Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2013

PHYSICAL SCIENCES P1

MARKS: **150**

TIME: **3 hours**

* P H S C E 1 *

This question paper consists of 23 pages, including a data sheet, a formula sheet and an answer sheet.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Write your FULL NAME and SURNAME in the appropriate spaces on the ANSWER SHEET and ANSWER BOOK.

2. Answer ALL the questions.

3. The question paper consists of TWO sections.

   SECTION A: 25 marks
   SECTION B: 125 marks

4. Answer SECTION A on the ANSWER SHEET and SECTION B in the ANSWER BOOK.

5. Non-programmable calculators may be used.

6. Appropriate mathematical instruments may be used.

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

8. Data and Information sheets are attached for your use.

9. Give brief motivations, discussions, et cetera where required.

SECTION A

Answer all questions 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 SI-unit of the quantity calculated by the product of force and velocity (1)

1.2 Electrical potential energy per unit charge (1)

1.3 The ability of a wave to spread out in wave fronts and thus bending around a sharp edge (1)

1.4 The spectrum that is produced when cooler vapour absorbs light of certain frequencies (1)

1.5 This phenomenon explains why electrons are emitted from a metal when light shines on it (1)

[5]

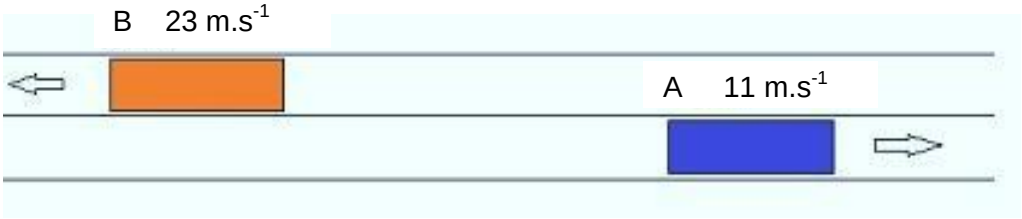
QUESTION 2: MULTIPLE-CHOICE QUESTIONS

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the best answer and mark the correct letter (A–D) next to the question number (2.1–2.10) with a cross (X) on the attached ANSWER SHEET.

2.1 When a projectile is moving vertically upwards it …

A has zero acceleration.
B accelerates downwards with a constant acceleration.
C loses its mass.
D has maximum velocity at its highest point. (2)

2.2 Goods train A travelling at a velocity of 11 $m.s^{-1}$ east passes a goods train B travelling at 23 $m.s^{-1}$ west on adjacent tracks as shown in the sketch below.



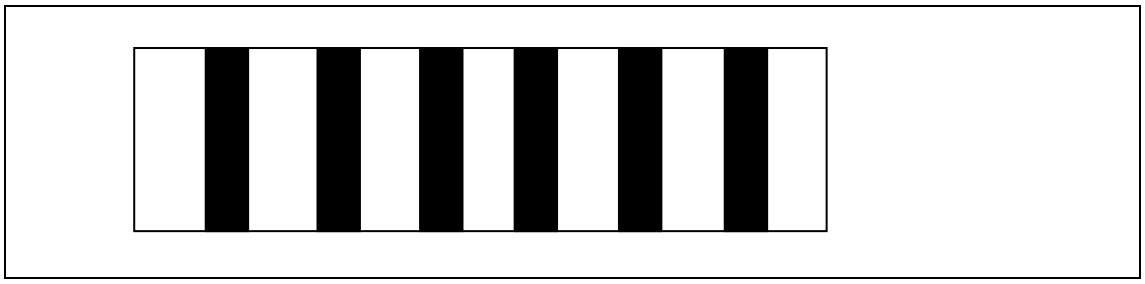
The magnitude and direction of the velocity of goods train A relative to B is ...

A 12 $m.s^{-1}$ west.
B 34 $m.s^{-1}$ west.
C 12 $m.s^{-1}$ east.
D 34 $m.s^{-1}$ east. (2)

2.3 The quantity which REMAINS CONSTANT for an object falling to the ground is ... (Ignore air friction).

A potential energy.
B kinetic energy.
C mechanical energy.
D momentum. (2)

Refer to the following diagram to answer QUESTIONS 2.4 and 2.5.



