education

Department of
Education
FREE STATE PROVINCE

NOVEMBER EXAMINATION

GRADE 11

TIME: 3 HOURS

This paper consists of 14 pages and two information sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 8 questions. Answer ALL questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
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 pocket 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 where applicable.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

QUESTION 1

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write down only the letter A, B, C or D next to the question number (1.1 to 1.10) in your ANSWER BOOK, e.g. 1.11 E.

1.1 Which one of the following forces always acts perpendicular to the surface on which a body is placed?

A Normal

B Friction

C Tension

D Gravitational force (2)

1.2 A sphere is hanging from the ceiling as shown in the diagram.

The reaction force of sphere's weight is the force of the …

A ceiling on the sphere.

B string on the sphere.

C ceiling on the string.

D sphere on the Earth. (2)

1.3 Two forces, **P** and **Q**, are acting on a car which is moving at a CONSTANT VELOCITY in a straight line. Force **P** is the driving force and force **Q** is the frictional force. What is the relationship between the magnitudes of the two forces?

A $P < Q$

B $P = Q$

C $P + Q > 0$

D $P + Q < 0$ (2)

1.4 Which one of the following statements is correct?

A A resistor absorbs charge.

B Insulators are usually metals.

C A charged object can repel neutral objects.

D The same type of charges repel one another. (2)

1.5 A negatively charged plastic comb is brought close to a small piece of paper. If the comb and the paper are attracted to each other, the original charge on the paper is ...

(i) positive.

(ii) negative.

(iii) positive or neutral.

(iv) negative or neutral.

Which of one the statements above is TRUE?

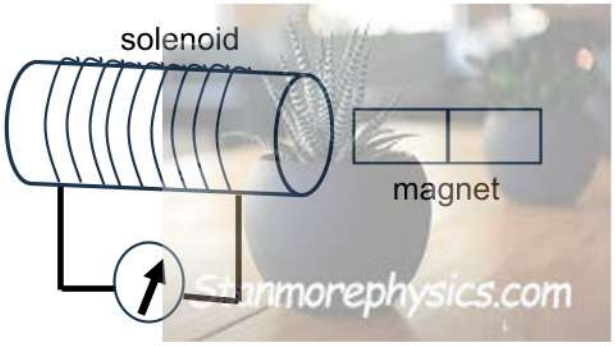
A (i) only

B (ii) only

C (iii) only

D (iv) only (2)

1.6 A galvanometer is connected to a solenoid as shown below. When there is relative motion between magnet and solenoid, a galvanometer registers a reading.



Which one of the following changes will decrease the reading on the galvanometer when a current is induced in the solenoid?

A Increase strength of the magnet.

B Increase of speed motion of the solenoid.

C Increase in the number of turns in the solenoid.

D Increase in distance between the solenoid and the inserted magnet. (2)

1.7 The direction of magnetic field around a straight current-carrying conductor is …

A clockwise around the conductor with conventional current out of the page.

B clockwise around the conductor with conventional current into the page.

C parallel to the conductor in the opposite direction to conventional current.

D parallel to the conductor in the same direction as conventional current. (2)

1.8 Factors that influence the resistance of a conductor are …

(i) time that current flows through the conductor.

(ii) cross-sectional area of the conductor.

(iii) the temperature of the conductor.

(iv) the length of the conductor.

Which combination is correct?

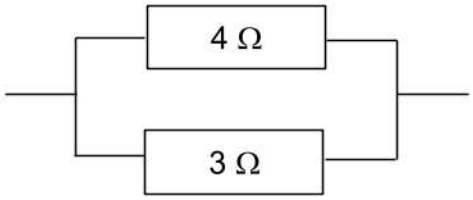
A (ii) , (iii) , (iv)

B (i) , (iii) , (iv)

C (ii) and (iv) only

D (i) , (ii) , (iii) , (iv) (2)

1.9 Two different resistors are connected in parallel as indicated in the diagram.



The effective resistance of the connection has a value …

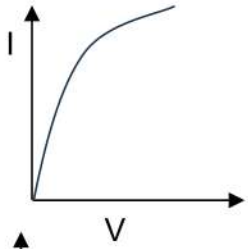
A equal to the largest resistor.

