Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2019

PHYSICAL SCIENCES P1

MARKS: **150**

TIME: **3 hours**

JPHSCE1

This question paper consists of 17 pages, including a 2 page data sheet.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of 11 questions.
2. Answer ALL the questions.
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instruments.
5. Number the questions 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, etc. 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.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four possible options are provided as answers to the following questions. Choose the answer and write down (A–D**)** next to the question number (1.1–1.10) on your ANSWER BOOK, for example 1.11 D.

1.1 A girl placed her pencil on a dashboard of a car while the car is stationary. When the car starts to move, which ONE of the following statements will be TRUE regarding the motion of the pencil?

A It will remain stationary.

B It will move forward with the car.

C It will move backwards as the car moves forward.

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

1.2 A lady applied a force **F** on a shopping trolley and the trolley moves forward while the lady remained stationary. Which ONE of the following statements is correct?

A The force exerted on the trolley by the lady is equal to the force exerted on the lady by the trolley.

B The lady did not experience a force exerted on her.

C The force exerted on the trolley by the lady is smaller than the force exerted on the lady by the trolley.

D The force exerted on the trolley by the lady is bigger than the force exerted on the lady by the trolley. (2)

1.3 The product of the net force acting on an object and the time that the net force acts on the object is the …

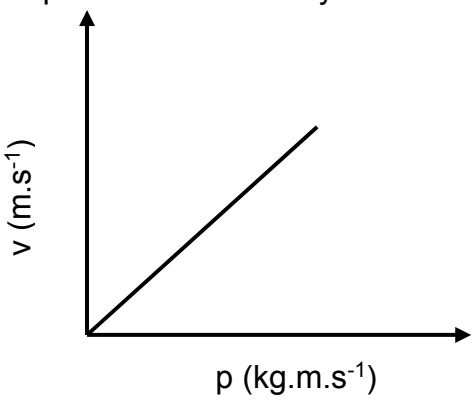
A rate of change of momentum of the object.

B impulse on the object.

C momentum of the object.

D acceleration of the object. (2)

1.4 The graph below represents the velocity versus momentum of an object.



Which ONE of the following quantities is represented by the **gradient** of this graph?

A Impulse

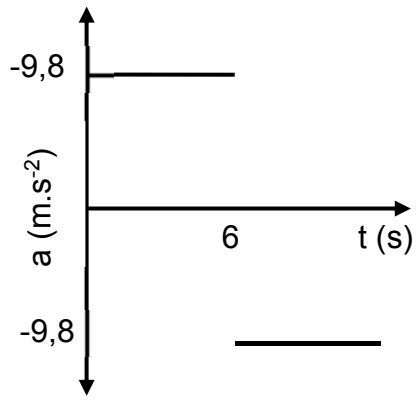
B Net force

C Mass of the object

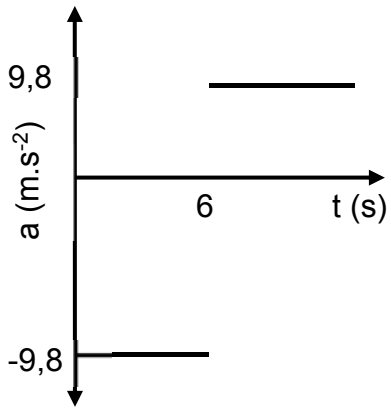
D Inverse of mass of the object (2)

1.5 Which ONE of the following acceleration versus time graphs represents the motion of a ball thrown vertically upwards to reach a maximum height after 6 s? **Take upwards as positive.**

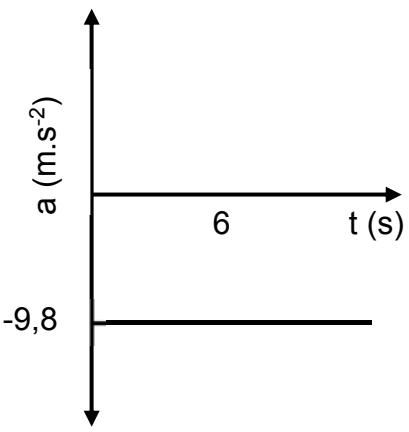
A



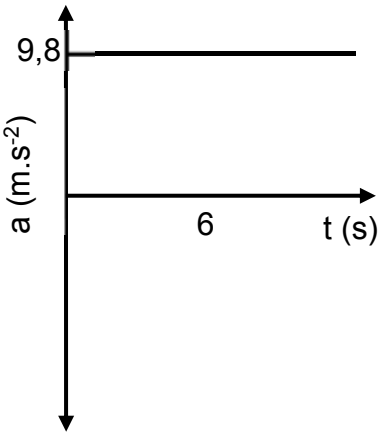
B



C



D



(2)

1.6 A projectile is moving upwards until it reaches its maximum height. Which ONE of the following statements is correct about the velocity?

A Velocity is zero at the maximum height.

B Velocity increases upwards.

C Velocity at maximum height is equal to velocity at point of projection.

D Velocity remain constant during its motion. (2)

1.7 Which ONE of the following statements regarding mechanical energy of an isolated is correct?

A Kinetic energy is always equal to potential energy.

B The change in kinetic energy is always equal to the change in potential energy.

C The sum of kinetic energy and potential energy is always equal to zero.

D The sum of kinetic energy and potential energy is always maximum at the maximum height. (2)

1.8 A block is moving on a horizontal surface. The work done by the gravitational force on the block is equal to zero because the …

A gravitational force on the object is equal to zero.

B gravitational force is in equilibrium with the normal force.

C angle between the gravitational force and the displacement is equal to 0°.

D angle between the gravitational force and the displacement is equal to 90°. (2)

1.9 An observer is moving relative to a stationary sound source which is emitting sound of frequency 800 Hz. As the observer moves towards the sound source, the detected frequency is 950 Hz. This observation is because the:

A Sound waves between the source and observer become compressed

B Sound waves between the source and observer become stretched out

C The amplitude of the sound waves between the source and observer increases

D The amplitude of the sound waves between the source and observer decreases (2)

1.10 The electrostatic force between two point charges which are a distance of **r** apart, is **F**. The charges are then moved to new positions such that the electrostatic force changes to $\frac{1}{16}$ **F**. The new distance in terms of **r** is …

A 4 **r**.

B $\frac{1}{4}$ **r**.

