LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2018

MARKS: 150

TIME: 3 hours

This question paper consists of 18 pages and 2-paged data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your NAME in the appropriate space on the ANSWER BOOK.
2. This question paper consists of 10 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 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. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. 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 E

1.1 The force or the component of a force which a surface exerts on an object with which it is in contact, and which is perpendicular to the surface is called...

A frictional force.

B normal force.

C gravitational force.

D applied force. (2)

1.2 A physics learner stands on a scale in a lift that is moving upwards at a CONSTANT VELOCITY.

The reading on a scale, compared to the reading when the lift was stationary, would be...

A the same.

B zero.

C smaller.

D greater. (2)

1.3 The sketch below shows the path followed by a ball bouncing on the floor in the absence of air resistance.

Which ONE of the following vectors CORRECTLY represents the force **F** acting on the ball when it is in position **A**?

A 

C 

B 

D 

(2)

1.4 Which ONE of the following is the unit of measurement for the **rate of change of momentum**?

A ampere

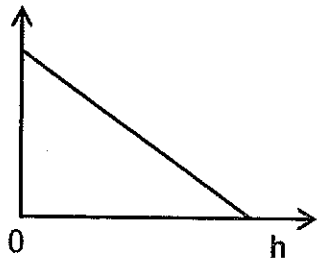
B coulomb

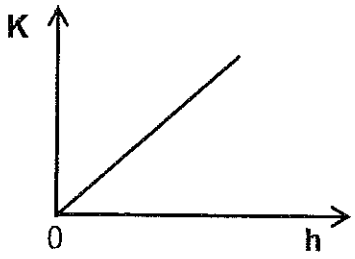
C newton

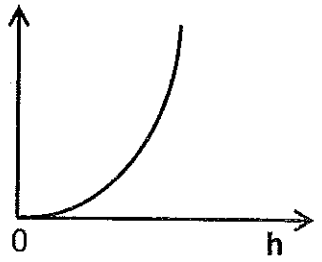
D watt (2)

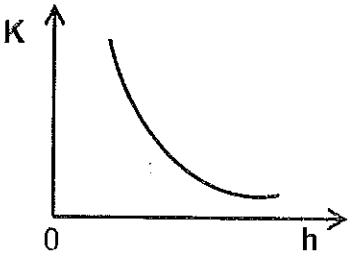
1.5 An object is dropped from a height, **h**, above ground level. Ignore the effects of air resistance.

Which ONE of the following graphs BEST represents the relationship between its kinetic energy **K** and its height **h** above ground level?

A


B


C


D


(2

1.6 A source of sound with frequency 620 Hz is placed on a moving platform that approaches an educator at speed **v**. An educator hears sound with frequency f_1. Then the source of sound is held stationary while the educator approaches it at the same speed **v**. The educator hears sound with a frequency f_2.

Which ONE of the following mathematical statements is CORRECT?

A $f_1 = f_2 > 620$ Hz

B $f_1 > f_2 > 620$ Hz

C $f_1 = f_2 < 620$ Hz

D $f_2 > f_1 > 620$ Hz

(2)

1.7 The electrostatic force that one point charge exerts on the other point charge must be increased by a **factor of four** by changing the distance between them.

The distance between the two point charges must be...

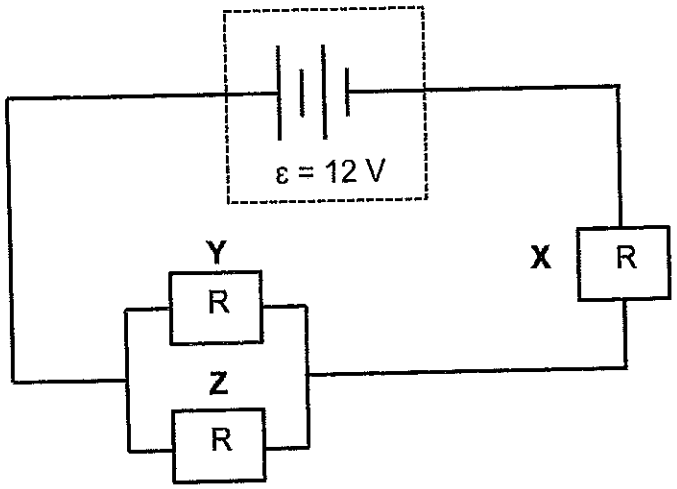
A increased by a factor of 2.

