



education

Department of
Education
FREE STATE PROVINCE

GRADE 10

**PHYSICAL SCIENCES
(PHYSICS & CHEMISTRY)**

JUNE 2016

MARKS: 150

TIME: 3 HOURS

This paper consists of 14 pages and 2 information sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space in the ANSWER BOOK.
2. This question paper consists of ELEVEN 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 subsections, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable 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.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

QUESTION 1

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (1.1–1.10) in your ANSWER BOOK, for example 1.11 D.

1.1 Table salt is an example of a(n) ...

- A homogeneous mixture.
- B heterogeneous mixture.
- C pure substance.
- D element. (2)

1.2 An ionic bond usually occurs between ...

- A two non-metals.
- B two metals.
- C a metal and a non-metal.
- D a metal and a semi-metal (2)

1.3 According to the atomic model proposed by ..., electrons in atoms move in specific energy levels.

- A Dalton
- B Thomson
- C Rutherford
- D Bohr (2)

1.4 Which ONE of the following does NOT occur as diatomic molecules?

- A Carbon
- B Bromine
- C Chlorine
- D Hydrogen (2)

- 1.5 Which ONE of the following gives the number of each type of atom present in one formula-unit of calcium nitrate?

	Ca	N	O
A	2	1	3
B	1	1	5
C	2	2	5
D	1	2	6

(2)

- 1.6 A compound consists of X^{2+} ions and Y^{3-} ions. Which ONE of the following represents the formula of this compound?

- A $2X3Y$
- B X_3Y_2
- C $3X2Y$
- D X_2Y_3

(2)

- 1.7 Which formula is the correct formula for potassium sulphite?

- A K_2S
- B KS
- C K_2SO_3
- D KSO_3

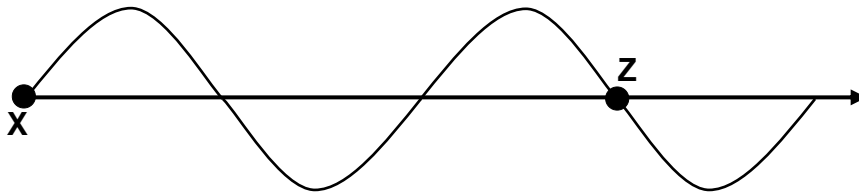
(2)

- 1.8 The pitch of a sound wave is related to its ...

- A wavelength.
- B frequency.
- C amplitude.
- D loudness.

(2)

1.9 The diagram below shows two points, **X** and **Z**, on a wave.



How many wavelengths separate points **X** and **Z**?

- A $\frac{3}{4}$
- B 1
- C $1\frac{1}{2}$
- D 3

(2)

1.10 Which ONE of the following statements BEST explains the colour display of the Northern Lights?

- A The acceleration of charged particles along the Earth's magnetic field lines at the poles.
- B The interaction of the Earth's electric and magnetic fields.
- C Electrically charged particles enter the Earth's magnetosphere from outer space.
- D Collisions between charged particles from the sun and gas particles in the Earth's atmosphere.

(2)

[20]

QUESTION 2 (Start on a new page.)

Consider the household items in the table below.

Ice water	Sugar crystals
Salt solution	Graphite used in a pencil
Vinegar	A paper clip
Bicarbonate of soda	Air
Bean soup	Granite counter top

2.1 Choose from the above table:

- 2.1.1 TWO homogeneous mixtures (2)
- 2.1.2 TWO heterogeneous mixtures (2)
- 2.1.3 TWO compounds (2)
- 2.1.4 TWO elements (2)
- 2.1.5 The substance with the molecular formula NaHCO_3 (1)
- 2.1.6 The substance that consists of carbon only (1)

2.2 Consider the bonds between particles in the paper clip.

- 2.2.1 Name the type of chemical bond between the particles. (1)
- 2.2.2 Briefly describe how the bond in QUESTION 2.2.1 is formed. (2)

[13]

QUESTION 3 (Start on a new page.)

Use the attached periodic table to answer this question.

Only write down the NAME of the element next to the question number.

