



education

Department of
Education
FREE STATE PROVINCE

EXAMINATION

GRADE 10

TECHNICAL SCIENCES

NOVEMBER 2019

MARKS: 150

TIME: 3 HOURS

This paper consists of 13 pages and THREE data 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 12 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: 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 your ANSWER BOOK.

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

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

(2)

- 1.2 Which one of the following scientific notations of 13 600 m is correct?

A 1,36 km

B $1,36 \times 10^4$ m

C $13,6 \times 10^3$ m

D $1,36 \times 10^{-5}$ m

(2)

- 1.3 Which one of the following pairs represents a scalar and a vector quantity?

	Scalar	Vector
A	Velocity	Distance
B	Displacement	Velocity
C	Distance	Speed
D	Distance	Velocity

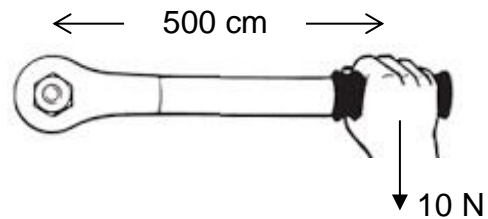
(2)

- 1.4 Three forces acts on a body. A force of 3 N is applied to the right, one of 2 N is applied to the left and another of 5 N is applied to the right. Which one of the following combinations is correct?

	Magnitude of the resultant force	Direction of the resultant force
A	$5 \text{ N} + (-2 \text{ N}) + 3 \text{ N}$	To the left
B	$5 \text{ N} + 2 \text{ N} + 3 \text{ N}$	To the right
C	$5 \text{ N} + (-2 \text{ N}) + 3 \text{ N}$	To the right
D	$5 \text{ N} + (-2 \text{ N}) + (-3 \text{ N})$	To the left

(2)

- 1.5 A force of 10 N is applied at right angles to a bolt at a distance of 500 cm from the bolt.



Which one of the following represents the torque, in N·m, on the bolt?

- A 10×5
 - B 10×50
 - C 10×500
 - D 100×500 (2)
- 1.6 A charge of 5 nC is the same as ...
- A $5 \times 10^{-3} \text{ C}$.
 - B $5 \times 10^{-6} \text{ C}$.
 - C $5 \times 10^{-9} \text{ C}$.
 - D $5 \times 10^{-12} \text{ C}$. (2)
- 1.7 Which one of the following is the basic SI unit for electric current?
- A Ohm
 - B Volt
 - C Ampere
 - D Coulomb (2)
- 1.8 Which one of the following does NOT influence the resistance of a metal wire?
- A Shape of the wire
 - B Length of the wire
 - C Thickness of the wire
 - D Temperature of the wire (2)

1.9 What is the name of the compound CuCl_2 ?

- A Copper chloride
- B Copper chlorate
- C Copper chlorite
- D Copper chlorine (2)

1.10 What is the SI-unit of heat?

- A K
 - B $^{\circ}\text{C}$
 - C $^{\circ}\text{F}$
 - D J (2)
- [20]**

QUESTION 2

2.1 Convert the following:

2.1.1 60 cm to km (2)

2.1.2 45 seconds to minutes (2)

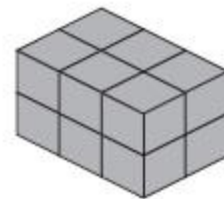
2.1.3 16°C to $^{\circ}\text{F}$ by using the formula: $T_{\text{C}} = (T_{\text{F}} - 32) \times \frac{5}{9}$ (2)

2.2 Simplify the following expression WITHOUT using a calculator, and show ALL steps. Give your answer as a decimal number.

