Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES P1 (PHYSICS)

COMMON TEST

SEPTEMBER 2017

NATIONAL SENIOR CERTIFICATE

GRADE 10

MARKS: 150

TIME: 2 hours

This question paper consists of 11 pages, a data sheet and a graph sheet.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate spaces on the ANSWER BOOK.
2. Answer ALL the questions in the ANSWER BOOK.
3. Non-programmable calculators may be used.
4. Appropriate mathematical instruments may be used.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Data sheets are attached for your use.
7. Give brief motivations, discussions, et cetera where required.
8. Round off your answers to a minimum of 2 decimal places.
9. Question 6.2 requires the drawing of a graph. Be sure to submit the Graph Sheet with your Answer Booklet.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Write ONLY letters (A-D) next to the question number (1.1 – 1.10) in the ANSWER BOOK, e.g. 1.11 C

1.1 Which ONE of the following is a correct representation of a vector and scalar?

	VECTOR	SCALAR
A.	Distance	Speed
B.	Speed	Velocity
C.	Displacement	Velocity
D.	Weight	Speed

(2)

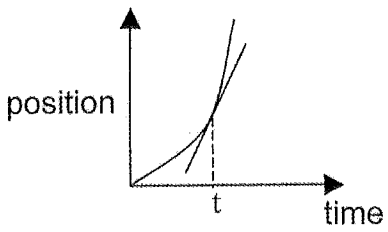
1.2 Two forces act on an object. The resultant of these forces ...

A is called a balanced force.
B has the same effect as the two forces acting together.
C has the opposite effect as the two forces acting together.
D is always equal to the two forces. (2)

1.3 Car X is travelling North at 30 $m \cdot s^{-1}$. Car Y is travelling South at 20 $m \cdot s^{-1}$. The velocity of car Y relative to car X is ...

A 10 $m \cdot s^{-1}$ south
B 10 $m \cdot s^{-1}$ north
C 50 $m \cdot s^{-1}$ south
D 50 $m \cdot s^{-1}$ north (2)

1.4 The following is a position: time graph for a moving object.



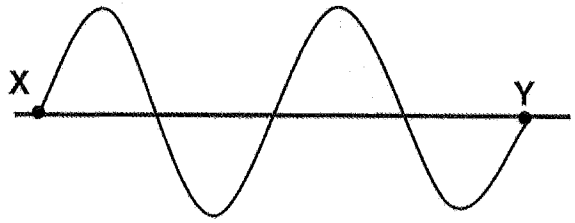
The gradient to the tangent at time t yields ...

A Average velocity
B Instantaneous velocity
C Displacement
D Acceleration (2)

1.5 A car moving in an easterly direction on a straight road accelerates uniformly at 2 $m.s^{-2}$ west. Which one of the following statements about the car is correct?

A Its displacement will decrease by 2 m for every second.
B Its velocity will increase by 2 $m{\cdot}s^{-1}$ for every second.
C Its velocity will decrease by 2 $m{\cdot}s^{-1}$ for every second.
D Its velocity is a constant 2 $m{\cdot}s^{-1}$ for every second. (2)

1.6 The diagram below shows two points X and Y on a wave train.



How many wavelengths separate point X and Y?

A 1
B 1,5
C 2
D 0,75 (2)

1.7 From the following, the electromagnetic wave with the longest wavelength is ...

A Infrared
B Ultraviolet
C Microwave
D Visible light (2)

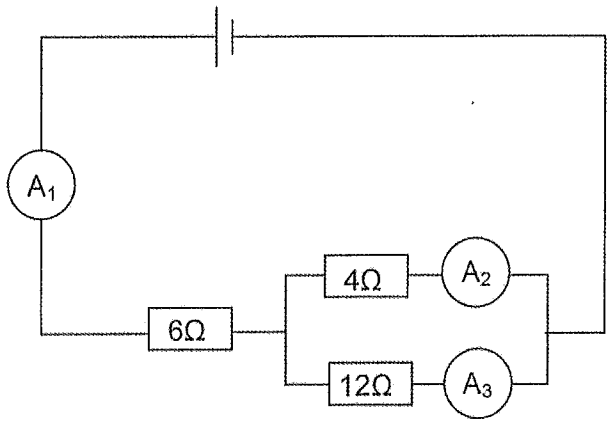
1.8 A glass rod is charged positive by rubbing the glass rod with a silk cloth. During this process...

