Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2010

PHYSICAL SCIENCES – PAPER 1

MARKS: 150

TIME: 3 hours

* P H S C E 1 *

This question paper consists of 15 pages and 3 pages of data and graph paper.

INSTRUCTIONS AND INFORMATION

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

2. Answer ALL the questions.

3. The question paper consist of TWO sections:

   SECTION A: [25 MARKS]
   SECTION B: [125 MARKS]

4. Answer SECTION A and 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. Start each question in SECTION B on a new page.

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

SECTION A

Answer this section in the ANSWER BOOK.

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) in the ANSWER BOOK.

1.1 The property of a body which makes it unsafe for a person, not wearing a safety belt, in a moving car during a collision. (1)

1.2 The measure of the rate of change of momentum between two colliding objects. (1)

1.3 The physical quantity responsible for the movement of electrons through a conductor. (1)

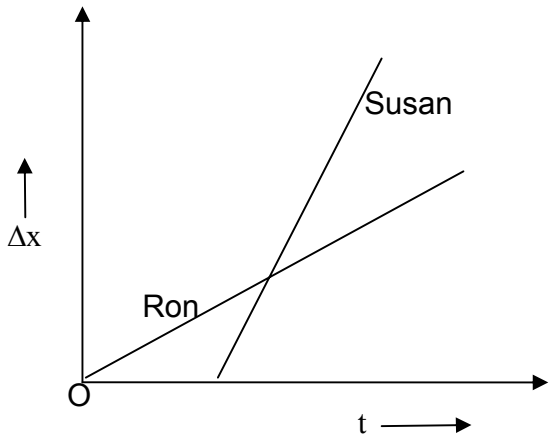
1.4 The electromagnetic waves used in satellite communication systems. (1)

1.5 A device used to store charges. (1)
[5]

QUESTION 2: 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 write only the letter (A –D) next to the question number (2.1 – 2.10) in the ANSWER BOOK.

2.1 The change in position versus time (Δx vs Δt) graphs for two children, Ron and Susan returning from their school to their homes, are shown in the diagram below. Which statement, deduced from the graphs, is correct?

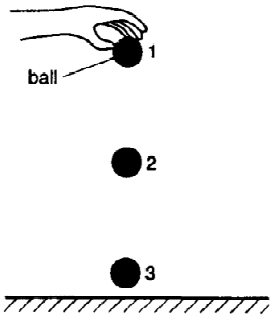


A Ron and Susan walk the same distance home.
B Ron walks faster than Susan.
C Susan walks faster than Ron.
D Both of them walk at the same speed. (2)

2.2 Forces do exist in pairs. The law in physics which explains or describes this fact is …

A Newton's first law
B Newton's second law
C Newton's third law
D Newton's law of gravitation. (2)

2.3 A ball is dropped from a height as shown.



Ignoring the effects of air resistance, the total mechanical energy is …

A greatest at point 1.
B greatest at point 2.
C greatest at point 3.
D the same at all points. (2)

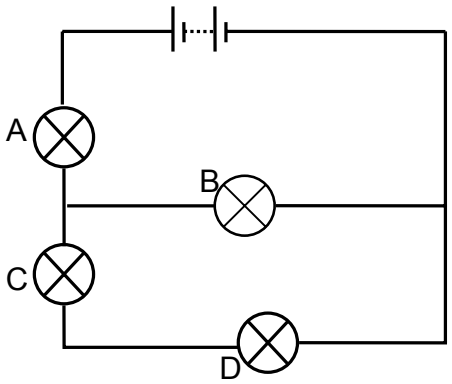
2.4 Huygen's wave theory of light cannot explain …

A diffraction.
B interference.
C polarisation.
D the photoelectric effect. (2)

2.5 Window panes of houses may crack when there is a nearby explosion. This is caused by …

A electromagnetic waves.
B shock waves.
C microwaves.
D transverse waves. (2)

2.6 In the circuit shown below, the battery lights up all four lamps A, B, C and D. When one of the lamp filaments melts, the other three lamps stay on. Which lamp filament melts?



