Province of the
EASTERN CAPE
EDUCATION

# NATIONAL SENIOR CERTIFICATE

## GRADE 12

## JUNE 2024

# PHYSICAL SCIENCES P1

**MARKS:** 150

**TIME:** 3 hours

This question paper consists of 17 pages, including 3 datasheets.

**INSTRUCTIONS AND INFORMATION**

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

## QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 According to Newton's Second Law of Motion, the net force acting on an object is:

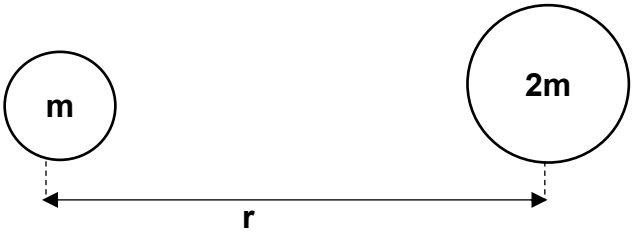
A Equal to the acceleration of the object.

B Inversely proportional to the acceleration of the object.

C Indirectly proportional to the acceleration of the object.

D Directly proportional to the acceleration of the object. (2)

1.2 Two isolated bodies, **A** and **B**, with masses **m** and **2m** respectively, are placed a distance **r** from each other.




Consider the following statements regarding the gravitational force exerted by bodies **A** and **B** on each other.

(i) The force exerted by **B** on body **A** is half that exerted by **A** on body **B**.
(ii) The force exerted on the bodies is independent of the masses of the bodies.
(iii) The force exerted on body **A** by **B** is equal but opposite to that exerted on body **B** by **A**.
(iv) The forces will always be attractive.

Which of the statements above is/are TRUE?

A (i), (ii) and (iv) only

B (ii), (iii) and (iv) only

C (iii) and (iv) only

D (iv) only (2)

1.3 Three identical spheres, **P, Q** and **R**, with masses $M_P = m$, $M_Q = 2m$ and $M_R = 3m$ respectively, are dropped from the same height above the ground. Ignore the effect of air friction.

How will the acceleration of the objects compare as they fall to the ground?

A $a_R > a_Q > a_P$

B $a_P > a_Q > a_R$

C $a_P = a_Q = a_R$

D $a_R < a_Q < a_P$ (2)

1.4 The net work done to stop a moving object is equal to the …

A inertia of the object.

B change in kinetic energy of the object.

C change in momentum of the object.

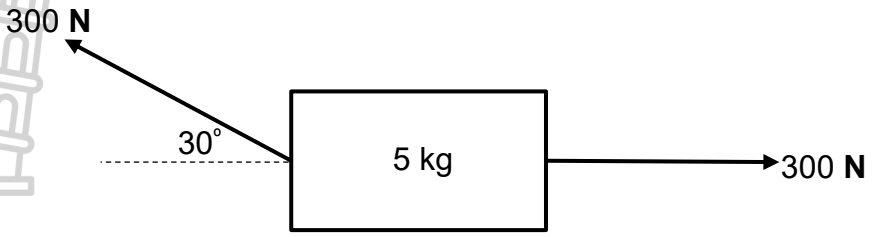
D change in impulse of the object. (2)

1.5 Two objects experience an ELASTIC collision in an isolated 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 Two forces, each of magnitude 300 **N**, are simultaneously applied to a crate at rest on a horizontal surface as shown in the diagram below.
Ignore the effects of friction.




Work will be done by the net force on the crate because the crate will …

A be lifted off the surface.

B accelerate to the left.

C accelerate to the right.

D remain at rest. (2)

1.7 A boy, mass 2 **m** and a girl mass **m**, on roller skates are holding hands and facing each other. They then push off against each other. The girl experiences force **F** and an acceleration **a**, to the left.

Which ONE of the following best describes the magnitudes of the force and acceleration experienced by the boy? Ignore the effects of friction.

| | **ACCELERATION ($m.s^{-2}$)** | **FORCE (N)** |
|---|---|---|
| A | 2**a** | ½ **F** |
| B | 2**a** | **F** |
| C | ½ **a** | **F** |
| D | ½ **a** | 2**F** |

(2)

1.8 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 ...

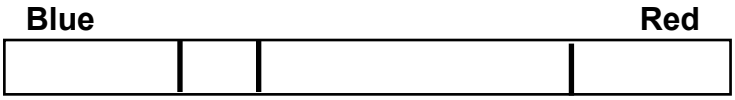
A wavelength between the source and the observer decreases.

B wavelength between the source and the observer increases.

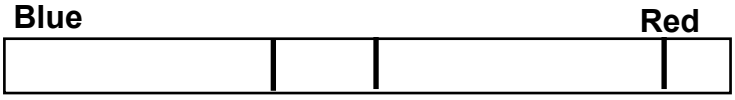
C wavelength between the source and the observer remains unchanged.

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

1.9 Astronomers obtained the following spectral lines from an element from the laboratory and a distant star.




**Spectrum of element in laboratory**



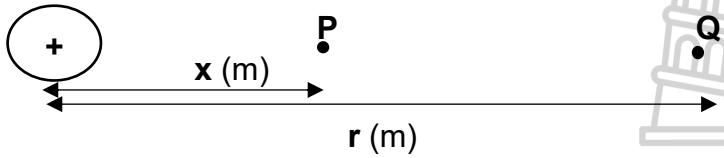

**Spectrum of element from a distant star**

The observation confirms:

| | MOVEMENT OF THE STAR | SPECTRAL LINES |
|---|---|---|
| A | Away from earth | Red shifted |
| B | Towards earth | Red shifted |
| C | Away from earth | Blue shifted |
| D | Towards earth | Blue shifted |

(2)

1.10 In the diagram below **P** and **Q** are points from a charged sphere such that the electric fields at point **Q** is **E** and at point **P** is 9 **E**. Determine the distance **x** in terms of **r**.




