



education

Department of
Education
FREE STATE PROVINCE

CONTROL TEST

GRADE 10

PHYSICAL 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 EIGHT 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.

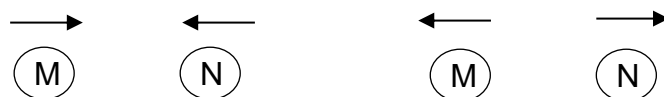
1.1 Which combination consists of two vectors?

- A Length and distance
- B Distance and velocity
- C Acceleration and length
- D Velocity and acceleration (2)

1.2 Which symbol represents the device used to measure the rate of flow of charge?

- A 
- B 
- C 
- D  (2)

1.3 Two identical, metal spheres, **M** and **N**, carrying different charges, are brought into contact and then separated again.



If the charge on **M** after separation is **q**, the charge on **N** after separation is ...

- A zero.
- B equal to **q**.
- C less than **q**.
- D greater than **q**. (2)

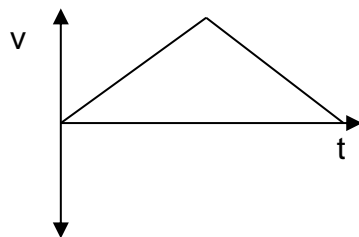
1.4 Which one of the following statements is true for a body that is accelerating at a constant rate?

- A The rate of change of velocity remains constant.
- B The rate of change of position remains constant.
- C The position changes by the same amount in equal time intervals.
- D The velocity increases by increasing amounts in equal time intervals. (2)

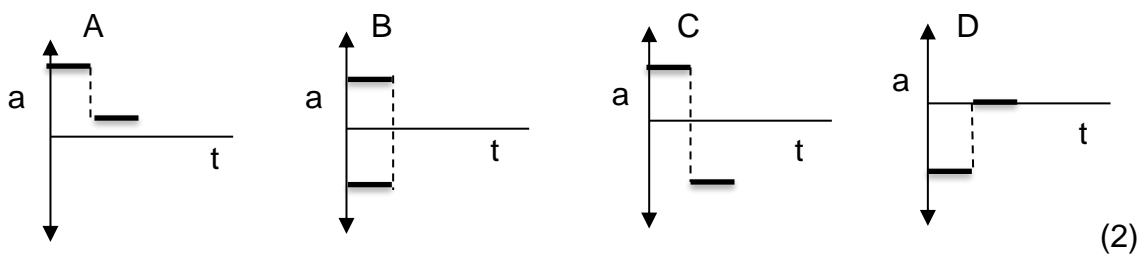
1.5 What is the SI unit of $a\Delta t$ in the equation $v_f = v_i + a\Delta t$?

- A s^{-1}
- B m
- C $m \cdot s^{-2}$
- D $m \cdot s^{-1}$ (2)

1.6 Consider the velocity-time graph of a motorbike in motion.



Which one of the graphs below represents the acceleration-time graph of the motorbike?



1.7 Which element is malleable at STP?

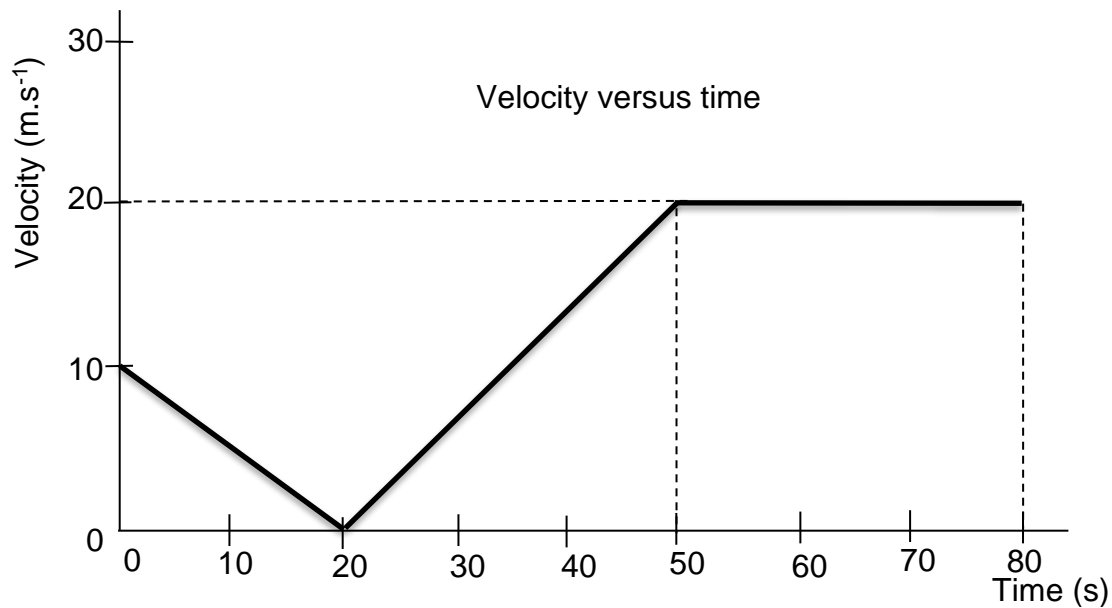
- A Chlorine
- B Copper
- C Sulphur
- D Helium (2)

