Province of the
EASTERN CAPE
EDUCATION

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REPUBLIC OF SOUTH AFRICA

CHIEF DIRECTORATE – CURRICULUM MANAGEMENT

GRADE 12 LEARNER SUPPORT PROGRAMME

REVISION AND REMEDIAL TEACHING INSTRUMENT: QUESTIONS AND ANSWERS

SUBJECT: PHYSICAL SCIENCES – FIRST PAPER

June 2009

This document consists of 16 pages.

Strictly not for test/examination purposes

INSTRUCTIONS AND INFORMATION

1. Write your name and/or examination number (and centre number if applicable) in the appropriate spaces on the ANSWER SHEET and ANSWER BOOK.

2. Answer ALL the questions.

3. Answer SECTION A on the attached ANSWER SHEET and place the completed answer sheet inside your answer book.

4. Answer SECTION B in the ANSWER BOOK.

5. Non-programmable calculators may be used.

6. Appropriate mathematical instruments may be used.

7. Number the questions correctly according to the numbering system used in this question paper.

8. Data sheets are attached for your use.

9. Give brief motivations, discussions, etcetera where required.

SECTION A

Answer this section on the attached ANSWER SHEET.

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for EACH of the following descriptions. Write only the word/term next to the question number (1.1 – 1.5) on the attached ANSWER SHEET.

1.1 The product of force and velocity (1)

1.2 The type of connection of resistors that results in the division of potential difference among the resistors. (1)

1.3 A point or space where a unit positive charge will experience an electric force. (1)

1.4 Light that has a single frequency. (1)

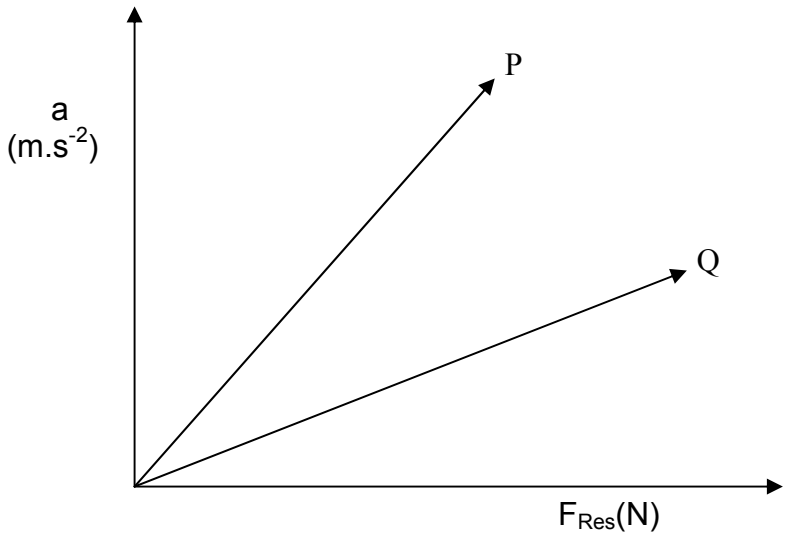
1.5 Light energy occurs in "packets" called … (1)
[5]

QUESTION 2: FALSE ITEMS

The following statements given in questions 2.1 to 2.5 are **FALSE**. Write the correct statements next to the question number(2.1 - 2.5) on the attached ANSWER SHEET.

2.1 During inelastic collision in a closed system momentum and kinetic energy is always conserved. (2)

2.2 During Deon's investigation of the relationship between the acceleration (a) and the resultant force (F_{Res}) on TWO objects (P and Q) moving on a frictionless surface, he obtains the graphs below. In this investigation Deon concludes that the mass of P is greater than the mass of Q.



(2)

2.3 Diffraction is the phenomenon best suited to explain the particle nature of light. (2)

2.4 The magnitude of the induced emf in a coil is inversely proportional to the rate of change of magnetic flux linkage. (2)

2.5 The electrical resistance of a conductor increases as the thickness of the wire increases. (2)

[10]

QUESTION 3: MULTIPLE-CHOICE QUESTIONS

Four possible options are provided as answers to the following questions. Each question has only **ONE** correct answer. Choose the best answer and make a cross (X) in the correct block (A –D) next to the question number (4.1 – 4.5) on the attached ANSWER SHEET.