A electrons are transferred from the glass rod to the silk cloth.
B electrons are transferred from the silk cloth to the glass rod.
C protons are transferred from the glass rod to the silk cloth.
D protons are transferred from the silk cloth to the glass rod. (2)

1.9 The work done in moving a quantity of charge across two points in an electrical circuit is best described as ...

A Energy
B Current strength
C Potential difference
D Resistance (2)

1.10 Study the following circuit.



The statement that best describes the readings on the ammeters is …

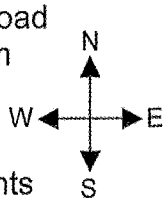
A $A_1 = A_2 + A_3$ and $A_2 = A_3$
B $A_1 = A_2 + A_3$ and $A_2 > A_3$
C $A_1 = A_2 + A_3$ and $A_2 < A_3$
D $(A_2 + A_3) > A_1$ and $A_2 > A_3$ (2)

10 x 2 [20]

QUESTION 2

2.1 Define a vector. (2)

2.2 During a training session an athlete runs 120 m East along a straight road (A to B). After a short rest, she runs 80 m West (B to C) and then 60 m West (C to D). The total time for this session took two minutes.



2.2.1 Draw a vector scale diagram to represent the three displacements (A to B; B to C; C to D). Label all the vectors clearly. (Use a scale of 1 cm = 20 m) (3)

2.2.2 On the vector scale diagram draw and indicate the resultant vector for her motion. (1)

2.2.3 Calculate the total distance covered by the athlete. (1)

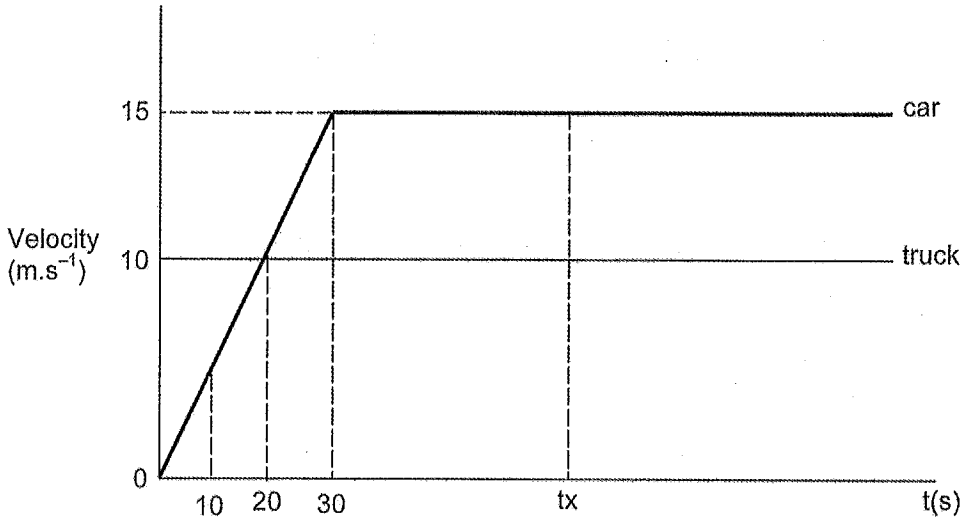
2.2.4 What is her change in position at D, relative to A? (1)

2.2.5 Calculate the average velocity of the athlete. (4)

[12]

QUESTION 3

A car is at rest at a traffic light. When the light turns green, the car takes off, accelerating uniformly for 30 seconds to a velocity of 15 $m \cdot s^{-1}$. At the same time that the car takes off, a truck passes it, travelling at a constant velocity of 10 $m \cdot s^{-1}$. The following graphs represent the motion of both vehicles.