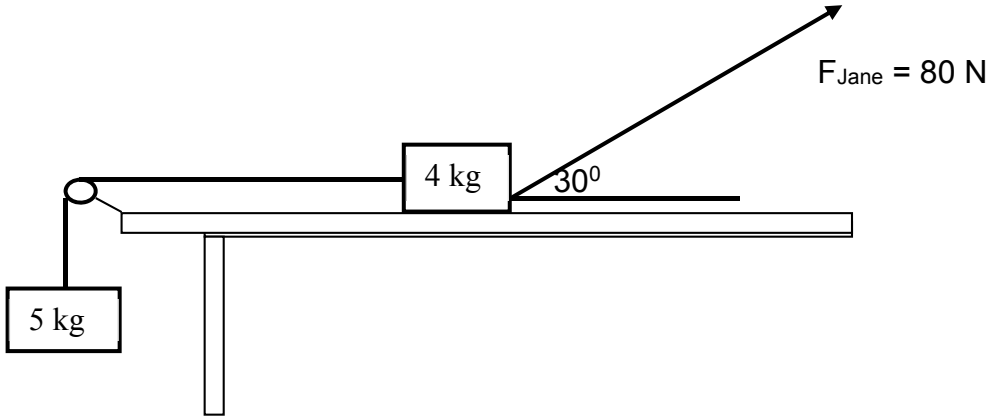
C 8 **r**.

D $\frac{1}{8}$ **r**.

(2)
[20]

QUESTION 2 (Start on a NEW page.)

Two boxes, with masses of 5 kg and 4 kg, are connected by a light inextensible string passing over a frictionless pulley. The 4 kg box experiences a frictional force of 8,14 N due to the surface as it is pulled by Jane with a force of 80 N. The force applied by Jane makes an angle of 30° with the horizontal as shown in the diagram below.



2.1 State Newton's Second Law of motion in words. (2)

2.2 Draw a labelled free-body diagram of all the forces acting on the 4 kg box. (5)

2.3 Calculate the tension experienced in the string connecting the boxes. (5)

[12]

QUESTION 3 (Start on a NEW page.)

A man of mass **m**, has a weight of 126,30 N on the moon. The mass and radius of the moon are $7,35 \times 10^{22}$ kg and $1,74 \times 10^3$ km respectively.

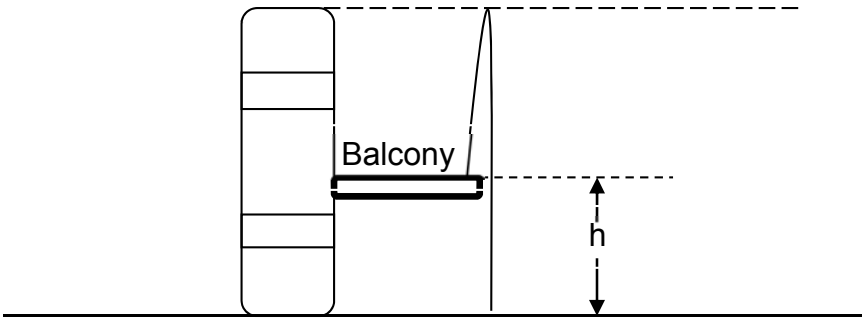
3.1 State Newton's Law of Universal Gravitation in words. (2)

3.2 Calculate the mass of the man while he stands on the moon. (4)

[6]

QUESTION 4 (Start on a NEW page.)

A boy lies on a balcony of a building which is at a height **h** above the ground. He throws a ball vertically upwards at a velocity of 13 $m.s^{-1}$. The ball reached its maximum height at the top of the building. Ignore the effects of air resistance.



4.1 Define the term *projectile motion*. (2)

4.2 Calculate the time it took the ball to reach the maximum height. (3)

4.3 Calculate the magnitude of the displacement of the ball from the point of projection to its maximum height. (4)

4.4 It took the ball 3,28 s to reach ground surface from the point of projection.

Calculate the:

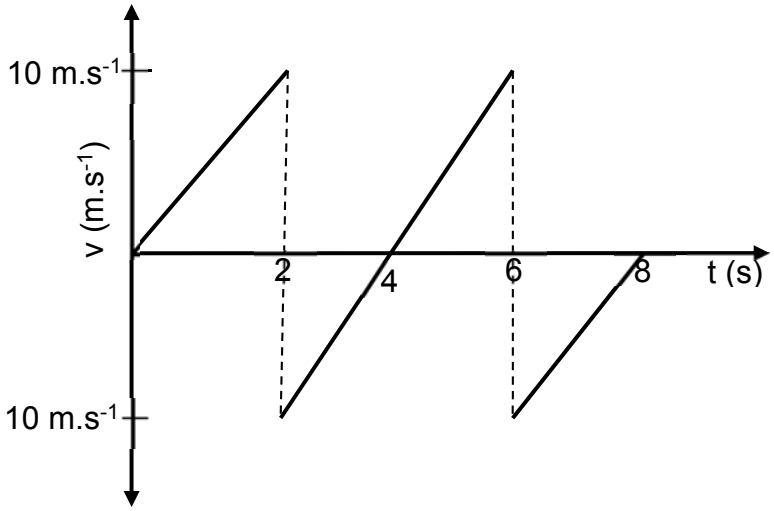
4.4.1 Velocity with which the ball hits the ground surface (3)

4.4.2 Height of the building (6)

[18]

QUESTION 5 (Start on a NEW page.)

The graph below represents the motion of a basketball ball which is dropped from a height of 8 m above the ground. The ball bounced a number of times on the ground.



5.1 Which direction is taken as positive? (Upwards or Downwards) (1)

5.2 How many times did the ball bounce? (1)

5.3 Is the collision of the ball with the ground elastic or inelastic? (1)

5.4 At what time(s) was the ball at a maximum height after it was dropped? (2)

5.5 Draw a corresponding position vs time graph for the entire motion of the basketball from the time it was dropped.

Indicate the following:

- The height from which the ball was dropped
- The time(s) when the ball was at its maximum height (3)

[8]

QUESTION 6 (Start on a NEW page.)

