Province of the
EASTERN CAPE
EDUCATION

Iphondo leMpuma Kapa: Isebe leMfundo
Provinsie van die Oos Kaap: Department van Onderwys
Porafensie Ya Kapa Botjhabela: Lefapha la Thuto

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2025

PHYSICAL SCIENCES P1

MARKS 150

TIME: 3 hours

* J P H S C E 1 *

This question paper consists of 18 pages including 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME in the appropriate space on the ANSWER BOOK.
2. Answer ALL the questions.
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. Show ALL formulae and substitutions 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 answers to the following questions. Choose the answer and write ONLY the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 A box is placed on top of a truck while the truck is stationary. When the truck starts to move, which ONE of the following statements will CORRECTLY describe the motion of the box?

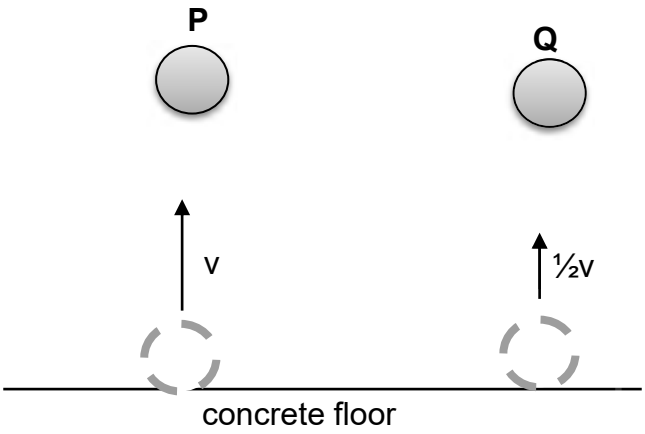
A It will remain stationary.

B It will move forward in the direction of the truck.

C It will move backwards as the truck is moving forward.

D It will first move forward and then backwards. (2)

1.2 Ball **P** and ball **Q**, of the same mass, are dropped from the same height onto a concrete floor. Both balls hit the concrete floor at the same speed, **v**. Ball **P** rebounds with the same vertical speed, **v**, but ball **Q** rebounds with speed ½**v**.



Which ONE of the following statements regarding the collision of EACH ball with the concrete floor is CORRECT?

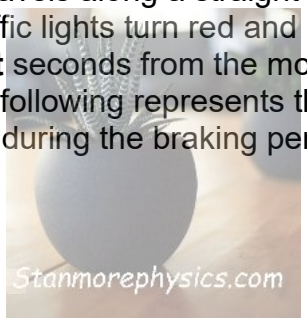
A Kinetic energy is conserved for both balls **P** and **Q**.

B The change in momentum of ball **P** is greater than that of ball **Q**.

C The contact time with the floor is the same for both balls **P** and **Q**.

D Momentum is conserved for the collision of ball **P**, but not for that of ball **Q**. (2)

1.3 A car of mass **m** travels along a straight road with a velocity of magnitude **v**. The driver sees the traffic lights turn red and immediately applies the brakes. The car stops uniformly in **t** seconds from the moment that the brakes were applied. Which ONE of the following represents the MAGNITUDE of the average force exerted on the car during the braking period of **t** seconds?



A $\frac{v}{t}$

B mv

C mvt

D $\frac{mv}{t}$ (2)

1.4 A ball is projected vertically upwards. Ignore air resistance. Which ONE of the following statements about the acceleration of the ball at its maximum height is CORRECT? The acceleration is equal to …

A zero.

B g and is directed downwards.

C g and is directed upwards.

D g and is directed horizontally. (2)

1.5 Consider the statements below:

I Work is done on an object when a force displaces the object in the direction of the force.

II Mechanical energy of a system is conserved when an external force does no work on the system.

III The work done on an object by a net force is equal to the kinetic energy of the object.

Which ONE of the above statement(s) is/are TRUE?

A I Only

B I and II only

C II and III only

D I, II and III (2)

1.6 If the net work done on a moving object is POSITIVE, then we can conclude that the kinetic energy of the object …

A has not changed.

B has increased.

C has decreased.

D is zero. (2)

1.7 An object moving with a velocity **v** has kinetic energy K. If the velocity of the object doubles to **2v,** the net work done will be …

A 2K.

B K.

C 3K.

D 4K. (2)

1.8 An observer stands at a distance **x** from a stationary ambulance blowing its siren at a certain frequency at an accident scene. The pitch of sound that the observer hears compared to the pitch of sound produced from the siren will be …

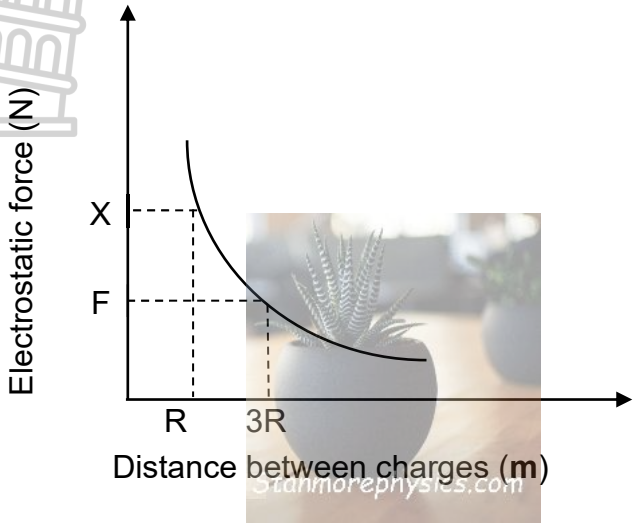
A equal to.

B greater than.

C less than.

D zero. (2)

1.9 The graph below, not drawn to scale, shows the relationship between the electrostatic force exerted by two point charges on each other and its distance between the charges.



Which ONE of the following is the CORRECT representation of the magnitude of force **X** shown on the graph?

