Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2022

PHYSICAL SCIENCES P1

MARKS: **150**

TIME: **3 hours**

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

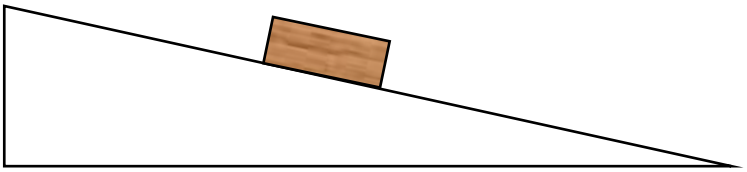
INSTRUCTIONS AND INFORMATION

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.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

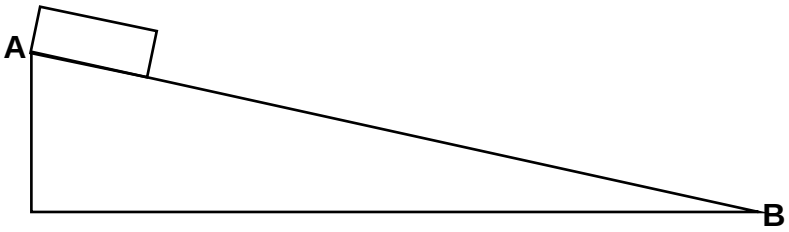
Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write ONLY the letter (A–D) next to the question numbers (1.1–1.10) in the ANSWER BOOK, for example 1.11 B.

1.1 A wooden crate rests on an inclined plane as shown in the diagram below. Which ONE of the following formulae is the CORRECT expression regarding the forces acting on the block?



A $F_f = F_{applied}$
B $F_N = F_{//}$
C $F_N = F\perp$
D $F\perp = F_{//}$ (2)

1.2 A glass block moves from point **A** to point **B** on a frictionless inclined surface as shown in the diagram below. Which ONE of the following statements is TRUE for the TOTAL Mechanical Energy (E_{mech}) and Kinetic Energy (E_k) as the block moves from point **A** to point **B**?



	TOTAL MECHANICAL ENERGY E_{mech}	**Kinetic Energy E_k**
A	$E_{mech}(A) = E_{mech}(B)$	$E_k(A) = E_k(B)$
B	$E_{mech}(A) < E_{mech}(B)$	$E_k(A) < E_k(B)$
C	$E_{mech}(A) = E_{mech}(B)$	$E_k(A) < E_k(B)$
D	$E_{mech}(A) > E_{mech}(B)$	$E_k(A) > E_k(B)$

(2)

1.3 A physical quantity that is described as a measure of the resistance of a body to a change in its state of motion is the ...

A acceleration.
B inertia.
C Newton's Second Law of Motion.
D Newton's Third Law of Motion. (2)

1.4 An object is thrown vertically upwards.

Which ONE of the following statements is TRUE concerning the acceleration and velocity of the object when it reaches its maximum height?

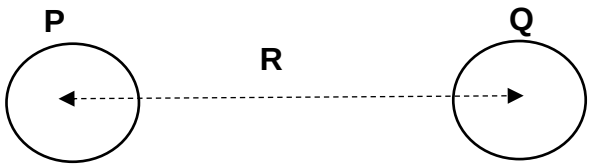
	Acceleration	Velocity
A	9,8 $m.s^{-2}$ downwards	9,8 $m.s^{-1}$ downwards
B	0 $m.s^{-2}$	9,8 $m.s^{-1}$ downwards
C	0 $m.s^{-2}$	0 $m.s^{-1}$
D	9,8 $m.s^{-2}$ downwards	0 $m.s^{-1}$

(2)

1.5 A ball rolls from point **A** to **D** as shown in the diagram below. The sections **AB** and **CD** are frictionless, while **BC** is rough. Which ONE of the following statements is TRUE?

A The total mechanical energy changes when the ball rolls from B to C.
B The ball has the same kinetic energy at A and C.
C The total mechanical energy of the ball decreases from C to D.
D Kinetic energy is conserved during the complete motion from A to D. (2)

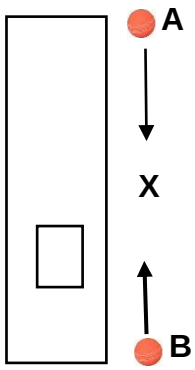
1.6 Two objects of masses **P** and **Q** respectively, are placed such that their centres are a distance **R** apart. The force they exert on each other is **F**.



When the mass of **P** is halved (**½ P**) and the distance between their centres is doubled to **2R**. The new force they exert on each other will be …

A ½ F.
B ¼ F.
C ⅛ F.
D 4 F. (2)

1.7 Ball **A** is dropped from the top of a building. Ball **B** is thrown upwards from the ground 1 s later. They move past each other at point **X**. Ignore the effects of air resistance.



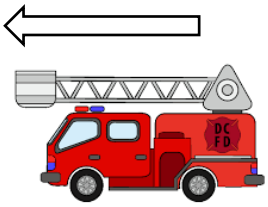
Which ONE of the following statements is TRUE when the two balls meet at point **X**?

A the distance travelled by each ball will be equal.
B the sum of the distance travelled by **A** and **B** will be equal to the height of the building.
C ball **B** will not reach the top of the building.
D the time ball **A** takes to reach point **X** is less than the time for ball **B** to reach point **X**. (2)

1.8 Which ONE of the following physical quantities below can be measured in the base unit $kg.m^2.s^{-2}$?

A Kinetic energy
B Acceleration
C Velocity
D Momentum (2)

1.9 A fire engine moves towards a building that is on fire. The siren of the fire engine has a frequency **f**. The frequency that the firemen in the fire engine will hear as they travel towards the burning building will be ...



