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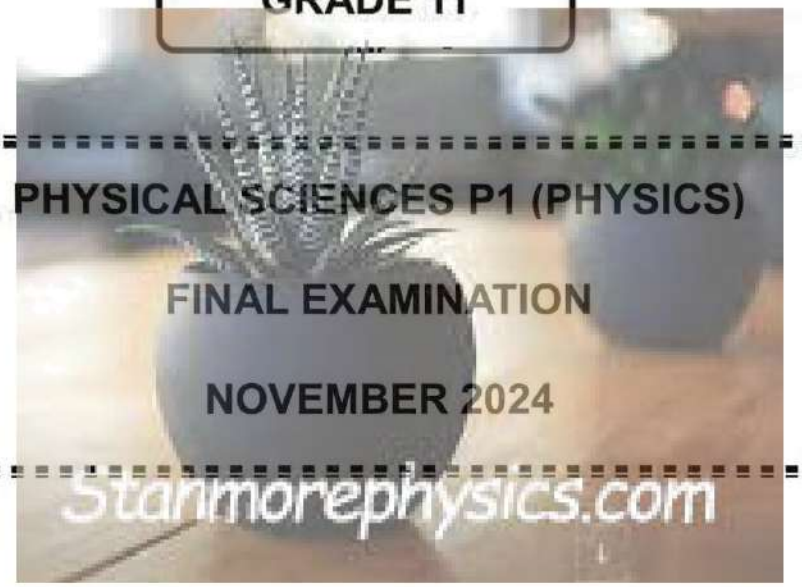
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11



PHYSICAL SCIENCES P1 (PHYSICS)

FINAL EXAMINATION

NOVEMBER 2024

MARKS: 150

TIME : 3 hours

This question paper consists of 12 pages and 3 data sheets.

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INSTRUCTIONS AND INFORMATION

1. Write your NAME in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 8 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 sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions et cetera where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

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QUESTION 1: MULTIPLE CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK.

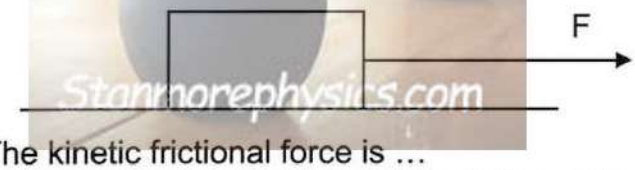
1.1 Which ONE of the following pairs can be classified as scalar quantities?

A Mass and inertia
B Inertia and weight
C Weight and frictional force
D Frictional force and mass (2)

1.2 The vertical component of a force acting on an object moving horizontally…

A accelerates the object horizontally.
B accelerates the object vertically.
C has a tendency to move the object vertically.
D has a tendency to move the object horizontally. (2)

1.3 A crate is moved, from rest, across a rough horizontal surface by a force F. Which ONE of the following statements about the kinetic frictional force acting on the crate is possible?



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The kinetic frictional force is …

A greater than the maximum static frictional force and less than F.
B greater than the maximum static frictional force and greater than F.
C less than the maximum static frictional force and greater than F..
D less than the maximum static frictional force and less than F. (2)

1.4 Consider the following statements related to Newton's third law:
When a force acts on an object,

(i) the reaction to this force acts on the same object.
(ii) the reaction to this force acts on a different object.
(iii) the time for which the force acts is greater than the time for which the reaction to this force acts.
(iv) the force and the reaction to this force are in opposite directions.

Which of the above statements is/are true?

A (i) and (iv) only.
B (ii) and (iv) only.
C (i), (iii) and (iv) only.
D (ii), (iii) and (iv) only. (2)

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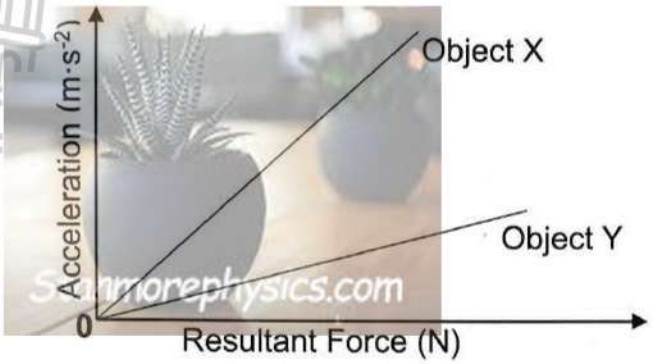
1.5 The acceleration versus resultant force graphs for the motion of objects X and Y are shown below. Which ONE of the following statements is true?

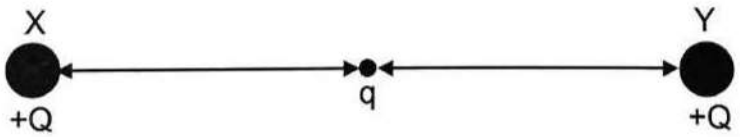


A Object X has a greater mass than object Y.
B Object Y has a greater mass than object X.
C If both objects experience the same acceleration, the resultant force on object X is greater than that on object Y.
D For the same resultant force, object X has a smaller acceleration than object Y. (2)

1.6 The magnitude of the gravitational acceleration on Earth is **g**. What will the value of the gravitational acceleration be on planet X, which has the SAME mass as Earth, but HALF the radius of Earth?

