KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10



MARKS: 100

DURATION: 2 hours

This question paper consists of 10 pages and a data sheet.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of SIX questions. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use the attached DATA SHEET.
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. Write neatly and legibly.

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QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four 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 (1.1–1.5) in the ANSWER BOOK, for example 1.6 E.

1.1 In which ONE of the following media will sound travel the fastest?

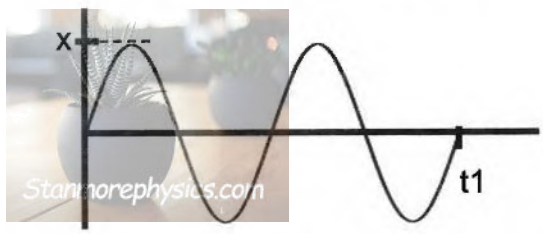
A Air

B Water

C Steel

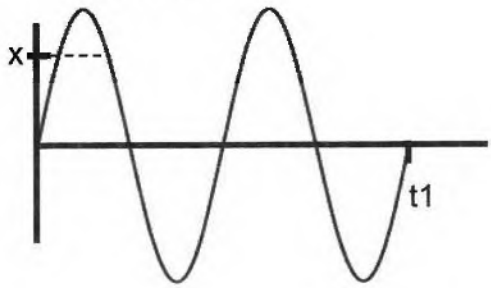
D Vacuum (2)

1.2 A sound produces the wave pattern below.



Which diagram represents the sound wave at a higher pitch but same loudness?

A



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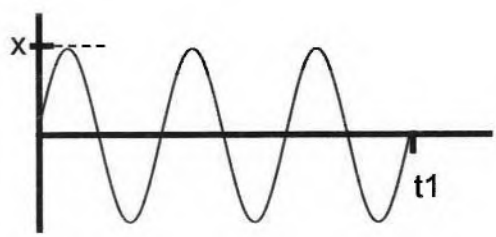

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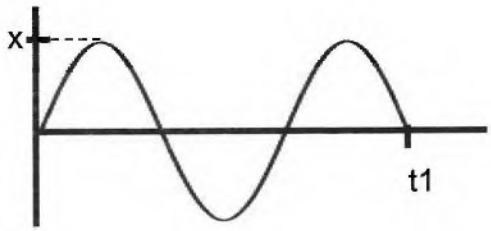

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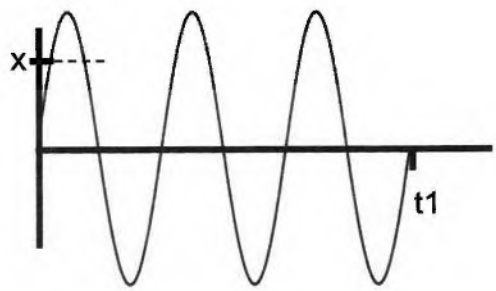

(2)

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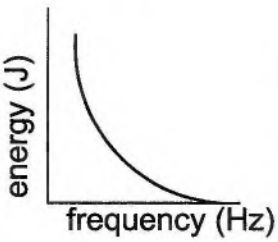
1.3 Which graph represents the relationship between the frequency and energy of a photon?

A



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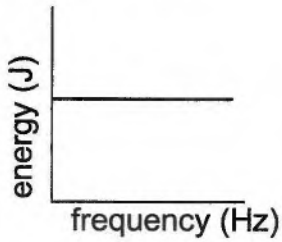

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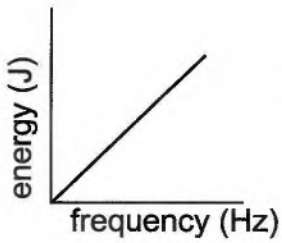
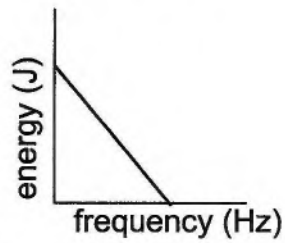


D



(2)

1.4 Which ONE of the following is equivalent to 1 AMPERE?

A $1\ C \cdot s^{-1}$

B $1\ C \cdot s$

C $1\ J \cdot C$

D $1\ J \cdot C^{-1}$ (2)

1.5 Which ONE of the following CANNOT be the charge of an object?

A $3{,}2 \times 10^{-19}\ C$

B $8{,}0 \times 10^{-19}\ C$

C $6{,}4 \times 10^{-19}\ C$

D $7{,}2 \times 10^{-19}\ C$ (2)

[2 X 5 = 10]

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QUESTION 2 (Start on a new page.)

