



education

Department of
Education
FREE STATE PROVINCE

CONTROL TEST

GRADE 10

TECHNICAL SCIENCES

NOVEMBER 2021

MARKS: 100

TIME: 2 HOURS

This paper consists of 10 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 10 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 Convert 1 500 000 to scientific notation.

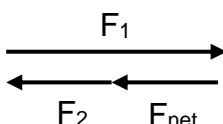
- A 15×10^{-6}
- B 15×10^{-5}
- C $1,5 \times 10^6$
- D $1,5 \times 10^7$ (2)

1.2 Which one of the following is an example of a vector quantity?

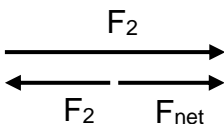
- A Distance
- B Velocity
- C Time
- D Mass (2)

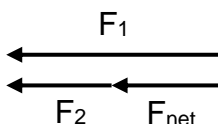
1.3 Which one of the following tail-to-head vector diagrams is the correct representation of $F_{\text{net}} = F_1 + F_2$?

- A

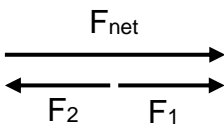


B


- C



D


- (2)

1.4 Two children are sitting on a BALANCED seesaw. The NET torque on the seesaw is ...

- A equal to the torque caused by the boy.
- B equal to the torque caused by the girl.
- C infinite.
- D zero. (2)

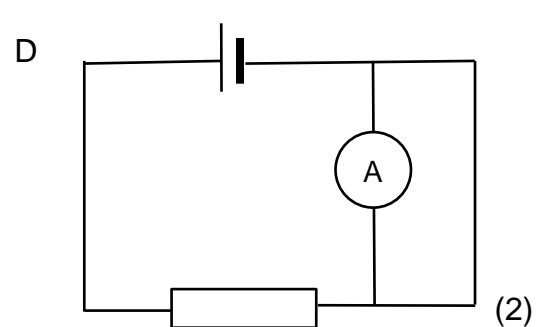
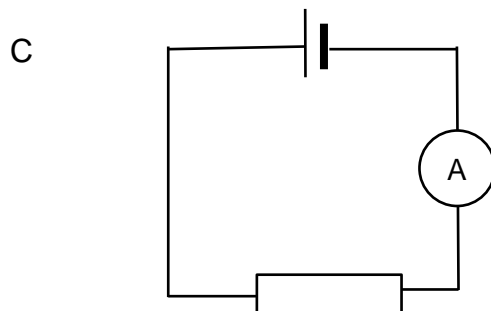
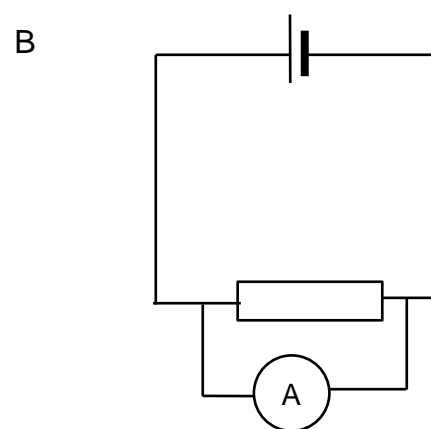
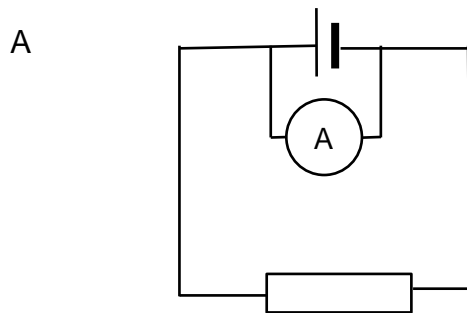


1.5 The kinetic energy of a moving body will increase the most if its ...

- A mass is doubled.
- B velocity is doubled.
- C mass is halved.
- D velocity is halved.

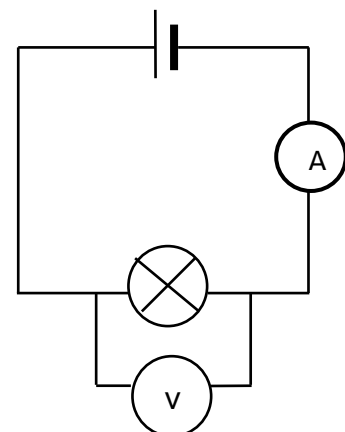
(2)

1.6 In which one of the circuits below is the ammeter correctly connected?



1.7 Consider the closed circuit represented on the right. The cell resistance can be ignored. How will the ammeter and voltmeter readings change if the bulb burns out?