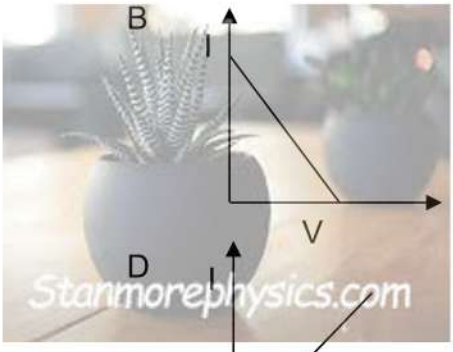
B equal to the sum of the resistors.

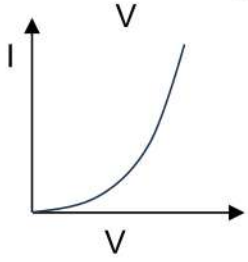
C smaller than each individual resistor.

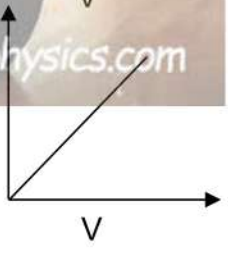
D greater than the sum of the resistors. (2)

1.10 Which one of the following graphs best represents the relationship between current and potential difference for a non-Ohmic conductor?

A


B


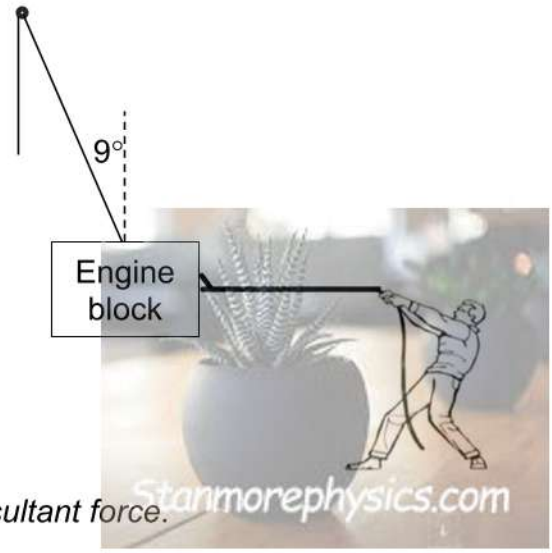
C


D


(2)
[20]

QUESTION 2

An engine block of mass 650 kg is suspended from a fixed point by an inextensible cable. A learner pulls a rope, attached to the engine block, horizontally to the right so that the cable forms an angle of 9° with the vertical. The engine is then kept in this position.



2.1 Define the term *resultant force*. (2)

2.2 Write down the magnitude of the resultant force on the engine block when kept stationary. (1)

2.3 Draw a labelled free body diagram showing all the forces acting on the engine block. (3)

2.4 Illustrate the answer to QUESTION 2.2 by means of a vector diagram. (2)

2.5 Calculate the magnitude of the:

2.5.1 Tension force. (3)

2.5.2 Horizontal force applied (3)

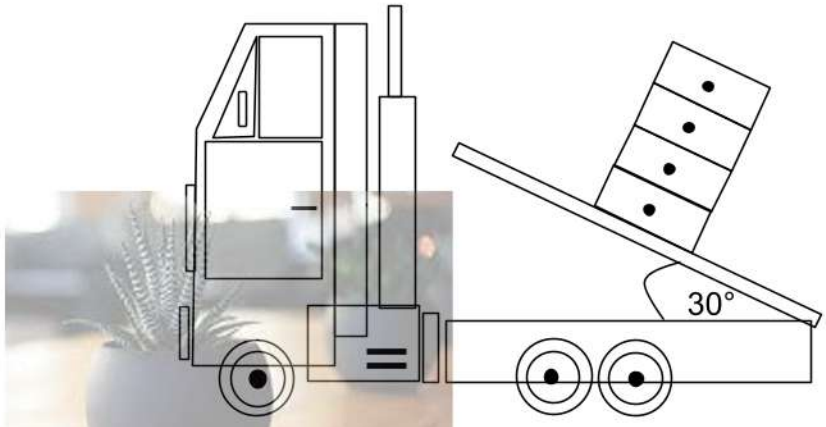
2.6 The cable can withstand a maximum tension of 7 500 N. The engine block is now pulled to the right so that the cable now forms an angle of 32° with the vertical. Use calculation to determine with reason whether the cable will snap or not. (5)

[19]

QUESTION 3

3.1 A wooden cabinet of unknown mass, **m**, rests on the back of a tip-up truck. The back tilts slowly, until it makes an angle of 30° with the horizontal. The cabinet remains stationary.

