



education

Department of
Education
FREE STATE PROVINCE

EXAMINATION

GRADE 10

TECHNICAL SCIENCES

JUNE 2018

MARKS: 200

TIME: 3 HOURS

This paper consists of 15 pages, two data sheets and one sheet of graph paper.

INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 11 questions. 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. 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: MULTIPLE-CHOICE QUESTIONS

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 – 1.10) in the ANSWER BOOK.

- 1.1 Which one of the following is the correct combination of the SI unit and CGS unit for distance and length?

	SI unit	CGS unit
A	km	cm
B	m	m
C	cm	km
D	m	cm

(2)

- 1.2 Which one of the following is the correct conversion of 100 km.h^{-1} to m.s^{-1} ?

- A $(100 \times 3600) \div 1000$
 B $(100 \times 1000) \div (60 \times 60)$
 C $(100 \times 1000) \div 60$
 D $(100 \times 60) \div 1000$

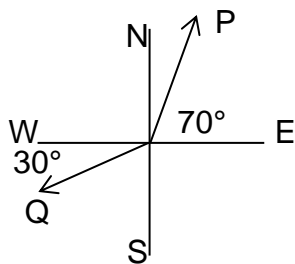
(2)

- 1.3 A person is moving at a constant speed of 4 m.s^{-1} . Which one of the following is the correct expression for the distance covered, in m, in one minute?

- A $\frac{4}{60}$
 B $\frac{4}{1}$
 C 4×1
 D 4×60

(2)

1.4 Consider the two vectors **P** and **Q**.



Which one of the following combinations represents the bearings of the vectors?

	Vector P	Vector Q
A	70°	30°
B	20°	240°
C	70°	240°
D	20°	30°

(2)

1.5 Which one of the following elements is NOT a ferromagnetic substance?

A Al

B Ni

C Co

D Fe

(2)

1.6 Which one of the following properties can be used to IDENTIFY a substance?

A Mass

B Volume

C Density

D Temperature

(2)

1.7 Which element has properties of both metals and non-metals?

A Si

B Ne

C Al

D O

(2)

1.8 Which one of the following substances is NOT a mixture?

- A Air
- B Brass
- C Boron
- D Tap water (2)

1.9 When one object is used to rub another object, positive charges collect on one of them and negative charges on the other. What phenomenon is illustrated by this?

- A Dynamic electricity
- B Static electricity
- C Magnetism
- D Resistance (2)

1.10 When you switch off the light in your room, it usually does not turn off the TV set. What is the reason for this?

- A They are connected in series.
 - B They are connected in parallel.
 - C Normally a TV set does not require electricity.
 - D Normally they use different sources of voltage. (2)
- [20]**

QUESTION 2

2.1 Convert the following quantities and SHOW ALL THE STEPS.

2.1.1 20 nC to C. (1)

2.1.2 8×10^{-10} km to mm. (2)

2.1.3 75 seconds to hours. (2)

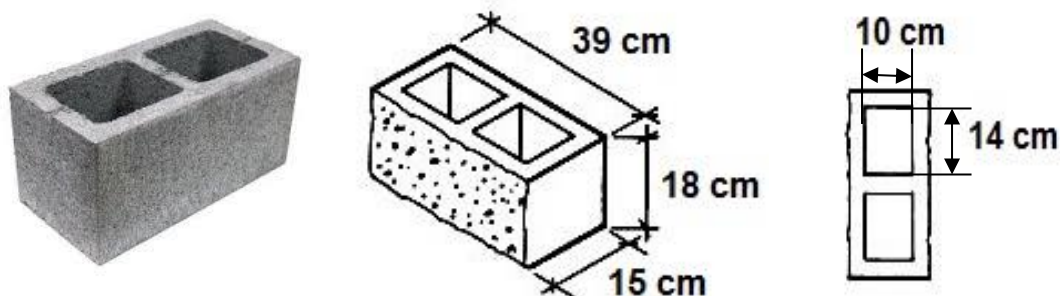
2.1.4 32°C to $^{\circ}\text{F}$ by using the formula $T_{^{\circ}\text{C}} = (T_{^{\circ}\text{F}} - 32) \times 5/9$. (2)

