Education and Sport Development

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NORTH WEST PROVINCE

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES:PHYSICS (P1)

JUNE 2019

MARKS: 150

TIME: 3 hours

This question paper consists of 16 pages including 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of 9 questions. Answer ALL the questions in the ANSWER BOOK.

2. Start EACH question on a NEW page.

3. Number the answers correctly according to the numbering system used in this question paper.

4. Leave ONE line open between 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 SHEETS.

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 discussions, et cetera where required.

11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given 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) in the ANSWER BOOK, e.g.1.11 D.

1.1 Which one of the following combinations of base units represents change in momentum?

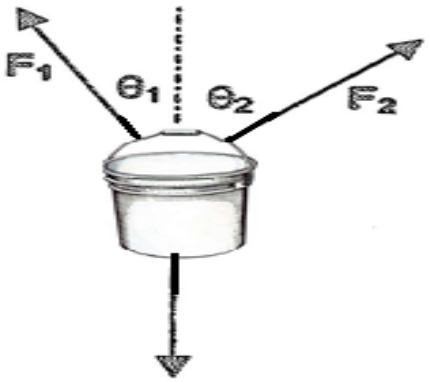
A $kg.m.s^{-2}$

B $kg.m^2.s^{-1}$

C $kg.m.s^{-1}$

D $kg.m^{-1}.s^{-1}$ (2)

1.2 A bucket of oil is held at rest between Nonofo and Robert. The magnitude of the force that Nonofo exerts on the bucket is F_1 and the force makes an angle θ_1 with the vertical. The magnitude of the force that Robert exerts on the bucket is F_2 and the force that makes angle θ_2 with the vertical.



If θ_1 is smaller than θ_2, which one of the following statements concerning the magnitudes of the forces is true?

Magnitude of the force

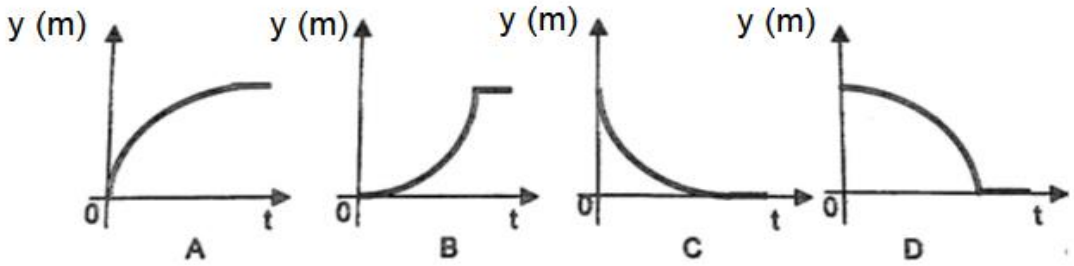
A $F_1 > F_2$

B $F_1 = F_2$

C $F_1 < F_2$

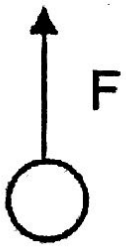
D $F_1 + F_2$ = Force due to gravity (2)

1.3 Mark drops a bag of sweets from the second floor a building. The bag lands on the ground below. Which one of the following displacement –time graphs best represents the displacement of the bag, from the moment it is dropped until it lands on the ground and remains stationery?
Ignore the effects of air friction.



(2)

1.4 An object, with mass **m**, is accelerated vertically upwards by an applied force **F** acting on it. Ignore the effects of air friction.



Which one of the following is true for the work done by the applied force **F** and the net force $\mathbf{F_{net}}$ respectively?

	WORK DONE BY F	**WORK DONE BY Fnet**
A	$\Delta U + \Delta K$	$\frac{1}{2}mv^2$
B	$\Delta U - \Delta K$	$\frac{1}{2}mv^2$
C	$\Delta U + \Delta K$	ΔK
D	$mgh + \frac{1}{2}mv^2$	ΔU

(2)

1.5 A body of mass **m** moves at constant velocity **v** through a displacement **x** against a constant frictional force **F**. What is the power required to keep the body at this constant velocity?

