Province of the
EASTERN CAPE
EDUCATION

NATIONAL
SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2016

PHYSICAL SCIENCES P1

MARKS: 150

TIME: 3 hours

This question paper consists of 16 pages including a 2 page data sheet.

INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of NINE questions. Answer ALL the questions in the ANSWER BOOK.

3. Start EACH question on a NEW page in the ANSWER BOOK.

4. Number your 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 and PERIODIC TABLE.

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

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the best answer and write down ONLY the letter (A–D) next to the question number (1.1–1.10) in your ANSWER BOOK, for example 1.11 D.

1.1   A boy throws a tennis ball vertically upwards into the air. At the maximum height its ...

   A   potential energy is a maximum.

       B   potential energy is a minimum.

       C   mechanical energy is zero.

.

       D   kinetic energy is a maximum.   (2)

1.2   A learner pushes a block of mass **M** at a constant velocity with a stick over a rough horizontal surface with a force **F** at 30° to the horizontal (FIGURE 1). The free-body diagram below shows all forces acting on the block.

FIGURE 1
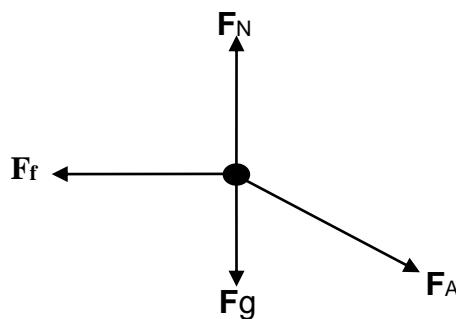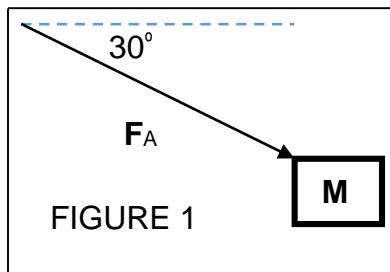
Which ONE of the following indicates the CORRECT relationship between the magnitude of the forces in the free-body diagram?

       A $F_f = F_A$

   B $F_f = F_A \sin 30^{\circ}$

       C $F_f = F_A \cos 30^{\circ}$

       D $F_f = F_A \cos 60^{\circ}$ (2)

1.3   Four circuits of three identical resistors connected in different positions are shown below. Which ONE of the following circuit diagrams will allow the largest current through the ammeter A?
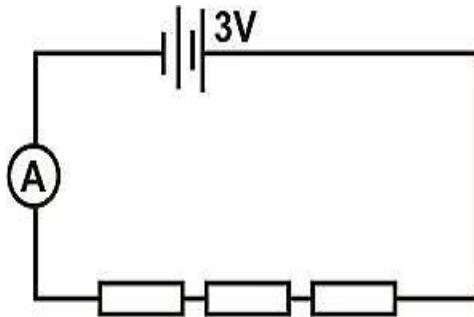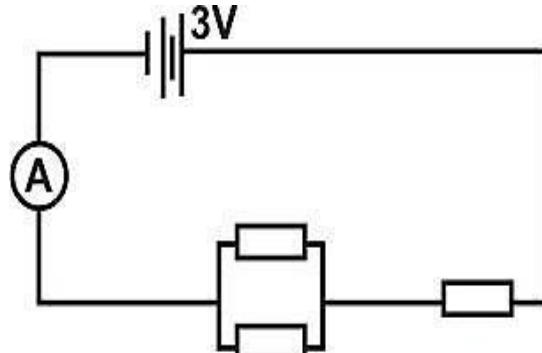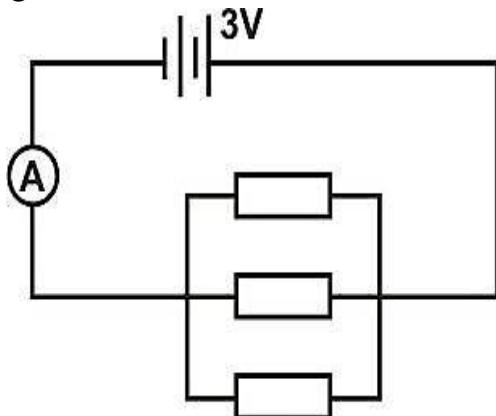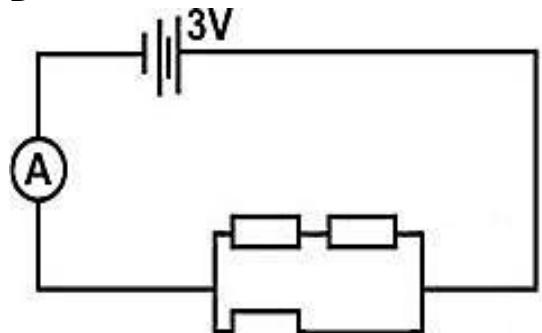
(2)

1.4   The resultant of all the forces acting on an object is zero if the object …

    A   is accelerated.