	Ammeter reading	Voltmeter reading
A	Increases	Increases
B	Becomes zero	Becomes zero
C	Does not change	Does not change
D	Becomes zero	Does not change



(2)

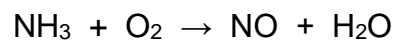
1.8 What happens when an object becomes positively charged?

- A It loses electrons.
- B It receives electrons.
- C It loses protons.
- D It receives protons. (2)

1.9 The correct chemical name of CuCl_2 is ...

- A copper chloride.
- B copper(I) chloride.
- C copper(II) chloride.
- D copper(III) chloride. (2)

1.10 Consider the following chemical reaction.



What are the coefficients in the balanced equation?

	NH_3	O_2	NO	H_2O
A	4	5	4	6
B	4	6	4	5
C	2	4	4	6
D	1	3	1	6

(2)
[20]

QUESTION 2

2.1 The sun is the star in the centre of our solar system and it has a surface temperature of 5 778 K. It burns 500 million tons of hydrogen per second.

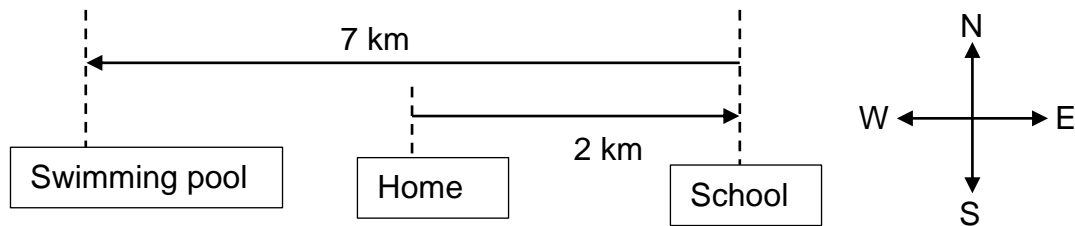
2.1.1 Convert the temperature to °C.
Hint: $T_K = T_{\text{°C}} + 273$ (1)

2.1.2 How many kilograms of hydrogen are burned per second?
Hint: 1 ton is the same as 1 000 kg. (1)

2.2 Consider the following formula: $E = hf + \frac{1}{2}mv^2$
Make v the SUBJECT of the formula, in other words, $v = \dots$
Show ALL the steps. (3)
[5]

QUESTION 3

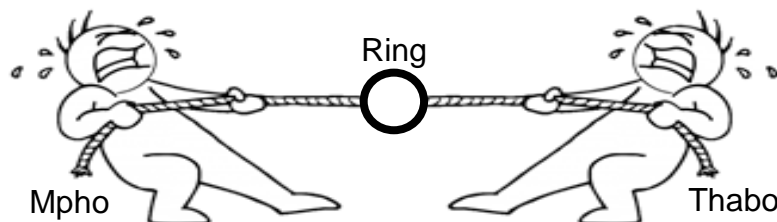
Mr Henry departs from his home at 13:00 to pick up his daughter at school, which is 2 km from his home in an easterly direction. He arrives at the school at 13:05. At 13:12 they depart from the school to go to the swimming pool, which is 7 km from the school in a westerly direction. They arrive at the swimming pool at 13:25.



- 3.1 Calculate the total distance that Mr Henry has travelled between his home and the swimming pool. (2)
 - 3.2 What is the displacement from the home to the swimming pool? (2)
 - 3.3 Calculate the average speed, in $\text{m}\cdot\text{s}^{-1}$, for the entire journey. (3)
 - 3.4 Calculate the average velocity, in $\text{m}\cdot\text{s}^{-1}$, for the entire journey. (4)
- [11]**

QUESTION 4

- 4.1 Each of Mpho and Thabo is pulling on a rope with a horizontal force of 50 N in opposite directions as shown below. The two ropes are tied to a ring.



- 4.1.1 Is force a scalar or a vector? Give a reason for your answer. (2)
- 4.1.2 What is the magnitude of the resultant force on the ring due to the two ropes? (1)
- 4.1.3 Will the ring remain stationary? Write only YES or NO. (1)

- 4.2 Neo is pulling a rock the right with a horizontal force along a rough surface.

