Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2018

PHYSICAL SCIENCES P1

MARKS: **150**

TIME: **3 hours**

* J P H S C E 1 *

This question paper consists of 18 pages including 3 data sheets.

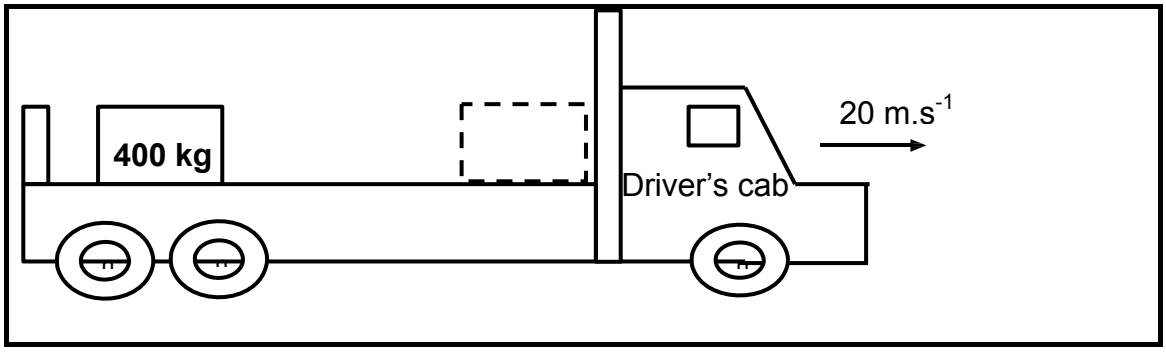
INSTRUCTIONS AND INFORMATION

1. Write your NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.
2. Answer ALL the questions.
3. Non-programmable calculators may be used.
4. Appropriate mathematical instruments may be used.
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, etcetera 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. Each question has only ONE correct answer. Choose the best answer and ONLY write down the letters (**A**, **B**, **C** or **D**) next to the question number (1.1–1.10) in your ANSWER BOOK, for example 1.11 E.

1.1 A flatbed truck carrying a 400 kg concrete block, near the back of its flatbed, is travelling to the right along a straight level road at 20 $m.s^{-1}$.



The truck collides head-on with a stationary truck and stops immediately. The concrete block slides to the front in the right. Which ONE of the following is the best explanation as to why the block slides forward?

A The truck exerts a force on the block.

B The inertia of the concrete block causes it to slide forward.

C The velocity of the concrete block relative to the ground remains constant.

D The concrete block experiences an acceleration due to a resultant force. (2)

1.2 Two different masses exert a force **F** on each other when they are a distance **r** apart. What will the force be if the distance between them is **doubled**?

A ¼ **F**

B ½ **F**

C 2 **F**

D 4 **F** (2)

1.3 The mass of an object, **M**, is twice the mass of another object **N**.

Both objects are released simultaneously from the same height. How does the velocity of **N** compare with the velocity of **M** just before they strike the ground? (Ignore the effects of air resistance.) The velocity of **N** is …

A half the velocity of **M**.

B twice the velocity of **M**.

C equal to the velocity of **M**.

D a quarter the velocity of **M**. (2)

1.4 Which ONE of the following physical quantities represents the **rate of change of momentum** of an object?

A Net force

B Kinetic energy

C Impulse

D Acceleration (2)

1.5 Two objects experience an INELASTIC collision in a closed system. Which ONE of the following combinations regarding the momentum and kinetic energy is correct?

	MOMENTUM	KINETIC ENERGY
A	Is not conserved	Is conserved
B	Is conserved	Is not conserved
C	Is not conserved	Is not conserved
D	Is conserved	Is conserved

(2)

1.6 A sound source is moving relative to a stationary observer. As the sound source moves away from the observer, its frequency appears to decrease because the …

A wavelength between the source and observer decreases.

B wavelength between the source and observer increases.

C wavelength between the source and observer remains unchanged.

D loudness between the source and observer increases. (2)

1.7 An airbag **can protect a driver from serious injury** during a collision because as the contact time …

A increases, the net force will decrease.

B decreases, the net force will remain the same.

C increases, the net force will increase.

D decreases, the net force will decrease. (2)

1.8 The siren of a stationary train delivers sound waves of frequency 800 Hz. The train starts moving in such a way that the WAVELENGTH of the sound waves that reach a stationary listener, INCREASES. The frequency that the stationary listener hears, could possibly be …

A 850 Hz

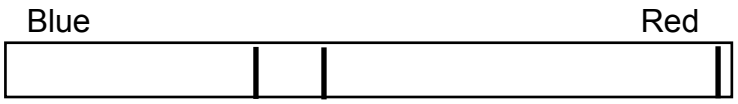
B 800 Hz

C 750 Hz

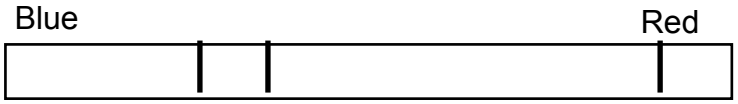
D 1 000 Hz (2)

1.9 Astronomers obtained the following spectral lines of an element:

Spectrum of element in laboratory:



Spectrum of element from distant star:



This observation confirms that the …

A star is moving towards the earth.

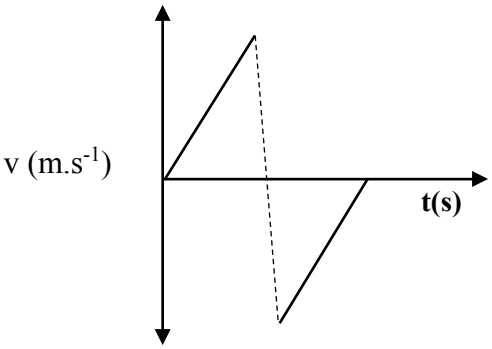
B star is moving away from the earth.

C universe enlarges.

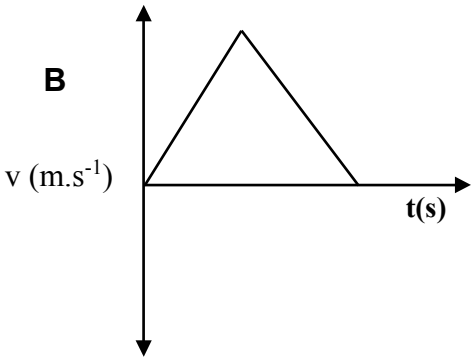
D star is undergoing no relative movement. (2)

1.10 A ball is dropped to the ground from a certain height and bounces back to the same height. Which ONE of the following velocity versus time graphs represents the motion of the ball if downwards is taken as positive?

