



education

Department of
Education
FREE STATE PROVINCE

EXAMINATION

GRADE 10

TECHNICAL SCIENCES

NOVEMBER 2017

MARKS: 200

TIME: 3 HOURS

This paper consists of 15 pages, TWO information sheets and ONE answer sheet.

INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of TEN 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 only the letter A, B, C or D next to the question number (1.1 – 1.15) in your ANSWER BOOK.

1.1 What is the SI-unit of force?

- A Joule
- B Newton
- C Ampere
- D Meter per second squared (2)

1.2 The symbol for the SI-unit of heat is ...

- A K.
- B °C.
- C °F.
- D J. (2)

1.3 Which one of the following is the MOST UNSUITABLE thermometer to measure the temperature of ill patients in a hospital?

- A Thermometer strip
- B Bimetallic thermometer
- C Bulb thermometer that contains alcohol.
- D Bulb thermometer that contains mercury.

1.4 Consider the following formula: $y = mx + c$

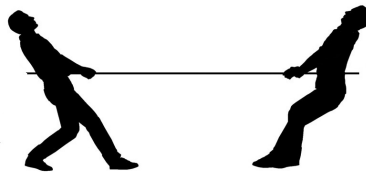
Which one of the following is correct?

- A $c = y - mx$
- B $c = mx - y$
- C $c = \frac{y}{mx}$
- D $c = \frac{mx}{y}$ (2)

1.5 Which one of the following numbers is the largest?

- A 200×10^{-3}
- B $2\,000 \times 10^{-3}$
- C $2\,000 \times 10^{-4}$
- D $0,2 \times 10^{-2}$ (2)

1.6 Two men compete in a tug of war. One applies a force of 110 N on the rope and the other one applies a force of 90 N on the rope.



What is the magnitude of the RESULTANT force on the rope?

- A 20 N
- B 90 N
- C 110 N
- D 200 N (2)

1.7 Two forces of 2 N and 8 N are exerted on a box. These forces act along a straight line. What is the only possible choice for the MAGNITUDE of the RESULTANT force?

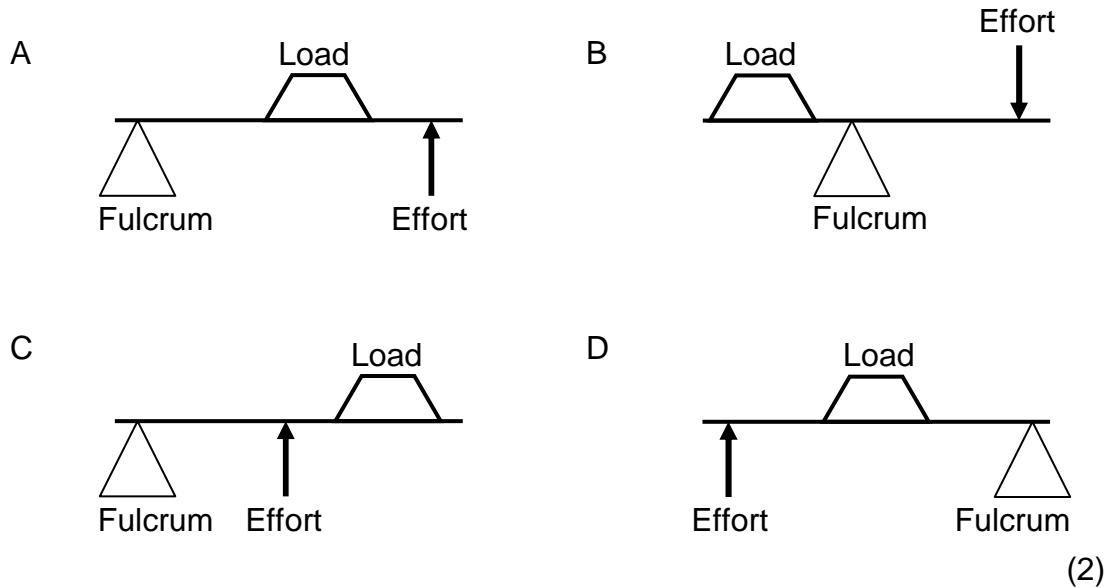
- A 2
- B 8
- C 10
- D 16 (2)