- 1.8 The process whereby solid substances change directly into gases is called ...
- A condensation.
 - B evaporation.
 - C sublimation.
 - D melting. (2)
- 1.9 When a chemical change occurs ...
- A there is no change in mass, no change in the number of atoms and no change in the number of molecules.
 - B there is no change in mass, no change in the number of atoms, but there is a change in the number of molecules.
 - C there is no change in mass, but the number of atoms and the number of molecules change.
 - D the mass, number of atoms and number of molecules all change. (2)
- 1.10 The arrangement of elements on the periodic table is based on their ...
- A decreasing atomic number in the vertical columns.
 - B increasing atomic number in the horizontal rows.
 - C decreasing atomic mass in the periods.
 - D increasing atomic mass in the groups. (2)

[20]

QUESTION 2

Consider the following velocity versus time graph of the motion of a car on a straight road.



2.1 Define the term *average velocity*. (2)

2.2 Describe the motion of the car from 50 s to 80 s. (2)

2.3 Convert $30 \text{ m}\cdot\text{s}^{-1}$ to $\text{km}\cdot\text{h}^{-1}$. (2)

2.4 For how long was the car moving with a negative acceleration? (1)

2.5 The car accelerated from 20 s to 50 s. Use the equations of motion to calculate the **MAGNITUDE** of the following for this time interval:

2.5.1 Displacement (3)

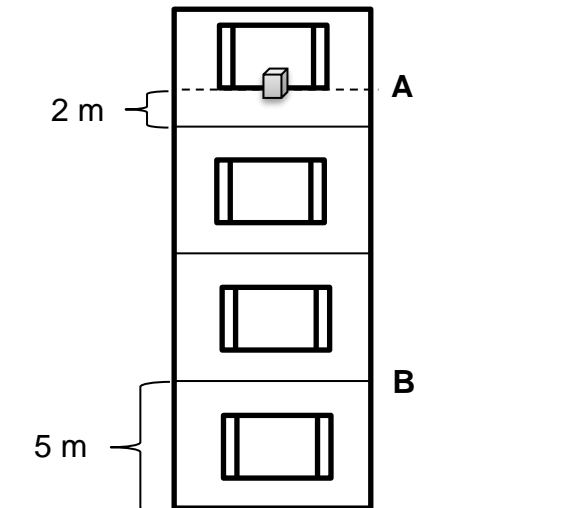
2.5.2 Acceleration (4)

2.6 Is displacement a scalar or vector quantity? Explain your answer. (3)

[17]

QUESTION 3

A box of mass 3 kg is dropped by mistake from point **A** of a block of flats. The height of each room is 5 m. The height from the floor of each room to the bottom part of the window is 2 m.

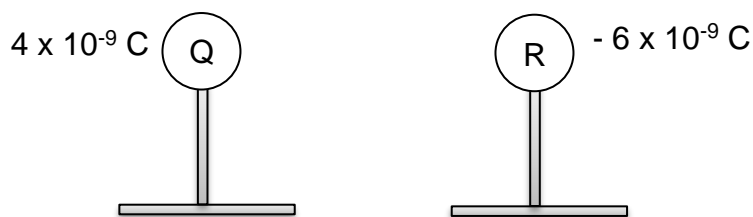


3.1 Define *mechanical energy*. (2)

3.2 Calculate the mechanical energy of the box at point **B**. (4)
[6]

QUESTION 4

Each of two small, identical, metal spheres, **Q** and **R**, is attached to an insulated stand. They are charged and carry charges of $4 \times 10^{-9} \text{ C}$ and $-6 \times 10^{-9} \text{ C}$ respectively as shown below.



The spheres are brought into contact for a few seconds and then separated.