$$\frac{6 \times 10^9}{4 \times 10^4} \quad (2)$$

2.3 The object on the right is called a cuboid because it consists of a number of small cubes.

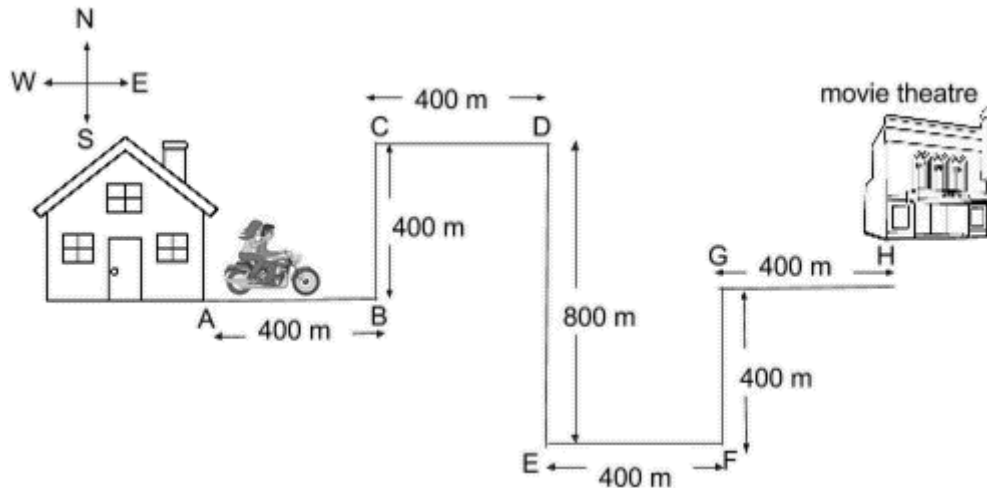
How many small cubes are there?



(1)
[9]

QUESTION 3

Peter picks up his girlfriend with his motorbike at her home and takes her to the movies. He follows the route as indicated from his girlfriend's house at point **A** to the movie theatre at point **H**. **A** and **H** are on the WEST-EAST axis.



3.1 Define *distance*. (2)

3.2 Calculate the:

3.2.1 Total distance from **A** to **H** (2)

3.2.2 Displacement from **A** to **H** (2)

3.3 After the movie they go back to the girlfriend's house along the same route and it takes them 15 MINUTES.

Calculate their:

3.3.1 Average speed in $\text{m}\cdot\text{s}^{-1}$ (3)

3.3.2 Average velocity in $\text{m}\cdot\text{s}^{-1}$ (4)

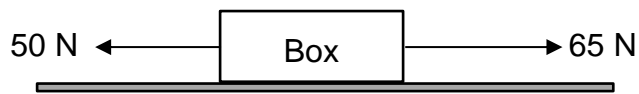
3.4. Two forces act on an object as shown below.



3.4.1 Are these two forces exactly the same? Write down only YES or NO. (1)

3.4.2 Give a reason for your answer to question 3.4.1. (2)

- 3.5 Joe and Peter stand on the opposite sides of a box. Joe pulls the box to the right with a horizontal force of 65 N and Peter pulls the box to the left with a horizontal force of 50 N.

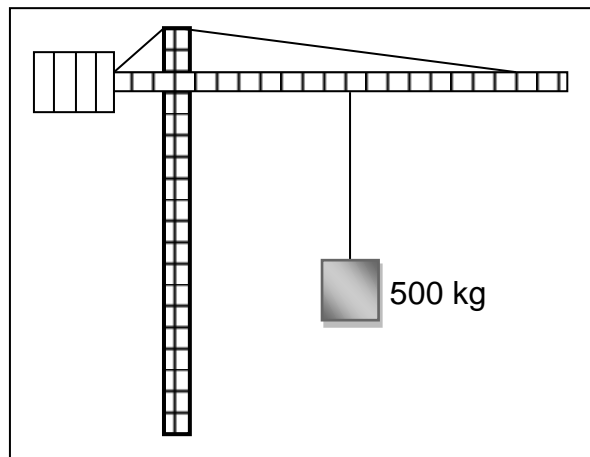


- 3.5.1 Draw a labelled free-body diagram and indicate ALL the HORIZONTAL forces acting on the box. (2)

- 3.5.2 Calculate the resultant horizontal force on the box. (2)
[20]