1.8 Which combination is correct regarding the types of forces?

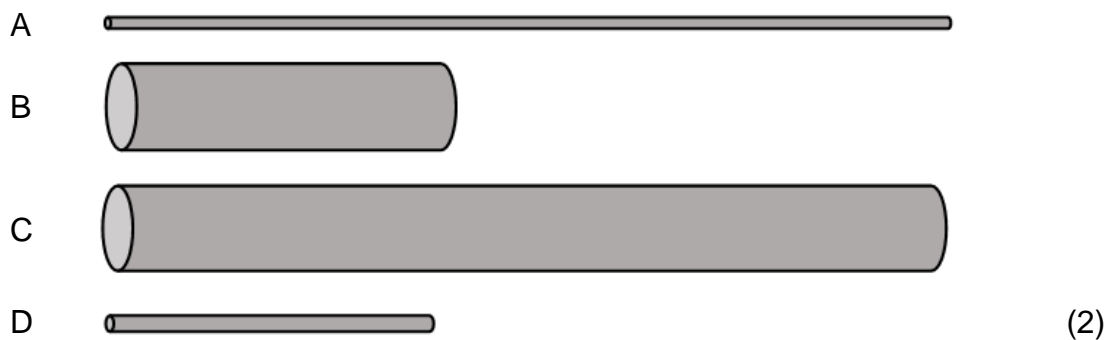
	CONTACT FORCES		NON-CONTACT FORCES	
A	Normal	Friction	Magnetic	Tension
B	Gravity	Electrostatic	Friction	Normal
C	Electrostatic	Friction	Gravity	Magnetic
D	Friction	Tension	Electrostatic	Magnetic

(2)

1.9 Which one of the following is a class 1 lever?



1.10 Four pieces of nichrome wire are represented below. Which one of them has the highest resistance at the same temperature?

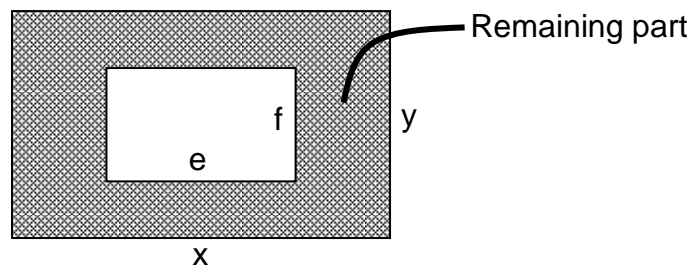


1.11 Which one of the following gives the correct unit, or combination of units, for the physical quantity?

	Quantity	Unit
A	Current	$C.s^{-1}$
B	Energy	kW
C	Resistance	V.A
D	Potential difference	$A.\Omega^{-1}$

(2)

- 1.12 A boilermaker has a rectangular sheet of metal with a length of x and width of y . He cuts out a smaller rectangular piece with length of e and width of f .



Which one of the following equations gives the AREA of the REMAINING part of the original sheet of metal (the shaded part in the sketch)?

- A $(x - e)(y - f)$
- B $\frac{1}{2}xy$
- C $xy - ef$
- D $xy + ef$ (2)

- 1.13 How can one describe *isotopes*?

- A Atoms from different elements with the same atomic numbers, but different mass numbers.
- B Atoms from the same element of which the number of protons are the same, but the number of neutrons differ.
- C Atoms from different elements with the same mass number, but different atomic numbers.
- D Atoms from the same element of which the number of neutrons are the same, but the number of protons differ. (2)

- 1.14 Which one of the following is the correct sp-notation for the electron distribution in one atom of sodium?

- A $1s^2 2s^2 2p^6 3s^1$
- B $1s^2 2s^2 2p^7$
- C $1s^2 2s^2 2p^6 3s^2$
- D $1s^2 2s^2 2p^8$ (2)

