education

Department of Education
FREE STATE PROVINCE

EXAMINATION

GRADE 10

PHYSICAL SCIENCES

JUNE 2018

MARKS: 150

TIME: 3 HOURS

This paper consists of 13 pages and two 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 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 Which one of the following is an example of a metal?

A Sodium

B Oxygen

C Carbon

D Neon (2)

1.2 Consider the atom represented by $^{222}_{86}\mathrm{Rn}$. There are ... electrons, ... protons and ... neutrons in this atom.

A 222 ; 86 ; 86

B 136 ; 136 ; 222

C 86 ; 86 ; 222

D 86 ; 86 ; 136 (2)

1.3 Which one of the following electronic configurations give a stable ion with a charge of 2+?

A $1s^2 2s^2 2p^6 3s^1$

B $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

C $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

D $1s^2 2s^2 2p^6 3s^2 3p^4$ (2)

1.4 The number of outer electrons in a magnesium atom is exactly the same as those in a/an ...

A neon atom.

B argon atom.

C sodium atom.

D calcium atom. (2)

1.5 Which one of the following elements DOES NOT occur in nature in its elemental form?

A Zinc

B Silver

C Sodium

D Copper (2)

1.6 What is the correct chemical name of $CuC\ell_2$?

A Copper chloride

B Copper(I) chloride

C Copper(II) chloride

D Copper(III) chloride (2)

1.7 Waves in which the particles of the medium vibrate PERPENDICULAR to the direction in which the waves move are known as ... waves.

A longitudinal

B transverse

C horizontal

D vertical (2)

1.8 If a note that is played on a piano has the same PITCH as one played on a guitar, the two notes have the same ...

A quality.

B amplitude.

C loudness.

D frequency. (2)

1.9 Which one of the following shows the different types of electromagnetic radiation in order of INCREASING frequency?

A Infrared rays; visible light; ultraviolet rays; X-rays

B Infrared rays; X-rays; visible light; ultraviolet rays

C X-rays; ultraviolet rays; infrared rays; visible light

D X-rays; ultraviolet rays; visible light; infrared rays (2)

1.10 Materials that are strongly attracted by magnets and which are easily magnetised are called …

A magnetic storms.

B magnetospheres.

C ferromagnetic.

D magnets. (2)
[20]

QUESTION 2

It is sometimes necessary to separate mixtures into their components. Four separation methods are summarised in the table below.

Method A	Filtering of a muddy-water mixture.
Method B	Distillation of a water-ethanol mixture to remove the water. Ethanol boils at 78°C and water boils at 100°C at sea level. (Distillation is the process by which a liquid is heated to produce a vapour which is then condensed.)
Method C	Separation of salt and iron filings by using a magnet.
Method D	Separation of a water-sunflower oil mixture by using a separating funnel. The sunflower oil is LESS dense than water.

2.1 Classify each of the following mixtures as HETEROGENEOUS or HOMOGENEOUS:

2.1.1 Muddy-water (1)

2.1.2 Ethanol and water (1)

2.1.3 Water and sunflower oil (1)

2.2 Consider method **B**.

2.2.1 Which phase change take place when water boils? (2)

2.2.2 Which one of water or ethanol has the weaker forces of attraction between their molecules? Give a reason for your answer. (2)

2.3 Consider method **C**. Which property of the components in this mixture make the separation method possible? (2)

2.4 Consider method **D**.

2.4.1 Which liquid forms the top layer in the water-sunflower oil mixture? Give a reason for your answer. (2)

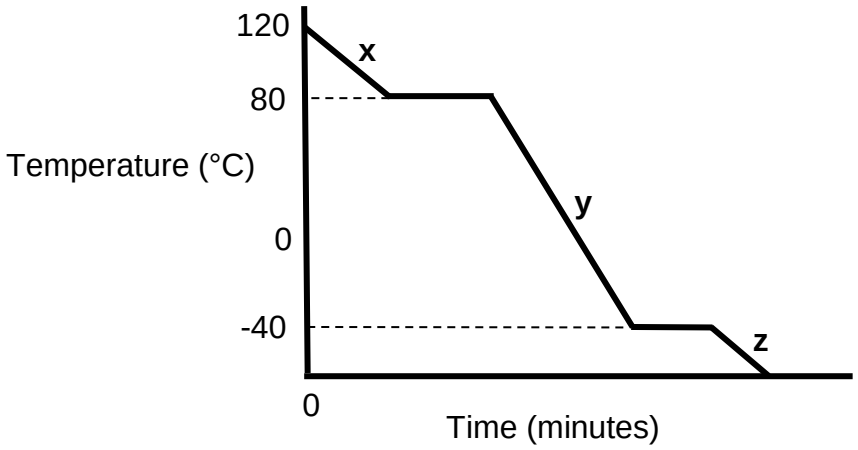
2.4.2 Which one of 250 mℓ water or 250 mℓ sunflower oil has the greater mass? Explain your answer by referring to density. (4)
[15]

