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Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2024

PHYSICAL SCIENCES P1

MARKS: 150

TIME: 3 hours

IPHSCE1

This question paper consists of 18 pages including 2 data sheet.

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INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME in the appropriate space in the ANSWER BOOK.
2. Answer ALL the 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. You may use a non-programmable calculator.
6. Leave ONE line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
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 motivations, discussions, etc. where required.
11. Write neatly and legibly.

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QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 Which of the following is a scalar quantity?

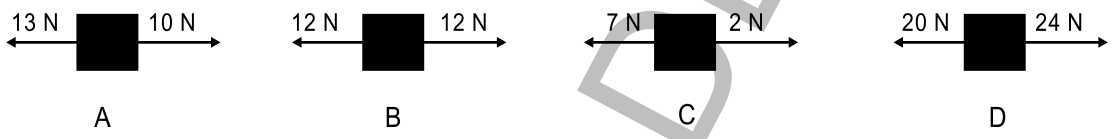
A Force

B Velocity

C Acceleration

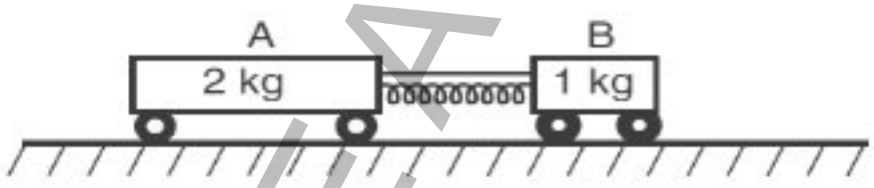
D Speed (2)

1.2 The objects below are all identical and resting on frictionless surfaces. Which object will experience the greatest acceleration?



(2)

1.3 The diagram below shows two trolleys held together by a compressed spring. The trolleys are initially at rest on a frictionless horizontal surface. Trolley **A** has a mass of 2 kg and trolley **B** has a mass of 1 kg.



The string breaks and the trollies move apart. The magnitude of the force that the spring exerts on trolley **A** is **F**. What is the magnitude of the force the spring exerts on trolley **B**?

A ½ F

B F

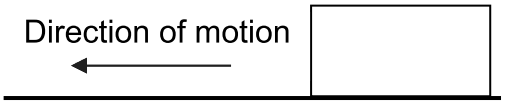
C 2F

D 4F (2)

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1.4 A block, slides to the left on a rough horizontal surface as shown in the diagram below. What are the directions of the resultant force and the acceleration of the block?



	DIRECTION OF RESULTANT FORCE	DIRECTION OF ACCELERATION
A	to the right	to the left
B	to the right	to the right
C	to the left	to the left
D	to the left	to the right

(2)

1.5 A crate is being pushed across a rough horizontal floor at a constant velocity. If the force applied is suddenly removed, the crate will …

A stop immediately.

B immediately start slowing down to a stop.

C continue at constant velocity for a short time and then slow down to a stop.

D continue at constant velocity. (2)

1.6 A satellite experiences a gravitational force of magnitude **F** on the surface of the earth. The radius of the earth is **R**. The satellite now orbits the earth at an unknown height above the surface of the earth and experiences a gravitational force of magnitude ¼ **F**.

This unknown height above the earth's surface is …

A **R.**

B 2**R.**

C 3**R.**

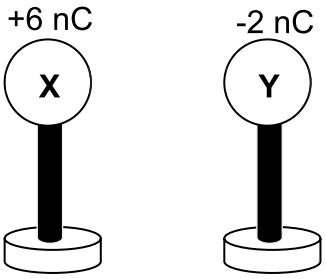
D 4**R.** (2)

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1.7 Two identical metal spheres **X** and **Y**, on isolated stands, have charges of +6 nC and -2 nC respectively. **Y** is brought into contact with **X** and then placed at its original position again.



What is the direction in which electrons are transferred and the final charge on the spheres?

