Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE/
*NASIONALE
SENIOR SERTIFIKAAT***

GRADE/*GRAAD 12*

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**PHYSICAL SCIENCES P1/*FISIESE WETENSKAPPE V1*
MARKING GUIDELINE / *NASIENRIGLYN*
(EXEMPLAR/*EKSEMPLAAR*)**

MARKS/PUNTE: 150

This marking guideline consists of 14 pages./
Hierdie nasienriglyn bestaan uit 14 bladsye.

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 verkeerd 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 not 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, $m.s^{-1}$ 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 $m.s^{-1}$ 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   B ✓✓   (2)

1.2   C ✓✓   (2)

1.3   C ✓✓   (2)

1.4   D ✓✓   (2)

1.5   A ✓✓   (2)

1.6   C ✓✓   (2)

1.7   B ✓✓   (2)

1.8   A ✓✓   (2)

1.9   D ✓✓   (2)

1.10   B ✓✓   (2)
                                                                              [20]

QUESTION/*VRAAG 2*

2.1 When object **A** exerts a force on object **B**, ✓ object **B** simultaneously exerts an oppositely directed force of the same magnitude on object **A**. ✓
*Wanneer voorwerp **A** 'n krag op voorwerp **B** uitoefen, oefen voorwerp **B** 'n krag gelyk in grootte en in teenoorgestelde rigting op voorwerp **A** uit.* ✓   (2)

2.2

OPTION 1/*OPSIE 1*	**OPTION 2/***OPSIE 2*
F_A on/op B ✓ F_N ✓ F_f ✓ F_g ✓	F_N ✓ F_A on/op B ✓ F_f ✓ $F_{g\parallel}$ $F_{g\perp}$ ✓ for both components/*vir beide komponente*

(4)

2.3 Data:
$M_B = 25$ kg
$f_B = 15$ N
$a = 1,5$ m.s^{-2}
$F_{A \text{ on } B} = ?$
$F_{B \text{ on } A} = ?$

$F_{net} = ma$
$F_{A \text{ on } B} + f_B + F_{g\parallel} = ma$ ⎫ ✓ Any one/E*nige een*
$F_{A \text{ on } B} + f_B + mgSin35° = ma$ ⎭
$F_{A \text{ on } B} + (-15) + (-25 \times 9,8 \times 0,574)$ ✓ $= 25 \times 1,5$ ✓
$F_{A \text{ on } B} - 155,63 = 37,50$
$F_{A \text{ on } B} = 193,13$ N ✓
$F_{B \text{ on } A} = -F_{A \text{ on } B}$
$F_{B \text{ on } A} = -193,13$ N
$F_{B \text{ on } A} = 193,13$ N ✓ down the slope/ *teen die helling af* ✓   (6)

2.4 $F_{net} = ma$
$F_{Nceba} + F_{B \text{ on } A} + f_A + F_{g\parallel} = ma$ ⎫ ✓ Any one/E*nige een*
$F_{Nceba} + F_{B \text{ on } A} + f_A + mgSin35° = ma$ ⎭
$F_{Nceba} + (-193,13) + (-4,5) + (-10 \times 9,8 \times 0,574)$ ✓ $= 10 \times 1,5$ ✓
$F_{Nceba} - 253,88 = 15$
$F_{Nceba} = 268,88$ N ✓   (4)
          [16]

QUESTION/*VRAAG* 3

3.1　When a net/resultant force acts on an object of mass m, the object accelerates in the direction of the net force. ✓ The accelereation is directly proportional to the net force and inversely proportional to the mass. ✓ *Wanneer 'n netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die netto krag. ✓ Die versnelling is direk eweredig aan die netto krag en omgekeerd aan die massa van die voorwerp. ✓*　　　(2)

3.2　$F_{net} = ma$
　　　$F_g + F_N + F_Y = ma$　　　⎫
　　　$F_g + F_N + F_a Sin40° = ma$　⎭　✓ Any one/E*nige een*

　　　$F_g + (-623,3) + (-500Sin40°) = mx0$ ✓
　　　$F_g - 623,3 – 321,39 = 0$
　　　$F_g = 944,69$ N
　　　$mg = 944,69$ ✓
　　　$mx9,8 = 944,69$ ✓
　　　$m = 96,40$ kg ✓　　　(5)

3.3　**For 96,4 kg box / *vir 96,4 kg houer***

　　　$F_{net} = ma$
　　　$F_X + f_k + T = ma$　　⎫
　　　$F_a Cos40° + f + T = ma$　⎭　✓ Any one/E*nige een*

