



Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

SEPTEMBER 2018

PHYSICAL SCIENCES P1

MARKS: 150

TIME: 3 hours



This question paper consists of 18 pages including a 2-page data sheet.

INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME in the appropriate space on the ANSWER BOOK.
2. Answer ALL the questions.
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instrument.
5. Number the answers correctly according to the numbering system used in this question paper.
6. You are advised to use the attached DATA SHEETS.
7. The formulae and substitutions must be shown in ALL calculations.
8. Give brief motivations, discussions, et cetera where required.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Start EACH question on a NEW page.
11. All diagrams are not necessarily drawn according to scale.

QUESTION 1: 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 down only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK.

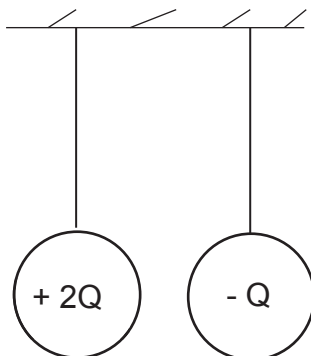
- 1.1 A car travels EAST at constant velocity. The net force on the car is ...
- A east.
B west.
C zero.
D south. (2)
- 1.2 A person on planet A, having radius R , experiences a gravitational force F . When the person is on planet B having a radius $5R$, the gravitational force experienced will be:
- A $\frac{1}{25} F$
B $\frac{1}{5} F$
C $5 F$
D $25 F$ (2)
- 1.3 Three masses m , $2m$ and $3m$ are simultaneously dropped from the same height in vacuum. The accelerations of the masses are a_1 , a_2 and a_3 respectively.
Which ONE of the options below, regarding their accelerations, is correct?
- A $a_1 < a_2 < a_3$
B $a_1 > a_2 < a_3$
C $a_1 < a_2 > a_3$
D $a_1 = a_2 = a_3$ (2)
- 1.4 The kinetic energy of an object having a mass m , velocity v and momentum p is E_k . Which ONE of the following will represent the kinetic energy of the *same* object when its momentum changes to $2p$?
- A $4E_k$
B $2E_k$
C $\frac{1}{4} E_k$
D $\frac{1}{2} E_k$ (2)
- 1.5 A block is sliding across a rough horizontal surface. The work done by friction changes only the:
- A Kinetic energy
B Potential energy
C Internal energy
D Kinetic and internal energies (2)

1.6 The Doppler effect is used in medicine to ...

- A detect cancer.
- B determine the length of an artery.
- C monitor the heartbeat of a foetus.
- D monitor the growth rate of a foetus.

(2)

1.7 Two small, identical oppositely charged spheres suspended from light inextensible strings, are held in fixed positions and prevented from touching. Refer to the diagram below.

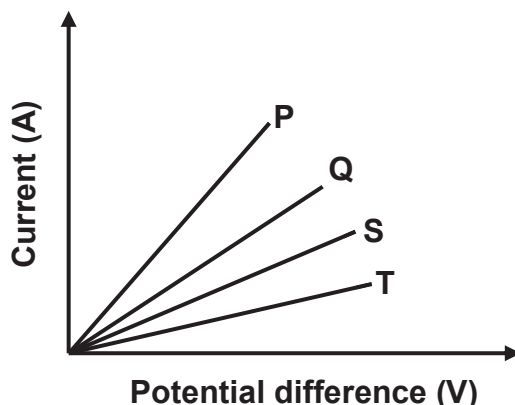


Which ONE of the following statements best describes the behaviour of the spheres when they are released?

- A They will move towards each other, touch each other momentarily and then separate.
- B They will move towards each other, touch each other momentarily and remain in contact.
- C They will remain at their original positions and then vibrate.
- D They move away from each other momentarily and then move towards each other.

(2)

- 1.8 The graphs of current versus potential difference obtained for four different resistors **P**, **Q**, **S** and **T** are shown below.