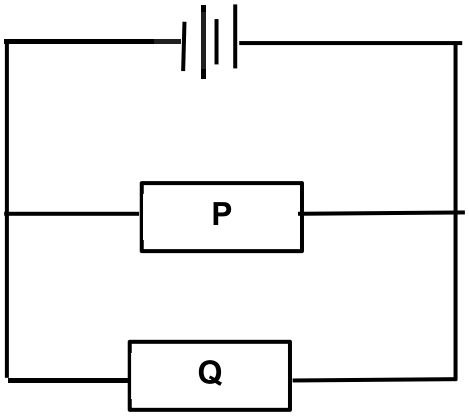
	DIRECTION OF ELECTRON TRANSFER	FINAL CHARGE
A	Y to X	-2 nC
B	Y to X	2 nC
C	X to Y	4 nC
D	X to Y	-4 nC

(2)

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1.8 Two Ohmic conductors **P** and **Q** are connected in parallel to a battery as shown in the diagram below.



The resistance of conductor **Q** is much greater than that of conductor **P**. How does the potential difference across conductor **Q** and the current in **Q** compare to that of conductor **P**?

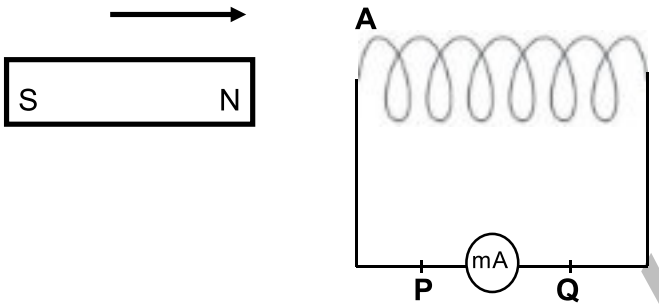
	POTENTIAL DIFFERENCE	CURRENT
A	Equal	Less than
B	Equal	Greater than
C	Greater than	Greater than
D	Less than	Less than

(2)

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1.9 In the diagram below, the magnet is being pushed into the solenoid.

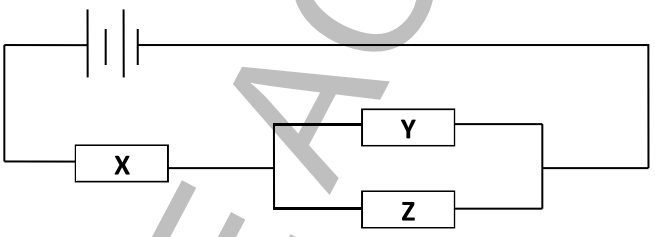


What will the polarity of point **A** on the solenoid and the direction of the induced current in the solenoid be?

A	North	**P** to **Q**
B	South	**Q** to **P**
C	South	**P** to **Q**
D	North	**Q** to **P**

(2)

1.10 Three identical resistors **X, Y** and **Z** with equal resistance are connected as shown in the circuit diagram below.



If the power in **X** is P, then the power in **Y** is …

A P.

B ½ P.

C ¼ P.

D 2P. (2)

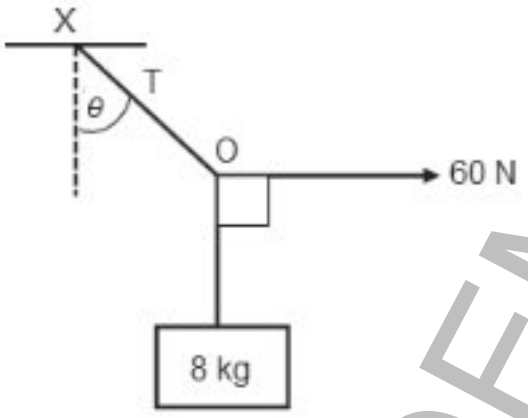
[20]

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QUESTION 2 (Start on a new page.)

A light string is suspended from the ceiling **X**. An object of mass 8 kg is tied to the string at **O**. A horizontal force of 60 N is exerted at point **O**, causing the string **OX** to experience a tension **T** as shown in the diagram below. The system is in equilibrium.