QUESTION 4

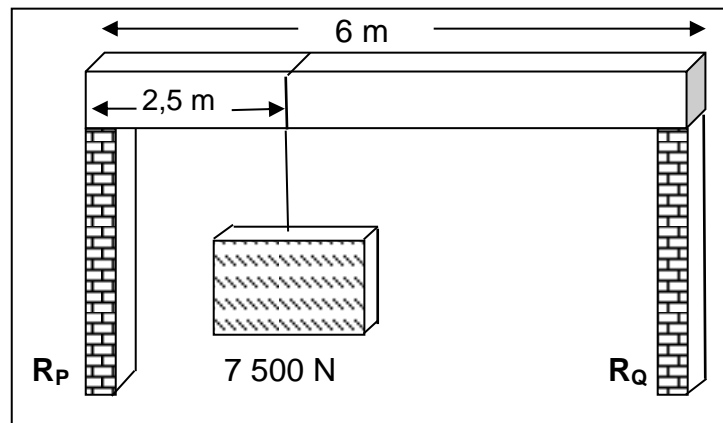
- 4.1 A crane is lifting a mass of 500 kg from the ground.



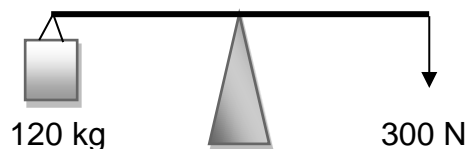
- 4.1.1 Define the term *moment of force (torque)*. (2)
- 4.1.2 Calculate the moment of force (torque), in magnitude and direction, if the mass is attached 15 m from the fulcrum? (4)
- 4.1.3 Does the height of the mass above the ground affect the torque? Explain your answer. (2)

- 4.2 A beam with a length of 6 m is placed on two upright walls to assist in the lifting of a 7 500 N crate, as shown in the diagram on the right.

The crate is hanging 2,5 m from the left wall.



- 4.2.1 State the *law of moments* in words. (2)
- 4.2.2 Calculate the magnitudes of reaction forces R_P and R_Q that are exerted by the walls on the beam. (7)
- 4.3 John is using an effort force of 300 N to keep a load of 120 kg horizontal with the help of a lever.



- 4.3.1 Calculate the magnitude of the force exerted by the 120 kg on the lever. (3)
- 4.3.2 Calculate the mechanical advantage of the lever. (3)

[23]

QUESTION 5

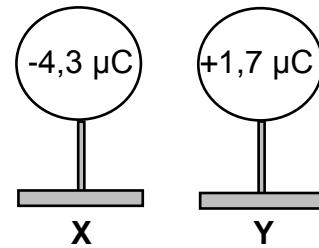
A cricket player hits a 0,16 kg cricket ball straight up into the air. The ball leaves the cricket bat at a velocity of $45 \text{ m} \cdot \text{s}^{-1}$.

- 5.1 Define the term *kinetic energy*. (2)
- 5.2 Calculate the kinetic energy of the ball when it leaves the bat. (3)
- 5.3 Write your answer to question 5.2 in scientific notation. (1)
- 5.4 Calculate the maximum height reached by the ball from the point where it leaves the cricket bat. Ignore friction. (3)

[9]

QUESTION 6

Two identical metal spheres, **X** and **Y**, on isolated stands, carry charges of $-4,3 \mu\text{C}$ and $+1,7 \mu\text{C}$ respectively as shown on the right.



The spheres are allowed to touch where after they are taken back to their original positions.

6.1 State the *principle of conservation of charge* in words. (2)

6.2 Calculate the charge, in coulomb, on sphere **Y** AFTER they have been separated. (3)

6.3 Calculate how many electrons were transferred during contact if the magnitude of the charge on ONE electron is $1,6 \times 10^{-19} \text{ C}$. Use the following formula:

$$n_e = \frac{Q_f - Q_i}{Q_e}$$

n_e is the number of electrons
 Q_f is the charge after contact
 Q_i is the charge before contact
 Q_e is the charge on one electron

(4)
[9]

QUESTION 7

With constant advancement in technology we rely more and more on the use of electric circuits in everyday life.