A ⅓ **r**

B ½ **r**

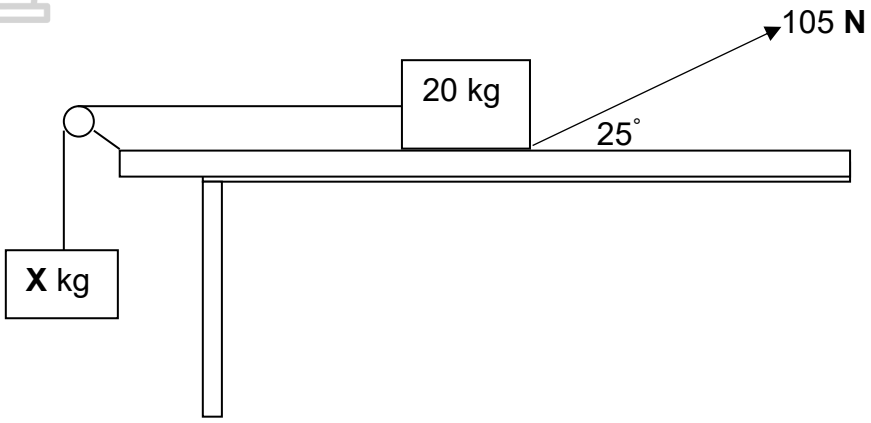
C ⅙ **r**

D ⅔ **r** (2)

**[20]**

**QUESTION 2 (Start on a new page.)**

A block of mass 20 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. A force of 105 N is applied to the 20 kg block at an angle of 25° to the horizontal to accelerate the system at 2 $\mathbf{m \cdot s^{-2}}$ to the right as shown in the diagram below.




2.1 Define the term *kinetic frictional force* in words. (2)

2.2 Draw a free-body diagram of all the forces acting on the 20 kg block. (5)

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

Calculate the:

2.3.1 Kinetic frictional force acting on the 20 kg block (4)

2.3.2 Tension in the string that connects the two blocks (4)

2.3.3 Mass **X**, of the hanging block (2)

**[17]**

**QUESTION 3 (Start on a new page.)**

A spaceship with a mass of 1 500 kg is orbiting the earth at a distance, **$2 \times 10^5$ km** from the centre of the earth as shown in the diagram below.


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

3.2 Calculate the force that the earth exerts on the spaceship. (4)

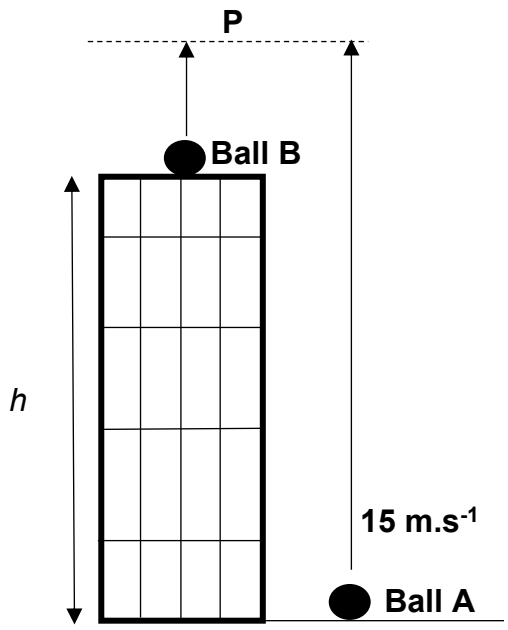
3.3 How does the magnitude of the force that the spaceship exerts on Earth compare to the answer calculated in QUESTION 3.2? State a relevant law to support your answer. (2)

3.4 The spaceship now orbits closer to the Earth at a new distance of $1 \times 10^8$ m from the centre of the earth. Calculate the acceleration of the spaceship at this position. (4)

**[12]**

**QUESTION 4 (Start on a new page.)**

Ball **A** is thrown vertically upwards from the bottom (foot) of a building which is *h* metres high with a speed of **15 m.s$^{-1}$**. After 0,5 s, ball **B** is also thrown vertically upwards from the top of the building. Both balls reach a maximum height at point **P** at the same time as shown in the diagram below. Ignore the effects of air friction.




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

4.2 Calculate:

4.2.1 The time taken for ball **A** to return to the ground (3)

4.2.2 The speed at which ball **B** is thrown upwards (4)

4.2.3 The height of the building *h* (5)

4.2.4 How does the velocity of ball **A** compare to that of ball **B** at the instant when the two balls hit the ground? Give a reason for your answer. (2)

4.3 On the same set of axes, sketch the velocity-time graph for the motion of the balls **A** and **B** from the moment they are thrown vertically upwards until they reach the ground.

Indicate the following in the graph:

- Initial velocity of both balls, **A** and **B**
- The time when the two balls, **A** and **B** are at the maximum height
- The time when the two balls, **A** and **B** reach the ground (5)

**[21]**

**QUESTION 5 (Start on a new page.)**

A truck of mass 1 500 kg travelling at a constant speed of 20 $m.s^{-1}$ to the west along a straight horizontal road collides with a stationary car of mass 900 kg and the two vehicles moved together after the collision. The collision lasted for 0,2 s. Ignore the effect of friction.