A $\frac{1}{2}Fx$

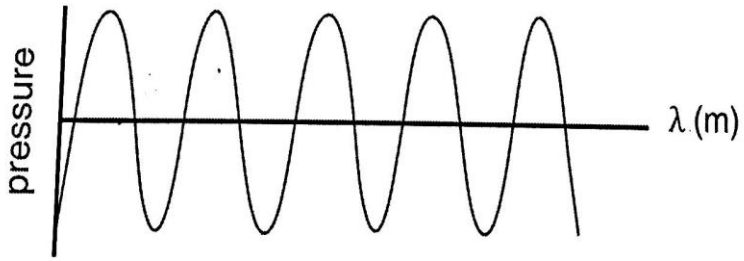
B Fv

C mv

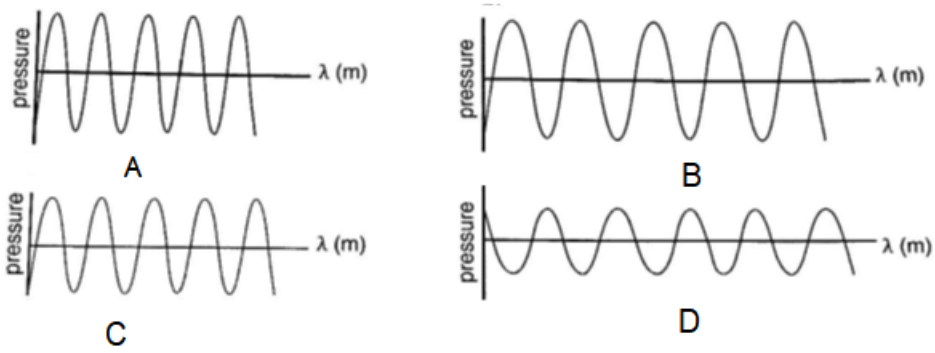
D Fx

(2)

1.6 The graph below shows the pressure versus wavelength of a sound wave when the source is stationery relative to the listener.

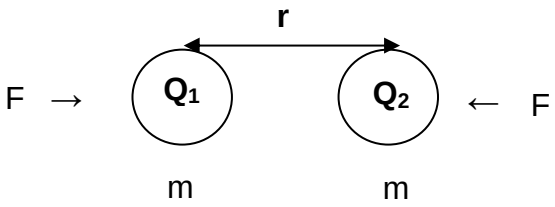


Which one of the following diagram best shows the source moving towards the listener?

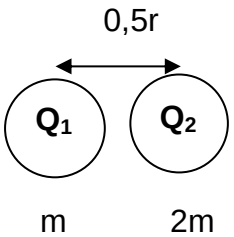


(2)

1.7 The electrostatic force **F** exerted on each other by two identical metal spheres, each of mass **m** and separated by a distance **r**, can be represented as in the diagram below:



Two other spheres of masses m and 2m respectively are separated by a distance 0,5r

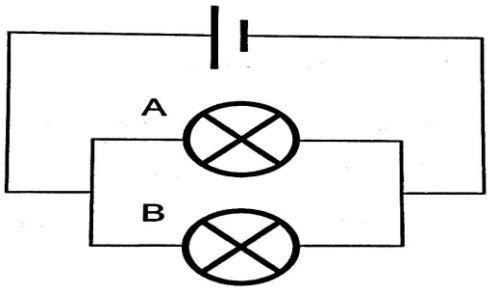


Which ONE of the following options best represents the new forces which these spheres experience?

	Force on m	**Force 2m**
A	4F	8F
B	8F	8F
C	4F	4F
D	2F	4F

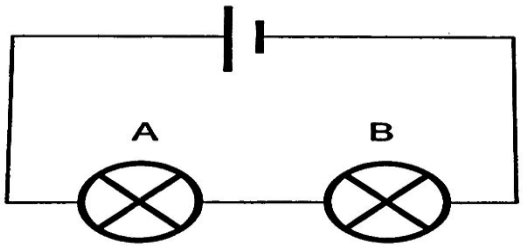
(2

1.8 In the circuit represented below (circuit 1), the internal resistance of the cell is negligible. Bulb A glows brighter than bulb B.