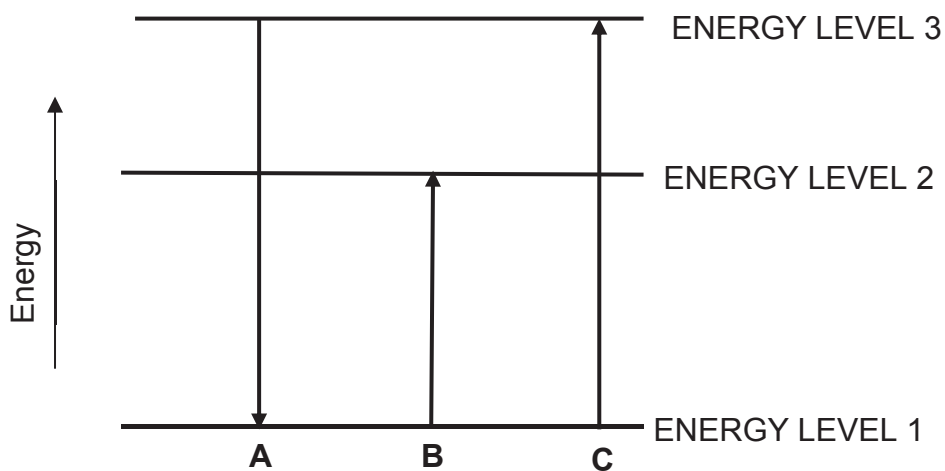


The resistor with the largest resistance is ...

- | | | |
|---|----|-----|
| A | P. | |
| B | Q. | |
| C | S. | |
| D | T. | (2) |
- 1.9 An electrical device that uses electrical energy to produce mechanical energy is called a(n) ...

- | | | |
|---|-----------------|-----|
| A | dynamo. | |
| B | alternator. | |
| C | electric motor. | |
| D | generator. | (2) |

- 1.10 In the diagram below **A**, **B** and **C** represent transitions made by an electron in an atom.



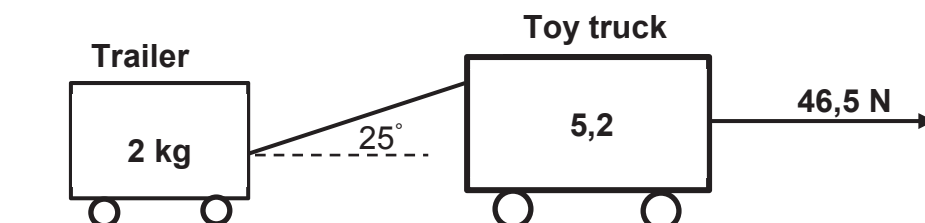
Which of the transition(s) represent energy absorption?

- A A only
- B B only
- C A and C only
- D B and C only

(2)
[20]

QUESTION 2 (Start on a NEW page.)

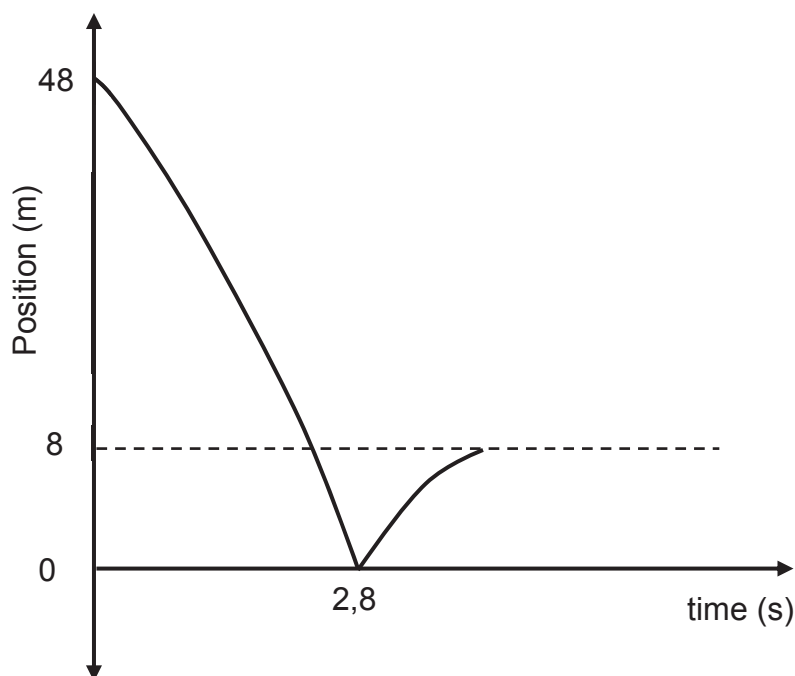
- 2.1 A toy truck of mass 5,2 kg is towing a trailer of mass 2 kg. The trailer is attached to the truck by means of a massless, inextensible rope, inclined at 25° to the horizontal, as shown on the diagram below. The pulling force on the truck is 46,5 N. The kinetic frictional force experienced by the truck is 12 N. The kinetic frictional force experienced by the trailer is 5,1 N.