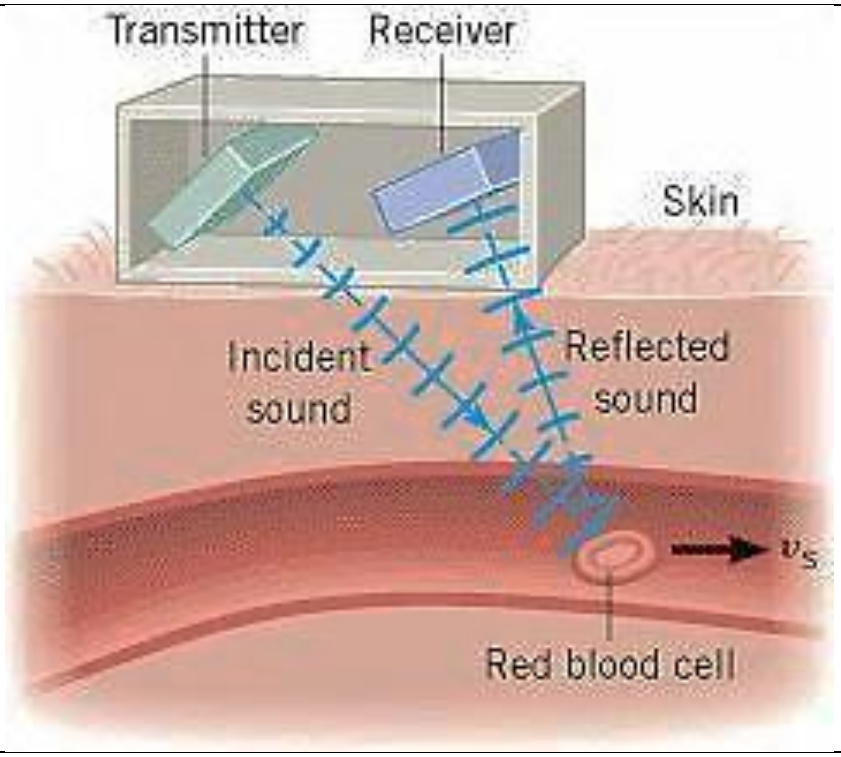
2.4 The above-mentioned pattern shows equally spaced dark and bright bands. The experiment during which this is obtained is called …

A single slit diffraction.
B double slit diffraction
C single slit interference.
D double slit interference. (2)

2.5 The above mentioned pattern provides evidence that light behaves as …

A particles.
B waves.
C both.
D neither. (2)

2.6

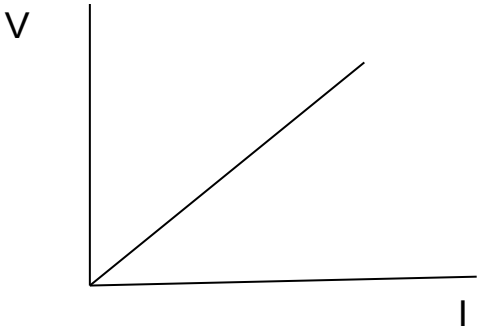


The device in the diagram is used to locate regions where blood vessels have narrowed. It is an application of a certain phenomenon in a certain field, such as …

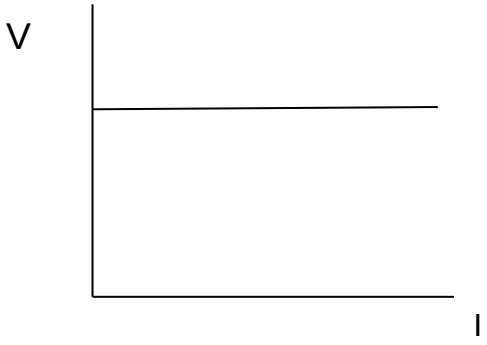
A reflection in astronomy.
B photoelectric effect in Life Sciences.
C Doppler effect in medicine.
D diffraction in transport and industry. (2)

