Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2023

PHYSICAL SCIENCES P1

MARKS: **150**

TIME: **3 hours**

This question paper consists of 19 pages, including a 2-page data sheet.

INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME in the appropriate space on the ANSWER BOOK.
2. This question paper consists of TEN questions. Answer ALL the questions in the ANSWER BOOK.
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instruments.
5. Number the answers correctly according to the numbering system used in this question paper.
6. You are advised to use the attached DATA SHEETS.
7. The formulae and substitutions must be shown in ALL calculations.
8. Give brief motivations, discussions, et cetera where required.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Start EACH question on a NEW page.
11. All diagrams are not necessarily drawn according to scale.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write ONLY the letter (A–D) next to the question numbers (1.1–1.10) in the ANSWER BOOK, for example 1.11 B.

1.1 The base unit of energy can be written as …

A $kg.m.s^{-1}$.

B $kg.m.s^{-2}$.

C $kg.m^2.s^{-2}$.

D N.s. (2)

1.2 A wooden block is pulled up a rough, inclined surface using a rope. The wooden block moves at a constant velocity. This means that:

A There are no forces acting on the block.

B There are no vertical forces acting on the block.

C Only gravitational force acts on the block.

D The vector sum of all forces acting on the block is equal to zero. (2)

1.3 Which of the following situations is an example of uniform acceleration?

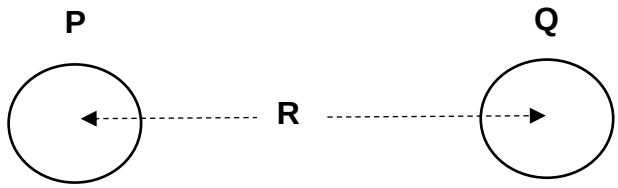
A An astronaut experiences weightlessness while he is in space.

B A feather drops to the ground inside a vacuum.

C A wooden box slides down a smooth surface at a constant velocity.

D A leaf falls to the ground on a windy day. (2)

1.4 Two objects of mass **P** and **Q** respectively, are placed at a distance **R** from each other. The force they exert on each other is **F**.



When the distance between the objects changes to $\frac{2}{3}$ **R**, the force that the two objects exert on each other will be …

A $\frac{4}{9}$ **F**.

B 2¼ **F**.

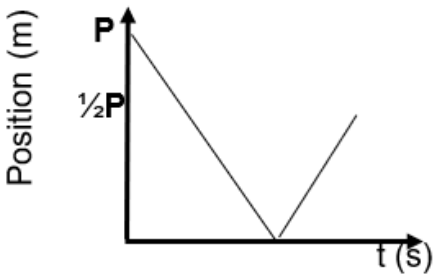
C $\frac{2}{3}$ **F**.

D $\frac{3}{2}$ **F**. (2)

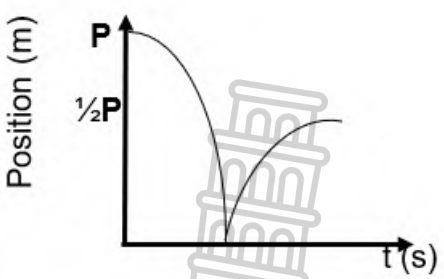
1.5 A rubber ball is thrown vertically downwards from the top of the building which is **P** m above the ground. The ball bounces off the ground and reaches a height of ½ **P** m above the ground. Ignore the effect of air friction and contact time between the ball and the ground.

Which ONE of the following position-time graphs is CORRECT for the motion of the ball described above?

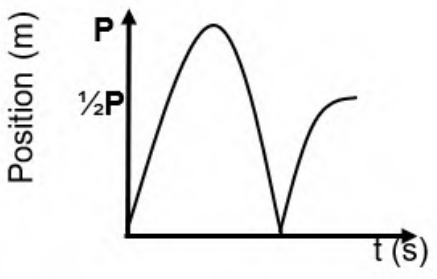
A



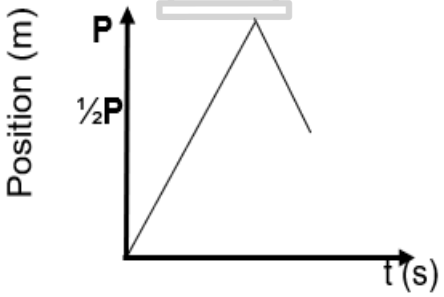
B



C



D



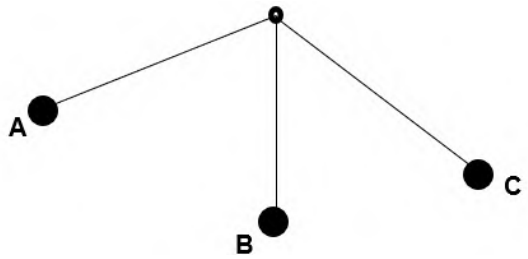
(2)

1.6 Two objects are involved in an elastic linear collision in a closed system. Which ONE of the following is TRUE about their momentum and kinetic energy respectively?

	MOMENTUM	KINETIC ENERGY
A	Conserved	Conserved
B	Conserved	Not conserved
C	Not Conserved	Conserved
D	Not Conserved	Not Conserved

(2)

1.7 A simple pendulum is set up by hanging a metal ball from a thin string as shown in the diagram below. The pendulum swings from point **A** and then past point **B** and passes point **C**. Ignore the effect of air friction.



Which ONE of the following statements is TRUE for this pendulum?

A The gravitational potential energy at **A** and **C** is the same.

B The pendulum comes to rest at point **C** where its gravitational potential energy is a maximum.

C The total mechanical energy of the ball is the same at **B** and **C**.

D The velocity of the pendulum is a maximum at **B** and a minimum at **C**. (2)

1.8 A truck moves at a velocity of ***x*** m.s^{-1}. The mass of the truck is ***m***. A container, mass ½ ***m*** is dropped vertically onto the truck. The velocity of the truck changes to ⅔ ***x***. The kinetic energy of the truck has changed by a fraction of …

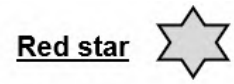
A $\frac{2}{3}$.

