3.3 Separate compound units with a multiplication dot, not 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 vermenigvuldigpunt 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
Positive marking regarding calculations will be followed in the following cases.
Positiewe nasien met betrekking tot berekenings sal in die volgende gevalle geld:

4.1 **Sub question to sub question:** When a certain variable is incorrectly calculated in one sub question (e.g. 3.1) and needs to be substituted into another sub question (3.2 or 3.3), **full marks** are to be awarded for the subsequent sub questions.
***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 **Multi-step question in a sub question:** If the candidate has to calculate, for example, current in the 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 byvoorbeeld, 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 to QUESTIONS 3.1, and 3.1 is incorrect, no marks can be awarded for QUESTION 3.2. However, if the answer for e.g. QUESTION 3.1. is based on a calculation, the motivation for the incorrect answer in QUESTION 3.2 should 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. VRAAG 3.1 egter op 'n berekening gebaseer is, kan die motivering vir die verkeerde antwoord in VRAAG 3.2 oorweeg word.

QUESTION 1/*VRAAG 1*

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

QUESTION 2/ *VRAAG 2*

2.1 An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force/*'n Voorwerp in rus of konstante snelheid sal so bly, behalwe as 'n ongebalanseerde krag op hom inwerk.* ✓✓ (2)

2.2 Since smooth surface, no frictional force is acting on skateboard, so constant velocity/*Dit is 'n gladde oppervlakte, geen weerstand, so konstante snelheid* ✓✓ (2)

2.3.1 $f = \mu_k N$✓ = (0,2)(9,8)(95)(cos30°) ✓ = <u>161,25N</u> ✓ (3)

2.3.2 $F_{net} = ma$✓ => $F_{G//} + (-f) = ma$ => (95)(9.8)sin30° – 161,25✓ = 95 a✓

<u>a = 3,2 m.s^{-2}</u>✓ (4)

2.3.3 $\Delta x = v_i\Delta t + \frac{1}{2} a \Delta t^2$ ✓ => 2.1 = v_i (0,3) + (0,5)(3,2)(0,3)^2✓

$v_f = 6,25$ m.s^{-1}

$v_f^2 = v_i^2 + 2 a \Delta x$ => 6,25^2 ✓ = 1,2^2 + 2 (3,2) Δx✓

<u>$\Delta x = 5,88$ m</u>✓ (5)

NOTE: If *g* instead of *a* is used in the equation, maximum 4 marks

[16]

QUESTION 3/*VRAAG 3*

3.1 In a closed system the total momentum is constant. OR The sum of momentum before collision is equal to the sum of momentum after collision in a closed system./*In 'n geslote sisteem bly die totale momentum konstant. OR Die somtotaal van die momentum voor die botsing is gelyk aan die somtotaal van die momentum na die botsing.* ✓✓ (2)

3.2 $\sum$p before/*voor* = $\sum$p after/*na* or/*of*

$m_T v_i + m_c v_i = (m_T + m_c)v_f$ ✓ => 1 x 10^4(2) + (5 x 10^3)(0)✓ = 1.5 x 10^4 v_f✓

v_i = <u>1,33 m.s^{-1}</u> ✓ (4)

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

3.4. Impulse = $\Delta p = mv_f - mv_i$ ✓ = 1 x 10^4(1.33) - 1 x 10^4(2) ✓ = -6700 N.s✓

∴ 6700 N.s/ kgms^{-1} left ✓ (4)

3.5. Before collision/*Voor botsing* $E_k = ½ mv^2$ ✓ $= ½ 1 \times 10^4(2)^2 + 0$ ✓ $= 2 \times 10^4$ J

After collision/*Na botsing* $E_k = ½ mv^2 = ½ 1.5 \times 10^4(1.33)^2$ ✓ $= 1.33 \times 10^4$ J

2×10^4 J is not equal to/*is nie gelyk aan* 1.33×10^4 J✓ (4)

3.6 Net work done on an object is equal to the change in the kinetic energy/✓✓
Die netto arbeid verrig is gelyk aan die verandering in die kinetiese energie (2)

3.7 $F_{net}.\Delta x\cos\theta = \Delta E_k = ½ mv_f^2 - ½ mv_i^2$ ✓

$3000.\Delta x \cos 180$✓ $= 0.5(1.5 \times 10^4)(0)$ ✓ $- 0.5(1.5 \times 10^4)(1.33)^2$ ✓

