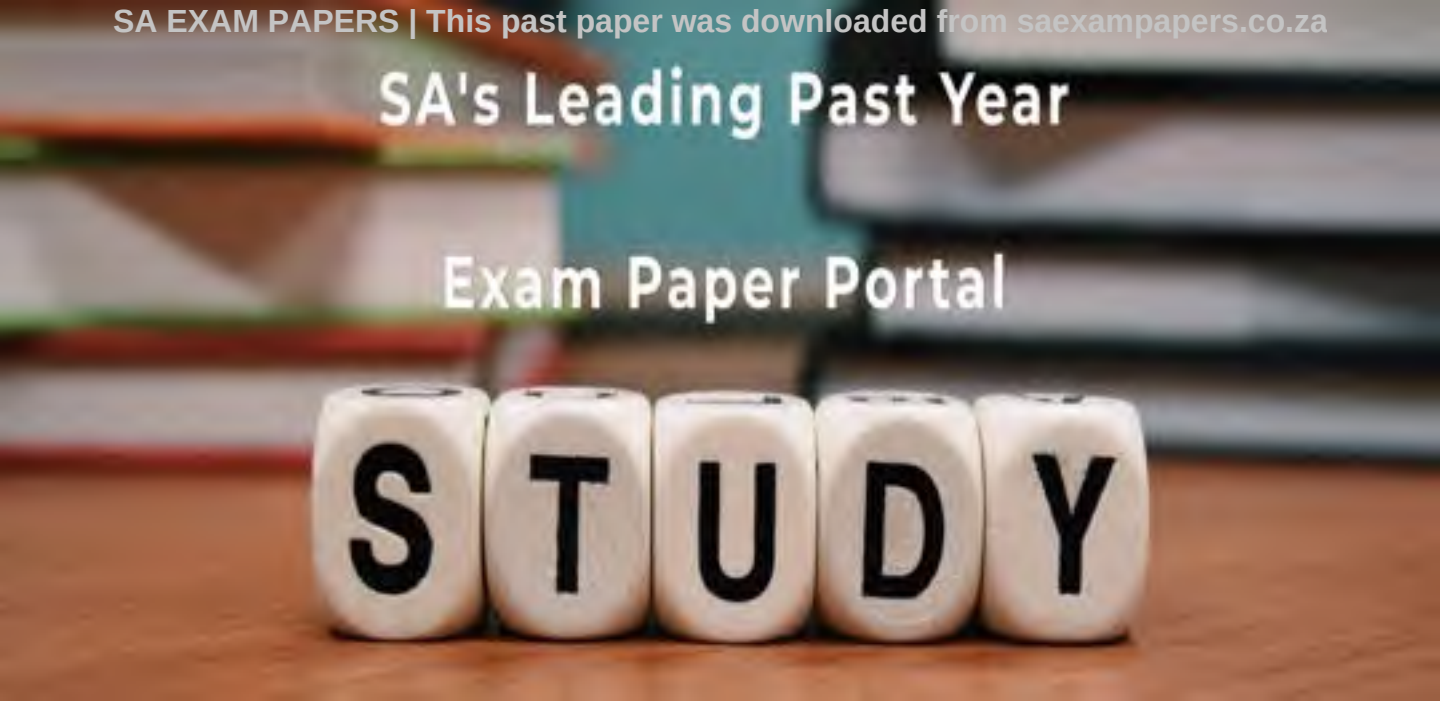


You have Downloaded, yet Another Great Resource to assist you with your Studies ☺

Thank You for Supporting SA Exam Papers

Your Leading Past Year Exam Paper Resource Portal

Visit us @ www.saexampapers.co.za

Western Cape Government
Education
FOR YOU

CAPE WINELANDS EDUCATION DISTRICT

PHYSICAL SCIENCES P1

GRADE 12

COMMON PRELIMINARY EXAMINATION
SEPTEMBER 2024

MARKS: 150

TIME: 3 hours

This exam paper consists of 14 pages and 3 datasheets.