A 3F

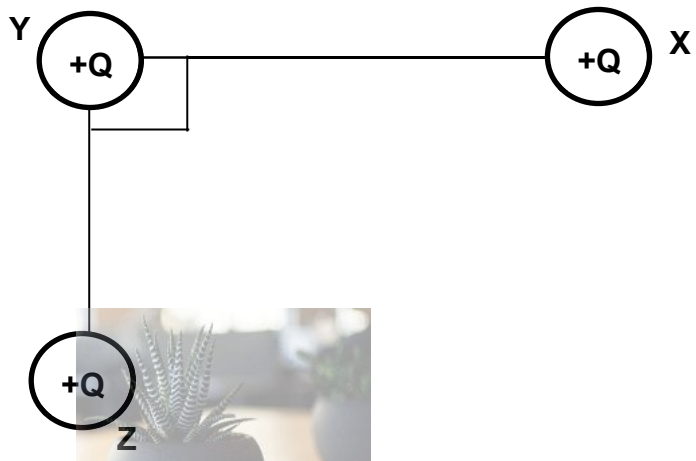
B 9F

C ⅓F

D $^1/_9$F

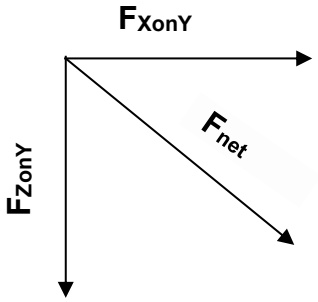
(2)

1.10 Three identical charges **X**, **Y** and **Z** are arranged in a vacuum as shown in the diagram below.

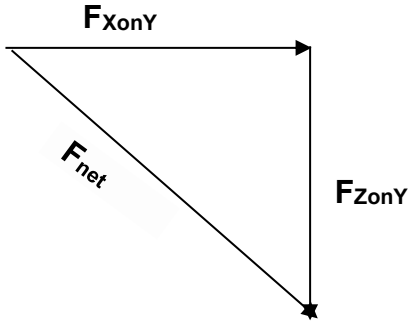


Which of the following vector diagrams NOT drawn to scale represent the forces acting on sphere **Y** and the net force on sphere **Y**?

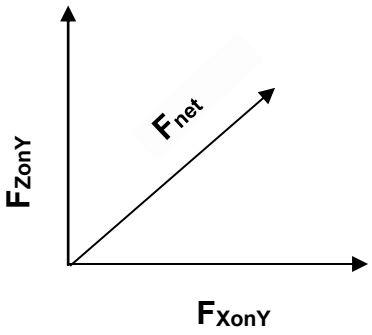
A



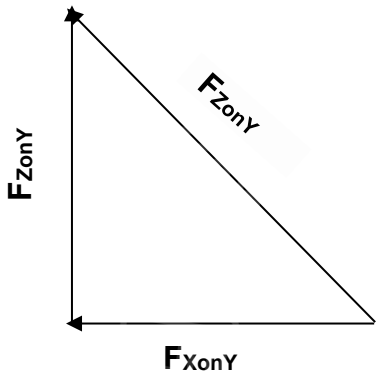
C



B



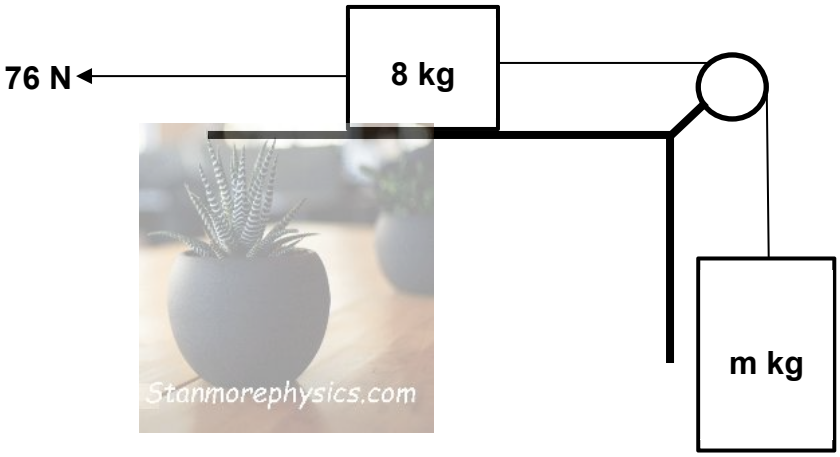
D



(2)
[20]

QUESTION 2

A block of mass 8 kg is placed on a horizontal surface and is connected to an **m** kg block which hangs vertically by means of an INEXTENSIBLE string that passes over a light frictionless pulley as shown in the diagram below. A force of 76 N is applied horizontally to keep the system sliding downwards at a CONSTANT VELOCITY.



2.1 State Newton's second law of motion in words. (2)

2.2 Draw a labelled free-body diagram of all forces acting on the 8 kg block. (5)

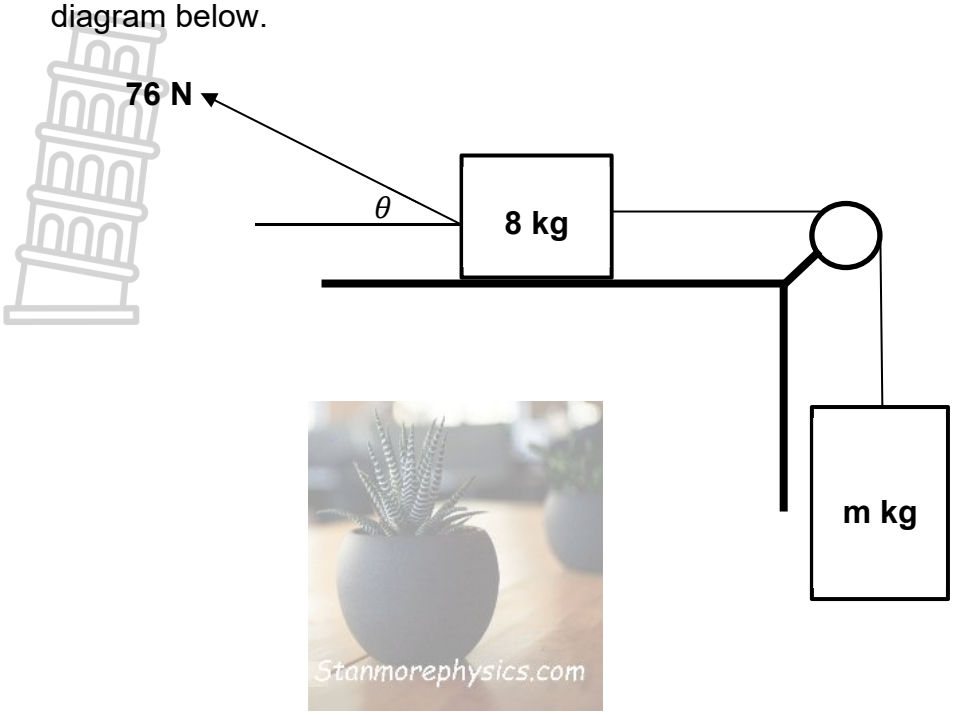
2.3 The coefficient of kinetic friction (μ_k) between the block and the surface is 0,2.

Calculate:

2.3.1 The frictional force acting on the 8 kg block (3)

2.3.2 **m**, the mass of the hanging block (4)

2.4 The applied force now acts at an angle θ to the horizontal as shown in the diagram below.



What will be the effect on the following?

Choose from INCREASE, DECREASE or REMAIN THE SAME.