3.1 Sharon does exercises in the gymnasium. In which of the following cases would her power output be the greatest? She does

A. 90 J work in 30 s.
B. 100 J work in 40 s.
C. 10 J work in 10 s.
D. 75 J work in 15 s. (2)

3.2 Matutu throws a ball vertically upwards. The ball experiences an increase in

A. Acceleration.
B. Potential energy.
C. Kinetic energy.
D. Momentum. (2)

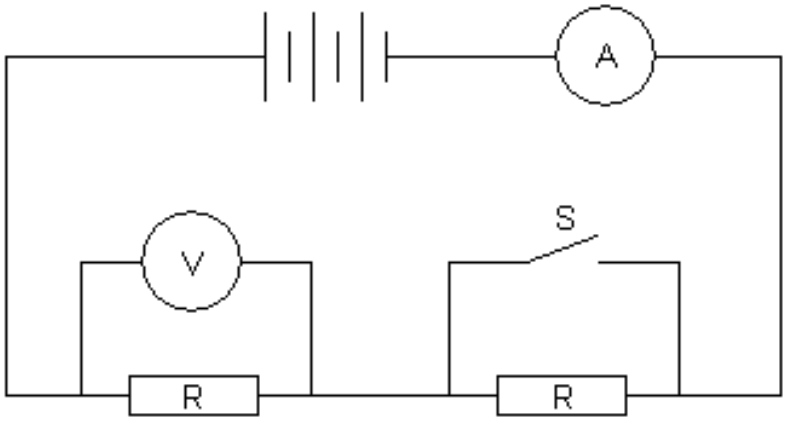
3.3 Jonas throws a tennis ball, mass 50 g, in a westerly direction at a velocity of 7 $m.s^{-1}$ towards a wall. The ball bounces back from the wall at a velocity of 5 $m.s^{-1}$. The change in momentum is

A. 600 $kg.m.s^{-1}$ easterly.
B. 600 $kg.m.s^{-1}$ westerly.
C. 0,6 $kg.m.s^{-1}$ easterly.
D. 0,6 $kg.m.s^{-1}$ westerly. (2)

3.4 The capacitance of a capacitor is 1 farad when

A. it is connected to a 1 Ω resistor and it discharges.
B. 1 J of energy is gained by storing 1 C of charge.
C. 1 C of charge is stored over a potential difference of 1 V.
D. it is fully charged by a current of 1 A in 1 s. (2)

3.5 The voltmeter in the circuit has a high resistance and the ammeter a low resistance. The TWO resistors are identical. What will happen to the reading on the ammeter and voltmeter if switch S is closed?



	Voltmeter	Ammeter
A.	Increases	Increases
B.	Increases	Decreases
C.	Decreases	Increases
D.	Decreases	Decreases

(2)

[10]

TOTAL SECTION A: 25

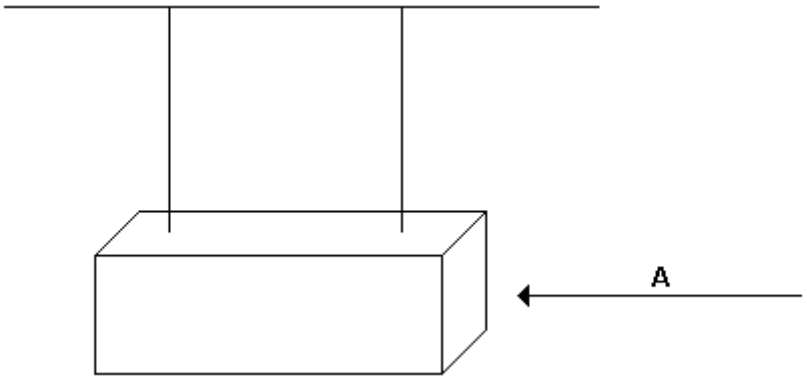
SECTION B

INSTRUCTIONS AND INFORMATION

1. Answer SECTION B in the ANSWER BOOK.
2. The formulae and substitutions must be shown in ALL calculations.
3. Round off your answers to TWO decimal places.
4. Start each question on a new page.