- 2.1.1 Draw a labelled free-body diagram showing all forces acting on the TRUCK. (5)
- 2.1.2 State Newton's Second Law of motion in words. (2)
- 2.1.3 Calculate the tension in the rope. (6)
- 2.2 The mass and radius of the planet Mars are approximately $6,39 \times 10^{23}$ kg and $3,39 \times 10^6$ m respectively. Calculate the gravitational acceleration on the surface of Mars. (3)
- [16]**

QUESTION 3 (Start on a NEW page.)

The position-time graph for a ball thrown vertically downwards from the top of a 48 m tall building is shown below. The graph is not drawn to scale. The ball bounces off the ground, reaching a maximum height of 8 m. Ignore the effect of air resistance.



3.1 Calculate the speed at which the ball:

3.1.1 Is thrown downwards (4)

3.1.2 Hits the ground (3)

3.1.3 Bounces off the ground (3)

3.2 Draw a velocity-time graph (not to scale) for the entire motion of the ball.

Indicate the following on your graph:

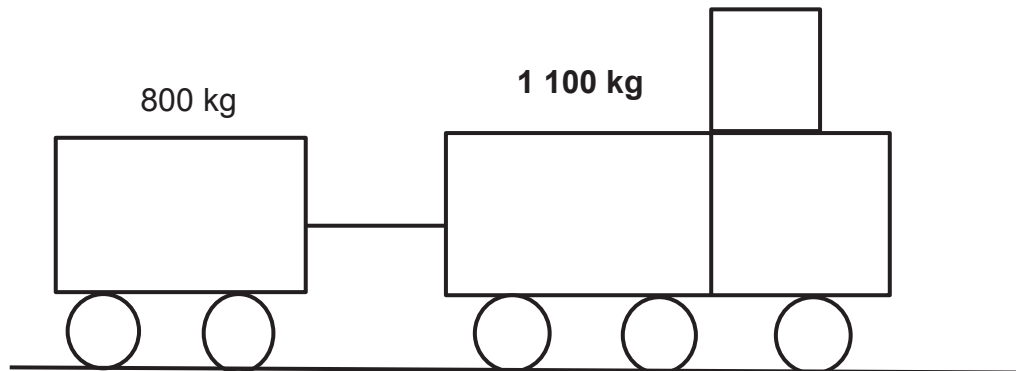
- (i) Initial velocity with which the ball was thrown
- (ii) Velocity with which the ball hit the ground
- (iii) Time taken to attain this velocity
- (iv) The velocity with which the ball bounces off the ground (4)

[14]

QUESTION 4 (Start on a NEW page.)

A 1 100 kg truck is pulling an 800 kg trailer by means of a massless rope at a constant speed of $45 \text{ km}\cdot\text{h}^{-1}$ to the right as shown in the diagram below.