2.2 Simplify the following expression WITHOUT using a calculator and SHOW ALL THE STEPS. Give your answer as a decimal number (not in scientific notation).

$$\frac{15 \times 10^3}{3 \times 10^8} \quad (3) \quad [10]$$

QUESTION 3

Cinder blocks are light building bricks made from the ashes of coal bonded together by cement. The diagrams below represent a top view and a side view of a cinder block. Study it thoroughly and answer the questions that follow.



3.1 Calculate the volume, in cm^3 , of that part of one cinder block that CONSISTS OF CEMENT ONLY. (6)

3.2 Convert your answer to question 3.1 to m^3 . In this case, show ALL THE NUMBERS to the right of the comma; DO NOT ROUND OFF. (2)

3.3 Calculate the mass, in kg, of ONE cinder block if the mass of dried cement is 2 400 kg per cubic meter. (3)

3.4 To make the cinder blocks, cement is poured into a mould at a rate of $1,25 \times 10^{-6} \text{ m}^3 \cdot \text{s}^{-1}$. Calculate the time, in hour, it will take to make 250 of these cinder blocks if one mould is used. (6)

- 3.5 The cement used to make the cinder blocks are mixed in a cylindrical drum with a diameter of 70 cm. The drum rotates at a speed of 2 rpm ("rpm" stands for revolutions per minute). The engineer on site wants you to calculate the rotation speed of the drum in $\text{m}\cdot\text{s}^{-1}$.

The formula to do this is $\text{Speed} = 2\pi(\text{radius of drum})(\text{rps})$ where

"rps" stands for revolutions per second.

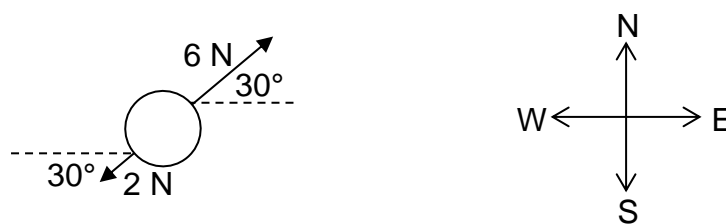
Use this formula and calculate the rotation speed of the drum in $\text{m}\cdot\text{s}^{-1}$.

(4)

[21]

QUESTION 4

- 4.1 Two forces, 6 N and 2 N, act on a circular object, as shown in the diagram below. The angle BETWEEN each force and the horizontal is 30° .



- 4.1.1 Define the term *resultant force*. (2)

- 4.1.2 Give the direction of the 2 N force in terms of its BEARING. (1)

- 4.1.3 Determine the resultant of the forces graphically by using a scale in which 1 cm represents 1 N. (4)

- 4.2 Three forces, F_1 , F_2 and F_3 , are acting on an object. The magnitudes of F_1 and F_2 are 100 N and 120 N respectively. The magnitude of F_3 is unknown. F_1 acts to the right and F_2 acts to the left. RIGHT is considered the POSITIVE direction. The RESULTANT of the three forces is 70 N to the left.

- 4.2.1 Is force a vector or scalar? Explain your answer. (3)

- 4.2.2 Calculate the magnitude and direction of F_3 . Begin your calculation with a suitable equation that gives the relationship between the resultant and the three forces.

(6)

[16]

QUESTION 5

Consider the following properties of materials.

Strength	Brittle	Malleable
Density	Magnetic	Melting point
Boiling point	Electrical conductor	Thermal conductor
Electrical isolator	Thermal isolator	

Write down question numbers 5.1 to 5.5 one below the other and next to each number write down ONE of the above-mentioned properties that describes the statement the best.