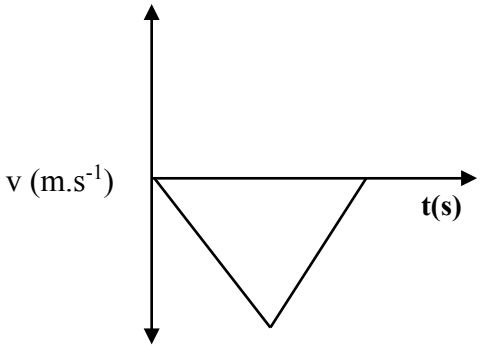
A



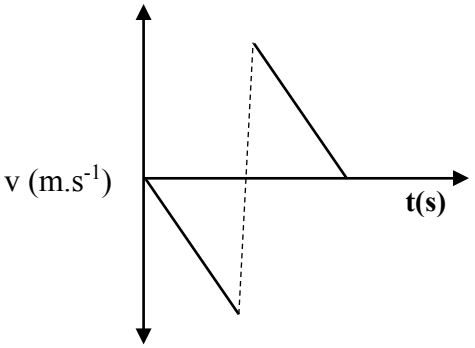
B



C



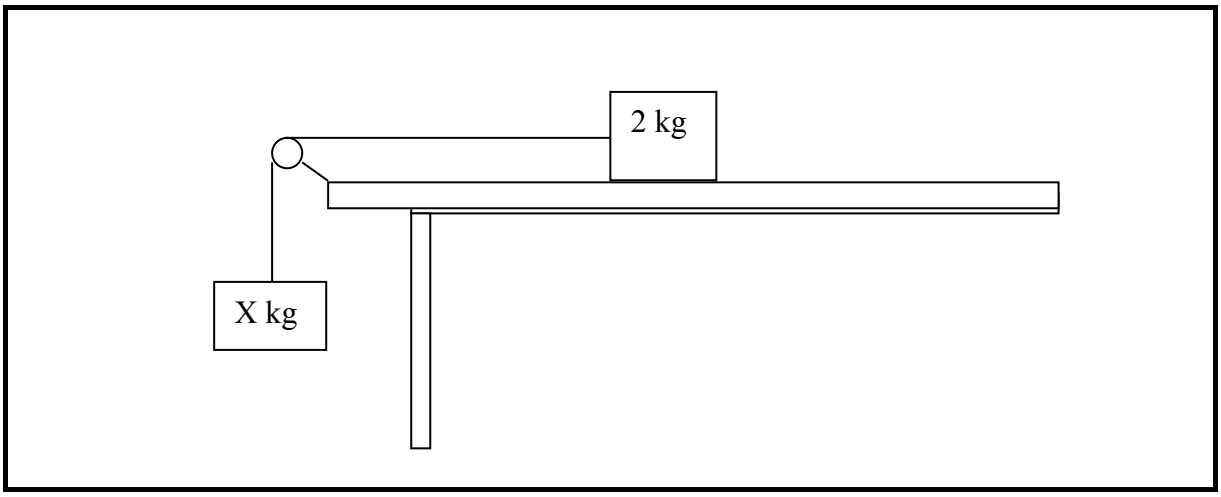
D



(2)
[20]

QUESTION 2 (Start on a NEW page.)

A block of mass 2 kg is at rest on a rough horizontal surface. The block is connected with a light inextensible string that is hanging over a frictionless pulley, to another block of mass **X** kg. The 2 kg block now accelerates at 4 $m \cdot s^{-2}$ to the left.



2.1 Write down Newton's Second Law of Motion in words. (2)

2.2 Draw a free-body diagram of all forces acting on the 2 kg block. (4)

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

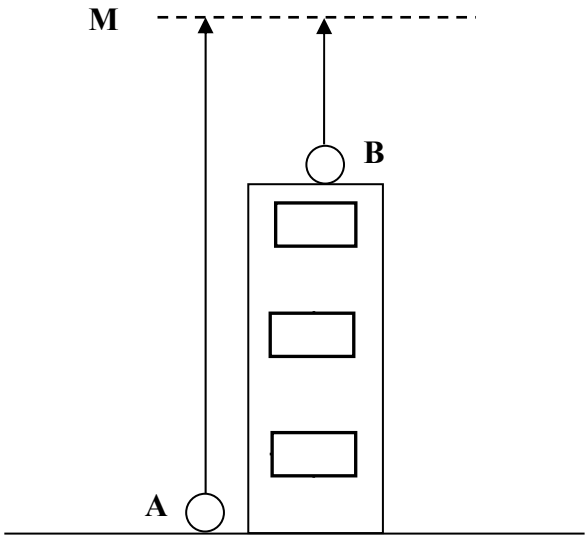
2.3.1 The kinetic frictional force acting on the 2 kg block (3)

2.3.2 **X**, the mass of the hanging block (5)

[14]

QUESTION 3 (Start on a NEW page.)

Ball A is thrown vertically upwards from the ground with a speed of 12 $m.s^{-1}$ and reach height **M**. After 0,72 s, **ball B** is also thrown upwards from the top of a building. Both balls undergo a **free fall** and reach the maximum height at point **M** at the **same time** as shown in the diagram below.



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

3.2 Calculate the:

3.2.1 Time taken by ball **A** to reach the maximum height at **M** (3)

3.2.2 Velocity at which ball **B** is thrown to reach point **M** (4)

3.2.3 Height of the building (6)

3.3 Sketch the velocity-time graph for the motion of ball **A** from the time it was projected until it reaches the maximum height.

Indicate the following on your graph:

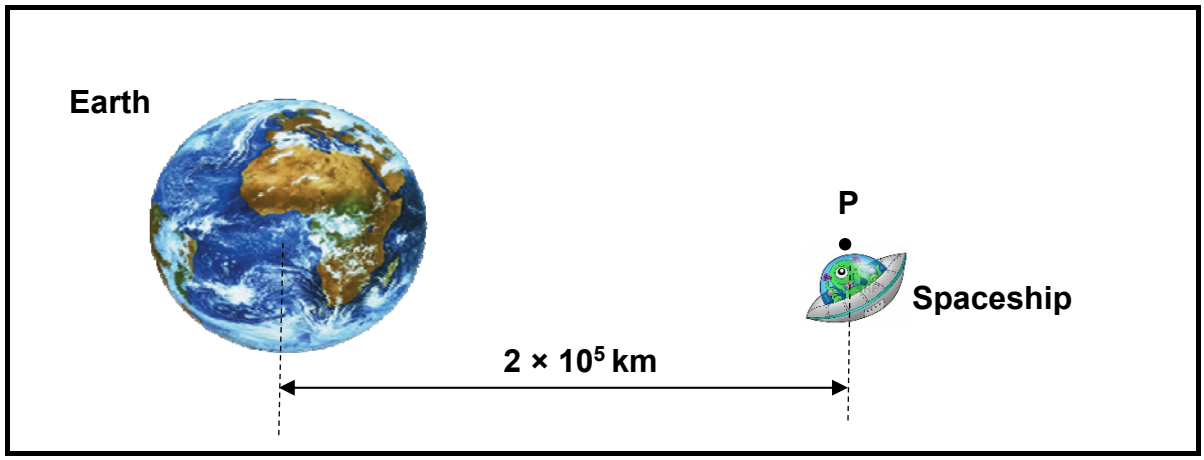
(i) initial velocity and time of ball **A**

(ii) velocity and time of ball **A** at the maximum height, **M** (4)

[19]

QUESTION 4 (Start on a NEW page.)