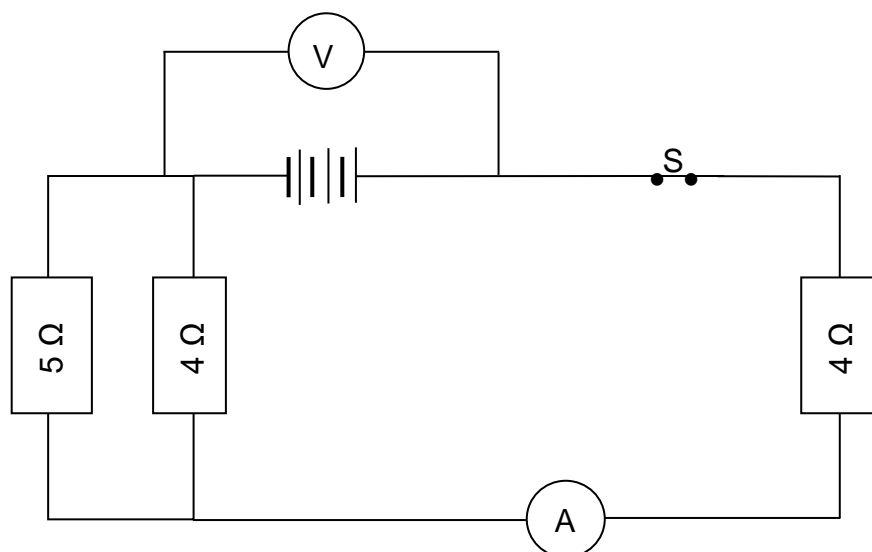
4.1 Which one of the two spheres loses electrons? Write down **Q** or **R**. (1)

4.2 State the *principle of conservation of charge*. (2)

4.3 Calculate the new charge on sphere **R** after the separation. (3)
[6]

QUESTION 5

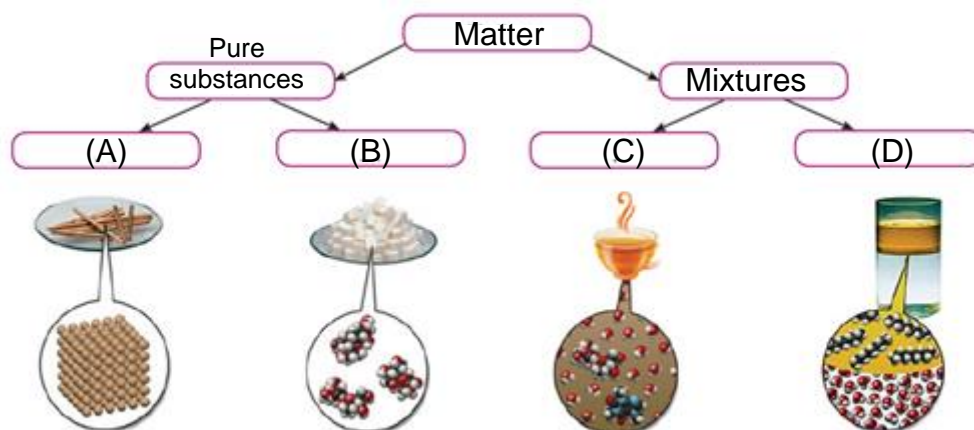
The following circuit consists of three resistors, an ammeter, a voltmeter and a switch. Study the circuit and answer the questions.



- 5.1 Define the term *resistance*. (2)
- 5.2 Calculate the total resistance of the circuit. (4)
- 5.3 If the battery can transfer a total of 120 J of energy to 10 C of charge, calculate the following:
- 5.3.1 Voltmeter reading (3)
- 5.3.2 The ammeter reading when 10 C of charges passes through the ammeter in 5,18 s. (3)
- [12]**

QUESTION 6

- 6.1 Matter can be subdivided into pure substances and mixtures as shown below.



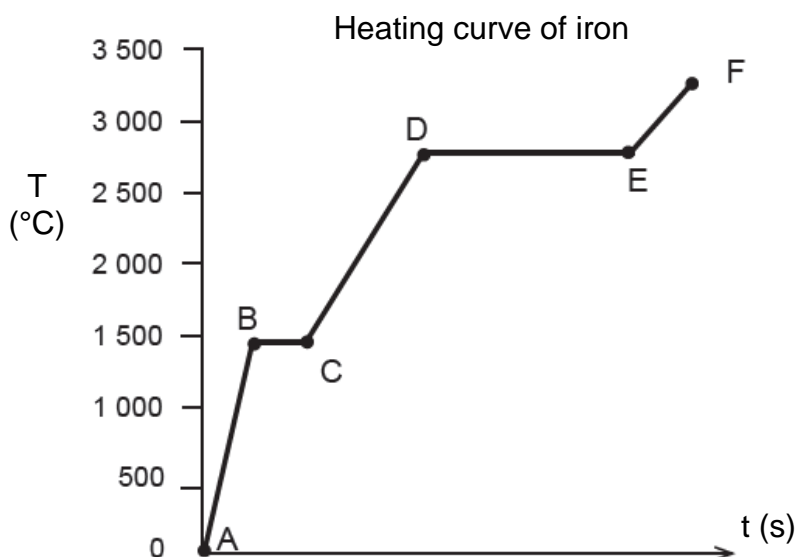
6.1.1 Define a *pure substance*. (2)