circuit 1

The bulbs are disconnected and then re-connected in series to the same cell as represented by the circuit below (circuit 2)



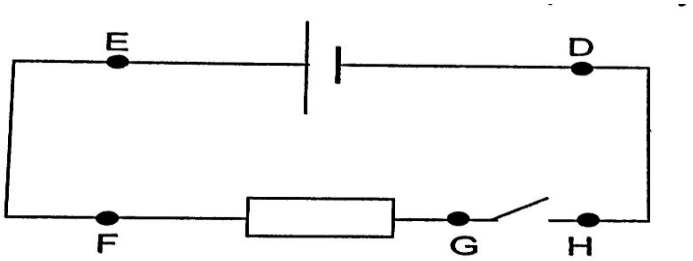
circuit 2

Which one of the following combinations correctly represents the comparison of the resistance of each bulb and the power dissipated in each bulb in circuit 2?

	Resistance	**Power**
A	$R_A < R_B$	$P_A < P_B$
B	$R_A < R_B$	$P_A > P_B$
C	$R_A > R_B$	$P_A < P_B$
D	$R_A > R_B$	$P_A > P_B$

(2)

1.9 A cell is connected to a resistor and an open switch. Five points in the circuit are labelled D, E, F,G and H respectively.



A voltmeter have a zero reading if it is connected across points…

A ED

B FH

C FG

D GH (2)

1.10 The emf of a battery can be defined as the:

A Rate at which current delivered.

B The rate at which energy delivered.

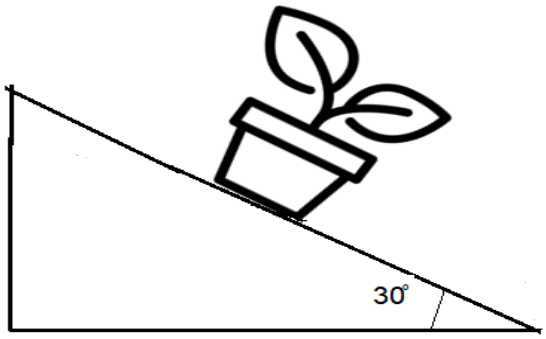
C The relationship between potential difference and current.

D The total amount of energy supplied per coulomb of charge in a cell. (2)

[20]

QUESTION 2 (Start on a new page)

A flower pot with mass 8 kg is placed on an inclined plane which is at an angle of 30˚ to the horizontal. The flower pot accelerates down the incline and the coefficient of kinetic friction is 0,4.



2.1 Draw free body diagram of all the forces acting on the flower pot. (3)

2.2.1 Define the term normal force.

2.2.2 Calculate the magnitude of the normal force which the flower pot exerts on the inclined plane. (2)

2.3 Calculate the magnitude of the force which the pot experiences parallel to the inclined plane due to its weight. (2)

2.4 Calculate the frictional force which the flower pot experiences while it is accelerated. (3)

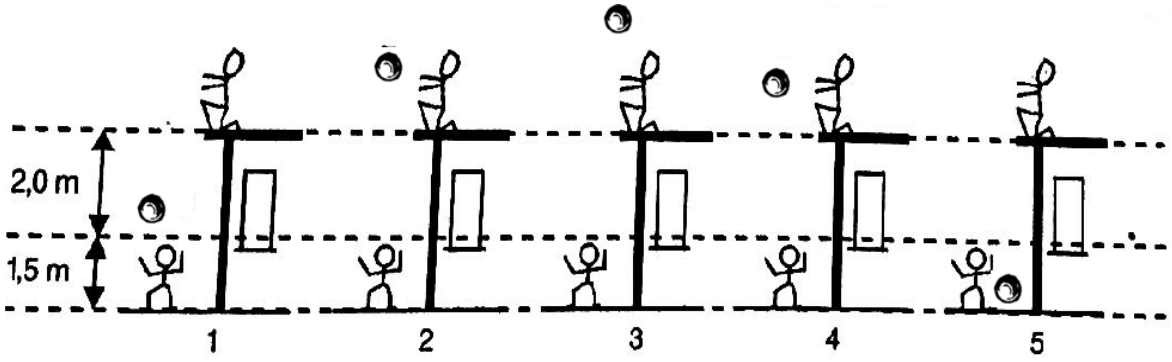
2.5 Calculate the magnitude of resultant force and its acceleration. (4)

2.6 Calculate the kinetic energy of the pot after it has moved 2 m down the incline from rest. (5)

[21]

QUESTION 3 (Start on a new page)

Mmereki throws a ball vertically upwards at 7 $m.s^{-1}$ to his father who is on the roof of the house. His father does not catch the ball and it falls back to the ground. The sketches show successive positions of the ball as it goes up and falls back down. Ignore the effects of air resistance.