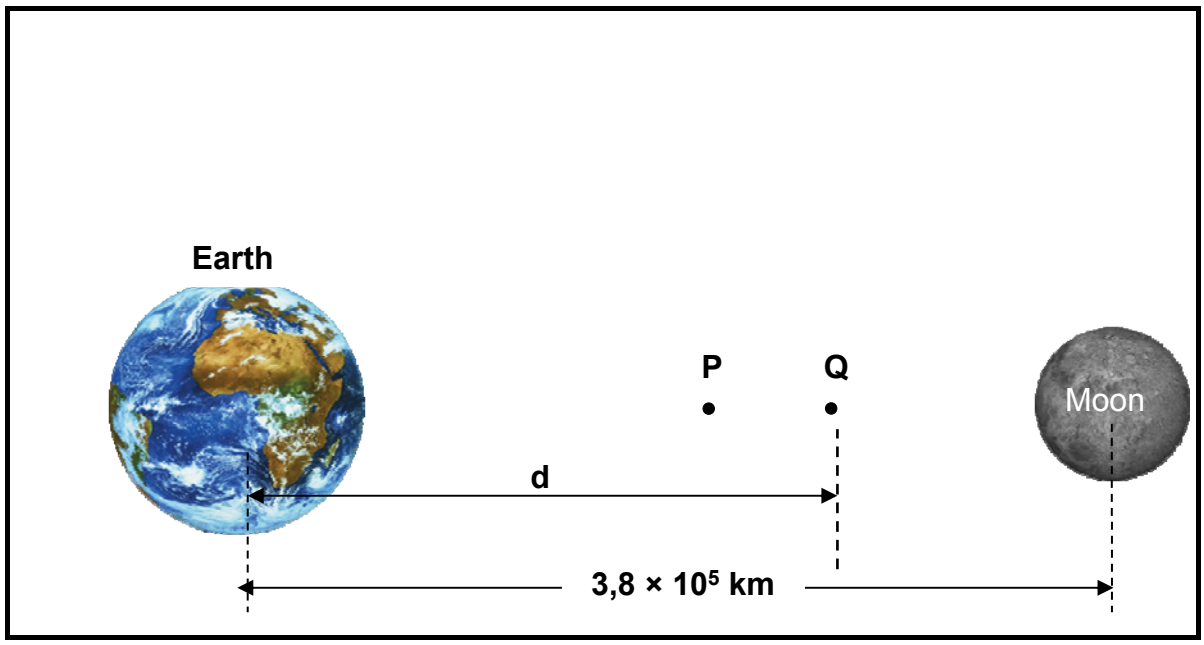
A space ship, mass **m** kg, is at rest at point **P**, 2×10^5 km from the centre of the earth. The gravitational force that the spaceship experiences at point **P** is 34,9 N.



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

4.2 Calculate the mass of the spaceship. (4)

Point **Q** is a point on a straight line between the moon and the earth's centres. Point **Q** is a distance **d** from the centre of the earth. The space ship experiences a ZERO net force when it is at rest at point **Q**. The mass of the moon is 7,35 x 10^{22} kg. The distance between the centre point of the earth and the moon is 3,8 x 10^5 km.

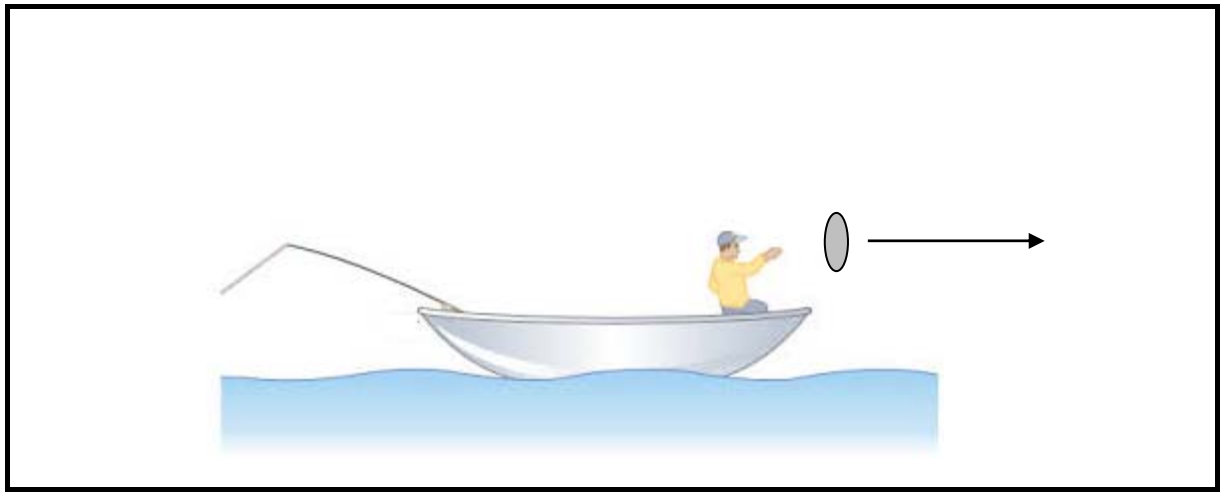


4.3 Calculate the distance between points **P** and **Q** . (5)

[11]

QUESTION 5 (Start on a NEW page.)

A man sitting in a stationary boat in the middle of a lake, wants to reach the shore, 60 m away. The man throws an object of mass 1 kg horizontally at a speed of 10 $m \cdot s^{-1}$ in the direction shown in the diagram below.



The mass of the man is 40 kg and the mass of the boat is 60 kg. The effects of air resistance and friction between the water and the boat can be ignored.

5.1 Write down the principle of conservation of linear momentum in words. (2)

5.2 In which direction will the man and-boat combination move? (1)

5.3 Calculate the momentum of the object after it has been thrown. (3)

The man's throwing action when he throws the object, takes 0,1 s.

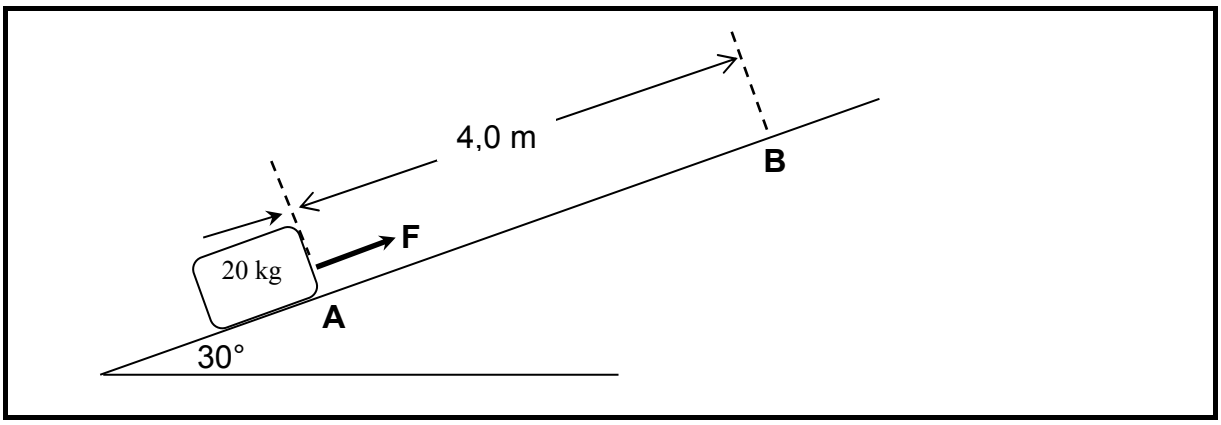
5.4 Calculate the average force that the man exerts on the object. (4)

5.5 The man is expected to reach the shore in less than 15 minutes. Use calculations to find out how long it will take him to reach the shore after throwing the object if the boat is moving at a constant speed. (5)

[15]

QUESTION 6 (Start on a NEW page.)