　　　$500 Cos40° + (-115) +(- T)$ ✓ $= 96,4a$ ✓

　　　$383,02 – 115 – T = 96,4a$
　　　$268,02 - T = 96,4a$
　　　$T = 268,02 – 96,4a$ .... (1)

　　　For 15 kg box / *vir 15 kg houer*

　　　$F_{net} = ma$
　　　$F_g + T = ma$　⎫
　　　$mg + T = ma$　⎭　✓ Any one/E*nige een*
　　　$-15x9,8 + T$ ✓ $= 15a$ ✓
　　　$-147 + T = 15a$　　　(Substitute/*Stel in vir* T)

　　　$-147 + (268,02 – 96,4a) = 15a$
　　　$121,02 = 111,40a$
　　　$a = 1,09$ m.s^{-2} ✓　　　(7)
　　　　　　　　　　　　　　　　　　[14]

QUESTION/*VRAAG* 4

4.1　It (projectile) is <u>an object</u> upon which the <u>only force acting is the force of gravity.</u> ✓✓
　　Dit (projektiel) is 'n <u>voorwerp</u> waarop die <u>enigste krag wat daarop inwerk, die gravitasiekrag is.</u> ✓✓

OR/OF

　　Projectile is an object that <u>experiences only gravitational force</u>. ✓✓
　　Projektiel is 'n voorwerp wat <u>slegs die gravitasiekrag ondervind</u>. ✓✓　　　　　(2)

4.2

OPTION 1 /*OPSIE 1*	
(upwards positive) ***(opwaarts positief)***	**(downwards positive)** ***(afwaarts positief)***
$v_f^2 = v_i^2 + 2g\Delta y$ ✓ $0^2 = 5^2 + 2\,(-9,8)\,\Delta y$ ✓ $\Delta y = 1,28$ m ✓	$v_f^2 = v_i^2 + 2g\Delta y$ ✓ $0^2 = (-5)^2 + 2\,(9,8)\,\Delta y$ ✓ $\Delta y = -1,28$ m $\Delta y = 1,28$ m, (upward) ✓
OPTION 2/*OPSIE 2*	
(upwards positive) ***(opwaarts positief)***	**(downwards positive)** ***(afwaarts positief)***
$v_f = v_i + g\Delta t$ $0 = (5) + (-9,8).\Delta t$ $\therefore \Delta t = 0,51$ s $\Delta y = v_i\Delta t + \dfrac{1}{2}g\Delta t^2$ ✓ $\quad = (5)(0,51) + \dfrac{1}{2}(-9,8)(0,51)^2$ ✓ $\therefore \Delta y = 1,28$ m ✓	$v_f = v_i + g\Delta t$ $0 = (5) + (-9,8).\Delta t$ $\therefore \Delta t = 0,51$ s $\Delta y = v_i\Delta t + \dfrac{1}{2}g\Delta t^2$ ✓ $\quad = (-5)(0,51) + \dfrac{1}{2}(9,8)(0,51)^2$ ✓ $\Delta y = -1,28$ m $\therefore \Delta y = 1,28$ m, (upwards) ✓

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(3)

4.3　The maximum height reached by ball A (Δy_{max})
　　Die maksimum hoogte bereik deur bal A (Δy_{max})　= 1,28 + 5 = 6,28 m

　　Maximum height reached by ball B is given by:
　　Makisum hoogte bereik deur bal B is:

(upwards positive) ***(opwaarts positief)***	**(downwards positive)** ***(afwaarts positief)***
$v_f^2 = v_i^2 + 2g\Delta y$ ✓ $0^2 = 8^2 + 2\,(-9,8)\,\Delta y$ ✓ $\Delta y_B = 3,27$ m ✓ Since $\Delta y_B < \Delta y_{max}$ ✓ OR 3,27 m < 6,28 m $\therefore$ Ball B did not reach the maximum height. ✓ $\therefore$ *Bal B het nie die maksimum hoogte bereik nie.*	$v_f^2 = v_i^2 + 2g\Delta y$ ✓ $0^2 = (-8)^2 + 2\,(9,8)\,\Delta y$ ✓ $\Delta y = -3,27$ m $\Delta y_B = 3,27$ m, (upward) ✓ Since $\Delta y_B < \Delta y_{max}$ ✓ OR 3,27 m < 6,28 m $\therefore$ Ball B did not reach the maximum height. ✓ $\therefore$ *Bal B het nie die maksimum hoogte bereik nie.*

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(5)