    B   is slowed down.

    C   slides down an incline at a constant velocity.

   D   moves around a circle at constant velocity.   (2)

1.5   Which of the following observations from our daily lives DO NOT refer to Newton's third law of motion:

    A   A swimmer is able to move forward in a swimming pool.

    B   A rocket floats in space.

    C   A rocket is propelled into space.

    D   An owl flaps its wings to stay in flight.   (2)

1.6 Two resistors of 3 Ω and 6 Ω respectively are connected as shown in the sketch below. The internal resistance of the battery is negligible. The ratio $I_1 : I_2$ of the electric currents in the resistors is:
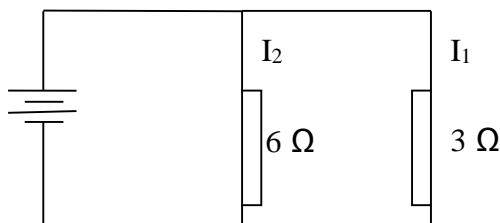
A 1 : 1

B 1 : 2

C 2 : 1

D 1 : 4 (2)

1.7 Two forces of magnitudes 11 N and 5 N respectively, act simultaneously on an object. Which ONE of the following CANNOT be the resultant of the two forces?

A 5 N

B 16 N

C 6 N

D 9 N (2)

1.8 A boy stands on a balcony listening at a woman singing downstairs but cannot see the woman. The main phenomenon that allows the boy to hear the sound is …

A transmission.

B reflection.

C refraction.

D diffraction. (2)

1.9 The diagram below represents two small spheres hanging on insulated strings on a ceiling. Sphere **Q** carries a charge that is twice as big as the charge carried by sphere **P**. The spheres are separated by a distance of 60 cm, as shown below. If the distance is double to 120 cm, the electrostatic FORCE (**F**) exerted by sphere **P** on sphere **Q** is …


A ¼ F.
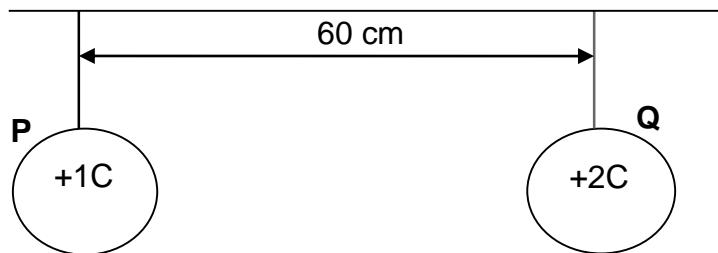
B ½ F.

C 2 F.

D 4 F. (2)

1.10 In the diagram below is a bar magnet is moving relative to a coil. The current induced in the coil is in the direction indicated. The magnet …
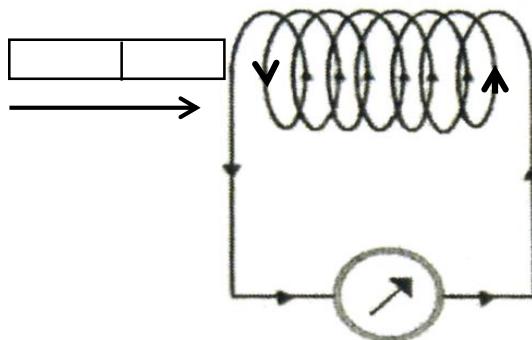
A is stationary.

B is approaching the coil with a north pole.

C induces an electric field around the coil.

D is approaching the coil with a south pole. (2)

[20]

QUESTION 2 (Start on a new page.)