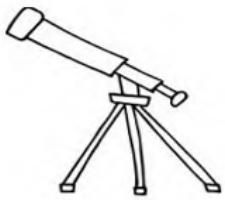
B $\frac{1}{2}$.

C $\frac{3}{4}$.

D $\frac{4}{9}$. (2)

1.9 Jane observes some red stars through a telescope at night. The reason for these observations is as follows:

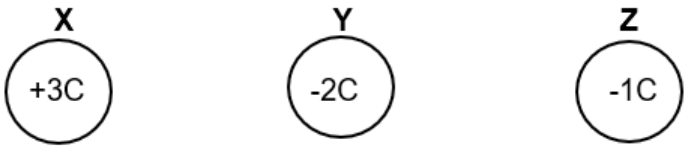




	Relative motion of the red star	Apparent frequency of the red star
A	Away from the earth	Higher
B	Towards the earth	Higher
C	Away from the earth	Lower
D	Towards the earth	Lower

(2)

1.10 Three spheres with charges are placed as follows in space. The distance between the **X** and Y is equal to the distance between **Y** and **Z**. Which of the charges will experience a net force to the right?



A Sphere **X** and **Y**

B Sphere **X**

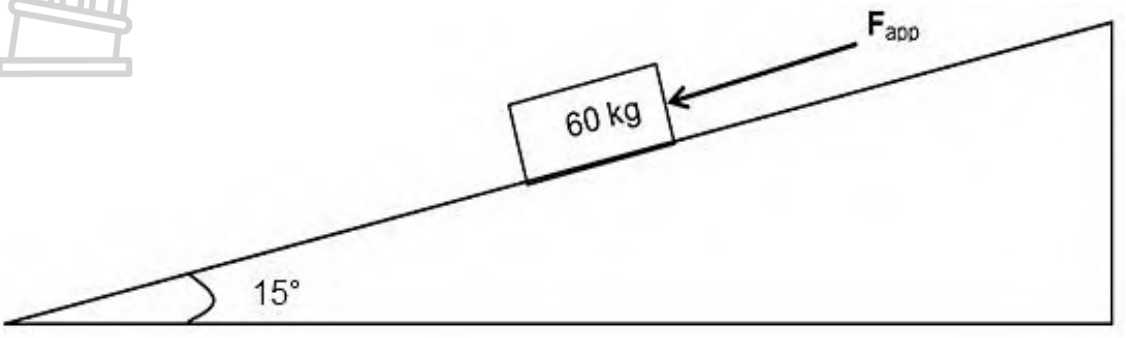
C Sphere **Y**

D Sphere **Z** (2)

[20]

QUESTION 2 (Start on a new page.)

A container of mass 60 kg is placed on an inclined surface which makes an angle of 15° with the horizontal. A force **F** = 120 N is applied to the container as shown in the diagram below. The container accelerates down the inclined surface. The coefficient of kinetic friction (μ_k) between the container and the surface of the inclined surface is 0,75.



2.1 State *Newton's First Law of Motion* in words. (2)

15°

2.2 Draw a labelled free-body diagram of all the forces acting on the container as it moves down the inclined surface. (4)

2.3 Calculate the magnitude of the kinetic frictional force between the crate and the inclined surface. (4)

2.4 The angle between the inclined surface and the horizontal is now increased. How will this affect the answer calculated in QUESTION 2.3 above?

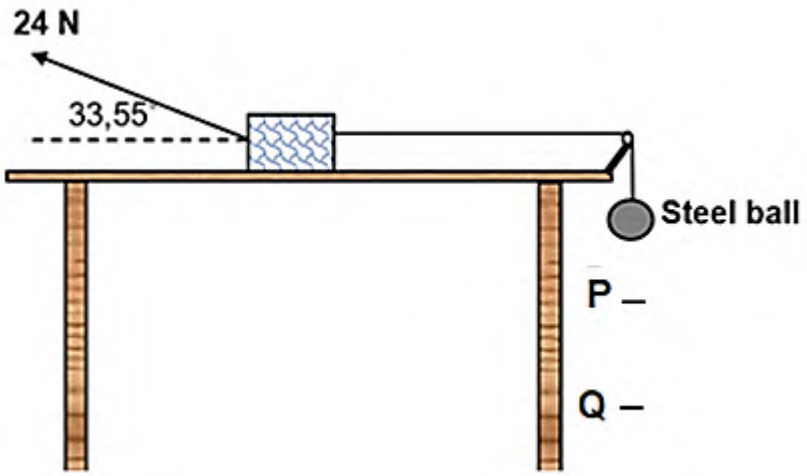
Write only INCREASE, DECREASE or REMAINS THE SAME.
Give a reason for your answer. (2)

2.5 Calculate the magnitude of the acceleration of the container as it moves down the inclined surface. (5)

[17]

QUESTION 3 (Start on a new page.)

A wooden block, placed on a frictionless table, is connected to a steel ball by means of a light, inextensible string that passes over a frictionless pulley. A force of 24 N is applied to the wooden block at an angle of 33,55° to the horizontal to the left as shown in the diagram below. The wooden block moves at a CONSTANT VELOCITY to the right. The steel ball moves past point **P** with a velocity of 0,25 $m.s^{-1}$.



3.1 Name the Newton's Third Law pair (action-reaction) forces acting between the block and the table. (2)

3.2 Calculate the mass of the steel ball. (4)

3.3 It takes the wooden block 1,2 s to move from point **P** to point **Q**.

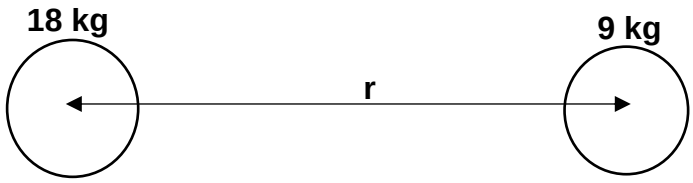
Calculate the distance between points **P** and **Q**. (2)

3.4 At the instant that the steel ball moves past point **Q,** the string breaks. How long does the steel ball take to reach the ground which is 0,55 m below point **Q**? (4)

[12]

QUESTION 4 (Start on a new page.)