7.1 Name THREE differences between parallel and series circuits. (3)

7.2 Draw the symbols for the following components:

7.2.1 Two cells in parallel (2)

7.2.2 A variable resistor (1)

7.3 What is the function of a voltmeter? (2)

7.4 Complete the sentences by selecting ONE of the two words:
 SERIES or PARALLEL

7.4.1 A voltmeter is connected in ... (1)

7.4.2 An ammeter is connected in ... (1)

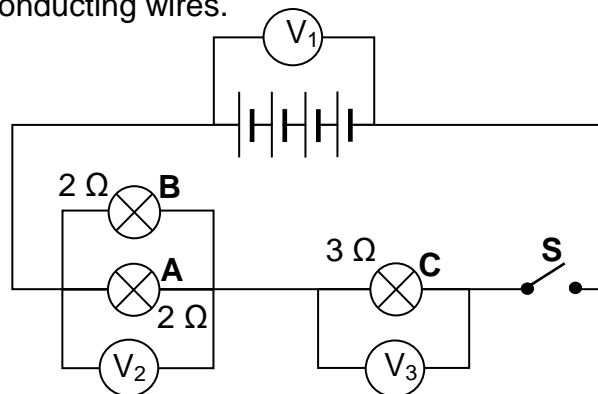
7.5 You are given three identical resistors to use in a circuit.

7.5.1 How will you combine the three resistors to achieve the lowest possible total resistance? (1)

7.5.2 How will this combination influence the total current in the circuit? (1)
[12]

QUESTION 8

Learners connect a circuit as shown in the diagram below. The battery consists of four cells and the EMF of EACH cell is 1,5 V. Each of bulbs **A** and **B** has a resistance of $2\ \Omega$ and bulb **C** has a resistance of $3\ \Omega$. Ignore the resistance of the battery and the conducting wires.



8.1 Define the term *electric current* in word. (2)

8.2 Explain the term *resistance*. (2)

8.3 Calculate the total resistance in the circuit. (4)

8.4 Calculate the total current in the circuit when switch **S** is closed. (3)
[11]

QUESTION 9

Consider the following table.

Column 1	Column 2
Cobalt	Plastic pen
Silicon	Iodine crystals
Sulphur	Nickel paper clip
Argon	Copper wire

9.1 Write down ONE material from COLUMN 1 which is a:

9.1.1 Non-metal, but not a gas (1)

9.1.2 Gas at room temperature (1)

9.1.3 Metalloid (1)

9.2 Write down ONE material from COLUMN 2 which is:

9.2.1 Brittle (1)

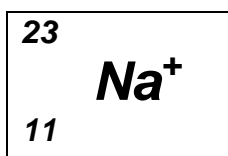
9.2.2 Magnetic (1)

9.2.3 An electrical insulator (1)

[6]

QUESTION 10

Consider the following information about one of the elements on the period table.



10.1 How many of the following does ONE Na⁺ have?

10.1.1 Electrons (1)

10.1.2 Protons (1)

10.1.3 Neutrons (1)

10.2 Is Na⁺ an atom or an ion? Give a reason for your answer. (2)

10.3 In which period do you find this element on the period table? (1)

10.4 Draw an Aufbau diagram for Na⁺. (3)

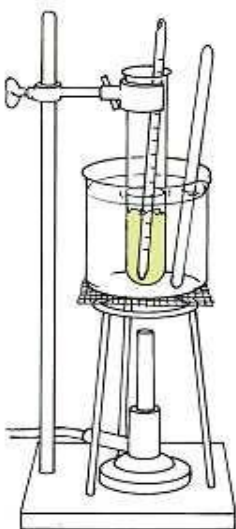
[9]

QUESTION 11

- 11.1 Define the term *compound*. (2)
- 11.2 Write down the chemical FORMULA of the following compounds:
- 11.2.1 Iron(II) sulphate (2)
- 11.2.2 Sodium chloride (2)
- 11.3 Give the chemical NAME for the following compounds:
- 11.3.1 CaCO_3 (2)
- 11.3.2 H_2SO_4 (2)
- 11.4 Write a balanced equation for the reaction between hydrochloric acid and sodium hydroxide. (3)
- [13]**

QUESTION 12

Learners want to determine the boiling point of paraffin wax (the substance from which candles can be made). They set up the apparatus as indicated below. They use a test-tube containing the wax and heat it in a beaker with water. The table shows the results of the experiment.