The maximum static friction between the surface of the truck and wooden cabinet is 294 N.



3.1.1 State Newton's first law of motion in words. (2)

Calculate the:

3.1.2 Mass of wooden cabinet. (4)

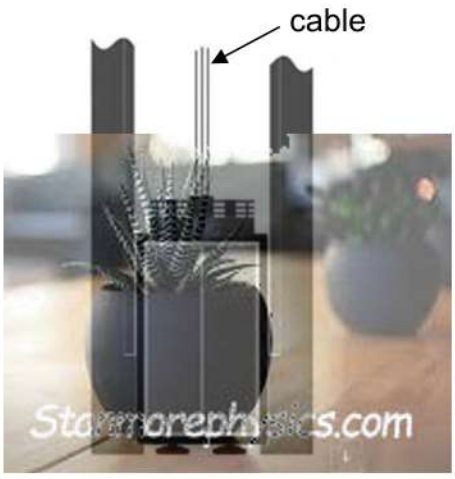
3.1.3 Coefficient of static friction. (3)

3.1.4 The angle of 30° is now decreased. How will this change affect the following:
Write down only INCREASES, DECREASES OR REMAINS THE SAME.

(a) The coefficient of friction, calculated in QUESTION 3.1.3. (1)

(b) The frictional force. Explain the answer. (3)

3.2 A girl stands in a stationary lift. The combined weight of the girl and the lift is 5 000N.



3.2.1 How will the tension in the lift cables change when the lift accelerates upwards?
Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

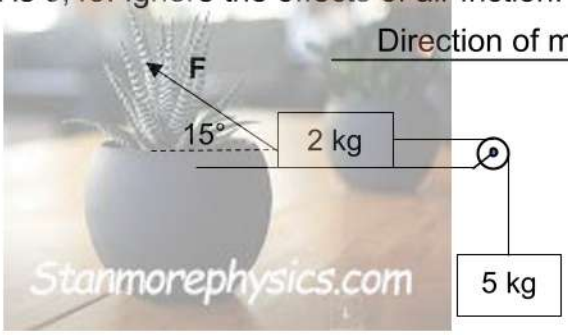
3.2.2 Explain the answer to QUESTION 3.2.1. (2)

3.2.3 The cable of the lift suddenly snaps while it is moving upwards.
Explain the observed movement of the lift. (2)
[18]

QUESTION 4

A block of mass, 2 kg resting on a rough horizontal table, is connected by a light inextensible string passing over a frictionless pulley to another block of mass 5 kg. The 5 kg block hangs vertically as shown in the diagram below.

A force 40 N is applied to the block of mass 2 kg at an angle of 15° to the horizontal, causing the block to accelerate to the right at CONSTANT ACCELERATION. The coefficient of the kinetic friction between the table and the block is 0,45. Ignore the effects of air friction.



4.1 Define normal force in words. (2)

4. 2 Draw a labelled free-body diagram showing ALL the forces acting on the 2 kg block. (5)

Calculate the magnitude of the:

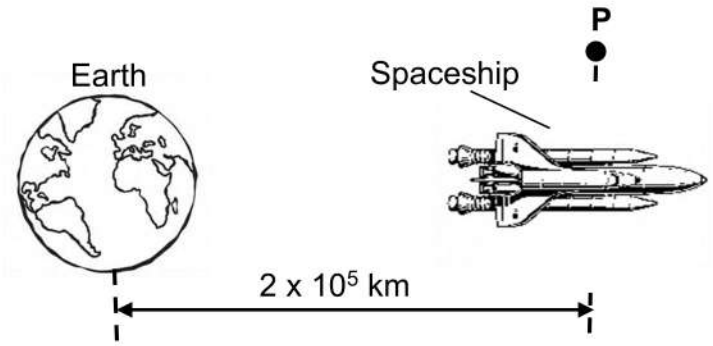
4.3 Normal force acting on the 2 kg block. (4)