Two spherically shaped objects of masses 18 kg and 9 kg respectively are placed with their centre at a distance of **r** m apart as shown in the diagram below. The objects exert a gravitational force of 1,34 x 10^{-10} N on each other.



4.1 State *Newton's Universal Law of Gravitation* in words. (2)

4.2 Calculate the distance **r** between the centres of the spheres. (5)

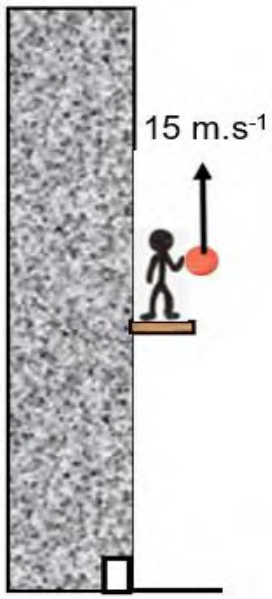
4.3 The 9 kg sphere is replaced by a 12 kg sphere. The gravitational force between the two spheres is still 1,34 x 10^{-10} N.

How will the distance between the two objects compare to the answer in QUESTION 4.2?

Write only LARGER, SMALLER or EQUAL TO. (1)
[8]

QUESTION 5 (Start on a new page.)

A man stands on the balcony of a building which is exactly halfway between the top of the building and the ground as shown in the diagram below. He projects a cricket ball upwards and it passes the top of the building after 1,27 s. Ignore the effect of air resistance. The diagram below is not drawn to scale.



5.1 Define the term *free fall.* (2)

5.2 Calculate the:

5.2.1 Height of the building (4)

5.2.2 Time the cricket ball took to reach its maximum height (3)

5.2.3 Velocity with which the ball hits the ground (4)

5.3 Draw a sketch velocity-time graph for the motion of the cricket ball from the moment that it was projected until it hits the ground.

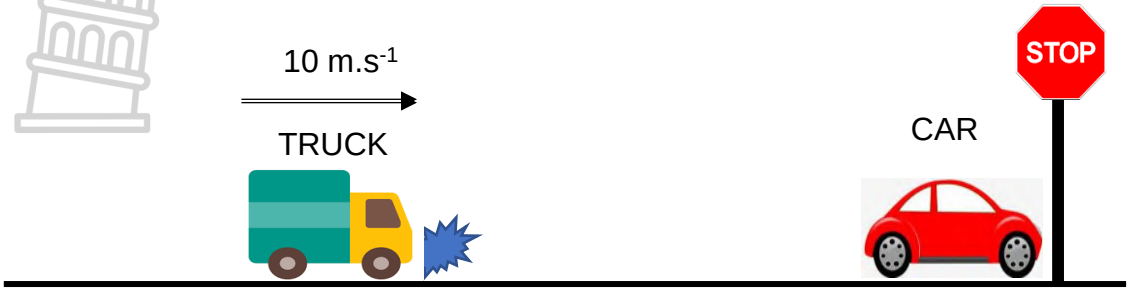
Indicate the following clearly on your graph:

- Initial velocity of the ball
- Time it took the ball to reach the top of the building
- Velocity of the ball when it hits the ground (4)

[17]

QUESTION 6 (Start on a new page.)

A truck of mass 5 600 kg travelling at a velocity of 10 m.s^{-1} to the east, collides with a stationary car of mass 1 800 kg. The collision lasted for 0,59 s. After the collision, the truck and the car are coupled and move together eastwards.



6.1 State the principle of the *Conservation of Linear momentum* in words. (2)

6.2 Calculate the:

6.2.1 Velocity of the truck-car system after the collision (4)

6.2.2 Force that the truck exerts on the car (5)

6.3 If the collision lasted three (3) times longer, how will your answer in QUESTION 6.2.2 be influenced?

Write down only INCREASE, DECREASE or SIMILAR. (1)

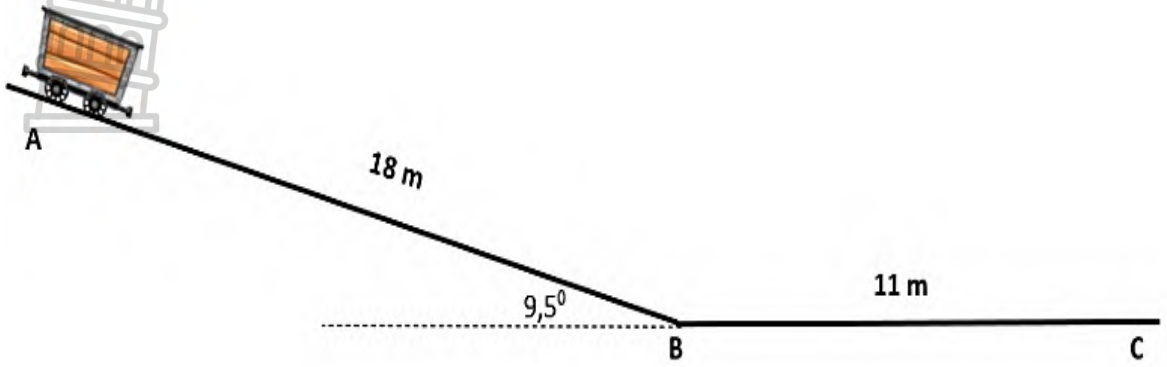
6.4 Explain your answer in QUESTION 6.3. (2)

6.5 Name TWO safety features that can be found in vehicles so that serious injuries can be minimised when collisions like this take place. (2)

[16]

QUESTION 7 (Start on a new page.)

A trolley of mass 685 kg moves from rest from point **A** down a frictionless, inclined surface as shown in the diagram below. **AB** is 18 m long while **BC** is 11 m. The incline makes an angle of 9,5° with the horizontal. The diagram is not drawn to scale.