5.1 Explain what is meant by the term *isolated system.* (2)

5.2 State the principle of conservation of linear momentum in words. (2)

5.3 Calculate the:

5.3.1 Speed of the vehicles after collision (4)

5.3.2 Net force exerted by the truck on the car (4)

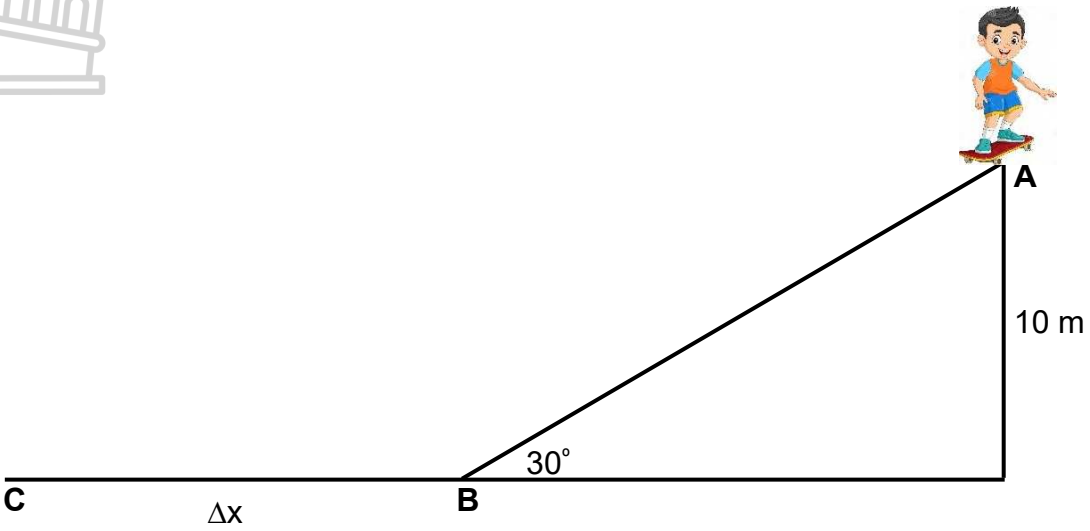
5.4 Is the collision ELASTIC or INELASTIC? Use relevant calculations to explain your answer. (5)

5.5 Delicate equipment is usually packaged using bubble wrap for safety of the equipment. Explain how this process keeps the equipment safe. (3)

**[20]**

**QUESTION 6 (Start on a new page.)**

The diagram below shows a boy skateboarding on a ramp which is inclined at 30° to the horizontal. A constant frictional force of 50 **N** acts on the skateboard as it moves from point **A** to point **B**. Consider the boy and the skateboard as a single unit of mass 60 kg. Ignore the effects of air friction.




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

6.2 Use energy principle to calculate the speed of the boy-skateboard unit at point **B**. (6)

6.3 Point **C** is $\Delta x$ meters to the left of point **B**. The boy-skateboard unit comes to rest at point **C**. The coefficient of kinetic frictional force ($\mu_k$) for the surface **BC** is 0,15.

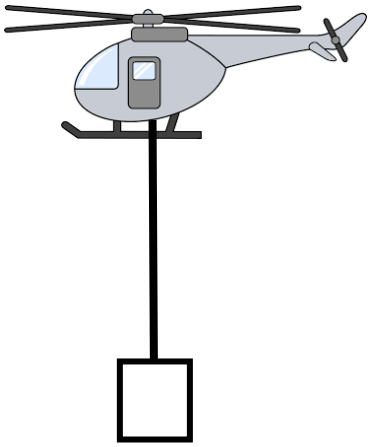
6.3.1 State the work-energy theorem in words. (2)

6.3.2 Use the work-energy theorem to calculate the distance $\Delta x$ that the boy-skateboard unit moved before coming to rest at point **C**. (5)

**[16]**

**QUESTION 7 (Start on a new page.)**

A helicopter hovers at a height of 30 m above the ground. It lowers a package of mass 150 kg vertically downwards at a constant velocity onto the ground as shown in the diagram below. The tension in the cable is 950 N. Air friction is NOT to be ignored.



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

7.2 Identify TWO non-conservative forces acting on the package during its downward motion. (2)

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

7.4 Use ENERGY PRINCIPLES to calculate the magnitude of the air friction acting on the package as it is lowered to the ground. (5)

**[12]**

**QUESTION 8 (Start on a new page.)**

An observer walks at a constant velocity towards a stationary sound source that emits sound at a frequency of 2 450 Hz. The frequency detected by the observer as she approaches the sound source is 2 500 Hz.

8.1 State the Doppler effect in words. (2)

8.2 Explain in terms of wave motion why the detected frequency is higher than the emitted frequency. (3)

8.3 Calculate the speed of the observer as it approaches the sound source. Take the speed of sound in air as 340 $m.s^{-1}$. (5)

8.4 How would the wavelength of the sound wave emitted by the source change in the following scenarios?

Write down only INCREASE, DECREASE or STAYS THE SAME.

When the observer:

8.4.1 Stands next to the sound source (1)

8.4.2 Moves away from the sound source (1)

8.5 The observer decides to run towards the direction of the sound source at a higher constant speed than the speed calculated in QUESTION 8.3. How will this affect the following?

Write down only INCREASES, DECREASES or STAYS THE SAME.

8.5.1 The detected frequency (1)

8.5.2 The speed of sound (1)

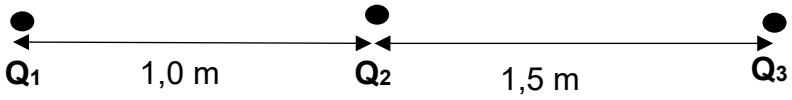
8.5.2 The emitted frequency from the sound source (1)

8.6 Give TWO applications of the Doppler effect in the medical field. (2)
**[17]**

## QUESTION 9

In the diagram below, $Q_1$, $Q_2$ and $Q_3$ are three stationary point charges placed along a straight line. The distance between $Q_1$ and $Q_2$ is 1,0 m and the distance between $Q_2$ and $Q_3$ is 1,5 m, as shown in the diagram below.