Two transverse pulses, **A** and **B**, approach a point P in the same medium. Pulse **B** is travelling to the LEFT and has an amplitude three times larger than that of Pulse **A**. Both pulses have a wavelength of 5 cm. The pulses experience DESTRUCTIVE interference at point P where they form a trough with an amplitude of 6 cm.

2.1 NAME and STATE the principle used to determine the resultant amplitude of the pulse formed at point P. (3)

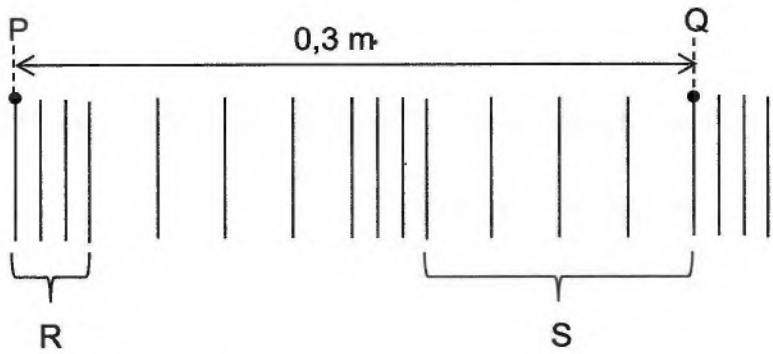
2.2 Determine the amplitude of Pulse **B** before it reaches point P. (3)

2.3 Write down the wavelength of the pulse at point P. (1)

2.4 Draw the pulses after they pass point P. Label each pulse clearly. (3)
[10]

QUESTION 3 (Start on a new page.)

3.1 The distance between points P and Q is 0,3 m on the wave pattern shown below.



The speed of the wave is 1,5 $m \cdot s^{-1}$

3.1.1 Is the above wave TRANSVERSE or LONGITUDINAL? (1)

3.1.2 Write down the names of the sections of the wave labelled R and S. Provide the letter and next to it the correct name. (2)

3.1.3 Calculate the wavelength of the wave. (2)

3.1.4 Determine the period of the wave. (4)

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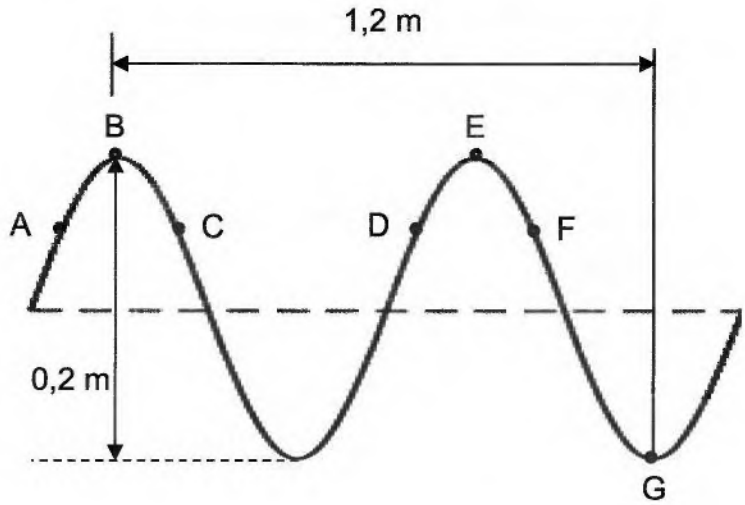
3.2 The diagram below represents a wave moving from left to right. The distance between points B and G is 1,2 m.



TWO complete wave cycles pass point B every second.