A traffic officer, driving a van of mass 1 500 kg at a velocity of 30 $m.s^{-1}$, chased after a driver of a car of mass 1 200 kg travelling at 80 $km.h^{-1}$, who did not stop at a red traffic light (robot). He accidentally hit the back of the driver's car. After the collision the driver's car continued to move forward at a velocity of 25 $m.s^{-1}$. *Ignore the effects of friction.*

6.1 State the Principle of Conservation of Linear Momentum in words. (2)

6.2 Calculate the velocity of the van after collision. (5)

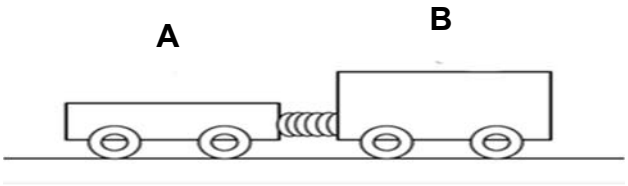
6.3 Calculate the change in momentum of the car. (3)

6.4 By means of calculations, determine whether the collision was elastic or inelastic. (5)

[15]

QUESTION 7 (Start on a NEW page.)

Two trolleys, **A** and **B**, of masses 500 g and 750 g respectively are at rest and connected to each other by means of a compressed spring as shown on the diagram below. When the spring is released, trolley **A** moves at a constant velocity of 2,5 $m.s^{-1}$ to the left. *Ignore the effects of friction*.



7.1 In which direction will trolley **B** move? Explain your answer. (3)

7.2 Calculate the magnitude of the velocity of trolley **B**. (4)

7.3 Trolley **A** continues to move to the left until it hits a wall at a velocity of 2,5 $m.s^{-1}$. The wall exerts a net force of 21,5 N on trolley **A** over a period of 0,1 s. *Ignore the effects of friction*.

7.3.1 What is the magnitude of the net force exerted by trolley **A** on the wall? Explain your answer. (3)

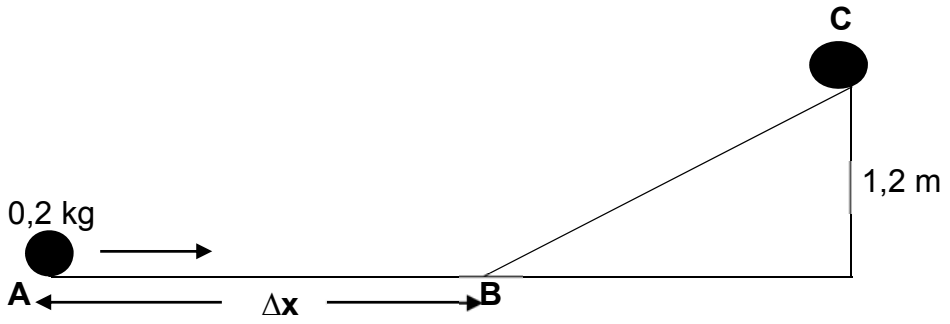
7.3.2 Calculate the velocity of trolley **A** after colliding with the wall. (5)

7.3.3 An identical trolley **C**, of the same mass and velocity as trolley **A** collides with the same wall. The wall exerts a net force on trolley **C** in an increased contact time compared with contact time of trolley **A**. How will the impulse of trolley **C** compare with that of trolley **A**? Write down only INCREASE, DECREASE or STAYS THE SAME. Give a reason for your answer. (3)

[18]

QUESTION 8 (Start on a NEW page.)

A steel ball of mass 0,2 kg rolls from point **A** to **C** and comes to rest at **C**, as shown on the diagram below. From **A** to **B** is a rough horizontal surface while from **B** to **C** it is frictionless. Point **C** is 1,2 m vertically above ground.



8.1 State the principle of conservation of mechanical energy in words. (2)

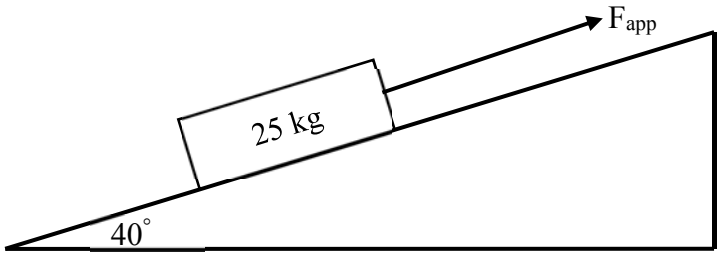
8.2 Use ENERGY PRINCIPLES to calculate the velocity of the ball at point **B**. (4)

8.3 If the initial velocity of the ball at point **A** is 6 $m.s^{-1}$ and it took the ball 0,82 s to reach point **B,** calculate the distance Δx indicated on the diagram. (3)

[9]

QUESTION 9 (Start on a NEW page.)

A box, with a mass of 25 kg, is pulled with a force of 260 N up a rough inclined surface that makes an angle of 40° with the horizontal as shown in the diagram below. The coefficient of kinetic friction is 0,16 between the box and the surface.



9.1 Define *work-energy theorem* in words. (2)

9.2 Draw a labelled free-body diagram of all the forces acting on the box. (4)

9.3 If the box started moving from rest, calculate its velocity after it had covered a distance of 8 m up the slope. (6)

9.4 Calculate the power dissipated in moving the box over a distance of 8 m. (4)

[16]

QUESTION 10 (Start on a NEW page.)

10.1 Khosi detected two different frequencies, 750 Hz and 700 Hz, as he moved at constant velocity relative to a stationary ambulance which was emitting a sound through its siren.

10.1.1 State Doppler effect in words. (2)

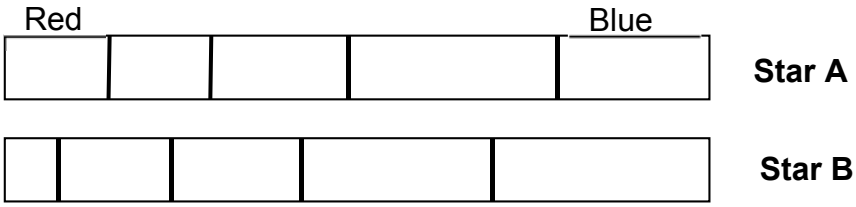
10.1.2 Which ONE of the frequencies was detected while Khosi was moving towards the ambulance? (1)

10.1.3 Explain your answer in QUESTION 10.1.2 in terms of wavelength. (3)

10.1.4 Calculate the velocity at which Khosi was moving if the speed of sound in the air is 340 $m.s^{-1}$. (6)

10.1.5 Calculate the frequency of the sound of the source. (3)

10.2 The diagrams below show two stars moving relative to each other.



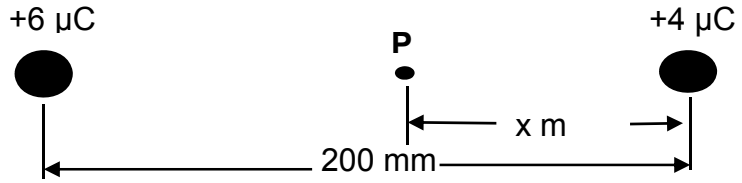
10.2.1 Is **star B** moving towards or away from **star A**? Explain your answer in terms of shift, wavelength and frequency. (4)

10.2.2 How does astronomers describe the phenomenon explained in QUESTION 10.2.1 above? (1)

[20]

QUESTION 11 (Start on a NEW page.)