A constant force **F** is applied to a crate of mass 20 kg to move it upwards along a frictionless inclined plane as shown in the diagram. Its speed at **A** is 12 $m \cdot s^{-1}$ and at **B** are 10,8 $m \cdot s^{-1}$. The distance **AB** is 4,0 m.



6.1 Draw a free-body diagram showing ALL the forces acting on the crate while it is moving up the incline. (3)

6.2 Define the term *conservative force*. (2)

6.3 Write down the NAME of the conservative force that acts on the crate. (1)

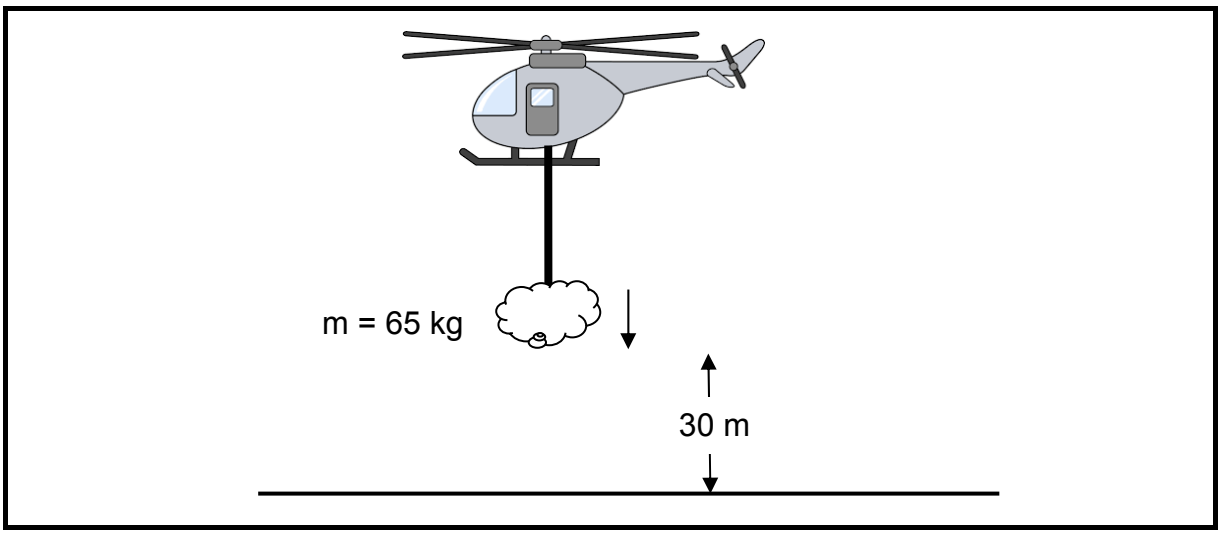
6.4 Calculate the magnitude of the normal force on the crate. (3)

6.5 In which direction does the net force act on the crate as it moves up the incline?
Write only **FROM A TO B** or **FROM B TO A**. (1)

6.6 Use ENERGY PRINCIPLES to calculate the magnitude of the force **F.** (5)
[15]

QUESTION 7 (Start on a NEW page.)

A helicopter hovers above the ground with a bale of wool of mass 65 kg connected to it by a cable as shown in the diagram below. The bale of wool is lowered vertically downwards with a constant acceleration. When the bale is 30 m above the ground, its velocity is 2,2 $m.s^{-1}$ and it **comes to rest** on the ground. Air friction is NOT to be ignored.



7.1 Identify TWO *non-conservative forces* acting on the bale during its downward motion. (2)

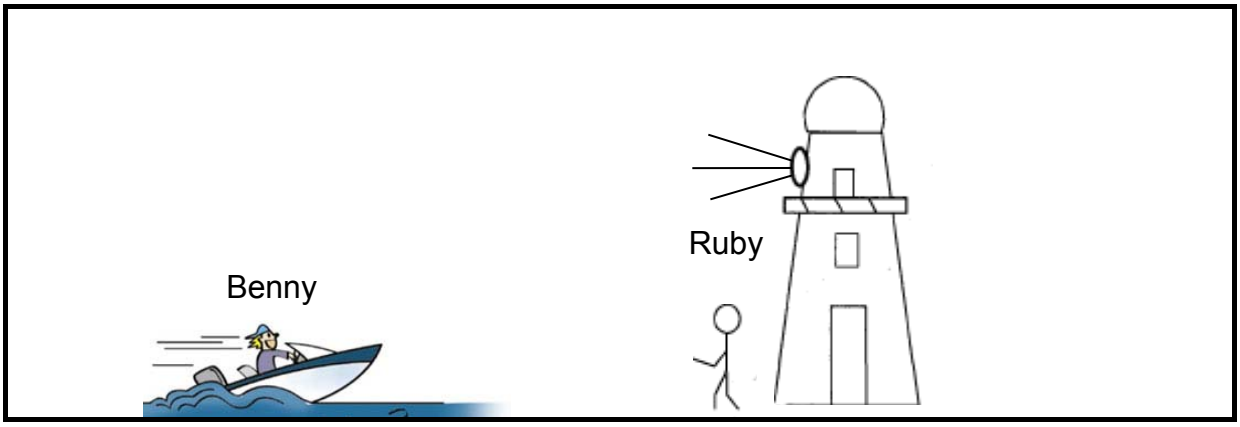
7.2 Draw a free-body diagram showing ALL the forces acting on the bale while it is being lowered to the ground. (3)

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

7.4 Use the work-energy theorem to calculate the acceleration of the bale as it is lowered to the ground. (5)
[12]

QUESTION 8 (Start on a NEW page.)

Benny is driving his speedboat at a constant speed towards a lighthouse. The fog horn from the lighthouse blows with a frequency of 180 Hz. The apparent frequency of sound heard by Benny is 188 Hz. Ruby, his friend, stands in front of the lighthouse, as shown in the diagram below. Use the speed of sound in the air as 340 $m.s^{-1}$.