**DIAGRAM 1**



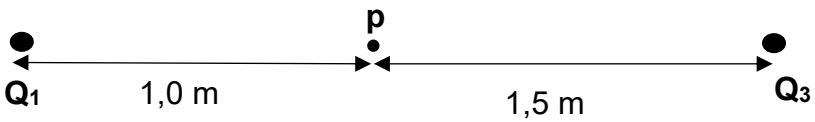

9.1 State Coulomb's law in words. (2)

9.2 The magnitude of charges $Q_1$ and $Q_2$ are unknown. The charge on $Q_1$ is positive. The charge on $Q_3$ is $+2 \times 10^{-6}$ C and it experiences a net electrostatic force to the left.

What is the sign of the charge on $Q_2$? Write down only POSITIVE or NEGATIVE. (2)

9.3 When charge $Q_2$ is removed, the magnitude of the electrostatic force experienced by charge $Q_3$ due to $Q_1$ becomes 0,012 N.

**DIAGRAM 2**




9.3.1 Calculate the magnitude of the charge now on $Q_1$. (4)

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

9.3.3 Calculate the magnitude of the net electric field at point **P** as shown in **DIAGRAM 2** above. (5)

**[15]**

**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<br>*Swaartekragversnelling* | g | 9,8 m•s$^{-2}$ |
| Universal gravitational constant<br>*Universelegravitasiekonstant* | G | 6,67 x 10$^{-11}$ N•m$^2$•kg$^{-2}$ |
| Speed of light in a vacuum<br>*Spoed van lig in 'n vakuum* | c | 3,0 x 10$^8$ m•s$^{-1}$ |
| Planck's constant<br>*Planck se konstante* | h | 6,63 x 10$^{-34}$ J•s |
| Coulomb's constant<br>*Coulomb se konstante* | k | 9,0 x 10$^9$ N•m$^2$•C$^{-2}$ |
| Charge on electron<br>*Lading op elektron* | e | -1,6 x 10$^{-19}$ C |
| Electron mass<br>*Elektronmassa* | $m_e$ | 9,11 x 10$^{-31}$ kg |
| Mass of earth<br>*Massa op aarde* | M | 5,98 x 10$^{24}$ kg |
| Radius of earth<br>*Radius van aarde* | $R_E$ | 6,38 x 10$^6$ m |

## TABLE 2: FORMULAE/*TABEL 2: FORMULES*

### MOTION/*BEWEGING*

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

### FORCE/*KRAG*

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

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

| | |
|---|---|
| $W = F\Delta x\cos\theta$ | $U = mgh$ *or/of* $E_P = mgh$ |
| $K = \frac{1}{2}mv^2$ *or/of* $E_k = \frac{1}{2}mv^2$ | $W_{net} = \Delta K$ *or/of* $W_{net} = \Delta E_k$<br>$\Delta K = K_f - K_i$ *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*<br>$E = hf$ 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*

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

## ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

| | |
|---|---|
| $R = \frac{V}{I}$ | emf ($\varepsilon$) = I(R + r)<br>emk ($\varepsilon$) = I(R + r) |
| $R_s = R_1 + R_2 + \ldots$<br>$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ | $q = I\,\Delta t$ |
| $W = Vq$<br>$W = VI\Delta t$<br>$W = I^2R\Delta t$<br>$W = \frac{V^2\Delta t}{R}$ | $P = \frac{W}{\Delta t}$<br>$P = VI$<br>$P = I^2R$<br>$P = \frac{V^2}{R}$ |

## ALTERNATING CURRENT/*WISSELSTROOM*

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

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**Website:** www.ecdoe.gov.za

| | | | |
|---|---|---|---|
| Ref. no. | 13/P | Tel.: | (040) 608 7031/060 523 8658 |
| Enquire: | Mrs P. Japhta | Fax: | 040 608 7295 |

# ERRATUM

**TO:** **CHIEF EDUCATION SPECIALISTS**
**DISTRICT CURRICULUM COORDINATORS**
**DISTRICT ASSESSMENT OFFICIALS (DAOs**
**DISTRICT SUBJECT ADVISORS (DSAs)**
**PROVINCIAL SUBJECT COORDINATORS**
**CIRCUIT MANAGERS**
**DEPUTY CHIEF EDUCATION SPECIALISTS**
**SENIOR EDUCATION SPECIALISTS**
**PRINCIPALS OF SCHOOLS IN THE FET BAND**

**SUBJECT:** **ERRATUM – PHYSICAL SCIENCES P1 GRADE 12 JUNE COMMON 2024**

**DATE:** **07 JUNE 2024**

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The Physical Sciences P1 Grade 12 June Common Examination was written on Friday, 31 May 2024. We were made aware of certain amendments and omissions that were discovered during the marking process and memorandum discussion on the provided marking guideline.

In order to address this and to ensure that learners are not disadvantaged, the following standardised approach to marking must be adopted across the Province. The following guidelines regarding marking was prepared in conjunction with the examiner and moderator.

## QUESTION 1

1.6. C ✓✓

## QUESTION 2

2.1. The force that opposes the motion of a moving object relative to the surface ✓.✓. (**2 or 0**)

2.3.1.

$f_k = \mu_k N$
$f_k = \mu_k (mg - F\sin\theta)$ } any one ✓.

$f_k = [0,2 \times (20 \times 9,8 - 105\sin 25^o \checkmark)]$ ✓.

$f_k = 30,33$ N left ✓.