B increased by a factor of 4.

C decreased by a factor of 4.

D decreased by a factor of 2. (2)

1.8 In the circuit diagram below the resistors **X**, **Y** and **Z** are IDENTICAL.



The internal resistance of the battery is negligible.

Which ONE of the following CORRECTLY represents the ratio of the POWER in **X** to the POWER in **Y**?

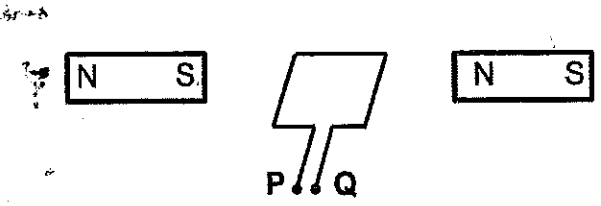
A 4:1

B 1:4

C 9:4

D 4:9 (2

1.9 The diagram below shows a coil in a magnetic field.



When the coil is part of a DC motor, which ONE of the following must be connected to **P** and **Q**?

A AC supply

B Slip rings

C Split ring

D Soft iron core (2)

1.10 The model of light supported by the photoelectric effect is the …

A wave model.

B electron model.

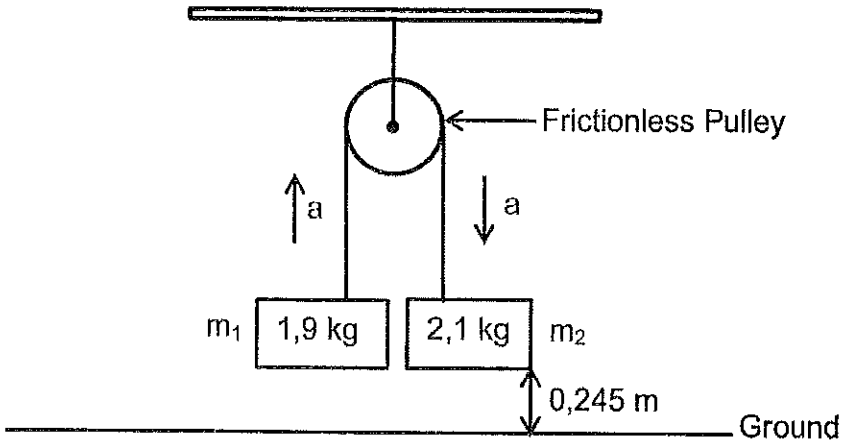
C particle model.

D diffraction model. (2)

[20]

QUESTION 2 (Start on a new page.)

2.1 The sketch bellow shows an apparatus which can be used to determine the gravitational acceleration, **g**.
Two different masses $\mathbf{m_1}$ and $\mathbf{m_2}$ are attached to a light (massless), inextensible cord which hangs over a frictionless pulley, as the diagram below illustrates. The masses are initially held **at rest**.



Ignore the effects of air friction, and masses of the cord and pulley.

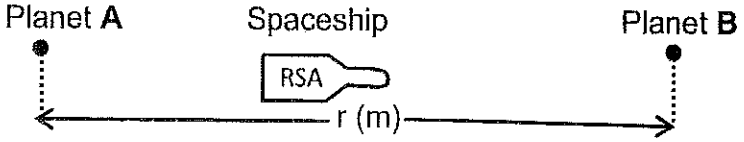
2.1.1 State, in words, *Newton's Second Law of Motion* in terms of acceleration. (2)

When the masses are released from rest, the system moves through 0,245 m in one second.

2.1.2 Draw a labelled free-body diagram for $\mathbf{m_1}$ as it moves upwards. (2)

2.1.3 Calculate the value of the gravitational acceleration, **g**. (6)

2.2 A spaceship of mass 'm' kg, leaves planet **A** and sets out into space towards a newly discovered planet **B**, as shown in the diagram below.