The diagram below shows a rope and pulley system of a device being used to lift a 122,5 kg container upwards at a constant velocity. Assume that the ropes are light and inextensible and the pulley is frictionless.
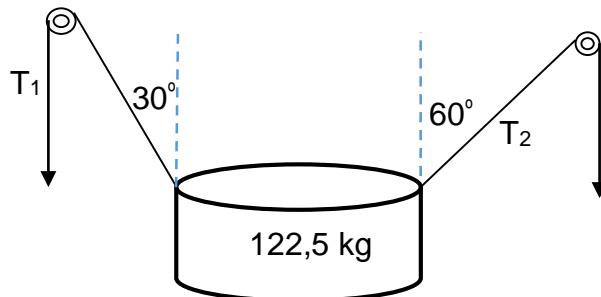
2.1 Calculate the weight of the container. (3)

2.2 The system is moving upwards at a constant velocity as indicated above.

    2.2.1 Draw a vector diagram of all forces acting on the container and indicate the angles represented in the diagram. (5)

    2.2.2 Determine the magnitudes of the forces T_1 and T_2. (7)

2.3 The system is moving upwards at a constant velocity.

    2.3.1 What does the statement above tell us about forces acting on the container? (2)

    2.3.2 Which Newton's law support your answer in QUESTION 2.3.1? (2)

[19]

QUESTION 3 (Start on a new page.)

A box of mass 5 kg is **pushed** along a horizontal surface, a distance of 4 m to point P eastwards by a constant force of 25 N as shown in the diagram below. The coefficient of kinetic friction between the object and the surface is 0,40.
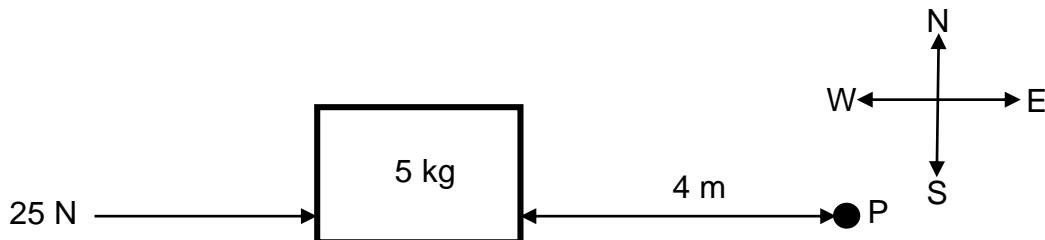
3.1   Draw a force diagram showing ALL forces acting on the 5 kg box.   (4)

3.2   Write down Newton's second law of motion in words.   (2)

3.3   Calculate the magnitude of the:

       3.3.1   Normal force acting on the 5 kg box   (4)

       3.3.2   Friction force acting on the 5 kg box   (3)

       3.3.3   Show by calculation that the box is accelerating to the right   (4)

                                                                          [17]

QUESTION 4 (Start on a new page.)

An object with a mass of 3 kg is allowed to hang over a frictionless pulley with a light inextensible string that is attached to the 5 kg box. The box is pulled on a rough surface with the force, **F$_A$**, of 36 N and is moving at a constant velocity.
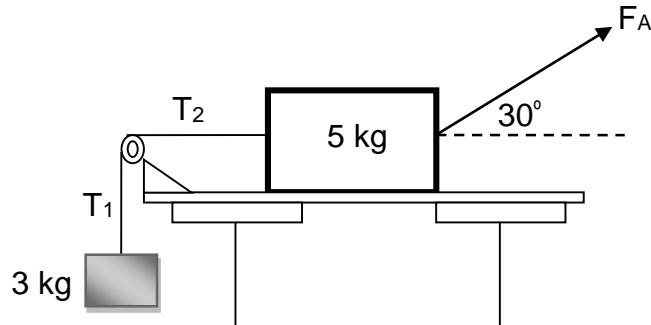
4.1	4.1.1	Draw a free-body diagram of forces acting on a 3 kg object.	(2)
	4.1.2	Determine the magnitude of the tension force on the 3 kg object.	(4)

4.2 Draw a free-body diagram of ALL forces exerted on the 5 kg box. (5)

4.3 What is the magnitude of the tension, T$_2$, on the 5 kg box? (1)

4.4 Calculate the friction force between the surface and the 5 kg box. (5)

[17]

QUESTION 5 (Start on a new page.)

Halley's comet, of approximate mass of 1×10^{15} kg, was $1,3 \times 10^{8}$ km from the Earth (mass = 6×10^{24} kg) at its point of closest approach during its last sighting in 1986.

5.1   State *Newton's Law of universal gravitational* in words.   (2)

5.2   Is the magnitude of gravitational force experienced by the comet **GREATER THAN, EQUAL TO, OR LESS THAN** the gravitational force experienced by the earth?   (1)

5.3   State the Physics Law in words that is applicable to the answer given in QUESTION 5.2 above.   (2)

5.4   Does the acceleration of the comet **INCREASE, DECREASE** or **REMAIN THE SAME** as it moves closer to the earth? Explain.   (3)

5.5   Calculate the magnitude of the gravitational force exerted by the earth on Halley's comet at a point of closest approach.   (5)

[13]

QUESTION 6 (Start on a new page.)