Two point charges of +6 µC and +4 µC are placed 200 mm apart in a vacuum.



11.1 Define *electric field at a point* in words. (2)

11.2 Calculate the value of x when the net electric field at point **P** is $1,88 \times 10^6$ $N.C^{-1}$ to the left. (6)
[8]

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 x 10^{-11} N•m^2•kg^{-2}
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 m•s^{-1}
Planck's constant *Planck se konstante*	h	6,63 x 10^{-34} J•s
Coulomb's constant *Coulomb se konstante*	k	9,0 x 10^9 N•m^2•C^{-2}
Charge on electron *Lading op elektron*	e	-1,6 x 10^{-19} C
Electron mass *Elektronmassa*	m_e	9,11 x 10^{-31} kg
Mass of earth *Massa op aarde*	M	5,98 x 10^{24} kg
Radius of earth *Radius van aarde*	R_E	6,38 x 10^3 km

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*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1 m_2}{d^2}$	$g = G\frac{M}{d^2}$

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 $K_{max} = \frac{1}{2}mv^2_{max}$	

ELECTROSTATICS/*ELEKTROSTATIKA*

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

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*

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

Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE/ NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

JUNE/*JUNIE* 2019

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

MARKS/*PUNTE*: **150**

This marking guideline consists of 20 pages.
Hierdie nasienriglyn bestaan uit 20 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 sustitusies.*

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*** *began word, sal 'n punt vir die korrekte formule en vir korrekte substitusies toegeken word, maar* ***geen verdere punte*** *sal toegeken word nie.*

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

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

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

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

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

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

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

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

2. UNITS/*EENHEDE*

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

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

2.3 Marks are only awarded for an answer, and not for a unit *per se*. Candidates will therefore forfeit the mark allocated for the answer in each of the following situations:

- Correct answer + wrong unit
- Wrong answer + correct unit
- Correct answer + no unit

Punte sal slegs vir 'n antwoord en nie vir 'n eenheid per se toegeken word nie. Kandidate sal die punt vir die antwoord in die volgende gevalle verbeur:

- *Korrekte antwoord + verkeerde eenheid*
- *Verkeerde antwoord + korrekte eenheid*
- *Korrekte antwoord + geen eenheid*

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

3. GENERAL/*ALGEMEEN*

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

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

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

4. POSITIVE MARKING/*POSITIEWE NASIEN*

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

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

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

5. NEGATIVE MARKING/*NEGATIEWE NASIEN*

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

QUESTION/*VRAAG 1*

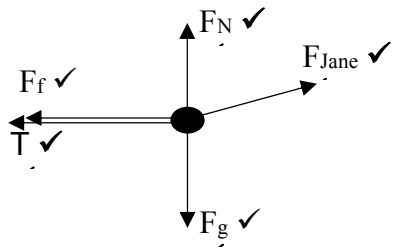
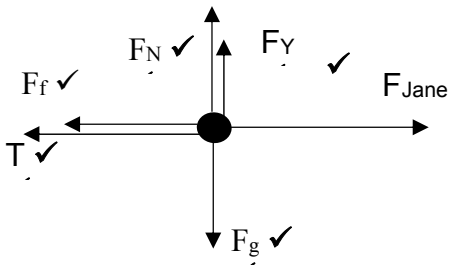
1.1	C ✓✓	(2)
1.2	A ✓✓	(2)
1.3	B ✓✓	(2)
1.4	D ✓✓	(2)
1.5	C ✓✓	(2)
1.6	A ✓✓	(2)
1.7	B ✓✓	(2)
1.8	D ✓✓	(2)
1.9	A ✓✓	(2)
1.10	A ✓✓	(2)

[20]

QUESTION /*VRAAG 2*

2.1 When a net force/resultant force acts on an object, it produces the acceleration of the object in the direction of the net force/resultant force. This acceleration is directly proportional to the net/resultant force ✓ and inversely proportional to the mass of the object. ✓
Indien 'n netto/resulterende krag op 'n voorwerp inwerk, veroorsaak dit 'n versnelling van die voorwerp in die rigting van die netto/resulterende krag. Hierdie versnelling is direk eweredig aan die netto/resultante krag ✓ en omgekeerd eweredig aan die massa van die voorwerp. ✓ (2)

2.2

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

Mark awarded for both arrow and label./*Punt toegeken vir beide pylpunt en byskrif.*
Do not penalise for length of forces since drawing is not drawn to scale.
Moenie penaliseer vir lengte van kragte want diagram is nie volgens skaal nie.
Any other additional force(s)/*Enige addisionele krag(te)* $^{4}/_{5}$
If force(s) do not make contact with body/*Indien krag(te) nie kontak maak met voorwerp nie*. Max./Maks. $^{4}/_{5}$ (5)

2.3 Choose East (Right) to be positive/*Kies Oos (regs) as positief.*

4 kg box/-*houer*

$F_{net} = ma$
$F_x + f_k + T = ma$
$F_x - f_k - T = ma$
$F_{Jane}Cos30^\circ + f_k + T = ma$

✓ Any one / *Enige een*

80x0,866 + (-8,14) + (-T) ✓= 4a
69,28 – 8,14 – T = 4a
61,14 – T = 4a -------- (1)

5 kg box/-*houer*

$F_{net} = ma$
T + W = ma
T + (-9,8x5) ✓= 5a
T – 49 = 5a

$a = \frac{T - 49}{5}$ ------(2)

Subst (2) in (1):/*Stel (2) in (1):*

$61,14 - T = 4\left(\frac{T-49}{5}\right)$ ✓

305,7 – 5 T = 4 T – 196
9 T = 501,7
T = 55,74 N ✓ (5)

[12]

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 hulle massas ✓en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle middelpunte. ✓ (2)

3.2

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$F = \frac{Gm_1m_2}{r^2}$ ✓	$g_m = \frac{GM_m}{R_m}$ ✓
$126,30$✓$= \frac{6,67 \times 10^{-11} \times 7,35 \times 10^{22} m_2}{(1,74 \times 10^6)^2}$ ✓	$= \frac{6,67 \times 10^{-11} \times 7,35 \times 10^{22}}{(1,74 \times 10^4)^2}$ ✓
m_2 = 78,00 kg ✓	= 1,619252874 w = mg 126,30 = m x 1,619252874 ✓ m = 78,00 kg ✓

