14,7\textbf{d} + 29,4 = 0$
              $\qquad d = 2 \text{ m}$ ✓   (5)

4.4   REMAINS THE SAME/*BLY DIESELFDE* ✓   (1)
                                                                            [17]

QUESTION/*VRAAG 5*

5.1 The total(linear) momentum of an isolated (closed) system ✓ remains constant (is conserved) . ✓
Die totale (lineêre) momentum van 'n geïsoleerde (geslote) sisteem bly konstant (bly behoue).
OR/*OF*
In a isolated (closed) system, the total(linear) momentum ✓ before collision is equal to the total linear momentum after colllision. ✓
In 'n geïsoleerde (geslote) sisteem is die totale(lineêre) momentum voor botsing gelyk aan die totale (lineêre) momentum na botsing. (2)

5.2 EQUAL TO/*GELYK AAN* ✓ (1)

5.3 **Consider LEFT as positive/*Neem LINKS as positief***
$\sum p_{i} = \sum p_{f}$ ✓ Any one/*Enige een*
$(m_m + m_w)v_i = mv_{f\,m} + mv_{f\,w}$
$(80 + 50) \times 0$ ✓ $= (80) v_f + 50 \times -4$✓
$v_f = 2,5$ m·s⁻¹ left/*links* ✓ (4)

5.4
OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$F_{net}. \Delta t = \Delta p$ any one/ *enige een* ✓	$F_{net}. \Delta t = \Delta p$ any one/ *enige een* ✓
$= m(v_f - v_i)$	$= m(v_f - v_i)$
$= 50(4-0)$ ✓	$= 80(-2,5 - 0)$ ✓
200 N·s	= -200 N·s
$= 200$ N·s ✓ to the right/*na regs*	$= 200$ N·s ✓ to the left/*na links*
(3)
[10]

QUESTION/*VRAAG 6*

6.1 The (apparent) change in frequency/ pitch of the sound ✓ detected by a listerner because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓
Die (skynbare) verandering in frekwensie/toonhoogte van die klank deur 'n luisteraar waargeneem omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klankvoortplanting het.
OR/*OF*
An (apparent) change in (observed/detected) frequency/pitch/wavelength ✓ as a result of the relative motion between a source and the observer/listener. ✓
Die (skynbare) verandering in waargenome frekwensie/toonhoogte/golflengte as gevolg van die relatiewe beweging tussen die bron en waarnemer/luisteraar. (2)

6.2 As the police car is moving towards the woman, the wavelengths are compressed ✓ and become more shorter resulting in waves compressed and more waves will reach the listener per unit time, ✓ hence the frequency increases.
Indien die polisiemotor na die vrou beweeg, word die golflengtes saamgepers en word korter en meer golwe bereik die luisteraar per eenheid tyd, dus neem die frekwensie toe. (2)

6.3 $f_L = \dfrac{v \pm v_L}{v \pm v_s} f_s$ or/*of* $f_L = \dfrac{v}{v - v_s} f_s$

$396\checkmark = \dfrac{340}{340 - v_s}\checkmark (346)\checkmark$

$v_s = 42{,}93 \text{ m·s}^{-1}\checkmark$ (5)

6.4
- Determine whether arteries are clogged/narrowed/*Bepaal of are vernou is* ✓ OR/*OF*
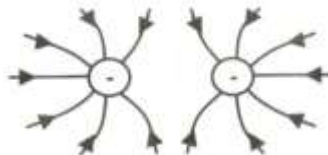- Determine heartbeat of foetus/*Bepaal die hartklop van 'n fetus* ✓ (1)

6.5 AWAY/*WEG VAN* ✓
Light from the distant star has a lower frequency compared to that of hydrogen. ✓ (Therefore the wavelength of the distant star is longer than the hydrogen which shows that it is shifted towards red.)
Lig van 'n verafgeleë ster het 'n laer frekwensie in vergelyking met dié van waterstof. (Dus is die golflengte van die verafgeleë ster langer as die van waterstof wat toon dit het 'n rooi verskuiwing gehad.) (2)

[12]