2.1 Explain the term *forces in equilibrium* in words. (2)

2.2 Draw a close vector diagram showing **ALL** the forces acting at point **O**. Indicate the angle on the diagram. (4)

2.3 Calculate the:

2.3.1 Magnitude of the tension **T** in the string **OX** (3)

2.3.2 Angle T that the string **OX** makes with the vertical (3)

2.4 Without doing a calculation, write down the magnitude of the resultant force at point **O.** (2)

[14]

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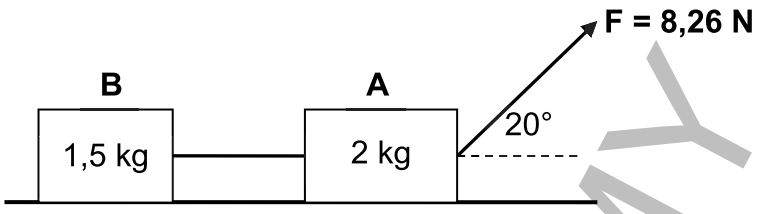
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QUESTION 3 (Start on a new page.)

A light inelastic string connects two blocks **A** and **B** of mass 2 kg and 1,5 kg respectively.

A 8,26 N force is applied at an angle of 20° on block **A** to keep the blocks moving at a CONSTANT VELOCITY across a rough surface to the right , as shown in the diagram below.



The coefficient of kinetic friction between block **A** and the rough surface is 0,33.

3.1 Define *resultant force* in words. (2)

3.2 Calculate the:

3.2.1 Magnitude of the frictional force acting between block **A** and the rough surface (4)

3.2.2 Coefficient of kinetic friction between block **B** and the rough surface (6)
[12]

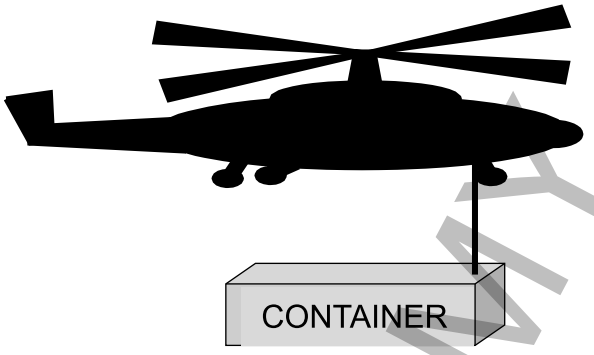
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QUESTION 4 (Start on a new page.)

A hovering rescuer helicopter has a container of supplies with a weight of 1 960 N, hanging from a cable. The tension in the cable is 2 100 N. The effect of air friction cannot be ignored.



4.1 State Newton's First Law of Motion in words. (2)

4.2 Why does the container remain stationary despite the tension being greater than the weight? (2)

Now the winch inside the helicopter starts to pull the container upwards with an acceleration of 0,13 $m \cdot s^{-2}$ while the helicopter remains in its position.

4.3 Calculate the mass of the container. (3)

4.4 Calculate the magnitude of the tension in the cable as the container is being pulled upwards. (4)

After an acceleration of a few metres the container is pulled up at a constant velocity of 0,8 $m \cdot s^{-1}$.

4.5 What will the magnitude of the tension in the cable be while the container moves upwards at a constant velocity? (1)

[12]

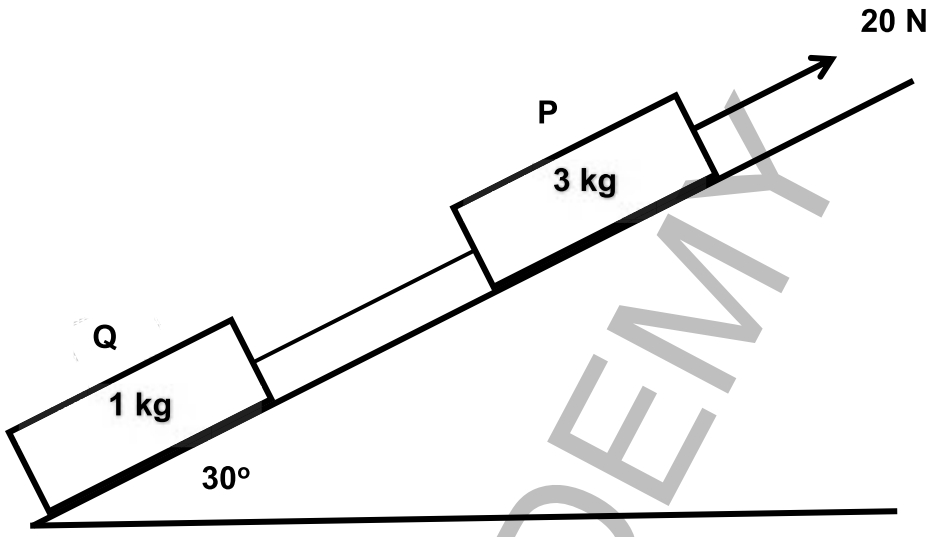
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QUESTION 5 (Start on a new page.)