QUESTION 4

An archer shoots an arrow, **A**, of mass 150 g, and while it travels with a velocity of 25 $m.s^{-1}$ it strikes a 1100 g wooden block. The wooden block hangs at rest on strings as indicated in the sketch. The arrow embeds itself in the wooden block.



4.1 Determine the initial velocity of the wooden block immediately after being struck by the arrow. (6)

4.2 State the name of the principle you used to answer QUESTION 4.1. (2)

4.3 What is the average force applied by the arrow on the wooden block if the arrow comes to rest within the wooden block 0,001 s after striking the wooden block? (5)

4.4 Determine the maximum height that the block and the embedded arrow will rise to if all the mechanical energy is conserved. (6)

4.5 The block and the embedded arrow actually rise to a height of 0,3 m above its original position. Compare the actual height given with your answer for question 4.4 and explain any difference in the TWO values. (2)

[21]

QUESTION 5

You are present when a research rocket is launched vertically. The rocket accelerates for the first 10 s of its flight, at which point all its fuel is used up. For the rest of the motion the rocket is in free fall. (The effects of air friction and the Earth's rotation can be ignored.)

The following data is provided:

Initial velocity at launch = 0 $m.s^{-1}$.
Constant acceleration provided by the combustion of the fuel on the rocket = 40 $m.s^{-2}$
Height reached at the point the fuel is used up = 2000 m

5.1 Using Newton's Third Law of motion, explain how the rocket is propelled upwards. (4)

5.2 Calculate the velocity reached by the rocket at the point the fuel is used up. (4)

5.3 Determine the height above the earth that the rocket reaches before it **starts falling back to earth.** (5)

5.4 Draw sketch graphs for the **UPWARD** motion of the rocket (take the upward direction as positive) for its

5.4.1 displacement against time. (4)
5.4.2 velocity against time. (4)

[21]

QUESTION 6

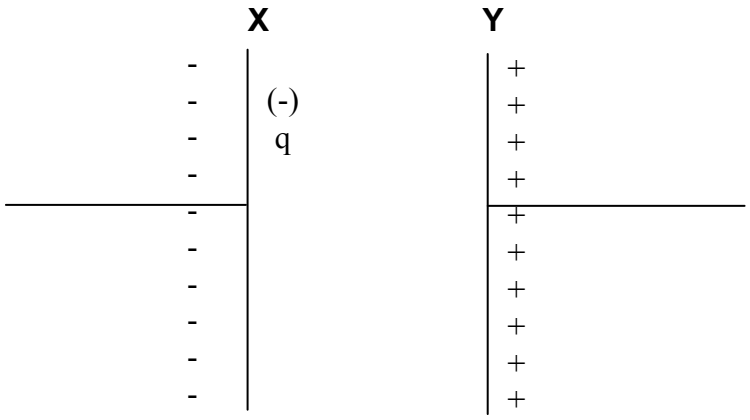
6.1 Write down the work-energy principle/relationship. (2)

6.2 A farmer used an electric pump to raise water from a borehole of depth 40m. If 500kg of water is to be pumped every minute and water is to be discharged at 4$m.s^{-1}$, Calculate the minimum power of the electric pump the farmer must use. (Ignore friction) (7)

[9]

QUESTION 7

A potential difference of 2400 V is applied across TWO parallel metal plates, X and Y. The electric field between the TWO plates is 3,8 x 10^4 N.C^{-1}. A charge, q, of magnitude – 8,5x 10^{-9} C, is placed at the negative plate and then released.



7.1 Draw a neat sketch of the electric field between the parallel plates. (3)

7.2 Calculate the electrostatic force that q experiences. (4)

7.3 How much work is done to move the charge from plate X to plate Y? (4)

7.4 How much energy will be required to move the charge back from plate Y to a point halfway between the plates? (2)

[13]

QUESTION 8

Benni is asked to compare the capacitance of different capacitors. He considers 3 different capacitors and finds that they have the following specifications:

	X	**Y**	**Z**
Area (m²)	2,1 x 10^{-3}		4,2 x 10^{-3}
Distance (d)	3,5 mm	2 x 10^{-4} m	1,75 x 10^{-3} m
Capacitance	0,08 μF	0,04 μF	0,08 μF

8.1 The space between the metal plates of capacitor **Y** consists of a vacuum. Calculate the area of the metal plates used for this capacitor. (5)

8.2 Benni is requested to double the capacitance of capacitor **Z** to 0,16 μF. State TWO possible physical changes he can make to obtain this. (4)

8.3 State TWO advantages of a capacitor over a torch battery. (2)

[11]

QUESTION 9

Sachin uses six 60 W bulbs for 4 hours daily in his house. To minimize the electricity consumption in South Africa and to save energy, Eskom has adopted different strategies. One of the strategies is to provide each household with 18 W energy-saving fluorescent bulbs to use in the place of conventional bulbs. The Eskom tariff for one unit (1 kWh) of electricity is R 0,60.