(4)

[6]

QUESTION/*VRAAG* 4

4.1 Projectile motion is the motion of an object upon which the only force acting is the force of gravity. ✓✓
Projektielbeweging is die beweging van 'n voorwerp waarop die enigste krag wat daarop inwerk, gravitasiekrag is. ✓✓

OR/OF

Projectile motion is the motion of an object that experiences only gravitational force. ✓✓
Projektielbeweging is die beweging van 'n voorwerp wat slegs gravitasiekrag ondervind. ✓✓ (2)

4.2

OPTION/*OPSIE* 1	
(upwards positive) *(opwaarts positief)*	**(downwards positive)** *(afwaarts positief)*
$v_f = v_i + g\Delta t$ ✓	$v_f = v_i + g\Delta t$ ✓
$0 = (13) + (-9.8).\Delta t$ ✓	$0 = (-13) + (9.8).\Delta t$ ✓
$\therefore \Delta t = 1{,}33$ s ✓	$\therefore \Delta t = 1{,}33$ s ✓

(3)

OPTION/*OPSIE* 2	
(upwards positive) *(opwaarts positief)*	**(downwards positive)** *(afwaarts positief)*
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0^2 = 13^2 + 2(-9{,}8)\Delta y$	$0^2 = -13^2 + 2(9{,}8)\Delta y$
$\Delta y = 8{,}62244898$ m	$\Delta y = -8{,}62244898$ m
$\Delta y = \frac{v_f + v_i}{2}\Delta t$	$\Delta y = \frac{v_f + v_i}{2}\Delta t$
$8{,}62244898 = \frac{0+13}{2}\Delta t$ ✓	$-8{,}62244898 = \frac{0-13}{2}\Delta t$ ✓
$\therefore \Delta t = 1{,}33$ s ✓	$\therefore \Delta t = 1{,}33$ s ✓

(3)

OPTION/*OPSIE* 3	
(upwards positive) *(opwaarts positief)*	**(downwards positive)** *(afwaarts positief)*
$v_f^2 = v_i^2 + 2g\Delta y$ ✓	$v_f^2 = v_i^2 + 2g\Delta y$ ✓
$0^2 = 13^2 + 2(-9{,}8)\Delta y$	$0^2 = -13^2 + 2(9{,}8)\Delta y$
$\Delta y = 8{,}62244898$ m	$\Delta y = 8{,}62244898$ m
$\Delta y = v_i\Delta t + \frac{1}{2}g\Delta t^2$	$\Delta y = v_i\Delta t + \frac{1}{2}g\Delta t^2$
$8{,}62 = 13\,\Delta t + \frac{1}{2}(-9{,}8)\Delta t^2$ ✓	$-8{,}62 = -13\,\Delta t + \frac{1}{2}(9{,}8)\Delta t^2$ ✓
$\therefore \Delta t = 1{,}33$ s ✓	$\therefore \Delta t = 1{,}33$ s ✓

(3)

4.3

OPTION/*OPSIE* 1	
(upwards positive) ***(opwaarts positief)***	**(downwards positive)** ***(afwaarts positief)***
$v_f^2 = v_i^2 + 2g\Delta y$ ✓ 0^2 ✓ $= (13)^2 + 2(-9,8)\Delta y$ ✓ $\Delta y = 8,62$ m ✓	$v_f^2 = v_i^2 + 2g\Delta y$ ✓ 0^2 ✓ $= (-13)^2 + 2(9,8)\Delta y$ ✓ $\Delta y = 8,62$ m ✓

OPTION/*OPSIE* 2	
(upwards positive) ***(opwaarts positief)***	**(downwards positive)** ***(afwaarts positief)***
$\Delta y = v_i\Delta t + \frac{1}{2}g\Delta t^2$ ✓ $= 13(1,33)$ ✓ $+ \frac{1}{2}(-9,8)(1,33)^2$ ✓ $= 8,62$ m ✓	$\Delta y = v_i\Delta t + \frac{1}{2}g\Delta t^2$ ✓ $= -13(1,33)$ ✓ $+ \frac{1}{2}(9,8)(1,33)^2$ ✓ $= -8,62$ m $= 8,62$ m, (upwards/*opwaarts*) ✓

OPTION/*OPSIE* 3	
(upwards positive) ***(opwaarts positief)***	**(downwards positive)** ***(afwaarts positief)***
$\Delta y = \frac{v_f + v_i}{2}\Delta t$ ✓ $= \frac{0+13}{2}$ ✓x 1,33✓ $= 8,65$ m ✓	$\Delta y = \frac{v_f + v_i}{2}\Delta t$ ✓ $= \frac{0-13}{2}$ ✓x 1,33 ✓ $= -8,65$ m $= 8,65$ m ✓

(4)

4.4 4.4.1

OPTION/*OPSIE* 1	
Taking top of building as starting point / *Neem toppunt van gebou as beginpunt*	
(upwards positive) *(opwaarts positief)*	**(downwards positive) *(afwaarts positief)***
$v_f = v_i + a\Delta t$ ✓ $v_f = 0 + (-9,8)(3,28 - 1,33)$ ✓ $v_f = -19,11\ m.s^{-1}$ $v_f = 19,11\ m.s^{-1}$ ✓	$v_f = v_i + a\Delta t$ ✓ $v_f = 0 + (9,8)(3,28 - 1,33)$ ✓ $v_f = 19,11\ m.s^{-1}$ ✓

OPTION/*OPSIE* 2	
Taking balcony as a starting point *Neem balkon as beginpunt*	
(upwards positive) *(opwaarts positief)*	**(downwards positive) *(afwaarts positief)***
$v_f = v_i + a\Delta t$ ✓ $v_f = -13 + (-9,8)(3,28 - 1,66)$ ✓ $v_f = -19,08\ m.s^{-1}$ $v_f = 19,08\ m.s^{-1}$ ✓	$v_f = v_i + a\Delta t$ ✓ $v_f = 13 + (9,8)(3,28 - 2,66)$ ✓ $v_f = 19,08\ m.s^{-1}$ ✓

(3)