INSTRUCTIONS AND INFORMATION

1. Write your name in the space below and submit the question paper with your answer s

   NAME AND SURNAME: .....

   GRADE: .....

2. This question paper consists of **10 QUESTIONS**. Answer ALL the questions on your ANSWER SHEETS.
3. Start EACH question on a NEW page on your ANSWER SHEETS.
4. Number the answers correctly according to the numbering system used in this question paper
5. Leave ONE line between two sub questions, 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 (concise) motivations, discussions etc. where required.
12. Write neatly and legibly.

QUESTION 1 (MULTIPLE-CHOICE)

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) on your ANSWER SHEETS.

1.1 The net force acting on an object is equal to the ...

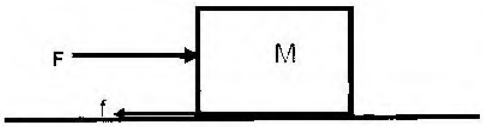
A mass of the object.

B acceleration of the object.

C change in momentum of the object.

D rate of change in momentum of the object. (2)

1.2 A box **M** is being pushed horizontally at a constant velocity on a rough surface by a force **F**.



If the force **F** acting on the box decreases, then the ...

A frictional force acting on the box decreases.

B acceleration of the box increases.

C velocity of the box decreases.

D normal force increases. (2)

1.3 A police car, with its siren on, is traveling at a constant speed TOWARDS a stationary sound detector. The siren emits sound waves of frequency f and speed v. Which ONE of the following combinations best describes the frequency and speed of the detected sound waves?

	FREQUENCY	**SPEED**
A	Less than f	v
B	Less than f	Less than v
C	Greater than f	Less than v
D	Greater than f	v

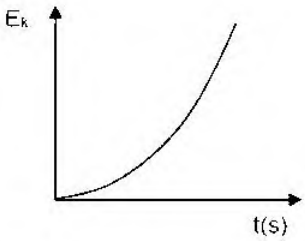
(2)

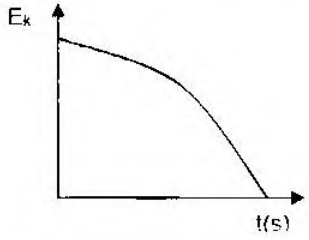
1.4 In which of the following rows does the type of collision match with total linear momentum and kinetic energy?

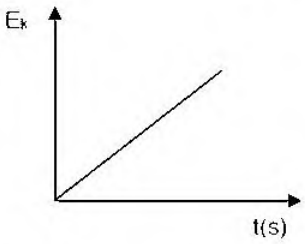
	TYPE OF COLLISION	TOTAL MOMENTUM	KINETIC ENERGY
A	Elastic	Conserved	Not conserved
B	Inelastic	Conserved	Not conserved
C	Inelastic	Not conserved	Conserved
D	Elastic	Not conserved	Conserved

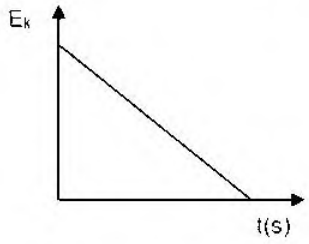
(2)

1.5 A stone is dropped from the edge of a cliff. Which ONE of the following graphs best represents the change in kinetic energy of the stone during its fall?

A 

B 

C 

D 

(2)

1.6 An object moves in a straight line on a ROUGH horizontal surface. If the net work done on the object is zero, then …

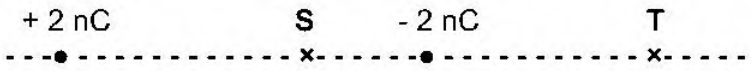
A the object has zero kinetic energy.

B the object moves at constant speed.

C the object moves at constant acceleration.

D there is no frictional force acting on the object. (2)

1.7 Two charges of + 2 nC and - 2 nC are located on a straight line. **S** and **T** are two points that lie on the same straight line as shown in the diagram below.