QUESTION/*VRAAG 7*

7.1 The (electrostatic)force ✓ experienced per unit positive charge ✓(placed at a point)
Die (elektrostatiese) krag ondervind per eenheids positiewe lading (geplaas by 'n punt). (2)

7.2 $E_M = \dfrac{kQ}{r^2}$

$= \dfrac{9 \times 10^9 . Q_M}{(0{,}03)^2}\checkmark = 1 \times 10^{13} . Q_M$ ←   ✓Either of the two/ *Enige van die twee*

$E_N = \dfrac{kQ}{r^2}$

$= \dfrac{(9 \times 10^9)(6 \times 10^{-9})}{(0{,}03)^2}$

$= 540\,000 \cdot \text{N·C}^{-1}$
$E_{net} = E_M + (-E_N)\checkmark$
$5{,}2 \times 10^5\checkmark = 1 \times 10^{13} \cdot Q_m - 540\,000\checkmark$
$5{,}2 \times 10^5 + 540\,000 = 1 \times 10^{13} \cdot Q_M$
$Q_m = 2 \times 10^{-9}$ C east / *oos* ✓ (7)

7.3 7.3.1

Criteria for sketch/*Kriteria vir skets*	Marks/Punte
Correct shape/*Korrekte vorm*	✓
Correct direction/*Korrekte rigting*	✓
Field lines not crossing each other/*Veldlyne kruis nie*	✓

(3)

7.3.2 (a)

OPTION/*OPSIE* 1
$Q_{new} = \dfrac{Q_M + Q_N}{2}$ ✓ $= \dfrac{(2 \times 10^{-9})+(-6 \times 10^{-9})}{2}$ ✓ $= -2 \times 10^{-9}$ C $n_{e^-} = \dfrac{Q_f - Q_i}{Q_{e^-}} = \dfrac{(-2 \times 10^{-9}) - (2 \times 10^{-9})}{-1,6 \times 10^{-19}}$ ✓ $= 2,5 \times 10^{10}$ electrons /elektrons ✓

OPTION/*OPSIE* 2
$Q_{new} = \dfrac{Q_M + Q_N}{2}$ ✓ $= \dfrac{(2 \times 10^{-9}) + (-6 \times 10^{-9})}{2}$ ✓ $= -2 \times 10^{-9}$ C $n_{e^-} = \dfrac{Q_f - Q_i}{Q_{e^-}} = \dfrac{(-2 \times 10^{-9})-(-6 \times 10^{-9})}{-1,6 \times 10^{-19}}$ ✓ $= 2,5 \times 10^{10}$ electrons /elektrons✓

(4)

(b)

$F = \dfrac{kQ_1 Q_2}{r^2}$ $= \dfrac{(9 \times 10^9)(2 \times 10^{-9})(2 \times 10^{-9})}{(0,02)^2}$ ✓ $= 9 \times 10^{-5}$ N to the right/ *na regs* ✓

(3)

[19]

QUESTION/*VRAAG* 8

8.1 Electric motor (DC motor) ✓ / *Elektriese motor (GS motor)* (1)

8.2 Electrical energy converted to mechanical energy ✓
Elektriese energie omgesit in meganiese energie (2)

8.3 8.3.1 Increase the strength of the current ✓
Verhoog die sterkte van die stroom (1)

8.3.2 Parallel ✓ (1)

8.4 8.4.1 Maximum voltage✓✓/*Maksimum spanning*
Accept/*Aanvaar:* V_{max}/V_{maks} (1)

8.4.2

OPTION/OPSIE 1	**OPTION/OPSIE 2**
$V_{rms} = \dfrac{V_{max}}{\sqrt{2}} = \dfrac{330}{\sqrt{2}}$ ✓ $= 233,35$ V $V_{wgk} = \dfrac{V_{max}}{\sqrt{2}} = \dfrac{330}{\sqrt{2}} = 233,35$ V $P_{average} = V_{rms} \times I_{rm}$ ✓ $P_{gem} = V_{wgk} \times I_{wgk}$ $\quad = 233,35 \times 12$ ✓ $\quad = 2800,2$ W ✓	$P_{average} = \dfrac{V_{max}}{\sqrt{2}} \times I_{rms}$✓ $P_{gem} = \dfrac{V_{max}}{\sqrt{2}} \times I_{wgk}$ $P_{ave}/P_{gem} = \dfrac{330}{\sqrt{2}}$ ✓ $\times 12$ ✓ $\quad = 2800,14$ W ✓
For 8.4.2 accept range from P$_{average}$ from 2800,14 W to 2800,20 W ***Vir 8.4.2 aanvaar gebied vir P$_{gem}$ van 2800,14 W tot 2800,20 W***	

