LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

# NATIONAL SENIOR CERTIFICATE

## GRADE 12



## PHYSICAL SCIENCES: PHYSICS (P1)

## JUNE 2025


**MARKS: 150**

**TIME: 3 HRS**

MEPHSCP1

**This exam paper consists of 16 pages and 3 data sheets**

**INSTRUCTIONS AND INFORMATION**

1. Write your NAME in the appropriate space on the ANSWER BOOK
2. This question paper consists of 9 questions. Answer ALL the questions in the ANSWER BOOK
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions et cetera where required.
12. Write neatly and legibly.

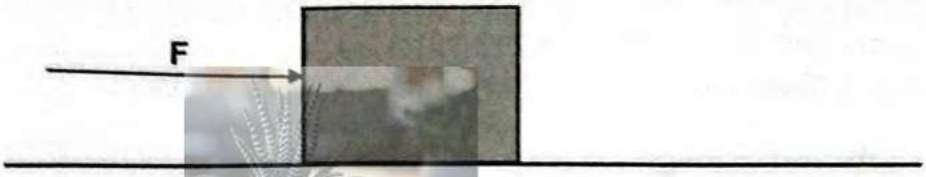


## QUESTION 1: MULTIPLE CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write the letter (A-D) next to the question numbers (1.1 – 1.10) in the ANSWER BOOK, e.g. **1.11 E**.

1.1 The following diagram shows the presence of a perfectly horizontal FORCE exerted on a box.




Which ONE of the following equations can be used to calculate the NORMAL FORCE on the box CORRECTLY?

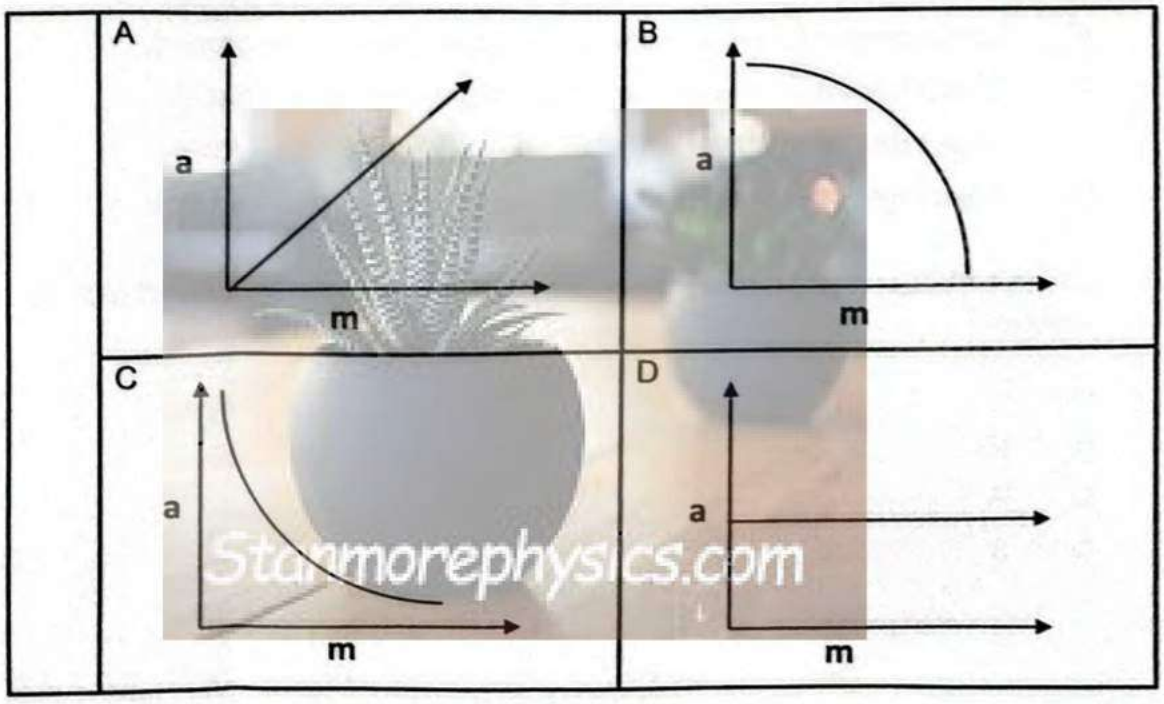
A $N = mg$

B $N = w + F_y$

C $N = w + F_x$

D $N = w - F_y$ (2)

1.2 According to Newton's second law, which ONE of the following sketch graphs BEST illustrate the relationship between acceleration (a) and mass (m) of the object?




(2)

1.3 In the equation $x = \frac{\Delta p}{\Delta t}$, $x$ probably represents...

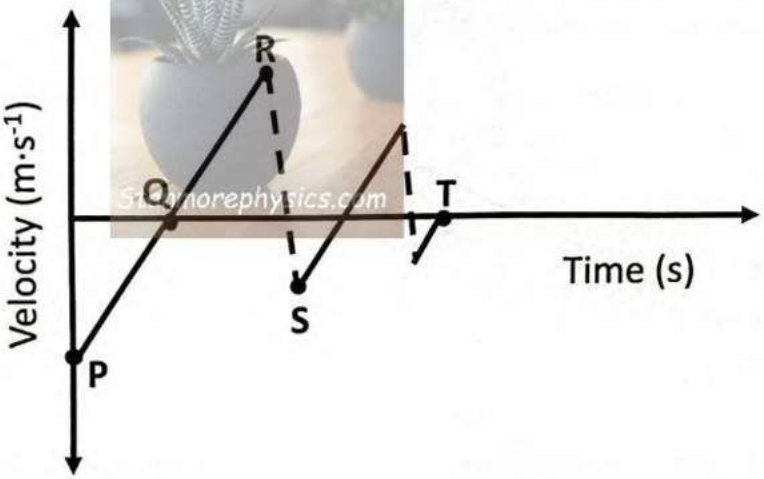
A Net force.

B Momentum.

C Impulse.

D Weight. (2)

The following velocity-time sketch graph shows the movement of an object. Use the graph to answer QUESTIONS 1.4 and 1.5.
**P, Q, R, S** and **T** show specific points during the motion of the object.




1.4 Which ONE of the following statements correctly describes the motion of the object?

A Object dropped from a certain height and it falls to the ground.

B Object thrown downwards and bounces twice on the ground.

C Object dropped, falls to the ground and bounces three times.