2.7 Which of the following graphs represents potential difference versus current for a non-ohmic conductor?

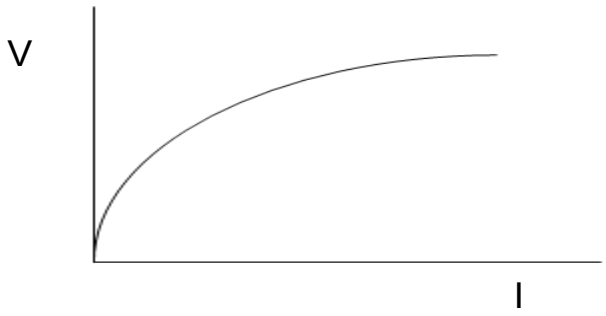
A



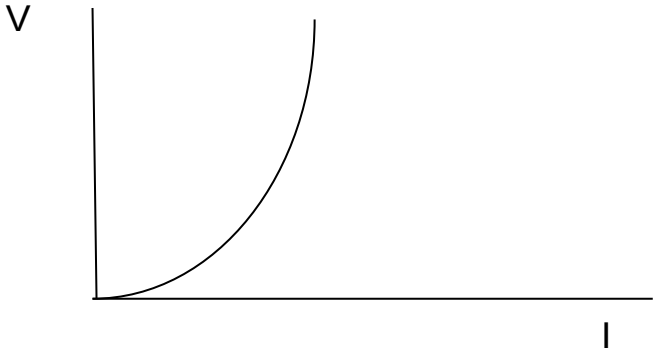
B



C

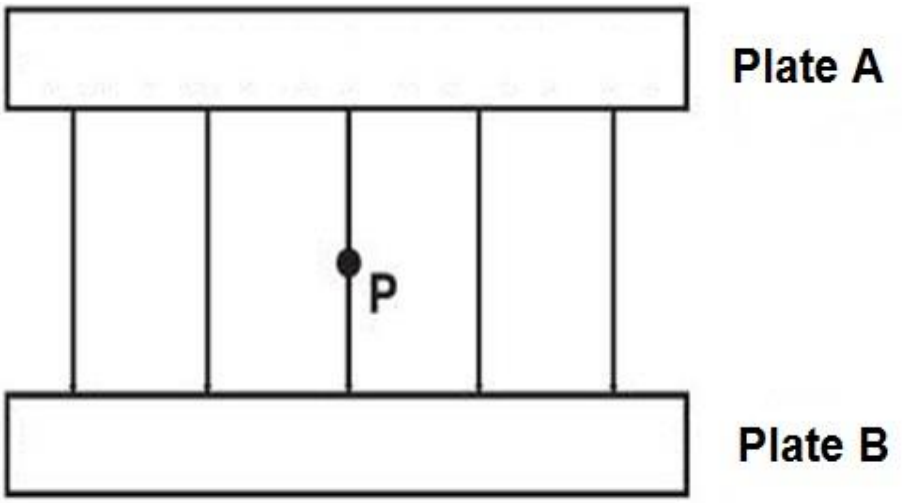


D



(2)

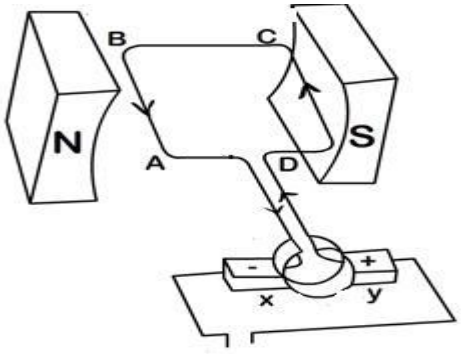
2.8



A POSITIVE test charge is placed in an electric field between parallel plates of a capacitor. The test charge moves from plate B to plate A. It can be concluded that …

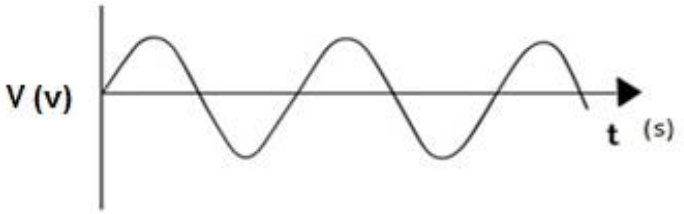
A plate A is positively charged.
B plate B is positively charged.
C plate B is negatively charged.
D plate A is an insulator. (2)

2.9 A simplified sketch of a generator is shown below.

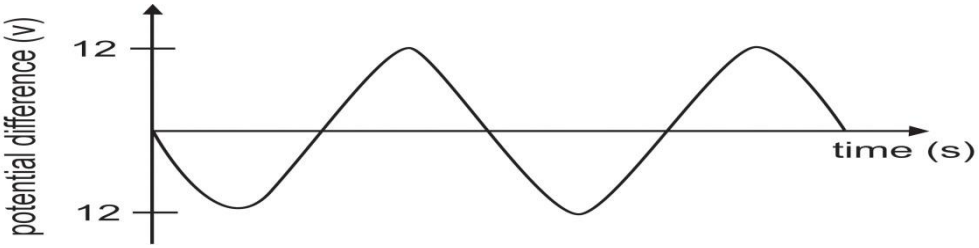


Which ONE of the following potential difference versus time graphs represents the output of this generator?

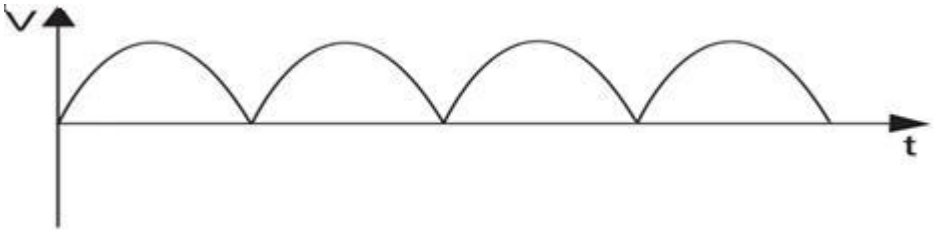
A



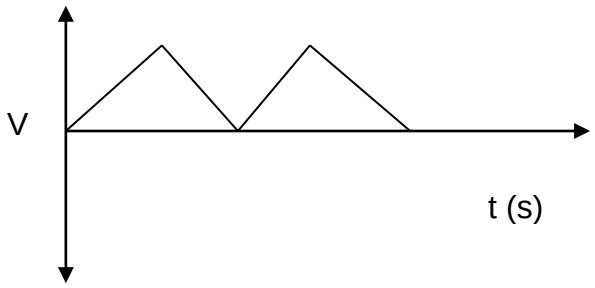
B



C



D



(2)

2.10 A 200 W UV light is shone on zinc metal and **electrons are ejected** from the metal. The 200 W UV light is replaced with a 40 W of the same UV light. Which of the following correctly describes the electrons being ejected?