3.1 What is the magnitude and direction of the acceleration of the ball during its motion up and down? (1)

3.2 The roof is 3,5 m above the ground and Mmereki throws the ball upwards at 7 $m.s^{-1}$ from a height of 1,5 m above the ground. For what period of time is the ball above the level of roof and thus available for his father to catch? (3)

3.3 If air friction affect the motion, how does the resultant force acting on the ball change during its:

3.3.1 Upward motion? Explain (2)

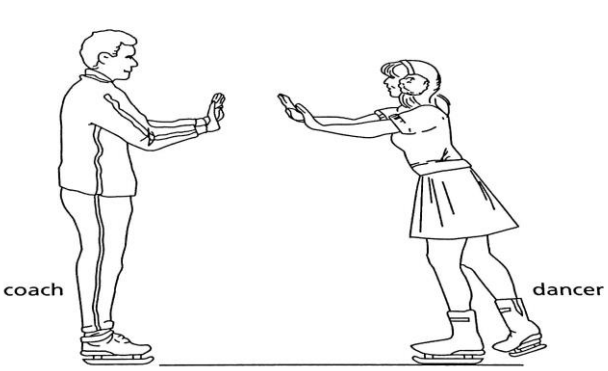
3.3.2 Downward motion? Explain (2)

3.4 Calculate the velocity of the ball when it strikes the ground? (5)

[13]

QUESTION 4 (Start on a new page)

The diagram below shows an ice dancer and her coach. They are standing still on the ice facing each other.



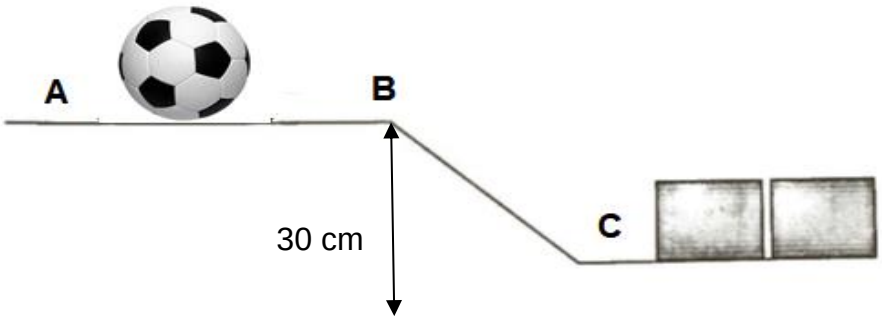
The dancer pushes her coach and they move away from each other.

4.1 When the dancer pushes her coach, the momentum of each of them changes.

4.1.1 State one similarity and one difference between the momentum of the dancer and her coach. (2)

4.1.2 The mass of the dancer is 50 kg and her coach is 90 kg. As they move away from each other the speed of dancer is 1,5 $m.s^{-1}$. Calculate the speed of her coach. (4)

4.2 A ball of mass 50 g moves at a constant speed of 3 $m.s^{-1}$ from A to B as shown in the diagram below. It then moves down a ramp of height 30 cm. On reaching C, it collides with two stationery blocks each of mass 15 g. All three objects become coupled and move to the right. The surfaces have negligible friction.