A 3 **f**.
B 2 **f**.
C **f**.
D ½ **f**. (2)

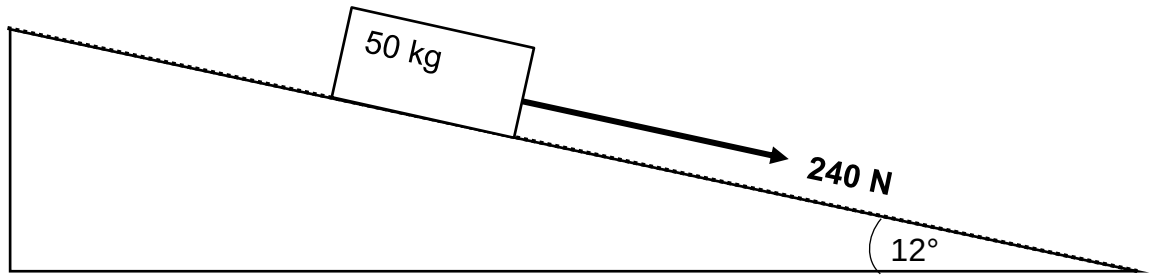
1.10 Two identical conducting spheres **P** with a charge of +3,2 x 10^{-19} C and **Q**, with a charge of -6,4 x 10^{-19} C, are brought into contact. During contact, sphere **P** will ...

A. gain 2 electrons.
B. gain 3 electrons.
C. lose 3 electrons.
D. lose 3 protons. (2)

[20]

QUESTION 2

A rope is used to apply a force of 240 N to a 50 kg crate to pull it down a rough inclined surface at a CONSTANT VELOCITY. The incline surface makes an angle of 12° 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 crate. (4)

2.3 Define the term *kinetic frictional force.* (2)

2.4 Calculate the:

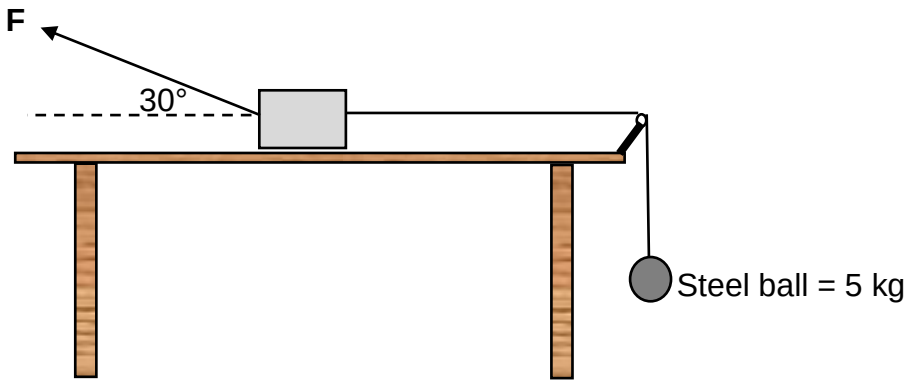
2.4.1 Magnitude of the kinetic frictional force between the crate and the surface of the inclined surface (4)

2.4.2 Value of the coefficient of kinetic frictional force (μ_k) between the crate and the surface of the inclined surface (4)

[16]

QUESTION 3

A metal box is connected to a steel ball of mass 5 kg by means of a light, inextensible string that passes over a frictionless pulley as shown in the diagram below. A force **F** is applied at an angle of 30° to the horizontal to the metal box. The force **F** is gradually increased and just before **F** becomes equal to 65 N, *the system just starts to move.*
The normal force that the table exerts on the metal box is **36,1 N.**



3.1 Give the name of the frictional force explained by the term *just before the metal box starts moving*. (1)

3.2 Draw a free body diagram of ALL the forces acting on the metal box. (5)

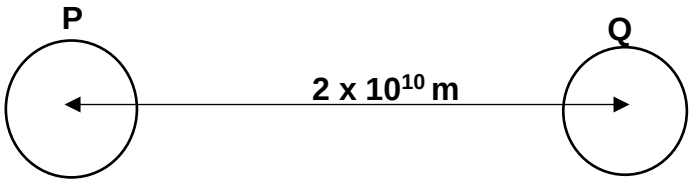
3.3 Calculate the:

3.3.1 Magnitude of the force mentioned in QUESTION 3.1 (5)

3.3.2 Mass of the metal box (4)
[15]

QUESTION 4

Two small, spherical planets P and Q of mass 1,2 x 10^{18} kg and 3 x 10^{18} kg respectively move in space with their centres 2 x 10^{10} m apart, as shown in the diagram below. Assume no other forces act on the planets.



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

4.2 Calculate the gravitational force between the two planets. (5)

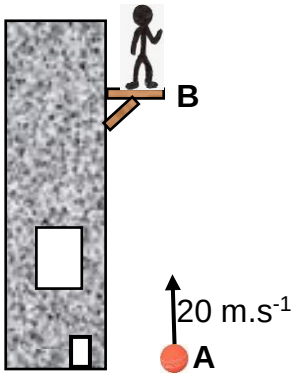
4.3 The radii of the planets are equal. How will the acceleration due to gravity on the surface of planet **P** (g_P) compare with the acceleration due to gravity on the surface of planet **Q** (g_Q)?

Write only GREATER THAN, LESS THAN or SIMILAR. Briefly explain your answer. (2)

[9]

QUESTION 5

A cricket ball is projected upwards from the bottom of a building at point **A** at a velocity of 20 $m.s^{-1}$. It reaches a maximum height above the building and returns to point **B** as shown in diagram below. A man standing on a balcony of the building at point **B** catches the ball 1,66 s after it had reached its maximum height. Ignore the effect of air resistance.