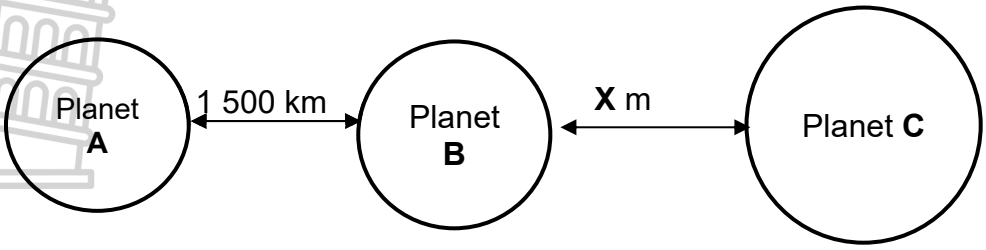
2.4.1 The coefficient of kinetic friction? (1)

2.4.2 The kinetic friction acting on the 8 kg block? Explain your answer. (3)

[18]

QUESTION 3

Consider three planets **A**, **B** and **C** arranged in a straight line as shown in the diagram below.



	MASS OF PLANET (kg)	RADIUS OF PLANET (m)
A	$6,42 \times 10^{23}$	$3,93 \times 10^{6}$
B	$5,98 \times 10^{24}$	$6,38 \times 10^{6}$
C	$1,92 \times 10^{25}$	$7,20 \times 10^{6}$

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

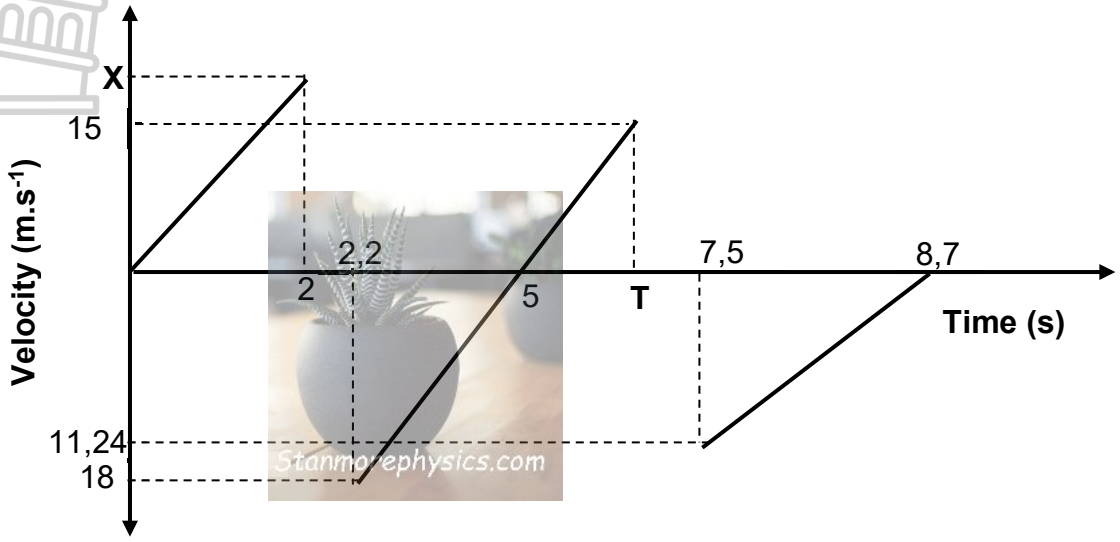
3.2 Calculate the gravitational force exerted by planet **A** on planet **B**. (4)

3.3 Planet **B** experiences a zero net force due to planet **A** and planet **C**. Calculate the distance **X** on the diagram above. (6)

[12]

QUESTION 4

The velocity-time graph below, NOT drawn to scale, shows the motion of a ball from a certain height above the ground. The ball bounces a few times and all sections of the graph have the same gradient. Ignore the effect of air friction.



4.1 Give a reason why all sections of the graph have the same gradient. (1)

4.2 Is the downwards motion POSITIVE or NEGATIVE. (1)

4.3 How many times did the ball bounce. (1)

4.4 Calculate the:

4.4.1 Velocity **X** on the graph (3)

4.4.2 Time **T** on the graph (4)

4.4.3 Height above the ground where the ball was projected (3)

4.4.4 Maximum height reached after the second bounce (3)

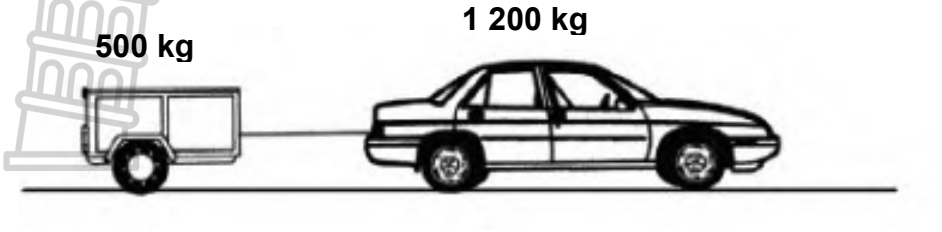
4.5 Sketch a position-time graph for the entire motion of the ball. Indicate the following on the graph:

- Height above the ground where the ball was projected
- Maximum height reached after the second bounce
- All the times indicated on the graph above (4)

[20]

QUESTION 5

A car of mass 1 200 kg is moving at a constant velocity of 12 m.s^{-1} to the right and pulls a trailer of mass 500 kg. Ignore the effect of all frictional forces.



5.1 State the law of conservation of linear momentum in words. (2)

5.2 Calculate the momentum of the car-trailer system. (3)

The rope connecting the trailer to the car suddenly breaks and the car and trailer are separated.