(2)

2.7 A parallel plate capacitor is charged. If the plates are moved further apart the …

A electric field increases.
B electric field decreases.
C potential difference decreases.
D capacitance increases. (2)

2.8 Two waves pass through the same region of space at the same time resulting in the superposition of the waves. This is the definition for …

A interference.
B sonic boom.
C polarisation.
D diffraction. (2)

2.9 The minimum energy required for the emission of electrons from the surface of a metal by the action of light is …

A activation energy.
B threshold frequency.
C work function.
D energy of a photon. (2)

2.10 The sun's spectrum is a (n) …

A absorption spectrum.
B emission spectrum.
C continuous spectrum.
D infra-red spectrum. (2)

[20]

TOTAL SECTION A: 25

SECTION B

INSTRUCTIONS AND INFORMATION

1. Start each QUESTION on a NEW page.
2. Leave one line between two subsections, for example between QUESTION 3.1 and 3.2.
3. The formulae and substitutions must be shown in ALL calculations.
4. Round off ALL numerical answers to TWO decimal places.

QUESTION 3 (Start on a new page.)

The following text is adapted from *"Encyclopaedia 2009 Ultimate Reference Suite".*

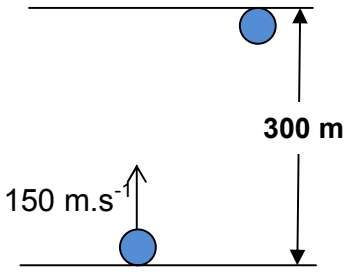
AMAZING LAWS IN PHYSICS!

Two pilots were discussing the following statement
"Can a body have zero velocity but still be accelerating?"

One of them said that if there is no velocity there can still be acceleration for certain motion.

3.1 Is his statement correct? Give a reason for your answer. (3)

3.2



A body is dropped from a height of 300 m. At exactly the same moment another body is projected from the ground vertically upwards with a velocity of 150 m.s^{-1}.

Calculate the …

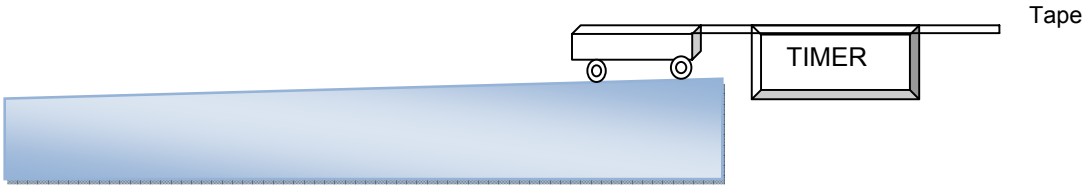
3.2.1 time it will take for the two objects to reach the same height. (7)

3.2.2 height reached above the ground in QUESTION 3.2.1. (3)

[13]

QUESTION 4

4.1 A group of learners set up a smooth frictionless surface. A trolley is attached to a timer using ticker tape as shown below. The trolley was then allowed to roll down the incline and using the tape the learners calculated the trolley's velocity.



The experiment was repeated three more times varying the slope of the surface and the velocity of the trolley was calculated each time. For the four sets of readings of the velocity they calculated the trolley's momentum, kinetic energy and the $\sqrt{E_k}$. The values are recorded in the table below.

Momentum (p)	**Kinetic energy E_k (J)**	$\sqrt{E_k}$
0	0	0
4	40	6,1
8	160	12,8
12	360	19,7
16	640	25,6