USE ONLY THE GRAPH (NOT equations of motion) to answer the following questions.

3.1 After how long will the truck and car have the same velocity? (1)

3.2 Describe, in words, the motion of the car after 30 seconds. (2)

3.3 Calculate the acceleration of the car during the first 30 seconds. (3)

3.4 How far ahead of the car is the truck after 30 seconds? (6)

3.5 Calculate the time taken (tx) for the car to catch up with the truck. (7)

[19]

QUESTION 4

4.1 A car, starting from rest, reaches a velocity of 25 $m \cdot s^{-1}$ in 20 seconds. It then travels at this constant velocity for another 10 seconds. The brakes are then applied bringing the car to a stop in a distance of 200 m.

4.1.1 Define velocity. (2)

4.1.2 Calculate the acceleration of the car during the first 20 seconds. (3)

4.1.3 What is the displacement of the car after the first 30 seconds? (5)

4.1.4 Calculate the acceleration of the car of the last 200 m. (3)

4.1.5 Determine for how long the brakes was applied. (4)

4.1.6 Draw an acceleration-time sketch graph for the entire motion of the car. Indicate the relevant acceleration and time values for each part of the motion. (5)

4.2 A driver travelling along a road in a 100 $km \cdot h^{-1}$ zone notices a sign that says "Maintain a two second following distance".

4.2.1 What is meant by the words in inverted commas? (2)

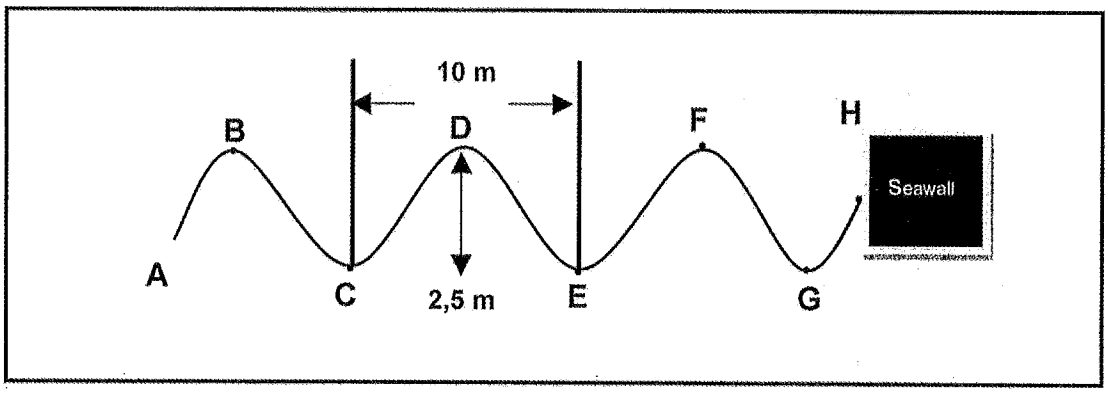
4.2.2 Convert 100 $km \cdot h^{-1}$ into $m \cdot s^{-1}$. (2)

4.2.3 Calculate the minimum following distance, in metres, that the driver must maintain when travelling at the maximum allowed speed. (3)

[29]

QUESTION 5

Water waves crash against a seawall around the harbour. Eight waves hit the seawall in 4 s. The distance between points C and E is 10 m. The height of the waveform is 2,5 m.



5.1 Indicate the following by using the letters A to H:

5.1.1 Two positions of equilibrium. (2)

5.1.2 One crest (1)

5.1.3 One wavelength (1)

5.1.4 Two points that are in phase with each other. (2)

5.2

5.2.1 Define the *amplitude* of a wave. (2)

5.2.2 If the height of the wave is doubled, what will be the new amplitude of the wave? (1)

5.3 Calculate the speed of this wave. (5)
[14]

QUESTION 6

The following table shows the frequencies of photons and the corresponding energies.