A ¼ **g**
B 4 **g**
C ½ **g**
D 2 **g** (2)

1.7 A small test charge, q, is placed exactly halfway between two fixed identical charged spheres, X and Y, each carrying a charge of +Q, as shown in the diagram below.



The net electrostatic force experienced by the test charge will be…

A towards X.
B towards Y.
C zero.
D greater than zero. (2)

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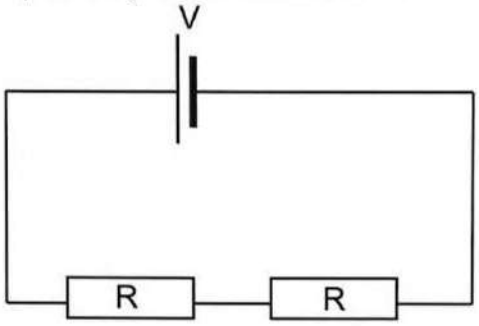
1.8 The minimum resistance that can be obtained by connecting two 4 Ω resistors in a circuit is …

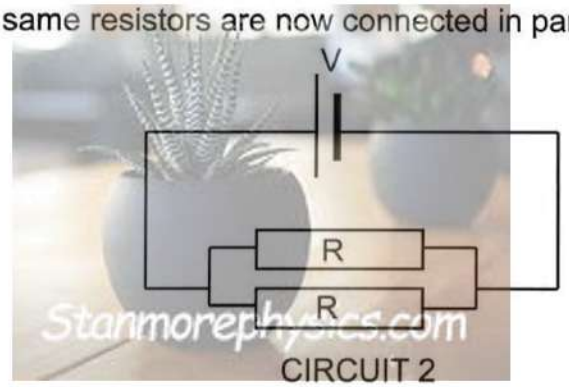
A 8 Ω
B 4 Ω
C 3 Ω
D 2 Ω (2)

1.9 The two resistors in CIRCUIT 1 below are identical. They are connected to a cell with emf V and negligible internal resistance.
The power dissipated by each resistor is **P**.



CIRCUIT 1

The same resistors are now connected in parallel, as shown in CIRCUIT 2.



CIRCUIT 2

What is the power dissipated by each resistor in CIRCUIT 2?

A 2**P**
B 4**P**
C 8**P**
D 16**P** (2)

1.10 A bar magnet is moved into and out of a solenoid. Which ONE of the following changes will result in a LARGER induced emf in the solenoid?

A Using a weaker magnet.
B Using a solenoid with fewer turns.
C Using a solenoid with a smaller diameter.
D Moving the magnet faster into and out of the solenoid. (2)

[20]

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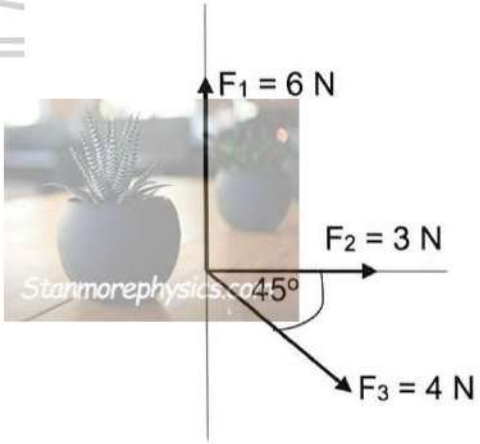
QUESTION 2 : (Start on a new page)

Three co-planar forces, F_1, F_2 and F_3 of magnitude 6 N, 3 N and 4 N respectively act on an object. The sketch below, not drawn to scale, shows the directions of the forces.



2.1 Define *resultant force*. (2)

2.2 Calculate the:

2.2.1 Magnitude of the resultant force acting on the object (8)

2.2.2 Direction of the resultant force (3)
[13]

QUESTION 3: (Start on a new page)

3.1 Define *inertia.* (2)

3.2 A passenger is seated in a fast-moving taxi when the taxi driver suddenly slams on the brakes. Use your knowledge of Newton's laws to explain why the passenger moves forward when the brakes are applied. (3)

3.3 Explain why wearing a seat belt is a safety measure for the occupants of a vehicle. (2)

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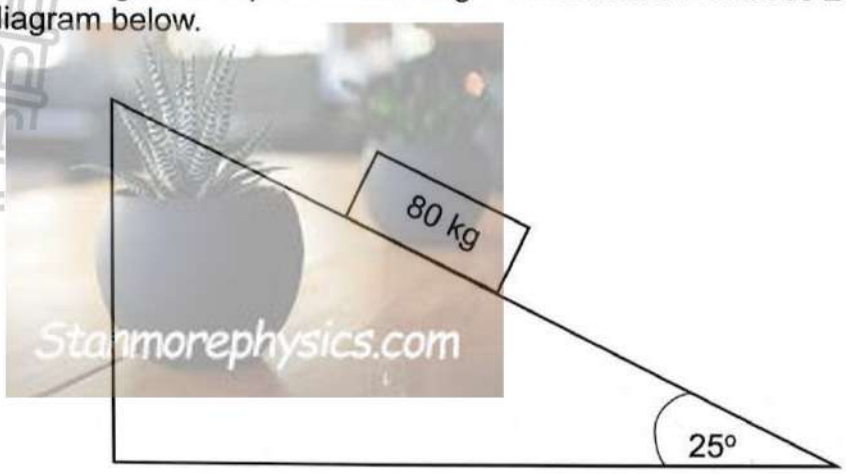
3.4 A crate of mass 80 kg lies on a rough plane inclined at 25° to the horizontal. The crate begins to slip when the angle of inclination exceeds 25°. Refer to the diagram below.