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

5.2 Calculate the:

5.2.1 Time it took the cricket ball to reach its maximum height (4)

5.2.2 Height of the balcony above the ground (5)

5.2.3 Speed with which the ball strikes the man's hand when he catches it (3)

5.3 Draw a sketch velocity-time graph for the motion of the cricket ball from the moment that it was projected until the man catches the ball at point **B**.

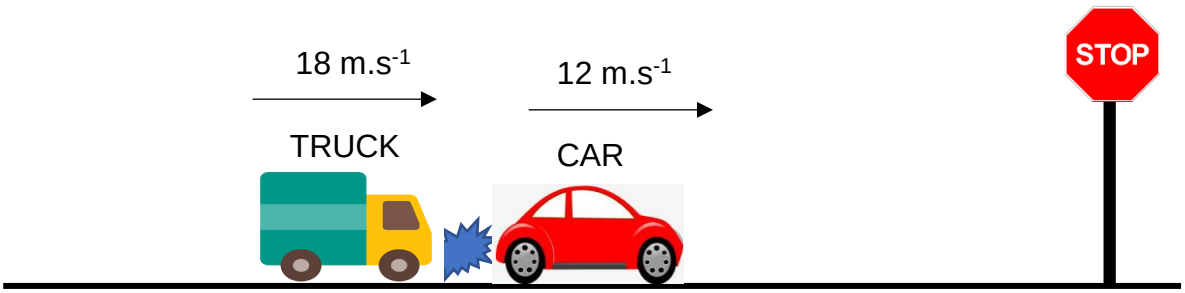
Indicate the following clearly on your graph:

- Initial velocity of the ball.
- Time when the ball is at the maximum height.
- Time when the man catches the ball.
- Velocity of the ball just before the man catches it. (5)

[19]

QUESTION 6

A truck of mass 3 200 kg travelling at a velocity of 18 $m.s^{-1}$ to the east, collides with a car of mass 1 800 kg travelling at a velocity of 12 $m.s^{-1}$ in the same direction, as shown in the diagram below. After the collision, the truck continues to move in the same direction at velocity of 10 $m.s^{-1}$.



6.1 Define the term *momentum* in words. (2)

6.2 Calculate the:

6.2.1 Momentum of the truck before the collision (3)

6.2.2 Velocity of the car after the collision (5)

6.3 Is the collision between the truck and the car elastic or inelastic? Explain your answer. (3)

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

[15]

QUESTION 7

During a gymnastic routine at the Olympic Games, a gymnast jumps in the air and lands vertically as shown in the diagram below. The mass of the gymnast is 45 kg. From her maximum height it takes 0,35 s before she lands on a mat. She bends her knees while landing. After landing on the mat it took her 0,69 s to come to a complete stop.

7.1 Calculate the velocity with which the gymnast lands on the mat. (4)

7.2 Define the term *impulse* in words. (2)

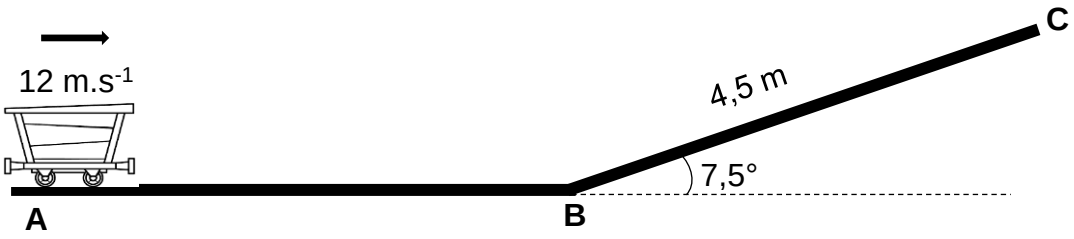
7.3 Calculate the force of the mat on the gymnast after she has landed on it. (5)

7.4 Using your answer in QUESTION 7.3, explain why it is necessary for the gymnast to bend her knees on landing to avoid serious injury. (3)

[14]

QUESTION 8

A mining trolley of mass 540 kg moving to the right, approaches point **A** with a velocity of 12 $m.s^{-1}$ and comes to rest at point **C**. **AB** is rough while **BC** is frictionless. The coefficient of kinetic friction between the trolley and the rough surface **AB** is 0,8. **BC** is 4,5 m long and makes an angle of 7,5° with the horizontal as shown in the diagram below.



8.1 State the Principle of CONSERVATION OF MECHANICAL ENERGY in words. (2)

8.2 Use the PRINCIPLE OF CONSERVATION OF MECHANICAL ENERGY to calculate the velocity of the trolley at point **B**. (4)

8.3 Calculate the kinetic frictional force between the trolley and the rough surface **AB** in the diagram above. (3)

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

8.5 Use energy principles ONLY to calculate the …

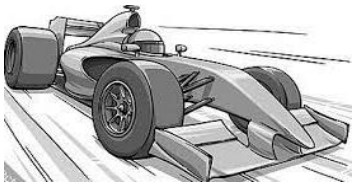
8.5.1 work done by friction as the trolley moves from point **A** to point **B**. (4)

8.5.2 distance from point **A** to point **B**. (4)

[19]

QUESTION 9

A racing car races towards a video camera as shown in the diagram below. The frequency that the engine of the racing car produces is 680 Hz. The video camera records the sound at a frequency of 875 Hz.
Take the speed of sound to be 340 $m.s^{-1}$.