3.2.1 Write down the amplitude of the wave. (1)

3.2.2 Identify a point that is in phase with point C. (1)

3.2.3 Define the term *frequency* in words. (2)

Calculate:

3.2.4 The time taken for the wave to move from point B to point G. (4)

3.2.5 The speed of the wave. (3)

[20]

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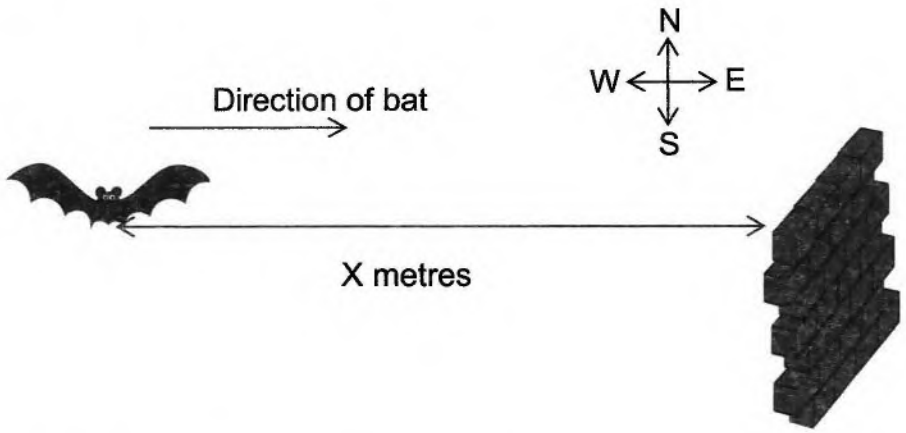
QUESTION 4 (Start on a new page.)

4.1 The average human ear can hear sounds up to a frequency of 20 kHz. Bats can detect frequencies of up to 200 kHz, using this adaption to navigate. They emit high frequency sound waves and detect the echo.

A bat flying at a constant velocity of 3 $m \cdot s^{-1}$ due east emits a sound wave when it is X metres away from a wall. The sound bounces off the wall and the bat detects the echo 2 seconds later.
During this 2 second interval the bat continued flying due east covering a distance of 6 metres.

Take the speed of sound in air as 340 $m \cdot s^{-1}$.



4.1.1 Define the term *echo* in words. (2)

4.1.2 Determine the initial distance X between the bat and the wall. (4)

The wavelength of the sound wave emitted by the bat is 7,56 x 10^{-3} m.

4.1.3 Use suitable calculations to determine whether a human ear will be able to hear the sound. (4)

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4.2 Listed below is information for two different types of electromagnetic radiations.

Radiation 1: frequency of 8×10^{15} Hz
Radiation 2: wavelength of $7,5 \times 10^{-5}$ m

4.2.1 Calculate the frequency of Radiation 2. (3)

4.2.2 Determine the energy of a photon of Radiation 1. (3)

4.2.3 Which radiation has a higher penetrating ability?
Choose from RADIATION 1 or RADIATION 2.
Give a reason for the answer. (3)

4.2.4 The frequency of Radiation 1 is halved. Will the wavelength of this radiation INCREASE, DECREASE or REMAIN THE SAME?
Give a reason for the answer. (2)

[21]

QUESTION 5 (Start on a new page.)

5.1 An uncharged glass rod is rubbed with a silk cloth resulting in the rod becoming positively charged.

5.1.1 Explain how the rod becomes positively charged. (2)

In the diagram below, the positively charged rod is now held to the left of a neutral sphere suspended by a light insulated string, causing the sphere to move.



5.1.2 Define the term *polarization* in words. (2)

5.1.3 Will the sphere move to the LEFT or to the RIGHT? (1)

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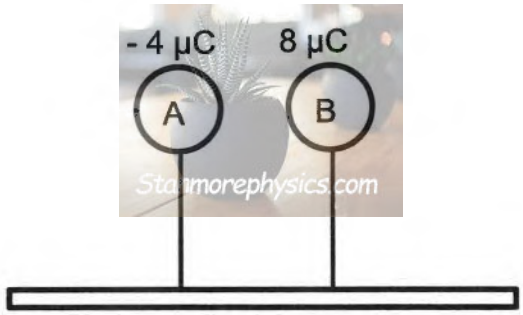
5.2 A and B are two identical spheres, mounted on insulated stands, carrying charges of – 4 µC and 8 µC respectively.