After travelling 60% of the way to planet **B**, the commander discovers that the **net force** of the two planets on the spaceship is ZERO.

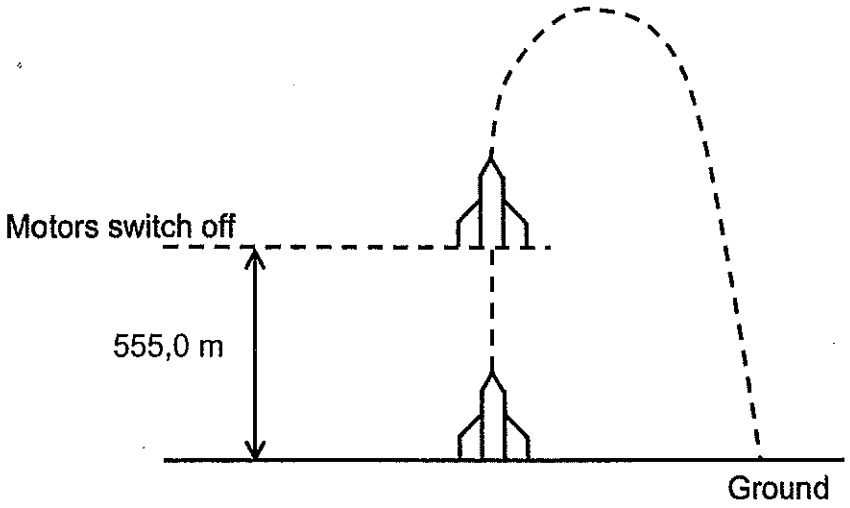
2.2.1 Give a reason why Newton's Law of Universal Gravitation is referred to as **an inverse square Law.** (1)

2.2.2 Show, by means of an appropriate calculation, that the **ratio** of the masses of the two planets is given by $\mathbf{M_A:M_B = 9:4}$ (4)
[15]

QUESTION 3 (Start on a new page.)

(NB: USE ONLY EQUATIONS OF MOTION IN THIS QUESTION.)

A 7 200 kg rocket blasts off vertically **from rest** from the launch pad with a constant upwards acceleration of 2,20 $m \cdot s^{-2}$.
When it has reached the height of 555,0 m, its engines suddenly fail, (its motors switch off).The diagram below shows the path followed by the rocket.



Ignore the effects of air resistance.

3.1 Explain what is meant by a *projectile*. (2)

3.2 Show, by means of suitable calculations, that the maximum height that this rocket reaches above the ground is **679, 592 m**. (5)

3.3 Hence determine the:

3.3.1 Time taken after the engine failure for the rocket to come crashing down to the ground. (3)

3.3.2 Speed of the rocket just before it crashes to the ground (3)

3.4 Sketch a velocity versus time graph for the motion of the rocket from the moment of engine failure until it crashes to the ground. Take the time when the rocket's engines fail as t = 0 s.

Clearly show the values of the following on the graph:

- Velocity of the rocket when it crashes to the ground
- Time at which the rocket crashes to the ground (3)

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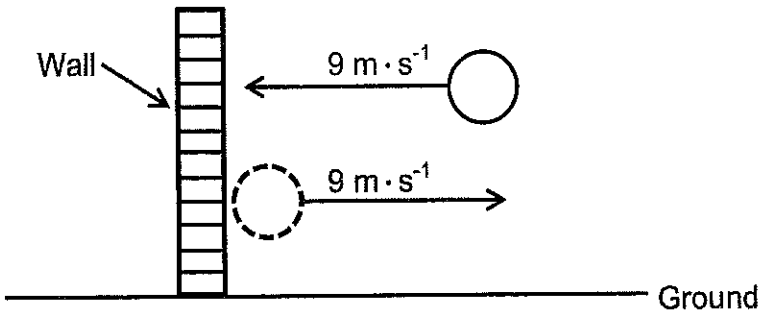
QUESTION 4 (Start on a new page.)