$\Delta x = 4.42$ m✓

Option/*Opsie* 2: $W_{nc} = \Delta E_k + \Delta E_P$✓

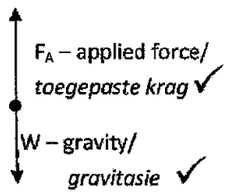
$3000.\Delta x \cos 180$ ✓ $= 0.5(1.5 \times 10^4)(0)$ ✓ $- 0.5(1.5 \times 10^4)(1.33)^2$ ✓ $+ 0$

$\Delta x = 4.42$ m✓ (5)
[23]

QUESTION 4/*VRAAG 4*

4.1 Body or object on which only force of gravity acts on while in motion/*Liggaam of voorwerp waarop slegs gravitasiekrag inwerk*✓✓ (2)

4.2.



(2)

4.3. $F_{net} = F_A - F_g = m.a$✓ $\Rightarrow F_A - (250+m)g = ma$

$7700 - 9.8(250)$ ✓ $- 9.8\,m$ ✓ $= (m+250).(6)$ ✓

$m = 237.34$ kg✓ (5)

4.4. $v_f^2 = v_i^2 + 2a\Delta x$ ✓ $= 0 + 2(6)(5)$ ✓ $= 60$

$v_f = 7.75\ m.s^{-1}$✓ (3)

NOTE: If *g* instead of *a* is used in the equation, maximum 2 marks

4.5. $v_f^2 = v_i^2 + 2g\Delta x$✓ $\Rightarrow 0 = 7.75^2 + 2(-9.8)\Delta x$✓ $\Rightarrow x = 3.06$ m✓ (upward +)

x total $= 3.06 + 5 = 8.06$ m✓ (4)

4.6 $\Delta x = v_i\,\Delta t + ½\,a\,\Delta t^2$ ✓ $\Rightarrow -8.06 = (0)\,\Delta t + (0{,}5)(-9{,}8)\,\Delta t^2$✓

$\Delta t = 1{,}28$ s✓ (3)
[19]

QUESTION 5/*VRAAG 5*

5.1.1 Doppler effect/*Doppler effek*✓ (1)

5.1.2 There was a relative movement between the source (ship) and the observer/ *Daar is relatiewe beweging tussen die bron (skip) en die luisteraar.*✓✓ (2)

5.2 $f_L = \left(\frac{v \pm v_L}{v \pm v_s}\right) f_s$✓

$f_s \frac{v}{v-v_s} = f_o = \frac{v}{v-v_s} f_s$

95✓ $(\frac{340}{340-6})$✓ = $(\frac{340}{340-v})$✓ 94✓

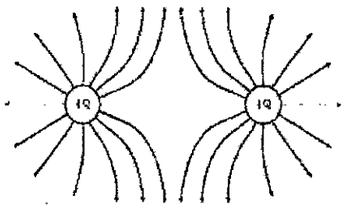
$\underline{V = 9.52\ m.s^{-1}}$✓ (6)

[9]

QUESTION 6/*VRAAG 6*

6.1 Force between two point charges are directly proportional to the product of the charges and inversely proportional to the square distance between them /*Die krag tussen twee puntladings is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.* ✓✓ (2)

6.2



✓✓✓

Mark/ *punte*	Criteria/*kriteria*
1	Shape/*vorm* No marks for irregular shapes/*geen punte vir onreëlmatige vorm.*
1	Direction/*rigting*
1	Lines touching charge/*lyne raak ladings*

(3)

6.3 $F_g = \frac{k Q_1 Q_2}{r^2}$ ✓ $F_g = ma$✓

0,098✓ = $\frac{9x10^9\ 4x10^{-6} Q_2}{0{,}012^2}$ ✓ $F_g = (0{,}01)(9{,}8)$✓

$Q_2 = 3{,}92 \times 10^{-10}$ C ✓ = 0,098N (6)

[11]

QUESTION 7/*VRAAG 7*

7.1 Force experienced per unit positive charge near a charged object/*Krag ervaar per eenheid positiewe lading naby 'n gelaaide voorwerp.*✓✓ (2)

7.2 $E = \frac{F}{Q}$ ✓ $= \frac{3 \times 10^{-6}}{-2 \times 10^{-9}}$ ✓ = -1500 N.C^{-1} = <u>1500 N.C^{-1}</u> ✓ (3)