5.2.1 Determine the number of excess electrons on sphere A. (3)

The spheres are allowed to touch and are then separated.

5.2.2 In which direction will electrons flow when the spheres are in contact with each other? Choose from: A to B OR B to A (1)

5.2.3 State the *principle of conservation of charge* in words. (2)

5.2.4 Calculate the new charge on sphere A. (3)

A third sphere, C, carrying a charge of – 6 µC, is now brought into contact with sphere B.

5.2.5 Calculate the number of electrons transferred when these spheres are in contact with each other. (5)

[19]

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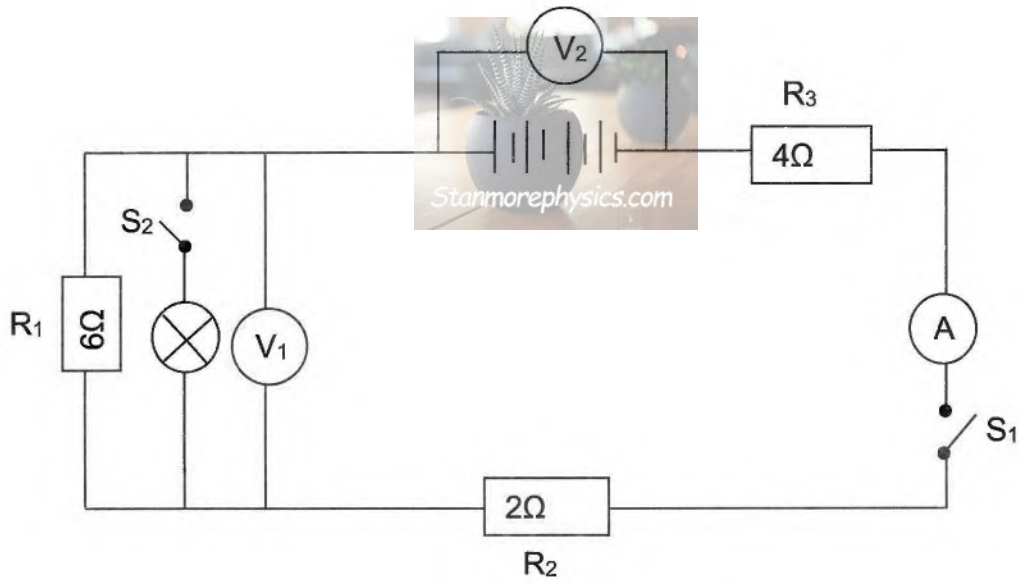
QUESTION 6 (Start on a new page)

A battery consisting of 4 identical cells of unknown emf is connected to three resistors and a bulb, as shown in the circuit diagram below. The connecting wires and the battery have negligible resistance.



6.1 Define the *term potential difference* in words. (2)

6.2 Which voltmeter/s will provide a NON-ZERO reading when both switches S_1 and S_2 are opened? (1)

Switch S_1 is now closed while S_2 remains open. The ammeter reads 2A.

6.3 Calculate the reading on voltmeter V_2. (4)

Both switches S_1 and S_2 are now closed. The ammeter reads 3A.

6.4 Calculate the :

6.4.1 Reading on voltmeter V_1 (4)

6.4.2 Resistance of the bulb. (5)

6.4.3 Energy transferred to the bulb in 1 minute (4)
[20]

TOTAL: 100

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DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	9,8 $m.s^{-2}$
Speed of light in a vacuum	c	3,0 x 10^{8} $m{\cdot}s^{-1}$
Planck's constant	h	6,63 x 10^{-34} J·s
Charge on electron	q_e	-1,6 x 10^{-19} C
Electron mass	m_e	9,11 x 10^{-31} kg

TABLE 2: FORMULAE

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WAVES, SOUND AND LIGHT

$v = f\lambda$ or $c = f\lambda$	$T = \frac{1}{f}$
E = hf	$E = \frac{hc}{\lambda}$

ELECTROSTATICS

$Q = n \times q_e$	$Q = \frac{Q1 + Q2}{2}$

ELECTRIC CIRCUITS

$Q = I \times \Delta t$	$\frac{1}{Rp} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots.$
$R_s = R_1 + R_2 + \cdots$	$V = \frac{W}{Q}$
V = I x R	

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KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES

COMMON TEST

MARKING GUIDELINE

MARCH 2024

MARKS: 100

DURATION: 2 hours

This marking guideline consists of 6 pages.