8.1 State the Doppler effect in words. (2)

8.2 Explain why Ruby perceives the same frequency of 180 Hz. (2)

8.3 How would the wavelength of the sound wave produced by the fog horn change if the frequency of the sound wave is lower than 180 Hz? Write down only INCREASES, DECREASES or STAYS THE SAME. (1)

8.4 Give a reason for your answer in QUESTION 8.3. (2)

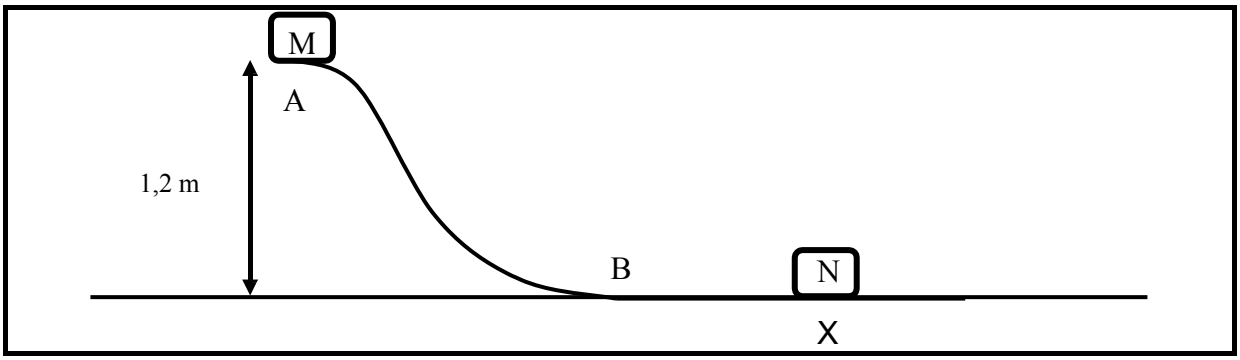
8.5 Calculate the speed of the boat as it approaches the lighthouse. (5)

8.6 Ruby runs in the direction of the boat at a constant speed of 5 $m \cdot s^{-1}$. Show, by calculations, that the frequency Ruby now hears, is lower than 180 Hz. (4)

[16]

QUESTION 9 (Start on a NEW page.)

The diagram below represents a frictionless track. **B** and **X** are points on the horizontal section of the track.



A block **M** of mass 0,40 kg is stationary at point **A** while a second block **N**, with mass 0,30 kg, is stationary at point **X**. Point **A** is 1,20 m higher than the horizontal section of the track. Ignore the effects of air resistance on the blocks. The block at **A** is now released from rest.

9.1 Calculate the speed of the block when it reaches point **B**. (4)

9.2 Block **M** collides with the stationary block **N** at point **X**. The two blocks then move together after the collision.

9.2.1 Calculate the speed of the attached blocks immediately after the collision. (4)

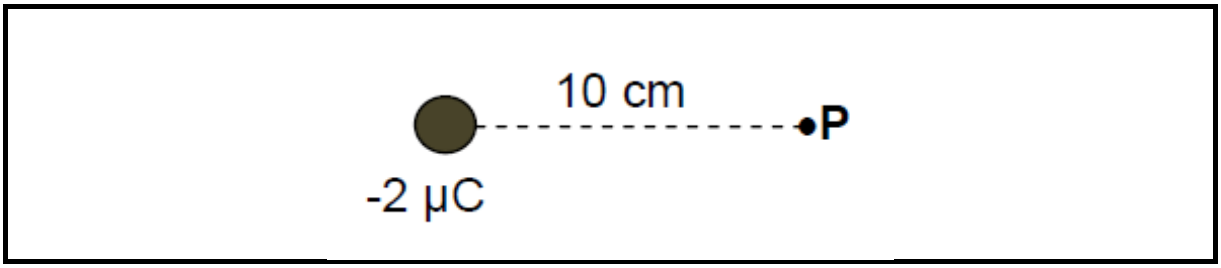
9.2.2 Calculate the amount of energy that was **lost** during the collision. (6)

9.2.3 Is the collision elastic or inelastic? (1)

[15]

QUESTION 10 (Start on a NEW page.)

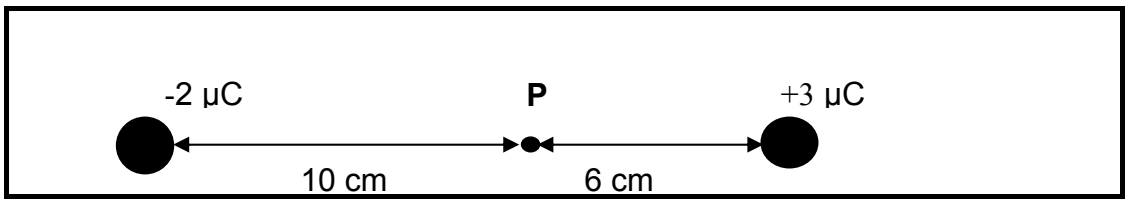
A charge of -2 µC is positioned 10 cm from point **P,** as shown below.



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

10.2 Draw the electric field lines associated with this charge. (2)

10.3 Another charge of magnitude +3 µC is placed 6 cm on the right hand side of point **P** in line with the other charge as shown in the diagram below.



Calculate the:

10.3.1 Force that the -2 µC charge exerts on the +3 µC charge (4)

10.3.2 Net electric field strength experienced at point P as a result of the two charges (5)

[13]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

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

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

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

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

Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

JUNE/*JUNIE* 2018

PHYSICAL SCIENCES P1 MARKING GUIDELINE *FISIESE WETENSKAPPE V1 NASIENRIGLYN*

MARKS/*PUNTE*: 150

This marking guideline consists of 15 pages./
Hierdie nasienriglyn bestaan uit 15 bladsye.

GENERAL GUIDELINES

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 '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 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 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 die kandidaat egter nie 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, $m \cdot s^{-1}$. For marking purposes, $m \cdot s^{-1}$ 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 $m \cdot s^{-1}$ 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 konseptuele 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.

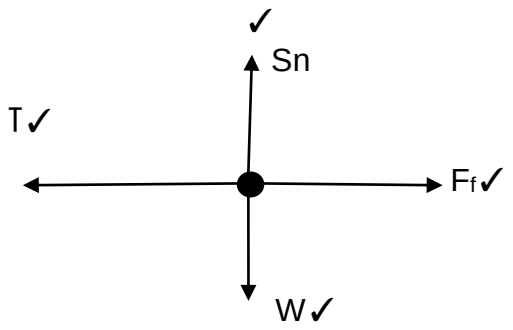
QUESTION/*VRAAG* 1

1.1 B ✓✓ (2)
1.2 A ✓✓ (2)
1.3 C ✓✓ (2)
1.4 A ✓✓ (2)
1.5 B ✓✓ (2)
1.6 B ✓✓ (2)
1.7 A ✓✓ (2)
1.8 C ✓✓ (2)
1.9 A ✓✓ (2)
1.10 A ✓✓ (2)
[20]

QUESTION/*VRAAG 2*

2.1 If the 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.
Indien 'n resulterende/netto krag op 'n voorwerp inwerk, sal die voorwerp versnel in die rigting van die resulterende/netto krag met 'n versnelling wat direk eweredig is aan die resulterende/netto krag ✓en is omgekeerd eweredig aan die massa ✓van die voorwerp. (2)

2.2



(4)