4.4.2

OPTION/*OPSIE* 1	
(upwards positive) *(opwaarts positief)*	**(downwards positive) *(afwaarts positief)***
$\Delta y = h = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $h = -13(0,62)$ ✓$+\frac{1}{2}(-9,8)(0,62)^2$✓ $h = -9,94\ m$ ✓ Height of building*/Hoogte van gebou* $= h + \Delta y$ $= 8,62 + 9,94$ ✓ $= 18,56\ m$ ✓	$\Delta y = h = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $h = 13(0,62)$ ✓ $+ \frac{1}{2}(9,8)(0,62)^2$ ✓ $= 9,94\ m$ ✓ Height of building*/Hoogte van gebou* $= h + \Delta y$ $= 8,62 + 9,94$ ✓ $= 18,56\ m$ ✓

OPTION/*OPSIE* 2	
(upwards positive) ***(opwaarts positief)***	**(downwards positive)** ***(afwaarts positief)***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $\underline{(-19,11)^2}$ ✓ = $\underline{(-13)^2 + 2(-9,8)(\Delta y_1)}$ ✓ h = Δy = 10,01 m ✓ Height of building/*Hoogte van gebou* = Δy + h = 8,62+ 10,01 ✓ = 18,62 m ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $\underline{(-19,11)^2 = (-13)^2}$ ✓+ 2(-9,8)(Δy$_1$)✓ h = Δy = 10,01 m ✓ Height of building/*Hoogte van gebou* = Δy + h = 8,62+ 10,01 ✓ = 18,62 m ✓

OPTION/*OPSIE* 3	
(upwards positive) ***(opwaarts positief)***	**(downwards positive)** ***(afwaarts positief)***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(-19,08)^2 = (-13)^2 + 2(-9,8)\Delta y$ ✓ h = Δy = 9,95 m ✓ Height of building/*Hoogte van gebou* = Δy + h = 8,62+ 9,95 ✓ = 18,57 m ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(-19,08)^2 = (-13)^2 + 2(-9,8)\Delta y$ ✓ h = Δy = 9,95 m ✓ Height of building/*Hoogte van gebou* = Δy + h = 8,62+ 9,95 ✓ = 18,57 m ✓

(6)
[18]

QUESTION/*VRAAG* 5

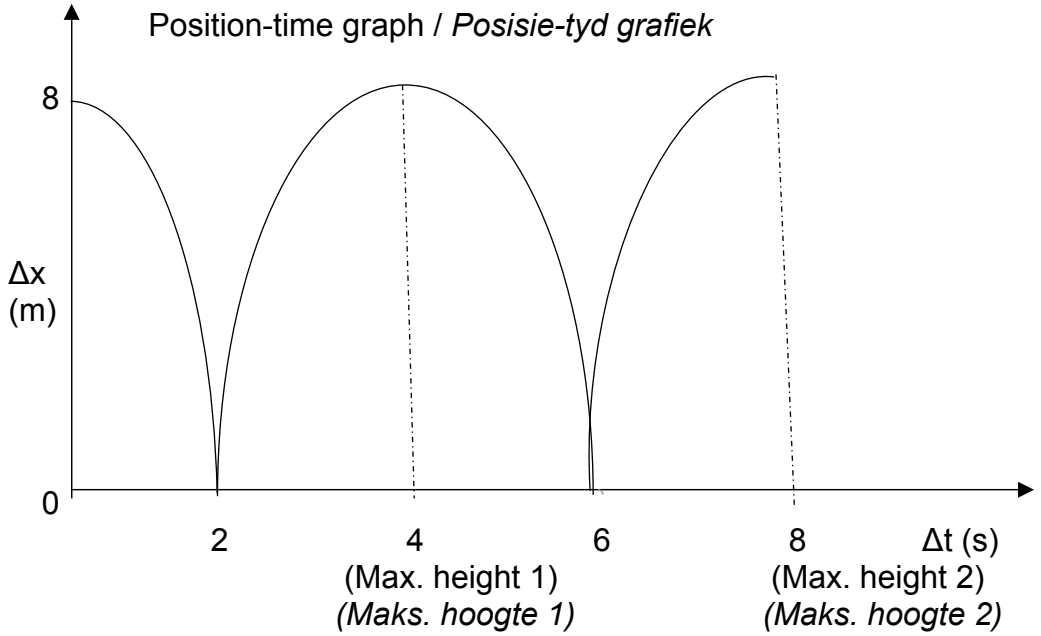
5.1 Downwards / *Afwaarts* ✓ (1)

5.2 Two (times) **OR** 2 (times)
Twee (keer) **OF** 2 (keer) ✓ (1)

5.3 Elastic / *Elasties* ✓ (1)

5.4 4 s ✓ and / *en 8* s ✓ (2)

5.5 **Positive marking from QUESTION 5.4 /** ***Positiewe merk vanaf VRAAG 5.4***



Criteria for graph / ***Kriteria vir die grafiek***	**Marks/*Punte***
The height from which the ball was dropped *Hoogte van waar bal laat val is*	✓
The times when the ball was at its maximum height – 4 s and 8 s *Die tye wanneer die bal sy maksimum hoogte bereik – 4 s en 8 s*	✓
Shape of the graph/*Vorm van die grafiek*	✓

(3)
[8]

QUESTION/*VRAAG* 6

6.1 The total linear momentum of an isolated system is conserved. ✓✓
Die totale lineêre momentum van 'n geïsoleerde sisteem bly behoue. ✓✓

OR/*OF*

In an isolated system the total linear momentum before collision is equal to the total linear momentum after collision. ✓✓
In 'n geïsoleerde sisteem is die totale lineêre momentum voor 'n botsing gelyk aan die totale lineêre momentum na 'n botsing. ✓✓ (2)

6.2 $\Sigma p_i = \Sigma p_f$
$m_v v_{iv} + m_c v_{ic} = m_v v_{fv} + m_c v_{fc}$ ✓

$\underline{1500 \times 30 + 1200 \times \frac{80000}{3600}}$ ✓ = $\underline{1500\ v_{fv} + 1200 \times 25}$ ✓

$v_{fv} = 27{,}78\ m.s^{-1}$ ✓ in the same direction / *in dieselfde rigting*. ✓ (5)

6.3

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$\Delta p = mv_f - mv_i$ ✓ $\Delta p = 1200 \times 25 - 1200 \times \frac{80000}{3600}$ ✓ $\Delta p = 3333{,}33\ kg.m.s^{-1}$ In the direction of the motion *In dieselfde rigting as beweging* ✓	$\Delta p = mv_f - mv_i$ ✓ $\Delta p = 1500 \times 27{,}78 - 1500 \times 30$ ✓ $\Delta p = -3330\ kg.m.s^{-1}$ $\Delta p = 3330\ kg.m.s^{-1}$ In the direction of the motion *In dieselfde rigting as beweging* ✓