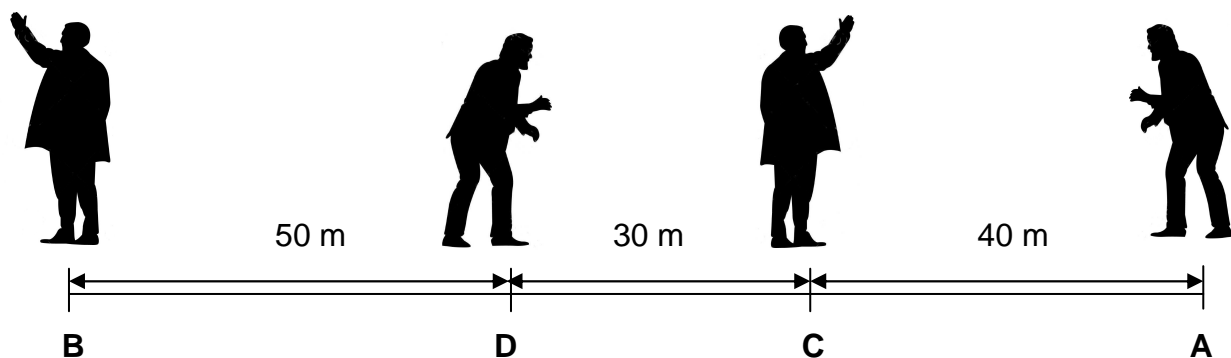
1.15 Which one of the following is an element?

- A CuO
- B LiNO_3
- C H_2
- D $\text{Fe}_2(\text{SO}_4)$

(2)
[30]

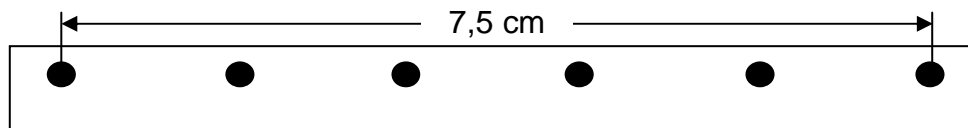
QUESTION 2 (Start on a new page.)

2.1 A rugby coach walks along a straight line next to a rugby field to encourage his players while the game is on. He walks from position **A** to **B** in 60 s, from **B** to **C** in 36 s and from **C** to **D** in 14 s. Study the diagram below and answer the questions that follow.



- 2.1.1 Define the term *scalar*. (1)
- 2.1.2 Calculate the total time it takes the coach to walk from **A** to **D**. (1)
- 2.1.3 Calculate the total distance the coach has walked from **A** to **D**. (2)
- 2.1.4 Determine the DISPLACEMENT of the coach from **A** to **D** by means of an accurate CONSTRUCTION of the different vectors in which you use the tail-to-head method. Use a scale where 1 cm represents 10 m. (5)
- 2.1.5 Calculate the average speed of the coach between **A** and **D**. (3)
- 2.1.6 Convert the speed you have calculated in question 2.1.5 to $\text{km}\cdot\text{h}^{-1}$. (3)
- 2.1.7 How does the magnitude of the coach's average velocity between **A** and **D** compare with his average speed between **A** and **D**? Write down only GREATER THAN, LESS THAN or SAME AS. Explain your answer without doing a calculation. (3)

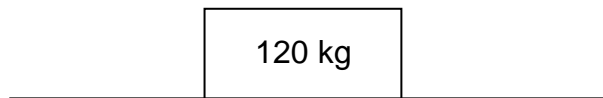
- 2.2 While conducting an experiment to determine the speed of a trolley, 126 dots are made in 5 s on a ticker-tape of which a part is shown below. Assume that all the dots are the same distance apart.



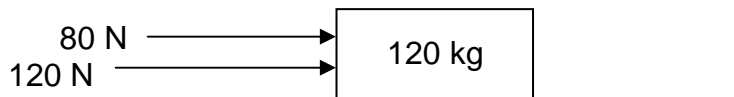
- 2.2.1 What type of motion is represented by this ticker-tape? (1)
- 2.2.2 Calculate the frequency of the ticker-timer. (4)
- 2.2.3 Calculate the speed of the trolley in $\text{m}\cdot\text{s}^{-1}$. (5)
- [28]**

QUESTION 3 (Start on a new page.)

A 120 kg box is at rest on a horizontal table with a rough surface.



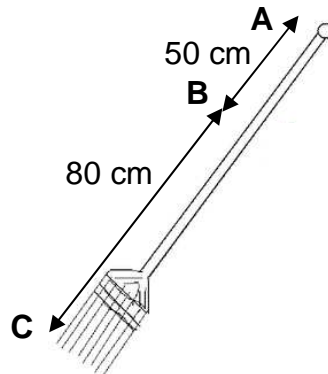
- 3.1 Calculate the magnitude of the weight of the box. (3)
- 3.2 Explain why the box does not fall through the table. (3)
- 3.3 Two learners push the box to the right with horizontal forces of 80 N and 120 N, but the box DOES NOT MOVE.