3.4.1 Define the term *static friction*. (2)

3.4.2 Draw a free-body diagram showing all the forces acting on the crate. (3)

3.4.3 Define the term *normal force*. (2)

3.4.4 Calculate the magnitude of the normal force. (3)

3.4.5 Calculate the magnitude of the maximum static frictional force acting on the crate. (3)

3.4.6 Calculate the coefficient of static friction between the crate and the plane. (3)

3.4.7 If the mass of the crate is increased, will the crate begin to slide? Choose from YES or NO.
Explain the answer. (3)

3.4.8 If the angle of inclination is changed from 25° to 20°, how would this change affect the static frictional force acting on the crate? Choose from INCREASES, DECREASES, or REMAINS THE SAME.
Explain the answer. (3)
[29]

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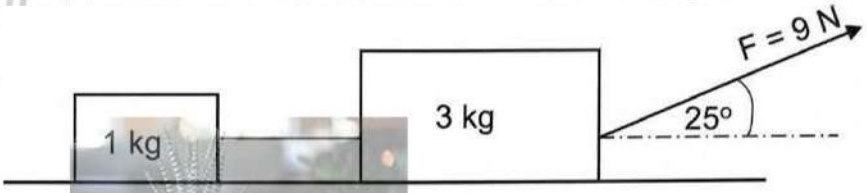
QUESTION 4: (Start on a new page)

Two blocks of masses 1 kg and 3 kg are connected by a light, inextensible string. The blocks are initially at rest on a smooth horizontal surface. A force F of magnitude 9 N is applied to the 3 kg block, as shown in the diagram below.



4.1 State Newton's Second law of motion in words. (2)

4.2 Draw a free-body diagram showing all the forces acting on the 3 kg block. (4)

4.3 By applying Newton's Second law to each block separately, calculate the:

4.3.1 Magnitude of the acceleration of the blocks (5)

4.3.2 Tension in the string (2)

4.4 The 1 kg block is replaced by a block with a bigger mass, while the force applied on the 3 kg block remains unchanged. State whether the tension calculated in Question 4.3.2 will INCREASE, DECREASE or STAY THE SAME. Give a reason for the answer. (3)
[16]

QUESTION 5: (Start on a new page)

5.1 State Newton's Law of universal gravitation in words. (2)

5.2 Differentiate between the MASS and the WEIGHT of an object. (2)

5.3 A 70 kg mountain climber reaches the top of Mount Everest, 8,85 km above sea level. Take the surface of Earth to be sea level.

At the top of Mount Everest, determine the:

5.3.1 Acceleration due to gravity (4)

5.3.2 Mountain climber's weight (3)

5.4 A learner makes the following statement:
"An astronaut orbiting Earth experiences weightlessness because he or she is beyond the pull of Earth's gravity".

5.4.1 Define *weightlessness*. (2)

5.4.2 Is the statement correct? Choose from YES or NO.
Explain the answer. (3)
[16]

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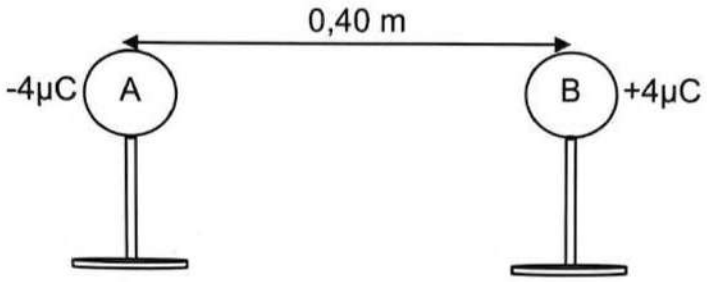
QUESTION 6: (Start on a new page)

The diagram below shows two identical spheres, A and B on insulated stands, carrying charges of –4μC and +4μC respectively. The distance between the centres of the spheres is 0,40 m.

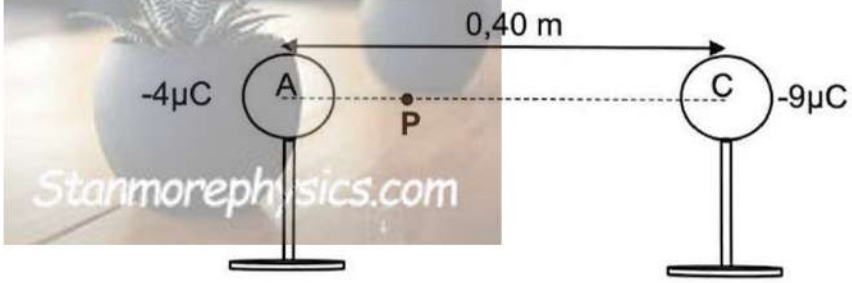


6.1 State *Coulomb's Law* in words. (2)

6.2 Calculate the electrostatic force that sphere A exerts on sphere B. (4)

6.3 Draw the electric field pattern due to the two spheres. (3)

Sphere B is now replaced by a third sphere, sphere C, carrying a charge of –9μC. **P** is a point along the line joining the centres of the spheres, as shown in the diagram below.