4.4	(upwards positive) *(opwaarts positief)*	(downwards positive) *(afwaarts positief)*	
	$v_f = v_i + g\Delta t$ ✓ $0 = \underline{(5) + (-9,8) . \Delta t}$ ✓ $\therefore \Delta t = 0,51$ s $v_f = v_i + g\Delta t$ $= \underline{(8) + (-9,8) . 0,51}$ ✓ $\therefore v_f = 3,00$ m.s^{-1} ✓	$v_f = v_i + g\Delta t$ ✓ $0 = \underline{(5) + (-9,8) . \Delta t}$ ✓ $\therefore \Delta t = 0,51$ s $v_f = v_i + g\Delta t$ $= \underline{(-8) + (9,8) . 0,51}$ ✓ $v_f = -3,00$ m.s^{-1} $\therefore v_f = 3,00$ m.s^{-1} ✓	(4)

4.5 **(Upwards positive)**
For ball A/ *Vir bal A*
$v_f = v_i + g\Delta t$ ✓
$v_f = (5) + (-9,8) . \Delta t$ ...... (1) ✓

For ball B/ *Vir bal B*
$v_f = v_i + g\Delta t$
$v_f = (8) + (-9,8) . \Delta t$ ...... (2) ✓

Equating (1) and (2)/ *Stel (1) gelyk aan (2)*:
Since ball A will be moving downwards then/*Aangesien bal A afwaarts beweeg dat*:
$-(5 - 9,8.\Delta t) = 8 - 9,8.\Delta t$ ✓
$19,6.\Delta t = 13$
$\Delta t = 0,66$ s
$\Delta t = 0,011$min ✓   (5)
[19]

QUESTION/*VRAAG* 5

5.1 A system on which the net external forces acting is zero. ✓✓
Dit is 'n sisteem waarop die netto eksterne krag wat op die sisteem inwerk, nul is. ✓✓   (2)

5.2 **Let east be positive/*Laat oos positief wees***
$p = mv$ ✓
$= 1\,140 \times 30$ ✓
$= 34\,200$ kg.m.s^{-1}, (east/*oos*) ✓   (3)

5.3 $\Sigma p_i = \Sigma p_f$
$m_v v_{iv} + m_c v_{ic} = m_v v_{fv} + m_c v_{fc}$ } ✓
$1\,650\, v_{iv} + 1\,140 \times 30$ ✓ $= 1\,650 \times -12 + 1\,140 \times 10$ ✓
$1\,650\, v_{iv} = 11\,400 - 34\,200 - 19\,800$
$v_{iv} = -25,82$
$v_{iv} = 25,82$ m.s^{-1} ✓, west ✓   (5)

5.4 Principle of conservation of linear momentum ✓
The total linear momentum of an isolated system remains constant (preserved). ✓✓
Beginsel van behoud van lineêre momentum. ✓
Die totale lineêre momentum in 'n geïsoleerde sisteem bly konstant (behoue). ✓✓   (3)

5.5 $\Delta p = m(v_f - v_i)$ ✓
$\Delta p = 1\,650\,(-12 - (-25,82))$ ✓
$\Delta p = 22\,803\;kg.m.s^{-1}$ ✓   (3)

[16]

QUESTION/*VRAAG* 6

6.1   The net/resultant force acting on an object is equal to the rate of change in momentum of the object. ✓✓
Die netto/resulterende krag wat op 'n voorwerp inwerk, is gelyk aan die tempo van verandering van momentum van die voorwerp. ✓✓   (2)

6.2   Total $E_{k\ Before}$ = $E_{k\ tree} + E_{k\ car}$
$= \frac{1}{2}\,m\,v_{tree}^2 + \frac{1}{2}\,m$ $\left.\begin{array}{c} \\ \\ \end{array}\right\}$ ✓ Any one/*Enige een* v_{car}^2
$= \frac{1}{2}\,(m)(0^2)$ ✓ $+ \frac{1}{2}\,(1\,125)(25)^2$ ✓
$= 351\,562,5\;J$ ✓   (4)

6.3   **Impulse of the tree/***Impuls van die boom***:**
Let original direction be positive/*Laat die oorspronklike rigting positief wees*
$F_{net}\Delta t\;(car) = m(v_f - v_i)$ ✓
$= 1\,125(-6 - 25)$ ✓
$= -34\,875\;N$
$F_{net}\Delta t\;(car) = 34\,875\;N$, backwards/*terugwaarts*
$F_{net}\Delta t\;(tree) = 34\,875\;N$ ✓, original direction of the car/ *oorspronklie rigting van die motor*. ✓   (4)