D Object thrown upwards, falls to the ground and bounces twice. (2)

1.5 Which LETTER (P,Q,R, S or T) indicates the highest point that the object reaches?

A **P**

B **Q**

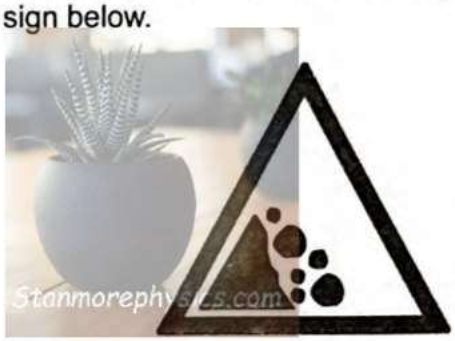
C **R**

D **S** (2)

1.6 The Kinetic energy of a moving object can be QUADRUPLED (increased by FOUR TIMES) by...

A doubling the object's mass.
B doubling the object's speed.
C halving the object's mass.
D halving the object's mass. (2)

1.7 Consider the situation when rocks are sliding down a hill or mountain, as shown in the road sign below.



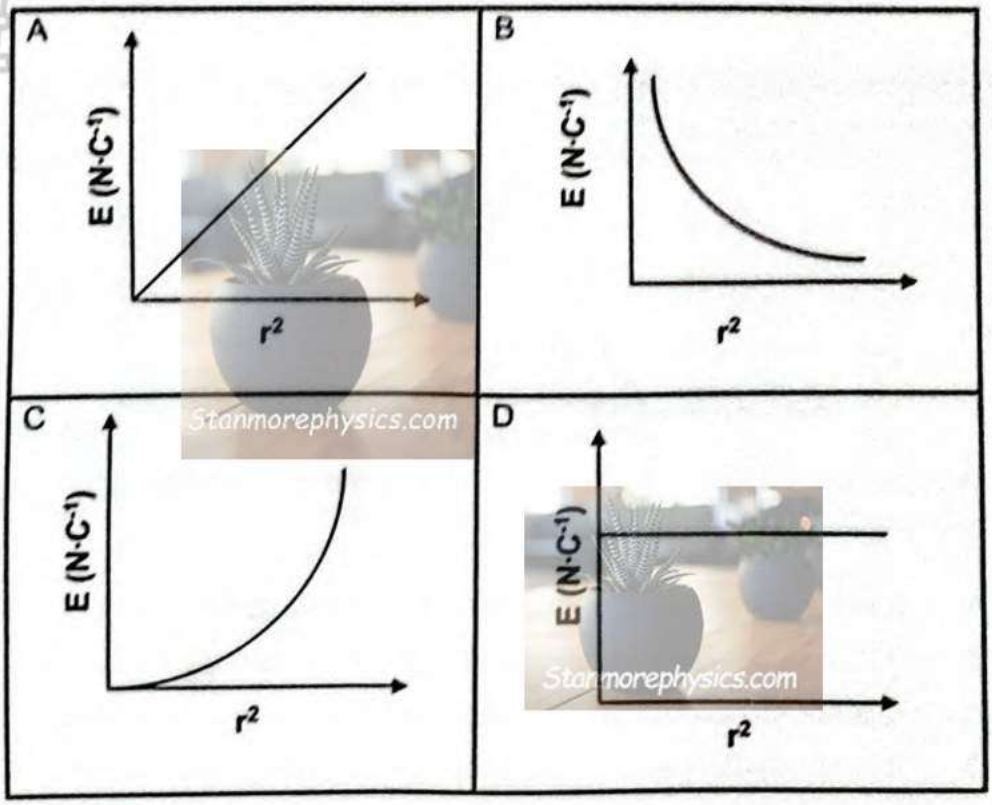

Which of the following descriptions will accurately describe the rolling/sliding down of rocks?

A It is an isolated system and mechanical energy increases
B It is not an isolated system and mechanical energy increases
C It is not an isolated system and mechanical energy decreases
D It is an isolated system and mechanical energy decreases (2)

1.8 The magnitude of an electric field at a specific point away from a charge can be determined using the formula:

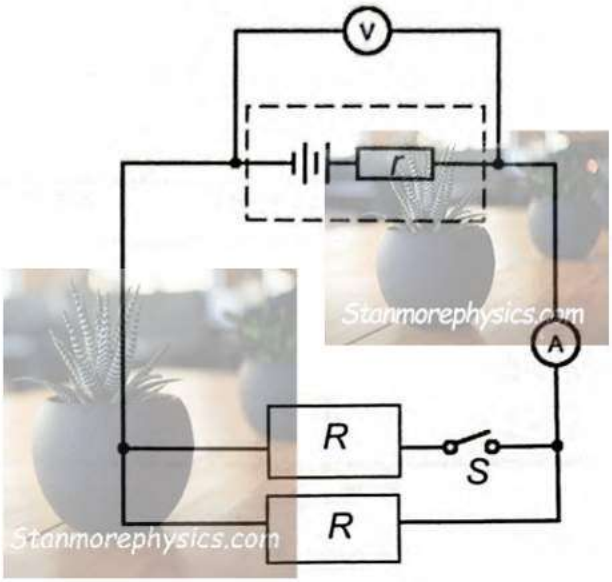
$$E = \frac{kQ}{r^2}$$

Which of the following sketch graphs illustrates the correct mathematical relationship between electric field and distance from the charge?




(2)

1.9 The following circuit diagram shows two IDENTICAL resistors that are connected to a battery with an internal resistance **r**. The switch **S** is initially OPEN.




Which ONE of the combinations below CORRECTLY represents the **voltmeter** and **ammeter** readings when **S** is closed?

| | VOLTMETER READING | AMMETER READING |
|---|---|---|
| A | Decrease | Increase |
| B | Increase | Decrease |
| C | Increase | Increase |
| D | Decrease | Decrease |

(2)

1.10 A train driver is blowing the whistle as it moves through a station WITHOUT STOPPING. A person waiting for the next train notices that the sound of the whistle is changing as the train *approaches*, *passes* and *moves away* from the station.

Which ONE of the following combinations of frequencies that the observer hears is CORRECT?