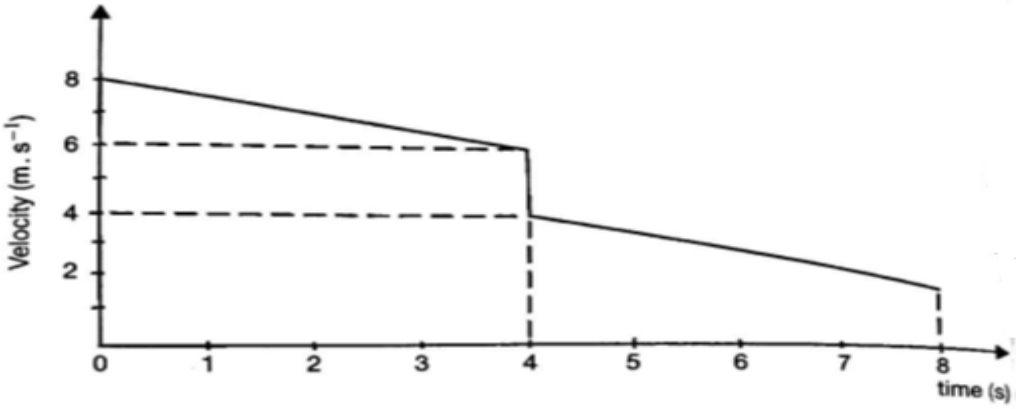
4.2.1 State the law of conservation of mechanical energy. (2)

4.2.2 Determine the velocity of the coupled objects by using energy principle. (4)

[12]

QUESTION 5 (Start on a new page)

A trolley with a mass of 4 kg, moves at 8 m.s^{-1} when t is 0 s. It moves freely across a rough surface. When t is 4 s, a piece of clay is dropped vertically on to the trolley and sticks to it. The velocity-time graph of the motion of the trolley is given below.

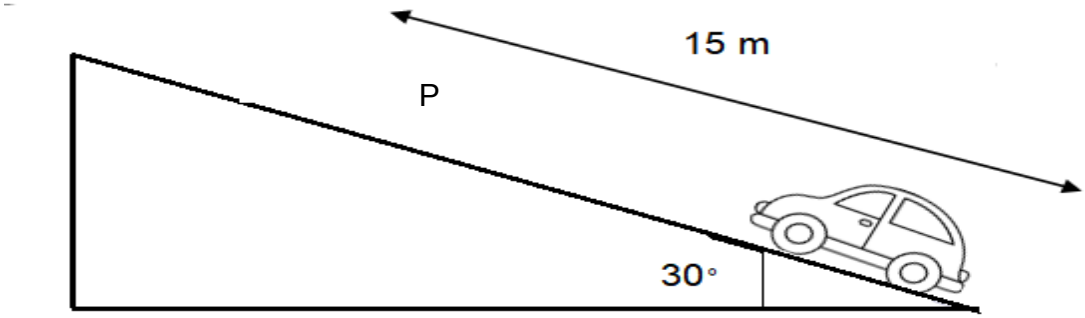


5.1 Calculate the frictional force on the trolley for the first 4 s. (3)

5.2 Calculate the work done by the frictional force during the first 4 s. (3)

5.3 Calculate the mass of the clay which was dropped onto the trolley. (2)

5.4 A toy car of mass 1,5 kg having its own momentum, is able to move up a slope of incline 30˚. It comes to rest momentarily at a point P, 15 m from the bottom. Whilst moving up, a constant frictional force acts on it. The coefficient of kinetic friction is 0,3. Ignore effects of air friction.



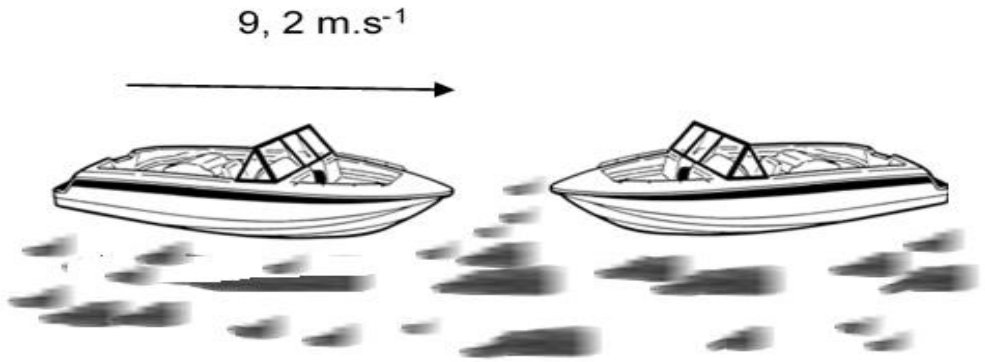
5.4.1 State work-energy theorem in words. (2)