A tennis ball with a mass of 80 g, is thrown horizontally and collides perpendicularly with a wall at a velocity of 9 m · s^{-1}. The ball rebounds in the opposite direction at 9 m · s^{-1}, as shown in the diagram below.



4.1 Define, in words, the term *impulse* of a force as used in physics. (2

4.2 Calculate the impulse that acts on the tennis ball while it is in contact with the wall. (3

4.3 Use a calculation to show that the **collision** of the tennis ball with the wall is **elastic**. (3

4.4 Draw vector diagrams (not to scale) to illustrate the relationship among the *initial momentum*, the *final momentum* and the *change in momentum* of the tennis ball.

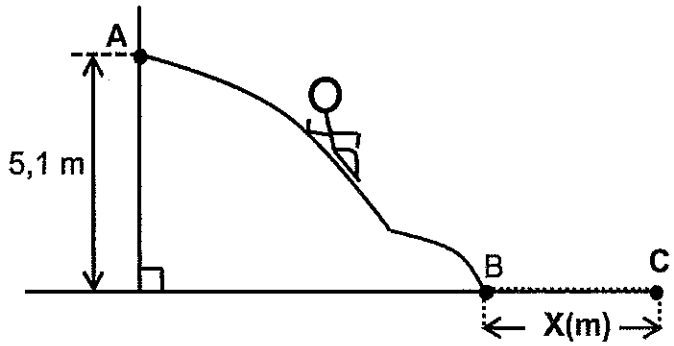
Clearly show the following on the diagram:

- The initial momentum, p_i
- The final momentum, p_f
- The change in momentum, Δp

(3
[1

QUESTION 5 (Start on a new page.)

The diagram below illustrates a child of mass 20 kg sliding down a frictionless ramp.



5.1 Define a *non-conservative force.* (2)

5.2 Use the relationship $W_{nc} = \Delta E_p + \Delta E_k$ to show that in the absence of non-conservative forces, mechanical energy is conserved. (3)

5.3 Use the **principle of conservation of mechanical energy** to calculate the speed of the child on landing at the bottom, at point **B**. (3)

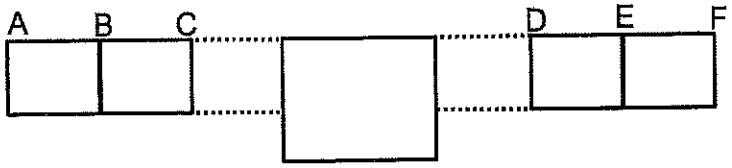
The coefficient of kinetic friction between the child and the horizontal surface at the bottom of the ramp, is 0, 2.

5.4 If the child stops at **C,** use **energy principles** to calculate the distance **X** that the child travels before stopping. (4)

[12]

QUESTION 6 (Start on a new page.)

6.1 A fire engine races towards a burning building CD with the sirens blaring. Two pedestrians, **X** and **Y**, hear the fire engine and stand still to watch.

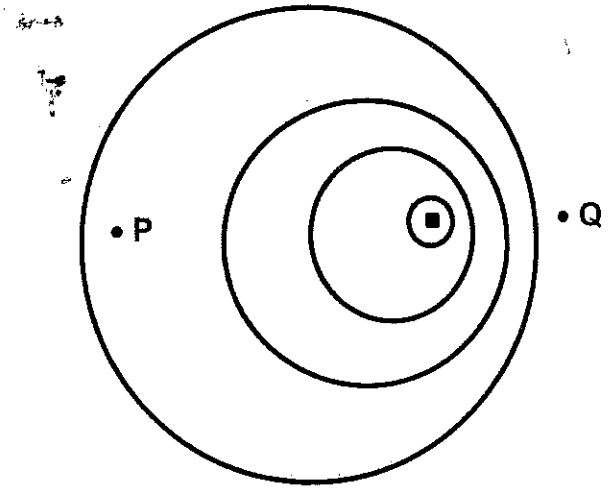


Pedestrian **X** is standing at point **B** and pedestrian **Y** is standing at point **E**. **X** hears a higher pitch and **Y** hears a lower pitch.