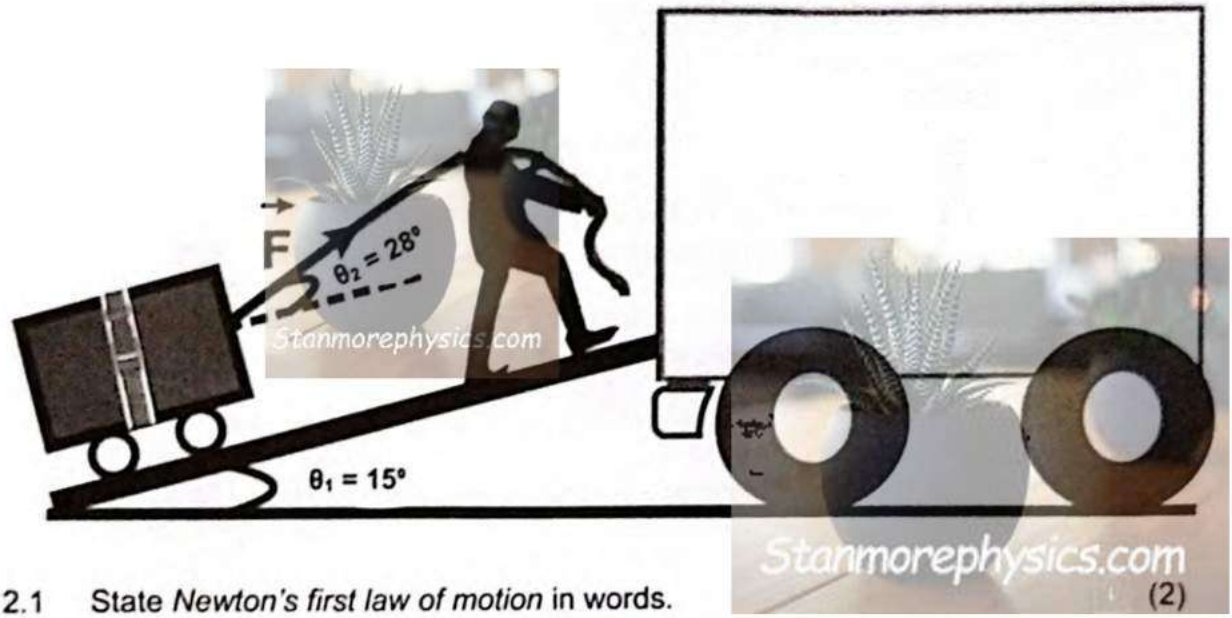
| | APPROACHING | PASSING | MOVING AWAY |
|---|---|---|---|
| A | $f_L < f_s$ | $f_L > f_s$ | $f_L = f_s$ |
| B | $f_L = f_s$ | $f_L > f_s$ | $f_L < f_s$ |
| C | $f_L > f_s$ | $f_L = f_s$ | $f_L > f_s$ |
| D | $f_L > f_s$ | $f_L = f_s$ | $f_L < f_s$ |

(2)

**[20]**

**QUESTION 2**

A person loads a box into a truck. He/She fastens the 48-kg box on a 4,3-kg trolley and pulls it up a ROUGH ramp (inclined plane) at CONSTANT VELOCITY using a light inelastic rope. The angle of the ramp with the ground is $\theta_1 = 15°$. The angle of the tension force on the box is $\theta_2 = 28°$ with the ramp. The coefficient of kinetic friction between the wheels of the trolley and the ramp is 0,22. The applied force, *F*, has a magnitude that is THREE TIMES that of the frictional force.




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

2.2 Draw a labelled free-body diagram for the box-trolley system as it moves up the ramp. (4)

2.3 Calculate the:

2.3.1 Kinetic frictional force between the trolley and the ramp (5)

2.3.2 Tension in the rope as the box-trolley system moves up the ramp (4)

2.3.3 Normal force on the box-trolley system (3)

2.4 Define, in words, the term *power* as applied in physics. (2)

2.5 The person moves the trolley-box system over the 5-m long ramp in 3,2 s. Calculate the power delivered by the applied force. (5)

**[25]**

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

A builder is standing on a crane **A** moving downwards at a CONSTANT VELOCITY of 3 $m \cdot s^{-1}$. He/she drops a brick **B** when the crane is 18 m above the ground. The crane continues to move downwards. After 1 s, he/she throws down a second brick **C** and BOTH bricks hit the ground at the **same time**.

*Take upwards as the positive direction.*

The following questions are based on the time *just* as the first brick **B** is dropped until it hits the ground.

4.1 Write down the initial velocity of the first brick **B**. (1)

4.2 Calculate the time taken for the first brick **B** to hit the ground. (4)

4.3 Determine the:

4.3.1 Height from which the second brick **C** is thrown (3)

4.3.2 Velocity with which the second brick **C** leaves the crane. (4)

4.3.3 Height of the crane at the moment that the two bricks hit the ground. (4)

4.4 Draw labelled position-time sketch graphs to show the movement of the crane **A**, the first brick **B** and the second brick **C from the time that B is released until both bricks hit the ground** on the same set of axis.

TAKE THE GROUND AS ZERO POSITION.

Clearly indicate the values of the following on the graph:

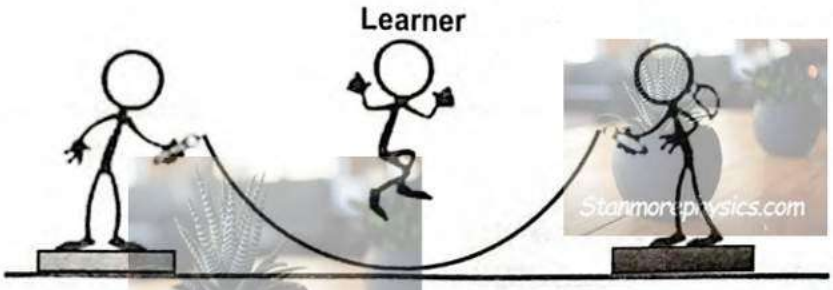
- Initial positions of **A, B** and **C**
- Time and position at which **C** is thrown
- Final time and corresponding positions of **A, B** and **C** (6)

**[22]**

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

A physics learner of mass 52 kg, skips over a rotating rope by jumping directly upwards. He/She manages to reach a vertical height of 47 cm above the ground.

Neglect the effects of air resistance.




5.1 Explain what is meant by *isolated system* as applied in physics. (2)

5.2 Draw a labelled free-body diagram for the learner at maximum height. (1)

5.3 Using ONLY ENERGY PRINCIPLES, calculate the speed with which the learner leaves the ground (4)

5.4 When jumping, the learner must land and then push him-/herself upwards to lift off the ground.

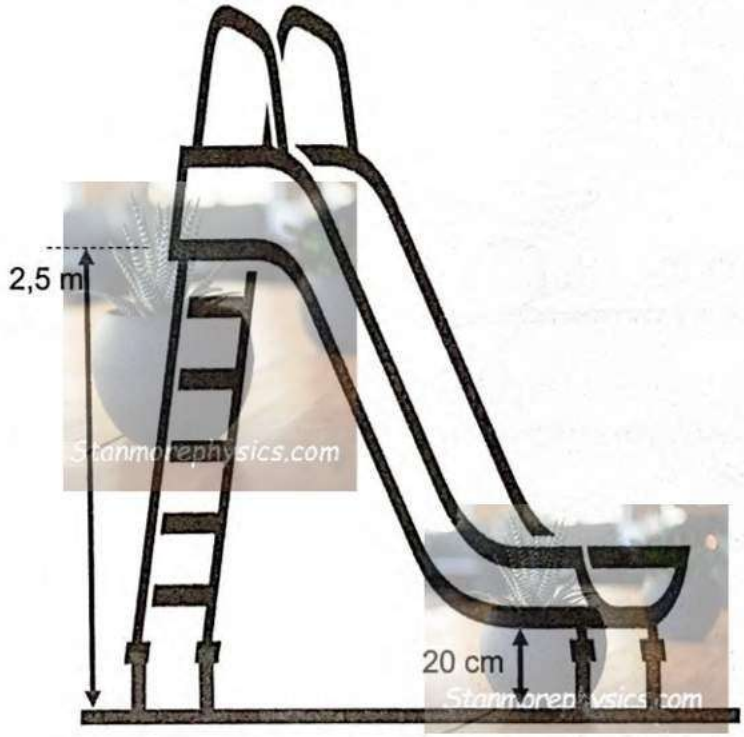
Calculate the change in momentum of the learner from the moment that he/she starts pushing him-/herself upwards until the moment he/she leaves the ground. (4)