4.1.1 Write an investigative question for this investigation. (2)

4.1.2 Write a hypothesis for this investigation. (2)

4.1.3 Draw a graph of p vs $\sqrt{E_k}$ on the given graph paper with p on the *x*-axis. (4)

4.1.4 Write a conclusion for this investigation from your graph. (2)

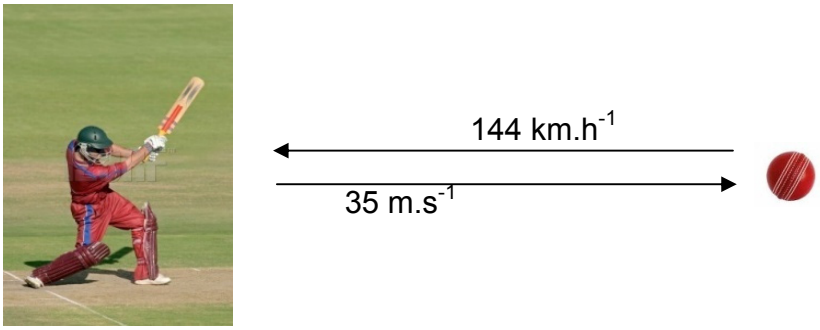
4.1.5 Does your conclusion support your hypothesis? (1)

4.1.6 Name ONE quantity to be kept constant during this investigation. (1)

[12]

QUESTION 5

5.1.



A cricket ball of mass 150 g is bowled at a batsman at a speed of 144 km.h^{-1}. The batsman hits the ball and it travels in the opposite direction at a speed of 35 m.s^{-1}.

5.1.1 Convert 144 km.h^{-1} to m.s^{-1}. (1)

5.1.2 Calculate the magnitude of the impulse which the bat applies to the ball. (4)

5.1.3 Without any further calculations write down the magnitude of the change in momentum which the cricket ball undergoes. (1)

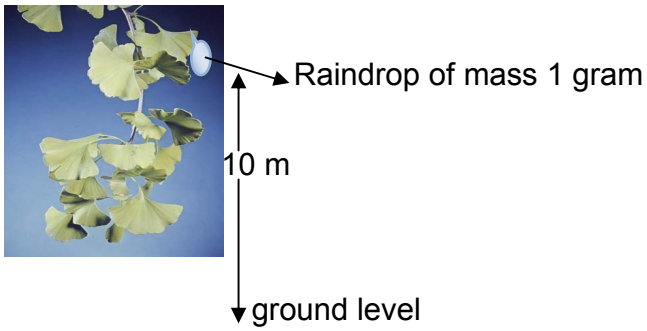
5.2 A fielder at mid-on catches this ball. While doing so he pulls his hands back as the ball is caught. By this technique the fielder avoids injury to his hands. Explain the science behind this action of the fielder. (3)

[9]

QUESTION 6

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

6.2



A rain drop is initially at rest on a leaf and then falls under the influence of the downward gravitational force and the opposing frictional force (reaction force). Consider a drop of mass 1,00 g falling from the leaf at a height of 10 m above the ground and striking the ground with a speed of 4 ms^{-1}. Calculate the work done by the frictional force. (9)

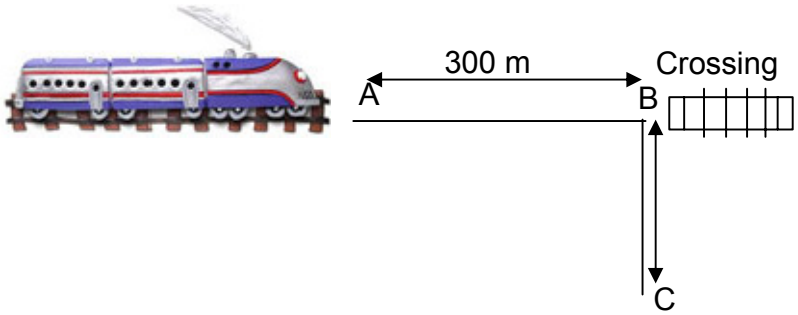
[11]

QUESTION 7

7.1 What is the Doppler Effect? (2)

7.2 Give ONE application of the Doppler Effect used by the South African Navy. (1)

7.3



A train A, approaching a railway crossing B, at a speed of 20 $m.s^{-1}$ sounds a siren at a frequency of 640 Hz, when it is 300 m away from the crossing. The speed of sound in air is 340 $m.s^{-1}$.