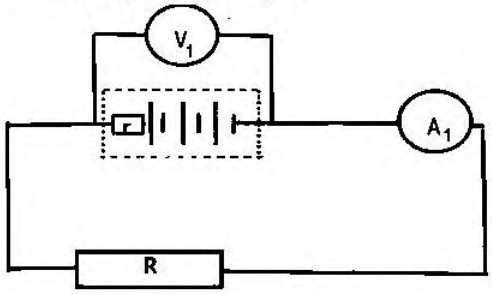


Which ONE of the following correctly represents the directions of the RESULTANT electric fields at **S** and at **T**?

	DIRECTION OF THE RESULTANT ELECTRIC FIELD AT POINT S	**DIRECTION OF THE RESULTANT ELECTRIC FIELD AT POINT T**
A	Right	Left
B	Left	Left
C	Right	Right
D	Left	Right

(2)

1.8 The circuit below is set up. The battery has an EMF of 9 V and an internal resistance of 0,2 Ω. The reading on A_1 is 1,8 A.



Which statement is CORRECT when a charge of 1 C flows in the circuit?

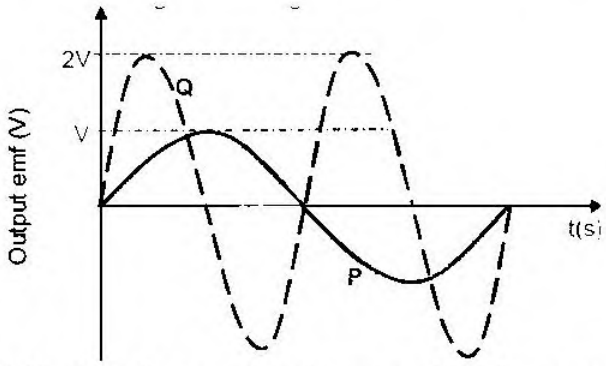
A 9 J of energy is dissipated in the resistor.

B 9 V is the potential difference across the resistor.

C 8,64 A is flowing in the circuit.

D 8,64 J of energy is dissipated in the resistor. (2)

1.9 Graph **P** represents the output emf of an AC generator. Graph **Q** is the output emf after a change has been made using the SAME generator.



Which ONE of the following changes has been made to the generator to produce graph **Q**?

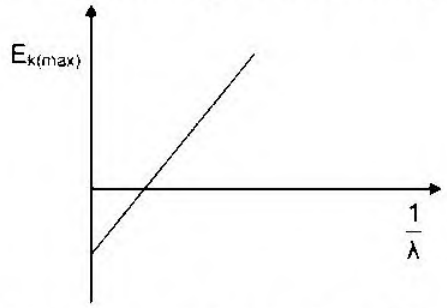
A The number of turns of the coil has been doubled.

B The surface area of the coil has been doubled.

C The speed of rotation has been doubled.

D The strength of the magnetic field has been doubled. (2)

1.10 The graph below is obtained from an experiment on the photoelectric effect.



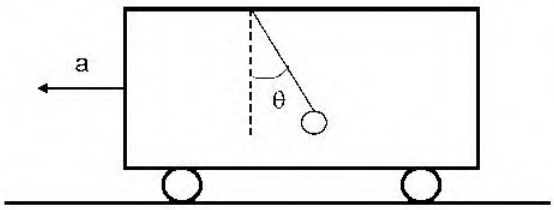
Which ONE of the following represents the gradient of the graph?

A hc B h C $Ek_{(max)}\lambda$ D W_0

[20]

QUESTION 2 (Start on a new page)

A group of learners design a device that consists of a light ball on a string hanging from the roof of a cargo truck. This device is used to determine the acceleration of the truck. When the truck is stationary or moving at a constant speed, the ball will hang straight down, but when it is undergoing a constant acceleration, the ball hangs down at an angle θ, as shown in the diagram below.