5.5 Write down the impulse of the ground on the learner during the motion as described in QUESTION 5.4 above. (1)

5.6 After reaching his/her maximum height, the learner falls back down and reaches the ground. He/she bends his/her legs while landing. Explain how this prevents injuries. Refer to *net force*, *time* and *change in momentum* in your explanation. (2)
**[14]**

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

A 35 kg child wants to slide down a rusted 5 m long slide. The top of the slide has a vertical height of 2,5 m and a final height of 20 cm above the ground as shown in the diagram below. The child experiences a constant frictional force of 7,5 N.




6.1 Define the term *Non-conservative force.* (2)

6.2 Calculate the work done by the frictional force during the child's motion down the slide. (3)

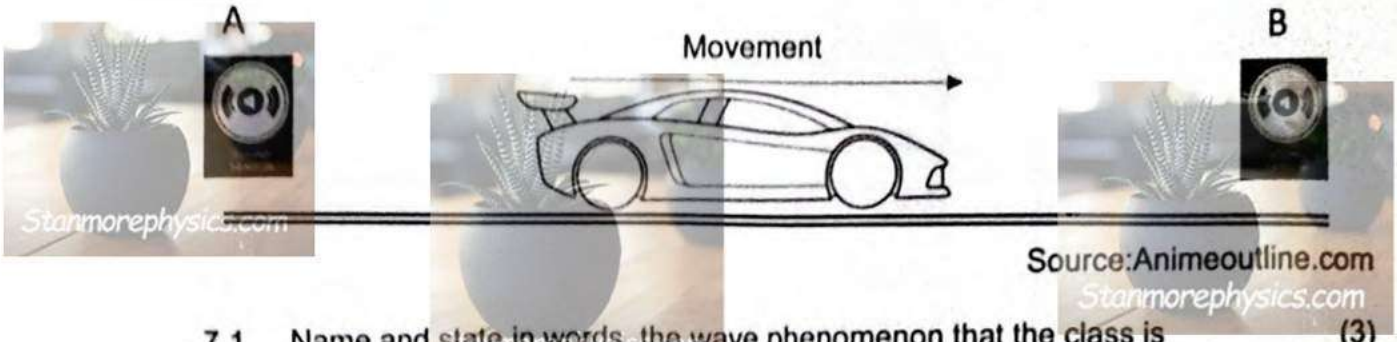
6.3 Use ENERGY PRINCIPLES to calculate the speed with which he/she reaches the end of the slide if his/her initial speed is 0,3 $m \cdot s^{-1}$. (5)

**[10]**

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

A racing car makes a great amount of noise while moving at high speeds. A class wants to determine the effect of movement on the **observed frequency** and asks a racing driver to assist in an investigation. They set up two sound detectors and let the car drive from detector **A** to detector **B** several times at **different speeds**. The car produces a sound with a frequency of 1 700 Hz and one of the detectors records a frequency of 2 030 Hz.




7.1 Name and state in words, the wave phenomenon that the class is investigating. (3)

7.2 For this investigation, write down the:

7.2.1 Independent variable (1)

7.2.2 Dependent variable (1)

7.3 Which ONE of the detectors (**A** or **B**) recorded the frequency of 2 030 Hz? (1)

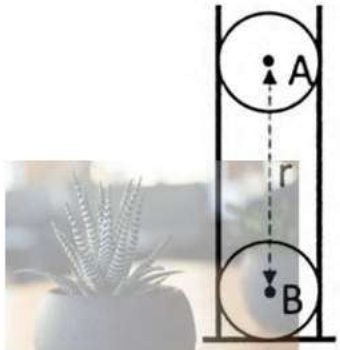
7.4 Suggest a reason for the answer in QUESTION 7.3 above with reference to frequency. (1)

7.5 Calculate the speed at which the racing car is traveling. (4)

**[11]**

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

Two **identical negatively charged** small spheres, **A** and **B** are placed in a glass test tube. They repel each other and **A** settles when the distance **r** between their centres is 25 mm as shown in the diagram. The mass of EACH ball is 20 g.




Neglect the effects of air resistance.



8.1 State *Coulomb's Law* in words. (2)

8.2 Draw a labelled free-body diagram for sphere **A.** (2)

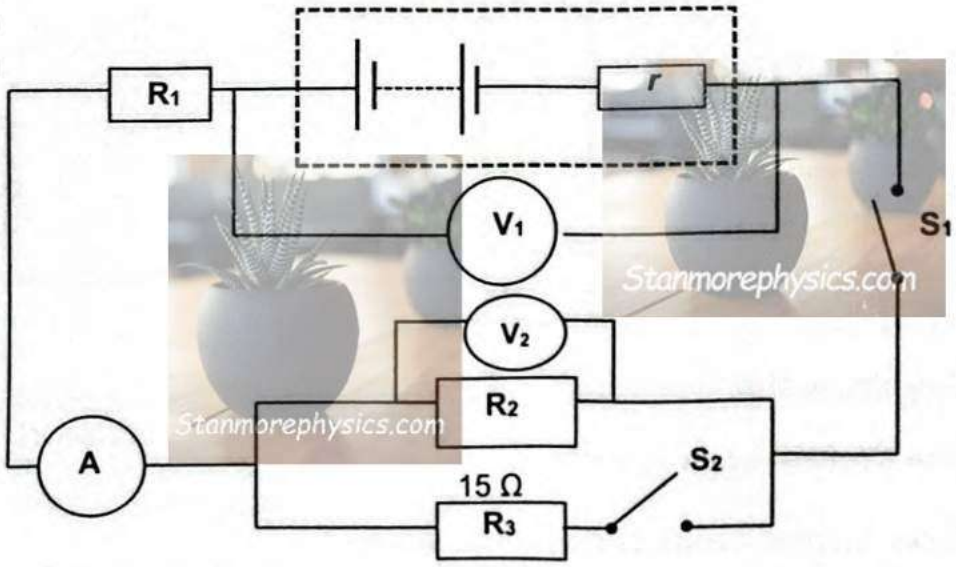
8.3 Calculate the magnitude of the charge on EACH sphere. (4)

8.4 Draw the electric field pattern due to the two spheres **A** and **B.** (3)

8.5 Calculate the electric field of **B** at the centre of sphere **A.** (4)
**[15]**

**QUESTION 9 (start on a new page)**

A battery with an internal resistance of 0,7 Ω is connected in the circuit diagram below. The switches are **both open** and $R_1$ has a resistance that is TWICE the resistance of $R_2$.