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QUESTION 1:

1.1 C ✓✓ (2)
1.2 B ✓✓ (2)
1.3 C ✓✓ (2)
1.4 A ✓✓ (2)
1.5 D ✓✓ (2)
[10]

QUESTION 2

2.1 Principle of superposition. ✓ The algebraic sum of the amplitudes of two pulses✓ that occupy the same space at the same time. ✓ (3)

2.2

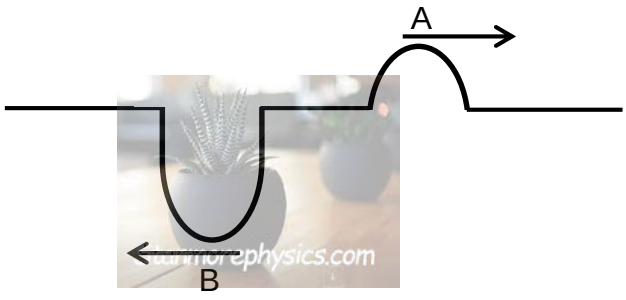
<u>OPTION 1</u>
Let the amplitude of Pulse A = x
The amplitude Pulse B = - 3x
x + (-3x) ✓= -6 ✓
x = 3 cm
Amplitude of Pulse B = 3x
= 3(3)
= 9cm ✓

<u>OPTION 2</u>
Let the amplitude of Pulse A = ⅓x
The amplitude Pulse B = - x
⅓x + (-x) ✓= -6 ✓
x = 9 cm ✓

(3)

2.3 5 cm ✓ (1)

2.4 <u>Criteria</u>
Pulse A drawn as crest and Pulse B drawn as trough with labels ✓
Pulse B has a greater amplitude than A ✓
Pulse B drawn left of A ✓ (3)



[10]

QUESTION 3

3.1

3.1.1 Longitudinal ✓ (1)

3.1.2 R – Compression ✓ (2)
S – Rarefaction ✓

3.1.3 $\lambda = \frac{0,3}{2}$ ✓
$= 0,15$ m ✓ (2)

3.1.4 **POSITIVE MARKING FROM QUESTION 3.1.3**

OPTION 1

$v = f \times \lambda$ ✓
$1,5 = f \times 0,15$ ✓
$f = 10$ Hz
$T = \frac{1}{f}$
$T = \frac{1}{10}$ ✓
$T = 0,1$ s ✓

OPTION 2

$\text{speed} = \frac{\text{distance}}{\text{time}}$ ✓
$1,5$ ✓$= \frac{0,15}{\text{time}}$ ✓
$T = 0,1$ s ✓

(4)

3.2 3.2.1 0,1 m ✓ (1)

3.2.2 (point) F✓ (1)

3.2.3 The number of wave pulses per second. ✓✓ (2)

3.2.4 $T = \frac{1}{f}$
$= \frac{1}{2}$ ✓
$= 0,5$ s
time = 1,5 ✓x 0,5 ✓
$= 0,75$ s ✓ (4)

3.2.5 **POSITIVE MARKING FROM Q 3.2.4**

OPTION 1

$\text{speed} = \frac{\text{distance}}{\text{time}}$
$\text{speed} = \frac{1,2}{0,75}$ ✓
$= 1,6$ m.s^{-1} ✓

OPTION 2

$\lambda = \frac{1,2}{1,5} = 0,8\ m$
$v = f \times \lambda$
$= 2$ ✓ x 0,8✓
$= 1,6$ m.s^{-1} ✓ (3)

[20]

QUESTION 4

4.1

4.1.1 A reflection of sound waves. ✓✓ (2)

4.1.2 **OPTION 1**

$\text{speed} = \frac{\text{distance}}{\text{time}}$

$340✓ = \frac{\text{distance}}{2✓}$

Distance = 680 m

X + (X – 6) = 680 ✓

X = 343 m ✓

OPTION 2

2X = Distance of bat in 2s + distance of echo in 2s

2X = 6 +(2✓ x 340✓) ✓

X = 343 m ✓ (4)