5.3 In which direction will the trailer move the instant the rope breaks. State a relevant PHYSICS LAW to support your answer. (3)

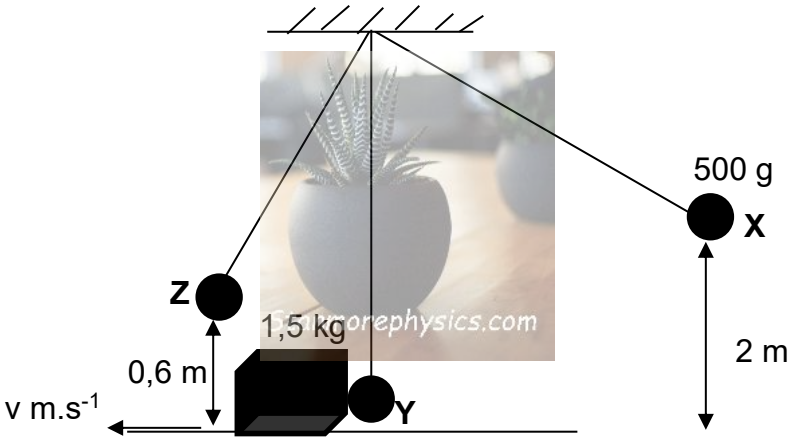
5.4 Calculate the velocity of the trailer after it separated from the car. (4)

5.5 Use a relevant calculation to determine whether the collision is ELASTIC or INELASTIC. (5)

[17]

QUESTION 6

A steel ball of mass 500 g attached to an inextensible string, hangs from a ceiling. The ball is held at position **X**, a height of 2 m above a horizontal table with a 1,5 kg crate placed on it. When the ball is released, it collides with the crate at position **Y**. The crate moves to the left with a speed of **v** $m.s^{-1}$ while the ball continues its swing to position **Z**, and reaches a maximum height of 0,6 m above the table shown in the diagram below. A frictional force of 50 N acts on the crate as it moves to the left. Ignore the air friction.



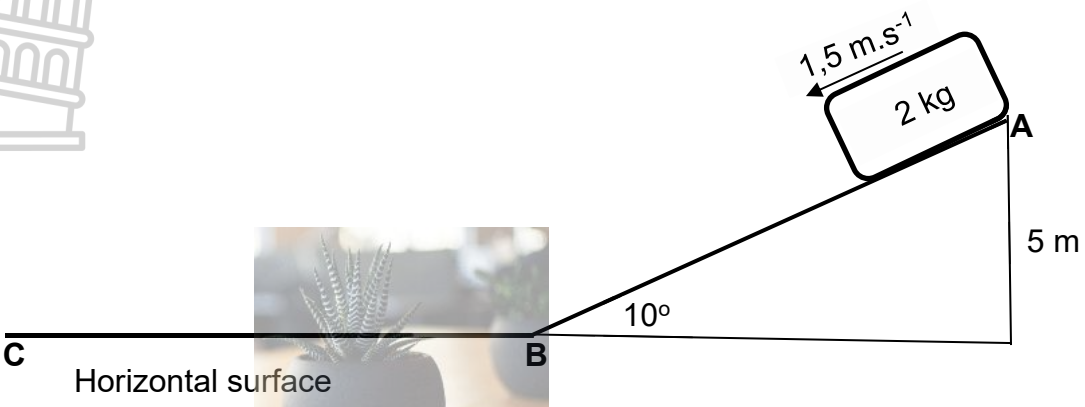
6.1 State the law of conservation of mechanical energy in words. (2)

6.2 Calculate the work done by the gravitation force in moving the steel ball from point **A** to **B**. (3)

6.4 Calculate the speed **v**, of the crate after the steel ball collides with it. (5)
[10]

QUESTION 7

In the diagram below, a small object of mass 2 kg is sliding at velocity of 1,5 m.s^{-1} down a rough plane inclined at 10^{o} to the horizontal surface.



At the bottom of the plane, the object continues sliding onto the rough horizontal surface and eventually comes to a stop. The frictional force acting on the block while it slides along the inclined surface is 2,5 N.

The coefficient of kinetic friction between the object and the surface is the same for both the inclined surface and the horizontal surface.

7.1 Define the term *non-conservative force*. (2)

7.2 Draw a labelled free-body diagram of all the forces acting on the block while it is on the inclined surface. (3)

7.3 State the work-energy theorem in words. (2)

7.4 Use ENERGY PRINCIPLES to calculate the:

7.4.1 Speed of the block at the bottom of the incline at point **B** (5)

7.4.2 Distance **BC** that the block moves before it comes to a stop (5)
[17]

QUESTION 8

The siren of a fire truck moving at a constant speed 20 $m.s^{-1}$ along a straight horizontal road emits sound with a wavelength of 0,34 m. A detector on the same road records sound waves from the fire truck with a lower frequency than the sound emitted by the siren. Take the speed of sound in air as 340 $m.s^{-1}$.

8.1 Define *Doppler effect* in words. (2)

8.2 Is the fire truck driving TOWARDS or AWAY FROM the detector? Give a reason for your answer. (2)

8.3 Explain in terms of wave motion why the detector records sound waves with lower frequency. (3)

8.4 Calculate the:

8.4.1 Frequency of the siren (3)

8.4.2 Frequency recorded by the detector (6)

8.5 The speed of the fire truck now increased to 25 $m.s^{-1}$. How will the increase in speed affect the following?

Choose from INCREASE, DECREASE or STAYS THE SAME.

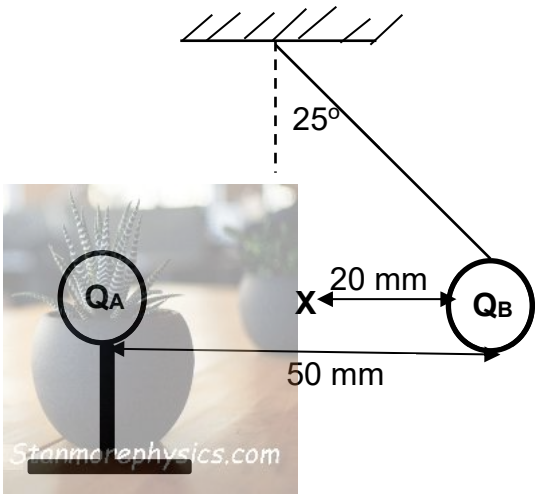
8.5.1 The frequency of the sound waves emitted by the siren. (1)

8.5.2 The frequency of the sound waves recorded by the detector. (1)

[18]

QUESTION 9

Q_A and Q_B are metal charged spheres. Q_A is placed on an insulated stand while Q_B hangs from a ceiling by means of an inextensible string that makes an angle of 25° to the vertical as shown in the diagram below. Q_A carries a charge of +15 nC while Q_B has a mass of 6 x 10^{-5} kg and carries an unknown charge. Q_B is in equilibrium.