When $S_1$ is closed, the reading on $V_1$ decreases by 1,7 V. The reading on $V_2$ is 5 V.

9.1 State *Ohm's Law* in words. (2)

9.2 Calculate the:

9.2.1 Current in resistor $R_2$ (3)

9.2.2 Resistance of $R_1$ (4)

9.2.3 EMF of the battery (3)

$S_2$ is NOW closed and this results in a change in the value of $V_1$.

9.3 Calculate the

9.3.1 Reading on the ammeter **A** (5)

9.3.2 Power dissipated in $R_2$ (4)

**[21]**

**Grand Total: 150**

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## GRADE 12

## PHYSICAL SCIENCES: PHYSICS (P1)

## JUNE 2025

## FINAL AND AMENDE MARKING GUIDELINE/ FINALE EN AANGEPASTE MERK RIGLYNE

**MARKS: 150**

**These marking guidelines consist of 9 pages**

 please turn over

**QUESTION 1**

1.1 A✓✓

1.2 C✓✓

1.3 A✓✓

1.4 D✓✓

1.5 B ✓✓

1.6 B ✓✓

1.7 C ✓✓

1.8 B ✓✓

1.9 A ✓✓

1.10 D ✓✓

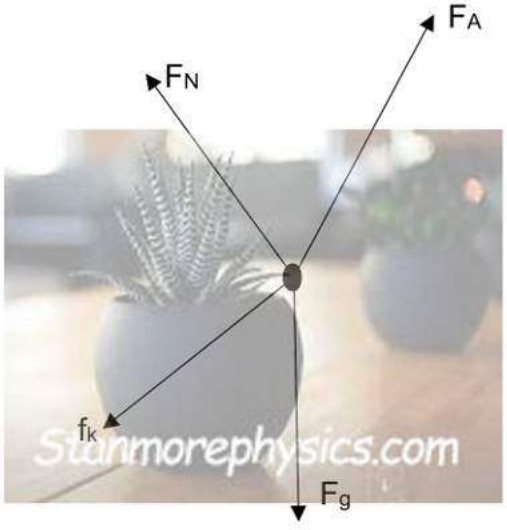

(2 x 10 =20)

**QUESTION/VRAAG 2**

2.1 A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it. ✓✓

*'n Voorwerp sal in 'n toestand van rus of konstante bewegin bly tot 'n nie-sero resultante krag daarop inwerk.* ✓✓ **(2)**

2.2




 Please turn over

| ACCEPTED SYMBOLS/AANVAARDE SIMBOLE | | |
|---|---|---|
| $F_N$ | Normal force/N /$F_{surface\ on\ box}$ | *Normaalkrag/ N/$F_{oppervlak\ op\ krat}$* |
| $f_k$ | Kinetic friction / friction /Frictional force | *Kinetiese wrywing/wrywing/wrywingskrag* |
| $F_g$ | w, weight/Gravitational force/ $F_{earth\ on\ box}$ | *Gewing/Gravitasiekrag/ $F_{aarde\ op\ die\ voorwerp}$* |
| $F_A$/F | Applied force /Tention/T | *$F_T$/ FToegepaste krag/Spanningskrag* |
| Notes:<br>• Mark awarded for label and arrow<br>• Do not penalize for length of arrows<br>• Any additional force/s: -1<br>• If force(s) do not make contact with the body: -1 mark<br>• -1 mark if all arrowheads are omitted but correctly labelled.<br>**(4)** | | *Notas:*<br>• *Punt toegeken vir pyl en pylpunt*<br>• *Moenie lengte van pyle penaliseer nie*<br>• *Addisionele krag/te:-1*<br>• *As kragte nie kontak maak met kol nie: -1*<br>• *-1 punt as alle kragte teenwoordig is en benoem maar geen pylpunte nie.* |
| | | |

2.3.1 **OPTION 1**

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

$3f_k\cos28^0$✓ $- f_k - (48 + 4{,}3)(9{,}8)\sin15^0$ ✓ $= 0$ ✓

$f_k = 80{,}45$ N✓

(This value is checked and correct)

**NOTES:**

Formula for N1/N2
Substitution of zero
Substitution for $F_{Ax}$
Substitution for $F_{gII}$
Answer = 80,45 N

**OPTION 2**

$f_k = N\mu_k$ ✓

$= \mu_k(mg\cos\theta_1 - F_T \sin\theta_2)$

$= 0{,}22$✓ (48 +4,3)(9,8)cos15 ✓ – $3f_k$sin28✓)

$= 83{,}15$N ✓

**NOTES:**

Formula for $f_k$
Substitution of 0,22
Substitution for $F_{Ax}$
Substitution for $F_{gII}$
Answer = 83,15 N

2.3.2 **POSITIVE MARKING FROM QUESTION 2.3.1**

Tension in the rope is the applied force/ *Spanning in die tou is die toegepaste krag*

$F_A = 3f_k$ ✓ **(Ratio)**

$F_A = 3$✓$(80,45)$✓

$F_A =$ 241,35 N✓

**OR**

$F_A = 3f_k$ ✓ **(Ratio)**

$F_A = 3$✓$(83,15)$✓

$F_A$ =249,4557

$F_A$ = 249,46 N ✓

**Range: 241,35 – 249,46 N**

**OPTION 2**

$F_{net} = F_x - F_{g\parallel} - f_k$ ✓

0 = $F_A$cos 28 – 52,3(9,8)sin 15✓ – 80,45 ✓

$F_A$ = 241,36 N✓

**OR**

$F_{net} = F_x - F_{g\parallel} - f_k$ ✓

0 = $F_A$cos 28 – 52,3(9,8)sin 15✓ – 83,15 ✓

$F_A$ = 244,41 N✓

**Range: 241,36 – 244,47 N**

**OPTION 3**

$F_A^2 = F_x^2 + F_y^2$ ✓

$= (3f_k\cos 28)^2 + (3f_k\sin 28)^2$ ✓

$= (3(80,45)\cos 28)^2 + (3(80,45)\sin 28)^2$ ✓

$= (213,21)^2 + (113,36)^2$

$F_A$ = 241,47 N ✓ **(4)**

2.3.3 **(POSITIVE MARKING FROM QUESTION 2.3.1 and 2.3.2**

**OPTION 1**

$f_k = N\mu_k$✓

80,45 = N (0,22) ✓

N = 365,68 N ✓

**Range: 365,68 – 377,95 N**

**OR**

$f_k = N\mu_k$✓

83,15 = N (0,22) ✓

N = 377,95 N ✓

**OPTION 2:**

$F_{net} = 0$

$N = F_{g\perp} - F_y$ ✓ **Any One**

$= mg\cos\theta_1 - F_A \sin\theta_2$

$= \underline{(48 + 4,3)(9,8)(\cos 15) - 241,35 \sin 28}$ ✓

$= 381,76866$

$= 381,77$ N ✓

**(3)**

2.4 Rate at which work is done/ Rate at which energy is expended/transferred ✓✓

*Tempo waarteen arbeid verrig word/ Tempo waarteen energie oorgedra word.* ✓✓

**(2 OR 0)** **(2)**

2.5 (**POSITIVE MARKING FROM QUESTION 2.3.2) check alternative answers from 2.3.2**