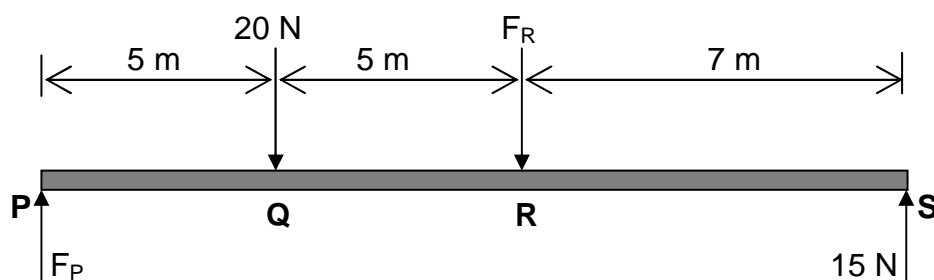
- 3.3.1 Draw a free-body diagram, with labels, of ALL the forces acting on the box. (5)
- 3.3.2 Calculate the magnitude and direction of the RESULTANT of the 80 N and 120 N forces. (4)
- 3.3.3 Explain why the box does not move. In your explanation, give the name of the specific force that is responsible for this. (3)
- 3.3.4 What do you call a force that keep other forces in equilibrium? (1)
- [19]**

QUESTION 4 (Start on a new page.)

- 4.1 A learner sweeps the classroom with a broom. He places his top hand at point **A** and his bottom hand at point **B**, with **A** and **B** 50 cm apart. The bottom end of the broom, **C**, is 80 cm from **B**. The learner sweeps by MOVING HIS BOTTOM HAND (**B**) to and fro while keeping his hand at **A** stationary.

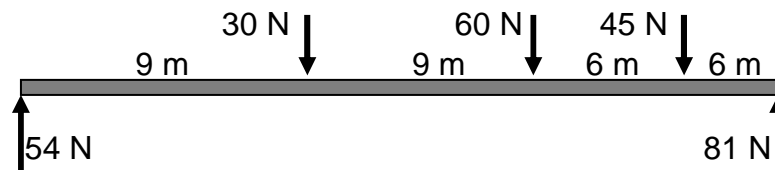


- 4.1.1 The broom behaves as a lever. In terms of the terminology used for levers, give names for the points marked **A**, **B** and **C**. (3)
- 4.1.2 To which class of lever does the broom belong to? Write only 1, 2 or 3. (1)
- 4.1.3 Define the term *mechanical advantage*. (2)
- 4.1.4 Calculate the mechanical advantage of the broom. (3)
- 4.1.5 Briefly explain how you can increase the mechanical advantage of the broom. (2)
- 4.2 A beam is supported by reaction forces, F_P and 15 N, at points **P** and **S**. Two point loads of 20 N and F_R are acting at **Q** and **R** respectively. The beam is balanced and its weight can be ignored. The distances between **P**, **Q**, **R** and **S** are given in the diagram.



- 4.2.1 Give the *law of moments* in words. (2)
- 4.2.2 Take force moments about point **R** and calculate the magnitude of F_P . (5)
- 4.2.3 Calculate the magnitude of F_R . (3)

- 4.3 Point loads and reaction forces are acting on a beam as shown in the diagram below. Ignore the weight of the beam. The distance BETWEEN the forces is as follows: Between 54 N and 30 N is 9 m, between 30 N and 60 N is 9 m, between 60 N and 45 N is 6 m and between 45 N and 81 N is 6 m.