6.4 Define *electric field at a point*. (2)

6.5 If the net electric field at point **P** is zero, calculate the distance between point **P** and the centre of sphere A. (6)
[17]

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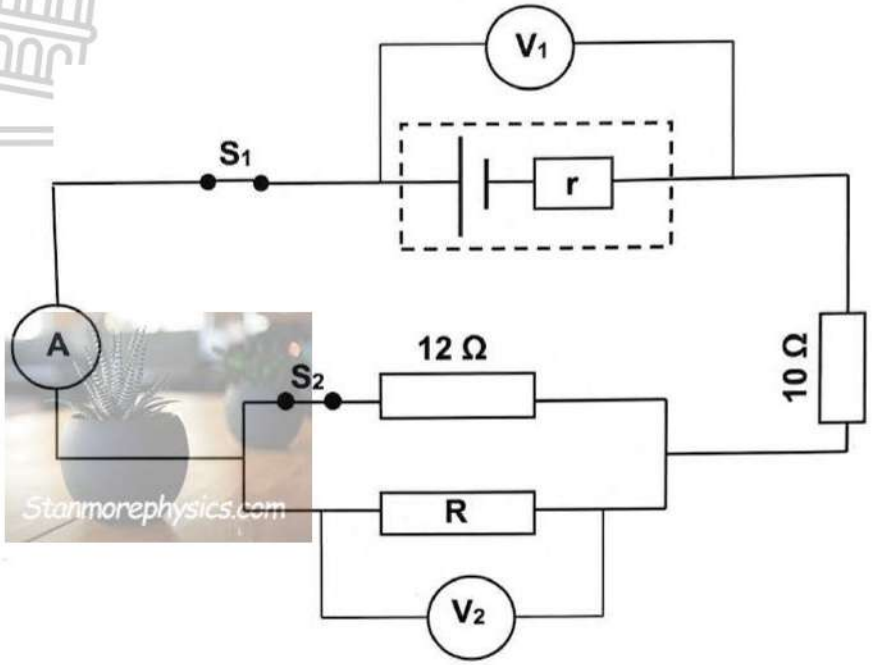
QUESTION 7: (Start on a new page)

The battery in the circuit diagram below has an internal resistance **r**. The ammeters and connecting wires have negligible resistance.



Both switches S_1 and S_2 are initially closed. The reading on voltmeter V_2 is 18 V and the power dissipated by resistor **R** is 12 W.

7.1 Calculate the:

7.1.1 Resistance of resistor **R** (3)

7.1.2 Reading on the ammeter (5)

7.1.3 Potential difference across the 10 Ω resistor (3)

7.2 When switch S_1 is opened the reading on voltmeter V_1 changes to 41,9 V. Calculate the internal resistance of the battery. (4)

7.3 Switch S_2 is now opened while S_1 is closed. Will the reading on the ammeter INCREASE, DECREASE or REMAIN THE SAME?
Give a reason for the answer. (2)

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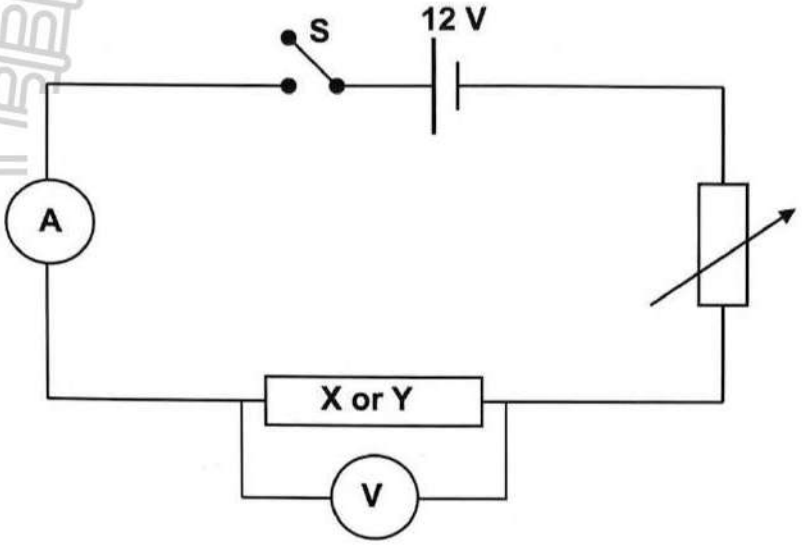
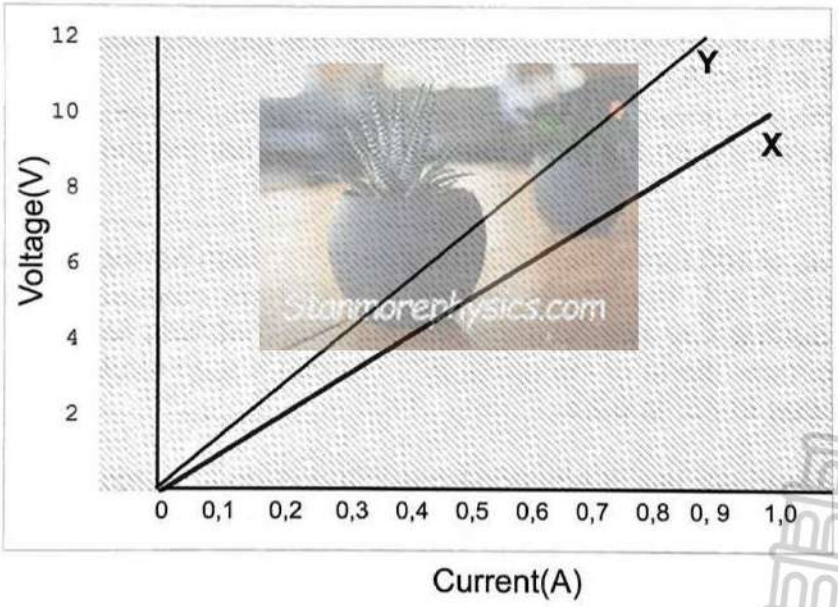
7.4 A learner sets up the circuit shown below to investigate Ohm's Law for each of two resistors **X** and **Y**. Ignore the internal resistance of the battery.