	Number of photo-electrons ejected per second	**Kinetic energy of photoelectrons**
A	Decreases	Decreases
B	Increases	Increases
C	Decreases	Stays the same
D	Increases	Decreases

(2)
[20]

TOTAL SECTION A: 25

SECTION B

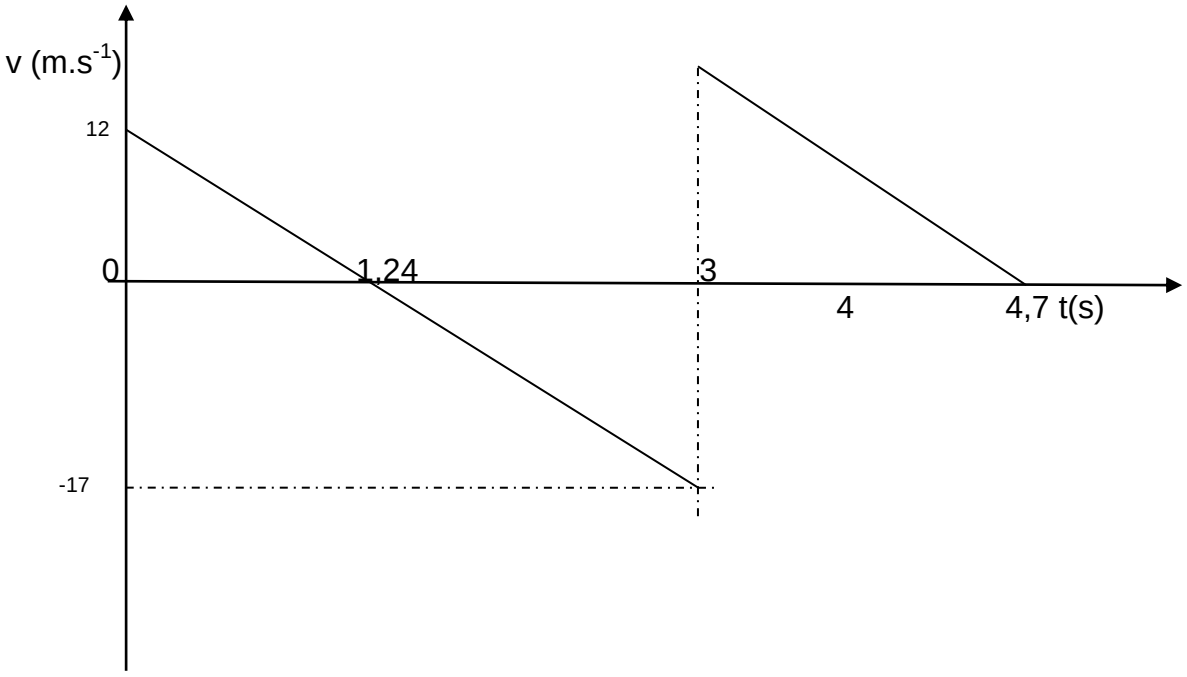
INSTRUCTIONS AND INFORMATION

1. Start each QUESTION on a NEW page.
2. Leave one line between two sub-questions, for example between QUESTIONS 3.1 and 3.2.
3. The formulae and substitutions must be shown in ALL calculations.
4. Round off all your final numerical answers to a minimum of TWO decimal places.
5. Answer this section in the ANSWER BOOK.

QUESTION 3 (Start on a new page.)

The velocity-time graph below shows the motion of a golf ball of mass 150 g, which is thrown vertically upwards from a platform above the ground. The ball strikes the ground and bounces back up again.

The collision of the ball with the ground is elastic.



3.1 Write down the physical quantity represented by the gradient of this graph. (1)

3.2 Write down the initial velocity of the golf ball. (1)

3.3 Write down the position of the ball at the following times during its motion:

3.3.1 t = 1,24 s (1)

3.3.2 t = 3 s (1)

3.3.3 t = 4,7 s (1)