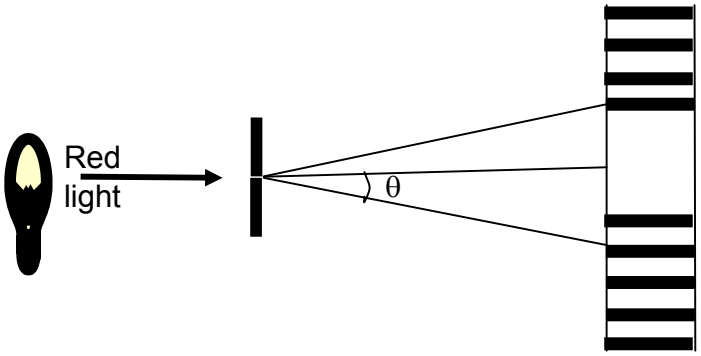
7.3.1 What will be the frequency heard by a person standing at B as indicated in the sketch above? (5)

7.3.2 Would a person standing at C hear the same frequency as the person standing at B? Briefly explain your answer. (2)

[10]

QUESTION 8

Monochromatic red light with a wavelength of 800 nm moves through a single slit and a pattern is observed on a screen as shown in the diagram below. In the diagram there is a central red band with narrower black bands either side with alternating red bands.



8.1 What is meant by monochromatic light? (2)

8.2 Name the wave phenomenon that produces the pattern explained above. (1)

8.3 The red light is replaced by blue light.

8.3.1 What do you observe? (2)

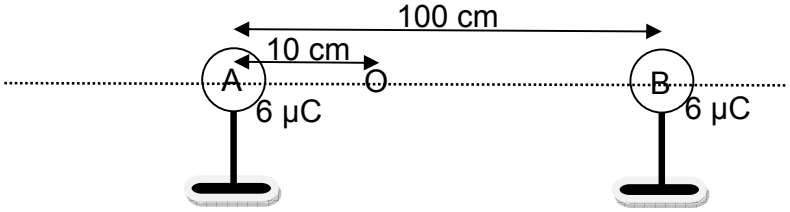
8.3.2 Give a reason for your observation in QUESTION 8.3.1. (1)

8.4 Determine the position of the second dark band (θ) formed on the screen when red light is passed through a slit of width 4 μm. (4)

[10]

QUESTION 9

Two insulated charged identical copper spheres, A and B, are placed with their centres 100 cm apart.



9.1 Calculate the magnitude of the electrostatic force if the charge on each sphere is 6 µC. (4)

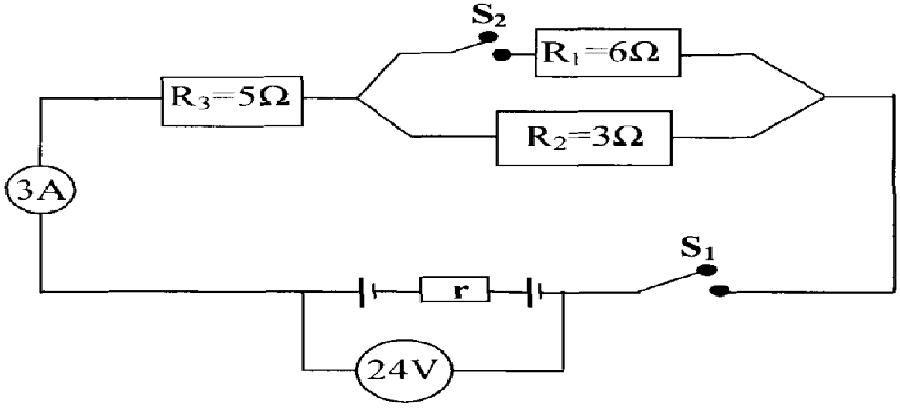
9.2 Is the force calculated in QUESTION 9.1, a force of attraction or repulsion? (1)

9.3 By what factor will the magnitude of the force in QUESTION 9.1 change if the distance between the spheres is halved and the charges on both A and B are doubled. (Do not calculate the new value.) (2)

9.4 Calculate the net electric field at point O as shown in the diagram above. (6)
[13]

QUESTION 10

A battery is used to supply current through the combination of three resistors R_1, R_2 and R_3 as shown in the circuit diagram below.