6.4
$F_{net}\;(car) = \dfrac{m(v_f - v_i)}{\Delta t}$ ✓

$F_{net}\;(car) = \dfrac{1\,125(-6 - 25)}{3,5}$ ✓

$F_{net}\;(car) = -9\,964\;N$
$F_{net}\;(car) = 9\,964\;N$, backwards/*terugwaarts* ✓   (3)

6.5   When the airbags deploy during collision, <u>the contact time of the driver with the airbag increases</u>. ✓ According to the equation $F_{net}\Delta t = \Delta p$, <u>when contact time increases the net force experienced by the driver decreases</u>. ✓ Then, the extent of injury is reduced.
Wanneer die lugsak gedurende die botsing ontplooi, sal die <u>kontaktyd van die bestuurder met die lugsak verhoog</u>. Volgens die vergelyking $F_{net}\Delta t = \Delta p$, <u>wanneer die kontaktyd verhoog sal die netto krag wat deur die bestuurder ervaar word verlaag</u>. ✓ Dus sal die omvang van die beserings verminder word.   (2)

6.6   Decrease ✓
      The final velocity will now be zero. ✓ Then, according to the equation:
      $\Delta p = m(v_f - v_i)$, it follows that <u>Δp will decrease</u>. ✓ If Δp decreases then F_{net}
      decreases as <u>they are directly proportional to each other</u>. ✓
      Verminder ✓
      Die finale snelheid sal nou nul wees. ✓ *Volgens die vergelyking: $\Delta p = m(v_f - v_i)$*
      dit volg dat <u>Δp sal verlaag</u>. ✓ *As Δp afneem dan sal F_{net} verlaag <u>aangesien</u>*
      <u>*hulle direk eweredig is aanmekaar.*</u> ✓   (4)
                                                                                       [19]

QUESTION/*VRAAG* 7

7.1 $F = \dfrac{Gm_1m_2}{r^2}$ ✓

      $F = \dfrac{(6,67 \times 10^{-11})(3,4 \times 10^3)(5,98 \times 10^{24})}{(2,32 \times 10^6)^2}$ ✓ ✓

      $= 251\ 959,05$
      $= 2,52 \times 10^5$ N ✓   (4)

7.2   Newton's Law of Universal Gravitation ✓
      Any two objects or particles in the universe attract each other with a force
      which is directly proportional to the product of their masses ✓ and inversely
      proportional to the square of the distance between their centres. ✓
      Newton se Universele Gravitasiewet
      Enige twee liggaam of deeltjie in die heelal trek mekaar aan met 'n krag wat
      direk eweredig aan die produk van hul massas ✓ *en omgekeerd eweredig*
      aan die kwadraat van die afstand tussen hul middelpunte aan. ✓   (3)

7.3 $F_1 = \dfrac{Gm_1m_2}{r^2} = F$

      $F_2 = \dfrac{Gm_1\dfrac{m_2}{2}}{\left(\dfrac{r}{2}\right)^2}$ ✓

      $F_2 = \dfrac{\dfrac{Gm_1m_2}{2}}{\dfrac{r^2}{4}}$ ✓

      $F_2 = 2\dfrac{Gm_1m_2}{r^2} = 2F$
      $F_2 = 2(2,52 \times 10^5$ N$)$
      $F_2 = 5,04 \times 10^5$ N ✓   (3)
                                                                                       [10]

QUESTION/*VRAAG* 8

8.1   8.1.1   The net work done on an object is equal ✓ to the change in the kinetic energy of the object. ✓
Die netto arbeid deur 'n voorwerp verrig is gelyk ✓ *aan die verandering in kinetiese energie van die voorwerp.* ✓

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

8.1.2

OPTION 1/*OPSIE 1*
$W_{net} = W_{F1} + W_{F2} + W_{//} + W_f$ ✓ $= F_1 \Delta x Cos180° + F_2 \Delta x Cos0° + mgSin30° \Delta x Cos180° + f \Delta x Cos180°$ $= \underline{(20)(20)(-1) + (100)(20)(1)}$ ✓ $+ \underline{(8)(9,8)(0,5)(20)(-1) + (8,5)(20)(-1)}$ ✓ $= -400 + 2000 - 784 - 170$ $= 646$ J ✓
OPTION 2/*OPSIE 2*

$F_{net} = F_2 + F_1 + F_{g_\parallel} + f$
     $= F_2 + F_1 + mgSin30° + f$
     $= 100 + (-20) + \{-(8)(9,8)(0,5)\} + (-8,5)$
     $= 32,3$ N
 $W_{net} = F_{net}\Delta x Cos\,\theta$ ✓
     $= F_{net}\,\Delta x Cos0°$
     $= (32,3)$ ✓ $(20)(1)$ ✓
     $= 646$ J ✓