The diagram below shows a 3 kg block connected to a 1 kg block with a light inextensible string. A constant horizontal force of 20 N pulls the system along a rough horizontal surface.



The frictional force between blocks **P** and **Q** and the surface is 2 N and 1 N respectively.

5.1 State Newton's Second Law of Motion in words. (2)

5.2 Draw a labelled free-body diagram showing ALL the forces acting on the 3 kg block. (5)

5.3 Calculate the magnitude of the acceleration of the 3 kg block. (6)
[13]

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QUESTION 6 (Start on a new page.)

Two satellites orbiting the earth are situated on opposite sides of the earth. Satellite **A** has a mass of 4 600 kg and Satellite **B** has a mass of 5 300 kg. Satellite **A** is at a height of 28 000 km above the surface of the earth.



6.1 State Newton's law of universal gravitation in words. (2)

6.2 Calculate the magnitude of the gravitational force between the earth and satellite **A**. (4)

6.3 Explain the term *weightlessness*. (2)

6.4 What distance above the earth's surface should satellite **B** be to experience the same force towards the earth as satellite **A**?

Answer only GREATER THAN, LESS THAN or EQUAL TO.
Explain the answer. (4)
[12]

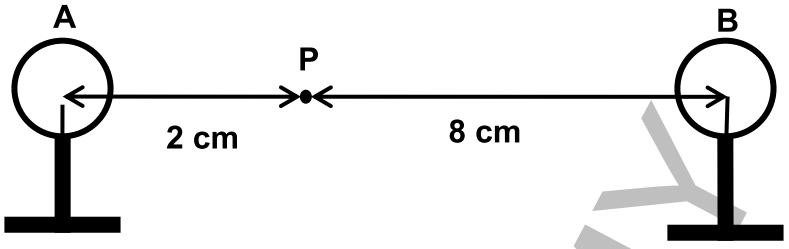
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QUESTION 7 (Start on a new page.)

Two identical metal spheres, **A** and **B**, on insulated stands are placed with their centres 10 cm apart. Sphere **A** has a charge of –15 nC while sphere **B** carries an unknown positive charge. **P** is a point 2 cm away from the centre of **A**, as shown in the diagram below.



The NET electric field at point **P** is 3,943 x 10^5 N.C^{-1} to the left.

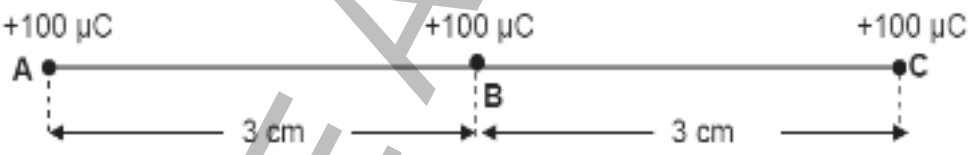
7.1 Define the term *electric field at a point.* (2)

7.2 Draw the electric field pattern between charges **A** and **B**. (3)

7.3 Calculate the magnitude of the unknown charge on sphere **B**. (8)

7.4 Sphere **B** is removed. State whether the electric field at **P**, due to charge on sphere **A**, will INCREASE, DECREASE or REMAIN THE SAME. (1)

7.5 Three +100 µC point charges, **A**, **B** and **C**, are equally spaced on a straight line in a vacuum. The charges are a distance of 3 cm from each other as shown in the diagram below.