2.3.3. **Positive Marking** from **2.3.1**.



**QUESTION 3**

3.2. No direction. Force between two objects.

3.3. EQUAL TO. ✓ Newston's law 3. ✓

**OR**

When object A exerts a force on object B, object B simultaneously exerts an oppositely directed force on object A of equal magnitude.

3.4.

$F_{net} = ma$ ✓
[(4 x14,98) ✓= 1500a] ✓
$a = 3,99 \times 10^{-2}\ m.s^{-2}$ ✓

**QUESTION 4**

4.1. The motion of an object upon which the only force acting is gravitational force. ✓✓

4.2.2. **Positive Marking** from **4.2.2**.

4.2.4. Same (initial) velocity ✓. They are undergoing Free fall motion✓ **OR** same gravitational acceleration ✓.

**QUESTION 5**

5.3.1 Typing error: $m_1v_{i1} + m_2v_{i2} = (m_1 + m_2)\ v_f$ ✓

**Positive Marking** from **5.3.1**

5.4. $E_{ktotal} = ½\ (mv_i^2 + mv_f^2)$

$E_{ktotal} = ½\ (mv_i^2 + mv_f^2)$ ✓

$E_{ki} = ½ \times 1\ 500 \times 20^2 + 0$ ✓

$E_{ki} = 300\ 000$ J
$E_{kf} = ½ \times 1\ 500 \times 12,5^2 + ½ \times 900 \times 12,5^2$ ✓

$E_{kf} = 187\ 500$ J
$E_{ki} \neq E_{kf}$ ✓

Inelastic collision. ✓

5.5. The buble wrap provides soft surface ✓ which increases the contact time of the collision ✓ and decreases the net force exerted on the equipment. ✓ **OR** Net force is inversely proportional to the contact time. ✓

**QUESTION 6**

6.1. Accept: W ✓ for Gravitational force.

6.3.2. Accept the Range (55,29-55,35)

**QUESTION 7**

7.1. Accept:

A force in which the ***total/net*** work done by the same force is dependent of the path taken. ✓✓ (**2 or 0**)

**QUESTION 8**

8.2. **Accepted**: The frequency perceived is higher than the frequency of the source✓ or The frequency with which the wave strike the ear is greater than the frequency at which they are produced. ✓

8.4.2. Stays the same ✓

**QUESTION 9**

9.1. Part marking

The electrostatic force between two points charges is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between them. ✓

9.3.1. **Positive Marking** from **9.3.1**.

9.3.3. $E_{net}$ = 29 530 $N.C^{-1}$ Right ✓.

We sincerely apologise for any inconvenience we might have caused.

Yours in education.

**MRS P.E. JAPHTA**
**(A) CES: AIDIBM SUBDIRECTORATE**

7 June 2024
**DATE**

Province of the
EASTERN CAPE
EDUCATION

# NATIONAL SENIOR CERTIFICATE / *NASIONALE SENIORSERTIFIKAAT*

## GRADE/*GRAAD* 12

## JUNE/*JUNIE* 2024

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

**MARKS/*PUNTE*:** **150**

This marking guideline consists of 11 pages./
*Hierdie nasienriglyn bestaan uit 11 bladsye.*

**QUESTION 1/*VRAAG 1***

1.1 D ✓✓ (2)

1.2 C ✓✓ (2)

1.3 C ✓✓ (2)

1.4 B ✓✓ (2)

1.5 D ✓✓ (2)

1.6 C ✓✓ (2)

1.7 C ✓✓ (2)

1.8 B ✓✓ (2)

1.9 A ✓✓ (2)

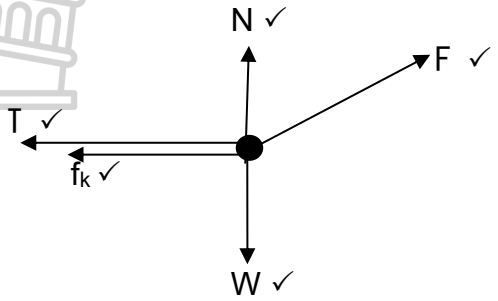
1.10 A ✓✓ (2)

**[20]**

**QUESTION 2/*VRAAG 2***

2.1 The force that opposes the motion of a moving object relative to the surface. ✓✓
*Die krag wat die beweging van 'n bewegende voorwerp relatief tot die oppervlakte teenwerk.* (2)

2.2




(5)

2.3 2.3.1 $f_k = \mu_k N$ } Any one / *Enige een* ✓
$f_k = \mu_k mg - F\sin\theta$ }
$f_k = [0,2 \times 20 \times 9,8 - \underline{105\sin 25^o}$ ✓$]$ ✓
$f_k = 30,33$ N ✓ (4)

2.3.2 **<u>2 kg block / *2 kg-blok*</u>**
Fnet = ma
$F\cos\theta - T - f = ma$ } Any one / *Enige een* ✓
$\underline{[105\cos 25^o}$ ✓ $- T - 30,33 = 20 \times 2]$ ✓
T = 24,83 N ✓ (4)

2.3.3 Fnet = ma
T – W = ma
T – mg = ma
$\underline{24,83 - m \times 9,8 = m \times 2}$ ✓
m = 2,10 kg ✓ (2)
**[17]**

**QUESTION 3/*VRAAG 3***

3.1 Each particle 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 met 'n krag direk eweredig aan die produk van hul masse, ✓ en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte aan.*✓ (2)

3.2 $F = \frac{Gm_1m_2}{r^2}$ ✓

$F = \frac{(6{,}67 \times 10^{-11})(5{,}98 \times 10^{24})(1\,500)}{(2 \times 10^{8})^2}$ ✓ ✓