3.4 Calculate each of the following WITHOUT THE USE OF EQUATIONS OF MOTION:

3.4.1 The height of the ball above the ground as it left the thrower's hand (4)

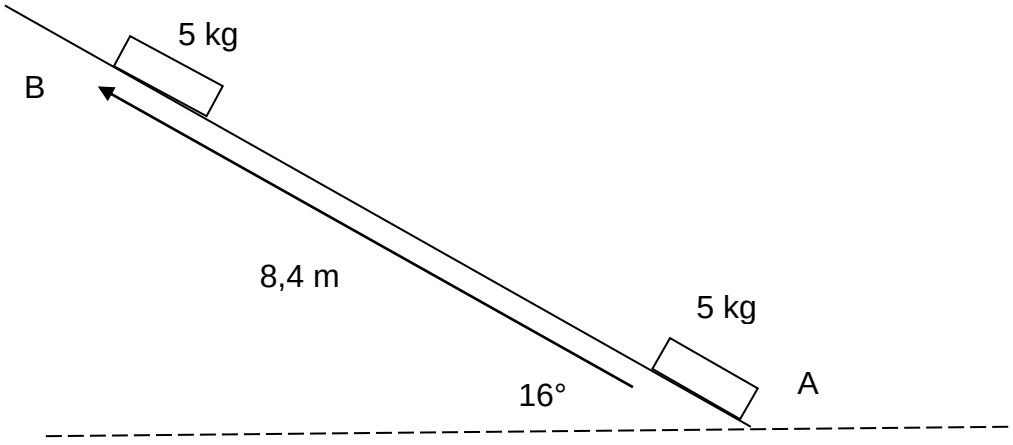
3.4.2 The height at which the ball bounces (3)

3.5 Calculate the impulse of the ball when it bounces off the ground. (3)

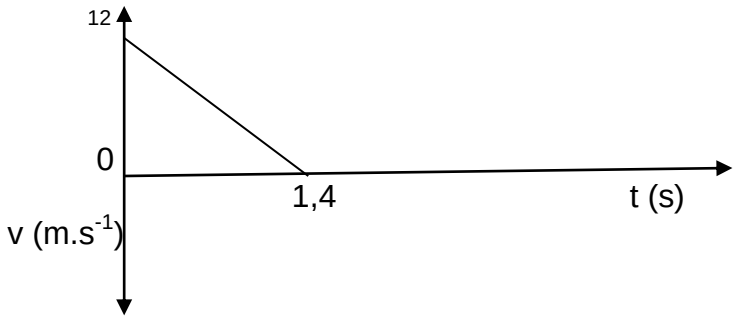
3.6 Draw the corresponding position versus time graph for the entire motion of the ball.
TAKE UP AS POSITIVE AND THE GROUND AS ZERO REFERENCE (3)
[18]

QUESTION 4 (Start on a new page.)

A 5 kg block slides up a rough slope inclined at 16° to the horizontal. The block slides past point A and moves 8,4 m before reaching its maximum height at point B.



The velocity-time graph below shows how the velocity of the block changes from the moment it passes point A until it reaches its maximum height at point B.



4.1 Describe the motion of the block from A to B. (2)

4.2 Use the information from the graph to calculate the change in the kinetic energy of the block between A and B. (3)

4.3 Write down the magnitude of *net work* done on the block between A and B. (1)

4.4 Write down the work energy theorem in words. (2)

4.5 Draw a free-body diagram which indicates all the forces acting on the block as it slides from A to B. Label the forces clearly. (3)

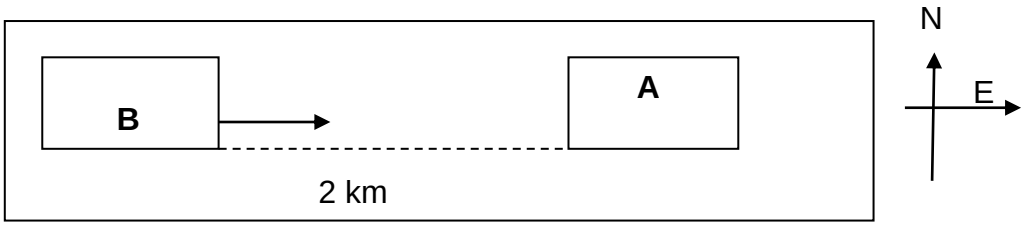
4.6 Calculate the work done by gravitational force on the block as it moves from point A to point B. (3)

4.7 Use the work energy theorem to calculate the work done by the frictional force as the block moves from point A to B. (5)

[19]

QUESTION 5 (Start on a new page.)

Truck B travelling at a velocity of 30 km.h^{-1} east, approaches a stationary truck A. At a distance of 2 km from A, the driver of truck B presses the hooter which produces a sound of frequency 13 kHz. The speed of sound in air on that day is 343 m.s^{-1}.



5.1 Will the frequency observed by the driver in truck A be higher or lower than 13 kHz? Give a reason for your answer. (2)