- 3.1 The element in period 2 with seven valence electrons (1)
- 3.2 An inert gas in period 3 (1)
- 3.3 The element with the smallest atomic radius (1)
- 3.4 The element in period 2 that forms an ion with a -3 charge (1)
- 3.5 A non-metal in group 1 (1)

- 3.6 The element having the same number of electrons as Ca^{2+} (1)
- 3.7 A period 3 element that will form an X^{2-} ion (1)
- 3.8 An alkali earth metal in the second period (1)
- 3.9 The element with five electrons spread over the first two energy levels (1)
- 3.10 A halogen in period 4 (1)
- [10]**

QUESTION 4 (Start on a new page.)

- 4.1 Many elements occur as different isotopes. For example, hydrogen occurs as the following isotopes:
 ${}^1_1\text{H}$, ${}^2_1\text{H}$ and ${}^3_1\text{H}$.
- 4.1.1 Define the term *isotope*. (2)
- 4.1.2 Write down TWO similarities in atomic structure of the above three hydrogen atoms. (2)
- 4.1.3 How do the chemical properties of the three hydrogen atoms compare? Give a reason for the answer. (2)
- 4.1.4 Write down the sp notation for ${}^3_1\text{H}$. (1)
- 4.2 Copper occurs as two isotopes in nature. The percentage occurrence of the two isotopes is as follows:
- ${}^{63}_{29}\text{Cu}$: 69,2% ${}^{65}_{29}\text{Cu}$: 30,8%
- 4.2.1 Write down the number of neutrons in an atom of Cu-65. (1)
- 4.2.2 Calculate the relative atomic mass of copper. (4)
- [12]**

QUESTION 5 (Start on a new page.)

5.1 Write down the chemical formula of:

5.1.1 Ammonium sulphate (2)

5.1.2 Potassium permanganate (2)

5.2 Write down the Lewis structure for the water molecule. (2)

5.3 Sodium hydrogen carbonate and hydrochloric acid react to form sodium chloride according to the following **BALANCED** equation.



5.3.1 Write down the common name of sodium chloride. (1)

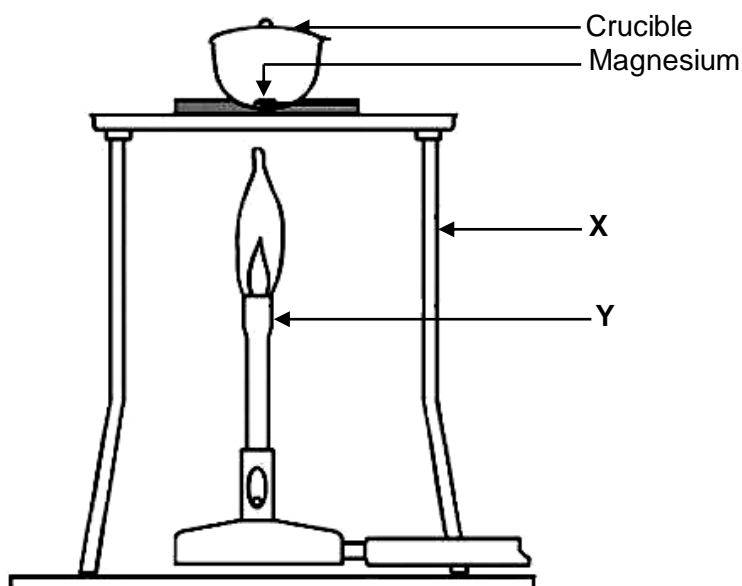
5.3.2 Write down the Law of Conservation of Mass in words. (2)

5.3.3 Show by means of a calculation that mass is conserved during the reaction represented by the above balanced equation. (6)

[15]

QUESTION 6 (Start on a new page.)

Two Grade 10 learners investigate whether mass is conserved during a reaction. They burn 5 g of magnesium in oxygen to form a white powder, magnesium oxide. They observe that heat is released during the reaction.