FREQUENCY (x 10^{14} H_z)	ENERGY (x 10^{-20} J)
2	13,3
3	19,9
4	26,5

6.1 Define a photon. (2)

6.2 USING THE GRAPH SHEET PROVIDED, plot a graph of Frequency (x-axis) versus Energy of photon (y-axis).
Draw a line of best fit for this graph. (5)

6.3 What is the relationship between frequency and energy of a photon? (1)

6.4 Calculate the gradient of this graph. (3)

6.5 What does this gradient represent? (1)

6.6 Using the graph, determine the frequency of a photon of light if its energy is 23×10^{-20}J. (1)

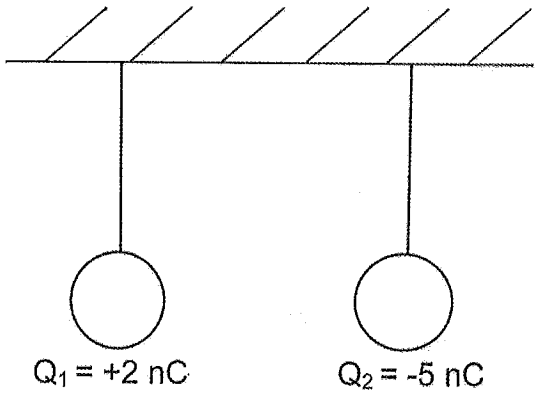
6.7 Calculate the wavelength of this photon mentioned in question 6.6. (4)

[17]

BE SURE TO SUBMIT THE GRAPH SHEET WITH YOUR ANSWER BOOKLET.

QUESTION 7

Two insulated, graphite-coated polystyrene spheres Q_1 and Q_2 are suspended from threads. The spheres are held in a small distance apart. The charges on the spheres are +2 nC and -5 nC. When the spheres are released they move towards each other.



7.1 Why do the spheres move towards each other when they are released? (2)

The two spheres now touch each other.

7.2 Calculate the new charge on each sphere. (3)

7.3 Will the force now be one of attraction or repulsion? Give a reason for your answer. (2)

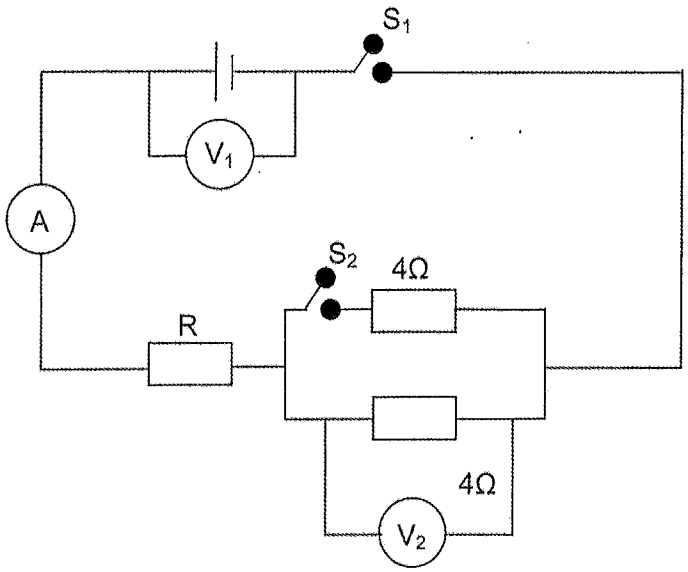
7.4 Calculate the number of electrons transferred when the spheres were in contact. (3)

7.5 Calculate the number of excess electrons on Q_2 after touching. (3)

7.6 What principle is used to calculate the answer to question 7.5? (2)
[15]

QUESTION 8

Study the circuit diagram below. Ignore the resistance of the battery and the wires.



When switch S_1 is opened, the voltmeter V_1 has a reading.

8.1 What is the term used to describe this reading on V_1? (2)

Both switches are now closed. The total resistance of the circuit becomes 4Ω.