5.1 One gram of gold can be hammered into a very thin sheet of gold. (2)

5.2 Lead is very suitable for weights in a gymnasium because small pieces are relatively heavy. (2)

5.3 The tip of a soldering-iron must withstand high temperatures. (2)

5.4 Wood is ideal to be used for the handles of pots and pans. (2)

5.5 A lump of sulphur breaks into smaller pieces when pressure is applied to it. (2)

[10]

QUESTION 6

- 6.1 An atom has a small centre while most of the atom's volume consists of empty space. Atoms are comprised of subatomic particles, which are neutral, negatively and positively charged. Answer the following questions





dealing with SODIUM, which can be written as $^{23}_{11}\text{Na}$.

- 6.1.1 What do we call the positively charged subatomic particles? (1)
- 6.1.2 How many neutral subatomic particles does a sodium atom have? (1)
- 6.1.3 What do we call the empty spaces around the centre of the atom in which we find the negatively charged subatomic particles? (1)
- 6.1.4 Which particles are found in the centre of the atom? (2)
- 6.1.5 What do we call the centre of the atom? (1)
- 6.1.6 How many negatively charged subatomic particles are there in one sodium ION? (1)
- 6.1.7 How many negatively charged subatomic particles are there in the highest energy level of a sodium atom? (1)
- 6.1.8 What do we call the particles referred to in question 6.1.7? (2)
- 6.2 Draw an Aufbau-diagram for one magnesium atom. (4)
- 6.3 Give the spectroscopic electron configuration (s-p notation) for an atom of element 13 on the periodic table. (2)
- 6.4 Answer the following questions regarding the periodic table:
- 6.4.1 Give the NAME of the group II elements. (1)
- 6.4.2 In which PERIOD do we find oxygen? (1)
- 6.4.3 Give the SYMBOL of a halogen in period 3. (1)
- 6.4.4 Give the NAME of the smallest atom. (1)
- 6.4.5 Give the NAME of a diatomic element in period 4. (1)

[21]

QUESTION 7

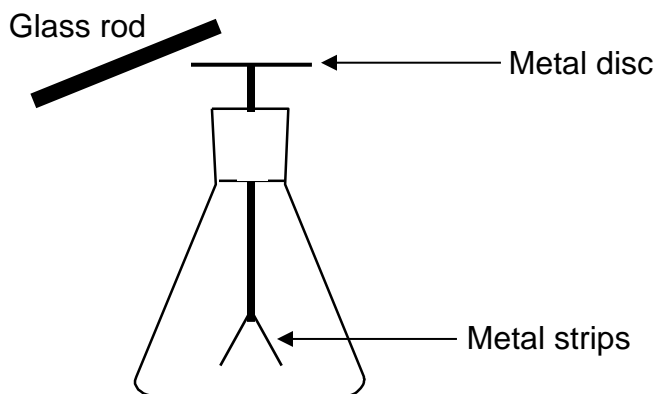
- 7.1 Study the key given for the following elements and use it to draw MOLECULES of the compounds listed below:

Element	Key	Element	Key
O		H	
S		C	

- 7.1.1 H₂O (1)
- 7.1.2 SO₂ (1)
- 7.1.3 CH₄ (1)
- 7.1.4 O₂ (1)
- 7.2 Give the chemical formulae for the following compounds:
- 7.2.1 Iron(III) hydroxide (2)
- 7.2.2 Sodium sulphate (2)
- 7.2.3 Magnesium carbonate (2)
- 7.3 Give the names of the following compounds:
- 7.3.1 Li₂SO₃ (2)
- 7.3.2 Ca(OH)₂ (2)
- 7.4 Rewrite the following equations in your answer book and balance them:
- 7.4.1 H₂ + O₂ → H₂O (2)
- 7.4.2 MgO → Mg + O₂ (2)
- 7.4.3 H₂ + N₂ → NH₃ (2)
- 7.4.4 C₄H₁₀ + O₂ → CO₂ + H₂O (4)
- [24]**