2.1 Draw a free body diagram of all the forces acting on the ball while in the position indicated in the sketch above. (2)

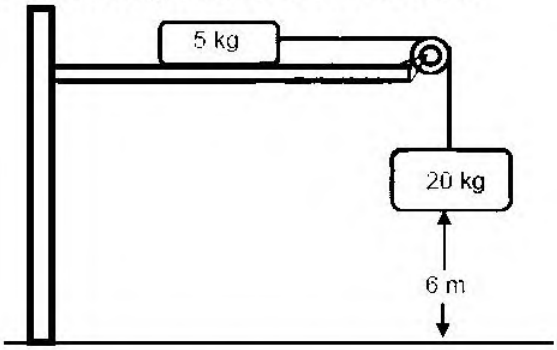
2.2 The mass of the ball is 50 g.

If the angle θ is 18°, calculate the:

2.2.1 Horizontal force on the ball. (4)

2.2.2 Magnitude of the acceleration of the truck. (3)

2.3 A 5 kg mass and a 20 kg mass are connected by a light inextensible string which passes over a light frictionless pulley. Initially, the 5 kg mass is held stationary on a horizontal surface, while the 20 kg mass hangs vertically downwards, 6 m above the ground, as shown in the diagram, not drawn to scale.



When the stationary 5 kg mass is released, the two masses begin to move. The coefficient of kinetic friction, μ_k, between the 5 kg mass and the horizontal surface is 0,4. Ignore the effects of air friction.

2.3.1 Calculate the acceleration of the 20 kg mass. (5)

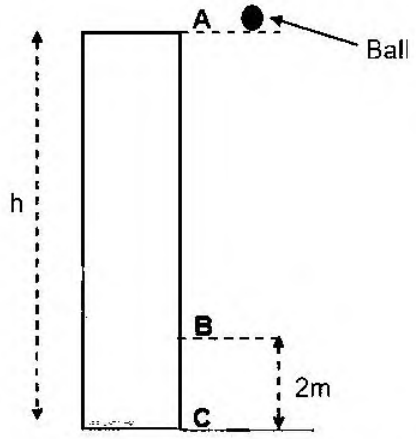
2.3.2 Calculate the speed of the 20 kg mass as it strikes the ground. (4)

[18]

QUESTION 3 (Start on a new page)

A group of learners set up an experiment to determine the height h of their school. They release a tennis ball from point **A** at the edge of the roof of the school building as shown in the diagram below. Point **B** is 2 m above the ground and the ball takes 0,125 s to cover the distance from point **B** to the ground (point **C**).

Ignore the effects of air friction.



3.1 Write down the magnitude of the rate of change of velocity of the ball. (1)

3.2 Calculate the:

3.2.1 Height, h, of the school building. (5)

3.2.2 Time it takes for the ball to reach the ground. (4)

3.2.3 Velocity with which the ball strikes the ground. (3)

3.3 Sketch a position versus time graph for the motion of the ball from the moment it was released until it strikes the ground. Use the ground as the zero-reference point.

Indicate the following on the graph:

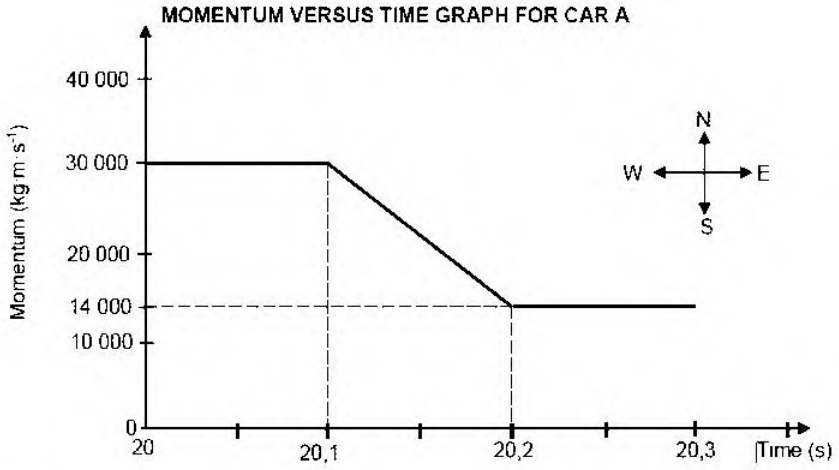
- The height from which the ball was released.
- Time when the ball strikes the ground. (3)