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

7.5.2 Calculate the net electrostatic force experienced by point charge **C** due to charge **A** and **B**. (7)

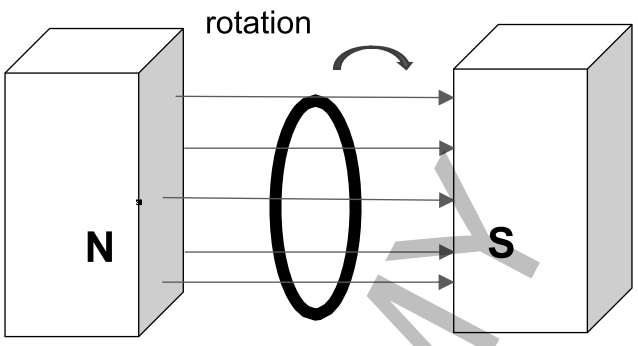
[23]

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QUESTION 8 (Start on a new page.)

A circular coil with 250 windings (turns) and a radius of 0,04 m, is rotated clockwise inside a magnetic field with a field strength of 3,2 T.



8.1 Calculate the magnetic flux through the coil at the position indicated on the diagram, where the coil is perpendicular to the field. (4)

8.2 If the coil rotates clockwise through 25°, and the emf induced is 2,8 V. Calculate the time in which this rotation took place. (4)

8.3 Which law can be used to explain the phenomenon described in QUESTION 8.2? NAME and state this law. (3)

8.4 8.4.1 If the circular coil is replaced with a square coil with a side length of 0,04 m, and the same movement is made in the same amount of time, will the induced emf be the same as, larger than or smaller than the circular coil?

Write down only THE SAME AS, LARGER THAN or SMALLER THAN. (1)

8.4.2 Explain the answer to QUESTION 8.4.1. (2)

[14]

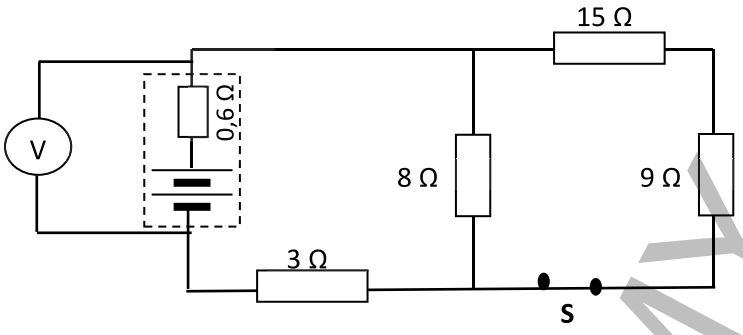
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QUESTION 9 (Start on a new page.)

The battery used in the circuit below has emf of 12 V and internal resistance of 0,6 Ω.



The resistance of the connecting wires can be ignored.

9.1 Define the term *emf of a battery* in words. (2)

9.2 Calculate the current that flows through the 3 Ω resistor. (7)

9.3 Determine the reading on the voltmeter.

The switch, S, is now opened. (3)

9.4 Will the reading on the voltmeter, **V**, INCREASE, DECREASE or REMAIN THE SAME? (1)

9.5 Fully explain your answer to QUESTION 9.4 above. (3)

9.6 A learner uses an electrical heater of resistance 48 Ω that operates at a potential difference of 240 V to heat her room for half an hour.

Calculate the cost of operating the heater if the cost of electricity is R2,56 per unit. (1 unit = 1 kW.h) (5)
[21]