9.1 By referring to the energy transformation that takes place, state why the energy-saving fluorescent bulbs are better to use than the conventional bulbs. (2)

9.2 Calculate the total energy consumed by the 6 conventional 60 W bulbs during a month of 30 days. (2)

9.3 Determine the cost of the energy consumed in QUESTION 9.2 (1)

9.4 Calculate the total energy consumed by the 6 energy-saving 18 W fluorescent bulbs during a month of 30 days. (2)

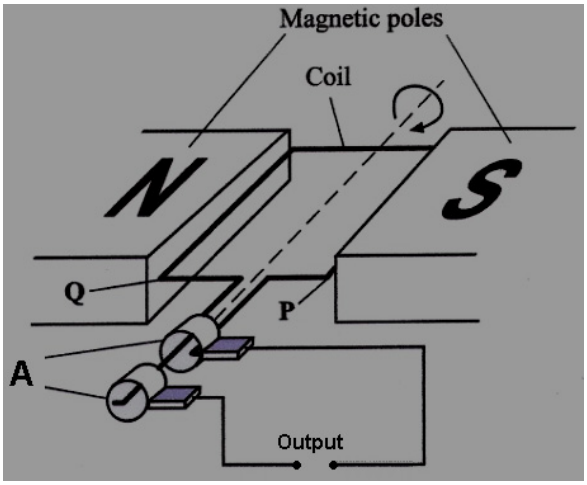
9.5 Determine the cost of energy consumed in QUESTION 9.4 (1)

9.6 Calculate the total amount of energy that Sachin would save per month, if he uses the energy-saving fluorescent bulbs in his house (2)

[10]

QUESTION 10

A generator or dynamo is used to produce electricity. Sipho's bicycle has a dynamo attached to the back wheel. When he pedals the wheel rotates, which in turn rotates the dynamo. The simplified sketch below shows the principle of operation of a basic electric generator or dynamo.

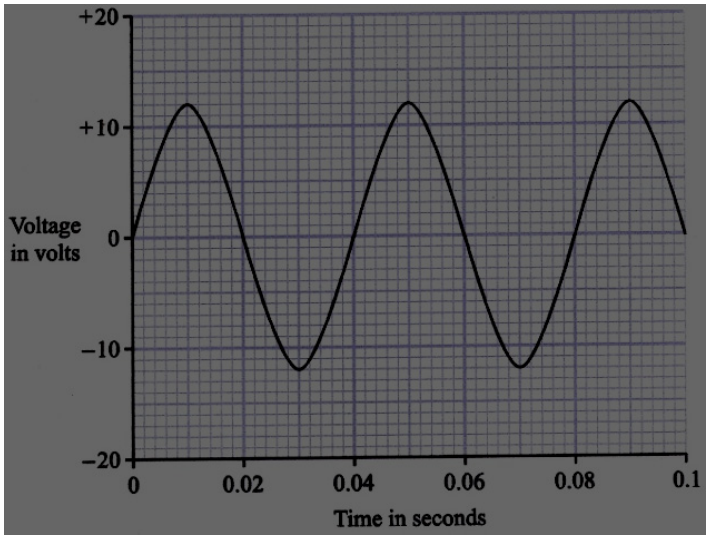


10.1 What type of energy conversion does take place in an electric generator? (2)

10.2 Is the generator illustrated in the above sketch an AC generator or a DC generator? Give a reason for your answer. (2)

10.3 The coil of the generator is rotated clockwise at a steady speed. Is the direction of the induced current in the coil from **P to Q** or from **Q to P**? (1)

10.4 The sketch graph of potential difference against time that represents the output of the above generator is given below.