5.4.2 Use work-energy theorem to calculate the car's initial velocity at the bottom of the inclined plane. (5)

[15]

QUESTION 6 (Start on a new page)

A ship is moving towards another stationery ship at 9,2 $m \cdot s^{-1}$. The speed of sound in water is 1482 $m \cdot s^{-1}$.The moving ship emits sound waves with wavelengths of 0,045 m.



6.1 State the Doppler effect in words. (2)

6.2 Determine the frequency of sound emitted by the moving ship. Give your answer in kHz. (2)

6.3 Is this frequency detectable by the human ear? Explain your answer. (2)

6.4 Calculate the frequency of the sound wave detected by the stationery ship. (4)

6.5 Many galaxies show a red shift of their spectra. The red shift can be used to calculate the velocities of galaxies relative to Earth. The table shows the data for three galaxies.

Galaxy	**Velocity (x $10^7 m \cdot s^{-1}$)**
P	0,15
Q	1,52
R	2,44

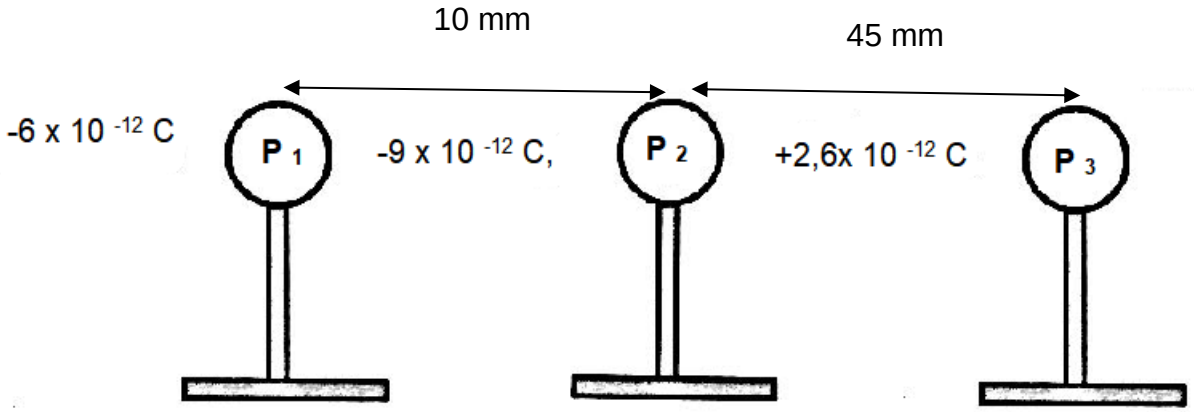
6.5.1 Which of the galaxies listed above is the furthest from earth? Explain your answer. (2)

6.5.2 Which of the galaxies listed above indicates the greatest red shift? Explain your answer. (2)

[14]

QUESTION 7 (Start on a new page)

Three charged spheres **P 1, P 2** and **P 3** with charges -6 x 10 $^{-12}$ C, -9 x 10 $^{-12}$ C, and +2,6x 10 $^{-12}$ C respectively are placed on an isolated stands as shown in the diagram.



7.1 Calculate the magnitude and direction of electrostatic force exerted on sphere **P$_1$** by both spheres **P 2** and **P 3** (5)

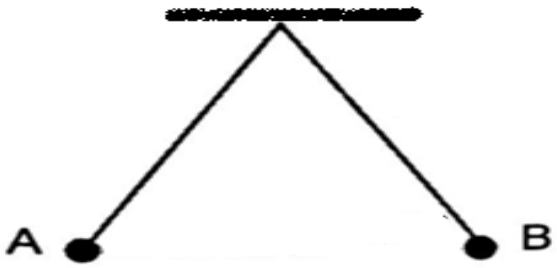
7.2 Spheres **P 2** and **P 3** are brought in to contact with each other and separated again to the original distance apart.

