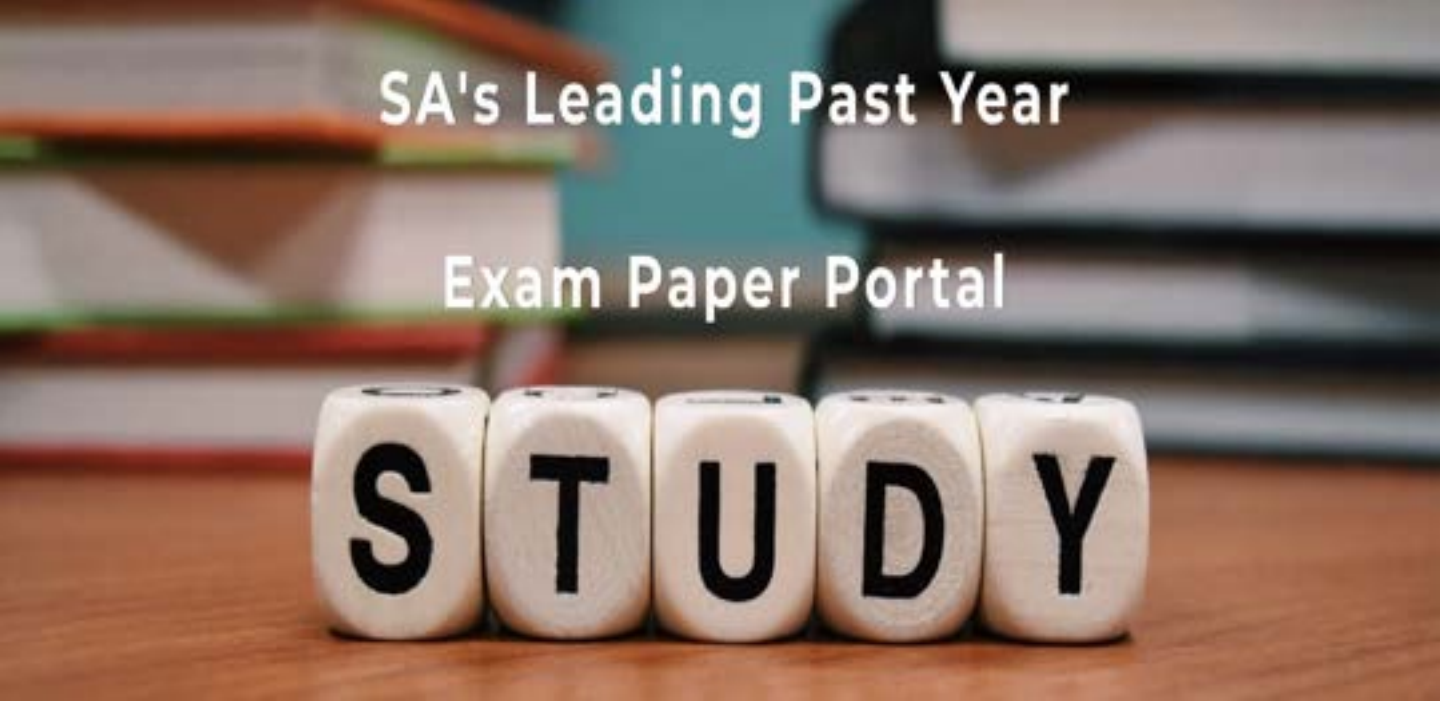


You have Downloaded, yet Another Great Resource to assist you with your Studies ☺

Thank You for Supporting SA Exam Papers

Your Leading Past Year Exam Paper Resource Portal

Visit us @ www.saexampapers.co.za

education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

NATIONAL SENIOR SERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2020

MARKS: 150

TIME: 3 hours

This question paper consists of 17 pages and 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name on the ANSWER BOOK.
2. This question paper consists of ELEVEN 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 open between two subquestions, 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.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 Which physical quantity is equal to the change of momentum?