The following graphs were obtained from the results of the investigation.



7.4.1 State Ohm's Law in words. (2)

7.4.2 Use the graph to determine the resistance of resistor **Y**. (4)

7.4.3 Resistors **X** and **Y** are connected in series to a battery in a circuit. Which resistor, **X** or **Y** will be more suitable to boil the same mass of water at a faster rate in an electric kettle?
Give a reason for the answer. (3)
[26]

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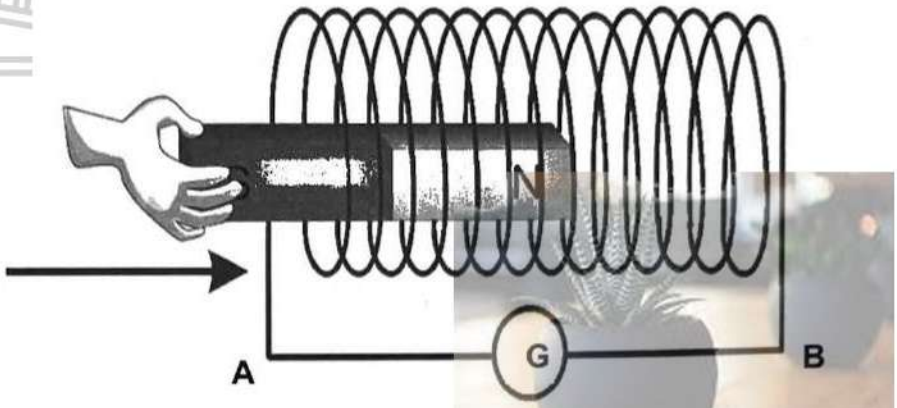
QUESTION 8: (Start on a new page)

In the diagram below the north pole of a bar magnet is being pushed into a coil. The emf induced in the coil is recorded by a galvanometer.



8.1 When the bar magnet moves in and out of the coil, the coil and the bar magnet exert a force on each other. Is this force MECHANICAL, ELECTROSTATIC or MAGNETIC? (1)

8.2 State the direction of the induced current through the galvanometer. Choose **A** to **B** or **B** to **A** (2)

8.3 Write down the reading on the galvanometer when the bar magnet is at rest inside the coil. (1)

8.4 A coil is made up of 100 turns of insulated copper wire, each having a circular area of $4,8 \times 10^{-4}$ m^2. The coil is placed in a uniform magnetic field of $3,9 \times 10^{-4}$ T in such a way that the angle between the magnetic field and the normal to the circular plane of the coil is 30°. The coil is then rotated so that the angle changes to 70° in 0,2 s.

8.4.1 State Faraday's law of electromagnetic induction in words. (2)

8.4.2 Calculate the magnitude of the emf induced in the coil. (4)

8.4.3 Calculate the current induced in the coil if it has an effective resistance of 2 Ω. (3)

[13]

TOTAL: 150

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DATA FOR PHYSICAL SCIENCES GRADE 11

PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11

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 $m \cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstante*	G	$6,67 \times 10^{-11}$ $N \cdot m^2 \cdot kg^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^8$ $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63 \times 10^{-34}$ $J \cdot s$
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^9$ $N \cdot m^2 \cdot C^{-2}$
Charge on electron *Lading op electron*	e^-	$-1,6 \times 10^{-19}$ C
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg
Mass of Earth *Massa van Aarde*	M	$5,98 \times 10^{24}$ kg
Radius of Earth *Radius van Aarde*	R_E	$6,38 \times 10^6$ m

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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

$F_{net} = ma$	
$f_s^{(max)} = \mu_s N$	$f_k = \mu_k N$
$w = mg$	
$F = \frac{Gm_1m_2}{r^2}$	$g = \frac{Gm}{r^2}$

ELECTROSTATICS / ELEKTROSTATIKA

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ OR/OF $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS / ELEKTRIESE STROOMBANE

$R = \frac{V}{I}$	emf (ε) = I (R + r)
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\,\Delta t$

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$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

ELECTRODYNAMICS

$\varepsilon = -N\frac{\Delta \emptyset}{\Delta t}$
$\emptyset = BACos\,\theta$

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GRADE 11

PHYSICAL SCIENCES P1 (PHYSICS)

MARKING GUIDELINE

NOVEMBER 2024

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MARKS: **150**

These marking guidelines consist of 10 pages.

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QUESTION 1

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

[20]

QUESTION 2

2.1

Marking criteria
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark

Resultant force is the vector sum✓ of two or more forces acting together✓

OR

That single force having the same effect✓ as two or more forces acting together. ✓ (2)

2.2.1

Vector	F_1 = 6 N	F_2 = 3 N	F_3 = 4 N	Resultant
x-component	0 N	3 N ✓	4cos 45°✓	5,83 N ✓ (to the right)
y-component	6 N	0 N✓	-4sin 45°✓	3,17 N ✓ (Upwards)

NOTE: If the 0 N is implied for the x–component of F_1, and the y–component of F_2, award the marks indicated by the rings.