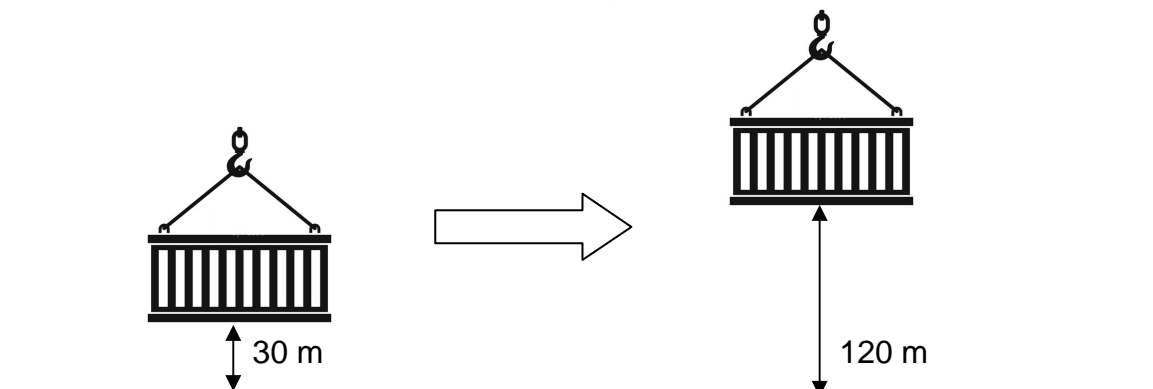


Use the answer sheet at the back of the paper to draw a BENDING MOMENT DIAGRAM for this beam. Show the magnitude of each bending moment on the diagram itself. It is not necessary to show your calculations separately. **Remember to HAND IN your answer sheet with the rest of your answers.**

(5)
[26]

QUESTION 5 (Start on a new page.)

- 5.1 Describe the term *kinetic energy* in words. (2)
- 5.2 Calculate the speed of a 500 g ball with kinetic energy of 250 J. (4)
- 5.3 A 1 300 kg container is hoisted with a crane from a position 30 m above the ground, where it is hanging motionless, to a position 120 m above the ground where it becomes stationary again. The kinetic energy of the container at a point 110 m above the ground is 5 000 J.

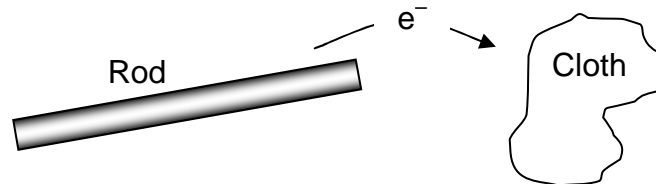


- 5.3.1 How much kinetic energy does the container have while it is motionless 30 m above the ground? (2)
- 5.3.2 Calculate the potential energy of the container at a height of 110 m above the ground. (3)
- 5.3.3 Calculate the mechanical energy of the container at a height of 110 m above the ground. Give your answer in scientific notation. (3)

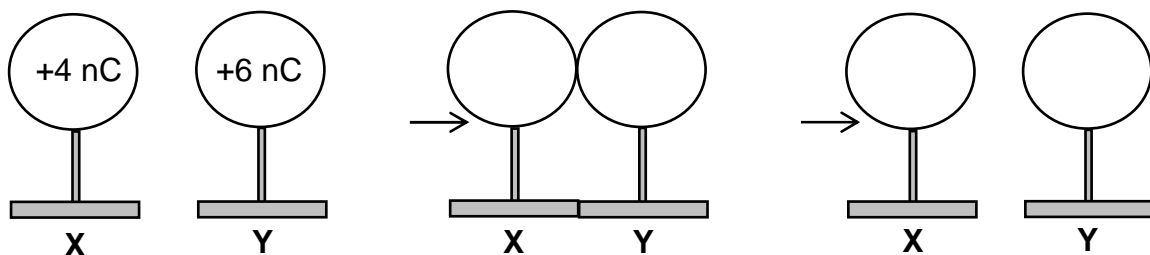
[14]

QUESTION 6 (Start on a new page.)

- 6.1 A neutral rod is rubbed with a neutral cloth and electrons are transferred from the rod to the cloth. The resulting charge on the rod has a magnitude of 4 nC.



- 6.1.1 Does the rod become negatively charged or positively charged? (2)
- 6.1.2 How does the MAGNITUDE and NATURE of the charge on the cloth compare to the charge on the rod? (2)
- 6.1.3 Calculate the NUMBER of electrons that was transferred from the rod to the cloth. (3)
- 6.2 Two small, metal spheres, **X** and **Y**, on insulated stands, carry charges of +4 nC and +6 nC. They are allowed to touch and separated again.



- 6.2.1 Were electrons transferred from **X to Y** or from **Y to X** during contact? Write only **X to Y** or **Y to X**. (1)
- 6.2.2 Write down the *principle of the conservation of charge* in words. (2)
- 6.2.3 Calculate the charge on sphere **X** AFTER separation. (3)

[13]

QUESTION 7 (Start on a new page.)

- 7.1 The grade 10 learners investigate the effect of an **INCREASING** **NUMBER** of bulbs, connected in **PARALLEL**, on the main current in a circuit. They use 1,5 V cells with no internal resistance to get a 6 V battery. They start with one bulb and measure the current. Two bulbs are then connected in parallel and then three bulbs in parallel. Each time, the current is measured.