9.1 Is the charge on Q_B POSITIVE or NEGATIVE? Give a reason for your answer. (2)

9.2 State Coulomb's law in words. (2)

9.3 Calculate the:

9.3.1 Tension in the string. (4)

9.3.2 Magnitude of the charge on Q_B (5)

9.3.3 Net electric field at point **X** shown on the diagram above. (5)

[18]

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 vakuum*	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 of 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* $E = h\frac{c}{\lambda}$
$E = W_o + E_k$ where/*waar* $E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_k = \frac{1}{2}mv^2$ 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 = VIΔt 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*

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

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NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

JUNE/*JUNIE* 2025

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

MARKS/*PUNTE*: **150**

This marking guideline consists of 17 pages./
Hierdie nasienriglyn bestaan uit 17 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 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 formules 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 berekeninge, 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, not a full stop, for example, $m•s^{-1}$.
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 $m•s^{-1}$.
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 QUESTION 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 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 VRAAG 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/*VRAAG* 1: MULTIPLE-CHOICE QUESTIONS
MEERVOUDIGEKEUSE-VRAE

1.1 C ✓✓ (2)

1.2 B ✓✓ (2)

1.3 D ✓✓ (2)

1.4 B ✓✓ (2)

1.5 B ✓✓ (2)

1.6 B ✓✓ (2)

1.7 C ✓✓ (2)

1.8 A ✓✓ (2)

1.9 B ✓✓ (2)

1.10 D ✓✓ (2)

[20]

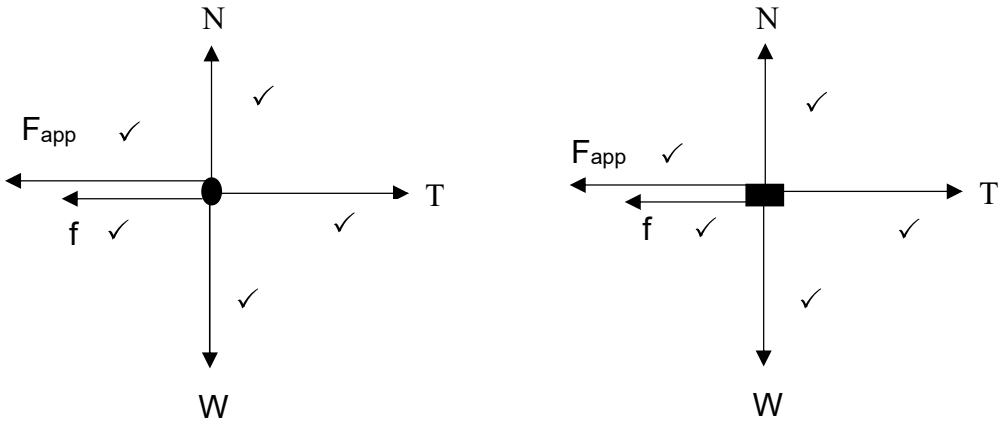
QUESTION/*VRAAG* 2

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

Acceleration is directly proportional to the resultant/net force ✓and inversely proportional to the mass of the object. ✓
Versnelling wat direk eweredig is aan die resultante/netto krag en omgekeerd eweredig aan die massa van die voorwerp is.

The resultant/net force acting on an object is directly proportional the rate of change in momentum. ✓✓ (2 or 0)
Die resulterende/netto krag wat op 'n voorwerp inwerk is direk eweredig aan die tempo van verandering in momentum. (2 of 0) (2)

2.2



Mark awarded for arrow and label / *Punt toegeken vir benoeming en pyltjie*
Do not penalise for length of arrows since drawing is not drawn to scale/ *Moenie vir die lengte van die pyltjies penaliseer nie, die tekening is nie volgens skaal geteken nie*
Any other additional force(s)/ *Enige ander addisionele krag(te)* $^{4}/_{5}$
If force(s) do not make contact with body / *Indien krag(te) nie met die voorwerp kontak maak nie:* Max./ *Maks.* $^{4}/_{5}$ (5)

2.3 2.3.1 $f_k = \mu_k N$ / $f_k = \mu_k mg$ } Any one / *Enige een* ✓
$f_k = 0,2 \times 8 \times 0,8$ ✓
$f_k = 15,68$ N ✓ (3)

Positive marking from QUESTION 2.3.1 / Positiewe nasien vanaf VRAAG 2.3.1

	DOWNWARDS POSITIVE / *AFWAARTS AS POSITIEF*	**UPWARDS POSITIVE/ *OPWAARTS AS POSITIEF***
2.3.2	$F_{net} = ma$ $F_g - T = ma$ $T - F - f = ma$ } Any one / *Enige een* ✓ $T - 76 - 15,68 = 0$ ✓ $T = 91,68$ N $m \times 9,8 - 91,68 = 0$ ✓ $m = 9,36$ kg ✓	$F_{net} = ma$ $T - F_g = ma$ $F + f - T = ma$ } Any one / *Enige een* ✓ $76 + 15,68 - T = 0$ ✓ $T = 91,68$ N $91,68 - (m \times 9,8) = 0$ ✓ $m = 9,36$ kg ✓ (4)

2.4 2.4.1 Remains the same / *Bly dieselfde* ✓ (1)

2.4.2 Decrease / *Afneem*.✓ Normal force decreases / *Normaal krag neem af*. ✓
$N = F_g - F\sin\theta$ $f_k \alpha N$ / $f_k = \mu_k N$ ✓ (3)
[18]

QUESTION/*VRAAG* 3

3.1 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 wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte. (2)

3.2 $F = \frac{Gm_1m_2}{d^2}$ ✓

$F = \frac{6,67 \times 10^{-11} 6,42 \times 10^{23} \times 5,98 \times 10^{24}}{(3,93 \times 10^{6} + 1,5 \times 10^{6} + 6,38 \times 10^{6})^2}$ ✓] ✓

$F = 1,84 \times 10^{24}$ N ✓ (4)

3.3 **Positive marking from QUESTION 3.2 / *Positiewe nasien vanaf VRAAG 3.2***

$F_2 = \frac{Gm_1m_2}{d^2}$ ✓

$F_2 = \frac{6,67 \times 10^{-11} \times 1,92 \times 10^{25} \times 5,98 \times 10^{24}}{d^2}$ ✓

$F_2 = 7,658 \times 10^{39}/d^2$

$F_{net} = F_{CB} - F_{AB}$

$0 = 7,658 \times 10^{39}/d^2 - 1,84 \times 10^{24}$ ✓

$d = 6,45 \times 10^{7}$ m ✓

$X = 6,45 \times 10^{7} - 6,38 X 10^{6} - 7,20 \times 10^{6}$ ✓

$X 5,09 \times 10^{7}$ m ✓ (6)

[12]

QUESTION/*VRAAG* 4

4.1 The gradient represents the acceleration due to gravity (g*)* which is constant for free fall. ✓
Die gradiënt verteenwoordig die versnelling as gevolg van gravitasie (g) wat konstant is vir vrye val. (1)

4.2 DOWNWARDS IS POSITIVE/ *AFWAARTS IS POSITIEF* ✓ (1)

4.3 Twice / *twee keer* ✓ (1)

4.4 4.4.1

DOWNWARDS IS POSITIVE ***AFWAARTS IS POSITIEF***	**DOWNWARDS IS NEGATIVE** ***AFWAARTS IS NEGATIEF***
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$v_f = 0 + (9,8)\ (2)$ ✓	$v_f = 0 + (-9,8)\ (2)$ ✓
$v_f = 19,6$ m.s^{-1} downwards/ *afwaarts* ✓	$v_f = -19,6$ $V_f = 19,6$ m.s^{-1} downwards/*afwaarts* ✓ (3)