10.1 What is the value of the emf of the battery? Give a reason for your answer. (2)

10.2 When both switches are closed, the current through the 5 Ω resistor is found to be 3 A. Calculate the:

10.2.1 Internal resistance, r, of the battery. (4)

10.2.2 Current through resistance R_2. (3)

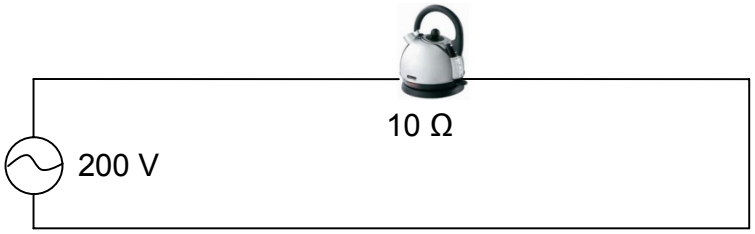
10.3 The switch S_2 is now opened. State, without any further calculations, how the following will change? Write only INCREASE, DECREASE OR REMAIN THE SAME.

10.3.1 The resistance of the circuit. (1)

10.3.2 The current in the circuit. (1)
[11]

QUESTION 11

A peak voltage of 200 V is applied to an electric kettle of resistance 10 Ω.



11.1 Calculate the:

11.1.1 rms value of the voltage. (3)

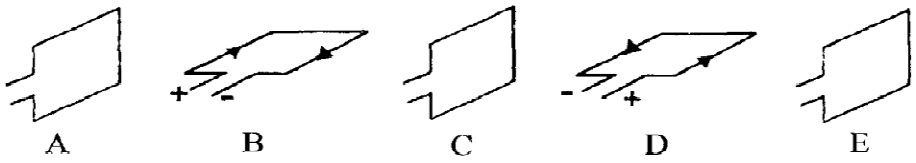
11.1.2 rms value of the current. (3)

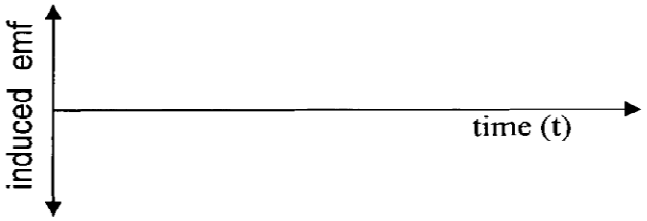
11.1.3 average power dissipated as heat. (3)

11.2 What will the reading be on an ammeter connected in series to the above circuit? (1)
[10]

QUESTION 12

The diagrams A to E below show five positions in sequence during the clockwise rotation of the coil of an alternating current(a.c.) generator.





12.1 Redraw the above axis in your answer book and sketch a graph of the induced emf versus time for the corresponding positions of the coil. Indicate on your graph the corresponding positions of the coil by writing letters A to E on the time axis. (2)

12.2 Which component makes the essential difference between an a.c. generator and a direct current (d.c.) generator? (2)

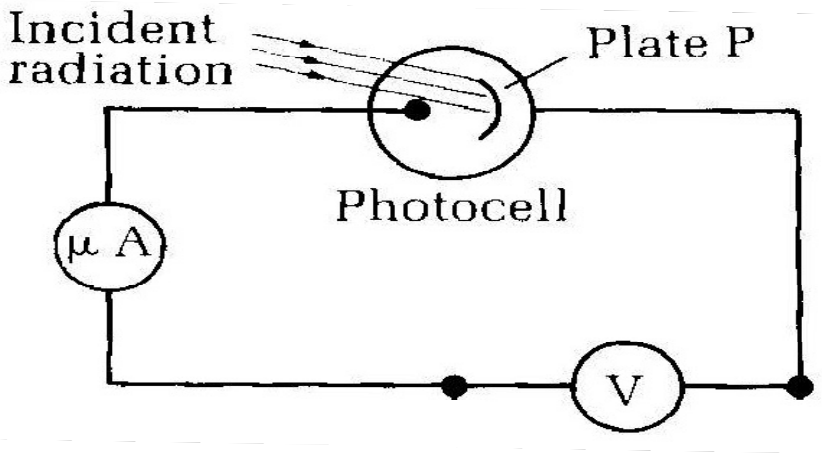
12.3 Give ONE advantage of a.c. over d.c. (1)