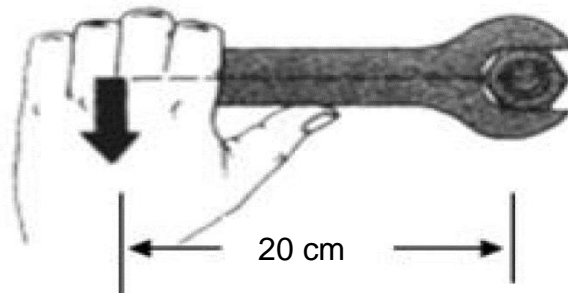


- 4.2.1 Draw a free-body diagram of ALL the forces acting on the rock. (4)

- 4.2.2 Which one of the forces in question 4.2.1 is a non-contact force? (1)
[9]

QUESTION 5

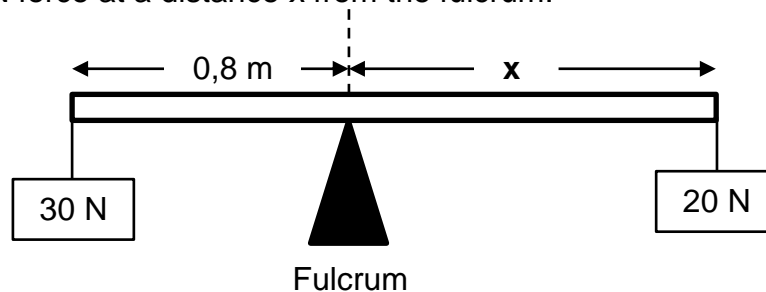
- 5.1 Peter is loosening the nuts on his bicycle's wheels. He exerts a force of 20 N on a spanner. The force is perpendicular to the spanner's handle, and the force is applied at a distance of 20 cm from the nut as shown.



- 5.1.1 Define the term *moment of force*. (2)

- 5.1.2 Calculate the magnitude of the moment of force in basic SI units. (3)

- 5.2 The diagram shows a HORIZONTAL beam with two downwards forces of 30 N and 20 N acting on it. The forces are applied to the ends of the beam. The 30 N force acts at a distance of 0,8 m from the fulcrum, and the 20 N force at a distance x from the fulcrum.



- 5.2.1 State the *law of moments* in words. (2)

- 5.2.2 Calculate the distance x . (3)
[10]

QUESTION 6

A 3 kg stone is dropped from the top of a cliff with a height of 400 m. The stone reaches the ground with a velocity of $53 \text{ m}\cdot\text{s}^{-1}$. The stone experiences air resistance as it falls.



6.1 Define the term *mechanical energy*. (2)

6.2 Write down the magnitude of the following:

6.2.1 Kinetic energy of the stone at the top of the cliff (1)

6.2.2 Gravitational potential energy of the stone on the ground (1)

6.3 Calculate the following:

6.3.1 Gravitational potential energy of the stone at the top of the cliff (3)

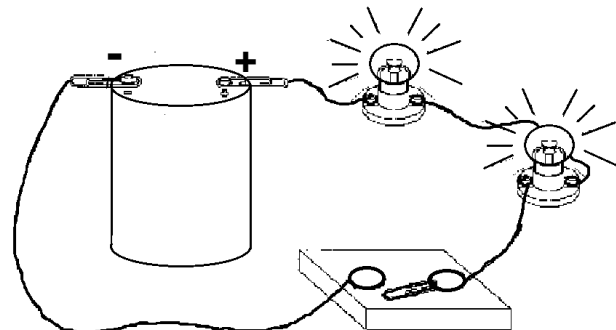
6.3.2 Kinetic energy of the stone when it hits the ground. (3)

[10]

QUESTION 7

7.1 Draw a circuit diagram consisting of two cells in series, two resistors in parallel, an ammeter and a voltmeter across the two resistors. (4)

7.2 The diagram on the right shows two light bulbs that are connected to a cell and a switch.



7.2.1 In which direction does the current flow in the external circuit when the switch is closed? Write ONLY '**Positive to negative**' or '**Negative to positive**'. (1)

7.2.2 The cell has a potential difference of 1,5 V. Refer to ENERGY and CHARGE to explain what this value of 1,5 V means. (2)