7.2.1 Calculate the new charge on spheres **P 2** and **P 3** (2)

7.2.2 How many excess electrons are on sphere **P 3** (2)

7.3 State Coulomb's law in words. (2)

7.4 Two small, identical positively charged metal balls, A and B are suspended by a non-conducting threads as shown in the diagram below. The balls repel each other with a force of 3,23 x 10^{-5} N. The charge on each ball is 4,8 nC.



7.4.1 Calculate the electric field strength at B due to A (3)

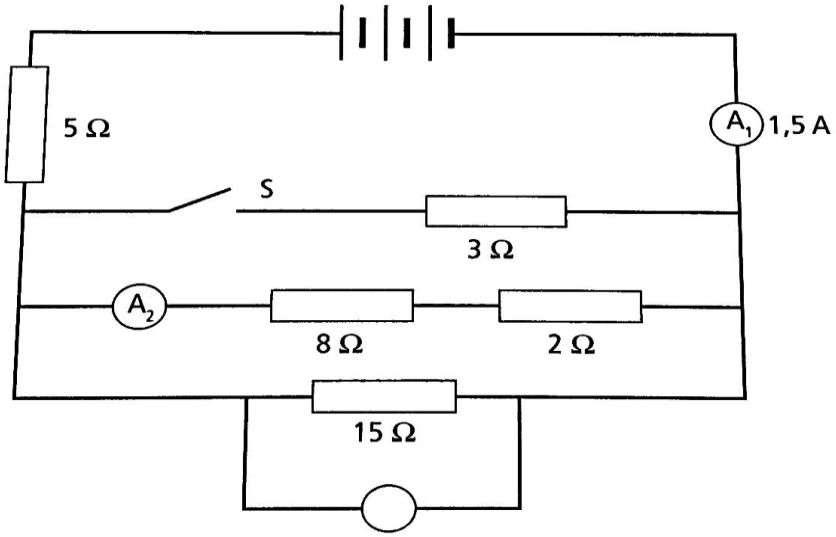
7.4.2 Calculate the distance between the centres of A and B (3)

7.4.3 Draw electric field pattern caused by these metal balls. (2)

[19]

QUESTION 8 (Start on a new page)

Three identical cells each with an emf of 4.5 V are connected in series as shown in the circuit diagram. The internal resistance (r) of the cells is unknown. When switch S is closed the ammeter reading on A_1 is 1,5 A..



8.1 Calculate the effective resistance of the external circuit. (2)

8.2 Calculate the potential difference across the 15 Ω resistor. (2)

8.3 Prove that the internal resistance of each cell in the battery is 0,67 Ω. (4)

8.4 Switch S is now opened. Indicate whether the following would INCREASE, DECREASE OR REMAINS SAME.

8.4.1 Effective resistance of the external circuit. Explain the answer. (2)

8.4.2 The reading on ammeter A_1.Explain the answer (2)

8.5 You are provided with a 12 V car battery with no internal resistance, and two identical headlight bulbs marked 12 V:3 A

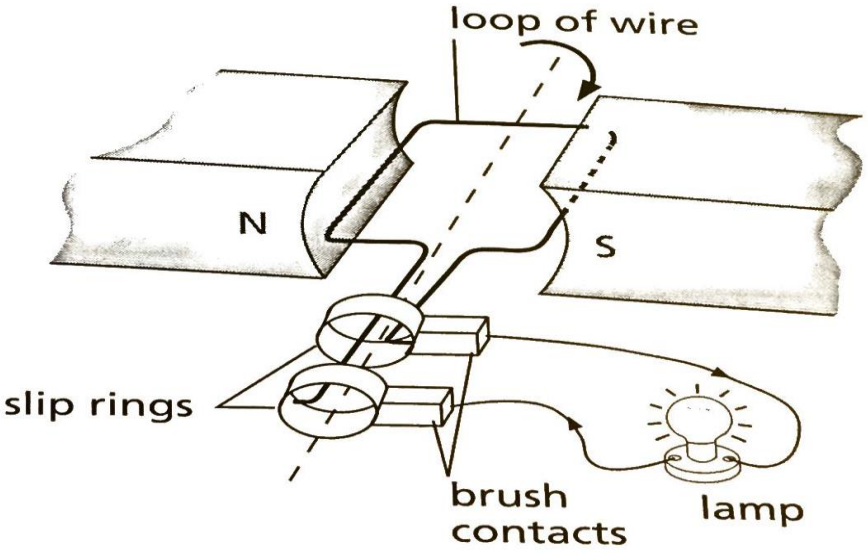
8.5.1 Draw a circuit diagram to illustrate how these components will be connected to ensure that the headlight bulbs operate optimally. (2)