QUESTION 8

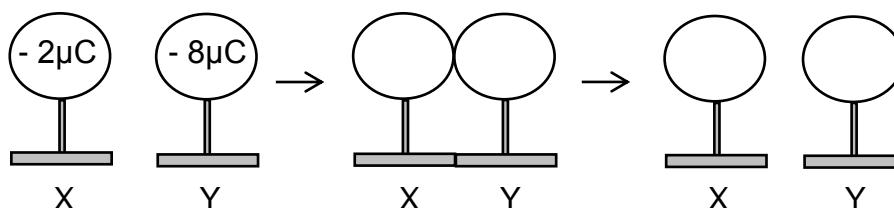
- 8.1 The following apparatus is used to observe the effect of electric charges as demonstrated when a charged glass rod is held near its metal disc.



- 8.1.1 What is the name of this apparatus? (1)

When a neutral glass rod is rubbed with a neutral silk cloth, the glass rod acquires a charge of $+8 \times 10^{-10} \text{ C}$.

- 8.1.2 Explain how the glass rod acquires its charge by describing the movement of the relevant particles. (2)
- 8.1.3 How does the charge on the silk compare with the charge on the glass after the rubbing has taken place and the silk cloth is taken away from the glass rod? (2)
- 8.1.4 With a charged glass rod NEAR the metal disc, the metal strips repel each other as shown in the diagram. What type of charge do the metal strips have? Choose from POSITIVE or NEGATIVE. (1)
- 8.2 Two small, identical, metal spheres, **X** and **Y**, on insulated stands, carry charges of $-2 \mu\text{C}$ and $-8 \mu\text{C}$ respectively. They are allowed to touch after which they are separated again.



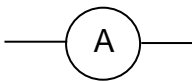








- 8.2.1 Write down the *principle of conservation of charge* in words. (2)
- 8.2.2 In which direction do the electrons move while the spheres are in contact? Write down either **X to Y** or **Y to X**. (1)
- 8.2.3 Calculate the charge on sphere **Y** AFTER the separation. Convert your final answer to coulomb. (4)
- 8.2.4 Calculate the NUMBER of electrons that are transferred from one sphere to the other while they are in contact. (4)

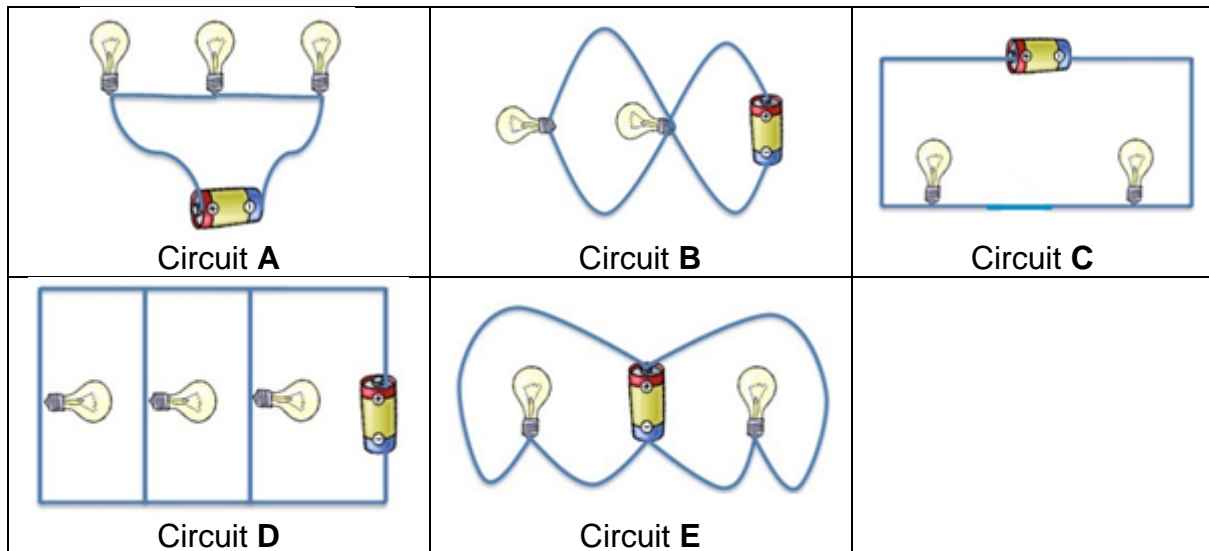
[17]