7.1 State the principle of the CONSERVATION OF MECHANICAL ENERGY. (2)

7.2 Use the principle stated in QUESTION 7.1 to calculate the velocity of the trolley at point **B**. (4)

7.3 Calculate the work done by the gravitational force to move the trolley from **A** to **B**. (4)

The trolley continues to move from point **B** and comes to rest at point **C**.

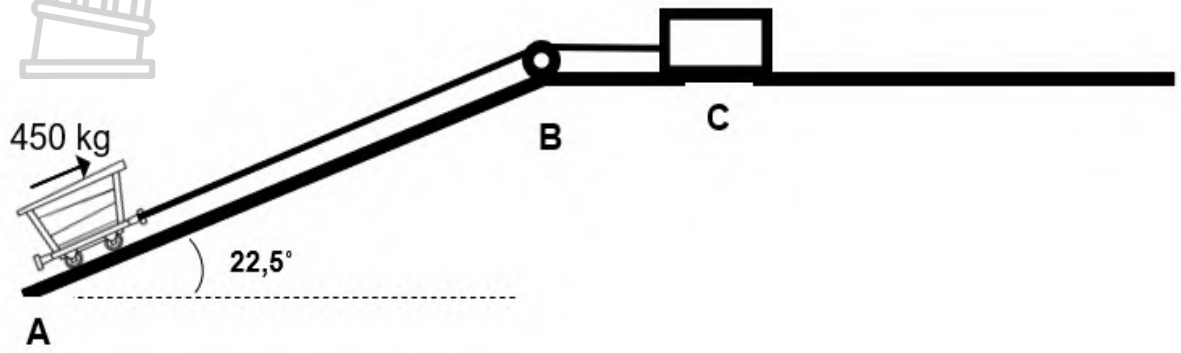
7.4 State the *work-energy Theorem* in words. (2)

7.5 Use the work-energy Theorem to calculate the magnitude of the frictional force between points **B** and **C**. (4)

7.6 Calculate the coefficient of kinetic friction between the trolley and surface **BC**. (4)
[20]

QUESTION 8 (Start on a new page.)

A trolley of mass 450 kg is pulled up an inclined surface by means of a motor placed at point **C**. The motor and the trolley are connected by a rope of negligible mass that passes over a frictionless pulley. The frictional force between the trolley's wheels and the inclined surface is 1 340 N.



8.1 Write down the name of a conservative force acting on the trolley. (1)

8.2 The trolley moves up the surface with a constant velocity of 1,57 $m.s^{-1}$.

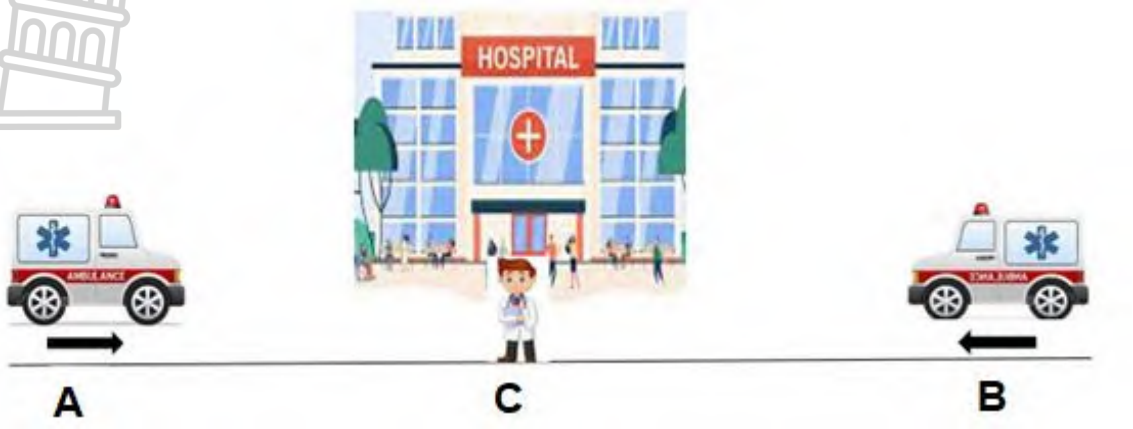
Calculate the:

8.2.1 Force that the motor exerts to move the trolley up the inclined surface (4)

8.2.2 Average power delivered by the motor to move the trolley up the inclined surface (4)
[9]

QUESTION 9 (Start on a new page.)

An ambulance, **A**, approaches a hospital from the west while its siren releases a sound with a frequency of 285 Hz. A doctor, standing in front of the hospital at point **C**, hears the ambulance's frequency to be 307 Hz. The speed of sound is 340 $m.s^{-1}$.



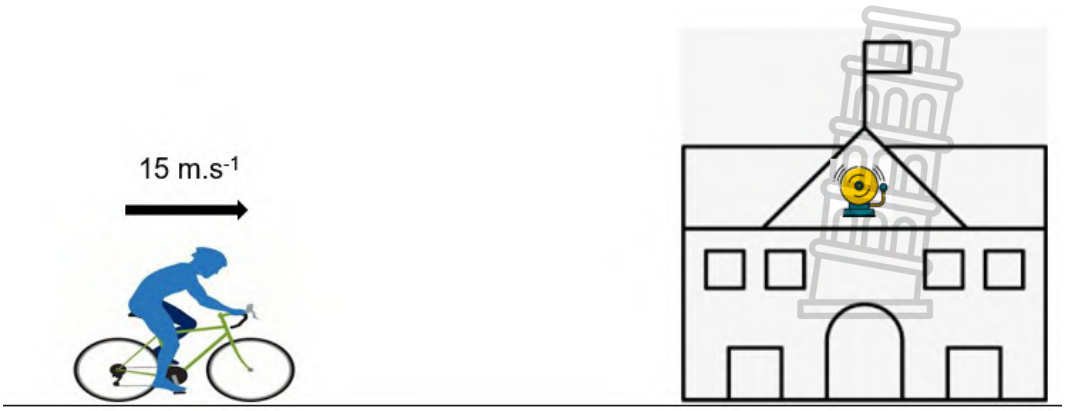
9.1 State the *Doppler effect* in words. (2)

9.2 Calculate the velocity of the ambulance as it approaches the hospital in $km.h^{-1}$. (5)

9.3 Ambulance **B** approaches the hospital from the east at a velocity of 100 $km.h^{-1}$. The two ambulances have similar sirens.
How does the frequency that the doctors hear from ambulance **B** compare to that of ambulance **A**, if the doctors stand at point **C**?
Choose from HIGHER THAN, LOWER THAN or THE SAME. Briefly explain your answer. (3)

9.4 State ONE use of the Doppler effect in die medical field. (1)

9.5 A cyclist rides towards a school and the school bell rings with a frequency of 625 Hz. The cyclist travels with a velocity of 15 $m.s^{-1}$. The speed of sound is 340 $m.s^{-1}$.