9.1 State the phenomenon that causes this apparent change in frequency. (2)

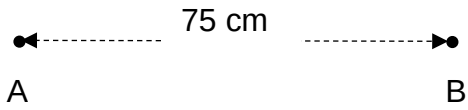
9.2 Calculate the velocity of the racing car as it approaches the video camera. Give your answer in $km.h^{-1}$. (6)

9.4 The racing car passes the video camera and travels further away. How does the frequency change as it travels away?
Write only INCREASES, DECREASES or STAYS THE SAME. Briefly explain your answer. (3)

9.5 State TWO uses of the phenomenon stated in QUESTION 9.1 in the medical field. (2)
[13]

QUESTION 10

Two identical opposite point charges **A** and **B** each carry a charge of magnitude 4×10^{-6} C and are placed 75 cm from each other in a vacuum as shown in the diagram below.



10.1 Draw the electric field pattern between charges **A** and **B**. (3)

10.2 Calculate the:

10.2.1 Force on charge **A** due to charge **B** (4)

10.2.2 Number of excess electrons on charge **B** (3)

[10]

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 of earth / *Massa op aarde*	M	5,98 × 10^{24} kg
Radius of earth / *Radius van aarde*	R_E	6,38 × 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* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{av} = Fv$	

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)
$R_s = R_1 + R_2 + ...$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + ...$	$q = I\Delta t$
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*

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

Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE / *NASIONALE SENIOR SERTIFIKAAT*

GRADE / *GRAAD* 12

JUNE / *JUNIE* 2022

PHYSICAL SCIENCES P1
MARKING GUIDELINE
FISIESE WETENSKAPPE V1
NASIENRIGLYN

MARKS/ *PUNTE*: 150

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

GENERAL GUIDELINES/*ALGEMENE RIGLYNE*

1. CALCULATIONS/*BEREKENINGE*

1.1 **Marks will be awarded for**: correct formula, correct substitution, correct answer with unit.
Punte sal toegeken word vir: *korrekte formule, korrekte substitusie, korrekte antwoord met eenheid.*

1.2 **No marks** will be awarded if an **incorrect or inappropriate formula is used**, even though there are many relevant symbols and applicable substitutions.
Geen punte *sal toegeken word waar 'n* ***verkeerde of ontoepaslike formule gebruik*** *word nie, selfs al is daar relevante simbole en relevante substitusies.*

1.3 When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.
Wanneer 'n fout gedurende ***substitusie in 'n korrekte formule*** *begaan word, sal 'n punt vir die korrekte formule en vir korrekte substitusies toegeken word, maar* ***geen verdere punte*** *sal toegeken word nie.*

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

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

1.6 Mathematical manipulations and change of subject of appropriate formulae carry no marks, but if a candidate starts off with the correct formula and then changes the subject of the formula incorrectly, marks will be awarded for the formula and correct substitutions. The mark for the incorrect numerical answer is forfeited.
Wiskundige manipulasies en verandering van die onderwerp van toepaslike formules tel geen punte nie, maar indien 'n kandidaat met die korrekte formule begin en dan die onderwerp van die formule 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 **Sub-question to sub-question**: When a certain variable is calculated in one sub-question (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 sub-questions.
***Subvraag na subvraag**: Wanneer 'n sekere veranderlike in een subvraag (bv. 3.1) bereken word en dan in 'n ander vervang moet word (3.2 of 3.3), bv. indien die antwoord vir 3.1 verkeerd is en word korrek in 3.2 of 3.3 vervang, word **volpunte** vir die daaropvolgende subvraag toegeken.*

4.2 **A multistep question in a sub-question**: 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 C ✓✓ (2)

1.3 B ✓✓ (2)

1.4 D ✓✓ (2)

1.5 A ✓✓ (2)

1.6 C ✓✓ (2)

1.7 B ✓✓ (2)

1.8 A ✓✓ (2)

1.9 C ✓✓ (2)

1.10 A ✓✓ (2)

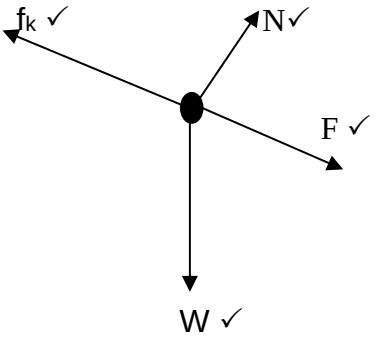
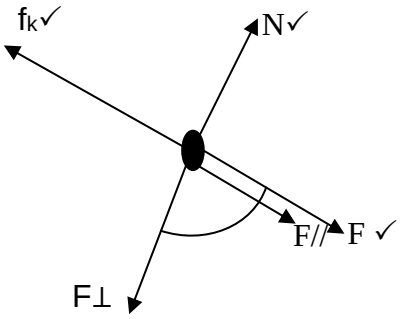
[20]

QUESTION/*VRAAG 2*

2.1 When a resultant/net force acts on an object, it accelerates in the direction of the force. The acceleration is directly proportional to the force ✓and inversely proportional to the mass of the object. ✓

Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, versnel dit in die rigting van die krag. Die versnelling is direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp. (2)

2.2

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
	 F⊥ and / *en* F// ✓

Mark awarded for arrow and label / *Punt vir beide pyl en byskrif* toegeken.
Do not penalise for length of arrows since drawing is not drawn to scale
Moenie vir die lengte van die pyltjie penaliseer nie aangesien skets nie na skaal geteken is nie
Any other additional force(s) / *Enige ander addisionele kragte* $^3/_4$
If force(s) do not make contact with body. Max. $^3/_4$
Indien krag(te) nie met die voorwerp kontak maak nie. Maks. $^3/_4$ (4)