2.3 2.3.1 $f_k = \mu_k N$ } ✓
$f_k = \mu_k mg$ } any one/*enige een*

$f_k = \underline{0,2 \text{ X } 2 \text{ x } 9.8}$ ✓

$f_k = 3.92$ N ✓ (3)

2.3.2 **2 kg block/*2 kg blok***

Fnet = ma

T + (-f) = ma ✓any one/*enige een*

NB: If right is positive/*As regs positief is*
f – T = - ma

T + (- 3,92) = 2 x 4 ✓

T = 8 + 3,92

T = 11,92 N

X kg block/ *X kg blok*

Fnet = ma

w + (-T) = ma (any mass substitution)

mg + (-T) = ma (*enige massa ingestel*)

m x 9,8 ✓ -11,92 = m x 4 ✓

5,8 m = 11,92

m = 2,06 kg ✓

(5)
[14]

QUESTION/*VRAAG 3*

3.1 Free-fall is the motion of an object when the only force acting on it is gravitational force ✓✓
Vryval is die beweging van 'n voorwerp indien die enigste krag wat daarop inwerk, gravitasiekrag is ✓✓ (2)

3.2.1

Option 1 (downwards positive) **OPSIE 1** (*afwaarts positief*)	**Option 2** (upwards positive) **OPSIE 2** (*opwaarts positief*)
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$0 = (12) + (-9.8).\Delta t$ ✓	$0 = (12) + (-9.8).\Delta t$ ✓
$\Delta t = 1.22$ s ✓	$\Delta t = 1.22$ s ✓

(3)

3.2.2

Option 1 (downwards positive) **OPSIE 1** (*afwaarts positief*)	**Option 2** (upwards positive) **OPSIE 2** (*opwaarts positief*)
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$0 = v_i + (9.8)(0,5)$ ✓	$0 = v_i + (-9.8)(0,5)$ ✓
$v_f = -4,90$ m.s^{-1}	$v_f = 4,90$ m.s^{-1} ✓
$v_f = 4,90$ m.s^{-1} ✓	$v_f = 4,90$ m.s^{-1}
upwards/*opwaarts* ✓	upwards /*opwaarts* ✓

(4)

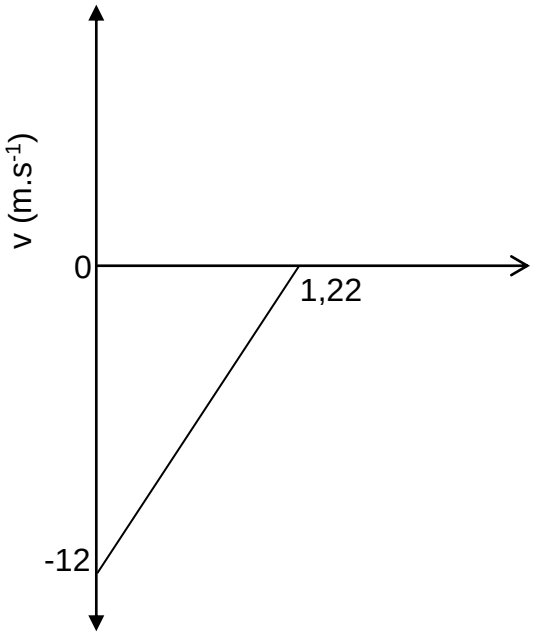
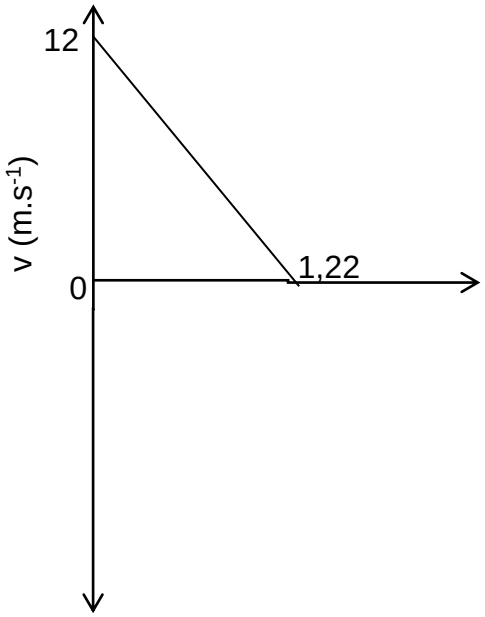
3.2.3

OPTION 1 (upwards positive) **OPSIE 1** (*opwaarts positief*)	**OPTION 2** (downwards positive) **OPSIE 2** (*afwaarts positief*)
Ball A height above the ground: ***Hoogte van Bal A bokant grond:*** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ 0✓ = $(12)^2 + 2(-9,8)\Delta y$ ✓ Δy = 7,35 m	**Ball A height above the ground:** ***Hoogte van Bal A bokant grond:*** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ 0✓ = $(-12)^2 + 2(9,8)\Delta y$ ✓ Δy = 7,35 m
Ball B height above the ground: ***Hoogte van Bal B bokant grond:*** $v_f^2 = v_i^2 + 2a\Delta y$ 0 = $(4.9)^2 + 2(-9,8)\Delta y$ ✓ Δy = 1,225 m	**Ball B height above the ground:** ***Hoogte van Bal B bokant grond:*** $v_f^2 = v_i^2 + 2a\Delta y$ 0 = $(-4.9)^2 + 2(9,8)\Delta y$ ✓ Δy = 1,225 m
Height of the building: ***Hoogte van die gebou:*** Height / *Hoogte* (h) = 7,351-1,225 ✓ ∴ h = 6,125 m ✓	**Height of the building**: ***Hoogte van die gebou:*** Height / *Hoogte*(h) = 7,351-1,225 ✓ ∴ h = 6,125 m ✓

OPTION/*OPSIE* 3	**OPTION/*OPSIE* 4**
Ball A above the ground: ***Bal A bokant die grond:*** $\Delta x = \left(\frac{vf + vi}{2}\right)\Delta t$ ✓ $\Delta x = \left(\frac{0+12}{2}\right)$✓ x 1,22 ✓ Δx_A = 7,32 m	**Ball A above the ground:** ***Bal A bokant die grond:*** $\Delta x = v_i\Delta t + \frac{1}{2}a\,\Delta t^2$ ✓ $\Delta x_A = 12x1,22$ ✓ $+\frac{1}{2}.-9,8$ x $(1,22)^2$ ✓ Δx_A = 7,35 m
Ball B above the ground ***Bal B bokant die grond:*** $\Delta x_B = \left(\frac{0+4,9}{2}\right)0,5$ ✓ Δx_B = 1,225 m	**Ball B above the ground:** ***Bal B bokant die grond:*** $\Delta x_B = 4,9 \times 0,5 + \frac{1}{2}.-9,8$ x $(0,5)^2$ ✓ Δx_B = 1,225 m
Height of the building: ***Hoogte van die gebou:*** Height / *Hoogte* (h) = 7,32-1,225 ✓ ∴ h = 6,095 m ✓	**Height of the building**: ***Hoogte van die gebou:*** Height / *Hoogte* (h) = 7,35-1,225 ✓ ∴ h = 6,125 m ✓