- 6.1 Write down the name of the apparatus labelled:
- 6.1.1 X (1)
- 6.1.2 Y (1)
- 6.2 For the product formed during this reaction, write down the:
- 6.2.1 Formula (1)
- 6.2.2 Type of structure in the solid phase (1)
- 6.2.3 Type of particles that make up the structure (1)
- 6.2.4 Type of chemical bond between the constituent particles (1)
- 6.3 Classify this reaction as:
- 6.3.1 A SYNTHESIS or a DECOMPOSITION reaction.
Give a reason for the answer. (2)
- 6.3.2 EXOTHERMIC or ENDOTHERMIC
Give a reason for the answer. (2)
- 6.4 The learners find that the mass of the crucible with the white powder is GREATER than the initial mass of the crucible with the magnesium.
- 6.4.1 Explain this increase in mass. (2)
- 6.4.2 Write a balanced equation for the reaction that takes place. (3)
- [15]**

QUESTION 7 (Start on a new page.)

7.1 Carbon dioxide in the solid phase is known as dry ice. Under normal circumstances, dry ice sublimates as it warms up.

7.1.1 Define the term *sublimation*. (2)

7.1.2 For carbon dioxide, write down the type of:

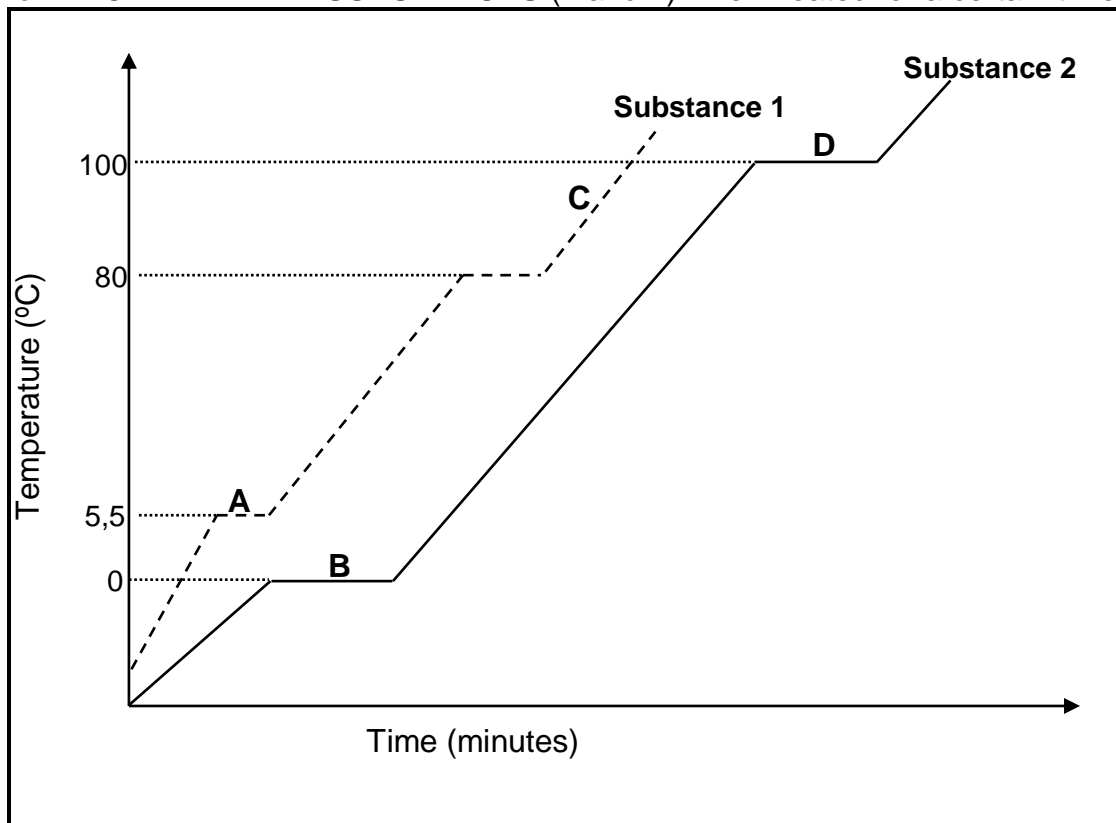
(a) Structure in the solid phase (1)

(b) Particles that make up the structure (1)

(c) Forces between the particles that make up the structure (1)

7.2 When you take a block of butter out of the fridge, it is hard. However, after 25 minutes at room temperature, it is soft enough to spread. Use the kinetic molecular theory to explain this observation. (3)

7.3 The graphs (not drawn to scale) below represent the change in temperature of TWO DIFFERENT SUBSTANCES (1 and 2) when heated for a certain time.