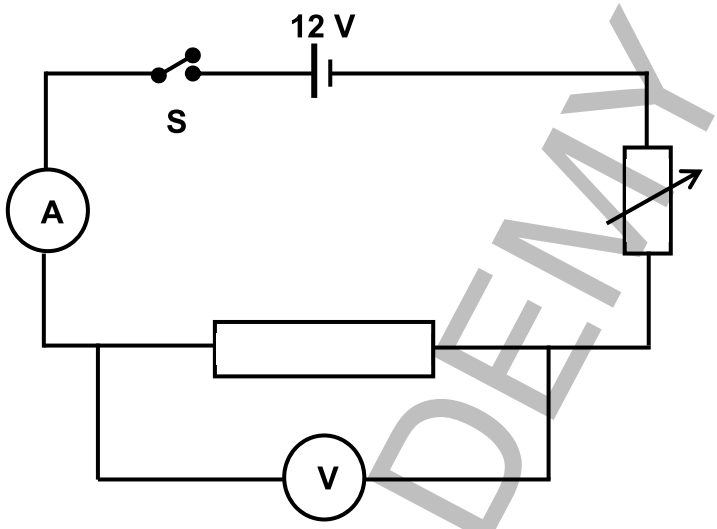
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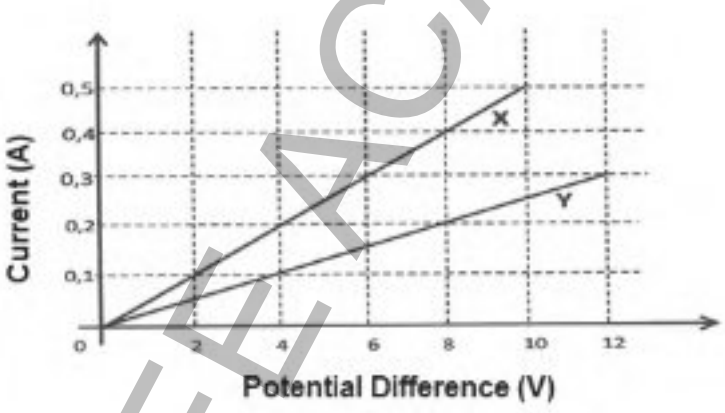
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QUESTION 10 (Start on a new page.)

A learner sets up the circuit as shown below to investigate the relationship between potential difference and current for each of two unknown resistors **X** and **Y**. In experiment **1** she connected resistor **X** and recorded the ammeter and voltmeter readings. She then repeated the procedure in Experiment **2** with resistor **Y**. Ignore internal resistance of the battery.



The results of the two experiments are shown on graphs below.



10.1 State Ohm's Law in words. (2)

10.2 What does the gradient of the graphs represent? (1)

10.3 Without any calculation, state which resistor, **X** or **Y**, has the greater resistance.

Give a reason for your answer. (2)

10.4 Use the graph to determine the resistance of resistor **X**. (4)
[9]

TOTAL: 150

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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 $m \cdot s^{-2}$
Universal gravitational constant *Universelegravitasiekonstant*	G	6,67 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	6,63 x 10^{-34} $J \cdot s$
Coulomb's constant *Coulomb se konstante*	k	9,0 x 10^9 $N \cdot m^2 \cdot C^{-2}$
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 earth *Massa op aarde*	M	5,98 x 10^{24} kg
Radius of earth *Radius op aarde*	R_E	6,38 x 10^6 m

TABLE 2: FORMULAE/TABEL 2: FORMULES

MOTION/BEWEGING

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

FORCE/*KRAG*

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$g = \frac{GM}{r^2}$
$\Pi_k = \frac{f_k}{N}$	$\Pi_s = \frac{f_{s(maks)}}{N}$

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ELECTROSTATICS / *ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$ $(k = 9,0 \times 10^9\ N\ m^2 \cdot C^{-2})$	$E = \frac{kQ}{r^2}$ $(k = 9,0 \times 10^9\ N\ m^2 \cdot C^{-2})$
$E = \frac{F}{q}$	$V = \frac{W}{q}$
$n = \frac{Q}{e}$ or/*of* $n = \frac{Q}{q_e}$	

ELECTROMAGNETISM/ELEKTROMAGNETISME

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

CURRENT ELECTRICITY / *STROOMELEKTRISITEIT*

$R = \frac{V}{I}$	Emf/Emk = I(R = v)
$R = r_1 + r_2 + r_3 + \ldots$ $\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \ldots$	$q = I \Delta t$
$W = Vq$ $W = VI \Delta t$ $W = I^2R \Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

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