(6)

3.3

OPTION 1/OPSIE 1 **Downwards is positive/*Afwaarts is positief***	**OPTION 2/OPSIE 2** **Upwards is positive/*Opwaarts is positief***
	

Criteria for graph / *Kriteria vir grafiek*	**Marks/*Punte***
Initial velocity/*Beginsnelheid*	✓
Shape (not beyond the time axis) *Vorm (nie verby tyd-as nie)*	✓
Final velocity and time at M, the maximum height *Eindsnelheid en tyd by M, die maksimum hoogte*	✓✓

(4)
[19]

QUESTION/*VRAAG* 4

4.1 Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓and inversely proportional to the square of the distance between their centres. ✓
Elke voorwerp in die heelal trek elke ander voorwerp 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)

4.2 $F = \frac{Gm_1m_2}{r^2}$

$34,9 = \frac{(6,67\times10^{-11})(5,98\times10^{24})(\mathbf{m})}{(2\times10^{8})^2}$ ✓ ✓

m = 3500 Kg ✓ (4)

4.3 $F_{net} = ma$

$F_{earth} = F_{moon}$

$\frac{Gm_sm_E}{r_E^2} = \frac{Gm_sm_m}{r_m^2}$

$F = \frac{Gm_1m_2}{r^2}$

Any one/ *Enige een* ✓

$\frac{5,98\times10^{24}}{d^2}$ ✓ $= \frac{7,35\times10^{22}}{(3,8\times10^{8}-d)^2}$ ✓

$\frac{(3,8\times10^{8}-d)^2}{d^2} = \frac{7,35\times10^{22}}{5,98\times10^{24}}$

$\frac{3,8\times10^{8}-d}{d} = 0,11$

$3,8\times10^{8} - d = 0,11\,d$

$1,11\,d = 3,8\times10^{8}$

$d = 3,42\times10^{8}$ ✓

∴Distance$_{(PQ)}$ /*Afstand*$_{(PQ)}$ $= 3,42\times10^{8} - 2\times10^{8}$

$= 1,42\times10^{8}$ m ✓ (5)

[11]

QUESTION/*VRAAG 5*

5.1 The total linear momentum in a closed system remains constant (is conserved) ✓✓
Die totale lineêre momentum in 'n sisteem bly konstant (bly behoue) ✓✓

OR/*OF*

The total momentum before a collision is equal to the total momentum after the collision in a closed system
Die totale momentum voor 'n botsing is gelyk aan die totale momentum na 'n botsing ✓✓ (2)

5.2 Left/ Backwards/ West /*Links of Terug of Wes* ✓ (1)

5.3 $p = mv$ ✓
$p = 1 \times 10$ ✓
$p = \underline{10 \text{ kg. m·s}^{-1} \text{ right}}$ / *regs* ✓ (3)

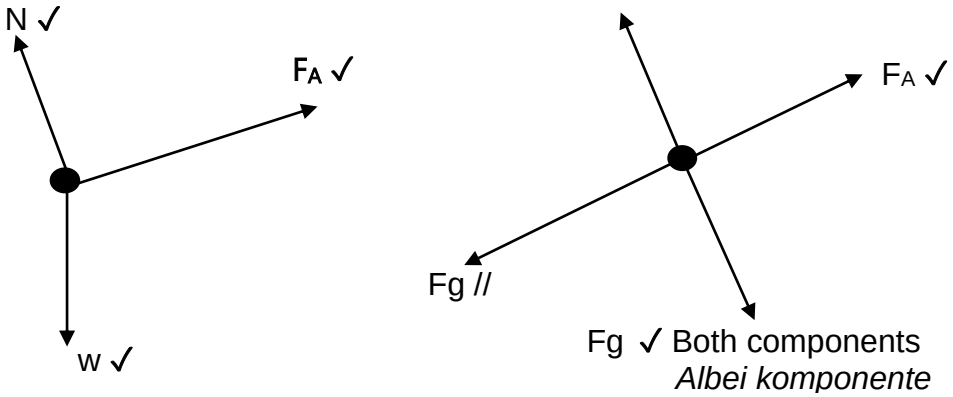
5.4 $F_{net}.\Delta t = \Delta p$ ✓
$F_{net}.0,1 = 1(10 - 0)$ ✓
$F_{net} = 1000$ N right /*regs* ✓✓ (4)

5.5 Take motion to the right as positive/
Neem die beweging na regs as positief.

$\Sigma p_i = \Sigma p_f$
$(m_1 + m_2)\, v_i = m_1 v_{f1} + m_2 v_{f2}$ (Any one/*Enige een*) ✓
$(1 + 100)(0) = (1)(10) + (100)\, v_{f2}$ ✓
$v_{f2} = -0,1 \text{ m·s}^{-1}$
Speed $= 0,1 \text{ m·s}^{-1}$
$\Delta x = v\,\Delta t$ ✓
$60 = (0,1)\,\Delta t$ ✓
$\Delta t = 600$ s
Yes, it takes 10 min/*Ja, dit neem 10 min* ✓ (5)
[15]

QUESTION/*VRAAG 6*

6.1



(3)

6.2 Force that is independent on the path taken. ✓✓
Krag wat onafhanklik is van die pad wat gevolg is (2)

6.4 Gravitational force / weight / *Gravitasiekrag of gewig* ✓ (1)

6.4 $F_{net} = ma = 0$
$F_N + (- mg \cos 30) = 0$
$F_N = mg \cos 30$ } any 1/ *enige 1* ✓

$F_N - 20 \times 9.8 \times \cos 30^0 = 0$ ✓
$F_N = 169.74$ N ✓ (3)

6.5 From B TO A / *Van B na A* ✓ (1)

6.6 **Option 1/*Opsie 1***
$W_{net} = \Delta E_K$
$W_{FA} + W_{g//} = \frac{1}{2} m(v_f^2 - v_i^2)$ } ✓ any one /*enige 1*

$F_A . \Delta x \cdot \cos\theta + \underline{mg \sin 30} . \Delta x . \cos\theta = \frac{1}{2} \times 20(10.8^2 - 12^2)$ ✓

$\underline{F_A \times 4 \times 1}$ ✓ + $\underline{20 \times 9.8 \sin 30 \times 4 \times -1}$ ✓ = - 273.6

$4 F_A - 392 = - 273.6$
$F_A = 29.6$ N ✓ (5)

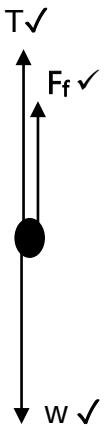
Option 2/ *Opsie 2*
$W_{nc} = \Delta E_p + \Delta E_K$ ✓
$W_f = mghf - mghi + \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$
$F \times 4.\cos 0^0$ ✓ $= 20 \times 9.8 \times 4 \sin 30^0$ ✓ $- 0 + \frac{1}{2} . 20 . (10.8^2 - 12^2)$ ✓
$F = 29,6$ N ✓

[15]

QUESTION/*VRAAG 7*

7.1 Air Friction ✓and Tension ✓/*Lugwrywing* ✓*en spanning* ✓ (2)

7.2



(3)