9.5.1 Calculate the frequency of the sound that the cyclist hears. (4)

9.5.2 Calculate the wavelength of the sound waves that the cyclist hears. (3)

[18]

QUESTION 10 (Start on a new page.)

Two identical negative point charges **P** and **Q** each carrying a charge of equal magnitude are placed 60 cm from each other in a vacuum as shown in the diagram below. The electrostatic force that the charges exert on each other is 4,55 x 10^{-2} N.

10.1 Draw the electric field pattern between charges **P** and **Q**. (3)

10.2 In which direction will charge **Q** experience a force due to charge **P**. (1)

10.3 State *Coulomb's Law* in words. (2)

10.4 Calculate the:

10.4.1 Magnitude of the charges on **P** and **Q** (4)

10.4.2 Number of excess charges on charge **P** (3)

[13]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 12

PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12

VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/ *SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity / *Swaartekragversnelling*	g	9,8 m•s^{-2}
Universal gravitational constant / *Universelegravitasiekonstant*	G	6,67 × 10^{-11} N•m^2•kg^{-2}
Speed of light in a vacuum / *Spoed van lig in 'n vacuum*	c	3,0 × 10^8 m•s^{-1}
Planck's constant / *Planck se konstante*	h	6,63 × 10^{-34} J•s
Coulomb's constant / *Coulomb se konstante*	k	9,0 × 10^9 N•m^2•C^{-2}
Charge on electron / *Lading op elektron*	e	-1,6 × 10^{-19} C
Electron mass / *Elektronmassa*	m_e	9,11 × 10^{-31} kg
Mass on earth / *Massa op aarde*	M	5,98 × 10^{24} kg
Radius of earth / *Radius van aarde*	R_E	6,38 × 10^6 m

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/*of* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^{\ 2} = v_i^{\ 2} + 2a\Delta x$ or/*of* $v_f^{\ 2} = v_i^{\ 2} + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/*of* $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1m_2}{d^2}$	$g = G\frac{M}{d^2}$

WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

$W = F\Delta x\cos\theta$	$U = mgh$ or/*of* $E_P = mgh$
$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{av} = Fv$	

WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/*of* $E = h\frac{c}{\lambda}$
$E = W_o + E_{k(max)}$ where/*waar* $E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_{k(\max.)} = \frac{1}{2}mv_{max}^2$ or/*of* $K_{max} = \frac{1}{2}mv_{max}^2$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{V}{d}$	$E = \frac{F}{q}$
$V = \frac{W}{q}$	$n = \frac{Q}{q_e}$

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	emf (ε) = I(R + r) emk (ε) = I(R + r)
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\Delta t$
W = Vq $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ P = VI $P = I^2R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT/*WISSELSTROOM*

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$	$P_{average} = V_{rms}I_{rms}$ / $P_{gemiddeld} = V_{wgk}I_{wgk}$ $P_{average} = I_{rms}^2R$ / $P_{gemiddeld} = I_{wgk}^2R$ $P_{average} = \frac{V_{rms}^2}{R}$ / $P_{gemiddeld} = \frac{V_{wgk}^2}{R}$

Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE / *NASIONALE SENIORSERTIFIKAAT*

GRADE/*GRAAD* 12

JUNE/*JUNIE* 2023

PHYSICAL SCIENCES P1 MARKING GUIDELINE/ *FISIESE WETENSKAPPE V1 NASIENRIGLYN*

MARKS/*PUNTE*: **150**

This marking guideline consists of 15 pages.
Hierdie nasienriglyn bestaan uit 15 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 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 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 1/*VRAAG 1*

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

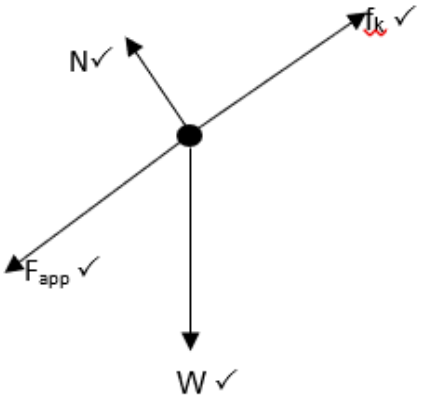
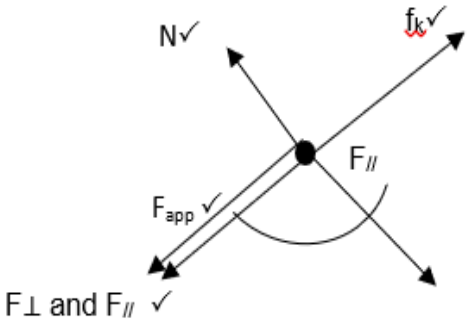
[20]

QUESTION/*VRAAG 2*

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

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

2.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
	

Mark awarded for arrow and labelling./ *Punt toegeken vir pyltjie en benoeming.*
Do not penalise for length of arrows since drawing is not drawn to scale. / *Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie.*

Any other additional force(s) / *Enige ander addisionele krag(te).* Max./*Maks.* $^3/_4$
If force(s) do not make contact with body / *Indien krag(te) nie met met die voorwerp kontak maak nie.* Max./*Maks.* $^3/_4$ (4)