A Work

B Impulse

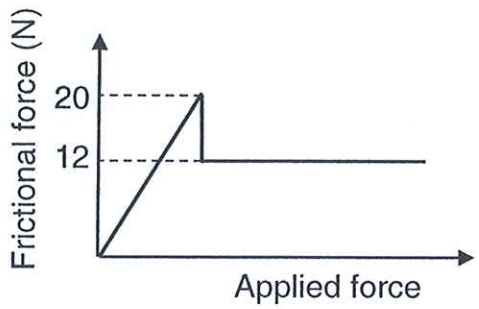
C Power

D Net force (2)

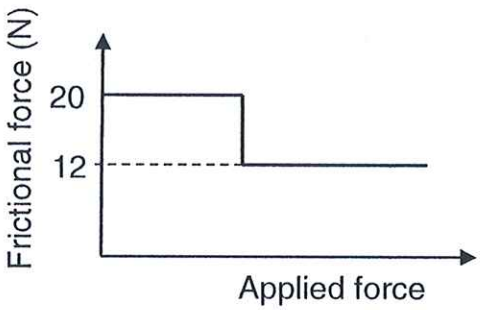
1.2 A block is at rest on a rough horizontal surface. The maximum static frictional force on the block is 20 N and the kinetic frictional force on the block is 12 N.

A spring scale is connected to the block. While pulling on the spring scale a learner increases the force until the block accelerates.

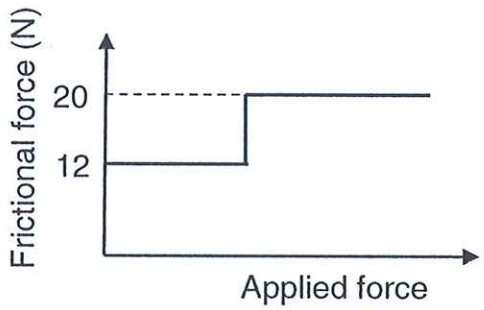
Which ONE of the following graphs best represents the relationship between the frictional force and the applied force on the block?



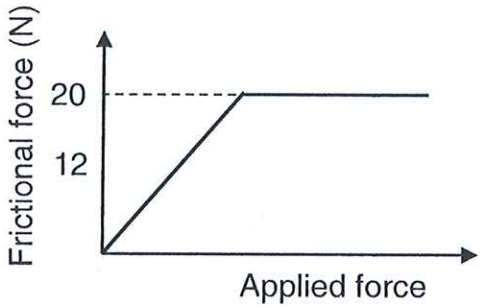
A



B



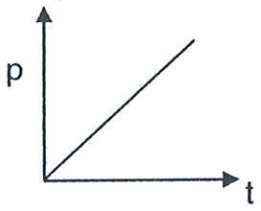
C



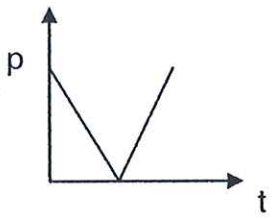
D (2)

1.3 A stone is projected vertically upwards and returns to the same position. Ignore the effects of air resistance.

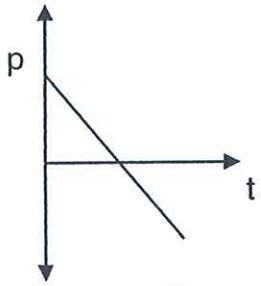
Which ONE of the following graphs best represents the relationship between momentum and time for the movement of the stone?



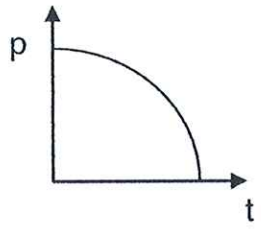
A



B



C



D (2)

1.4 The kinetic energy of an object is **X**.

If both the velocity and mass of the object is doubled, the kinetic energy of the object is...

A 3**X**

B 4**X**

C 6**X**

D 8**X** (2)

1.5 Consider the statements below regarding the Doppler effect in the light spectrum.

i) Blue shift of the spectrum is an indication that the planet is moving away from the earth.

ii) Red shift of the spectrum is an indication that the planet is moving away from the earth.

iii) Red shift is taking place due to a decrease in frequency and an increase in wavelength of the light.

iv) The direction in which a planet moves has no influence on the spectrum.

Which of the statements above is/are CORRECT?

A Only (ii)

B Only (i) and (iv)

C Only (i) and (iii)

D Only (ii) and (iii) (2)

1.6 Two small metal spheres, **X** and **Y**, on isolated stands carry charges of +2 nC and –6 nC respectively. Sphere **X** experiences a force **F** due to the charge on sphere **Y**.