2.3 The force that opposes the motion of an object and acts parallel to the surface. ✓✓

Die krag wat die beweging van 'n voorwerp teenstaan en parallel met die oppervlak inwerk. (2)

2.4.1 **OPTION 1 (Upwards on the plane is positive) / *OPSIE 1 (Teen die skuinsvlak op as positief)***

$F_{net} = ma$
$F_{net} = 0$ N
$f_k - F_R - F_{//} = 0$
$f_k - F_R - mg \sin\theta = 0$
} Any one/ *Enige een* ✓

$[f_k - 240 - \underline{(50)(9,8)\sin 12^\circ}✓] ✓ = 0$
$f_k = 341,88$ N ✓ (4)

2.4.2 **Positive marking from QUESTION 2.3 / *Positiewe nasien vanaf VRAAG 2.3***
Marking criteria / Nasienkriteria

$\mu_k = \frac{f_k}{N}$
$\mu_k = \frac{fk}{mg\cos\theta}$
} Any one/ *Enige een* ✓

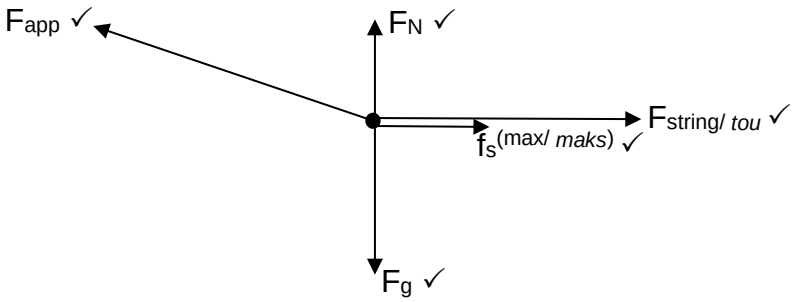
$\mu_k = [\frac{341,88}{(50\ x\ 9,8)\ cos\ 12^\circ✓}]$ ✓

$\mu_k = \underline{341,88}$
$\quad 479,29$
$\mu_k = 0,71$ ✓ (4)
[16]

QUESTION/*VRAAG* 3

3.1 Maximum static force of friction. ✓
Maksimum statiese wrywingskrag. (1)

3.2



Mark awarded for arrow and label / *Punt vir beide pyl en byskrif*.

Do not penalise for length of arrows since drawing is not drawn to scale.
Moenie vir die lengte van die pyltjie penaliseer nie aangesien nie na skaal geteken nie

Any other additional force(s) / *Enige ander addisionele krag(te)* $^4/_5$
If force(s) do not make contact with body. Max. $^4/_5$
Indien krag(te) nie met die voorwerp kontak maak nie. Maks. $^4/_5$ (5)

3.3.1 **OPTION 1 / *OPSIE 1***

$F_{net} = ma$
$F_T - mg = ma$
$F_x - F_T - f_s^{(max)} = ma$ Any one / *Enige een* ✓

$F_T - (5)(9,8) = 0$ ✓
$= 49$ N
$F_x = F_{app} \cos 30^\circ$
$= 65 \cos 30^\circ$ ✓
$= 56,29$ N
$56,29 - 49 - f_s^{(max)} = 0$ ✓
$f_s^{(max)} = 7,29$ N ✓

OPTION 2/*OPSIE 2*
$F_{net} = ma$
$F_T - mg = ma$
$F_x - F_T - f_s^{(max)} = ma$ Any one/ *Enige een* ✓

$[65 \cos 30^\circ$ ✓$- (5)(9,8)$ ✓$ - f_s^{(max)} = 0]$ ✓
$56,29 - 49 - f_s^{(max)} = 0$
$f_s^{(max)} = 7,29$ N ✓ (5)

3.3.2 **Vertical forces on metal box are in equilibrium / *Vertikale kragte op metaalhouer is in ewewig*:**
$F_g - F_v - F_N = 0$
$mg = F_{app} \sin 30^\circ - F_N$ Any one / *Enige een* ✓
$mg = [65 \sin 30^\circ$ ✓$- 36,1]$ ✓
$m \times 9,8 = 68,6$
$m = 7$ kg ✓ (4)
[15]

QUESTION 4 / *VRAAG* 4

4.1 There exists a force of attraction between any two masses in the universe. This force is directly proportional to the product of the masses ✓and inversely proportional to the square of the distance between their centres. ✓

Daar bestaan 'n aantrekkingskrag tussen enige twee massas in die heelal. Die krag is direk eweredig aan die produk van die massas en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte. (2)

4.2 $F = \frac{Gm_1m_2}{d^2}$ ✓
$= \frac{(6,67 \times 10^{-11})(1,2 \times 10^{18})(3 \times 10^{18})}{(2 \times 10^{10})^2}$ ✓✓✓
$= 6,0 \times 10^6$ N ✓ (5)

4.3 LESS THAN ✓
Mass of planet P < Mass of planet Q ✓
$g \propto$ Mass

KLEINER AS

Massa van planeet P < Massa van planeet Q
g ∝ *Massa* (2)
[9]

QUESTION/*VRAAG 5*

5.1 Motion of an object upon which the only force acting on it is gravitational force. ✓✓

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

5.2.1

UPWARDS IS POSITIVE / *OPWAARTS AS POSITIEF*	**DOWNWARDS IS POSITIVE / *AFWAARTS AS POSITIEF***
$v_f = v_i + g\Delta t$ ✓ $\underline{0 = 20}$ ✓ $+ (-9,8)\Delta t$ ✓ $\Delta t = 2,04$ s ✓	$v_f = v_i + g\Delta t$ ✓ $\underline{0 = -20}$ ✓ $+ 9,8\Delta t$ ✓ $\Delta t = 2,04$ s ✓