10.4.1 What is the peak voltage (V_{max}) of this generator? (1)

10.4.2 Calculate the rms value of the potential difference (V_{rms}) of this generator. (3)

10.4.3 A lamp of average power 20 W which can be used either with an AC or a DC supply is connected to the output of the generator mentioned above. Calculate the peak current through the lamp when connected to an AC supply. (6)

[15]

QUESTION 11

David is asked to calculate the resistance of a resistor. He connects the resistor **R**, three cells (connected in series), an ammeter and a light dimmer (which acts as a rheostat) into a circuit. He then connects a voltmeter, **V**, to determine the potential difference over the resistor. He sets the light dimmer at three different settings and obtains the following readings on the ammeter and the voltmeter:

Ammeter reading	**0,3 A**	**0,1 A**	**0,15 A**
Voltmeter reading	**6 V**	**2 V**	**3 V**

11.1 Draw a neat circuit diagram to indicate how David connected all the components in order to make the above-mentioned readings. (4)

11.2 Which law is illustrated by this investigation? (1)

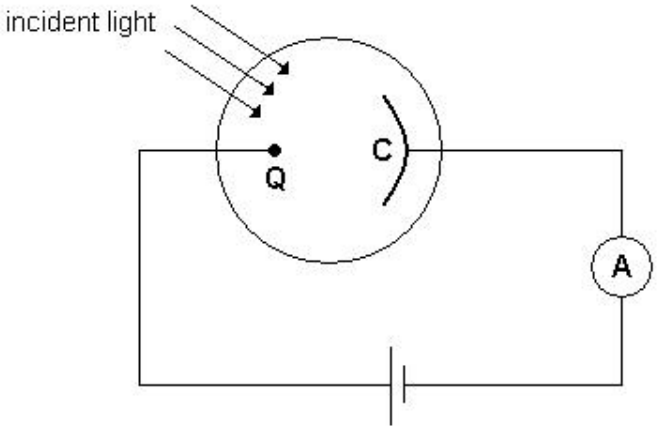
11.3 Draw a sketch graph (V vs I) of your results. (3)

11.4 Determine the resistance of the resistor. (3)

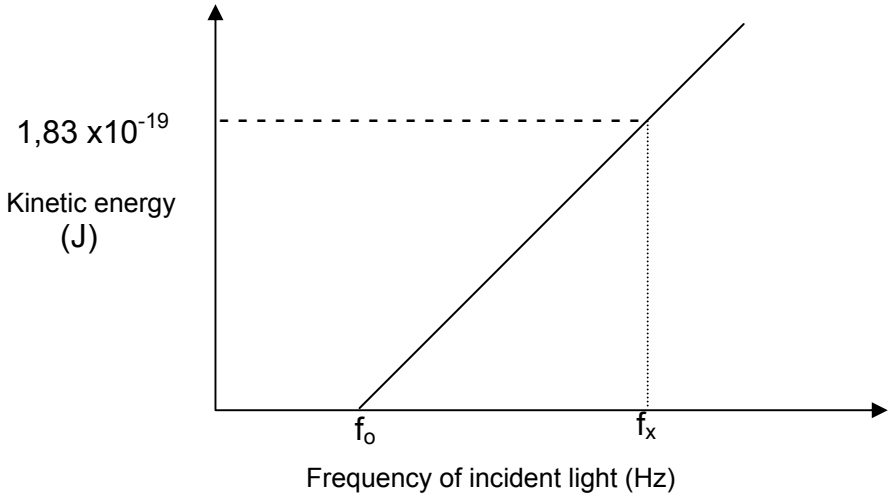
[11]

QUESTION 12

Learners in a physics class performed an experiment using a photo-electric cell to investigate the relationship between the photo electrons emitted and the frequency of the incident light falling on the cathode of the photo-electric cell.



A graph is plotted of the maximum kinetic energy (E_k) against the frequency of the incident light. When the straight line graph is extrapolated, it intercepts the x-axis at $f_o = 4{,}59 \times 10^{14}$ Hz.