5.2 Calculate the frequency of the sound that the driver in truck A hears. (4)

5.3 A woman is standing 1 km from the approaching truck B. When will she hear the actual frequency of the truck? (1)

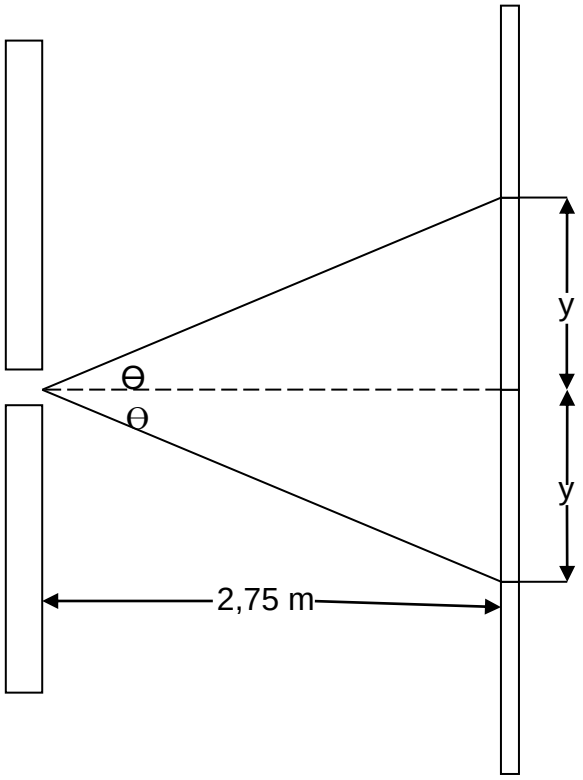
5.4 Name and explain the phenomenon in words that explains the change in the observed frequency calculated in QUESTION 5.2. (3)

5.5 Truck B is still approaching the stationary truck A at the same velocity. The driver presses the hooter again at a distance of 1,5 km from truck A. How does the frequency heard by the driver in truck A differ from your answer as calculated in QUESTION 5.2? Only write HIGHER THAN, REMAIN THE SAME or LESS THAN. (2)

[12]

QUESTION 6 (Start on a new page.)

Red light with a wavelength of 664 nm is shone through a single slit of width $1{,}20 \times 10^{-4}$ m. A pattern consisting of nodal and antinodal lines is observed on a screen 2,75 m from the slit.



6.1 Define the term *nodal lines*. (2)

6.2 Draw the observed diffraction pattern and indicate the positions where the waves meet in phase and out of phase. (4)

6.3 Calculate:

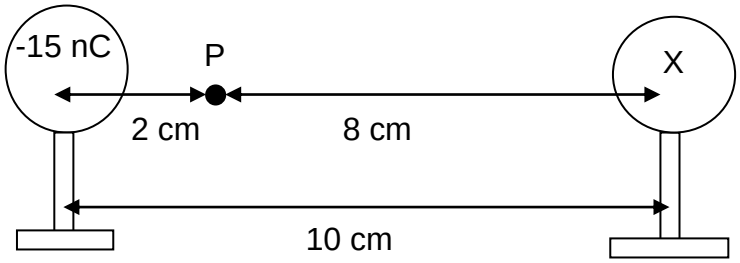
6.3.1 The angle at which the 3rd minimum is observed on the screen (4)

6.3.2 The distance, y, from the central maximum to the 3rd minimum (2)

[12]

QUESTION 7 (Start on a new page.)

Two metal spheres, A and B, on insulated stands is placed with their centres 10 cm apart as shown in the sketch below. A has a charge of -15 nC and B an unknown positive charge X.



The net electric field at point P is 3,943 x 10^5 N.C^{-1}.

7.1 Define an electric field at a point. (2)

7.2 Calculate the magnitude of the unknown charge X. (6)

The two spheres are made to touch and then returned to their original positions.

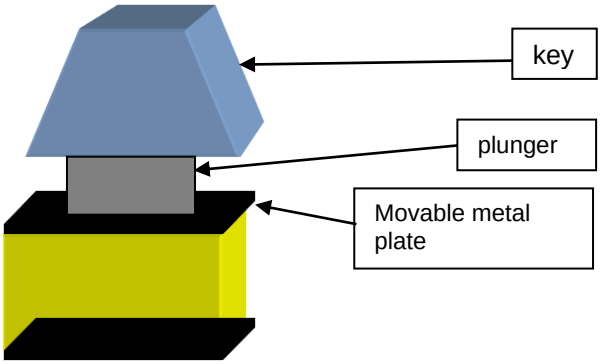
7.3 Calculate the magnitude and direction of the new electrostatic force exerted by each sphere on the other. (6)

7.4 Give TWO ways in which you can protect yourself from being struck by lightning when outside during a thunderstorm. (2)

[16]

QUESTION 8 (Start on a new page.)

Computer keyboard



One common kind of computer keyboard is based on the idea of capacitance. Each key is mounted on one end of the plunger, the other end being attached to a movable metal plate. The two plates of the key form a capacitor. When a key is pressed, the movable plate is pushed closer to the fixed plate. The area of each of the plates of the key that form a capacitor is $33,25 \times 10^{-5}$ m^2 and the plates are 0,015 mm apart.