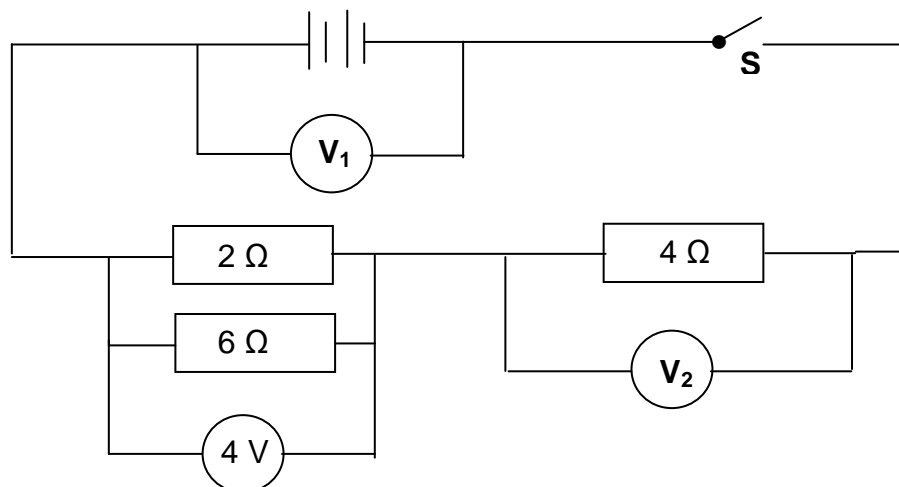
7.1.1 Define the term *electric current* in words. (2)

7.1.2 Draw a circuit diagram to show how the components should be connected to measure the main current with three bulbs in parallel. Include a voltmeter in your circuit diagram that measures the potential difference across the bulbs. (4)

7.1.3 Temperature affect the resistance of bulbs. How will you ensure that the resistance of the bulbs stays constant while you take the readings? (1)

7.1.4 What happens to the total current if the number of bulbs in parallel increases? Write only **INCREASE**, **DECREASE** or **STAYS THE SAME** and explain your answer. (3)

- 7.2 The resistance of the battery and wires in the following circuit diagram can be ignored. Switch **S** is initially open. When it is closed the potential difference across the 2 Ω and 6 Ω resistors is 4 V.



7.2.1 What does voltmeter V_1 register when switch **S** is open? (1)

*Switch **S** is now closed. Calculate the:*

7.2.2 Effective resistance of the 2 Ω and 6 Ω resistors (3)

7.2.3 Total resistance of the circuit (3)

7.2.4 Total current in the circuit (4)

7.2.5 Reading on V_1 (5)

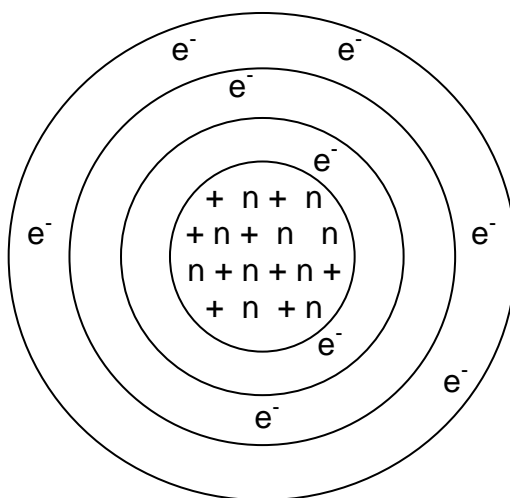
[26]

QUESTION 8 (Start on a new page.)

- 8.1 Consider the following properties of materials and answer the questions that follow:

Malleable Magnetic	Insulator Thermal conductor	Brittle
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- 8.1.1 Which of these properties are applicable to non-metals? (2)
- 8.1.2 Explain what is meant by *malleable*. (2)
- 8.1.3 Give the names of TWO magnetic elements. (2)
- 8.2 Consider the following model of an atom and answer the questions that follow (e^- represents an electron; + represents a proton; n represents a neutron):



- 8.2.1 Give the NAME of the element represented by the model. (1)
- 8.2.2 Is the element an atom or an ion? Give a reason for your answer. (2)
- 8.2.3 Give the atomic number of this element. (1)
- 8.2.4 Give the relative atomic mass of this element. (1)
- 8.2.5 Draw an Aufbau diagram for this element. (3)
- 8.2.6 Give the NAME of the GROUP in which this element is found on the periodic table. (1)
- 8.2.7 Is the element a metal, a non-metal or a metalloid? (1)

[16]

QUESTION 9 (Start on a new page.)