[16]

QUESTION 4 (Start on a new page)

The graph below shows how the momentum of car **A** changes with time just before and just after a head-on collision with car **B**. Car A has a mass of 1 500 kg, while the mass of car **B** is 900 kg. Car **B** was travelling at a constant velocity of 15 $m \cdot s^{-1}$ west before the collision.

Take east as positive and consider the system as isolated.



Use the information in the graph to answer the following questions.

Calculate the:

4.1 Magnitude of the velocity of car **A** just before the collision. (3)

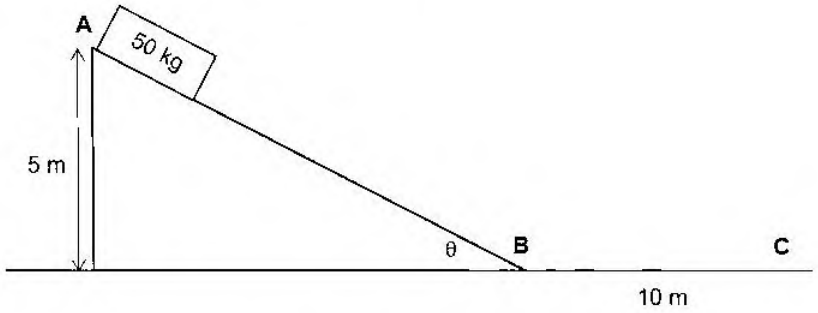
4.2 Velocity of car **B** just after the collision. (5)

4.3 Magnitude of the net average force acting on car **A** during the collision. (4)

[12]

QUESTION 5 (Start on a new page)

A crate of mass 50 kg is at rest at point **A** which is at a vertical height of 5 m above the horizontal surface. The inclined surface makes an angle θ with the horizontal, as shown in the diagram below. When the crate is released, it slides down the incline and reaches point B at the bottom of the incline with a speed of 8 $m \cdot s^{-1}$. The incline exerts a constant frictional force of 72 N on the crate while it slides from **A** to **B**.



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

5.2 Use energy principles to calculate the angle θ. (6)

After passing point **B**, the crate slides along a rough horizontal surface, coming to rest at point **C**, which is 10 m away from point **B**.

5.3 Draw a free body diagram of all forces acting on the crate while it slides from **B** to **C**. (3)

5.4 Calculate the work done by the frictional force to bring the crate to rest. (4)

[15]

QUESTION 6 (Start on a new page)

A police van with its siren on, travels at a constant speed between two observers, **A** and **B**. Observer A detects sound with a frequency of 545 Hz from the siren, while observer **B** detects a frequency of 615 Hz.

6.1 State the Doppler effect in words. (2)

6.2 In which direction is the police van moving?

Choose from TOWARDS OBSERVER **A** or TOWARDS OBSERVER **B**.

Give a reason for your answer. (2)

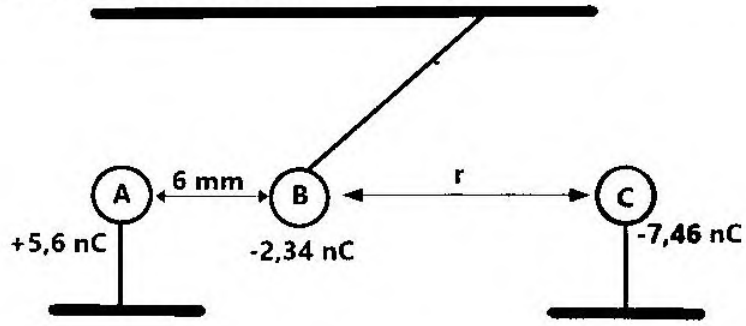
6.3 The speed of sound in air is 343 $m \cdot s^{-1}$. Calculate the frequency of the siren. (7)