8.5.2 Calculate total current in the circuit. (4)

[18]

QUESTION 9 (Start on a new page)

The diagram below shows a simple electricity generator.

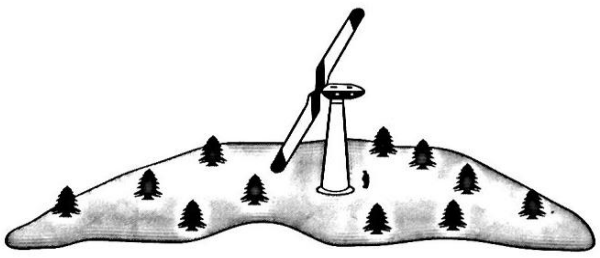


9.1 State two ways to increase the current produced by the generator. (2)

9.2 Most electricity in South Africa is generated by coal fired power stations.
Complete the sequence of useful energy transfers which take place in the power stations. The arrow indicates the energy transfer taking place.

Chemical energy of the coal → 9.2.1…..energy of the steam → 9.2.2….. energy of the turbine→9.2.3…..energy produced by the generator. (3)

9.3 The diagram shows a wind turbine which is used to produce electricity using energy from the wind.



9.3.1 What is the source of energy which creates wind? (1)

9.3.2 Explain the advantage of using a wind turbine to produce electricity. (1)

9.4 The national electricity network is used to deliver energy from the power stations to houses and industries all over the country. There are two types of electric currents namely alternating and direct current.
Draw two voltage time graphs to illustrate the difference between alternate and direct current. (4)

9.5 The peak value of the AC voltage across a speaker from a music system is 17 V and the speaker has a resistance of 10 Ω.

9.5.1 Calculate the rms voltage. (3)

9.5.2 Calculate the peak value of the current. (3)

9.5.3 Draw the circuit symbol for alternating current. (1)

[18]

TOTAL [150]

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

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

TABLE 1: PHYSICAL CONSTANTS / TABEL 1: FISIESE KONSTANTES

NAME / NAAM	SYMBOL / SIMBOOL	VALUE / WAARDE
Acceleration due to gravity *Swaartekragversnelling*	g	$9,8\ m{\cdot}s^{-2}$
Universal gravitational constant *Universele gravitasiekonstante*	G	$6,67 \times 10^{-11}\ N{\cdot}m^2{\cdot}kg^{-2}$
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	$6,63 \times 10^{-34}\ J{\cdot}s$
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2}$
Charge on electron *Lading op elektron*	E	$-1,6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}\ kg$
Mass of Earth *Massa van Aarde*	M_E	$5,98 \times 10^{24}\ kg$
Radius of Earth *Radius van Aarde*	R_E	$6,38 \times 10^6\ m$

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

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1 m_2}{d^2}$ or/of $F = G\frac{m_1 m_2}{r^2}$	$g = G\frac{M}{d^2}$ or/of $g = G\frac{M}{r^2}$

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

WAVES, SOUND AND LIGHT / GOLWE, KLANK EN LIG

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

ELECTROSTATICS / ELEKTROSTATIKA

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ or / of $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS / ELEKTRIESE STROOMBANE

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

ALTERNATING CURRENT / WISSELSTROOM

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$	$P_{ave} = V_{rms}I_{rms}$ / $P_{gemiddeld} = V_{wgk}I_{wgk}$
	$P_{ave} = I_{rms}^2R$ / $P_{gemiddeld} = I_{wgk}^2R$
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$	$P_{ave} = \frac{V_{rms}^2}{R}$ / $P_{gemiddeld} = \frac{V_{wgk}^2}{R}$