(4)

8.1.3 $W_{net} = \Delta E_k$
$W_{net} = E_{kf} - E_{ki}$ ✓ Any one/*Enige een*
$W_{net} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

646 ✓ $= \frac{1}{2}(8)v_f^2 - \frac{1}{2}(8)(0)$ ✓

$v_f^2 = \frac{(2)(646)}{8}$

    $= 161,5$

$v_f = 12,71$ m.s^{-1} ✓   (4)

8.2

$$\Delta E_k = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark$$

$$= \frac{1}{2}(1\,500)(26)^2 - \frac{1}{2}(1\,500)(0)^2 \checkmark$$

$$= 507\,000 \text{ J}$$

$$P = \frac{\Delta E_k}{\Delta t} \checkmark$$

$$= \frac{507\,000}{4} \checkmark$$

$$= 126\,750 \text{ W}$$

$$= 126{,}75 \text{ kW} \checkmark$$

(5)

[15]

QUESTION/*VRAAG* 9

9.1 9.1.1 It is the apparent **change in frequency** (or pitch/wavelength) of the sound detected by a listener because the sound source and the listener have **different velocities** relative to the medium of sound propagation. $\checkmark\checkmark$
*Dit is die **verandering in frekwensie** (toonhoogte/golflengte) van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar **verskillende snelhede** relatief tot die medium waarin die klank voortgeplant word, het.* $\checkmark\checkmark$

OR/*OF*

An **apparent change in observed/detected** frequency (pitch/ wavelength) as a result of relative motion between a source and an observer. $\checkmark\checkmark$
*Dit is **oënskynlike verandering in frekwensie** (toonhoogte/golflengte) wat waargeneem word as gevolg van die relatiewe beweging tussen die bron en waarnemer.* $\checkmark\checkmark$

(2)

9.1.2

$$f_L = \frac{v \pm v_L}{v \pm v_S} f_S$$

$$f_L = \frac{v - v_L}{v} f_S$$

$\checkmark$ Any one/*Enige een*

$$0{,}85x \checkmark = \frac{340 - v_L}{340}(x) \checkmark$$

$$289x = (340 - v_L)(x)$$

$$289 = 340 - v_L$$

$$v_L = 51 \text{ m.s}^{-1} \checkmark$$

(4)

9.1.3 When the listener moves away from the source the sound waves that reach him have <u>longer wavelength</u> $\checkmark$ and a sound with a lower pitch is registered because of a <u>lower frequency</u>. $\checkmark$
As die luisteraar van die bron af wegbeweeg, het die klankgolwe wat hom bereik <u>langer golflengte</u> en 'n klank met 'n laer toonhoogte geregistreer weens 'n <u>laer frekwensie</u>. $\checkmark\checkmark$

(2)

9.1.4   It would be the same ✓✓
        Dit sal dieselfde bly ✓✓   (2)

9.1.5 $F_L = 0,85f_S$
        $= 0,85 \times 190$ ✓
        $= 161,5$ Hz ✓   (2)

9.2   To measure the velocity of blood flowing through blood vessels. ✓
      To scan a fetus/foetus. ✓
      Om die snelheid van bloed wat deur are vloei, te meet. ✓
      Om 'n fetus te skandeer. ✓   (2)

                                                                                               [14]

QUESTION/*VRAAG* 10

10.1   The magnitude of the electrostatic force exerted by one point charge (Q) on
       another point charge (Q) 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 een puntlading (Q₁) op 'n ander
       puntlading (Q₂) uitoefen, is direk eweredig aan die produk van ladings en
       omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle.* ✓✓   (2)

10.2   **East is positive/*Oos is positief***

$F_{AN} = \dfrac{kQ_AQ_N}{r^2}$ ✓

$= \dfrac{(9x10^9)(4x10^{-9})(2x10^{-9})}{(0,014)^2}$ ✓

$= 0,0005$ N, East/*Oos*

$F_{BN} = \dfrac{kQ_BQ_N}{r^2}$

$= \dfrac{(9x10^9)(8x10^{-9})(2x10^{-9})}{(0,049)^2}$ ✓

$= 0,00006$ N, West/*Wes*,

$F_{net} = F_{AN} + F_{BN}$
$= 0,0005 - 0,00006$ ✓
$= 0,00044$ N, East/Right / *Oos/regs* ✓   (5)

                                                                                               [7]

                                                                TOTAL/*TOTAAL*:   150