F = 14,96 N ✓ (4)

3.3 EQUAL TO / *GELYK AAN*. ✓ Newton's 3rd law / *Newton se 3de wet.* ✓

**OR/*OF***

When object A exerts a force on object B, object B simultaneously exerts an oppositely directed force on object A of equal magnitude. ✓✓

*Wanneer voorwerp A 'n krag op voorwerp B uitoefen, sal voorwerp B gelyktydig 'n krag van gelyke grootte en in die teenoorgestelde rigting op voorwerp A uitoefen.* ✓✓ (2)

3.4 $F_{net} = ma$ ✓

[(4 x 14,98) ✓= 1 500a] ✓

$a = 3{,}99 \times 10^{-2}$ N ✓

**OR/*OF***

$g = \frac{GM}{r^2}$ ✓

$g = \frac{6{,}67 \times 10^{-11} \times 5{,}98 \times 10^{24}}{(1 \times 10^{8})^2}$ ✓ ✓

$g = 3{,}99 \times 10^{-2}$ N ✓ (4)

**[12]**

## QUESTION 4/*VRAAG 4*

4.1 The 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 gravitasiekrag is.* ✓✓ (2)

4.2 4.2.1

**OPTION 1/*OPSIE 1***

**Upwards positive / *Opwaarts as positief***
$v_f = v_i + a\Delta t$ ✓
$0 = (15) + (-9,8)\,\Delta t$ ✓
$\Delta t = 1,53$ s
$\Delta t_{total/totaal} = 2 \times 1,53 = 3,06$ s ✓

**Downwards positive / *Afwaarts as positief***
$v_f = v_i + a\Delta t$ ✓
$0 = (-15) + (9,8)\,\Delta t$ ✓
$\Delta t = 1,53$ s
$\Delta t_{total/totaal} = 2 \times 1,53 = 3,06$ s ✓

**OPTION 2/*OPSIE 2***

**Upwards positive / *Opwaarts as positief***
$v_f = v_i + a\Delta t$ ✓
$-15 = (15) + (-9,8)\,\Delta t$ ✓
$\Delta t = 3,06$ s ✓

**Downwards positive / *Afwaarts as positief***
$v_f = v_i + a\Delta t$ ✓
$15 = (-15) + (9,8)\,\Delta t$ ✓
$\Delta t = 3,06$ s ✓ (3)

4.2.2

**Upwards positive / *Opwaarts as positief***
$v_f = v_i + a\Delta t$ ✓
$[0 = (v_i) + (-9,8)(1,03)$ ✓$]$ ✓
$v_i = 10,094$ m.s$^{-1}$ upwards/ *opwaarts* ✓

**Downwards positive / *Afwaarts as positief***
$v_f = v_i + a\Delta t$ ✓
$[0 = v_i + (9,8)(1,03)$ ✓$]$ ✓
$v_i = -10,094$
$v_i = 10,094$ m.s$^{-1}$ upwards / *opwaarts* ✓ (4)

4.2.3

**Upwards positive / *Opwaarts as positief***

**Ball A height above the ground / *Hoogte van bal A bo die grond*:**
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0 = (15)^2 + 2(-9,8)\,\Delta y$ ✓
$\Delta y = 11,48$ m

**Ball B height above the ground/ *Hoogte van bal B bo die grond*:**
$v_f^2 = v_i^2 + 2a\Delta y$
$0 = (10,094)^2 + 2(-9,8)\,\Delta y$ ✓
$\Delta y = 5,20$ m

**Height of the building / *Hoogte van die gebou*:**
Height/*Hoogte* (h) = 11,48 -5,20 ✓
h = 6,28 m ✓

**Downwards positive / *Afwaarts as positief***

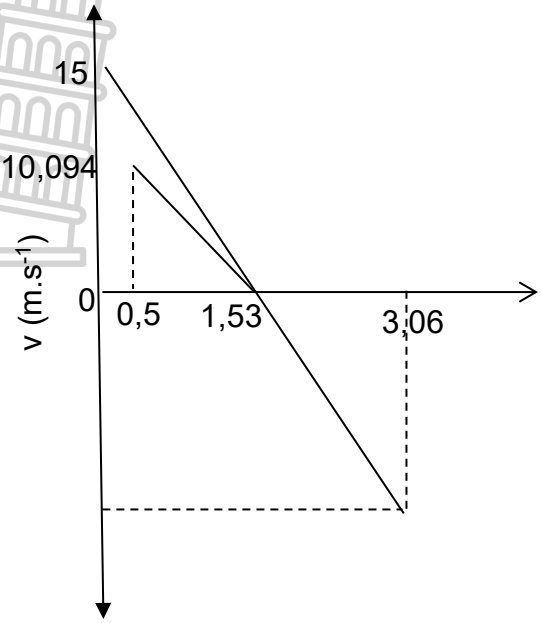
**Ball A height above the ground/ *Hoogte van bal A bo die grond*:**
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0 = (-15)^2 + 2(9,8)\,\Delta y$ ✓
$\Delta y = 11,48$ m

**Ball B height above the ground/ *Hoogte van bal B bo die grond*:**
$v_f^2 = v_i^2 + 2a\Delta y$
$0 = (-10,094)^2 + 2(9,8)\,\Delta y$ ✓
$\Delta y = 5,20$ m