4.1.3 $v = f \times \lambda$

$340 ✓ = f \times 7,56 \times 10^{-3}$ ✓

f = 44 973,5 Hz ✓

The sound will not be heard; its frequency is greater than 20kHz. ✓ (4)

4.2

4.2.1 $c = f \times \lambda$ ✓

$3 \times 10^8 = f \times 7,5 \times 10^{-5}$ ✓

$f = 4 \times 10^{12}$ Hz ✓ (3)

4.2.2 $E = h \times f$ ✓

$= 6,63 \times 10^{-34} \times 8 \times 10^{15}$ ✓

$= 5,304 \times 10^{-18}$ J ✓ (3)

4.2.3 RADIATION 1 ✓

A higher frequency will result in greater energy of the photon OR Energy of photon is directly proportional to the frequency. ✓

A greater energy of the photon increases the penetrating ability✓ (3)

4.2.4 INCREASE ✓

The wavelength is inversely proportional to the frequency. ✓ (2)

[21]

QUESTION 5

5.1

5.1.1 Electrons will be transferred ✓ from the glass rod to the silk cloth ✓ (2)

5.1.2 The partial or complete polar separation of positive and negative electric charge in a system. ✓✓ (2)

5.1.3 Left ✓ (1)

5.2

5.2.1 $Q = n \times q_e$ ✓

$-4\times10^{-6} = n \times 1,6\times10^{-19}$ ✓

$n = 2,5 \times 10^{13}$ electrons ✓ (3)

5.2.2 A to B ✓ (1)

5.2.3 The net charge of an isolated system remains constant during any physical process ✓✓ (2)

5.2.4 $Q = \frac{Q1 + Q2}{2}$ ✓

$Q = \frac{-4\times10^{-6} + 8\times10^{-6}}{2}$ ✓

$= 2 \times 10^{-6}$ C ✓ (3)

5.2.5 $Q = \frac{Q1 + Q2}{2}$

$Q = \frac{-6\times10^{-6} + 2\times10^{-6}}{2}$ ✓

$Q_B = -2 \times 10^{-6}$ C

$n = \frac{\Delta Q}{q_e}$ ✓

$= \frac{-2\times10^{-6} - 2\times10^{-6}}{-1,6\times10^{-19}}$ ✓ ✓

$= 2,5 \times 10^{13}$ electrons ✓

OR

$= \frac{-2\times10^{-6} - (-6\times10^{-6})}{1,6\times10^{-19}}$ ✓ ✓

$= 2,5 \times 10^{13}$ electrons ✓ (5)

[19]

QUESTION 6

6.1 The energy transferred per unit charge. ✓✓ (2)

6.2 V_2 ✓ (1)

6.3 V = IR ✓
= 2 ✓ x (4+2+6) ✓
= 24 V✓ (4)

6.4 **POSITIVE MARKING FROM QUESTION 6.3**

6.4.1
V = IR
$V_{4\Omega+2\Omega}$ = 3 ✓ x (4+2) ✓
= 18 V
V_1 = 24 – 18 ✓
= 6V ✓ (4)

6.4.2

OPTION 1	**OPTION 2**
$V_{6\Omega}$ = IR	V_p = IR
6 = I x 6 ✓	6 = 3 x R_p ✓
$I_{6\Omega}$ = 1A	R_p = 2Ω
I_{Bulb} = 3 – 1 ✓	$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓
= 2A	✓ $\frac{1}{2} = \frac{1}{R_{Bulb}} + \frac{1}{6}$ ✓
V_{Bulb} = IR ✓	R_{Bulb} = 3Ω ✓
6 = 2 x R ✓	
R_{Bulb} = 3Ω ✓	

(5)

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6.4.3

OPTION 1	**ACCEPT**
Q = I Δt	W = VIΔt ✓
= 2 x 60 ✓	= 6 ✓x 2 x 60✓
= 120 C	= 720 J ✓
W = V Q ✓	
= 6 x 120 ✓	
= 720J ✓	

(4)

[20]

TOTAL: 100