(4)

[10]

QUESTION/*VRAAG* 9

9.1   9.1.1 $R_{ext} = R_1 + R_2 = 6 + 6 = 12\ \Omega$
                     $V_{ext} = I\ R$ ✓
                     $10,8$ ✓ $= I \times 12$ ✓
                            $I = 0,9\ A$ ✓   (4)

   9.1.2   **POSITIVE MARKING FROM QUESTION 9.1.1**
           POSITIEWE NASIEN VANAF VRAAG 9.1.1

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$V = Ir$ ✓ $(12-10,8) = 0,9 \times r$ $1,2 = 0,9\ r$ ✓ $r = 1,33\ \Omega$ ✓	$\varepsilon = I(R + r)$ ✓ $12 = 0,9(12 + r)$ ✓ $r = 1,33\ \Omega$ ✓

(3)

9.2   9.2.1

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$R_p = \dfrac{R_2 \times R_{3+4}}{R_2 + R_{3+4}}$ ✓ $= \dfrac{6 \times 5}{6 + 5}$ ✓ $= 2,73\ \Omega$ $V_p = I\ R = 1,5 \times 2,73$✓ $= 4,1\ V$ $V_s = V_3 + V_{bulb}$ $4,1 = IR_3 + IR_{bulb}$ $4,1 = I\ (R_3 + R_2)$ $4,1 = I\ (3 + 2)$ ✓ $I = 0,82\ A$ $P = I^2 \times R$✓$=(0,82)^2 \times 2$✓$=1,34\ W$ ✓	$\dfrac{1}{R_1} + \dfrac{1}{R_2} = \dfrac{1}{R_p}$ ✓ $\dfrac{1}{6} + \dfrac{1}{3} = \dfrac{1}{Rp}$ ✓ $R_p = 2,73\ \Omega$ $V_p = I\ R_p = 1,5 \times 2,73$✓$= 4,1\ V$ $V_s = V_3 + V_2$ $4,1 = IR_3 + IR_2$ $4,1 = I\ (R_3 + R_2)$ $4,1 = I\ (3 + 2)$ ✓ $I = 0,82\ A$ $P = I^2 \times R = (0,82)^2 \times 2$✓$= 1,34\ W$✓

(7)

   9.2.2   Increases. ✓ External resistance decreases ✓ *and c*urrent increases ✓
           Neem toe. Eksterne weerstand neem af en stroom neem toe.   (3)

[17]

QUESTION/*VRAAG* 10

10.1 50×10^{-19} Hz ✓   (1)

10.2   The 45×10^{-19} Hz is less than the threshold frequency of light that can
       eject/release electrons from the surface of the metal ✓✓
       Die 45×10^{-19} Hz is minder as die drumpel frekwensie van lig wat elektrone
       kan uitstraal van die oppervlakte van die metaal   (2)

10.3 $hf = W_0 + \frac{1}{2}mv^2$
       $hf = W_o + E_K$ ✓ ANY one/*Enige een*
       $hf = hf_0 + E_K$
       $(6{,}63 \times 10^{-34})(110 \times 10^{-19})✓ = (6{,}63 \times 10^{-34})(50 \times 10^{-19}) ✓ + (\frac{1}{2} \times 9{,}11 \times 10^{-31}.v^2)✓$
       $v = 9{,}35 \times 10^{-11}$ m·s⁻¹ ✓   (5)

10.4   STAYS THE SAME. ✓
       Increase in the intensity increases the number of electrons emitted with the
       same kinetic energy. ✓
       BLY DIESELFDE.
       Deur die intensiteit te vermeerder die aantal elektrone wat uitgestraal word
       met dieselfde kinetiese energie.   (2)
                                                                                    [10]
                                                         TOTAL/*TOTAAL*:   150