8.1 What effect will a smaller distance between the plates have on the capacitance? Give a reason for your answer. (2)

8.2 Calculate the capacitance of this capacitor. (3)

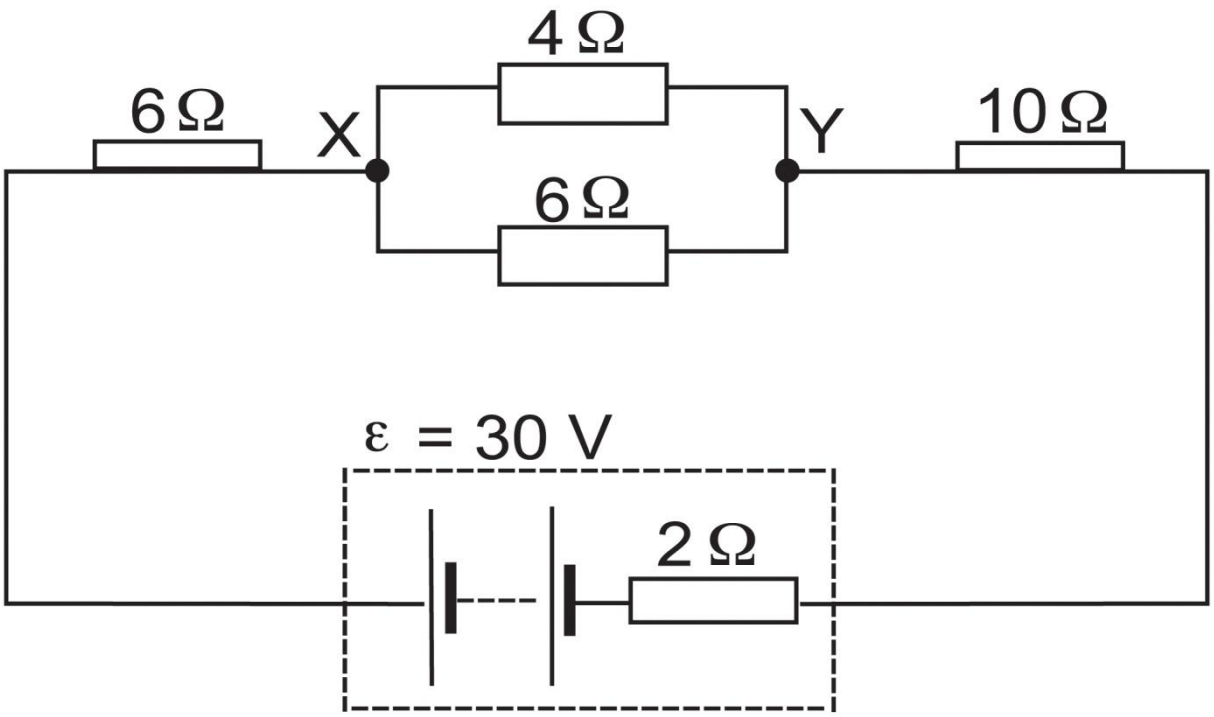
The above-mentioned capacitor is changed by inserting a dielectric between the plates and then connected as before.

8.3 Will the potential difference across the plates INCREASE, DECREASE or REMAIN THE SAME? Give a reason for your answer. (2)

[7]

QUESTION 9 (Start on a new page.)

Four resistors of different resistances are connected in a circuit as shown below. The battery has an *emf* of 30 V and an internal resistance of 2 Ω. The resistance of the connecting wires is negligible.



9.1 Define the concept *emf* of a battery. (2)

9.2 Calculate the current through the battery. (6)

9.3 Calculate the potential difference between points X and Y. (3)

[11]

QUESTION 10 (Start on a new page.)

10.1 Many of our domestic appliances like, for example vacuum cleaners, fans and washing machines make use of an alternating-current (AC) electric motor.

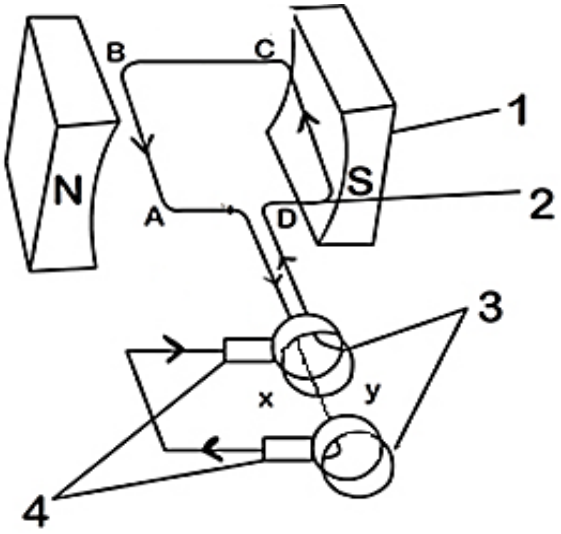
Write down:

10.1.1 The type of energy transfer that takes place in an electric motor (2)

10.1.2 The main difference between an AC and a DC motor (2)

10.1.3 A reason why a motor car's windscreen wiper is driven by direct current. (1)

10.2 The following diagram represents a simple AC generator (alternator). The direction of the initially induced current is indicated on the sketch.



10.2.1 Identify the components labelled 1 and 2. (2)

10.2.2 In which direction is the coil being rotated? (1)

10.2.3 Write down the name of the rule you used to determine the direction of rotation in QUESTION 10.2.2. (1)

10.2.4 Draw a graph to illustrate how the induced current varies with time for one complete cycle. (3)

10.2.5 Is the induced *emf* and induced current *in* phase or *out* of phase? Give a reason for your answer. (3)

10.2.6 What is the function of the components marked 3 and 4 in the above figure? (2)

10.2.7 Write down ONE structural change that can be made to the above-mentioned AC generator to change it to a DC generator (dynamo). (1)

[18]

QUESTION 11 (Start on a new page.)