The spheres are brought into contact with each other and are placed back in their original positions.

The magnitude of the electrostatic force that sphere **X** now experiences, is...

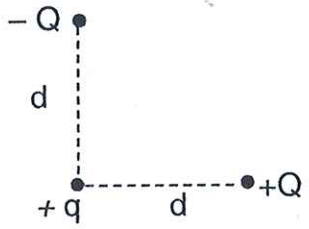
A $\frac{\mathbf{F}}{3}$

B 3**F**

C 6**F**

D 12**F** (2)

1.7 Two charges, –Q and +Q, are placed at a distance **d** from a positive charge +q. The charges, +Q and –Q, are allocated along lines perpendicular to each other as shown in the diagram below.

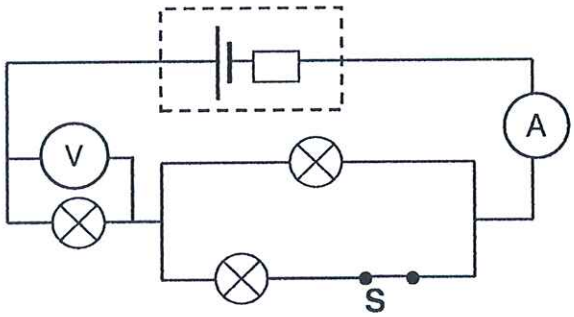


Which ONE of the following arrows indicate the direction of the net force that is experienced by charge +q due to the presence of charges +Q and –Q CORRECTLY?

A	
B	
C	
D	

(2)

1.8 Three identical light bulbs are connected to a cell with internal resistance. Switch **S** is CLOSED as shown in the circuit diagram below.

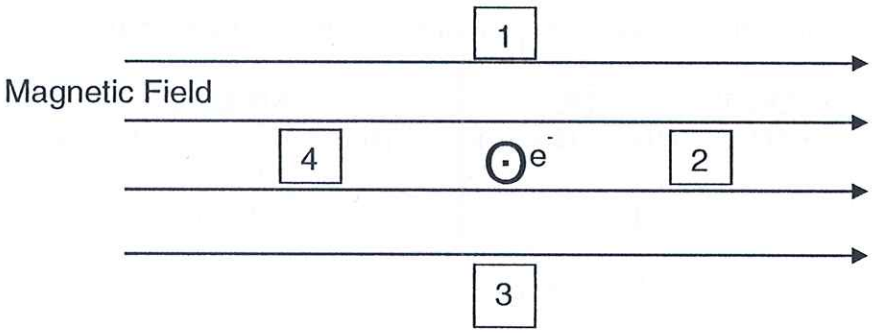


Switch **S** is now opened.
Which ONE of the following gives the CORRECT changes observed on the ammeter and the voltmeter?

	AMMETER READING	VOLTMETER READING
A	Increases	Increases
B	Increases	Decreases
C	Decreases	Decreases
D	Decreases	Increases

(2)

1.9 A magnetic field is set up from left to right as shown in the diagram below. A current of ELECTRONS moves in a conductor perpendicular to the plane of the paper towards the reader. The conductor experiences a force in the direction...



A 1

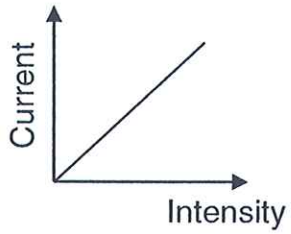
B 2

C 3

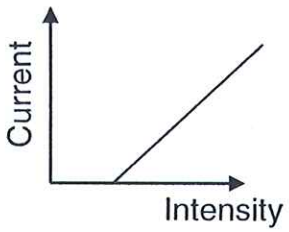
D 4 (2)

1.10 Violet light of variable intensity is radiated on a metal plate of a photo cell. The ammeter in the circuit indicates a reading.

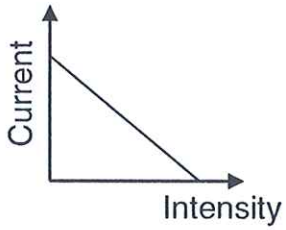
Which ONE of the following graphs shows the correct relationship between the current in the circuit and the intensity of the incident light?