(4)

5.2.2

OPTION 1 / *OPSIE 1*	
Positive marking from QUESTION 5.2.1 / *Positiewe nasien vanaf VRAAG 5.2.1*	
UPWARDS IS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS IS POSITIVE / *AFWAARTS AS POSITIEF***
Total time / *Totale tyd* = 2,04 + 1,66 ✓ = 3,7 s $\Delta y = v_i\Delta t + \frac{1}{2}g\Delta t^2$ ✓ $\Delta y = (20)(3,7)$ ✓ $+ \frac{1}{2}(-9,8)(3,7^2)$ ✓ $\Delta y = 6,92$ m ✓	Total time/ *Totale tyd* = 2,04 + 1,66 ✓ = 3,7 s $\Delta y = v_i\Delta t + \frac{1}{2}g\Delta t^2$ ✓ $\Delta y = (-20)(3,7)$ ✓ $+ \frac{1}{2}(9,8)(3,7^2)$ ✓ $\Delta y = -6,919$ m $\Delta y = 6,92$ m ✓ (If answer left as negative, then loses last mark) *(As antwoord as negatief gelaat word, verloor dan laaste punt)*

OPTION 2 / *OPSIE 2*	
Positive marking from QUESTION 5.2.1 / *Positiewe nasien vanaf VRAAG 5.2.1*	
UPWARDS IS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS IS POSITIVE / *AFWAARTS AS POSITIEF***
Time taken from B to ground *Tyd geneem van B na grond* $\Delta t = 2,04 - 1,66$ ✓ $= 0,38$ s $\Delta y = v_i\Delta t + \frac{1}{2}g\Delta t^2$ ✓ $\Delta y = (20)(0,38)$ ✓ $+ \frac{1}{2}(-9,8)(0,38^2)$ ✓ $\Delta y = 6,89$ m ✓	Time taken from B to the ground *Tyd geneem van B na grond* $\Delta t = 2,04 - 1,66$ ✓ $= 0,38$ s $\Delta y = v_i\Delta t + \frac{1}{2}g\Delta t^2$ ✓ $\Delta y = (-20)(0,38)$ ✓ $+ \frac{1}{2}(9,8)(0,38^2)$ ✓ $= -6,89$ m Height / *Hoogte* = 6,89 m above the ground / *bo die grond* ✓

OPTION 3 / *OPSIE 3*	**OPTION 3 / *OPSIE 3***
Positive marking from QUESTION 5.2.1 / *Positiewe nasien vanaf VRAAG 5.2.1*	
UPWARDS IS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS IS POSITIVE / *AFWAARTS AS POSITIEF***
Calculate the maximum height: *Bereken die maksimum hoogte:* $v_f^2 = v_i^2 + 2g\Delta x$ $0^2 = 20^2 + 2(-9,8).\Delta x$ ✓ $\Delta x = 20,41$ m Any one formula *Enige een formule* ✓ Ball falls for 1,66 m / *Bal val vir 1,66 m* $\Delta y = v_i\Delta t + \frac{1}{2}g\Delta t^2$ $\Delta y = (0)(1,66) + \frac{1}{2}(-9,8)(1,66^2)$ ✓ $\Delta y = -13,05$ m Height of the balcony / *Hoogte van die balkon* = 20,41 – 13,51 ✓ Height of the balcony / *Hoogte van die balkon* = 6,91 m ✓	Calculate the maximum height: *Bereken die maksimum hoogte:* $v_f^2 = v_i^2 + 2g\Delta x$ $0^2 = (-20)^2 + 2(9,8).\Delta x$ ✓ $\Delta x = 20,41$ m Any one formula *Enige een formule* ✓ Ball falls for 1,66 m *Bal val vir 1,66 m* $\Delta y = v_i\Delta t + \frac{1}{2}g\Delta t^2$ $\Delta y = (0)(1,66) + \frac{1}{2}(9,8)(1,66^2)$ ✓ $\Delta y = 13,05$ m Height of the balcony/ *Hoogte van die balkon* = 20,41 – 13,51 ✓ Height of the balcony/ *Hoogte van die balkon* = 6,91 m ✓

(5)