8.2 Define *ONE OHM*. (2)

8.3 Calculate the value of R. (5)

8.4 Calculate the reading on the ammeter if 180 C of charge passes through EACH of the 4Ω resistors in 2 minutes. (4)

1080 J of energy is needed to move this 180 C charge across one 4Ω resistor.

8.5 Calculate the reading on V_2. (3)

8.6 Without doing a calculation involving a formula, determine the reading on V_1. Explain how you arrived at your answer. (4)

Switch S_2 is now opened.

8.7 How will this affect the reading on:
(Choose from INCREASES; DECREASES or REMAINS THE SAME).

8.7.1 V_1 (1)

8.7.2 Ammeter, A. Explain without doing a calculation. (3)

[24]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES PAPER 1 (PHYSICS)

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·s
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}$ C
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg

TABLE 2: FORMULAE/ *TABEL 2: FORMULES*

MOTION/*BEWEGING*

$v_f = v_i + a\Delta t$	$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$

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

$v = f\lambda$	$T = \frac{1}{f}$
$E = hf$ or/*of* $E = h\frac{c}{\lambda}$	

ELECTROSTATICS/*ELEKTROSTATIKA*

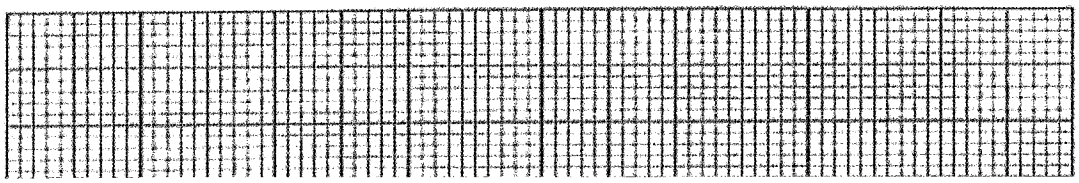
$Q = \frac{Q_1 + Q_2}{2}$	$n = \frac{Q}{e}$

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$Q = I\Delta t$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$
$R_s = R_1 + R_2 + \ldots$	$V = \frac{W}{q}$

NAME: _____ **GRADE:** _____

QUESTION 6.2



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Education

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REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES P1 (PHYSICS)

MARKING GUIDELINE

COMMON TEST

SEPTEMBER 2017

NATIONAL SENIOR CERTIFICATE

GRADE 10

MARKS: 150

This marking guideline consists of 8 pages.

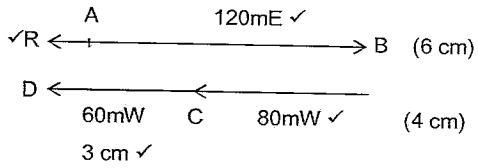
QUESTION 1

1.1 D ✓✓ (2)
1.2 B ✓✓ (2)
1.3 D ✓✓ (2)
1.4 B ✓✓ (2)
1.5 C ✓✓ (2)
1.6 C ✓✓ (2)
1.7 C ✓✓ (2)
1.8 A ✓✓ (2)
1.9 C ✓✓ (2)
1.10 B ✓✓ (2)
[20]

QUESTION 2

2.1 Physical quantity having magnitude and direction. ✓✓ (2 or 0) (2)

2.2
2.2.1 & 2.2.2



(3) & (1)

2.2.3 260m ✓ (1)

2.2.4 20mW ✓ (1)

2.2.5 $v = \frac{\Delta x}{\Delta t}$ ✓

$= \frac{20m}{120s}$ ✓

= 0,167 $m.s^{-1}$ ✓ West ✓ (4)
[12]

QUESTION 3

3.1 20 seconds ✓ (1)

3.2 Travelling at a constant velocity of 15 m·s^{-1} ✓ in the original direction. ✓ (2)

3.3 $a = \frac{\Delta v}{\Delta t}$ ✓

$= \frac{(15 - 0)}{(30 - 0)}$ ✓

= 0,5 m.s^{-1} in original direction ✓ (3)