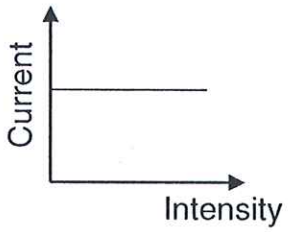
A



B



C



D (2)

[20]

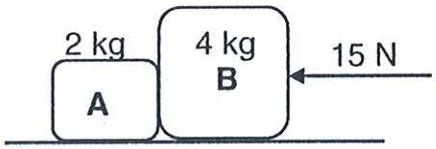
QUESTION 2 (Start on a new page.)

Block **A**, of mass 2 kg, is placed against block **B**, of mass 4 kg, on a rough horizontal surface.

The following table supplies the frictional forces that are experienced on each block:

	MAXIMUM STATIC FRICTIONAL FORCE ($f_{s(max)}$)	**KINETIC FRICTIONAL FORCE (f_k)**
Block A	5,88 N	2,35 N
Block B	11,76 N	4,70 N

A force of 15 N is applied horizontally on block **B** as shown in the diagram below.



2.1 State Newton's Second Law in words. (2)

2.2 Block **B** exerts a force **F** on block **A**.
Write down the magnitude and direction of the force that block **A** exerts on block **B**. (1)

2.3 The following statement is made:

"Because the applied force on block **B** is more than the maximum frictional force of block **B**, block **B** will accelerate to the left."

Explain in terms of NET FORCE and MOTION why this statement is FALSE. (2)

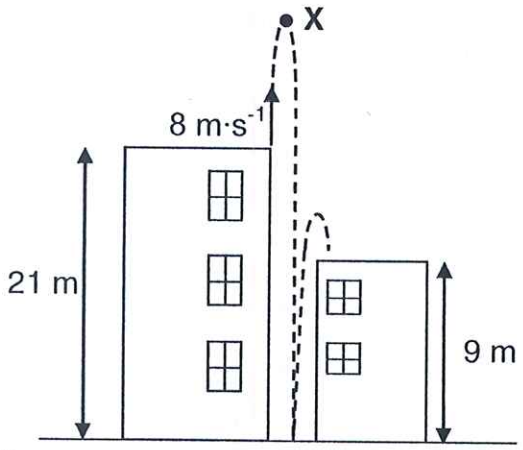
The 15 N force is removed and replaced with an unknown horizontal force $\mathbf{F_T}$.
The blocks accelerate at 4,5 $m \cdot s^{-2}$ to the left.

2.4 Draw a labelled free-body diagram for block **B**. (5)

2.5 Apply Newton's Second Law on EACH of the blocks to calculate the force $\mathbf{F_T}$. (5)
[15]

QUESTION 3 (Start on a new page.)

A ball is thrown vertically upwards at 8 $m \cdot s^{-1}$ from the top of a 21 m high building. The ball reaches the maximum height of its motion at point **X** and returns to the ground. Ignore effects of air resistance.



3.1 Is the ball in free fall at point **X**?
Choose from YES or NO.

Give a reason for the answer. (2)

3.2 Calculate the speed of the ball when it reaches the ground. (3)

The ball bounces on the floor and reaches the roof of an adjacent building 2,24 s after it bounced.

3.3 Calculate the speed with which the ball bounces upwards. (4)

3.4 Draw a velocity–time graph for the total movement of the ball since it was thrown until it reaches the roof of the adjacent building.

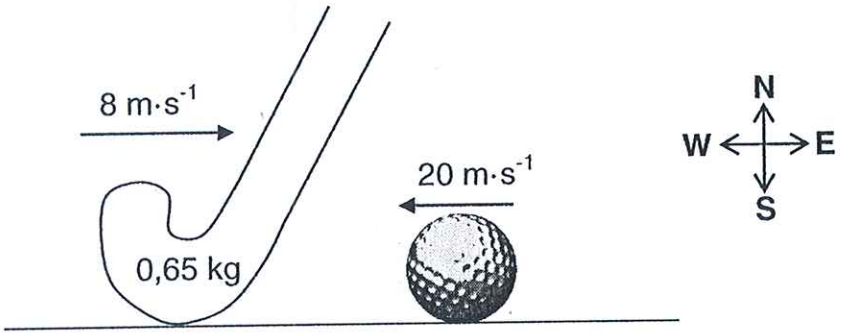
Clearly indicate the following on the graph:

- The velocity with which the ball was thrown.
- The velocity with which the ball hits the ground.
- The velocity with which the ball bounces upwards. (5)

[14]

QUESTION 4 (Start on a new page.)