4.4.2

DOWNWARDS IS POSITIVE ***AFWAARTS IS POSITIEF***	**DOWNWARDS IS NEGATIVE** ***AFWAARTS IS NEGATIEF***
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$15 = 0 + 9,8\ \Delta t$ ✓	$-15 = 0 + (-9,8)\ \Delta t$ ✓
$\Delta t = 1,53$ s	$\Delta t = 1,53$ s
T = 4 + 1,53 ✓	T = 4 + 1,53 ✓
T = 5,53 s ✓	T = 5,53 s ✓ (4)

4.4.3

OPTION 1 / *OPSIE 1*

DOWNWARDS IS POSITIVE ***AFWAARTS IS POSITIEF***	**DOWNWARDS IS NEGATIVE** ***AFWAARTS IS NEGATIEF***
$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓	$x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
$\Delta x = 0 \times 2 + \frac{1}{2} (9,8) \times 2^2$ ✓	$\Delta x = 0 \times 2 + \frac{1}{2} (-9,8) \times 2^2$ ✓
$\Delta x = 19,6$ m ✓	$\Delta x = -19,6$ $\Delta x = 19,6$ m ✓

OPTION 2 / *OPSIE 2*

DOWNWARDS IS POSITIVE ***AFWAARTS IS POSITIEF***	**DOWNWARDS IS NEGATIVE** ***AFWAARTS IS NEGATIEF***
$\Delta x = \frac{V_f + V_i}{2} \Delta t$ ✓	$x = \frac{V_f + V_i}{2} \Delta t$ ✓
$\Delta x = \frac{0+19,6}{2} \times 2$ ✓	$\Delta x = \frac{0+(-19,6)}{2} \times 2$ ✓
$\Delta x = 19,6$ m ✓	$\Delta x = -19,6$ m $\Delta x = 19,6$ m ✓

OPTION 3 / *OPSIE 3*

DOWNWARDS IS POSITIVE *AFWAARTS IS POSITIEF*	**DOWNWARDS IS NEGATIVE** *AFWAARTS IS NEGATIEF*
$v_f^2 = v_i^2 + 2\Delta x$ ✓	$v_f^2 = v_i^2 + 2\Delta x$ ✓
$19,6^2 = 0 + 2 \times 9,8\ \Delta x$ ✓	$-19,6^2 = 0 + 2 \times (-9,8)\ \Delta x$ ✓
$\Delta x = 19,6$ m ✓	$\Delta x = -19,6$
	$\Delta x = 19,6$ m ✓ (3)

4.4.4 **OPTION 1 / *OPSIE 1***

DOWNWARDS IS POSITIVE *AFWAARTS IS POSITIEF*	**DOWNWARDS IS NEGATIVE** *AFWAARTS IS NEGATIEF*
$\Delta x = v_i\ \Delta t + ½\ a\ \Delta t^2$ ✓	$\Delta x = v_i\ \Delta t + ½\ a\ \Delta t^2$ ✓
$\Delta x = -11,24 \times 1,2 + ½\ (9,8) \times 1,2^2$ ✓	$\Delta x = 11,24 \times 1,2 + ½\ (-9,8) \times 1,2^2$ ✓
$\Delta x = -6,43$	$\Delta x = 6,43$ m ✓
$\Delta x = 6,43$ m ✓	

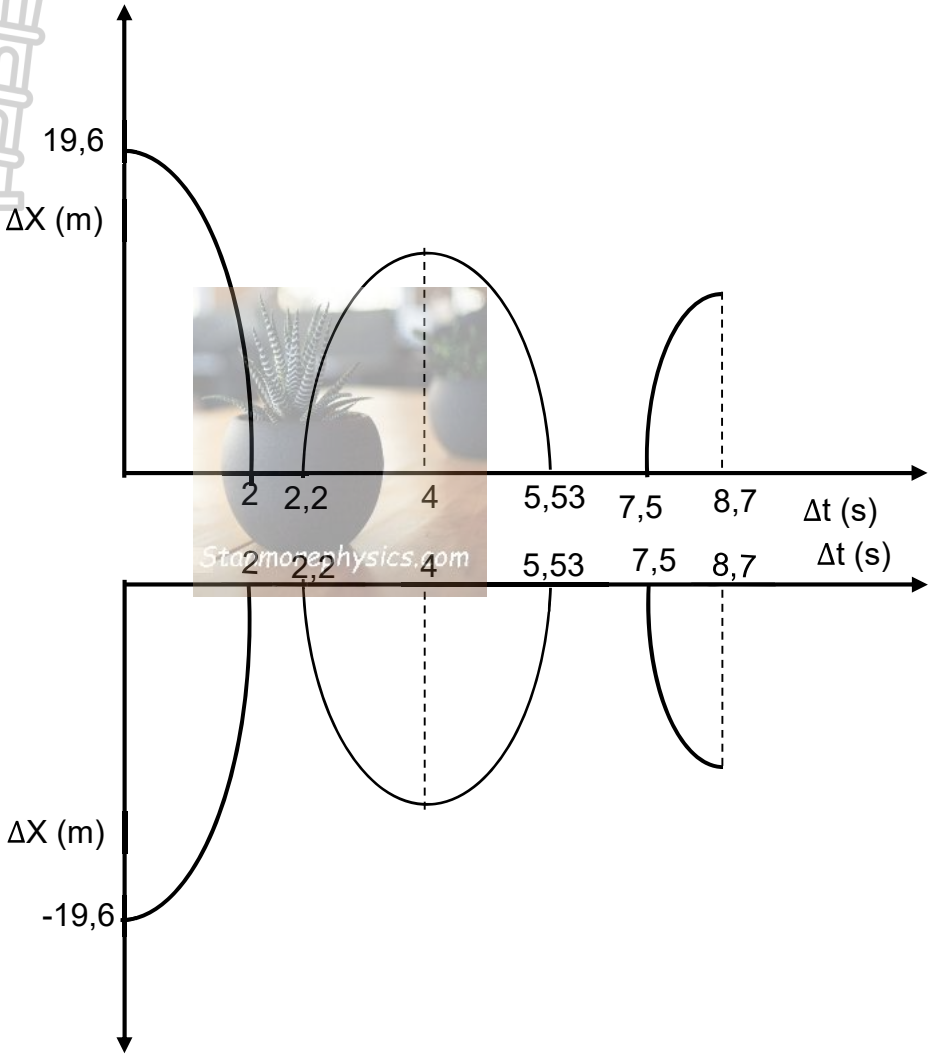
OPTION 2 / *OPSIE 2*

DOWNWARDS IS POSITIVE *AFWAARTS IS POSITIEF*	**DOWNWARDS IS NEGATIVE** *AFWAARTS IS NEGATIEF*
$\Delta x = \frac{v_f + v_i}{2}\ \Delta t$ ✓	$x = \frac{v_f + v_i}{2}\ \Delta t$ ✓
$\Delta x = \frac{0+11,24}{2} \times 1,2$ ✓	$\Delta x = \frac{0+(-19,6)}{2} \times 1,2$ ✓
$\Delta x = 6,74$ m ✓	$\Delta x = -6,74$ m
	$\Delta x = 6,74$ m ✓