3.4 Δx_{car} = ½ b x h Δx_{truck} = L x B

= ½ (15) x 30 ✓ = 30 x 10 ✓

= 225 m ✓ = 300 m ✓

∴ truck is ahead by 300 – 225 ✓ = 75 m ✓ (6)

3.5 $\Delta x_{truck} = 10\ t_x$ ✓✓

$\Delta x_{car} = 225 + (t - 30)(15)$ ✓✓

$10\ t_x = 225 + (t - 30)(15)$ ✓✓

t_x = 45 s ✓ (7)

[19]

QUESTION 4

4.1

4.1.1 Rate of charge of displacement ✓✓ (2 or 0) (2)

4.1.2 $V_f = V_i + at$ ✓

$25 = 0 + a.20$ ✓

A = 1,25 m.s^{-2} in direction of motion ✓ (3)

4.1.3 Mark positively from 4.1.2

$\Delta X_1 = v_i t + ½ at^2$ ✓ ΔX_2 = ut + ½ at^2

= 0 + ½ (1,25) . 20^2 ✓ = 25 x 10 ✓

= 250m = 250 m

ΔX_{total} = 250m + 250m ✓ = 500m ✓ (5)

4.1.4 $v^2 = u^2 + 2a\Delta x$ ✓

$0 = 25^2 + 2a\ 200$

a = 1,56 m·s^{-2} ✓

a = 1,56 m·s^{-2} opposite to direction of motion ✓ (3)

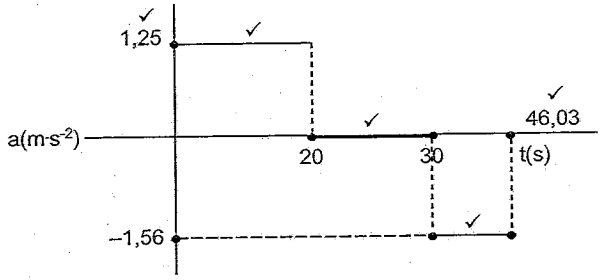
4.1.5 Mark positively from 4.1.4

$v_f = v_i + at$ ✓

0 = 25 ✓ + (–1,56)t ✓

= 16,03 s ✓ (4)

4.1.6



CRITERIA	MARK
Shape from 0 – 20	1
Shape from 20 – 30	1
Shape from 30 – 46,03	1
Both a values	1
All correct time values	1

(5)

4.2

4.2.1 It must take him 2 seconds to be at the position where the car is in front of him. ✓✓ (2)

4.2.2 $\frac{100 \times 1000}{3600}$ ✓ = 27,78 m·s^{-1} ✓ (2)

4.2.3 Mark positively from 4.2.2

27,78 metres in 1 s

x in 2 s ✓

x = 27,78 x 2 ✓

= 55,56 m ✓ (3)

[29]

QUESTION 5

5.1

5.1.1 A ✓ and H ✓ (2)

5.1.2 B or D or F (any 1) ✓ (1)

5.1.3 BD or DF or Ce or EG (any 1) ✓ (1)

5.1.4 B – D or D – F or C – E or E – G (any 1) ✓✓ (2)

5.2

5.2.1 Maximum displacement of a wave from rest position. ✓✓ (2 or 0) (2)

5.2.2 2,5 m ✓ (1)

5.3 T = 0,5 s ✓

v = λf ✓

$= 10 \checkmark \times \frac{1}{0,5} \checkmark$

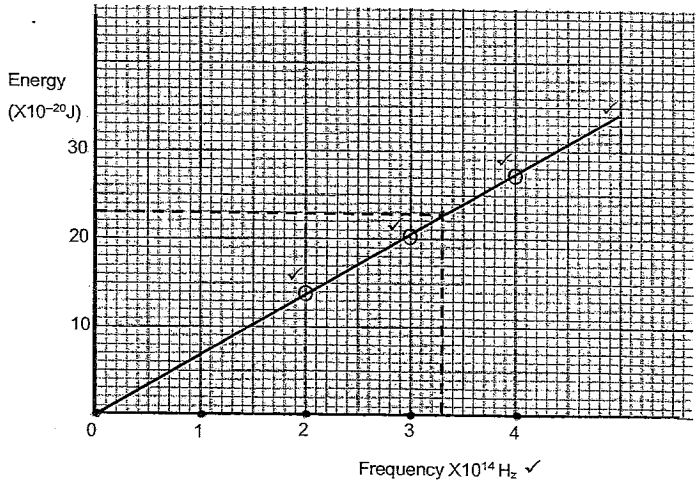
$= 20\ m{\cdot}s^{-1}$ ✓ (5)