(3)

6.4 $\Sigma E_{ki} = \frac{1}{2} m\ v_{ic}^2 + \frac{1}{2} m v_{iv}^2$ ✓

$\Sigma E_{ki} = \frac{1}{2} \times 1200 \times (\frac{80000}{3600})^2 + \frac{1}{2} \times 1500 \times 30^2$ ✓

$\Sigma E_{ki} = 971296{,}30\ J$

$\Sigma E_{kf} = \frac{1}{2} m\ v_{fc}^2 + \frac{1}{2} m v_{fv}^2$

$\Sigma E_{kf} = \frac{1}{2} \times 1200 \times (25)^2 + \frac{1}{2} \times 1500 \times 27{,}78^2$ ✓

$\Sigma E_{kf} = 953796{,}30\ J$

$\Sigma E_{ki} \neq \Sigma E_{kf}$ ✓

Collision is inelastic */ Botsing is onelasties* ✓ (5)

[15]

QUESTION/*VRAAG* 7

7.1 To the right / *na regs* ✓
For momentum to be conserved:
- momentum of trolley B = momentum of trolley **A**.
- momentum of **B** must be in an opposite direction to the momentum of trolley **A** ✓✓

Vir momentum om behoue te bly:
- *momentum van trollie **B** = momentum van trollie **A**.*
- *momentum van trollie **B** is in die teenoorgestelde rigting as die momentum van trollie **A**.* ✓✓ (3)

7.2 Let right/East be positive/*Laat regs/Oos positief wees*

$\Sigma p_i = \Sigma p_f$
$m_A v_{Ai} + m_B v_{Bi} = m_A v_{Af} + m_B v_{Bf}$
$(m_A + m_B)\, v_i = m_A v_{Af} + m_B v_{Bf}$
✓ Any one / *Enige een*

$(0,5 + 0,75) \times 0$ ✓ $= 0,5 \times (-2,5) + 0,75 v_{Bf}$ ✓

$v_{Bf} = 1,66\ m.s^{-1}$ (to the right/East)/*(na regs/oos)* ✓ (4)

7.3.1 21,5 N ✓
According Newton's Third law of motion, ✓ when the wall exerts a force on the trolley, the trolley simultaneously exerts a force (of 21,5 N) on the wall but in an opposite direction. ✓
Volgens Newton se Derde Bewegingswet, ✓ *indien die muur 'n krag op die trollie uitoefen, oefen die trollie gelyktydig 'n krag (van 21,5 N) op die muur maar in die teenoorgestelde rigting.* ✓

NOTE: *If learners just state Newton's third law without using it to explain, no marks will be awarded*
LET WEL: *As leerders net Newton's se derde wet sê sonder om teverduidelik, sal geen punte toegeken word.*

(3)

7.3.2 $F_{net}\,\Delta t = m\,\Delta v$
$F_{net}\,\Delta t = m\,\Delta(v_{Af} - v_{Ai})$
✓ Any one / *enige*

$-21,5 \times 0,1$ ✓$= 0,5(v_{Af} - 2,5)$ ✓
$-2,15 = 0,5\, v_{Af} - 1,25$
$v_{Af} = -1,8\ m.s^{-1}$
$v_{Af} = 1,8\ m.s^{-1}$✓ (to the left/west)(*na links/wes)* ✓ (5)

7.3.3 Remains the same. / *Bly dieselfde.* ✓
When the contact time increases, the net force decreases.
Indien die kontaktyd toeneem, verminder die netto krag. ✓✓ (3)
[18]

QUESTION/*VRAAG* 8

8.1 The (total) mechanical energy of an isolated system is conserved.
Die (totale) meganiese energie van 'n geïsoleerde sisteem bly behoue. ✓✓ (2)

8.2

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$ME_B = ME_C$ $(E_P + E_K)_B = (E_P + E_K)_C$ $(mgh + \frac{1}{2}m\,v^2)_B = (mgh + \frac{1}{2}m\,v^2)_B$ ✓ $0 + \frac{1}{2}(0,2)v_i^2$ ✓ $= 0,2(9,8)(1,2) + 0$ ✓ $V_i = 4,85\ m.s^{-1}$ ✓	$W_{nc} = \Delta E_k + \Delta E_p$ $0 = \frac{1}{2}m\,v_f^2 - \frac{1}{2}m\,v_i^2 + mgh_2 - mgh_1$ ✓ 0 ✓$= 0 - \frac{1}{2}(0,2)v_i^2 + 0,2(9,8)(1,2) - 0$ ✓ $V_i = 4,85\ m.s^{-1}$ ✓

(4)

8.3

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**	**OPTION/*OPSIE* 3**
$\Delta x = \frac{v_f + v_i}{2}\Delta t$ ✓ $= \frac{6 + 4,85}{2} \times 0,82$ ✓ $= 4,45\ m$ ✓	$v_f = v_i + a\Delta t$ $4,85 = 6 + a \times 0,82$ $a = -1,40\ m.s^{-2}$ $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= 6 \times 0,82 + 0,5 \times a \times 0,82^2$ ✓ $= 4,45\ m$ ✓	$v_f = v_i + a\Delta t$ $4,85 = 6 + a \times 0,82$ $a = -1,40\ m.s^{-2}$ $v_f^2 = v_i^2 + 2a\Delta x$ ✓ $4,85^2 = 6^2 + 2(-1,4)\,\Delta x$ ✓ $\Delta x = 4,46\ m$ ✓

(3)
[9]

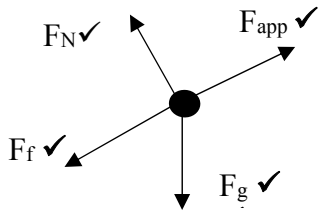
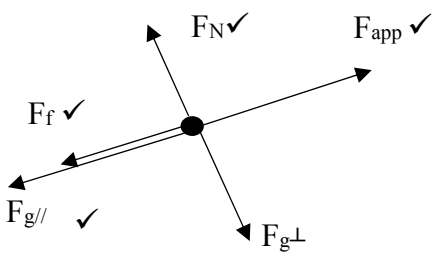
QUESTION/*VRAAG* 9