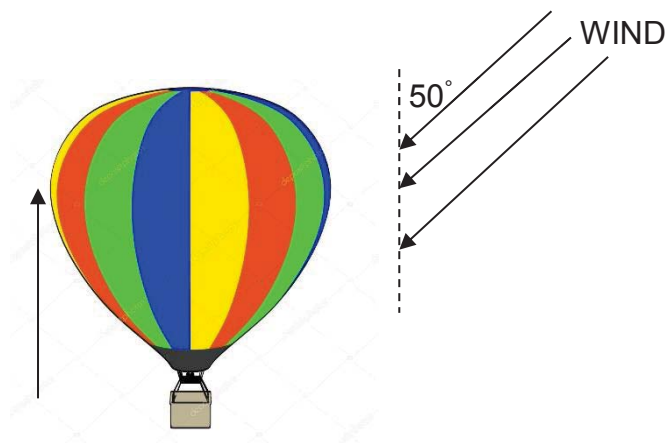
The rope snaps and the trailer continues to move to the right with an initial velocity of $9,06 \text{ m}\cdot\text{s}^{-1}$. Ignore all effects of friction.



- 4.1 Calculate the speed of the truck after the rope snapped. (4)
- 4.2 The truck collides with a wall and is brought to rest in 0,2 seconds.
- 4.2.1 Define the term *impulse*. (2)
- 4.2.2 Calculate the average net force exerted by the wall on the truck. (4)
- [10]**

QUESTION 5 (Start on a NEW page.)

A hot air balloon of mass 245 kg rises from the ground on a windy day. The wind blows in the direction as shown in the diagram, with a force of 1870 N. The hot air in the balloon provides an upward force of 3 000 N, causing the balloon to rise 12 m vertically upwards with a speed of 15 ms^{-1} .

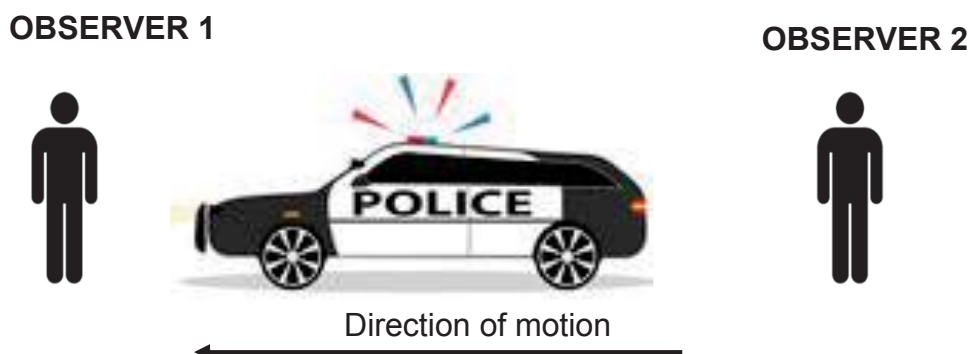


- 5.1 Draw a labelled free-body diagram showing all forces acting on the balloon. (3)
- 5.2 Calculate the:
- 5.2.1 Work done by gravitational force (3)
- 5.2.2 Net work done on the balloon (4)
- 5.3 State the work-energy theorem in words. (2)
- 5.4 Use the work-energy theorem to calculate the velocity of the balloon after it has risen 12 m. (3)

[15]