QUESTION 9

- 9.1 The following table shows components that are used in electric circuits, their symbols and functions. Missing information is represented by question numbers. Write down only these question numbers (9.1.1 to 9.1.6) and give the missing information. (6)

Picture of component	Symbol	Function
	9.1.1	An electrical instrument used to control a current by varying the resistance.
		9.1.2
	9.1.3	A device that converts electrical energy into light and heat energy.
		9.1.4
	9.1.5	A device that supplies electrical energy.
		9.1.6

- 9.2 All the cells and all the light bulbs in circuits **A** to **E** are identical. The emf of each cell is 1,5 V and the resistance of each bulb is $1\ \Omega$. Disregard the internal resistance of the cells and the resistance of the connecting wires.



9.2.1 In which circuit do the bulbs glow the dimmest? (1)

9.2.2 Give a reason for your answer to question 9.2.1. (2)

9.2.3 Identify TWO circuits in which the brightness of all the bulbs are the same. (2)

9.2.4 Calculate the potential difference across ONE of the bulbs in circuit **A**. (2)

9.2.5 Calculate the effective resistance of circuit **D**. (3)

9.2.6 Calculate the total current in circuit **C**. (4)

[20]

QUESTION 10

During an investigation to determine the effect of resistor length on resistance, different lengths of nichrome wire were used and the resistance of each was measured with a multi-meter. The following results were obtained.

Length of wire (cm)	10	30	50	70
Resistance (Ω)	1,60	4,80	8,00	11,20

- 10.1 Give the DEPENDANT variable for this investigation. (1)
- 10.2 Identify TWO variables that should to be controlled during the investigation in order to make it valid. (2)
- 10.3 Draw a graph of the data on the sheet of graph paper provided at the end of the question paper. Your graph must satisfy the following conditions:
- It must have a suitable heading.
 - The correct variables must be used on the y-axis and x-axis.
 - Each axis must be properly labelled.
 - A suitable scale must be used. (6)
- 10.4 Use your graph to determine which length of nichrome wire, in cm, has a resistance of 13 Ω . (1)
- 10.5 Draw a conclusion for this investigation. (2)
- [12]**

QUESTION 11

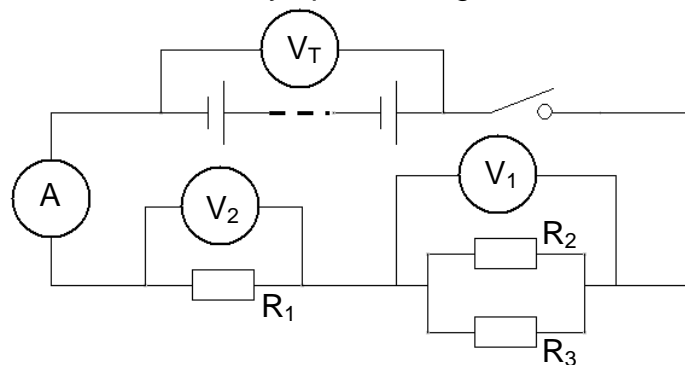
- 11.1 The potential difference in South Africa is 240 V. The element of a heater draws a current of 0,42 A.