A hockey ball, of mass 0,16 kg, moves at a velocity of 20 $m \cdot s^{-1}$ west. It hits a hockey stick, of mass 0,65 kg, that is moving at a velocity of 8 $m \cdot s^{-1}$ east. The ball is in contact with the hockey stick for 0,015 s.
After the collision the hockey ball moves at a velocity of 30 $m \cdot s^{-1}$ east.
Ignore the effects of friction.



4.1 State the law of conservation of momentum in words. (2)

4.2 Calculate the magnitude and direction of the:

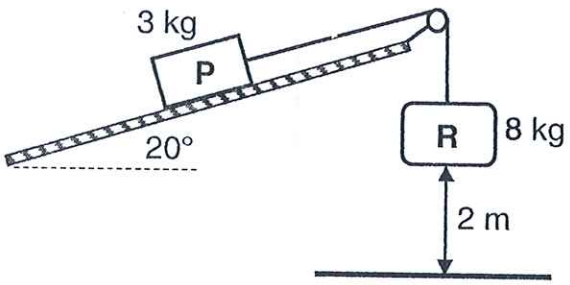
4.2.1 Velocity of the hockey stick after the collision (4)

4.2.2 Average net force exerted by the hockey stick on the hockey ball (3)
[9]

QUESTION 5 (Start on a new page.)

A 3 kg block **P**, is connected to a 8 kg block **R**, by a light inextensible string that is moving over a frictionless pulley. The kinetic frictional force (f_k) on block **P** is 15 N.

When the system is released from rest, block **R** moves downwards.



5.1 Draw a labelled free-body diagram for block **P**. (4)

5.2 Name the following forces that acts on the system:

5.2.1 A conservative force (1)

5.2.2 A force that is doing positive work (1)

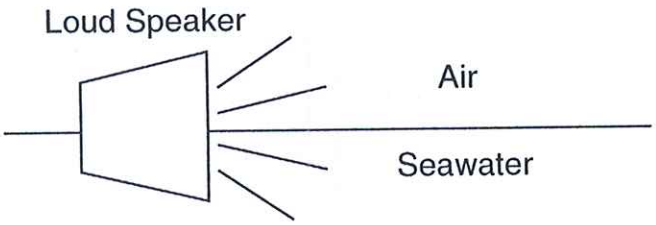
5.2.3 An internal force (1)

5.3 State the Work-Energy Theorem in words. (2)

5.4 Using energy principles only, calculate the speed of block **R** after it moved 2 m vertically downwards. (6)
[15]

QUESTION 6 (Start on a new page.)

A stationary loud speaker is submerged half way in seawater. The loud speaker delivers a sound with a constant frequency of 380 Hz. The sound waves move through the air and through the seawater as shown in the diagram below.



The table below gives the speed of the sound in the two different mediums at a specific time:

MEDIUM	SPEED OF SOUND ($m \cdot s^{-1}$)
Air	340
Seawater	1 500

6.1 Calculate the wavelength of the sound wave in seawater. (3)

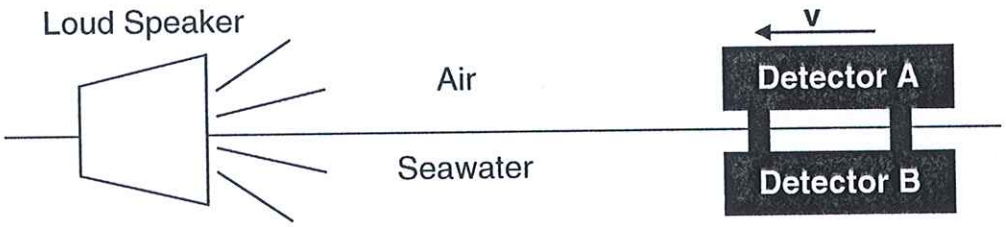
6.2 How will the wavelength in air compare to that in seawater? Choose from GREATER THAN, SMALLER THAN or EQUAL TO.