12.1 Write down an investigative question for this investigation. (2)

12.2 What is the frequency f_o on the graph called? (2)

12.3 Name ONE apparatus or device in which a photo-electric cell is used and explain the function of the photo-electric cell in the apparatus or device. (3)

12.4 Calculate the frequency f_x on the graph. (5)

12.5 Draw a sketch-graph of the **kinetic energy** of the photo-electrons (on the y-axis) **versus** the **intensity** of the incident light. (No values are needed on the graph) (2)

[14]

TOTAL SECTION B: 125

GRAND TOTAL: 150

DATA FOR PHYSICAL SCIENCES P1 GRADE 12
GEGEWENS VIR FISIESE WETENSKAPPE V1 GRAAD 12

TABLE 1: PHYSICAL CONSTANTS/*TABEL1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9{,}8\ m{\cdot}s^{-2}$
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	$6{,}63 \times 10^{-34}\ J{\cdot}s$
Gravitational constant *Swaartekragkonstante*	G	$6{,}67 \times 10^{-11}\ N{\cdot}m^{2}{\cdot}kg^{-2}$
Coulomb's constant *Coulomb se konstante*	k	$9{,}0 \times 10^{9}\ N{\cdot}m^{2}{\cdot}C^{-2}$
Charge on electron *Lading op elektron*	e^{-}	$-1{,}6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31}\ kg$
Permittivity of free space *Permittiwiteit van vry ruimte*	ε_0	$8{,}85 \times 10^{-12}\ F{\cdot}m^{-1}$
Permeability of free space *Permeabiliteit van vry ruimte*	μ_0	$4\pi \times 10^{-7}\ T{\cdot}m{\cdot}A^{-1}$

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

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$F\Delta t = \Delta p = mv_f - mv_i$	$F_g = mg$

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

$W = F\Delta x$	$U = E_P = mgh$
$K = E_k = \frac{1}{2}mv^2$	$W = \Delta K = \Delta E_k = E_{kf} - E_{ki}$
$P = \frac{W}{\Delta t}$	$P = Fv$

WAVES, LIGHT AND SOUND/*GOLWE, LIG EN KLANK*

$v = f\lambda$ or/*of* $v = \nu\lambda$	$T = \frac{1}{f}$ or/*of* $T = \frac{1}{\nu}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$	$E = hf$ or/*of* $E = h\nu$ or/*of* $E = h\frac{c}{\lambda}$
$\lambda = \frac{h}{mv}$	$\sin\theta = \frac{m\lambda}{a}$
$hf = W_0 + \frac{1}{2}mv^2$	

MATTER AND MATERIALS/*MATERIE EN MATERIALE*

$F = k\Delta x$	Stress/*Spanning* $= \frac{F}{A}$
Strain/*Vervorming* $= \frac{\Delta x}{\ell}$	

ELECTRICITY AND MAGNETISM/*ELEKTRISITEIT EN MAGNETISME*

$I_{RMS} = \frac{I_{max}}{\sqrt{2}}$ and/*en* $V_{RMS} = \frac{V_{max}}{\sqrt{2}}$	$\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$
$\Phi = BA$	$P_{average} = V_{RMS}I_{RMS}$ $P_{average} = \frac{V_{RMS}^2}{R}$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{V}{d}$	$U = \frac{kQ_1Q_2}{r}$
$E = \frac{F}{Q}$	$Q = It$
$C = \frac{Q}{V}$	$C = \frac{\varepsilon_0 A}{d}$

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + ...$
$R_s = R_1 + R_2 + ...$	$Emf = I(R + r)$

NAME/EXAMINATION NUMBER:
NAAM/EKSAMEN NOMMER:

ANSWER SHEET/*ANTWOORDBLAD*

QUESTION 1 / *VRAAG 1*

1.1 _____ (1)

1.2 _____ (1)

1.3 _____ (1)

1.4 _____ (1)

1.5 _____ (1)
[5]

QUESTION 2 / *VRAAG 2*

2.1 _____

_____ (2)

2.2 _____

_____ (2)

2.3 _____

_____ (2)

2.4 _____

_____ (2)

2.5 _____

_____ (2)
[10]

QUESTION 3 / *VRAAG 3*

3.1	A	B	C	D
3.2	A	B	C	D
3.3	A	B	C	D
3.4	A	B	C	D
3.5	A	B	C	D

(5 x 2) [10]

TOTAL SECTION A/*TOTAAL AFDELING A*: 25