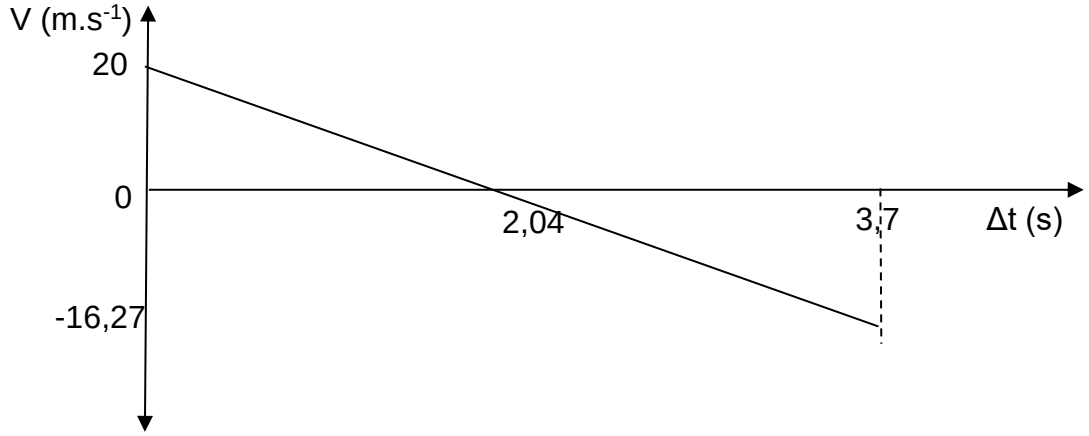
5.2.3

OPTION 1 / *OPSIE 1*	
Positive marking from QUESTION 5.2.1 / *Positiewe nasien vanaf VRAAG 5.2.1*	
UPWARDS IS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS IS POSITIVE / *AFWAARTS AS POSITIEF***
$v_f = v_i + g\Delta t$ ✓ $v_f = 0 + (-9,8)(1,66)$ ✓ $v_f = 16,27$ m.s^{-1} ✓	$v_f = v_i + g\Delta t$ ✓ $v_f = 0 + 9,8(1,66)$ ✓ $v_f = 16,27$ m.s^{-1} ✓
OPTION 2 / *OPSIE 2*	
Positive marking from QUESTION 5.2.1/ *Positiewe nasien vanaf VRAAG 5.2.1*	
UPWARDS IS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS IS POSITIVE / *AFWAARTS AS POSITIEF***
$v_f = v_i + g\Delta t$ ✓ $v_f = 20 + (-9,8)(3,7)$ ✓ $v_f = -16,26$ $v_f = 16,26$ m.s^{-1} ✓	$v_f = v_i + g\Delta t$ ✓ $v_f = -20 + 9,8(3,7)$ ✓ $v_f = 16,26$ m.s^{-1} ✓

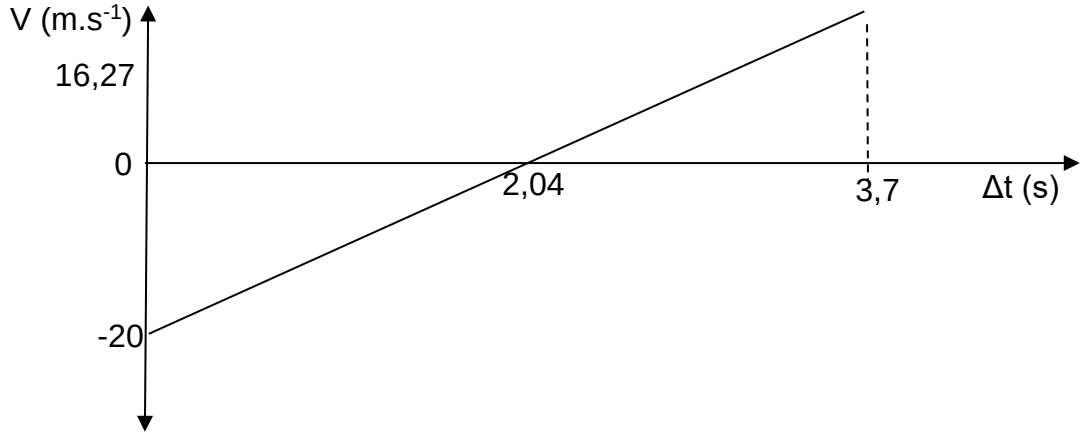
(3)

5.3 **Positive marking from QUESTION 5.2.3 / *Positief nasien vanaf VRAAG 5.2.3***

UPWARDS IS POSITIVE / *OPWAARTS AS POSITIEF*



DOWNWARDS IS POSITIVE / *AFWAARTS AS POSITIEF*



Marking criteria / *Nasienkriteria*	
Shape / *Vorm*	✓
Initial velocity / *Begin snelheid*	✓
Time at maximum height / *Tyd by maksimum hoogte*	✓
Velocity when man catches the ball / *Snelheid wanneer man bal vang*	✓
Time when man catches the ball / *Tyd wanneer man bal vang*	✓

(5)
[19]

QUESTION/*VRAAG 6*

6.1 The momentum of an object is the product of its mass and velocity. ✓✓
(2 or 0)

Die momentum van 'n voorwerp is die produk van sy massa en snelheid.
(2 of 0) (2)

6.2.1 $p = mv$ ✓
$p = 3200 \times 18$ ✓
$p = 56\ 700\ kg.m.s^{-1}$ ✓ (3)

6.2.2 $\Sigma p_i = \Sigma pf$
$p_{Ti} + p_{Ci} = p_{Tf} + p_{Cf}$ } Any one/*Enige een* ✓
$57600 + (12 \times 1800)$ ✓ $= (10 \times 3200) + 1800\ v_{Cf}$ ✓
$v_{Cf} = 26,22\ m.s^{-1}$✓ to the right / *regs* (or any indication of direction / *of enige aanduiding van rigting*) ✓ (5)

6.3 Inelastic. ✓(Only momentum is conserved) Kinetic energy is not conserved. ✓✓
Onelasties (Slegs momentum word behoue) Kinetiese energie is nie behoue nie. (3)

6.4 Airbags/seatbelts/Crumble zones (Any two ✓✓)
Accept headrests

Lugsakke/veiligheidsgordel/frommelsone (Enige twee)
Aanvaar hoofstutte (2)
[15]

QUESTION/*VRAAG 7*

7.1

UPWARDS IS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS IS POSITIVE / *AFWAARTS AS POSITIEF***
$v_f = v_i + g\Delta t$ ✓ $v_f = 0 + -9,8(0,35)$ ✓ $v_f = -3,43\ m.s^{-1}$ $v_f = 3,43\ m.s^{-1}$ ✓ downwards/*afwaarts* ✓	$v_f = v_i + g\Delta t$ ✓ $v_f = 0 + -9,8(0,35)$ ✓ $v_f = 3,43\ m.s^{-1}$ ✓ downwards/*afwaarts* ✓