Zingi and Tumi performed an investigation to identify an unknown material. They shone a ray of light on the unknown material, varying the angle of incidence and recording the angle of refraction. Results are recorded in **TABLE 6.1**.

TABLE 6.1:

Angle of incidence in degrees	0,0	5,0	10,0	15,0	20,0	25,0	30,0	35,0	40,0
Angle of refraction in degrees	0,0	3,76	7,50	11,2	14,9	18,5	22,1	25,5	28,9

TABLE 6.2: Refractive indices of some materials. Refractive index in air (n_{air}) is calculated at standard temperature and pressure (STP).

Medium	Refractive index	Medium	Refractive index
Vacuum 1	1	Acetone	1,36
Helium	1,000036	Ethanol)	1,36
Air*	1,0002926	Sugar solution (30%)	1,38
Carbon dioxide	1,00045	Fused quartz	1,46
Water: Ice	1,31	Glycerine	1,4729
Water: Liquid (20°C)	1,333	Sugar solution (80%)	1,49
Rock salt	1,516	Sapphire	1,77
Crown Glass	1,52	Glass (typical)	1,5 to 1,9
Sodium chloride	1,54	Cubic zirconia	2,15 to 2,18
Polystyrene	1,55 to 1,59	Diamond	2,419
Bromine	1,661	Silicon	4,01

6.1 Write down the aim of the investigation. (2)

6.2 Identify the following variables for the above investigation:

    6.2.1 Independent (1)

    6.2.2 Dependent (1)

6.3 Use:

    6.3.1 **TABLE 6.1** to calculate the refractive index of the unknown material (4)

    6.3.2 **TABLE 6.2** to identify the material (1)

6.4 If the refractive indices of air and sodium chloride are 1.00 and 1.54 respectively. Calculate the critical angle. (5)

**[14]**

QUESTION 7 (Start on a new page.)

A group of five learners in a Physics lesson demonstrated the diffraction of waves using a monochromatic red light of wavelength of 675×10^{-9} m. The red light was passed through the slit with a width of $3,2 \times 10^{-5}$ m and fell on a screen at a distance of 2,5 cm.
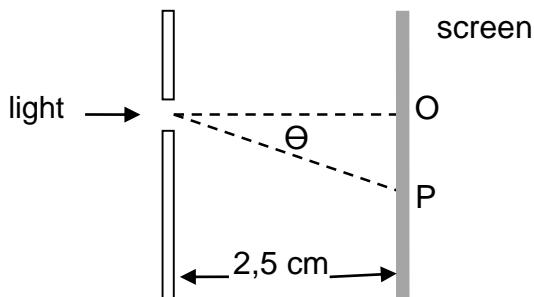
7.1 Define the term *diffraction*. (2)

7.2 Write down *Huygens's Principle*. (2)

7.3 On the screen, bright and dark bands were observed:

    7.3.1 What do these bright and dark bands on the screen represent? (2)

    7.3.2 How does the width of the central band compare to other bands? Write down only **NARROWER, BROADER** or **EQUAL**. (2)

7.4 A red light was replaced with a blue light. How would this change of colour affect the following?
Write down only **INCREASES, DECREASES** or **REMAINS THE SAME**.

    7.4.1 The wavelength (1)

    7.4.2 Degree of diffraction (1)

[10]

QUESTION 8 (Start on a new page.)

Two metal spheres charges, **Q1** and **Q2**, on insulated stands, carry charges of $+6 \times 10^{-6}$ C and -4×10^{-6} C respectively are separated by a distance of 3 m from their centres. A point charge at **P** is 1,2 m from **Q2** in the same plane as indicated in the diagram below.
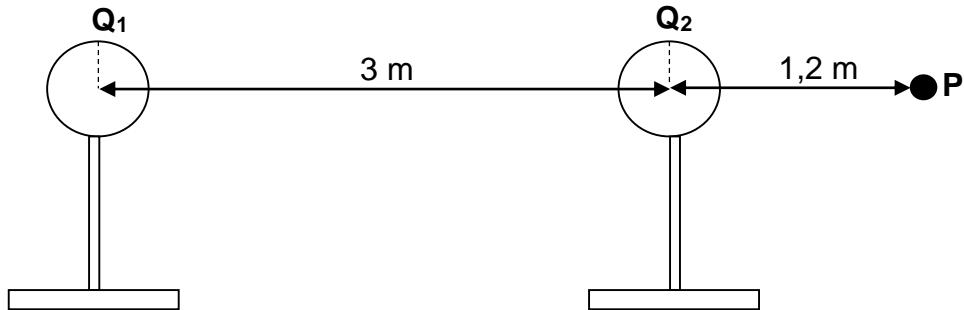
8.1   Define *Coulomb's law* in words.   (2)