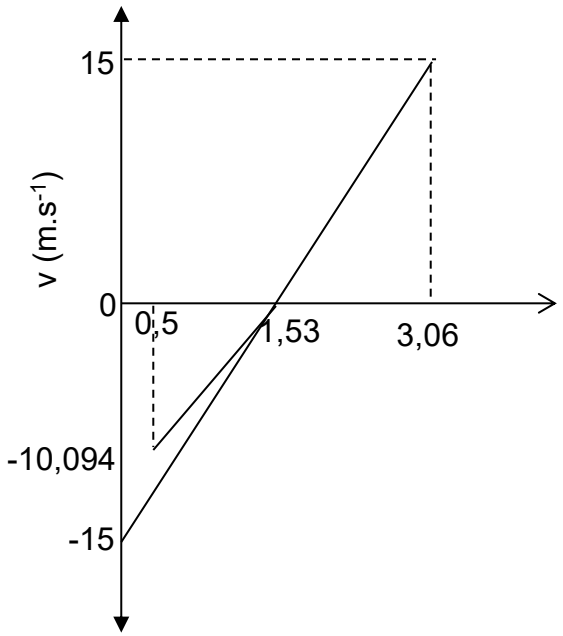
**Height of the building / *Hoogte van die gebou* :**
Height/*Hoogte* (h) = 11,48 – 5,20 ✓
h = 6,28 m ✓ (5)

4.2.4 They will have the same velocity. ✓ They are both undergoing free fall motion. ✓ /
*Hulle sal dieselfde snelheid het.* ✓ *Albei ondergaan vryval beweging.* ✓ (2)

4.3 **Upwards positive /**
***Opwaarts as positief***




**Downwards positive /**
***Afwaarts as positief***




| **Marking criteria for sketch/** ***Nasienkriteria vir skets*** | **Marks/*Punte*** |
|---|---|
| Initial velocity of ball A./ *Aanvanklike snelheid vir bal A.* | ✓ |
| Initial velocity of ball B./ *Aanvanklike snelheid vir bal B.* | ✓ |
| Shape of both graphs with graph of B starting at 0,5 s/ *Vorm van beide grafieke met beginpunt van grafiek B by 0,5 s* | ✓ |
| Time at maximum height/ *Tyd by maksimum hoogte* | ✓ |
| Final velocity and time when balls reach the ground/ *Finale snelheid en tyd wanneer die balle die grond bereik* | ✓ |

(5)
**[21]**

**QUESTION 5/*VRAAG 5***

5.1 A system in which the net external force is equal to zero./ ✓✓
*'n Stelsel waar die netto eksterne krag gelyk aan nul is.* (2)

5.2 The total linear momentum in an isolated system remains constant (is conserved). ✓✓
*Die totale lineêre momentum in 'n geïsoleerde stelsel bly konstant (is behoue).* (2)

5.3 5.3.1 $\Sigma p_i = \Sigma p_f$

$m_1v_{f1} + m_2v_{f2} = (m_1 + m_2)\, v_i$ } Any one/ *Enige een* ✓

$1\ 500 \times 20$ ✓ $+ 0 = (1\ 500 + 900)\, v_i$ ✓

$v_i = 12{,}5\ m.s^{-1}$ ✓ (4)

5.3.2

$F_{net}.\ \Delta t = \Delta p$ ✓
$F_{net}.\ 0{,}2$ ✓ $= 900\ (12{,}5 - 0)$ ✓
$F_{net} = 56\ 250$ N left/*links* ✓

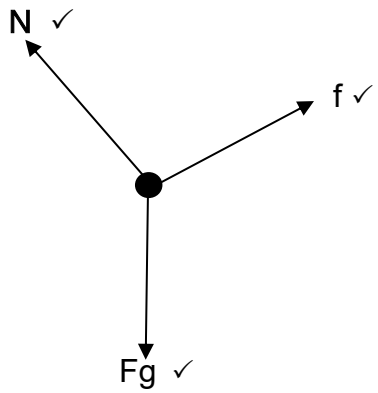
$F_{net}.\ \Delta t = \Delta p$ ✓
$F_{net}.\ 0{,}2$ ✓ $= 1\ 500\ (12{,}5 - 20)$ ✓
$F_{net} = 56\ 250$ N left/*links* ✓ (4)

5.4 $E_k = \frac{1}{2}mv^2$ ✓
$E_{ki} = \underline{\frac{1}{2} \times 1\ 500 \times 20^2} + 0$ ✓
$E_{ki} = 300\ 000$ J
$E_{kf} = \underline{\frac{1}{2} \times 1\ 500 \times 12{,}5^2 + \frac{1}{2} \times 900 \times 12{,}5^2}$ ✓
$E_{kf} = 187\ 500$ J
$E_{ki} \neq E_{kf}$ ✓
Inelastic collision / *Onelastiese botsing* ✓ (5)

5.5 The bubble wrap provides a soft surface ✓ which increases the contact time of the collision, ✓ and decreases the net force exerted on the equipment. ✓ /
*Die borrelplastiek verskaf 'n sagte oppervlakte wat die kontaktyd van die botsing verhoog en verlaag die netto krag wat op die toerusting uitgeoefen word.* (3)
**[20]**

**QUESTION 6/*VRAAG 6***

6.1




(3)

6.2 $W_{net} = \Delta E_K$
$W_f + W_{Fg} = ½ mv^2_f – ½ mv^2_i$ } Any one / *Enige een* ✓
$W_f + (-\Delta E_p) = ½ mv^2_f – ½ mv^2_i$
$[50(\frac{10}{sin30^o}) ✓ \times cos180^o] ✓ + 60 \times 9,8 sin30^o(\frac{10}{sin30^o})cos0^o$ ✓ $= ½ \times 60 \times v_f^2 – 0$ ✓
$v_f = 12,75\ m.s^{-1}$ ✓