$W = F\Delta x \cos\theta$

$= \underline{241,35(5)(\cos 28^\circ)}$ ✓

$= 1065,497$ J

**Range: 1065,497 - 1101,43 J**

**OR**

**calculate $F_x$**

$W_{Fx} = F_x \Delta x \cos\theta$

$= \underline{(241,35\cos 28)(5)(\cos 0)}$ ✓

$= 1065,497$ J

**Range: 1065,50 – 1079,01 J**

$P = \frac{W}{t}$ ✓ ✓

$= \frac{1065,497}{3,2}$ ✓

$= 332,9678$

$= 332,97$ W ✓ **Range: 332,97- 344,20 W** **(5)**

Carry over mark. Correctly substituting the value calculated for work in the power formula. But then the final (wrong) answer is not awarded a mark.

**OPTION 3:**

Speed = $\frac{\Delta x}{\Delta t} = \frac{5}{3,2\checkmark} = 1,5625$ m.s$^{-1}$

Carry over mark. Correctly substituting speed in power formula

$P_{ave} = F_{Ax} v_{ave}$ ✓ ($F_A$ from 2.3.2 Range: 241,35 – 249,49 N

= (241,35cos 28) ✓ (1,5625) ✓

= 332,97 W ✓ **(Range: 332,97 - 344,20W)**

**QUESTION 3**

3.1 In an isolated system, the total linear momentum is conserved/ remains constant. ✓✓
*In 'n geïsoleerde sisteem sal die totale lineêre momentum behoue bly/constant bly.* ✓✓ **(2 or 0)** **(2)**

3.2 $\sum p_i = \sum p_f$
$mv_i = mv_N + mv_{FT}$ ✓ Anyone/ *Enige een*

$(90000 + m_{FT})4500\checkmark = (90000)(11000)\checkmark + m_f(-3045)\checkmark$

$m_{FT} = 77\,534,79$ kg✓

**OPTION 2**

$\Delta p_N = -\Delta p_{FT}$ ✓

$m(v_f - v_i) = -m(v_f - v_i)$

9000 (11000✓ – 4500✓) = -m(4500- (-3045) ✓

m = 7753,48 kg ✓ **(5)**

3.3 **POSITIVE MARKING FROM 3.2**

$E_{ki} = \frac{1}{2}mv^2$ ✓Any one/ *Enige een*

$= \frac{1}{2}(90000 + 77534,79)(4500)^2$ ✓

$= 1,696 \times 10^{12}$J

$E_{kf} = \frac{1}{2}mv^2 + \frac{1}{2}mv^2$

$= \frac{1}{2}(90000)(11000)^2 + \frac{1}{2}(77534,79)(3045)^2$✓

$= 5,8 \times 10^{12}$J

$E_{ki} \neq E_{kf}$✓

Decoupling is not elastic✓ / *Ontkoppeling is onelasties* **(5)**

**QUESTION 4**

4.1 3 m·s$^{-1}$ ,downwards✓/*afwaarts* **(1)**

4.2 **NOTE: Allow positive marking from 4.1**
**IF SIGN CONVENTION IS NOT FOLLOWED: (-1)**

$v_f^2 = v_i^2 + 2a\Delta y$
$= (-3)^2 + 2(-9,8)(-18)$
$v_f = -19,02\ m \cdot s^{-1}$

$v_f = v_i + a\Delta t$ ✓
$19,02$✓ $= 3 + 9,8\Delta t$✓
$\Delta t = 1,63$ s✓

$\Delta y = v_i t + \frac{1}{2} a\Delta t^2$ ✓
-18 ✓ = (-3)t + ½ (-9,8)t² ✓
t = 1,63s ✓

**(4)**

For the following options, candidate calculated final velocity first:
$v_f^2 = v_i^2 + 2a\Delta$
$= (-3)^2 + 2(-9,8)(-18)$ ✓
$v_f$ = -19,02104

$F_{net}(t\Delta) = m(v_f - v_i)$✓
mg.Δt = m($v_f$ -$v_i$)
-9,8 (Δt) = (-19,02104 – (-3)) ✓
Δt = 1,63 s✓

$\Delta y = \left(\frac{v_i + v_f}{2}\right) t$✓
$-18 = \left(\frac{-19,02104 + (-3)}{2}\right)\Delta t$
Δt = 1,63 s✓

4.3.1 **IF SIGN CONVENTION IS NOT FOLLOWED: (-1)**
Calculate the distance that the crane moves in 1 second at constant velocity:
*Bereken die afstand wat die hyskraan in 1 sekonde beweeg teen konstante snelheid:*

$\Delta y = v_i\Delta t + \frac{1}{2} a(\Delta t)^2$ ✓
$= 3(1)$ ✓ + 0 (Non-essential zero may be omitted)
$\Delta y = 3$m

Speed = $\frac{distance}{time}$ ✓
Distance = speed x time
= 3(1) ✓
= 3m

$\Delta y = \left(\frac{v_i + v_f}{2}\right) t$✓
$= \left(\frac{-3-3}{2}\right)(1)$ ✓
= 3m

C was thrown from: 18 – 3 = 15 m✓ **(3)**

4.3.2 **POSITIVE MARKING 4.2 and 4.3.1**
**IF SIGN CONVENTION IS NOT FOLLOWED: (-1)**

**OPTION 1:**

$\Delta y = v_i \Delta t + \frac{1}{2}a(\Delta t)^2$ ✓

$-15 = v_i(0,63) + \frac{1}{2}(-9,8)(0,63)^2$ ✓

$v_i = -20,72 \text{ m.s}^{-1}$

$v_i = 20,72 \text{ m.s}^{-1}$ ✓**downwards** ✓ **Range: 20,519 – 20,72**

**OPTION 2:**
**Use of energy principles:**

$E_{mech\ top} = E_{mech\ bottom}$
$E_p + E_{ktop} = E_p + E_{kbottom}$
$mgh + \frac{1}{2}mv^2 = 0\frac{1}{2}mv^2$

Any one ✓

$(9,8)(15) + ½ v_i^2 = ½ (26,74)^2$ ✓

$v_i^2 = 20,519 \text{ m.s}^{-1}$ ✓ **downward** ✓

**(4)**

4.3.3 **POSITIVE MARKING FROM QUESTION 4.2**
**IF SIGN CONVENTION IS NOT FOLLOWED: (-1)**

Crane moves at constant velocity for 1,63s./ *Hyskraan beweeg teen konstante snelheid vir 1,63s.*