12.4 "For use in a.c. circuits, instead of a single thick wire, the wire is made or prepared by putting a number of thin wires together". Comment on this statement. (2)

[7]

QUESTION 13

13.1 The diagram below shows the workings of a photo cell. This type of cell is used in burglar alarms for houses and banks.



13.1.1 What is the energy conversion that takes place in a photo electric cell? (2)

13.1.2 Name the phenomenon on which a photo cell functions. (2)

13.1.3 The work function of sodium is $3,68 \times 10^{-19}$ J. Using a calculation determine if sodium shows photoelectric emission when it is radiated with light with a wavelength of $6,8 \times 10^{-7}$ m? (5)

[9]

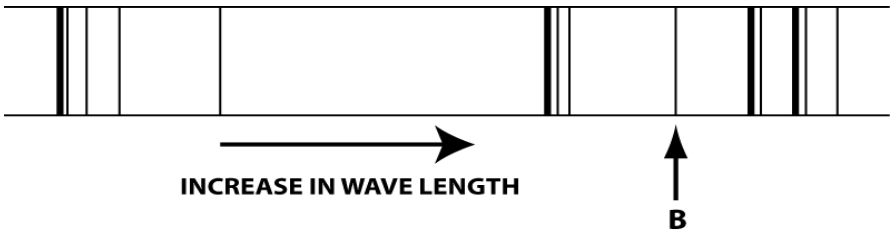
QUESTION 14

14.1 The pattern that forms when light is broken up into component frequencies is called a spectrum. Spectra are classified into two main types. Emission spectra and absorption spectra.

14.1.1 What is an emission spectrum? (2)

14.1.2 For what purpose is the emission spectrum of a source of light used? (2)

14.2 The figure below shows an emission spectrum of hydrogen.



Hydrogen spectrum showing some main spectral lines

The emission spectrum of hydrogen has many lines whereas a hydrogen atom has only one electron.

14.2.1 Explain how is possible that hydrogen can emit so many different frequencies. (3)

14.2.2 Determine the wavelength represented by line B if the frequency at the point is $4,5 \times 10^{14}$ Hz. (3)

[10]

TOTAL SECTION B: 125

GRAND TOTAL: 150

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GRAAD 12

SEPTEMBER 2010

PHYSICAL SCIENCES – PAPER 1/ FISIESE WETENSKAPPE – VRAESTEL 1

DATA / GEGEWENS

This data consists of 3 pages.
Hierdie gegewens bestaan uit 3 bladsye.

DATA/GEGEWENS

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekrag versnelling*	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	$6,63 \times 10^{-34}\ J{\cdot}s$
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	$8,85 \times 10^{-12}\ F{\cdot}m^{-1}$

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

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*

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

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

$v = f\lambda$ 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* $E = h\frac{c}{\lambda}$
$\sin\theta = \frac{m\lambda}{a}$	$hf = W_0 + \frac{1}{2}mv^2 = hf_0 + \frac{1}{2}mv^2$

ELECTROSTATICS / *ELEKTROSTATIKA*

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

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/*emk*(ε) = I(R + r)
$q = I\Delta t$	$W = Vq = VI\Delta t = I^2R\Delta t = \frac{V^2\Delta t}{R}$
$P = \frac{W}{\Delta t} = VI = I^2R = \frac{V^2}{R}$	

ALTERNATING CURRENT / WISSELSTROOM

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

NAME:..... GRADE:.....

QUESTION 4.1.3 **NAME……..**