6.4 Spectral lines of a certain gas observed from a distant star appear to be red shifted. Explain this observation by referring to the MOTION OF THE STAR and the FREQUENCY of the spectral lines. (2)

[13]

QUESTION 7 (Start on a new page)

A small polystyrene sphere, **B**, hangs from the ceiling and is attached by a string of negligible mass. Two other spheres, A and **C** are suspended on insulated stands. The charges on each sphere are **A** = +5,6 nC, **B** = - 2,34 nC and **C** = -7,46 nC. Assume that the surfaces of all the three spheres are conducting.



7.1 Define electrical field strength at a point. (2)

7.2 Sketch the electric field pattern around spheres **B** and C if **A** was removed. (3)

7.3 Charge **B** experiences a net electrostatic force of 0,004078 N due to charges **A** and **C**. Find the distance, **r**, between charges **B** and **C**. (5)

7.4 Charges **A** and **B** are allowed to touch and then moved back to the original distance between them.

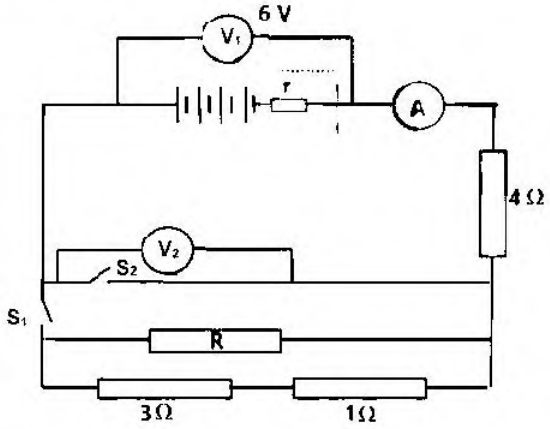
7.4.1 Calculate the new charge on each sphere. (2)

7.4.2 Explain the change, if any, to the field pattern between **B** and **C**. (2)

[14]

QUESTION 8 (Start on a new page)

The battery in the circuit diagram below has an EMF of **6 V** and an internal resistance of 0,4 Ω.



8.1 With both S_1 and S_2 open, give the reading on V_2. (1)

8.2 With only S_1 closed, the ammeter records a reading of 0,75 A. Explain the meaning of 0,75 A. (2)

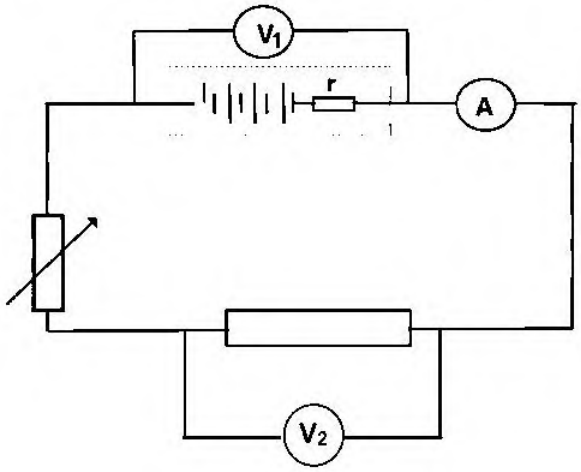
8.3 With only S_1 closed, calculate the:

8.3.1 External resistance of the circuit. (3)

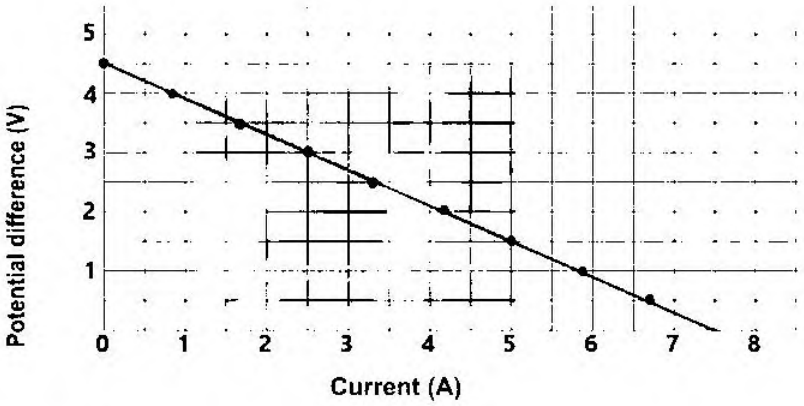
8.3.2 Resistance of resistor **R.** (3)

8.4 **S1** is now open and **S2** is closed. How will the power dissipated by the 4 Ω resistor change? Write only INCREASE, DECREASE OR REMAIN THE SAME. Explain the answer. (4)

Grade 12 learners conducted an investigation to determine the internal resistance of a battery. The circuit used is shown below. By varying the rheostat settings, the corresponding values of the circuit current and the potential difference, V_2, were recorded.



The results obtained were used to plot the graph below.



8.5 From this graph:

8.5.1 Deduce the EMF of the battery. (1)

8.5.2 Calculate the internal resistance of the battery. (3)

[17]

QUESTION 9 (Start on a new page)

A coal power station uses AC generators to produce electricity.

9.1 State the energy conversion that takes place in a generator. (2)

9.2 Draw a sketch graph of emf generated versus time for two complete cycles for an AC generator. (2)

9.3 Alternating current is used for the long-distance transmission of electricity. Give a reason why AC is preferred over DC to transmit electricity over long distances. (1)

9.4 An electrical kettle is marked 220 V. What does the 220 V represent? (1)

9.5 A certain AC generator produces a peak current of 6,25 A when connected to an electrical kettle of resistance 45 Ω.

Calculate the:

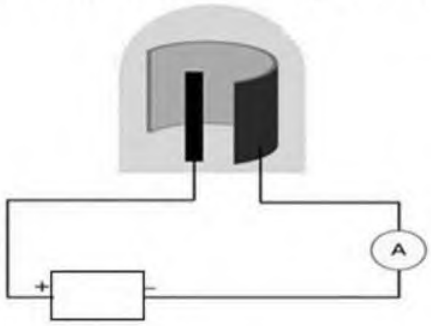
9.5.1 Root mean square (rms) current. (3)

9.5.2 Average power dissipated by the kettle when connected to this generator. (3)

[12]

QUESTION 10 (Start on a new page)

The diagram below shows a phototube that was used to demonstrate the photoelectric effect. The demonstration was carried out by shining light from a red; a green; a blue and an ultraviolet light source onto the surface of the phototube.



The results were recorded in the table below.

DEMONSTRATION NUMBER	COLOUR OF LIGHT USED	READING ON AMMETER
1	Red	No
2	Green	Yes
3	Blue	Yes
4	Ultraviolet	Yes

10.1 Explain what is meant by the photoelectric effect. (2)

10.2 Explain why there is no reading on the ammeter when a red light is used. (2)

10.3 For the following statements, use INCREASES, DECREASES or REMAINS THE SAME to complete the statement:

10.3.1 The kinetic energy of the photoelectrons … when ultraviolet light is shone onto the surface of the phototube instead of green light. (1)

10.3.2 The reading on the ammeter … when green light of higher intensity is shone onto the surface of the phototube. Explain this observation. (3)

10.4 The cathode is made of copper with a work function of $3,52 \times 10^{-19}$J. If ultraviolet light with a wavelength of 390 nm was used during demonstration **4**, calculate the speed of the photoelectrons that were ejected. (5)

[13]