OPTION 3 / *OPSIE 3*

DOWNWARDS IS POSITIVE *AFWAARTS IS POSITIEF*	**DOWNWARDS IS NEGATIVE** *AFWAARTS IS NEGATIEF*
$v_f^2 = v_i^2 + 2\Delta x$ ✓	$v_f^2 = v_i^2 + 2\Delta x$ ✓
$0^2 = -11,24^2 + 2 \times 9,8\ \Delta x$ ✓	$0^2 = 11,24^2 + 2 \times (-9,8)\ \Delta x$ ✓
$\Delta x = 6,45$ m ✓	$\Delta x = -6,45$
	$\Delta x = 6,45$ m ✓ (3)

4.5 **Positive marking from QUESTION 4.4.2 /** ***Positiewe nasien vanaf VRAAG 4.4.2***



CRITERIA FOR MARKING / *NASIENKRITERIA*	
Correct shape/ *Korrekte vorm*	✓
Point of projection indicated / *Projeksiepunt aangedui*	✓
Maximum height indicated/ *Maksimum hoogte aangedui*	✓
All relevant times indicated/ *Alle relevante tye aangedui*	✓

(4)
[20]

QUESTION/*VRAAG* 5

5.1 In an isolated system total linear momentum is conserved. ✓✓
In 'n geïsoleerde sisteem is die totale lineêre momentum behoue. (2)

5.2 $p = mv$ ✓
$p = (1\ 200 + 500) \times 12$ ✓
$p = 20\ 400$ kg.m.s^{-1} Right/ *Regs.* ✓ (3)

5.3 Right. Newton's first law of motion. A body will remain at rest or motion at constant velocity unless a non-zero resultant/net force acts on it
Regs. Newton se eerste bewegingswet. 'n Liggaam sal in rus bly of teen konstante snelheid beweeg, tensy 'n nie-nul-resulterende/netto krag daarop inwerk (3)

5.4 $\sum p_i = \sum p_f$
$(m_A + m_B)\, v_i = m_A v_{fA} + m_B v_{fB}$] Any one / *Enige een* ✓
$20\ 400$ ✓ $= 1\ 200 \times 15 + 500 v_{fB}$ ✓
$v_{IB} = 4{,}8$ m.s^{-1} right ✓ (4)

5.5 $E_k = \frac{1}{2}mv^2$ ✓
$E_{ki} = \frac{1}{2} \times (1\ 200 + 500) \times 12^2$ ✓
$E_{ki} = 122400$ J
$E_{kf} = \frac{1}{2} \times 1\ 200 \times 15^2 + \frac{1}{2} \times 500 \times 4{,}8^2$ ✓
$E_{kf} = 140\ 760$ J
$E_{ki} \neq E_{kf}$ ✓
Collision is inelastic/ *Botsing is onelasties.* ✓ (5)
[17]

QUESTION/*VRAAG* 6

6.1 In an isolated system the total mechanical energy is conserved. ✓✓
In 'n geïsoleerde sisteem, is die totale meganiese energie behoue. (2)

6.2 $W_{Fg} = - \Delta E_p$
$W_{Fg} = - mg (h_2 - h_1)$ } Any one / *Enige een* ✓
$W_{Fg} = - 0,5 \times 9,8 (0 - 2)$ ✓
$W_{Fg} = 9,8$ J ✓ (3)

6.3 **Positive marking from QUESTION 6.2 / *Positiewe nasien vanaf VRAAG 6.2***

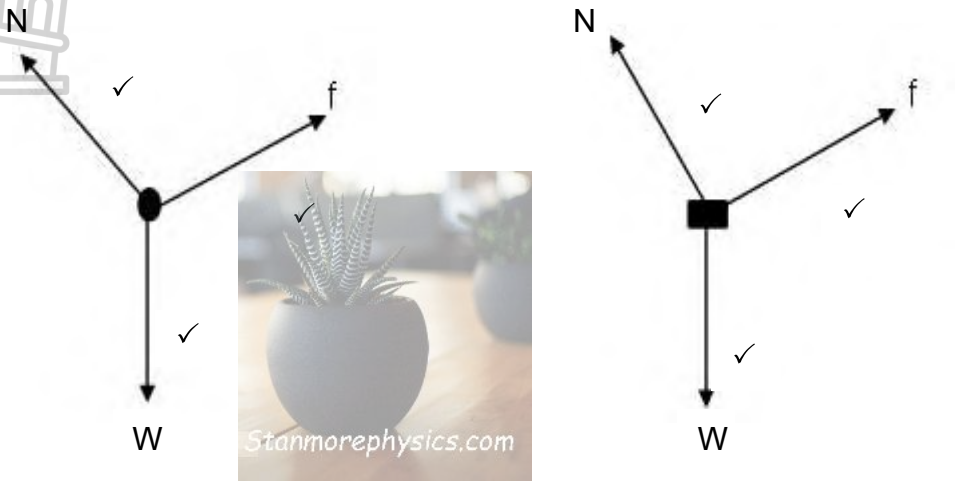
OPTION 1/ *OPSIE 1*
$ME_{total} = \Delta E_{k(crate)} + \Delta E_{p(ball)} + W_f$
$ME_{total} = ½mv_f^2 - ½mv_i^2 + mgh_2 - mgh_1$ } Any one / *Enige een* ✓
$9,8 = ½ \times 1,5v^2 - 0$ ✓ $+ 0,5 \times 9,8 \times 0,6 - 0$ ✓ $+ 5 \times 5\cos 180^o$ ✓
$v_f = 6,52$ m.s^{-1} ✓

OPTION 2 / *OPSIE 2*
$ME_{lost} = \Delta E_{k(crate)} + W_f$ ✓
$ME_{lost} = ½mv_f^2 - ½mv_i^2 + W_f$ } Any one / *Enige een* ✓
$9,8 - (0,5 \times 9,8 \times 0,6)$ ✓ $= ½ \times 1,5v^2 - 0$ ✓ $+ 5 \times 5\cos 180^o$ ✓
$v_f = 6,52$ m.s^{-1} ✓ (5)
[10]