7.3 The work done by the (net) force is equal to the change in the kinetic energy of an object ✓✓
Die arbeid verrig deur die (netto) krag is gelyk aan die verandering in die kinetiese energie van die voorwerp ✓✓
OR

Net work done by the force is equal to the change in kinetic energy of the object. ✓✓
Netto werk verrig deur die krag is gelyk aan die verandering in kinetiese energie van die voorwerp. (2)

7.4 Wnet = Δ Ek ✓
Fnet. Δx. cosθ = ½mvf^2 - ½mvi^2
Fnet (30) cos180^0 ✓= ½ (65) (0)^2 - ½ (65) (2,2)^2 ✓
Fnet x (- 30) = -15,73 N
ma = + 5,243333333
(65) a = 5,243333333 ✓
a = 0,08 m·s^{-2} ✓ (5)
[12]

QUESTION/*VRAAG* 8

8.1 The Doppler effect is the change in the observed 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 die waargenome frekwensie (of toonhoogte) van die klank wat 'n luisteraar waarneem want die klankbron en die luisteraar het verskillende relatiewe snelheid tot die medium van die klank. ✓✓
OR/ *OF*

The apparent change in the (observed) frequency when there is relative motion between the sound source and the observer. ✓✓
Die skynbare verandering in die waargenome frekwensie indien daar relatiewe beweging is tussen die klankbron en die waarnemer. ✓✓ (2)

8.2 The relative velocity between Ruby and the source of the sound is zero. ✓✓
Die relatiewe snelheid tussen Ruby en die bron van die klank is zero. ✓✓
The is no relative velocity between Ruby and the source of sound. ✓✓
Daar is geen relatiewe snelheid tussen Ruby en die bron van die klank nie. ✓✓ (2)

8.3 INCREASES / *NEEM TOE* ✓ (1)

8.4 Wavelength of the sound source received by listener per second is inversely proportional to the frequency produced and hence the longer wavelength will produce lower frequency. ✓✓
Die golflengte van die klankbron wat per sekonde by die luisteraar aankom is omgekeerd eweredig aan die frekwensie wat geproduseer word en dus sal die langer golflengte 'n laer frekwensie voortbring. ✓✓ (2)

8.5 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$

$f_L = \frac{v + v_L}{v} f_s$

(any one / *enige een*) ✓

188 ✓ = $\frac{340+v_L}{340}$ ✓ x 180 ✓

v_L = 15,11 m·s^{-1} ✓ (5)

8.6 $f_L = \frac{v \pm v_L}{v \pm v_s} f_S$

$f_L = \frac{v - v_L}{v} f_S$

✓ (any one / *enige een*)

$f_L = \frac{340-5}{340}$ ✓ x 180 ✓

f_L = 177,35 m·s^{-1} ✓ (4)

[16]

QUESTION/*VRAAG* 9

9.1 **Option 1 / *Opsie 1***

Emech at A = Emech at B ✓
(mgh + $\frac{1}{2}$mv^2) at A = (mgh + $\frac{1}{2}$mv^2) at B (any 1 / *enige 1*)

(0,4 x 9,8 x 1,2) + $\frac{1}{2}$ x 0,4 x 0^2 ✓= (0,4x 9,8 x 0) + $\frac{1}{2}$ x0,4 x v^2 ✓

v = 4,85 m.s^{-1} ✓

Option 2 / *Opsie 2*

Wnc = $\Delta E_p + \Delta E_K$ ✓
0 = mghf – mghi + $\frac{1}{2}$ mv^2_f – $\frac{1}{2}$mv^2_i (any one/*enige 1*)
0 = 0,4 x 9.8 x 0 - 0,4 x 9.8 x 1,2 ✓+ $\frac{1}{2}$ .0,4 v$_f^2$ – 0 ✓

V_f = 4,85 m.s^{-1} ✓ (4)

9.2.1 $\sum p_i = \sum p_f$

$mv_{i\,M} + mv_{i\,N} = (m_c + m_m)v_f$ ✓ (any one/*enige 1*)

$\underline{0,4 \times 4,85 + 0,3 \times 0}$ ✓$= \underline{(0,4 + 0,3)\,v}$ ✓

$1,94 + 0 = 0,7\,v$

$v = 2,77$ m.s^{-1} (right/*regs*) ✓ (4)

9.2.2 $\sum Ek_i = (\frac{1}{2}\,mv^2)_M + (\frac{1}{2}\,mv^2)_N$ ✓

$= (\frac{1}{2} \times 0,4 \times 4,85^2)$ ✓ $+ (\frac{1}{2} \times 0,3 \times 0^2)$ ✓

$= 4,7045$ J

$\sum K_f = (\frac{1}{2}\,mv^2)_M + (\frac{1}{2}\,mv^2)_N$

$= (\frac{1}{2} \times 0,4 \times 2,77^2) + (\frac{1}{2} \times 0,3 \times 2,77^2)$ ✓

$= 1,53458 + 1,150935$

$= 2,69$ J

Energy lost / *Verlore energie* $= \sum Ek_f - \sum Ek_i$ ✓

$= 2,01$ J ✓ (6)

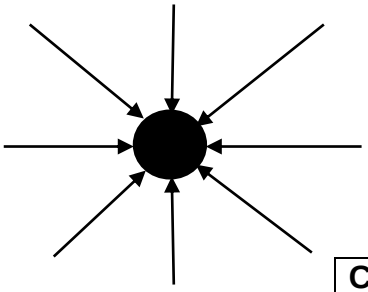
9.2.3 Inelastic / *Onelasties* ✓ (1)

[15]

QUESTION/*VRAAG* 10

10.1 The electric field at a point is a force per unit positive charge ✓✓
Die elektriese veld by 'n punt is die krag ervaar per eenheids positiewe lading ✓✓ (2)

10.2



Criteria for marking/*Kriteria vir nasien*	**Marks/*Punte***
Direction of arrows *Rigting van pyltjies*	✓
Shape of field lines *Vorm van die veldlyne*	✓

(2)

10.3.1 $F = \frac{KQ_1Q_2}{r^2}$ ✓

$F = \frac{(9x10^9)(2x10^{-6})(3x10^{-6})}{(0.16)^2}$ ✓ ✓

F = 2,11x10^6 N left /*links* ✓ (4)

10.3.2 $E = \frac{kQ}{r^2}$ ✓

$E_M = \frac{9x10^9 \text{ X } 2x\ 10^{-6}}{(0.1)^2}$ ✓

= 1,8 x10^6 N·C^{-1} left/*links*

$E_N = \frac{(9x10^9)(3x10^{-6})}{(0.06)^2}$

✓either of the two denominator conversions
✓*enige van die 2 deler omskakelings*

= 7,50 x10^6 N·C^{-1} left/*links*

$E_{net} = E_M + E_N$

E_{net} = 1,8 x10^6 +7,50 x10^6 ✓

= 9,3 x10^6 N·C^{-1} left/*links* ✓ (5)

[13]

TOTAL/*TOTAAL*: 150