2.3 $f_k = \mu_k N$
$f_k = \mu_k mg \cos\theta$ } Any one / *Enige een* ✓
$f_k = [(0,75)\ (60)(9,8 \cos 15^\circ)$ ✓] ✓
$f_k = 425,97$ N ✓ (4)

2.4 DECREASE ✓ As the angle increases the normal force decreases because ($N \propto \cos\theta$). Frictional force will decrease since $f_k \propto N$. ✓

VERLAAG. Soos die hoek toeneem sale die normaalkrag afneem aangesien ($N \propto \cos\theta$). Wrywingskrag sal afneem aangesien $f_k \propto N$. (2)

2.5 **Positive marking from QUESTION 2.4/*Positiewe nasien vanaf VRAAG 2.4***
$F_{net} = ma$
$F_{App} + f_{//} - f_f = ma$
$F_{App} + mg \sin\theta - f_f = ma$ } Any one / *Enige een* ✓

[120 + $60(9,8)(\sin 15^\circ)$ ✓ - 425,97]✓= 60 x a ✓
a = 4,44 m.s^{-2} (4,437) m.s^{-2} ✓ (5)
[17]

QUESTION 3/*VRAAG 3*

3.1 Force of block downwards on table, ✓ and force of table upwards on block. ✓

Afwaartse krag van blok op tafel en opwaartse krag van tafel op blok. (2)

3.2 $F_{net} = ma$
$T - F_g = ma$
$T - F_H = ma$
Any one / Enige een ✓

Wooden box / *Houtblok*
$T = F\cos\theta$
$T = 24 \cos 33,55^\circ$ ✓
$T = 20$ N
$T = 20$ N

Steel ball / *Staalbal*
$mg - 20 = 0$
$m(9,8) - 20 = 0$ ✓
$m = 2,04$ kg ✓ (4)

3.3 $\Delta x = v\Delta t$
$\Delta x = 0,25 \times 1,2$ ✓
$\Delta x = 0,3$ m ✓ (2)

3.4

$\Delta x = v_i\Delta t + ½ g \Delta t^2$ ✓	$\Delta x = v_i\Delta t + ½ g \Delta t^2$ ✓
$0,55$ ✓$= (0,25)\Delta t + ½(9,8)\Delta t^2$ ✓	$-0,55$ ✓$= (-0,25)\Delta t + ½(-9,8)\Delta t^2$ ✓
$\Delta t = 0,31$ s ✓	$\Delta t = 0,31$ s ✓

(4)
[12]

QUESTION/*VRAAG 4*

4.1 Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses, ✓and inversely proportional to the square of the distance between their centres. ✓

Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag direk eweredig aan die produk van hul massas, en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte.

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

Elke deeltjie in die heelal trek elke ander deeltjie aan met 'n krag direk eweredig aan die produk van hul massas, en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. (2)

4.2 $F = \frac{GM_1M_2}{r^2}$ ✓

$1{,}34 \times 10^{-10}$ ✓ $= \frac{(6{,}67 \times 10^{-11})(9 \times 18)}{r^2}$ ✓✓

$r = 8{,}98$ m (9 m) ✓ (5)

4.3 LARGER / *GROTER AS* ✓ (1)

[8]

QUESTION/*VRAAG 5*

5.1 Motion of an object where the only force acting on it is gravitational force/ gravity. ✓✓

Beweging waartydens die enigste krag wat op 'n voorwerp inwerk, die gravitasiekrag is. (2)

5.2.1

Downwards / Positive	**Upwards / Positive**
Afwaarts / Positief	***Opwaarts / Positief***
$\Delta y = v_i\Delta t + \frac{1}{2} g \Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2} g \Delta t^2$ ✓
$\Delta y = (-15)(1,27) + \frac{1}{2}(9,8)(1,27)^2$ ✓	$\Delta y = (15)(1,27) + \frac{1}{2}(-9,8)(1,27)^2$ ✓
$\Delta y = -11,15$ m	$\Delta y = 11,15$ m
Height / *Hoogte* = 11,15 x 2 ✓	Height / *Hoogte*= 11,15 x 2 ✓
= 22,3 m ✓	= 22,3 m ✓

(4)

5.2.2

Downwards / Positive	**Upwards / Positive**
Afwaarts / Positief	***Opwaarts / Positief***
$v_f = v_i + g\Delta t$ ✓	$v_f = v_i + g\Delta t$ ✓
$0 = -15 + 9,8\Delta t$ ✓	$0 = 15 + -9,8\Delta t$ ✓
$\Delta t = 1,67$ s ✓	$\Delta t = 1,67$ s ✓

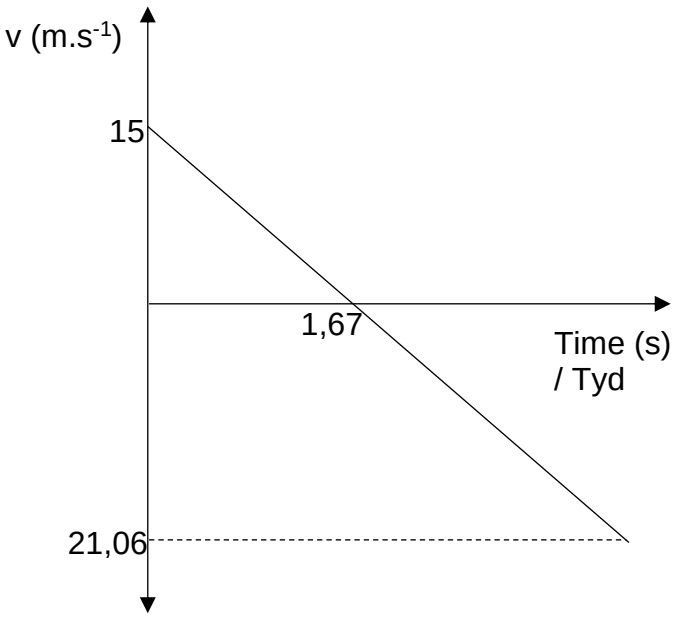
(3)