6.1.1 Write down the NAME of the phenomenon which explains why the pedestrians hear different frequencies. (1)

6.1.2 In which direction (**E to D** or **D to E**) is the fire engine travelling? (1)

The diagram below shows the wave fronts of the sound produced from the siren as a result of the motion of the fire engine.



6.1.3 On what side of the diagram (**P** or **Q**) is pedestrian **Y** standing when he hears the lower pitch? Provide reasons why pedestrian Y hears the siren at a lower pitch by referring to **speed of sound**, **wavelength** and **frequency**. (4)

The siren emits sound of frequency 440 Hz. Assume the speed of sound in air to be 330 $m \cdot s^{-1}$.

6.1.4 Calculate the frequency of sound heard by pedestrian **X** if the fire engine is travelling at 20 $m \cdot s^{-1}$. (3)

6.1.5 Consider pedestrian **X** and sketch a graph of apparent frequency (f_L) versus velocity (v_S) of the sound source. (NO NUMERICAL VALUES NEEDED) (2)

6.2 A helium line from the spectrum of the sun has a frequency of 5,10 x 10^{14} Hz. The frequencies of the same helium line from the Earth, which are observed in the line emission spectrum of two stars, are:

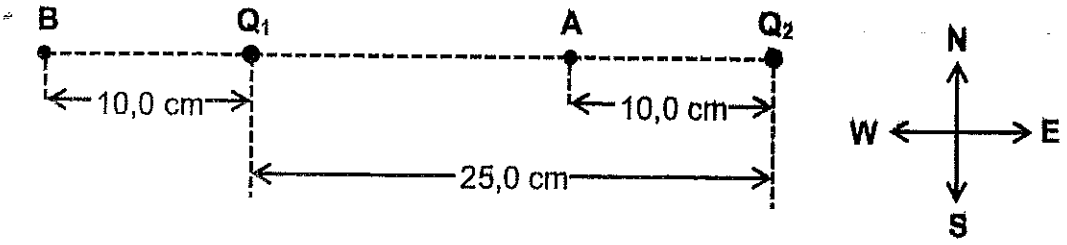
Star **A**: 5,12 x 10^{14} Hz
Star **B**: 5,02 x 10^{14} Hz

6.2.1 Which ONE of the stars (**A** or **B**) has a red shift? Give a reason for the answer. (2)

6.2.2 In which direction does star **A** move? State only: **Away from the Earth** or **Towards the Earth**. (1)
[14]

QUESTION 7 (Start on a new page.)

Two point charges, Q_1 and Q_2, are placed 25,0 cm apart along a straight line. The charge on Q_1 is - 6,25 nC and the charge on Q_2 is -12,5 nC. Point **A** is 10,0 cm **west** of Q_2 and point **B** is 10,0 cm **west** of Q_1, as the diagram below illustrates.



7.1 Describe the term *electric field*. (2

7.2 Calculate the magnitude of the **net electric field** at point **B** due to point charges Q_1 and Q_2. (5

7.3 State, in words, *Coulomb's Law of electrostatics*. (2

7.4 Determine the magnitude and state the direction of the electrostatic force that a **proton** will experience when placed at point **A**. (5

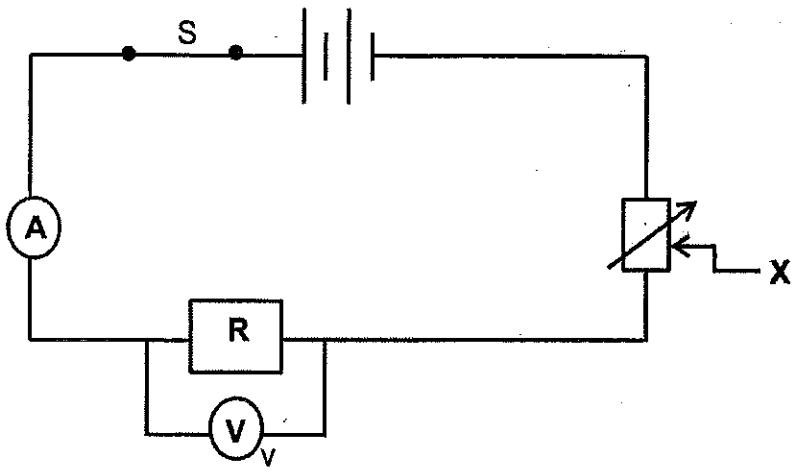
The point charges, Q_1 and Q_2, are now brought into contact with each other and then returned to their original positions.