Time (s)	Temperature (°C)	Observations
0	27	White solid
240	29	White solid
360	31	White solid
480	46	White solid, partly liquid
600	58	White solid partly liquid
720	62	White liquid
840	66	White liquid
960	70	Clear liquid
1 080	70	Clear liquid

- 12.1 Give a reason why it is unsafe to heat the paraffin wax over an open flame. (1)
- 12.2 Use the table to determine the boiling point of paraffin wax. (1)
- 12.3 Convert 29°C to kelvin. (2)
- 12.4 Briefly describe the difference between *heat* and *temperature*. (2)
- 12.5 Name the apparatus used to measure the temperature. (1)
- 12.6 Write down the:
 - 12.6.1 Dependent variable (1)
 - 12.6.2 Independent variable (1)

[9]

GRAND TOTAL: 150

DATA FOR TECHNICAL SCIENCES GRADE 10
GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 10

TABLE 1: PHYSICAL CONSTANTS / TABEL 1: FISIESE 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 elektron</i>	e ⁻	-1,6 x 10 ⁻¹⁹ C

TABLE 2: FORMULAE / TABEL 2: FORMULES

ELECTROSTATICS / ELEKTROSTATIKA

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

ELECTRIC CIRCUITS / ELEKTRIESE STROOMBANE

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

FORCE / KRAG

$F_g = mg$ OR/OF $w = mg$

MOMENT OF FORCE (TORQUE)

KRAGMOMENT / DRAAIMOMENT / WRINGKRAG

$\Gamma = Fd_{\perp}$

SIMPLE MACHINES / EENVOUDIGE MASJIENE

$MA = \frac{\text{Load}}{\text{Effort}} \quad \text{OR} \quad MA = \frac{\text{Effort distance}}{\text{Load distance}}$	
$MV = \frac{\text{Las}}{\text{Krag}} \quad \text{OF} \quad MV = \frac{\text{Kragafstand}}{\text{Lasafstand}}$	

MOTION / BEWEGING

$\text{speed} = \frac{\text{distance}}{\text{time}}$	$\text{spoed} = \frac{\text{afstand}}{\text{tyd}}$
$\text{velocity} = \frac{\text{displacement}}{\text{time}}$	$\text{snelheid} = \frac{\text{verplasing}}{\text{tyd}}$
$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$	$\text{versnelling} = \frac{\text{verandering in snelheid}}{\text{tyd}}$

ENERGY / ENERGIE

$E_p = mgh \quad \text{OR/OF} \quad U = mgh$	$E_k = \frac{1}{2}mv^2 \quad \text{OR/OF} \quad K = \frac{1}{2}mv^2$
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THE PERIODIC TABLE OF ELEMENTS
DIE PERIODIEKE TABEL VAN ELEMENTE

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
1 2,1 H 1																	2 He 4
3 1,0 Li 7	4 1,5 Be 9											5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 20 Ne
11 0,9 Na 23	12 1,2 Mg 24											13 1,5 Al 27	14 1,8 Si 28	15 2,1 P 31	16 2,5 S 32	17 3,0 Cl 35,5	18 40 Ar
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1,6 V 51	24 1,6 Cr 52	25 1,5 Mn 55	26 1,8 Fe 56	27 1,8 Co 59	28 1,8 Ni 59	29 1,9 Cu 63,5	30 1,6 Zn 65	31 1,6 Ga 70	32 1,8 Ge 73	33 2,0 As 75	34 2,4 Se 79	35 2,8 Br 80	36 84 Kr
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 1,6 Nb 92	42 1,8 Mo 96	43 1,9 Tc	44 2,2 Ru 101	45 2,2 Rh 103	46 2,2 Pd 106	47 1,9 Ag 108	48 1,7 Cd 112	49 1,7 In 115	50 1,8 Sn 119	51 1,9 Sb 122	52 2,1 Te 128	53 2,5 I 127	54 131 Xe
55 0,7 Cs 133	56 0,9 Ba 137	57 1,6 La 139	72 1,6 Hf 179	73 1,8 Ta 181	74 1,8 W 184	75 1,8 Re 186	76 1,9 Os 190	77 1,9 Ir 192	78 1,9 Pt 195	79 1,9 Au 197	80 2,0 Hg 201	81 1,8 Tl 204	82 1,8 Pb 207	83 1,9 Bi 209	84 2,0 Po	85 2,5 At	86 86 Rn
87 0,7 Fr	88 0,9 Ra 226	89 Ac															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

KEY/SLEUTEL

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

(Diagram showing Cu with atomic number 29, symbol Cu, and approximate relative atomic mass 63,5, with arrows pointing to these values from the key labels.)