7.3.1 For **Substance 2**, write down the:

(a) Melting point (1)

(b) Boiling point (1)

7.3.2 Name the processes represented on the graphs by:

(a) **B** (1)

(b) **D** (1)

7.3.3 Write down the phase, at 90 °C, of:

(a) Substance 1 (1)

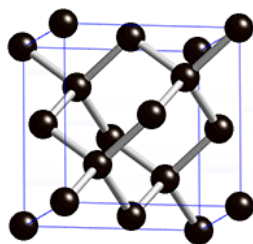
(b) Substance 2 (1)

7.3.4 The substances represented in the graph are water and benzene. Which substance, 1 or 2, is benzene? Give a reason for the answer.

(2)
[16]

QUESTION 8 (Start on a new page.)

The network structure for diamond is shown below. Diamond is a pure substance consisting only of carbon atoms.



8.1 Define the term *network structure*. (2)

8.2 Name the type of chemical bonds present between the carbon atoms in diamond. (1)

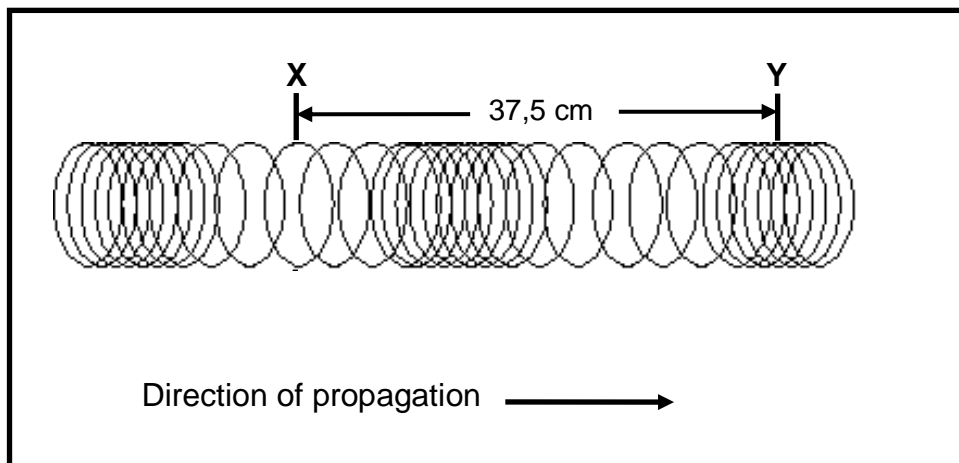
8.3 Draw a labelled Aufbau diagram for a carbon atom. (3)

8.4 Is diamond a METAL, a SEMI-METAL or a NON-METAL? (1)

[7]

QUESTION 9 (Start on a new page.)

9.1 The diagram below shows a wave generated in a slinky spring.



9.1.1 What type of a wave, LONGITUDINAL or TRANSVERSE, is generated in the slinky? Give a reason for the answer. (2)

9.1.2 For the above wave, write down the:

(a) Letter (**X** or **Y**) that represents a trough (1)

(b) Wavelength (in cm) (1)

9.1.3 The wave moves the distance between points **X** and **Y** in 0,75 s. Calculate the:

(a) Frequency of the wave (4)

(b) Speed of the wave (4)

9.2 A man stands between two tall buildings. When he claps his hands, he hears the echo from **building 1** after 2 seconds and the echo from **building 2** after 3 seconds. Take the speed of sound in air as $330 \text{ m}\cdot\text{s}^{-1}$.