QUESTION 3

3.1 Define the term *sublimation*. (2)

3.2 When you take a block of butter out of the fridge, it is hard. However, after 15 minutes at room temperature it is soft enough to spread. Use the kinetic molecular theory to explain this observation. (2)

3.3 The diagram below, not drawn to scale, shows the physical changes of a substance at atmospheric pressure.



3.3.1 Is this diagram a COOLING or a HEATING curve? Explain your answer. (2)

3.3.2 Write down the BOILING point, FREEZING point and MELTING point (IN THIS ORDER) for the substance. (6)

3.4 In what PHASE is the substance:

3.4.1 at 85°C; (2)

3.4.2 at room temperature (25°C); (2)

3.4.3 during the period represented by **z**; and (1)

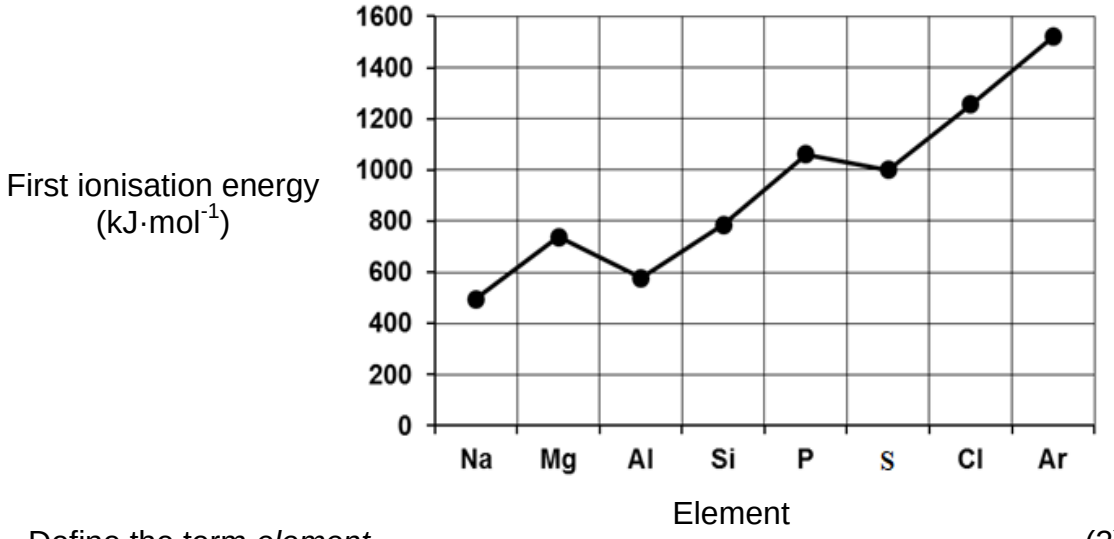
3.4.4 during the period represented by **y**? (1)

3.5 What happens to the temperature of the substance during a PHASE CHANGE? Write down only INCREASES, DECREASES or REMAINS THE SAME and GIVE A REASON for your answer. (3)
[21]

QUESTION 4

The graph below shows the first ionisation energies of elements in period three on the periodic table.

First ionisation energies of elements in period three



4.1 Define the term *element*. (2)

4.2 Use the list of elements on the graph and write down the following:

4.2.1 A noble gas (1)

4.2.2 A metalloid (1)

4.2.3 A halogen (1)

4.2.4 The electron configuration in sp-notation for aluminium (3)

4.2.5 The NAME of the group in which magnesium is found. (1)

4.3 Define the term *first ionisation energy*. (3)

4.4 Describe the general trend in the ionisation energies from sodium to argon as shown in the above-mentioned graph. (2)

4.5 Determine the first ionisation energy of sulphur from the graph. (1)

4.6 Write down the NAME of the element in period three with a first ionisation energy of 1 576 kJ·mol^{-1}. (1)

4.7 When a sodium atom loses an electron, a sodium ion is formed.

4.7.1 How many valence electrons does this ION have? (1)

4.7.2 Which ORBITAL in the sodium atom loses the electron? (1)

[18]

QUESTION 5

Many elements occur in nature as *isotopes*. For example, hydrogen occurs as $^{1}_{1}H$; $^{2}_{1}H$ and $^{3}_{1}H$.