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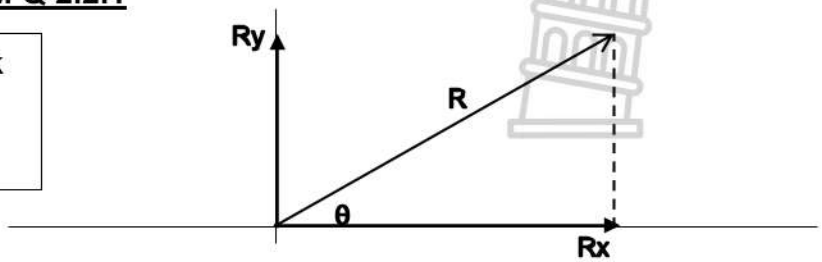
$R^2 = R_X^2 + R_Y^2$
$R^2 = 5{,}83^2 + 3{,}17^2$✓
$R = 6{,}64$ N ✓ (8)

2.2.2 **POSITIVE MARKING FROM Q 2.2.1**

NOTE: Award the formula mark to the substitution if formula is not given.



$\tan\theta = \frac{R_y}{R_x}$✓ :
$\tan\theta = \frac{3{,}17}{5{,}83}$✓
θ = 28,53° North of East ✓ OR θ = 61,47° East of North / Bearing. (3)

[13]

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QUESTION 3

3.1 Inertia is the resistance of an object to any changes in its state of motion. ✓✓ (2 OR 0). (2)

3.2
- Passenger and taxi move with the same velocity before brakes are applied. ✓
- When brakes are applied, the net force acts on the taxi✓ (and not the passenger).
- Due to inertia the passenger continues to move forward.✓ (3)

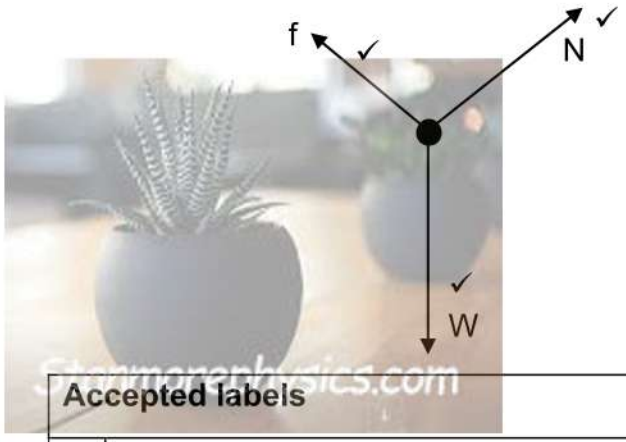
3.3 The occupant moving forward exerts a force on the seat belt. By Newton's third law, the seat belt exerts an equal force in the opposite direction✓ to prevent the occupant from moving forward.✓ (2)

3.4.1

Marking criteria
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark

Static frictional force is the force that opposes the tendency of motion of a stationary object relative to a surface. ✓✓ (2)

3.4.2



Accepted labels	
w	F_g /F_w /$F_{earth\ on\ P}$ /weight /mg /784 N /gravitational force
f	F_f /f_s /(static) friction
N	F_N /Normal /F_{normal}

Notes:
- Mark awarded for label and arrow.
- Do not penalise for length of arrows since drawing is not to scale.
- Any other additional force(s): Max $^2/_3$
- If everything correct, but no arrows: Max $^2/_3$
- If force(s) do not make contact with the dot: Max $^2/_3$

(3)

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3.4.3 **Marking criteria**
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark (3)

Normal force is the force (or the component of a force) which a surface exerts on an object in contact with it,✓and which is perpendicular to the surface.✓ (2)

3.4.4 $N = F_{g\perp} / mg \cos \theta$✓
$= 80 \times 9.8 \times \cos 25°$✓
$= 710,55$ N✓ (3)

3.4.5 $f_s^{max} = F_{g//} / mg \sin \theta$✓
$= 80 \times 9.8 \times \sin 25°$✓
$= 331,33$ N✓ (3)

3.4.6 **POSITIVE MARKING FROM Q3.4.4 and Q3.4.5**
$f_s^{max} = \mu_s \times N$✓
$331,33 = \mu_s \times 710,55$✓
$\mu_s = 0.47$✓ (0,466) (3)

3.4.7 Yes.✓
The component of the gravitational force parallel to the incline / $F_{g//}$ / mg sinθ increases✓ while f_s^{max} acting up the incline cannot increase. ✓
∴ There is a net force / acceleration down the incline. (3)

3.4.8 Decreases. ✓
The component of the gravitational force parallel to the incline / $F_{g//}$ / mgsinθ decreases✓and f_s can be less than f_s^{max} ✓so that $f_s = F_{g//}$. (3)
[29]

Q3.4.7
Correct answer is :
NO.✓Both the parallel component of the gravitational force and the maximum static frictional force increase✓ by the same magnitude.✓