9.2.1 What is an *echo*? (1)

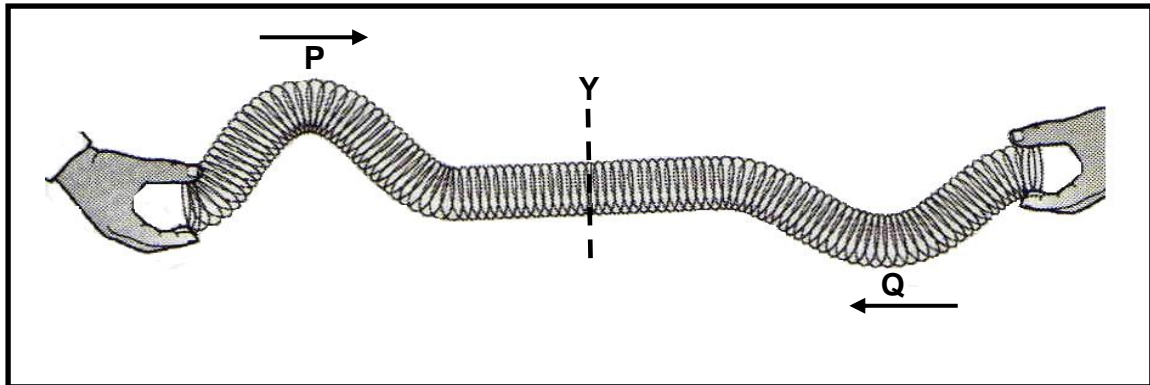
9.2.2 Describe how a sound wave is created and then transplanted through air. (2)

9.2.3 Calculate the distance between the two buildings. (6)

[21]

QUESTION 10 (Start on a new page.)

The diagram below shows two pulses, **P** and **Q**, that move towards each other in a slinky coil. Pulse **P** has an amplitude of +120 mm, and pulse **Q** has an amplitude of –80 mm. The pulses meet at position **Y**. Assume there is no loss of energy.



- 10.1 Define the term *pulse*. (2)
- 10.2 Write down the phenomenon that occurs at position **Y** when the two pulses meet. (1)
- 10.3 Draw a sketch to show pulses **P** and **Q**:
- 10.3.1 At their initial positions as shown in diagram. (2)
- 10.3.2 At the moment when they meet at position **Y**.
Indicate the resulting amplitude on the sketch. (3)
- 10.4 Draw a sketch of the pulses after meeting at position **Y**. Clearly label the pulses as **P** and **Q**. Indicate the amplitude of each. (3)

[11]

QUESTION 11 (Start on a new page.)

Two learners investigate the characteristics of a magnet. They have a bar magnet, a compass needle, a sheet of paper and iron filings at their disposal. The one end of the magnet is marked as *north* as shown below.



11.1 Define the term *magnetic field*. (2)

11.2 The learners place the sheet of paper over the magnet. They then sprinkle iron filings on the sheet of paper and gently tap the paper with a finger.

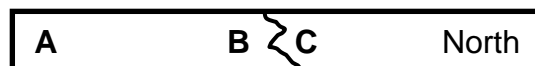
Draw the magnetic field pattern that will be observed. (2)

11.3 The learners now place the compass needle next to the end of the magnet marked as *north*.

On the same sketch as in QUESTION 11.2, draw the compass needle clearly showing what will be observed on the compass needle. (1)

11.4 What information about the magnetic field can be obtained from the compass needle? (1)

11.5 The magnet drops and breaks into TWO pieces as shown below.



11.5.1 What will be the polarity of side **B**? Explain the answer. (3)

11.5.2 What type of force, REPULSIVE or ATTRACTIVE, will be experienced between side **B** and side **C**? (1)

[10]

GRAND TOTAL: 150

**DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 1 (PHYSICS)**

**GEGEWENS VIR FISIIESE WETENSKAPPE GRAAD 10
VRAESTEL 1 (FISIKA)**

TABLE 1: PHYSICAL CONSTANTS / TABEL 1: FISIIESE KONSTANTES

NAME / NAAM	SYMBOL / SIMBOOL	VALUE / WAARDE
Speed of light in a vacuum <i>Spoed van lig in 'n vacuum</i>	c	$3,0 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
Plank's constant Plank se konstante	h	$6,63 \times 10^{-34} \text{ J}\cdot\text{s}$
Charge on electron <i>Lading op electron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Electron mass <i>Elektronmassa</i>	m_e	$9,11 \times 10^{-31} \text{ kg}$

TABLE 2: FORMULAE / TABEL 2: FORMULES

WAVES, SOUND AND LIGHT / GOLWE, KLANK EN LIG

$v = f\lambda$	$f = \frac{1}{T} \text{ or/of } T = \frac{1}{f}$
$E = hf = \frac{hc}{\lambda}$	

TABLE 2: THE PERIODIC TABLE OF ELEMENTS

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

29
1,9 Cu 63,5