9.1 Give the chemical formula for each of the following compounds:

9.1.1 Calcium carbonate (2)

9.1.2 Aluminium hydroxide (2)

9.1.3 Sodium nitrate (2)

9.2 What is a *compound*? (2)

9.3 Give the chemical name for each of the following compounds:

9.3.1 SO_2 (2)

9.3.2 $\text{Fe}_2(\text{SO}_4)_3$ (3)

9.4 Rewrite the following equations in your answer book and balance each one:

9.4.1 $\text{NO} + \text{O}_2 \rightarrow \text{NO}_2$ (2)

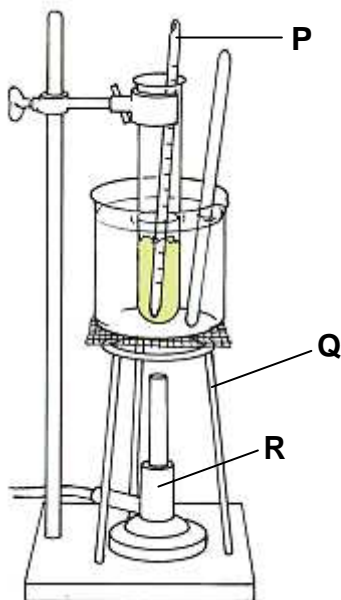
9.4.2 $\text{HCl} + \text{F}_2 \rightarrow \text{HF} + \text{Cl}_2$ (2)

9.4.3 $\text{Al}_2\text{O}_3 \rightarrow \text{Al} + \text{O}_2$ (2)

[19]

QUESTION 10 (Start on a new page.)

The set of apparatus below was used to determine the melting point of paraffin wax. A test-tube containing the wax was heated in a beaker with water. The table shows the results of the experiment.



Time (s)	Temperature (°C)	Observations
0	27	White solid
120	28	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

- 10.1 **P**, **Q** and **R** represent three pieces of apparatus. Give the name of each. (3)
- 10.2 It is unsafe to heat paraffin wax in the laboratory over an open flame. Give a reason for this. (1)
- 10.3 After how many seconds did you see the first signs of the paraffin wax turning into a liquid? (1)
- 10.4 At a temperature of 62°C, the liquid was not clear yet. What is the reason for the whitish colour of the liquid? (1)
- 10.5 What temperature can be considered the melting point of the wax? (1)
- 10.6 Convert 66°C to kelvin. (2)

[9]

GRAND TOTAL: 200

DATA FOR TECHNICALSCIENCES 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

PERIMETER / OMTREK

FORCE / KRAAG

Perimeter of a rectangle = 2ℓ + 2w <i>Omtrek van 'n reghoek = 2ℓ + 2b</i>	$F_g = mg$ OR/OF $w = mg$
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MOTION / BEWEGING

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

MOMENT OF FORCE (TORQUE) / KRAMOMENT / DRAAIMOMENT / WRINGKRAAG

$\Gamma = F \times d_{\perp}$ OR Moment = Force x perpendicular distance	$\Gamma = F \times d_{\perp}$ OF Kragmoment = krag x loodregte afstand
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SIMPLE MACHINES / EENVOUDIGE MASJINE

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

$E_p = mgh$ OR / OF $U = mgh$	$E_k = \frac{1}{2}mv^2$ OR / OF $K = \frac{1}{2}mv^2$
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ELECTROSTATICS / ELEKTROSTATIKA

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

ELECTRIC CIRCUITS / ELEKTRIESE STROOMBANE

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

[illegible]

ANSWER SHEET ON WHICH YOU
MUST DO YOUR BENDING MOMENT
DIAGRAM FOR QUESTION 4.3

ANTWOORDBLAD WAAROP JY JOU
BUIGMOMENTDIAGRAM MOET DOEN
VIR VRAAG 4.3

**HAND IT IN WITH YOUR
ANSWER BOOK.**

**HANDIG IN SAAM MET JOU
ANTWOORDBOEK**

Name/*Naam*: _____ Class/*Klas*: _____