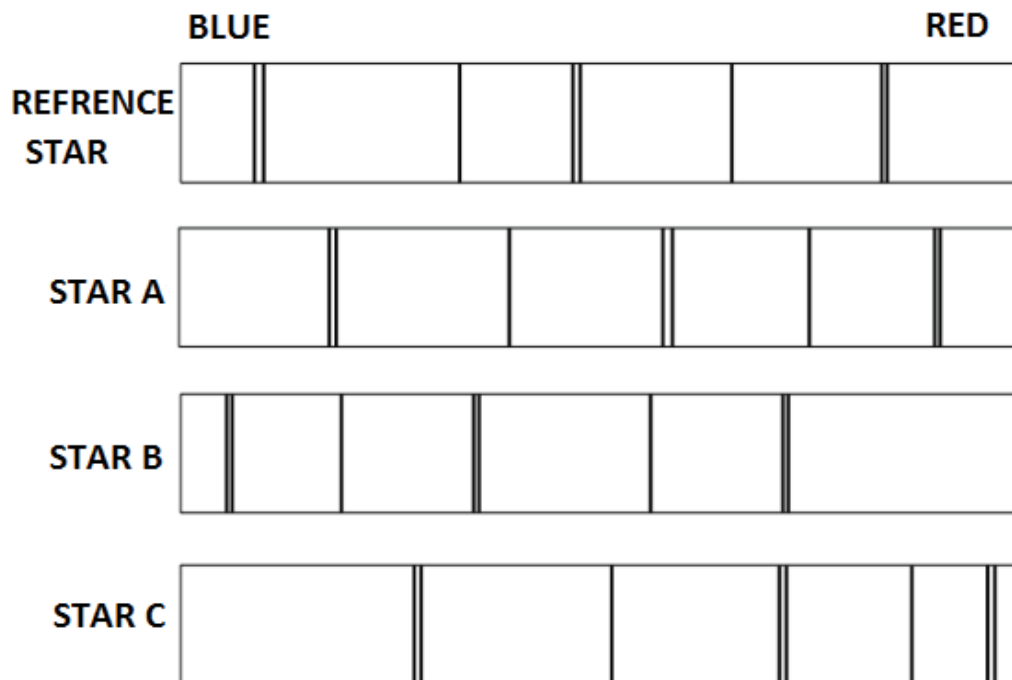
QUESTION 6 (Start on a NEW page.)

- 6.1 In the diagram below, a police car with its siren blaring, stationed between two stationary observers.



- 6.1.1 How does the frequency detected by observer 1 compare to the frequency detected by observer 2 while the car is stationary? Choose from, GREATER THAN, LESS THAN or EQUAL TO. Give a reason for the answer. (2)
- 6.1.2 The police car starts to move in the direction indicated by the arrow in the diagram. How does the frequency detected by observer 1 compare to the frequency detected by observer 2? Choose from: GREATER THAN, LESS THAN or EQUAL TO. (1)
- 6.1.3 Draw a diagram to support the answer in QUESTION 6.1.2. (3)
- 6.1.4 NAME the phenomenon described in QUESTIONS 6.1.1 and 6.1.2 above. (1)
- Observer 1 registers a frequency of 1 730 Hz as the police car approaches at a constant velocity of 25 m.s⁻¹. Take the velocity of sound in air as 340 m.s⁻¹.
- 6.1.5 Calculate the frequency of the siren. (5)

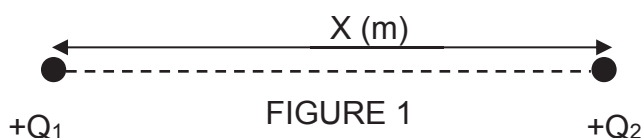
- 6.2 The spectral lines in the diagram below represent the hydrogen spectrum on different stars. Which of the stars is moving away fastest from the Reference star? Explain your answer.



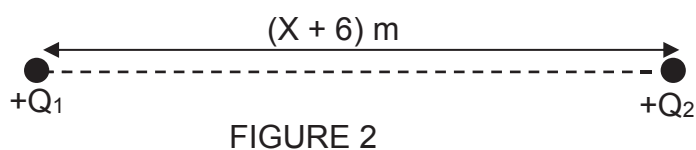
(2)
[14]

QUESTION 7 (Start on a NEW page.)

In FIGURE 1 below two identical point charges, placed a distance **X** apart, exert a force of 1 920 N on each other.



In FIGURE 2, the charges are separated a further 6 m. The force exerted by one charge on the other is 120 N.



(2)

7.1 State Coulomb's law in words.

7.2 Calculate the:

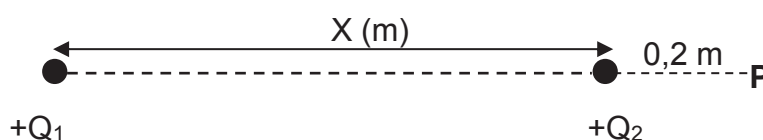
7.2.1 Distance **X** in metres

(5)

7.2.2 Magnitude of the charges

(4)

7.3 The charges are returned to their original positions as in FIGURE 1. An electron is located at point **P**, a distance of 0,2 m to the right of charge **Q₂**.