Give a reason for the answer. (3)

6.3 State the Doppler effect in words. (2)

Two detectors, **A** and **B**, are connected to each other and move at a constant speed **v** towards the loud speaker. The two detectors are in air and in seawater respectively as shown in the diagram below.

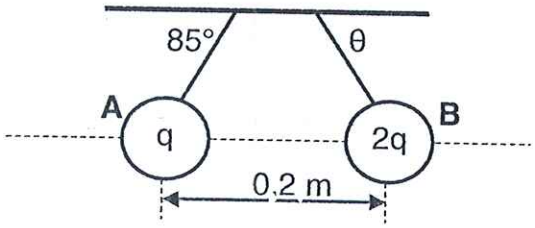
The difference in frequency as measured by the two detectors is 6,91 Hz.



6.4 Calculate the speed **v**. (5)
[13]

QUESTION 7 (Start on a new page.)

Two spheres, **A** and **B**, each with a mass of 30 g, are hanging from inextensible strings of equal lengths and carry charges of q and 2q respectively as shown in the diagram below.



7.1 State Coulomb's Law in words. (2)

7.2 Draw a labelled free-body diagram for sphere **A**. (3)

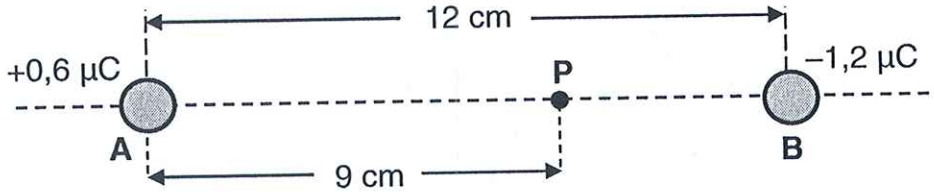
7.3 What is the magnitude of angle θ? Explain the answer. (3)

7.4 Calculate the charge q. (6)
[14]

QUESTION 8 (Start on a new page.)

Two small charged spheres, **A** and **B**, with charges +0,6 µC and –1,2 µC respectively, are placed 12 cm apart in a vacuum, as shown in the diagram below.

Point **P** is 9 cm to the right of sphere **A**.



8.1 Define the term *electric field at a point.* (2)

8.2 Draw a diagram that shows the net electric field pattern round the two spheres. (3)

8.3 Calculate the magnitude of the net electric field at point **P**. (5)

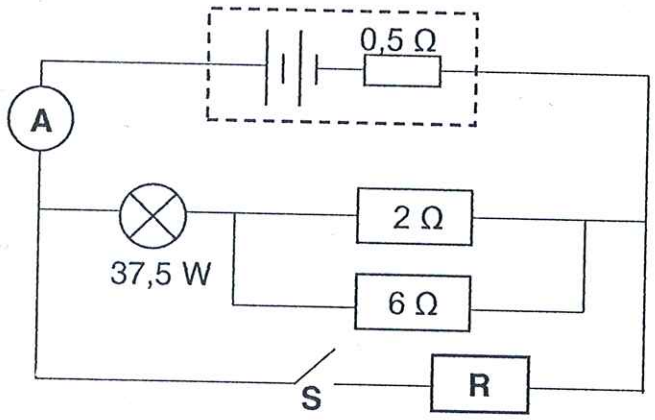
8.4 The position of charges **A** and **B** are exchanged. (Charge **A** is placed where charge **B** is and charge **B** where charge **A** is.)

How will the magnitude of the net electric field compare to that calculated in QUESTION 8.3? Choose from GREATER THAN, SMALLER THAN or EQUAL TO. (1)
[11]

QUESTION 9 (Start on a new page.)

Three resistors, a 37,5 W bulb and a battery with an internal resistance of 0,5 Ω, are connected as shown in the diagram below. The resistance of the three resistors are 2 Ω, 6 Ω and **R** respectively.

When switch **S** is OPEN, the ammeter reading is 2,5 A.