$\Delta y = v\Delta t$ ✓
$= (3)(1,63)$ ✓
$= 4,89 \text{ m}$

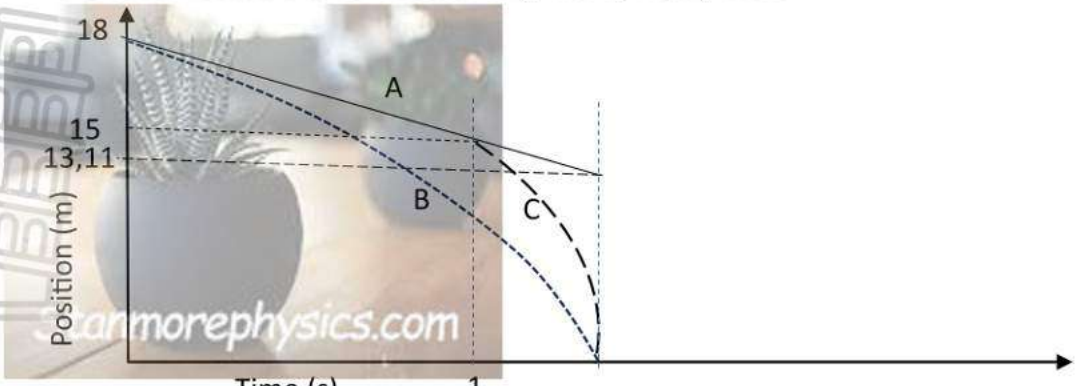
**OR**

$\Delta y = \left(\frac{v_i + v_f}{2}\right) t$ ✓
$= \left(\frac{-3-3}{2}\right)(1,63)$ ✓
$= 4,89$

Height = 18 –✓ 4,89 (Mark is for subtracting the answer from 18)
= 13,11m✓

**(3)**

4.4 **POSITIVE MARKING FROM 4.2, 4.3.1, 4.3.2, 4.3.3**




NOTES:
Starting height (AB) ✓
Drop height of C ✓
Throw time of C ✓
Final position of A ✓
B & C hit ground together ✓
Final time for all graphs ✓

*NOTAS:*
*Aanvanklike hoogte (AB)* ✓
*Gooi/val hoogte van C* ✓
*Gooi tyd van C* ✓
*Finale posisie van A* ✓
*B & C tref grond op dieselfde tyd* ✓
*Finale tyd vir al drie grafieke* ✓

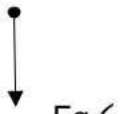
**(6)**

**QUESTION 5**

5.1 A system on which the external net force is zero. ✓✓
*'n Sisteem waarop die eksterne netto krag nul is* ✓✓

**(2 or 0) (2)**

5.2



Fg✓

* Any additional forces/*Addisionele kragte*: -1
* Allow w / weight /*Aanvaar gewig*

**(1)**

5.3 $\text{Mechanical Energy}_{\text{Bottom}} = \text{Mechanical Energy}_{\text{Top}}$
Meganiese energie$_{onder}$ = Meganiese energie$_{bo}$

$$(E_p + E_k)_{bottom} = (E_p + E_k)_{top}$$
$$\left(mgh + \frac{1}{2}mv^2\right)_{bottom} = \left(mgh + \frac{1}{2}mv^2\right)_{top}$$
$$W_{nc} = \Delta E_k + \Delta E_p$$
$$W_{net} = \Delta E_k$$
$$0 + \frac{1}{2}(52)(v^2)\checkmark = (52)(9,8)(0,47)\checkmark + 0$$
$$v_i = 3,04\ m \cdot s^{-1}\ \checkmark$$

Any one ✓

**NOTES:**
✓ Formula
✓ Subs Ep
✓ Subs Ek
✓ Answer

**(4)**

5.4 $\Delta p = mv_f - mv_i$ ✓
$\Delta p = m(v_f - v_i)$
$= 52(3,04 - 0)$✓
$= 158,08\ kg \cdot m \cdot s^{-1}$ ✓ upwards✓ *Iopwaarts* **(4)**

5.5 **POSITIVE MARKING FROM 5.4**
158,08 N·s upwards✓ /Opwaarts **(1)**

5.6 $F_{net}\Delta t = \Delta p$

**OR/*OF***

$F_{net} = \frac{\Delta p}{\Delta t}$

**OR/*OF***

$F_{net}\ \alpha\ \frac{1}{\Delta t}$

Any one✓

**AND:** momentum remains constant ✓

**OR:**

If time increase and force decrease✓, the momentum will remain the same✓

*As tyd toeneem en krag afneem ✓vir dieselfde verandering in momentum, ✓*
**(2)**
**[14]**

**QUESTION 6**

6.1 A force for which work done in moving an object between two points depends on the path taken. ✓✓
*'n krag waarvoor die arbeid verrig word om die voorwerp tussen twee punte beweeg afhang van die pad van beweging.* ✓✓ **(2 or 0)** **(2)**

6.2 $W_f = f\Delta x\cos\theta$✓
$= (7{,}5)(5)\cos 180°$✓
$= -37{,}5\ \text{J}$✓

**(3)**

6.3 **POSITIVE MARKING FROM 6.2**

$W_{nc} = \Delta E_p + \Delta E_k$
$W_{net} = \Delta E_k$
$W_{Fg} + W_f = \Delta E_k$

$W_{nc} = (mgh_f - mgh_i) + \frac{1}{2}m(v_f^2 - v_i^2)$

-37,5✓ = (35)(9,8)(20 x $10^{-2}$ – 2,5) ✓ + ½ (35)($v_f^2$ – $0{,}3^2$) ✓

$v_f = 6{,}56\ \text{m}\cdot\text{s}^{-1}$ ✓

**NOTE: If equations of motion is used: 0/5**

NOTE:
($W_{Fg}$ = Δmgh)
✓Formula
✓ Subst $W_f$
✓ Subst $\Delta E_p$
✓ Subst $\Delta E_k$
✓ Final answer

**(5)**

**[10]**

**QUESTION 7**

7.1 Doppler effect ✓
Change in the frequency/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. ✓✓ /
*Doppler effek*
*Verandering in frekwensie/toonhoogte van die waargenome klank agv relatiewe beweging tussen die bron en luisteraar* **(3)**