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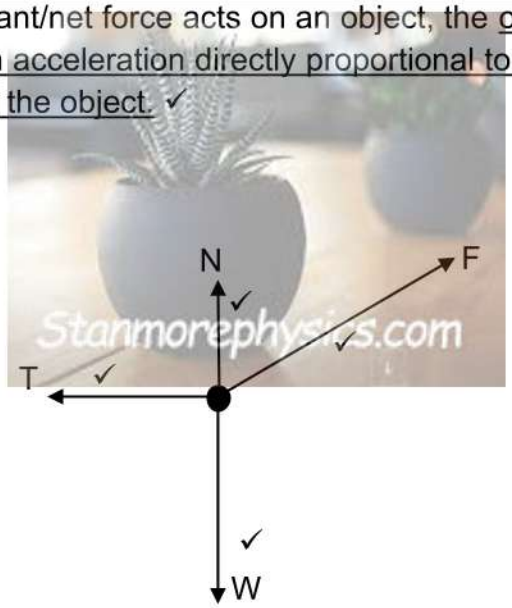
QUESTION 4

Marking criteria If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark

4.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an acceleration directly proportional to the force✓ and inversely proportional to the mass of the object. ✓ (2)

4.2



Accepted labels	
w	F_g /F_w /$F_{earth\ on\ P}$ /weight /mg /88,2 N /gravitational force
T	F_T /F_{string} /F_t /tension.
F	$F_{applied}$ / F_{app} / 9 N
N	F_N /Normal /F_{normal}

Notes:

- Mark awarded for label and arrow.
- Do not penalise for length of arrows since drawing is not to scale.
- Any other additional force(s): Max $^3/_4$
- If everything correct, but no arrows: Max $^3/_4$
- If force(s) do not make contact with the dot: Max $^3/_4$

(4)

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4.3.1 **MARKING CRITERIA**

- F_{net} = ma (for either block)✓
- Substitution of T and mass for 1 kg block✓
- Substitution on the left-hand side for the 3 kg block.✓
- Substitute 3 kg on the right-hand side for the 3 kg block. ✓
- Answer. ✓

For the 1 kg block

F_{net} = ma ✓

T = 1a✓----------eqn. 1

For the 3 kg block

F_{net} = ma

F_x – T = ma

(9 cos25° - T)✓= 3a✓----------eqn. 2

Therefore a = 2,04 $m \cdot s^{-2}$✓ (5)

4.3.2 **POSITIVE MARKING FROM Q 4.3**

OPTION 1:	**OPTION 2:**
T = 1a	F_{app} - T= m a
T = 1(2,04)	(9 cos25° - T) = 3 (2,04)✓
T = 2,04 N✓✓	T = 2,04 N✓

(2)

4.4 Increase✓

The increased mass of the smaller block increases the load, ✓ requiring a bigger force to pull it.✓ OR

T = Fcos25 – 3a. ✓ Acceleration decreases, ✓ hence T increases. (3)

[16]

QUESTION 5

5.1

Marking criteria
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark

Every particle in the universe attracts every other particle with a gravitational force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres. ✓✓ (2)

5.2 Mass is the amount of matter contained in the body.✓ Weight is the force with which the Earth attracts the body.✓

NOTE: If candidate states: Mass is a scalar quantity, while weight it is a vector quantity, award 1 mark only. (2)

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5.3.1 $g = \frac{G\,M}{r^2}$ ✓

$= \frac{6{,}67 \times 10^{-11} \times 5{,}98 \times 10^{24}}{(6{,}38 \times 10^{6} + 8850)^2}$ ✓

$= 9{,}77\ m{\cdot}s^{-2}$ ✓ downwards / towards the Earth's centre (4)

5.3.2

OPTION 1	**OPTION 2**
POSITIVE MARKING FROM Q 5.3.1	$F_g = \frac{G\,m_1 m_2}{r^2}$ ✓
$W = mg$ ✓	$F_g = \frac{6{,}67 \times 10^{-11} \times 5{,}98 \times 10^{24} \times 70}{(6{,}38 \times 10^{6} + 8850)^2}$ ✓
$= 70 \times 9{,}77$ ✓	$w = 684{,}04$ N ✓
$= 683{,}90$ N ✓	

(3)

5.4.1 The sensation experienced when all contact forces are removed / in free fall. ✓✓ (2 OR 0). (2)

5.4.2 No. ✓ The gravitational force exerted by Earth still exists in orbit. ✓ Astronauts experience weightlessness because the only force acting on them is the gravitational force. ✓ (3)

[16]

QUESTION 6

6.1

Marking criteria
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark

The magnitude of the (electrostatic) force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them. ✓✓ (2)

6.2 $F_e = \frac{k\,Q_1 Q_2}{r^2}$ ✓

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

$= 0{,}9$ N ✓ towards A / to the left ✓ (4)

NOTE: Direction must be marked independent of answer.