5.2.3

Downwards / Positive	**Upwards / Positive**
Afwaarts / Positief	***Opwaarts / Positief***
$v_f^2 = v_i^2 + 2g\Delta y$ ✓	$v_f^2 = v_i^2 + 2g\Delta y$ ✓
$v_f^2 = (-15)^2$ ✓ $+ 2(9,8)(11,15)$ ✓	$v_f^2 = (15)^2$ ✓ $+ 2(-9,8)(11,15)$ ✓
$v_f = 21,06$ m.s^{-1} ✓	$v_f = 21,06$ m.s^{-1} ✓

(4)

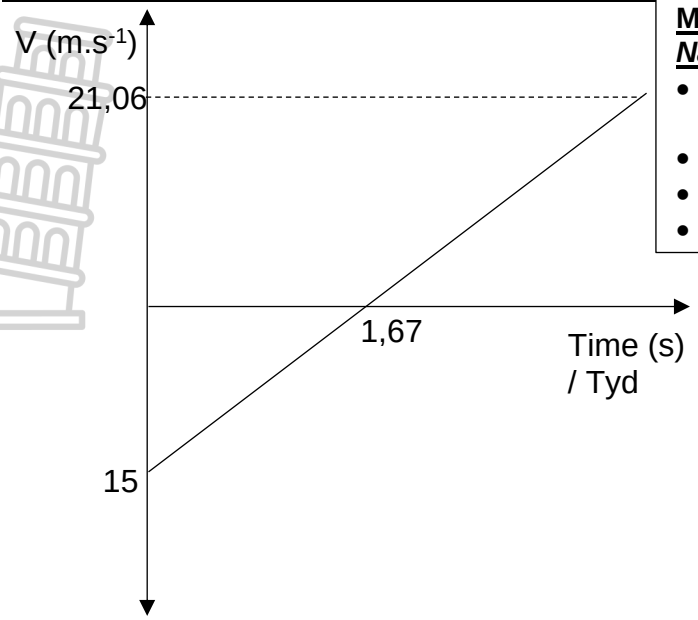
5.3 **DOWNWARDS POSITIVE/ *AFWAARTS – POSITIEF***



Marking criteria / *Nasienkriteria*
- Shape / Vorm (straight line / *reguitlyn)* ✓
- $v_i = -15$ ✓
- v_{ground} / *grond* = 21,06 ✓
- $\Delta t_{(B)} = 1,67$ s ✓

(4)

UPWARDS POSITIVE / *OPWAARTS – POSITIEF*



Marking criteria / *Nasienkriteria*

- Shape / Vorm (straight line / *reguitlyn)* ✓
- v_i = 15 ✓
- v_{ground} / *grond* = - 21,06 ✓
- $\Delta t_{(B)}$ = 1,67 s ✓

(4)
[17]

QUESTION 6/*VRAAG 6*

6.1 In an isolated system, the total linear momentum is conserved.

OR

The total linear momentum before a collision is equal to the total linear momentum after a collision in a closed system. ✓✓

In 'n geïsoleerde sisteem is die totale lineêre momentum behoue.

OF

Die totale lineêre momentum voor botsing is gelyk aan die totale lineêre momentum na botsing in 'n geslote sisteem. (2)

6.2.1 $m_Tv_i + m_cv_i = m_Tv_f + m_cv_f$ } Any one / *Enige een* ✓
$m_Tv_i + m_cv_i = (m_T + m_c)v_f$ }
$5600(10) + 1800(0)$ ✓$= (5600 + 1800)\ v_f$ ✓
$v_f = 7{,}57\ m.s^{-1}$ ✓ (4)

POSITIVE MARKING FROM QUESTION 6.2.1
POSITIEWE NASIEN VANAF VRAAG 6.2.1

6.2.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$F_{net}.\Delta t = mv_f - mv_i$ ✓ F_{net} x 0,59 ✓ = 5600(7,57 – 10) ✓ $F_{net} = -2{,}36 \times 10^4$ $F_{net} = 2{,}36 \times 10^4$ N ✓ (23644,07 N) East(wards) / *Oos(waarts)*✓	$F_{net}.\Delta t = mv_f - mv_i$ ✓ F_{net} x 0,59 ✓ = 1800(7,57 –0) ✓ $F_{net} = 2{,}36 \times 10^4$ N ✓ (23644,07 N) East(wards) / *Oos(waarts)*✓

(5)

6.3 DECREASE/*AFNEEM* ✓ (1)

6.4 $F_{net}\ \alpha\ \frac{1}{\Delta t}$ / the net force is inversely proportional the time ✓
Δv remains the same while Δt increases ✓
$\therefore F_{net}$ decreases.

$F_{netto}\ \alpha\ \frac{1}{\Delta t}$ / die netto krag is omgekeerd eweredig aan die tyd
Δv bly konstant terwyl Δt toeneem
$\therefore F_{netto}$ verlaag. (2)

6.5 Crumble zones / Less rigid metal used / *Frommelsone / minder rigiede metaal gebruik*
Head rests / *Kopstut*
Safety belts / *Veiligheidsgordel*
Air bags / *lugsakke*

Any two / *Enige twee* (or any other relevant answer/ *of enige ander relevante antwoord*) ✓✓ (2)
[16]

QUESTION 7/*VRAAG 7*

7.1 The total mechanical energy in a closed system ✓ remains constant. ✓
Die totale meganiese energie in 'n geslote sisteem bly constant. (2)

7.2 $(E_p + E_k)_A = (E_p + E_k)_B$
$(mgh + ½mv^2)_A = (mgh + ½mv^2)_B$ } Any one / *Enige een* ✓
$\underline{(685)(9,8)(18 \sin 9,5^0)}$ ✓ + ½(685)(0^2) = (685)(9,8)(0) + $\underline{½(685)(v_f^2)}$ ✓
$v_f = 7,63 \text{ m.s}^{-1}$ ✓ (4)