Calculate the net:

7.3.1 Electric field at point **P** due to the two charges

(5)

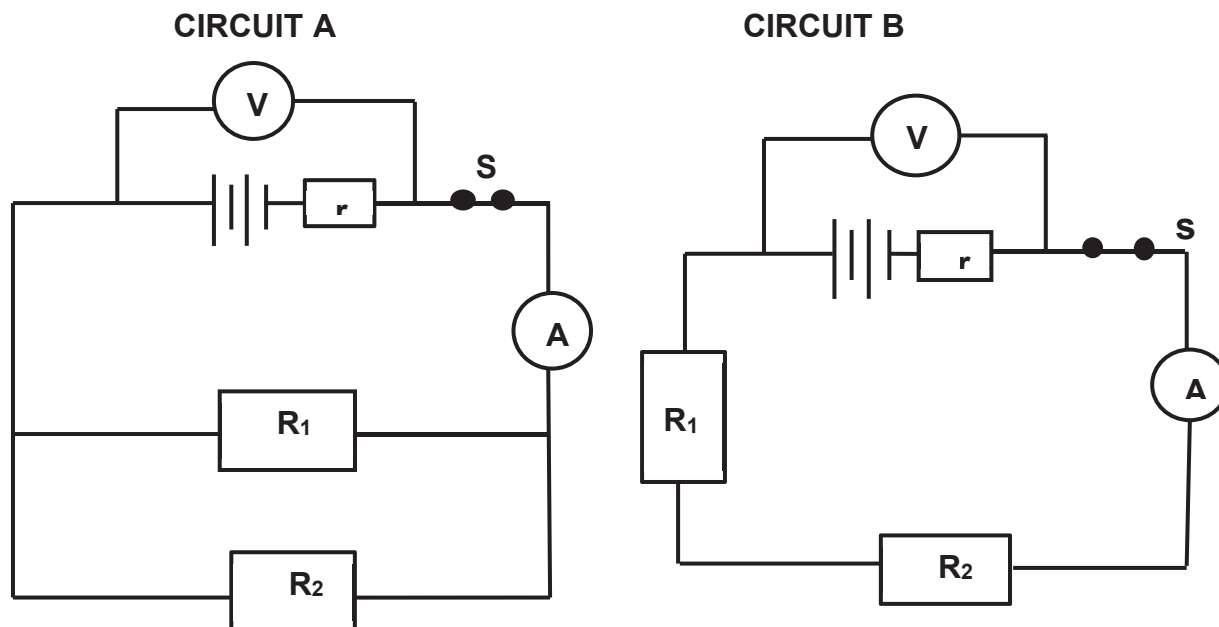
7.3.2 Force experienced by the electron at point **P** due to the two charges

(3)

[19]

QUESTION 8 (Start on a NEW page.)

- 8.1 A group of learners conduct experiments to determine the emf (\mathcal{E}) and internal resistance (r) of a battery. They build the circuits labelled **A** and **B** below and record their readings. The SAME BATTERY and the SAME RESISTORS are used in each experiment.



Experiment	V_{load} (V)	I_{circuit} (A)
1	20,58	1,71
2	14,4	4,8

- 8.1.1 Which experiment is represented by circuit **A**? (1)

Calculate the:

- 8.1.2 Internal resistance of the battery (4)

- 8.1.3 Emf of the battery (2)

- 8.1.4 Resistance of each resistor (4)