7.3 $E = \frac{k Q_1}{r^2} = \frac{9x10^9 (2x10^{-9})}{(2x10^{-2})^2}$ ✓ = 45 000 NC^{-1}

✓ $E = \frac{k Q_1}{r^2} = \frac{9x10^9 (3x10^{-9})}{(3x10^{-2})^2}$ ✓ = 30 000 NC^{-1}

$E_{net} \doteq$ 45 000 + 30 000✓ = 75 000 NC^{-1}✓ Left/*Links*✓ (6)

[11]

QUESTION 8/*VRAAG 8*

8.1 $\frac{1}{R} = \frac{1}{r} + \frac{1}{r} = \frac{1}{200} + \frac{1}{200}$ ✓ $= \frac{2}{200}$ R = 100 Ω

R_T = 100 + 25 ✓ = <u>125 Ω</u>✓ (3)

8.2 $P_{av} = \frac{V_{rms}^2}{R}$ ✓ => 2 $= \frac{V^2}{200}$ ✓ => V = <u>20 V</u>✓ (3)

8.3 $I_{rms} = \frac{V_{rms}}{R}$ ✓ $= \frac{20}{100}$ ✓ = 0,2 A

$I_{max} = I_{rms}\sqrt{2}$ $= 0{,}2\sqrt{2}$ ✓ = <u>0,28 A</u>✓ (4)

8.4 $V_{rms} = I_{rms}R$ ✓ = (0,2)(125) ✓ = 25 V✓ (3)

8.5.1 Increases/*Verhoog*✓ (1)

8.5.2 The total resistance in the circuit decreases✓ so the current increases, hence the potential difference will also increase✓ /*Die totale weerstand in die stroombaan verlaag, so die stroom verhoog, so potensiaalverskil sal ook verhoog.* (2)

[16]

QUESTION 9/*VRAAG 9*

9.1 Resistance inside a battery that causes the potential difference to drop as a current pass through the battery✓✓ /*Die weerstand in die battery wat die potensiaalverskil laat afneem wanneer 'n stroom deur die battery vloei.* (2)

9.2 $E = V_R + V_r$ ✓ => 12✓ $= V_R + (800)(5x10^{-3})$ ✓ => $V_R = 12 - 4$ <u>= 8V</u>✓ (4)

9.3 $P = I^2r$ ✓ $= (800)^2 (5x10^{-3})$✓ = 3200 W✓ or

$P = VI$✓ = (4)(800)✓ = 3200 W✓ (3)

9.4 The current will be less, due to the lost volts in the battery, so you might not be able to start the motor car✓✓ /*Die stroom sal laer wees a.g.v. die verlore volts in die battery, dus sal jy moontlik nie motor aan die gang kan sit nie.* (2)

[11]

QUESTION 10/*VRAAG 10*

10.1 Different metal atoms attract the electrons in the highest energy levels by different forces, first ionisation energy✓ */Verskillende metale se atome het verskillende kragte op elektrone in die hoogste energievlakke, eerste ionisasie energie.* (1)

10.2 $E = hf = h\frac{c}{\lambda} = W_o + E_k$✓

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

$$W_o = 8{,}65 \times 10^{-19} - 1{,}05 \times 10^{-19}$$

$$W_o = \underline{7{,}60 \times 10^{-19}\ J}✓$$

Metal X is Silver✓ (6)

10.3 Particle theory of light/*Deeltjieteorie van lig.*✓ (1)

10.4.1 Increases/*Verhoog*✓ (1)

10.4.2 Remains the same/*Bly dieselfde*✓ (1)

10.5.1 Ultraviolet light/ *Ultraviolet lig*✓ (1)

10.5.2 High energy waves or high frequency/*Hoë-energie Hoë frekwensie golwe*✓ (1)

10.6 Emission spectrum consist of bright lines or colours✓ of different frequencies or wavelengths emitted during the transition of electrons from high energy to low energy in excited atoms✓ */ Die emissiespektrum bestaan uit helder lyne of kleure van verskillende frekwensie of golflengtes wat uitgestraal word wanneer elektrone van hoë energie na lae energie beweeg in opgewekte atome.* (2)

[14]

TOTAL/*TOTAAL:* 150