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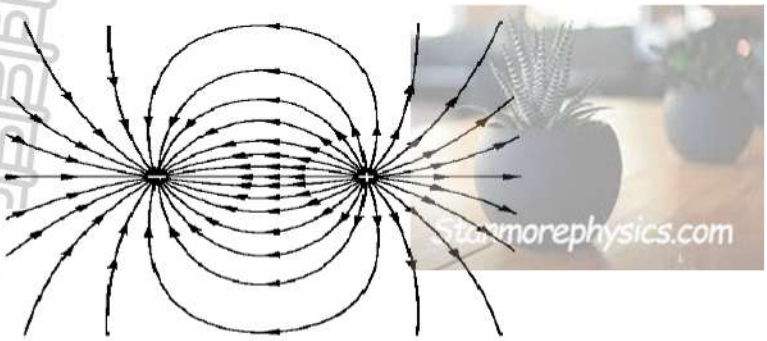
6.3 (3)



Marking Criteria:

- Correct direction of field – from positive to negative charge.✓
- Field lines not touching each other and starting from / touching the surfaces of the spheres. ✓
- Correct shape. ✓

6.4 **Marking criteria**
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark

The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point. ✓✓ (2)

6.5

Marking Criteria:

- Correct vector equation equating E_A and E_B.✓
- Correct formula to calculate electric field. ✓
- Substitution to calculate E_A. ✓
- Substitution to calculate E_B. ✓✓
- Final answer (r = 0,16 m). ✓

$E_A + E_C = 0$
$E_A = E_C$ } Any one ✓

$$\frac{kQ_A}{r^2} \checkmark = \frac{kQ_B}{(0,4 - r)^2}$$

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

$r = 0,16$ m✓

(6)
[17]

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QUESTION 7

7.1.1 $P = \frac{V^2}{R}$ ✓

$12 = \frac{18^2}{R}$ ✓

$R = 27\Omega$ ✓ (3)

7.1.2

OPTION 1:	**OPTION 2:**
POSITIVE MARKING FROM Q7.1.1:	$I_R = \frac{V}{R}$ ✓
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ OR $R_p = \frac{R_1 \times R_2}{R_1 + R_2}$ ✓	$P = VI$ ✓ OR $= \frac{18}{27}$ ✓
$\frac{1}{R_p} = \frac{1}{27} + \frac{1}{12}$ ✓ $= \frac{27 \times 12}{27+12}$ ✓	$12 = 18\ I_R$ ✓ $I_R = 0,67$ A
$R_p = 8,31\ \Omega$	$I_{12} = \frac{V_2}{R}$ ✓
$I_p = \frac{V_2}{R_p}$ ✓	$I_{12} = \frac{18}{12}$ ✓
$= \frac{18}{8,31}$ ✓	$I_{12} = 1,5$ A
$= 2,17$ A ✓ ∴ ammeter reading is 2,17 A	Ammeter reading = 0,67 + 1,5 = 2,17A ✓

(5)

7.1.3 **POSITIVE MARKING FROM Q7.1.2:**

$V = IR$ ✓

$V = 2,17 \times 10$ ✓

$V = 21,7$ V ✓ (3)

7.2

OPTION 1:	**OPTION 2:**
POSITIVE MARKING FROM Q7.1.2 & Q7.1.3	**POSITIVE MARKING FROM Q7.1.2**
$V_{lost} = 41,9 - (21,7 + 18)$ ✓	$\varepsilon = I(R + r)$ ✓
$= 2,20$ V	$41,9$ ✓ $= 2,17((8,31+10) + r)$ ✓
$V_{lost} = Ir$ ✓	$r = 1,00\ \Omega$ ✓
$2,20 = 2,17r$ ✓	**OR** $\varepsilon = V_{ext} + Ir$ ✓
$r = 1,01\ \Omega$ ✓	$41,9$ ✓ $= (21,7+18) + 2,17r$ ✓

(4)

7.3 Decrease. ✓ R_{TOT} increases. ✓ (2)

7.4.1 **Marking criteria**
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark

The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature. ✓✓ (2)

7.4.2 Gradient $= \frac{\Delta V}{\Delta I}$ ✓

$= \frac{(12-0)}{(0,9-0)}$ ✓ $= 13,33\ \Omega$

Therefore, the resistance of Y is 13,33 Ω ✓ (4)

NOTES:
Any ordered pair, correctly read from the graph can be used.
The fourth mark is for clearly indicating that the gradient is the resistance.

7.4.3 Y. ✓ The higher the resistance the higher the power output / $P \propto R$ ✓ (I is constant) thus more energy dissipated in the resistor per unit time / per second / in a given time. ✓ (3)

[26]

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QUESTION 8

8.1 Magnetic force. ✓ (1)

8.2 A to B✓✓ (2)

8.3 Zero. ✓ (1)

8.4.1 **Marking criteria**
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark

The magnitude of the induced emf across the ends of a conductor is directly proportional to the rate of change in the magnetic flux linked with the conductor. ✓✓ (2)

8.4.2

$$\varepsilon = -N\frac{\Delta\emptyset}{\Delta t}$$

$$\varepsilon = -N\frac{(\emptyset_{70^o}-\emptyset_{30^o})}{\Delta t}$$

$$\varepsilon = -N\frac{(BACos\ 70 - BACos30)}{\Delta t}$$

Any one ✓

$$\varepsilon = -100\frac{(3{,}9\times10^{-4}\times4{,}8\times10^{-4}\ Cos\ 70\checkmark - 3{,}9\times10^{-4}\times4{,}8\times10^{-4}\ Cos30\checkmark)}{0{,}2}$$

$\varepsilon = 4{,}90\times10^{-5}$ V✓ (4)

8.4.3 **POSITIVE MARKING FROM Q8.4.2**

$\varepsilon = IR / V = IR$✓

$4{,}90\times10^{-5} = I(2)$ ✓

$I = 2{,}45\times10^{-5}$ A✓ (3)

[13]

TOTAL: 150