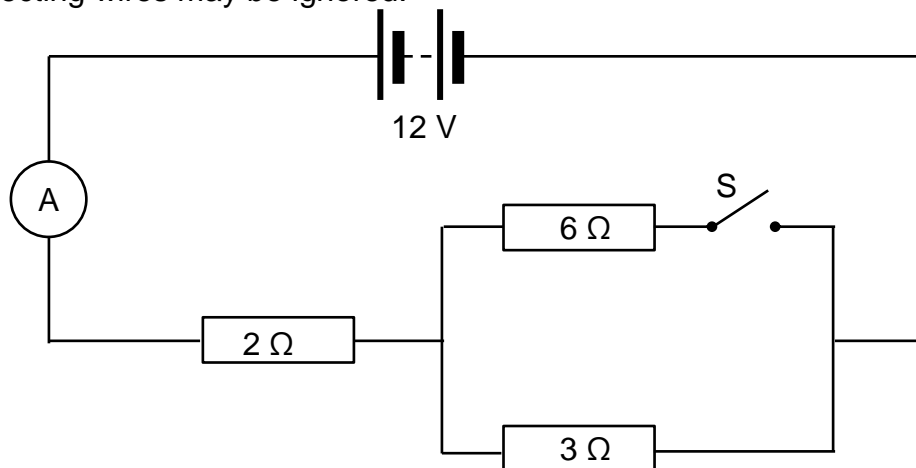
7.2.3 42 C of charge passes a certain point in the circuit every minute. Calculate the current. (3)

- 7.2.4 How would you decrease the total resistance in the circuit without removing any of the bulbs?

(1)
[11]

QUESTION 8

In the circuit represented below, the emf of the battery is 12 V. When switch **S** is CLOSED, the current in the ammeter is **x**. The resistance of the battery and connecting wires may be ignored.



- 8.1 Define the term *emf*. (2)

- 8.2 Calculate the TOTAL resistance in the circuit when switch **S** is CLOSED. (5)

- 8.3 Switch **S** is then OPENED.

- 8.3.1 How will this influence the total resistance in the circuit? (2)

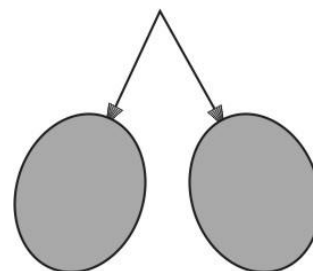
- 8.3.2 How will this influence the reading on the ammeter? Choose your answer from "less than **x**", "same as **x**" or "more than **x**".

(1)
[10]

QUESTION 9

Peter and John investigate the two types of charge and the effect the charges have on each other. They are provided with the following apparatus:

- Three blown-up balloons
- A woollen cloth
- A piece of cling wrap



They follow the following instructions and record their observations:

- Step 1: Rub one of the balloons with the woollen cloth.
- Step 2: Rub a second balloon with the woollen cloth and hold this balloon near the previous one. Peter and John observe that the two balloons REPEL each other.
- Step 3: Put away the first balloon. Rub the third balloon with cling wrap and hold it near the second balloon, which is still charged. Peter and John observe that the two balloons ATTRACT each other.

- 9.1 State a hypothesis for steps 1 and 2 of the instructions. (2)
- 9.2 Identify the dependent and independent variables in step 3. (2)
- 9.3 Write down the conclusion Peter and John can draw from their observations. (2)
- [6]**

QUESTION 10

- 10.1 Define the term *pure substance*. (2)
- 10.2 Consider the following elements, compounds and ions:

NaCl	SO ₄ ²⁻	Cu	H ₂ SO ₄	Ca	CO ₃ ²⁻
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- 10.2.1 Identify a compound from the list. (1)
- 10.2.2 Which one's is called "carbonate"? (1)
- 10.2.3 Which one is malleable and conduct electricity? (1)
- 10.3 A reaction between carbon monoxide and oxygen gas takes place to form carbon dioxide. Write down a balanced, chemical equation for this reaction. (3)
- [8]**

GRAND TOTAL: 100

**DATA FOR TECHNICAL SCIENCES 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 elektron</i>	e ⁻	-1,6 x 10 ⁻¹⁹ C

TABLE 2: FORMULAE / TABEL 2: FORMULES

MOTION/BEWEGING

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

FORCE/KRAG	MOMENT OF FORCE (TORQUE) KRAMOMENT/DRAAIMOMENT/WRINGKRAG
$F_g = mg$ OR/OF $w = mg$	$\tau = Fd_{\perp}$

SIMPLE MACHINES / EENVOUDIGE MASJIENE	ELECTROSTATICS ELEKTROSTATIKA
$MA = \frac{Load}{Effort}$ OR $MA = \frac{Effort\ distance}{Load\ distance}$ $MV = \frac{Las}{Krag}$ OF $MV = \frac{Kragafstand}{Lasafstand}$	$Q = \frac{Q_1 + Q_2}{2}$

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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ELECTRIC CIRCUITS / ELEKTRIESE STROOMBANE

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

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