11.1.1 Define *current* in a circuit. (2)

11.1.2 Calculate the amount of charge, in C, that flows through the element of the heater in two hours. (4)

11.1.3 Calculate the work done on the element during these two hours. (3)

- 11.2 The resistance of the battery and wires in the circuit diagram below can be ignored. The resistors' resistances are as follows: R_1 is 3,125 Ω , R_2 is 5 Ω and R_3 is 3 Ω . The switch is initially open. V_T registers 20 V.



11.2.1 What term do we use to refer to the reading on V_T when the switch is OPEN? Briefly explain what this term means. (3)

WHEN THE SWITCH IS CLOSED, THE AMMETER REGISTERS 4 A.

11.2.2 Calculate the reading on V_1 if the reading on V_2 is 12,5 V. (2)

11.2.3 Calculate the total resistance of the circuit. (3)

11.2.4 Is the current in R_2 GREATER THAN, SMALLER THAN or THE SAME AS the current in R_3 ? Explain your answer. (3)

11.2.5 Is the direction of the current CLOCKWISE or ANTI-CLOCKWISE? (1)

THE 5 Ω RESISTOR BURNS OUT. What will happen to the reading on each of the following? Write only INCREASE, DECREASE or STAY THE SAME.

11.2.6 Ammeter (2)

11.2.7 Voltmeter V_2 (2)

11.2.8 Voltmeter V_1 (2)

11.2.9 Voltmeter V_T (2)

[29]

GRAND TOTAL: 200

DATA FOR TECHNICALSCIENCES GRADE 10
GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 10

TABLE 1: PHYSICAL CONSTANTS / TABEL 1: FISIIESE KONSTANTES

NAME / NAAM	SYMBOL / SIMBOOL	VALUE / WAARDE
Acceleration due to gravity <i>Swaartekragversnelling</i>	g	9,8 m·s ⁻²
Charge on an electron <i>Lading op 'n electron</i>	e ⁻	-1,6 x 10 ⁻¹⁹ C

TABLE 2: FORMULAE / TABEL 2: FORMULES

PERIMETER, AREA, VOLUME & DENSITY
OMTREK, OPPERVLAKTE, VOLUME & DIGTHEID

Volume <i>Volume</i>	Volume = area of base x height <i>Volume = oppervlakte van basis x hoogte</i>
Perimeter of a rectangle <i>Omtrek van 'n reghoek</i>	Perimeter = 2ℓ + 2w <i>Omtrek = 2ℓ + 2b</i>
Area of a rectangle <i>Oppervlakte van 'n reghoek</i>	Area = ℓ x w <i>Oppervlakte = ℓ x b</i>
Area of a square <i>Oppervlakte van 'n vierkant</i>	Area = side x side <i>Oppervlakte = sy x sy</i>
Density of an object <i>Digtheid van 'n voorwerp</i>	Density = $\frac{\text{Mass}}{\text{Volume}}$ <i>Digtheid = $\frac{\text{Massa}}{\text{Volume}}$</i>

MOTION / BEWEGING

Speed = $\frac{\text{Distance}}{\text{Time}}$	Spoeed = $\frac{\text{Afstand}}{\text{Tyd}}$
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ELECTROSTATICS / ELEKTROSTATIKA

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

ELECTRIC CIRCUITS / ELEKTRIESE STROOMBANE

	Serie	Parallel
$I = \frac{Q}{\Delta t}$	$R_T = R_1 + R_2 + R_3$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
$V = \frac{W}{Q}$	$I_T = I_1 = I_2 = I_3$	$I_T = I_1 + I_2 + I_3$
$R = \frac{V}{I}$	$V_T = V_1 + V_2 + V_3$	$V_T = V_1 = V_2 = V_3$

Approximate relative atomic mass
Benaderde relatiewe atoommassa

Please turn over

GRAPH PAPER FOR QUESTION 10.3

NAME AND SURNAME: GRADE:

REMEMBER TO HAND IN THIS GRAPH PAPER WITH THE REST OF YOUR
ANSWERS.