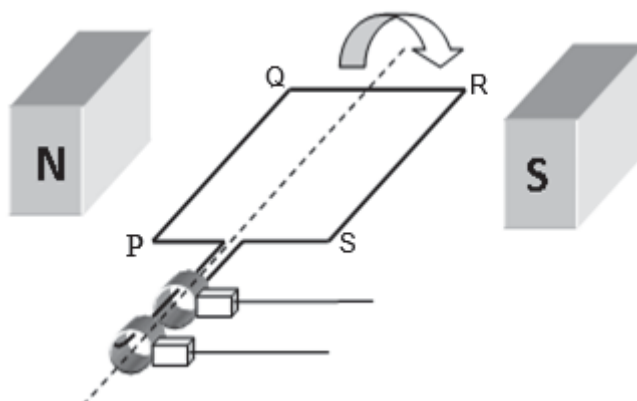
- 8.1.5 Resistor R_2 is now disconnected from circuit **A**. How will this change affect the electrical energy transferred per second by the battery? Write down INCREASE, DECREASE or REMAIN THE SAME. Explain your answer. (3)

- 8.2 The cost of electricity at a certain municipality is R1,20 per kWh. A bakery operates an electric oven which has a coil of resistance 52Ω . The current that passes through the coil is 16 A. Calculate how much the bakery pays for electricity per day if the electric oven is used for 6 hours per day. (4)

[18]

QUESTION 9 (Start on a NEW page.)

- 9.1 The simplified diagram below represents a generator rotated in the direction shown on the diagram.

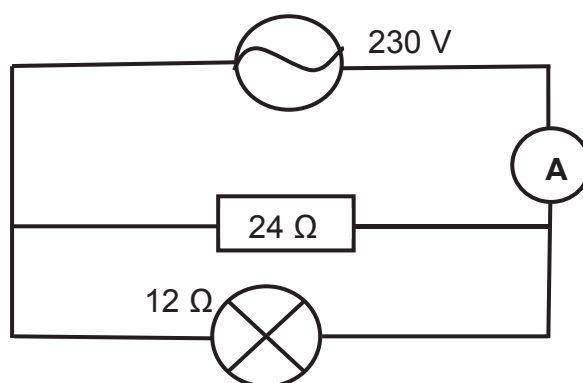


9.1.1 State the energy conversion that takes place in this generator. (2)

9.1.2 The generator is rotated clockwise as indicated in the diagram. What is the direction of the current in the section **PQ** of the device? Write down only **P to Q** or **Q to P**. (1)

- 9.2 The diagram below shows a simplified version for part of a household wiring circuit.

The voltage supply in a certain house is 230 V. A light bulb having a resistance of $12\ \Omega$ and a kettle having a resistance of $24\ \Omega$ are used at a certain time as shown in the diagram below.



Calculate the:

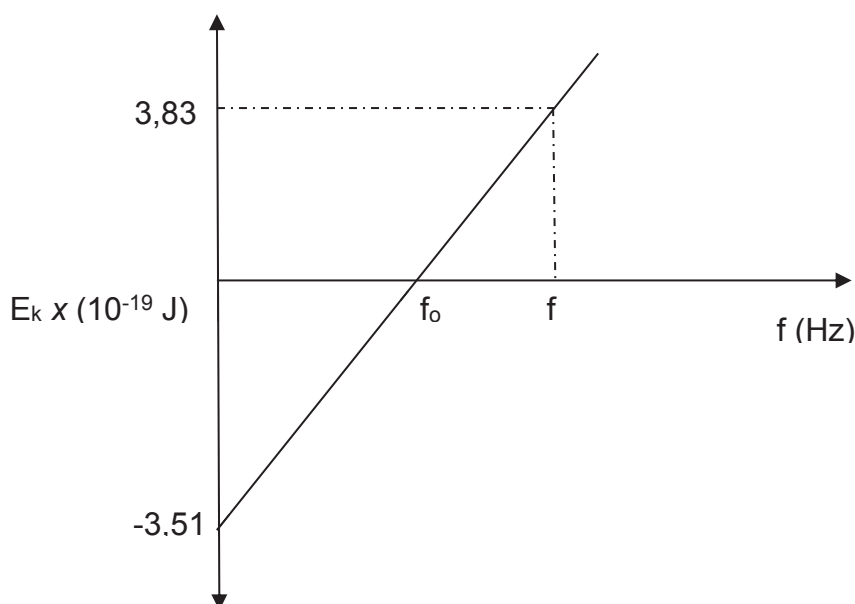
9.2.1 Peak (maximum) voltage of the domestic supply (3)

9.2.2 Average power dissipated if the two light bulbs and kettle are used at the same time (5)

[11]

QUESTION 10 (Start on a NEW page.)