7.5 Calculate the number of electrons transferred from one point charge to the other after they have made contact and have been separated again. (4
[1

QUESTION 8 (Start on a new page.)

8.1 A learner investigates the relationship between the **current** in a resistor and the **potential difference** across the resistor.

The circuit diagram below shows the apparatus that the learner uses.



The table below shows the results obtained.

VOLTMETER READING (V)	AMMETER READING (A)
3, 2	0, 4
7, 2	0, 9
9, 6	1, 2

8.1.1 Write down the NAME of the physics Law that the learner is investigating. (1)

8.1.2 State ONE factor which must be kept constant during the experiment. (1)

8.1.3 Formulate **a suitable hypothesis** for this investigation. (2)

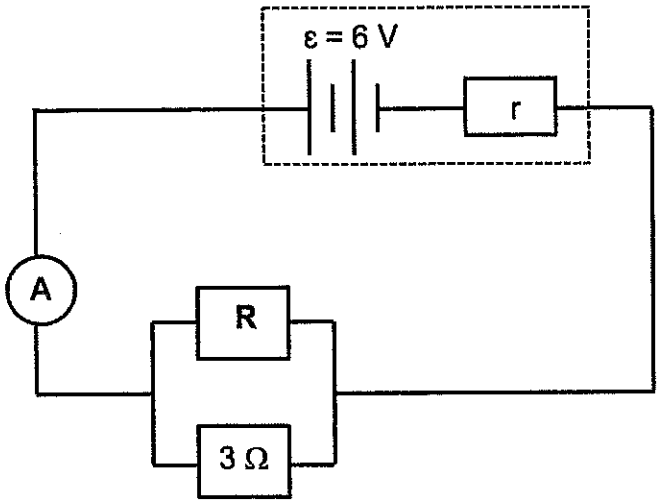
8.1.4 In this investigation, is the potential difference the DEPENDENT or INDIPENDENT variable? (1)

8.1.5 Write down the NAME and **state the purpose** of the piece (item) of apparatus labelled **X** in the circuit diagram above. (2)

8.1.6 Use the data in the table to determine whether or not these results are in accordance with the Law referred to in QUESTION 8.1.1. Show your calculations and conclusion. (4

8.1.7 Write down the resistance of the resistor used in this investigation. (1

8.2 In the circuit diagram below, the ammeter reads 2,4 A. The internal resistance of the battery is 0,5 Ω



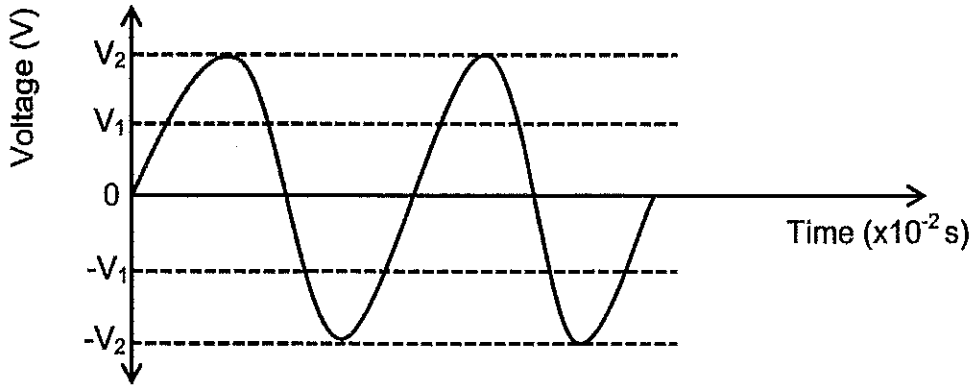
Calculate the:

8.2.1 Resistance of **R** (4

8.2.2 Rate at which energy is converted in the parallel resistor combination (3
[1

QUESTION 9 (Start on a new page.)