4.4 Kinetic frictional force. (3)

4.5 Acceleration of the 2 kg block. (5)
[19]

QUESTION 5

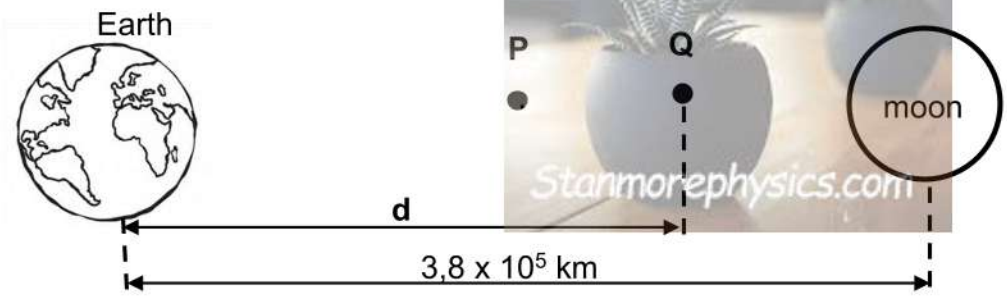
A spaceship of mass 3 500 kg is at rest at point **P**, which is 2 x 10^5 km from the centre of the earth.



5.1 State Newton's Law of Universal Gravitation. (2)

5.2 Calculate the magnitude of the gravitational force that the spaceship experiences at point **P**. (4)

The spaceship now moves to point **Q** which is on a straight line between the moon and Earth. The spaceship experiences a ZERO net force when it is at point **Q**, which is at a distance **d** from the centre of the Earth. The mass of the moon is 7,35 x 10^{22} kg and it is at an average distance of 3,8 x 10^5 km from Earth.

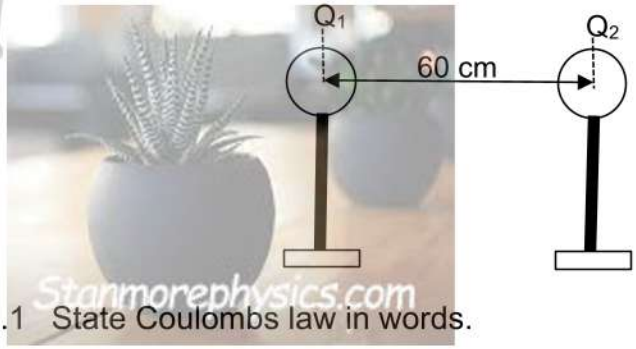


5.3 Calculate the distance between points **P** and **Q**. (5)

[11]

QUESTION 6

6.1 Two metal spheres, Q_1 and Q_2, on insulated stands, carry charges of $+6 \times 10^{-6}$ C and -4×10^{-6} C respectively. The distance between the spheres is 60 cm.



6.1.1 State Coulombs law in words. (2)

6.1.2 Calculate the magnitude of the force exerted by Q_1 on Q_2. (3)

The two spheres are allowed to come into contact and return to their original positions.

6.1.3 In which direction will the electrons flow while spheres Q_1 and Q_2 are in contact? Write down only from Q_1 to Q_2 OR from Q_2 to Q_1. (1)

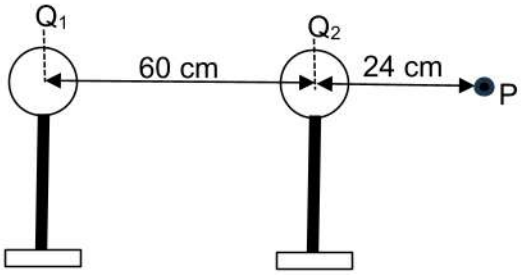
6.1.4 Explain the answer to QUESTION 6.1.3 (1)

Calculate the:

6.1.5 Net charge gained or lost by sphere Q_1 after the spheres have been in contact and allowed back to the original position. (3)

6.1.6 The number of electrons transferred. (3)

6.2 A point charge **P** is 24 cm from Q_2 in the same plane as indicated in the diagram below.



6.2.1 Define *electric field at a point*. (2)

6.2.2 Sketch the electric field pattern between the two charged spheres after contact (3)

6.2.3 Calculate the net electric field strength at point **P** as a result Q_1 and Q_2. (5)

[23]

QUESTION 7

7.1 A solenoid with 280 turns moves though a magnetic field. The rate at which the magnetic flux changes is 1,5 x 10^{-3} Wb·s^{-1}. The area of the coil is 2 x10^{-3} m^2.