(4)

7.2 Impulse is the product of the net force acting on an object and the time for which the net force acts on the object. ✓✓

Impuls is die produk van die netto krag wat op 'n voorwerp inwerk en die tyd wat die netto krag op die voorwerp inwerk. (2)

Positive marking from QUESTION 7.1 / *Positiewe nasien vanaf VRAAG 7.1*

7.3 $F_{net}.\Delta t = \Delta p$
$F_{net}.\Delta t = mv_f - mv_i$ } Any one / *Enige een* ✓
$F_{net} \times 0,69$ ✓ $= 45 \times 0 - 45 \times 3,43$ ✓
$F_{net} = 223,7$ N ✓ Upwards / *Opwaarts* ✓ (5)

7.4 $F_{net} = \frac{m\Delta v}{\Delta t}$

Δv remains the same. ✓
If the knees are not bent, the time to come to rest is very small (Δt decreases) ✓
F_{net} increases and can cause injury. ✓

$F_{net} = \frac{m\Delta v}{\Delta t}$
Δv bly dieselfde
As die knieë nie gebuig is nie, is die tyd om tot rus te kom baie klein (Δt verminder)
F_{netto} verhoog en kan beserings veroorsaak. (3)
[14]

QUESTION/*VRAAG* 8

8.1 In an isolated system, the total mechanical energy remains constant. ✓✓
In 'n geïsoleerde sisteem bly die totale meganiese energie konstant. (2)

8.2 $E_{mec(B)} = E_{mec(C)}$
$(E_p + E_k)_B = (E_p + E_k)_C$
$(mgh + \frac{1}{2}mv^2)_B = (mgh + \frac{1}{2}mv^2)_C$ } Any one / *Enige een* ✓
$(540)(9,8)(0) + \frac{1}{2}(540)v_B^2$ ✓ $= (540)(9,8)(4,5 \sin 7,5^\circ)$ ✓ $+ \frac{1}{2}(540)(0^2)$
$v_B = 3,39 \text{ m.s}^{-1}$ ✓ (4)

8.3 $f_k = \mu_k N$ ✓
$f_k = (0,8) \times (540)(9,8)$ ✓
$f_k = 4233,6$ N ✓ (3)

8.4 The net work done on an object is equal to the change in kinetic energy of the object. ✓✓

Die netto werk verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp. (2)

8.5.1 **Positive marking from QUESTION 8.2 / *Positiewe nasien van VRAAG 8.2.***
OPTION 1 / *OPSIE 1*
$W_{net} = \Delta E_k$
$W_f = \frac{1}{2}m(v_f^2 - v_i^2)$ } Any one / *Enige een* ✓
$W_f = \frac{1}{2} \times 540)(3,39)^2$ ✓ $- \frac{1}{2} \times 540(12^2)$ ✓
$W_f = -35\,777,13$ J ✓

OPTION 2 / *OPSIE 2*
$W_{nc} = \Delta E_k + \Delta E_p$
$W_f = \frac{1}{2}m(v_f^2 - v_i^2) + 0$ } Any one / *Enige een* ✓
$W_f = \frac{1}{2} \times 540 \times 3,39^2$ ✓ $- \frac{1}{2} \times 540 \times 12^2$ ✓
$W_f = -35\,777,13$ J ✓ (4)

8.5.2 **Positive marking from QUESTION 8.3 and 8.5.1**
Positiewe nasien vanaf VRAAG 8.3 en 8.5.1
$W_f = F_f.\Delta x.\cos\theta$ ✓
$-35777,13$ ✓ $= (4233,6).\Delta x.\cos 180^\circ$ ✓
$\Delta x = 8,45$ m ✓ (4)
[19]

QUESTION/*VRAAG* 9

9.1 The change in frequency or pitch detected by a listener because the listener and the sound source have different velocity 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. (2)

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

875 ✓ $= \frac{(340 + 0)}{(340 - v_S)}$ ✓ 680 ✓

$v_S = 75,77 \text{ m.s}^{-1}$

$v_S = 75,77 \times 3,6$ ✓

$v_S = 272,77 \text{ km.h}^{-1}$ ✓ (6)

9.3 Decreases ✓
As it moves away, wavelength increases ✓ but velocity remains constant. ✓
Frequency decreases.

Afneem
Soos dit wegbeweeg, verleng die golflengte maar die snelheid bly konstant.
Frekwensie neem af. (3)

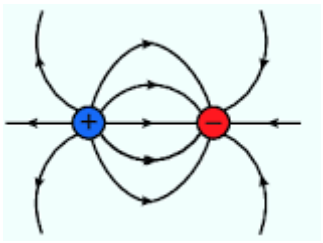
9.4 Measuring foetal heartbeat ✓
Monitoring and measuring of blood flow ✓

Meet fetus se hartklop
Monitering en meting van bloedvloei. (2)

[13]

QUESTION/*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 $F = \frac{kQ_1Q_2}{r^2}$ ✓

$F = \frac{(9 \times 10^9)(4 \times 10^{-6})(4 \times 10^{-6})}{(0,75)^2}$ ✓ ✓

F = 0,256 N right / *regs* ✓ (4)

10.2 $Q_e = nq_e$ ✓

$4 \times 10^{-6} = n \times (1,6 \times 10^{-19})$ ✓

$n = 2,5 \times 10^{13}$ protons / *protone* ✓ (3)

[10]

TOTAL/ *TOTAAL*: 150