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

OR/OF

The amount of work done by a net force ✓ on object is equal to the change in the object's kinetic energy. ✓
Die hoeveelheid arbeid wat deur 'n netto krag verrig word op 'n voorwerp ✓ is gelyk die verandering in die voorwerp se kinetiese energie. ✓ (2)

9.2

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

(4)

Mark awarded for both the arrow and label
Punt toegeken vir beide pylpunt en byskrif.
Do not penalise for length of forces since drawing is not drawn to scale.
Moenie penaliseer vir lengte van kragte want diagram is nie volgens skaal nie.
Any other additional force(s)/*Enige addisionele krag(te)* $^3/_4$
If force(s) do not make contact with body/*Indien krag(te) nie kontak maak met voorwerp nie*. Max./*Maks.* $^3/_4$

9.3 **OPTION/*OPSIE* 1**

$W_{net} = \Delta E_K$
$W_{net} = W_{App} + W_{//} + W_f$
$W_{App} + W_{//} + W_f = \Delta E_K$
} ✓ Any one / *Enige een*

$\underline{260(8)\text{Cos}0°)}$ ✓+ $\underline{0{,}16(25)(9{,}8)(\text{Cos}40°)(8)(\text{Cos}180°)}$ ✓+
$\underline{25(9{,}8)(\sin 40°)(8)(\text{Cos}180°)}$ ✓ = $\frac{1}{2}(25)v_f^2 - 0$ ✓
$2080 - 240{,}23 - 1259{,}86 = 12{,}5\ v_f^2$
$579{,}91 = 12{,}5\ v_f^2$
$v_f = 6{,}81\ m.s^{-1}$ ✓

OPTION/*OPSIE* 2

$W_{nc} = \Delta E_K + \Delta E_p$
$W_{app} + W_f = \Delta E_K + W_{Fg}$
} Any one / *Enige een* ✓

$\underline{260(8)(\cos 0°)}$ ✓+ $\underline{0{,}16(25)(9{,}8)(\text{Cos}40°)(8)(\cos 180°)}$ ✓=
$\underline{25(9{,}8)(\text{Sin}40°)(8)(\cos 180°)}$ ✓+ $\frac{1}{2}(25)v_f^2 - 0$ ✓
$v_f = 6{,}81\ m.s^{-1}$ ✓ (6)

9.4

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$\Delta x = \frac{(v_i + v_f)}{2}\Delta t$ $8 = \frac{(0+6,81)}{2}\Delta t$ ✓ $\Delta t = 2,35$ s $P = \frac{W}{\Delta t}$ ✓ $P = \frac{2080}{2,35}$ ✓ = 885,11 W ✓	$v_{av} = \frac{v_f + v_i}{2}$ $v_{av} = \frac{0+6,81}{2}$ ✓ $v_{av} = 3,405$ $P_{av} = F.v_{Av}$ ✓ $P_{av} = 260 \times 3,405$ ✓ = 885,3 W ✓

(4)
[16]

QUESTION/*VRAAG* 10

10.1.1 Doppler effect is 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 Doppler-effek is die verandering in frekwensie (of toonhoogte) van die klank wat deur die waarnemer waargeneem word ✓ omdat die bron van die klank en die luisteraar verskillende snelhede het relatief tot die medium van die klank. ✓

OR/OF

Doppler effect is the apparent change in frequency of a wave ✓when there is relative motion between the source and an observer ✓.
Die Doppler-effek is die skynbare verandering in die frekwensie van 'n golf ✓ *wanneer daar* relatiewe beweging tussen die bron en luisteraar *is.* ✓

OR/OF

Doppler Effect is an (apparent) change in observed/detected frequency (pitch), (wavelength) ✓ as a result of the relative motion between a source and an observer (listener) ✓
Die Doppler-effek is die (skynbare) verandering in die waargenome frekwensie (toonhoogte)(golflengte) ✓ *as gevolg van die relatiewe beweging tussen 'n bron en 'n luisteraar.*✓ (2)

10.1.2 750 Hz ✓ (1)

10.1.3 1) Waves are compressed as Khosi moves towards the source. ✓
2) Wavelength become shorter. ✓
3) Wavelength is inversely proportional to frequency, hence the detected frequency is higher. ✓
1) Golwe word saamgepers soos Khosi na die bron beweeg. ✓
2) Golflengte word korter. ✓
3) Golflengte is omgekeerd eweredig aan frekwensie, dus is die waargeneemde frekwensie hoër. ✓ (3)

10.1.4 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

<u>When Khosi approaches:/ *(Terwyl Khosi nader beweeg):*</u>

750 ✓ = $\frac{340 + v_L}{340} f_s$ ✓

$f_s = \frac{750 \times 340}{340 + v_L}$ …… (1)

<u>When the Khosi moves away: *(Terwyl Khosi wegbeweeg):*</u>

700 ✓ = $\frac{340 - v_L}{340} f_s$ ✓

$f_s = \frac{700 \times 340}{340 - v_L}$ …… (2)

(1) = (2) :

$\frac{750 \times 340}{340 + v_L} = \frac{700 \times 340}{340 - v_L}$

$750(340 - v_L) = 700(340 + v_L)$

$1450v_L = 17000$

$V_L = 11{,}72\ m.s^{-1}$ ✓ (6)

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓	$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓
$f_s = \frac{750 \times 340}{340 + 11{,}72}$ ✓	$f_s = \frac{700 \times 340}{340 - 11{,}72}$ ✓
f_s = 725,01 Hz ✓	f_s = 724,99 Hz ✓

(3)

10.2.1
- Away/*Weg van* ✓
- It shows a red shift. / *Dit toon 'n rooi verskuiwing.* ✓
- Frequency is decreasing. */ Frekwensie neem af.* ✓
- Wavelength becomes longer. / *Golflengte word langer*. ✓ (4)

10.2.2 The universe is expanding. / *Die heelal is besig om uit te sit.* ✓ (1)
[20]

QUESTION/*VRAAG* 11

11.1 The force per unit positive charge./
Die krag per eenheid positiewe lading. ✓✓ (2)

11.2 $E = \frac{kQ}{r^2}$

$E_{net} = E_1 + E_2$

✓ Any one/*Enige een*

$0 \checkmark = \frac{9 \times 10^9 \times 6 \times 10^{-6}}{(0,2 - x)^2} \checkmark + (-\frac{9 \times 10^9 \times 4 \times 10^{-6}}{x^2}) \checkmark$

x = 0,09 m ✓ (6)
[8]

TOTAL/TOTAAL: 150