Different frequencies of light are shone onto a sodium metal plate and the maximum kinetic energy of ejected electrons is determined each time. A graph of maximum kinetic energy versus frequency for the metal is shown below.



- 10.1 Define the term *work function* of a metal. (2)
- 10.2 Write down the value of the work function of sodium metal. (1)
- 10.3 The same light photons are incident on zinc metal. How will the gradient of the graph for zinc metal compare to the gradient of the graph for the sodium metal? Write only LESS THAN, GREATER THAN or EQUAL TO. Give a reason for your answer. (2)
- 10.4 Calculate the:
- 10.4.1 Frequency f_0 indicated on the graph (3)
- 10.4.2 Wavelength of the incident photons that correspond to the frequency f indicated on the graph above (5)

[13]**TOTAL: 150**

**DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)**

**GEGEWENS VIR FISIIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIIESE KONSTANTES

NAME/NAAM	SYMBOL/ SIMBOOL	VALUE/WAARDE
Acceleration due to gravity / Swaartekragversnelling	g	$9,8 \text{ m}\cdot\text{s}^{-2}$
Universal gravitational constant / Universelegravitasiekonstant	G	$6,67 \times 10^{-11} \text{ N}\cdot\text{m}^2\cdot\text{kg}^{-2}$
Speed of light in a vacuum / Spoed van lig in 'n vakuum	c	$3,0 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
Planck's constant / Planck se konstante	h	$6,63 \times 10^{-34} \text{ J}\cdot\text{s}$
Coulomb's constant / Coulomb se konstante	k	$9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$
Charge on electron / Lading op elektron	e	$-1,6 \times 10^{-19} \text{ C}$
Electron mass / Elektronmassa	m_e	$9,11 \times 10^{-31} \text{ kg}$
Mass of earth / Massa op aarde	M	$5,98 \times 10^{24} \text{ kg}$
Radius of earth / Radius van aarde	R_E	$6,38 \times 10^3 \text{ km}$

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

$F_{\text{net}} = ma$	$p = mv$
$f_s^{\text{max}} = \mu_s N$	$f_k = \mu_k N$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1 m_2}{d^2}$	$g = G \frac{M}{d^2}$

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 $E_k = \frac{1}{2} mv^2$	$W_{\text{net}} = \Delta K$ or/of $W_{\text{net}} = \Delta E_k$ $\Delta K = K_f - K_i$ or/of $\Delta E_k = E_{kf} - E_{ki}$
$W_{\text{nc}} = \Delta K + \Delta U$ or/of $W_{\text{nc}} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{\text{av}} = Fv$	

WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG

$v = f \lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/of $E = h \frac{c}{\lambda}$
$E = W_o + E_k$ where/waar $E = hf$ and/en $W_o = hf_o$ and/en $E_k = \frac{1}{2}mv^2$ or/of $K_{\max} = \frac{1}{2}mv_{\max}^2$	

ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{V}{d}$	$E = \frac{F}{q}$
$V = \frac{W}{q}$	$n = \frac{Q}{q_e}$

ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE

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

ALTERNATING CURRENT/WISSELSTROOM

$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}}$ / $I_{\text{wgk}} = \frac{I_{\text{maks}}}{\sqrt{2}}$ $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$ / $V_{\text{wgk}} = \frac{V_{\text{maks}}}{\sqrt{2}}$	$P_{\text{average}} = V_{\text{rms}} I_{\text{rms}}$ / $P_{\text{geniddeld}} = V_{\text{wgk}} I_{\text{wgk}}$ $P_{\text{average}} = I_{\text{rms}}^2 R$ / $P_{\text{geniddeld}} = I_{\text{wgk}}^2 R$ $P_{\text{average}} = \frac{V_{\text{rms}}^2}{R}$ / $P_{\text{geniddeld}} = \frac{V_{\text{wgk}}^2}{R}$
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