8.2   Draw the electric field pattern between the two charges.   (3)

8.3   Calculate:

     8.3.1   The electrostatic force exerted by **Q1** on **Q2**   (5)

     8.3.2   Calculate the electric field strength at point **P** as a result of **Q1** and **Q2**   (7)

     8.3.2   How many electrons are in excess in **Q2**   (2)

                                                                 [19]

QUESTION 9 (Start on a new page.)

In the circuit diagram below resistors **A** and **B** are connected in parallel and **C** in series as represented in the circuit below. The effective resistance across the parallel connection is 2 Ω and the reading on the voltmeter **V** is 24 V. The resistance of the connecting wires is negligible.
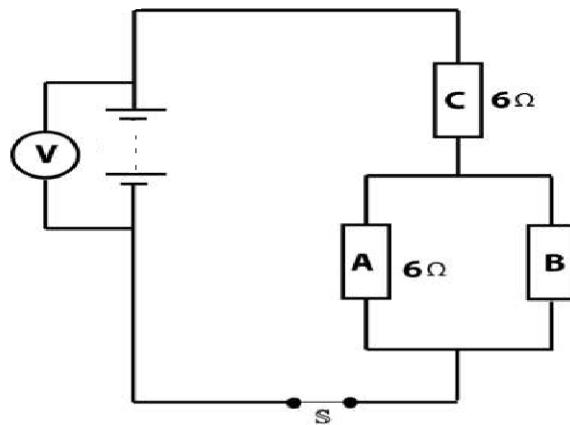
9.1   State *Ohm's law* in words.   (2)

Calculate the:

9.2   Resistance of resistor **B**   (5)

9.3   Current in the circuit   (7)

9.4   Potential difference across the resistor **A**   (7)

                                                                       [21]

                                               TOTAL: **150**

DATA FOR PHYSICAL SCIENCES GRADE 11
GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
PAPER 1 (PHYSICS) / *VRAESTEL 1 (FISIKA)*

TABLE 1: PHYSICAL CONSTANTS
*T**ABEL 1: FISIESE KONSTANTES***

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9,8$ m.s^{-2}
Universal Gravitational constant *Swaartekragkonstante*	G	$6,67 \times 10^{-11}$ N.m².kg^{-2}
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^9$ N.m².C^{-2}
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^8$ m.s^{-1}
Charge on electron *Lading op elektron*	e^-	$-1,6 \times 10^{-19}$ C
Electron mass *Electronmassa*	m_e	$9,11 \times 10^{-31}$ kg
Charge on electron *Lading op elektron*	e^-	$-1,6 \times 10^{-19}$ C
Radius of earth *Radius van aarde*	R_E	$6,38 \times 10^6$ m
Mass of earth *Massa van aarde*	M_g	$5,98 \times 10^{24}$ kg

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

$F_{net} = ma$	$w = mg$
$F = \dfrac{GM_1 M_2}{r^2}$	$f_{s(max)} = \mu_s N$
$f_k = \mu_k N$	

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

$n = \dfrac{c}{v}$	$T = \dfrac{1}{f}$
$n_1 \sin \theta_1 = n_2 \sin \theta_2$	$v = f\lambda$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \dfrac{k \, Q_1 Q_2}{r^2}$	$(k = 9{,}0 \times 10^9 \text{ N.m}^2.\text{C}^{-2})$	$E = \dfrac{F}{q}$
$E = \dfrac{kQ}{r^2}$	$(k = 9{,}0 \times 10^9 \text{ N.m}^2.\text{C}^{-2})$	$E = \dfrac{V}{d}$

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

$\Phi = BA \cos \theta$	$\mathcal{E} = -\dfrac{N \, \Delta\Phi}{\Delta t}$

CURRENT ELECTRICITY/*STROOMELEKTRISITEIT*

$R = \dfrac{V}{I}$	$R = R_1 + R_2 + \ldots$
$I = \dfrac{Q}{\Delta t}$	$\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3} + \ldots$
$W = Vq$ $W = VI\Delta t$ $W = I^2 R \, \Delta t$ $W = \dfrac{V^2 \, \Delta t}{R}$	$P = \dfrac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \dfrac{V^2}{R}$