The electromagnetic waves are arranged to form the electromagnetic spectrum.

Radio waves	Micro waves	Infrared radiation	Visible light	Ultra violet light	X-rays	Gamma rays

Some of the properties of electromagnetic radiation (like wavelength and frequency) can be explained by means of a wave model.

Refer to the information given above to answer the questions that follow.

11.1 Give ONE commercial use for each of the following:

11.1.1 X-rays (1)

11.1.2 Infrared (1)

11.1.3 Gamma rays (1)

Two learners have different views about the frequency and energy of electromagnetic waves in so much that they end up hypothesising differently:

Learner A: The lower the frequency of electromagnetic waves, the higher the energy and penetrating ability.

Learner B: The higher the frequency the higher the energy and the lower the penetrating ability.

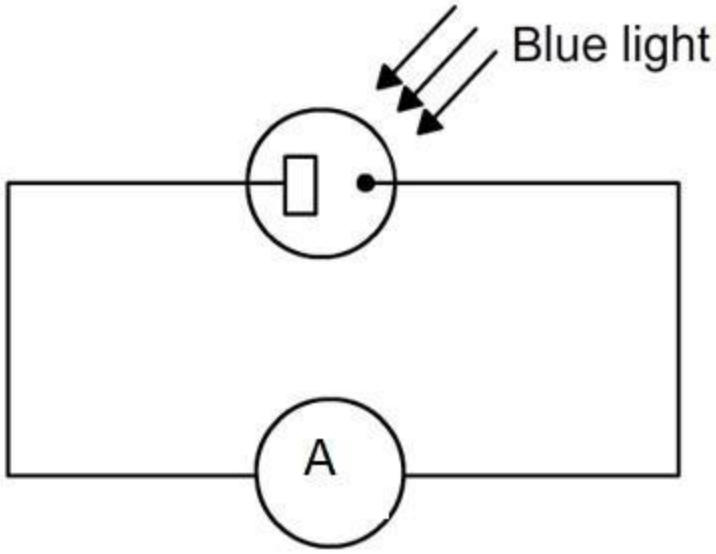
11.2 Which variable is manipulated in these hypotheses? (1)

11.3 Will the quantity given by the product of frequency and wavelength of electromagnetic waves be a DEPENDENT, INDEPENDENT or CONSTANT VARIABLE? (1)

11.4 Which hypothesis, if any, is correct according to your knowledge of electromagnetic waves? Explain. (2)

[7]

QUESTION 12 (Start on a new page.)



A photoelectric cell is irradiated with low intensity blue light and the micro-ammeter indicates a small current:

12.1 What are the carriers of charge:

12.1.1 Inside the photo cell? (1)

12.1.2 In the conducting wires? (1)

12.2 What name is given to the incident light quanta that are responsible for this phenomenon? (1)

12.3 This cell is now irradiated with a higher intensity of the same blue light.

12.3.1 What happens to the micro-ammeter reading? (1)

12.3.2 Explain this phenomenon briefly. (1)
[5]

TOTAL SECTION B: 125
GRAND TOTAL: 150

DATA/*GEGEWENS*

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

NAME/*NAAM*	SYMBOL/ *SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9{,}8\ m\cdot s^{-2}$
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*

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

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 $W_{net} = \Delta E_k$ $\Delta K = K_f - E_i$ or/of $\Delta E_k = E_{kf} - E_{ki}$
$P = \frac{W}{\Delta t}$	$P = Fv$

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

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ or/of $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ $E = h\frac{c}{\lambda}$
$\sin\theta = \frac{m\lambda}{a}$	$E = W_0 + E_k$ where/*waar* $E = hf$ and/en $W_0 = hf_0$ and/en $E_k = \frac{1}{2}mv^2$

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*

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

ALTERNATING CURRENT/*WISSELSTROOM*

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

PHYSICAL SCIENCES P1: ANSWER SHEET

GRADE 12

NAME: …….

SECTION A

QUESTION 1

1.1 _____ (1)

1.2 _____ (1)

1.3 _____ (1)

1.4 _____ (1)

1.5 _____ (1)

[5]

QUESTION 2

2.1	**A**	**B**	**C**	**D**
2.2	**A**	**B**	**C**	**D**
2.3	**A**	**B**	**C**	**D**
2.4	**A**	**B**	**C**	**D**
2.5	**A**	**B**	**C**	**D**
2.6	**A**	**B**	**C**	**D**
2.7	**A**	**B**	**C**	**D**
2.8	**A**	**B**	**C**	**D**
2.9	**A**	**B**	**C**	**D**
2.10	**A**	**B**	**C**	**D**

(10 x 2) **[20]**

TOTAL SECTION A: 25