A diagram below shows a sketch graph of output voltage versus time for an AC generator for two cycles of rotation of the coil which is used to supply power to a building. A house owner plugs a kettle into a 240 V socket.



9.1 State the NAME of the physical process that produces the output of the generator. (1)

9.2 Which ONE ($\mathbf{V_1}$ or $\mathbf{V_2}$) is the effective (rms) output of the generator? (1)

9.3 Write down in terms of $\mathbf{V_1}$ or $\mathbf{V_2}$, a **formula** that gives the relationship between $\mathbf{V_1}$ and $\mathbf{V_2}$. (1)

9.4 Calculate the value of $\mathbf{V_2}$. (2)

The power of the kettle is 1 200 W.

9.5 Define, in words, the term *root mean square (**rms**)* of the alternating current. (2)

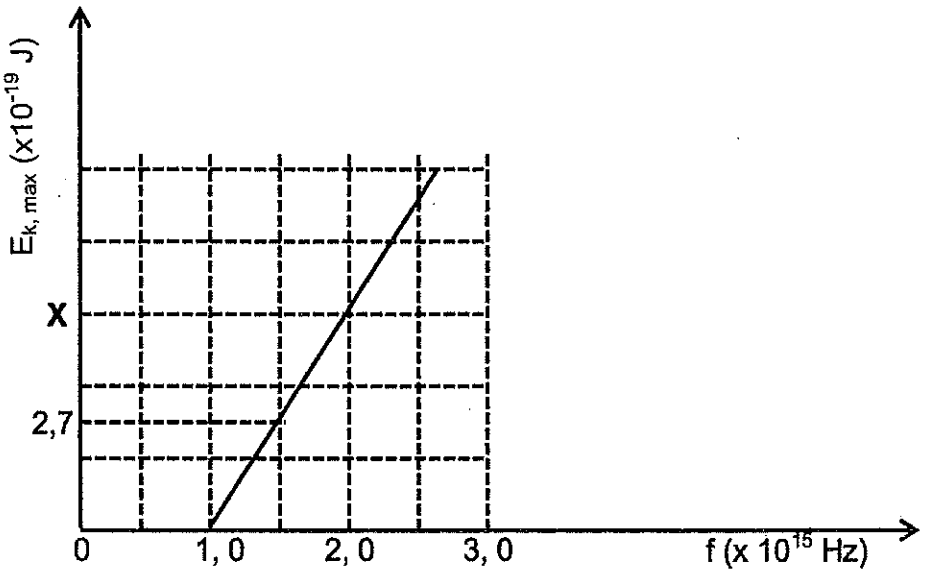
9.6 Calculate the peak (maximum) current in the kettle. (4)

9.7 State ONE advantage of using AC over DC for long distance transmission of electrical power. (1)
[12]

QUESTION 10 (Start on a new page.)

In an experiment using a photocell, ultraviolet light of **varying frequency** but **constant intensity** is made to strike a metal surface. The maximum kinetic energy ($E_{k,\ max}$) of photoelectrons for each frequency, f, is measured.

The graph below shows how the maximum kinetic energy ($E_{k,max}$) varies with the frequency, f.



10.1 Write down ONE precaution that should be taken when conducting this experiment. (1)

10.2 State ONE factor which determines the kinetic energy of photoelectrons emitted by a metal surface. (1)

10.3 **Use the graph** to determine the value of the:

10.3.1 Work function, W_o (3)

10.3.2 $E_{k,max}$ marked **X** (3)

Light of frequency 5,5 x 10^{14} Hz is made to strike a surface whose work function is 4,0 x 10^{-19} J.

10.4 Define, in words, the term *work function* of a metal. (2)

10.5 Show, by means of an appropriate calculation, that photoelectric effect will NOT take place. (3)
[13

TOTAL [15