7.1.1 State the Faraday's law in words. (2)

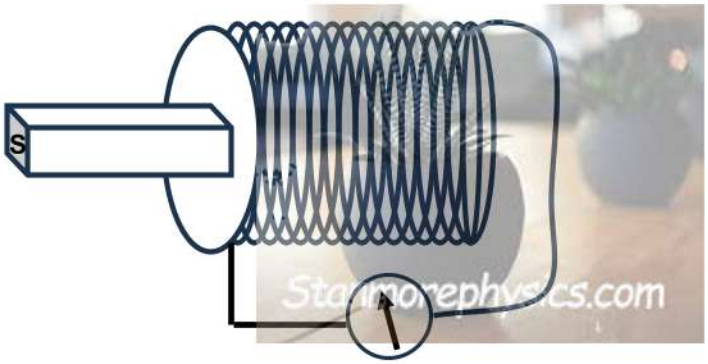
Calculate the:

7.1.2 Induced emf (3)

7.1.3 Strength of the magnetic field. (4)

7.1.4 Current in the coil if the resistance of the coil is 2 Ω (3)

7.2 In an experiment to investigate the factors that affect the magnitude of an induced emf, a student moves a magnet back and forth into the solenoid, as shown in the diagram.



The north pole of the magnet is moved into the solenoid.

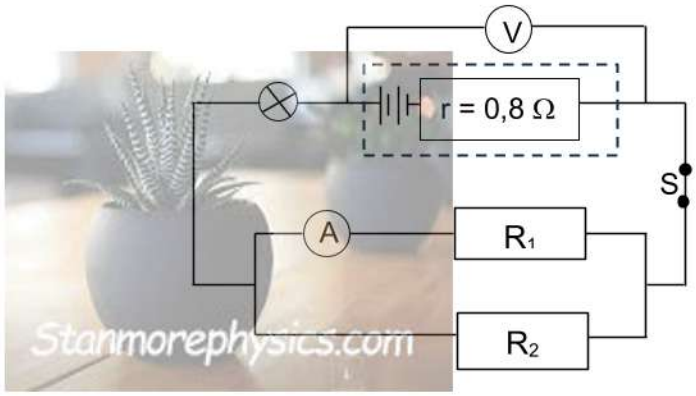
7.2.1 Write down the name of the principle illustrated above. (1)

7.2.2 Write down the induced polarity at the entrance of the solenoid. (1)

7.2.3 Explain the answer to QUESTION 7.2.2 (3)
[17]

QUESTION 8

8.1 The circuit diagram below shows a battery with an emf of 24 V and internal resistance of 0,8 Ω. The potential difference across R_1 is 15 V and the current through the ammeter is 3 A when switch **S** is closed. The resistance of $\mathbf{R_2}$ is THREE TIMES that of $\mathbf{R_1}$.



8.1.1 Explain what is meant by an emf of 24 V. (2)

Calculate the:

8.1.2 Resistance of $\mathbf{R_2}$. (4)

8.1.3 Current passing through the bulb (3)

8.1.4 Resistance of the bulb. (4)

8.2 The bulb is now removed and replaced with a conducting wire.

8.2.1 How will this change affect the reading on the ammeter **A**? Choose from INCREASES, DECREASES OR STAYS THE SAME. (1)

8.2.2 Explain the answer to QUESTION 8.2.1. (3)

8.3 A 100 W light bulb is replaced by a 21 W low energy equivalent bulb. The cost of 1 kWh of electricity is 91 c. The homeowner has an average of 10 light bulbs burning for 4 hours a day.

How much will the homeowner save in 30 days if he replaced these 100 W bulbs with the 21 W low energy bulbs? (6)
[23]

GRAND TOTAL = 150

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
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 $m \cdot s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	6,67 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Radius of Earth *Straal van Aarde*	R_E	6,38 x 10^6 m
Coulomb's constant *Coulomb se konstante*	k	9,0 x 10^9 $N \cdot m^2 \cdot C^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Charge on electron *Lading op elektron*	e	-1,6 x 10^{-19} C
Electron mass *Elektronmassa*	m_e	9,11 x 10^{-31} kg
Mass of the Earth *Massa van die Aarde*	M_E	5,98 x 10^{24} kg

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$\mu_s = \frac{f_{s(max)}}{N}$
$\mu_k = \frac{f_k}{N}$	

ELECTROSTATICS / *ELEKTROSTATIKA*

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

ELECTROMAGNETISM / *ELEKTROMAGNETISME*

$\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$	$\Phi = BA\cos\theta$

ELECTRIC CIRCUITS / *ELEKTRIESE STROOMBANE*

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