9.1 Define the term *current.* (2)

9.2 Calculate the:

9.2.1 Resistance of the bulb (3)

9.2.2 Emf of the battery (5)

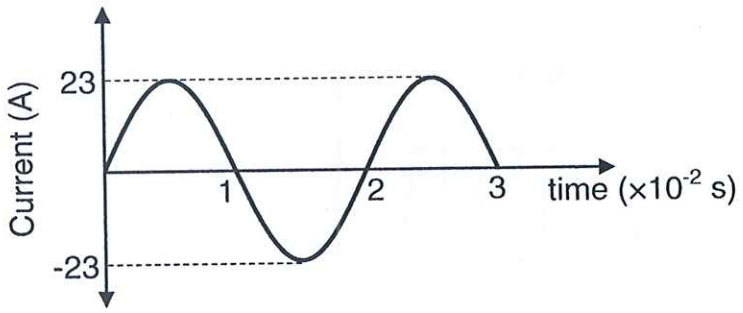
Switch **S** is now CLOSED. The ammeter reading will increase with 80%.

9.3 Calculate **R**. (4)

[14]

QUESTION 10 (Start on a new page.)

The following current versus time graph is drawn from results obtained from an AC-generator.



10.1 Name the energy conversion that takes place in an AC-generator. (1)

10.2 How many cycles is completed by the coil in 3×10^{-2} s? (1)

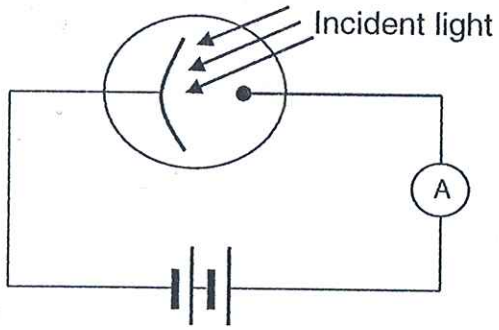
10.3 Calculate the:

10.3.1 Frequency of the alternating current (3)

10.3.2 Average power of the generator if the maximum voltage (V_{max}) is 311 V (5)
[10]

QUESTION 11 (Start on a new page.)

During an investigation, red and violet light are radiated respectively on the zinc cathode of a photo cell as shown in the diagram below.



The results are shown in the table below:

COLOUR	WAVELENGTH (nm)	AMMETER READING
Red	650	No
Violet	430	Yes

11.1 Define the term *work function* of a metal. (2)

11.2 Explain why there is no ammeter reading when red light is used. (2)

Violet light is radiated on the photo cell. The cathode of the photo cell has a threshold frequency of $6{,}94 \times 10^{14}$ Hz.

11.3 Calculate the maximum speed of the ejected electrons. (4)

During a second investigation violet light is radiated on the lithium cathode of a photo cell.
5×10^{20} photons per minute hit the cathode of the photo cell and the ammeter records a reading.

Assume that all light from the bulb reaches the cathode of the photo cell.

11.4 Calculate:

11.4.1 The power dissipated by the violet bulb (3)

11.4.2 The total charge released per second from the cathode (3)

11.4.3 The ammeter reading (1)

[15]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9{,}8\ m{\cdot}s^{-2}$
Universal gravitational constant *Universele gravitasiekonstant*	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 elektron*	e	$1{,}6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31}\ kg$
Mass of the Earth *Massa van die Aarde*	M	$5{,}98 \times 10^{24}\ kg$
Radius of the Earth *Radius van die Aarde*	R_E	$6{,}38 \times 10^{6}\ m$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1 m_2}{d^2}$ or/*of* $F = G\frac{m_1 m_2}{r^2}$	$g = G\frac{M}{d^2}$ or/*of* $g = G\frac{M}{r^2}$

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

$W = F\Delta x\cos\theta$	$U = mgh$ or/*of* $E_P = mgh$
$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	

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

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ or/of $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/*of* $E = h\frac{c}{\lambda}$
$E = W_o + E_{k(max)}$ or/*of* $E = W_o + K_{max}$ where/*waar* $E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_{k(max)} = \frac{1}{2}mv_{max}^2$ or/*of* $K_{max} = \frac{1}{2}mv_{max}^2$	

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) emk (ε) = I(R + r)
$R_s=R_1+R_2+\ldots$ $\frac{1}{R_p}=\frac{1}{R_1}+\frac{1}{R_2}+\ldots$	$q=I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P=\frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P=\frac{V^2}{R}$

ALTERNATING CURRENT/*WISSELSTROOM*

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