6.1.2 Use the letters (A) to (D) in the diagram to identify:

(i) A compound (1)

(ii) An element (1)

6.2 The heating curve of one ton of iron is shown below.



6.2.1 Define the term *boiling point*. (2)

6.2.2 What phase change occurs between points **B** and **C** on the graph? (1)
[7]

QUESTION 7

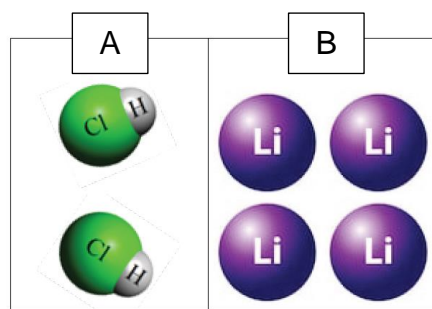
7.1 Consider the following two isotopes of chlorine: $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$

7.1.1 Define the term *isotope*. (2)

7.1.2 Write down THREE things that can be deduced from the numbers in the $^{35}_{17}\text{Cl}$ representation. (3)

7.1.3 Naturally occurring chlorine consists of 76% Cl-35 and 24% Cl-37. Calculate the relative atomic mass of chlorine. (3)

7.2 Consider the particle diagram on the right.



7.2.1 Define the term *chemical bond*. (2)

7.2.2 Identify the type of chemical bond that occurs in diagram **A**. (1)

7.2.3 Draw the Lewis structure of a molecule in diagram **A**. (2)

7.2.4 How many valence electrons does each atom in diagram **B** have? (1)
[14]

QUESTION 8

8.1 Consider the following law: *The total mass of substances that participate in a chemical reaction remains retained during the reaction*. Write down the NAME of this law. (1)

8.2 Consider the following diagram of a reaction between methane (CH_4) and oxygen gas (O_2) to produce carbon dioxide (CO_2) and water (H_2O).



methane

oxygen

carbon dioxide

water

Show that MASS IS RETAINED during this reaction. (4)

8.3 The molar mass of hydrated (water is present) sodium carbonate is $268 \text{ g} \cdot \text{mol}^{-1}$. The formula of hydrated sodium carbonate is $\text{Na}_2\text{CO}_3 \cdot \text{XH}_2\text{O}$. Calculate the number of moles of the waters of crystallisation (**X**) in the compound. (4)

8.4 A sample of a compound is found to contain 6 g of carbon, 1,5 g of hydrogen and 17,75 g of chlorine.

8.4.1 Define the term *empirical formula*. (2)

8.4.2 What is the basic SI unit for *amount of substance*? (1)

8.4.3 Determine the empirical formula of the compound. Show ALL calculations. (6)

[18]

GRAND TOTAL: 100

DATA FOR PHYSICAL SCIENCES GRADE 10
GEGEWENS VIR FISIIESE 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	$9,8 \text{ m}\cdot\text{s}^{-2}$
Charge on an electron <i>Lading op 'n elektron</i>	e^-	$-1,6 \times 10^{-19} \text{ C}$
Standard pressure <i>Standaarddruk</i>	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3\cdot\text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^θ	273 K
Avogadro's constant <i>Avogadro-konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE / TABEL 2: FORMULES

MOTION/BEWEGING

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$

ELECTROSTATICS/ELEKTROSTATIKA

$n = \frac{Q}{e}$	$n = \frac{Q}{q_e}$	$Q = \frac{Q_1 + Q_2}{2}$
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ENERGY/ENERGIE

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

ELECTRIC CIRCUITS / ELEKTRIESE STROOMBANE

$I = \frac{Q}{\Delta t}$	$R_T = R_1 + R_2 + R_3 + \dots$
$V = \frac{W}{Q}$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$
$R = \frac{V}{I}$	

CHEMISTRY/CHEMIE

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$	$n = \frac{V}{V_m}$
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TABLE 3: THE PERIODIC OF ELEMENTS / TABEL 3: 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 Ne 20
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 Ar 40
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 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 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 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 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 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	