QUESTION/*VRAAG* 7

7.1 A force for which the work done in moving an object between two points depends on the path taken. ✓✓
'n Krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, afhanklik is van die roete wat gevolg word. (2)

7.2



Mark awarded for arrow and label / *Punt toegeken vir benoeming en pyltjie*
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 geteken is nie*
Any other additional force(s) / *Enige addisionele krag(te)* $^{2}/_{3}$
If force(s) do not make contact with body. / *Indien krag(te) nie met die voorwerp kontak maak nie:* Max/ *Maks* $^{2}/_{3}$ (3)

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

7.4 7.4.1 **OPTION 1 / *OPSIE 1***

$W_{nc} = \Delta E_k + \Delta E_p$
$W_f = \Delta E_k + \Delta E_p$
$W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_2 - mgh_1$ } Any one / *Enige een* ✓

$2{,}5 \times \frac{5}{\sin 10^o}\cos 180^o$ ✓ = $\frac{1}{2} \times 2 \times v_f^2 - 1{,}5^2$ ✓ + $2 \times 9{,}8 \times 0 - 2 \times 9{,}8 \times 5$ ✓

$v_f = 5{,}32\ m.s^{-1}$ ✓

OPTION 2 / *OPSIE 2*

$W_{net} = \Delta E_k$
$W_{Fg} + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ } Any one / *Enige een* ✓

$2 \times 9{,}8 \times 5\cos 0^o$ ✓ + $2{,}5 \times \frac{5}{\sin 10^o}\cos 180^o$ ✓ = $\frac{1}{2} \times 2 \times v_f^2 - 1{,}5^2$ ✓

$v_f = 5{,}32\ m.s^{-1}$ ✓ (5)

7.4.2 **Positive marking from QUESTION 7.4.1 / Positiewe nasien vanaf VRAAG 7.4.1**

OPTION 1 / *OPSIE 1*

$f_k = \mu_k N$

$2,5 = \mu_k \times 2 \times 9,8\cos 10^o$ ✓

$\mu_k = 0,13$

$W_f = \Delta E_k + \Delta E_p$

$W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_2 - mgh_1$ } Any one / *Enige een* ✓

$0,13\ (2 \times 9,8)\ \Delta x \cos 180^o$ ✓ $= \underline{\frac{1}{2} \times 2 \times 0^2 - \frac{1}{2} \times 2 \times 5,32^2}$ ✓ $+ 0$

$\Delta x = 11,11$ m ✓

OPTION 2 / *OPSIE 2*

$f_k = \mu_k N$

$2,5 = \mu_k \times 2 \times 9,8\cos 10^o$ ✓

$\mu_k = 0,13$

$W_{net} = \Delta E_k$

$W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ } Any one / *Enige een* ✓

$\underline{0,13\ (2 \times 9,8)\ \Delta x \cos 180^o}$ ✓ $= \underline{\frac{1}{2} \times 2 \times 0^2 - 5,32^2}$ ✓

$\Delta x = 11,11$ m ✓

(5)
[17]

QUESTION/*VRAAG 8*

8.1 The change in frequency or pitch of 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 frekwense 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. (2)

8.2 AWAY FROM. ✓Detector records lower frequency. ✓
WEG VAN. Die detektor teken laer frekwensie aan. (2)

8.3 As the fire truck moves away from the detector, the wave fronts behind the truck become stretched out. ✓ The detector registers longer wavelength ✓ and lower frequency ✓
Soos die brandweerwa wegbeweeg van die detektor, word die golffronte agter die trok uitgerek. Die detektor registreer langer golflengte en laer frekwensie (3)

8.4 8.4.1 $v = f\lambda$ ✓
$340 = f \times 0{,}34$ ✓
$f = 1000$ Hz ✓ (3)

8.4.2 $f_L = \frac{v \pm v_L}{V \pm V_S} f_s$ ✓
$f_L = \frac{340}{340+20}$ ✓✓x 1000 ✓
$f_L = 944{,}44$ Hz
$v = f\lambda$
$340 = 944{,}44\ \lambda$ ✓
$\lambda = 0{,}36$ m ✓ (6)

8.5 8.5.1 Remains the same / *Bly dieselfde* ✓ (1)

8.5.2 Decreases / *Afneem* ✓ (1)
[18]

QUESTION/*VRAAG 9*

9.1 POSITIVE.✓ It is repelled by charge Q_A. ✓
POSITIEF. Dit word weggestoot deur lading Q_A. (2)

9.2 The magnitude of the electrostatic force exerted by one point charge on another point charge is directly proportional to the product of the magnitude of the charges ✓ and inversely proportional to the square of the distance between them. ✓
Die grootte van die elektrostatiese krag wat deur een puntlading op 'n ander puntlading uitgeoefen word, is direk eweredig aan die produk van die grootte van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. (2)

9.3 9.3.1 $F_g = mg$
$F_g = 6 \times 10^{-5} \times 9,8$ ✓
$F_g = 5,88 \times 10^{-4}$ N
$F_g = T\cos\theta$ ✓
$5,88 \times 10^{-4} = T\cos25^o$ ✓
$T = 6,49 \times 10^{-4}$ N ✓ (4)

9.3.2 $T \sin\theta = F_E$
$6,49 \times 10^{-4} \sin25^o = F_E$ ✓
$F_E = 2,74279 \times 10^{-4}$ N
$F_E = \frac{kQ_1Q_2}{r^2}$ ✓
$2,74279 \times 10^{-4}$ ✓$= \frac{9 \times 10^9 \times 15 \times 10^{-9} Q_B}{0,05^2}$ ✓
$Q = 5,08 \times 10^{-9}$ C ✓ (5)

9.3.3 **Positive marking from QUESTION 9.3.2 / Positiewe nasien vanaf VRAAG 9.3.2**

$E = \frac{kQ}{r^2}$ ✓
$E_B = \frac{9 \times 10^9 \times 5,08 \times 10^{-9}}{0,02^2}$ ✓
$E_B = 114\ 300$ N.C^{-1} left / *links*
$E_A = \frac{9 \times 10^9 \times 15 \times 10^{-9}}{0,03^2}$ ✓
$E_A = 150\ 000$ N.C^{-1} right / *regs*
$E_{net} = E_B - E_A$
$E_{net} = 114\ 300 - 150\ 000$ ✓
$E_{net} = -35\ 700$
$E_{net} = 35\ 700$ N.C^{-1} left / *links* ✓ (5)
[18]

TOTAL/*TOTAAL*: 150