**OR/*OF***

$W_{nc} = \Delta E_p + \Delta E_k$
$W_f = mgh_2 – mgh_1 + ½ mv^2_f – ½ mv^2_i$ } Any one / *Enige een* ✓
$[50(\frac{10}{sin\theta}) ✓ \times cos180^o] ✓ = \underline{0 – 60 \times 9,8 \times 10}$ ✓ $+ \underline{½ \times 60 \times v_f^2 – 0}$ ✓

$v_f = 12,75\ m.s^{-1}$ ✓ (6)

6.3 6.3.1 The net work done on an object is equal to the change in kinetic energy of an object./ ✓✓
*Die netto arbeid wat op 'n voorwerp verrig is, is gelyk aan die verandering in kinetiese energie van 'n voorwerp.* (2)

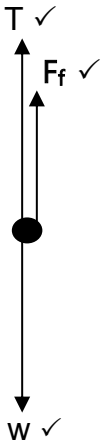
6.3.2 $W_{net} = \Delta E_K$
$W_f = ½ mv_f^2 – ½ mv_i^2$ } Any one / *Enige een* ✓
$f.\Delta x cos\theta = ½ mv^2_f – ½ mv^2_i$
$\underline{(0,15 \times 60 \times 9,8)}$ ✓ $\times \Delta x cos180^o]$ ✓ $= 0 – \underline{½ \times 60 \times 12,74^2}$ ✓
$\Delta x = 55,29$ m ✓ (5)
**[16]**

**QUESTION 7/*VRAAG 7***

7.1 A force in which the work done by the net force depends on the path taken./ ✓✓
*'n Krag waarvoor die arbeid verrig deur die netto krag afhanklik is van die roete wat gevolg word.* (2)

7.2 (Air) friction ✓ and tension/ ✓
*(Lug) wrywing en spanning* (2)

7.3




(3)

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

$W_{net} = \Delta E_k$
$T.\Delta x\cos\theta + f.\Delta x\cos\theta = \Delta E_k$ } Any one / *Enige een* ✓
$T.\Delta x\cos\theta + f.\Delta x\cos\theta = ½mv_f^2 – ½mv_i^2$

$950 \times 30\cos180^\circ$ ✓ $+ f \times 30\cos180^\circ$ ✓ $+ 150 \times 9,8 \times 30\cos0^\circ = 0$ ✓

$f = 520$ N ✓

**OPTION 2/*OPSIE 2***

$W_{nc} = \Delta E_p + \Delta E_k$
$W_f + W_T = mgh_2 – mgh_1 + ½ mv_f^2 – ½ mv_i^2$ } Any one / *Enige een* ✓
$f \times 30\cos180^\circ$ ✓ $+ 950 \times 30\cos180^\circ$ ✓ $= 0 – \underline{150 \times 9,8 \times 30}$ ✓ $+ 0$
$f = 520$ N ✓ (5)

**[12]**

**QUESTION 8/*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 frekwensie (toonhoogte) van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word het.*

**OR / *OF***

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

8.2 As the observer moves towards the sound source the wavefronts ahead become compressed, ✓ the wavelength decreases ✓ and the frequency increases. ✓/
*Soos die waarnemer na die klankbron beweeg, word die golffront saamgepers, die golflengte neem af en die frekwensie neem toe.* (3)

8.3 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$

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

Any one / *Enige een* ✓

$2\,500$ ✓ $= \frac{340 + v_L}{340}$ ✓ x 2 450 ✓
$v_L = 6{,}94\ m \cdot s^{-1}$ ✓ (5)

8.4 8.4.1 Stays the same / *Bly dieselfde* ✓ (1)

8.4.2 Decreases / *Verlaag* ✓ (1)

8.5 8.5.1 Increase / *Verhoog* ✓ (1)

8.5.2 Stays the same / *Bly dieselfde* ✓ (1)

8.5.3 Stays the same / *Bly dieselfde* ✓ (1)

8.6 To measure the heart beat of a foetus in the womb. ✓/
To measure the speed of blood in the veins. ✓/
*Om die hartklop van 'n fetus in die baarmoeder te meet.*
*Om die spoed van bloed in die are te meet.* (2)
**[17]**

**QUESTION 9/*VRAAG 9***

9.1 The electrostatic force between two-point charges is directly proportional to the product of the magnitude of the charges, and inversely proportional to the square of the distance between the charges. ✓✓/
*Die elektrostatiese krag tussen twee puntladings is direk eweredig aan die produk van die groottes van die ladings, en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.* (2)

9.2 NEGATIVE / *NEGATIEF* ✓✓ (2)

9.3 9.3.1 $F = \frac{kQ_1Q_2}{r^2}$ ✓

$0,012$ ✓ $= \frac{9 \times 10^9 \times 2 \times 10^{-6} \times Q}{2,5^2}$ ✓

$Q = 4,17 \times 10^{-6}$ C ✓ (4)

9.3.2 The electrostatic force experienced per unit positive charge. ✓✓/
*Die elektrostatiese krag per eenheidspositiewe-lading ervaar*. (2)

9.3.3 $E = \frac{kQ}{r^2}$ ✓

$E_1 = \frac{9 \times 10^9 \times 2 \times 10^{-6}}{1,5^2}$ ✓

$E_1 = 8\ 000$ N.C$^{-1}$ Left/*Link*

$E_2 = \frac{9 \times 10^9 \times 4,17 \times 10^{-6}}{1,0^2}$ ✓

$E_2 = 37\ 530$ N.C$^{-1}$ Right/*Regs*

$E_{net} = E_2 - E_1$
$E_{net} = 37\ 530 - 8\ 000$ ✓
$E_{net} = 29\ 530$ N.C$^{-1}$ Right/*Regs* ✓ (5)
**[15]**

**TOTAL/*TOTAAL*: 150**