7.2.1 Speed (of car)/Motion (of car) /*Spoed (van die motor)* ✓ **(1)**

7.2.2 (observed) frequency✓ / *(waargenome)frekwensie* **(1)**

7.3 B ✓ **(1)**

7.4 The <u>detected frequency is higher</u> ✓/*Die <u>waargenome frekwensie is hoër</u>* **(1)**

7.5 **NOTE: Allow any value for v. The question should be marked accordingly.**

$f_L = \left(\frac{v \pm v_L}{v + v_s}\right) f_s$ ✓

$2030$✓ $= \left(\frac{340}{340 - v_s}\right)(1700)$ ✓

$v_s = 55{,}27\ m \cdot s^{-1}$✓

$f_L = \left(\frac{v \pm v_L}{v + v_s}\right)$ ✓

$2030$✓ $= \left(\frac{343}{343 - v_s}\right)(1700)$ ✓

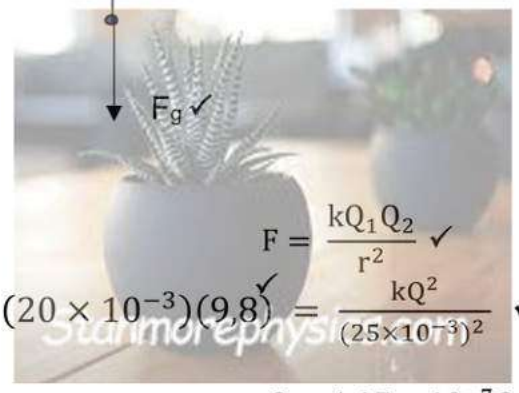
$V_s = 55{,}24\ m \cdot s^{-1}$✓

**(4)**
**[11]**

**QUESTION 8**

8.1 The magnitude of the electrostatic force exerted by one point charge (Q1) on another point charge (Q2) is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them:✓✓*I*
*Twee ladings sal 'n elektrostatiese krag uitoefen deur een puntlading op 'n ander is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.* **(2)**

8.2 $F_E/F_C/F_{AonB}$ ✓ (Coulombic force)




**(2)**

8.3 $F = \frac{kQ_1Q_2}{r^2}$ ✓

✓ $(20 \times 10^{-3})(9{,}8) = \frac{kQ^2}{(25 \times 10^{-3})^2}$ ✓

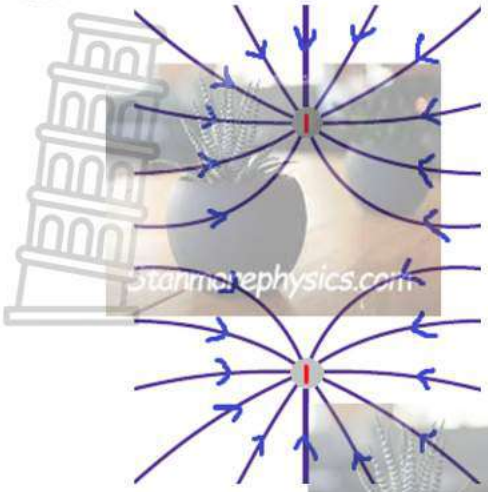
$Q = 1{,}17 \times 10^{-7}C$✓

**MARKING CRITERIA:**

- Coulomb's Law
- Correct substitution into Fg and $F_E$
- Equating Fg and $F_E$
- Final answer (sign not considered)

**(4)**

8.4



* All lines curve away (shape)✓*Ialle lyne buig weg (vorm)*
* All arrows point towards the charge (direction of the field lines)✓*IAlle pyle wys na die lading(rigtin van veldlyne)*
* No lines touching/crossing and all make contact with the charges✓ */Geen lyne raak/kruis of maak kontak met die ladings nie*

**(3)**

8.5

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

$$= \frac{(9 \times 10^9)(1{,}17 \times 10^{-7}) \checkmark}{(25 \times 10^{-3})^2 \checkmark}$$

$$= 1{,}68 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark$$

**(4)**

**QUESTION 9**

9.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature. ✓✓ **(2 or 0)**
*Die potensiaalverskil oor die punte van 'n geleier is direk eweredig aan die stroom in die geleier mits temperatuur constant bly* **(2)**

9.2.1

$$V_{internal} = Ir \checkmark$$
$$1{,}7 = I\,(0{,}7) \checkmark$$
$$I = 2{,}43 \text{ A} \checkmark$$

**(3)**

9.2.2 **(POSITIVE MARKING FROM QUESTION 9.2.1)**

$R_2$:

$V = IR \checkmark$

$5 = 2{,}43\,R_2 \checkmark$

$R_2 = 2{,}06\ \Omega$

$R_1 = 2R_2$ ✓

$\therefore R_1 = 4{,}12\Omega$ ✓

**(4)**

9.2.3 **(POSITIVE MARKING FROM QUESTIONS 9.2.1 AND 9.2.2)**
**OPTION 1**

$$\varepsilon = I(R + r) \checkmark$$
$$= (2{,}43)(0{,}7 + 2{,}06 + 4{,}12) \checkmark$$
$$\varepsilon = 16{,}72 \text{ V} \checkmark$$

**OPTION 2**

$I_{R1} = I_{R2}$

$\frac{V_{R1}}{R_1} = \frac{V_2}{R_2}$

$\frac{V_1}{2R_2} = \frac{5}{R_2}$ ✓

$V_1 = 10\ V$

$\varepsilon = 1,7 + 10 + 5$ ✓

$= 16,7\ V$ ✓

**(3)**

9.3.1 **(POSITIVE MARKING FROM 9.2)**

$\frac{1}{R_p} = \frac{1}{R_3} + \frac{1}{R_2}$

$\frac{1}{R_p} = \frac{1}{15} + \frac{1}{2,06}$ ✓

$R_p = 1,811$

$R_T = R_p + R_1$

$R_T = 1,811 + 4,12$ ✓

$R_T = 5,93\Omega$

$\varepsilon = I(R + r)$ ✓

$16,72 = I(5,93 + 0,7)$ ✓

$I = 2,52\ A$ ✓

**(5)**

**MARKING CRITERIA**

- Correct substitution into $R_p$/*Korrekte invervanging*
- Addition of $R_p$ and $R_1$/*Som van $R_p$ en $R_1$*
- EMF formula/ *EMK formule*
- Substituting into EMF formula *Invervanging in EMK formule*
- Final answer/*Finale antwoord*

9.3.2 **(POSITIVE MARKING FROM QUESTION 9.3.1)**

**MARKING CRITERIA**

- Substituting into Ohm's law/*Invervanging in Ohm se wet*
- Power formula/*Drywing formule*
- Substituting into power formula/*Invervanging in drywing*
- Final answer/*Finale antwoord*

V over $R_2$:

V= IR
= 2,52(1.811) ✓
= 4,56

$P = \frac{V^2}{R}$ ✓

$P = \frac{4,56^2}{2,06}$ ✓

P = 10,09 W✓


**OPTION 2**

I in $R_2$

I = 2,52✓ x $\frac{15}{17,02}$

I = 2,221 A

$R = I^2R$✓
= $(2,221)^2(2,52)$ ✓
= 10,16 W✓

**OPTION 3**

I in $R_2$

I = 2,52✓ x $\frac{15}{17,02}$

I = 2,221 A

P = VI ✓
= (4,56)(2,221) ✓
= 10,127 W ✓

**RANGE: 10,09 – 10,16 W** **(4)**

**[21]**

**GRAND TOTAL/GROOTTOTAAL: 150**