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*

$W_{//} = F_{//}.\Delta x.\cos\theta$
$W_{//} = mg \sin\theta.\Delta x.\cos\theta$ } Any one ✓
$W_{//} = [\underline{(685)(9,8)\sin 9,5^\circ}$ ✓ x18cos 0°] ✓
$W_{//} = 19\,943,36\ (1,99 \times 10^4)$ J ✓
	$W_{//} = F_{//}.\Delta x.\cos\theta$
	$W_{//} = mg \sin\theta.\Delta x.\cos\theta$ } Any one ✓
	$W_{//} = [\underline{(685)(9,8)}$ x18$\underline{\cos 80,5^\circ}$ ✓] ✓
	$W_{//} = 19\,943,36\ (1,99 \times 10^4)$ J ✓

(4)

7.4 The net work done on an object is equal to the change in kinetic energy. ✓✓
Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie. (2)

7.5 **Positive marking from QUESTION 7.2 / *Positiewe nasien vanaf VRAAG 7.2***
$W_{net} = \Delta E_k$
$W_f = ½m(v_f^2 - v_i^2)$ } Any one / *Enige een*
$F_f.\Delta x.\cos\theta = ½m(v_f^2 - v_i^2)$
$\underline{F_f.11.\cos 180^0}$ ✓ = $\underline{½(685)(0^2 - 7,63^2)}$ ✓
$F_f = 1812,66$ N ✓ (4)

7.6 **Positive marking from QUESTION 7.5 / *Positiewe nasien vanaf VRAAG 7.5***
$\underline{f_f} = \mu_k N$
$\mu_k = \underline{1812,66}$ ✓
(9,8 x 685) ✓
$\mu_k = 0,27$ ✓ (4)
[20]

QUESTION 8/*VRAAG 8*

8.1 Gravitational force / *Gravitasiekrag* ✓ (1)

8.2 $F_{net} = ma$
$F_{motor} - F_{//} - f_f = ma$
$F_{motor} - mg \sin \theta - f_f = ma$
Any one / *Enige een* ✓
$F_{motor} - (450)(9,8)(\sin 22,5^\circ)$ ✓ $- 1\ 340 = (450)0$ ✓
$F_{motor} = 3\ 027,63$ N ✓ (4)

Positive marking from QUESTION 8.2 / *Positiewe nasien vanaf VRAAG 8.2*

8.3 $P_{ave} = F.v$ ✓
$P_{ave} = 3\ 027,63 \times 1,57$ ✓
$P_{ave} = 4\ 758,39$ W ✓
Yes, it will be sufficient. / *Ja dit sal genoeg wees.* ✓ (4)
[9]

QUESTION 9/*VRAAG 9*

9.1 The change in frequency (or pitch) of the sound detected by a listener, because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓
Die verandering in frekwensie (of toonhoogte) 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.

OR / OF

The apparent change in frequency when a source of sound and the listener move relative to each other.
Die waargenome verandering in frekwensie wanneer die klankbron en die luisteraar relatief na mekaar beweeg. (2)

9.2 $f_L = \frac{v \pm v_L}{v \pm v_S} \cdot f_S$ ✓

307 ✓ $= \frac{340}{(340 - v_s)} \cdot$ ✓ 285 ✓

$v_s = 24{,}36\ m.s^{-1}$ ✓
$v_s = 87{,}7\ km.h^{-1}$ (5)

9.3 HIGHER / *HOËR* ✓
As ambulance **B** moves faster, ✓ the wavelength towards the doctor is shorter ✓ and the frequency higher.

*As ambulans **B** vinniger beweeg, sal die golflengte na die dokter korter en die frekwensie hoër wees.* (3)

9.4 Measure the heartbeat of a foetus / Meet die h*artklop van 'n fetus*] Any one/ ✓
Measure the rate of blood flow / Meet die t*empo van bloedvloei*] *Enige een* (1)

9.5.1 $f_L = \frac{v \pm v_L}{v \pm v_S} \cdot f_S$ ✓

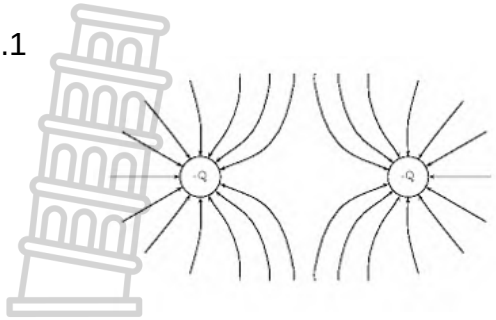
$f_L = \frac{(340 + 15)}{340} \cdot$ ✓ 625 ✓
$= 652{,}57$ Hz ✓ (4)

Positive marking from QUESTION 9.5.1 / *Positiewe nasien vanaf VRAAG 9.5.1*

9.5.2 $v = f\lambda$ ✓
$340 = 652{,}57 \times \lambda$ ✓
$\therefore \lambda = 0{,}54$ m ✓ (3)
[18]

QUESTION 10/*VRAAG 10*

10.1



Marking criteria / *Nasienkriteria*
Direction / *Rigting* ✓
Shape / *Vorm* ✓
Lines all touching charges and not crossing / *Lyne raak aan ladings en kruis nie* ✓

(3)

10.2 To the right (Westwards) / *Na regs (Weswaarts)* ✓ (1)

10.3 The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) 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 (Q_1) op 'n ander puntlading (Q_2) uitoefen is direk eweredig aan die produk van hul ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle. (2)

10.4 $F = \frac{kQ_PQ_Q}{r^2}$ ✓

$4,55 \times 10^{-2} = \frac{(9 \times 10^9)(Q^2}{(0,6)^2}$ ✓ ✓

$Q_P = Q_Q = (-)1,35 \times 10^{-6}$ C ✓ (4)

10.5 $Q_P = nq_e$ ✓

$1,35 \times 10^{-6} = n \times (1,6 \times 10^{-19})$ ✓

$n = 8,44 \times 10^{12}$ electrons / *elektrone* ✓ (3)

[13]

TOTAL/*TOTAAL*: 150