[14]

QUESTION 6

6.1 Photon: packet of energy found in light. ✓✓ (2 or 0) (2)

6.2



Criteria	Mark
Both axis correctly labelled	1
Plotting of points correctly	3 x 1 mark
Line of best fit	1

(5)

6.3 As frequency increases, energy of photon increases or directly proportional ✓ (1)

6.4 $\frac{\Delta E}{\Delta F} = \frac{26,5 - 19,9}{(4-3)} \checkmark \checkmark$

$= 6,6 \times 10^{-34}\ J{\cdot}s^{-1}$ ✓ (3)

6.5 Planck constant ✓ (1)

6.6 $3,3 \times 10^{14} Hz$ ✓ (or an acceptable range) (1)

6.7 C = λf ✓

$3 \times 10^{8} \checkmark = \lambda\ 3,3 \times 10^{14} \checkmark$

$\lambda = 9,09 \times 10^{-7}$ m ✓

OR

$E = \frac{hc}{\lambda}$ ✓

$23 \times 10^{-20} \checkmark = \frac{6,63 \times 10^{-34} \times 3 \times 10^{8}}{\lambda} \checkmark$

$\lambda = 8,65 \times 10^{-7}$ m ✓ (4)

[17]

QUESTION 7

7.1 Experience attractive force, ✓ unlike charges ✓ (2)

7.2 New charge $= \frac{Q_1 + Q_2}{2}$ ✓

$= \frac{2nC + (-5nC)}{2}$ ✓

$= -1,5$ nC ✓ (3)

7.3 Repulsion. ✓ Both have the same charge / like charges. ✓ (2)

7.4 No. of electrons $= \frac{\text{new Q} - \text{old Q}}{Qe}$ ✓

$= \frac{1,5\times10^{-9} - (-5\times10^{-9})}{-1,6\times10^{-19}}$ ✓

$= 2,19 \times 10^{10}$ electrons ✓ (3)

7.5 No. of excess electrons $= \frac{Q}{e}$ ✓

$= \frac{1,5\times10^{-9}}{1,6\times10^{-19}}$ ✓

$= 9,4 \times 10^{9}$ electrons ✓ (3)

7.6 Quantisation of charge. ✓✓ (2)
[15]

QUESTION 8

8.1 Emf ✓✓ (2)

8.2 One volt per ampere ✓✓ (2)

8.3 $\frac{\perp}{R_{//}} = \frac{\perp}{4} + \frac{1}{4}$ ✓

$R_{//} = 2\ \Omega$ ✓

$R_T = R + R_{//}$ ✓

$4 = R + 2$ ✓

$R = 2\ \Omega$ ✓ (5)

8.4 $Q = It$ ✓

180 ✓ $= I\ 120$ ✓

$I = 1,5$ A

∴ Ammeter $= 2 \times 1,5 = 3$ A ✓ (4)

8.5 $V = \frac{W}{Q}$ ✓

$= \frac{1080}{180}$ ✓

$= 6$ V ✓ (3)

8.6 $V_1 = 12$ V ✓

Resistance of R equal to resistance of parallel branch ✓

∴ $V_R = V_{//}$ ✓

$= 6$ V

V_T equal to $V_R + V_{11} = 12$ V ✓ (4)

8.7

8.7.1 Remains the same ✓ (1)

8.7.2 Decreases ✓
Resistance of circuit increases. ✓
Resistance inversely proportional to current. ✓ (3)
[24]

TOTAL: 150