5.1 Define the term *isotope*. (2)

5.2 Write down TWO similarities in atomic structure of these three hydrogen atoms. (2)

5.3 Write down TWO differences in atomic structure of these three hydrogen atoms. (2)

5.4 How do the chemical properties of these three hydrogen atoms compare? Give a reason for your answer. (2)

5.5 The element silicon is found in nature in the form of three isotopes, with the percentages in which they occur, indicated below.

^{28}Si	^{29}Si	^{30}Si
92,23%	4,67%	3,10%

5.5.1 Define the term *atomic number*. (2)

5.5.2 Which one of these isotopes is the heaviest? Give a reason for your answer. (2)

5.5.3 Calculate the relative atomic mass of silicon. (5)
[17]

QUESTION 6

6.1 Butane gas (C_4H_{10}) is used as fuel in cigarette lighters. When butane is ignited, it reacts with the OXYGEN GAS in the atmosphere to form CARBON DIOXIDE and WATER.

6.1.1 Butane has a covalent molecular structure. Which other substance(s) mentioned above is/are also classified as covalent molecular structures? (1)

6.1.2 Draw a Lewis diagram of a water molecule. (2)

6.1.3 Write down a balanced chemical equation for the above-mentioned reaction. (4)

6.2 Consider the following balanced equation of a chemical reaction:

$$Pb(NO_3)_2 + H_2S \rightarrow PbS + 2HNO_3$$

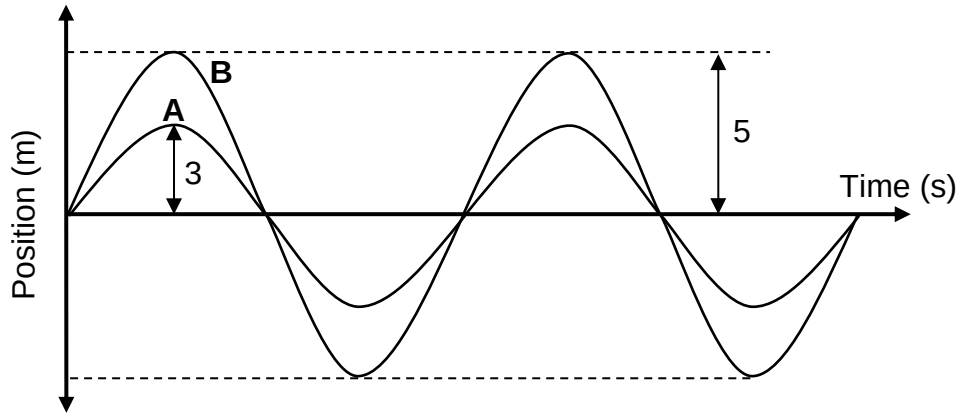
6.2.1 Calculate the total relative atomic mass of the reactants. (2)

6.2.2 Calculate the total relative atomic mass of the products. (2)

6.2.3 Which law is demonstrated by your calculations in questions 6.2.1 and 6.2.2? (1)
[12]

QUESTION 7

7.1 The diagram below shows two waves, **A** and **B**, of the same wavelength but different amplitudes, crossing each other.

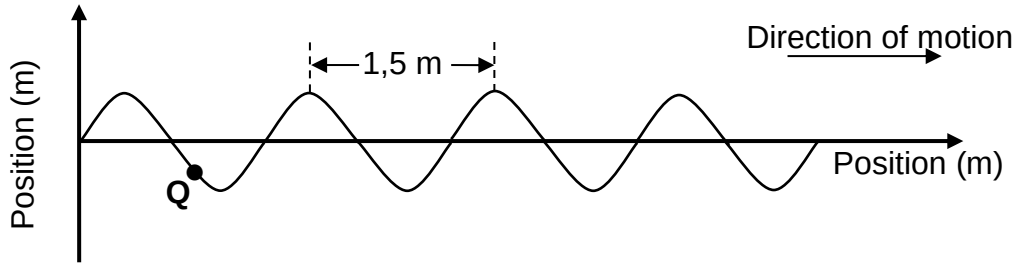


7.1.1 Define the term *amplitude*. (2)

7.1.2 Draw the shape of the RESULTING wave of **A** and **B**. Show the resulting amplitude on your diagram. (2)

7.1.3 Which wave property or principle is illustrated by your diagram in question 7.1.2? (2)

7.2 In the sketch below, not drawn to scale, **Q** represents an object on the surface of the water in a dam. A person standing on a bridge observes that object **Q** is moving up and down and reaches the highest point every 5 s.



7.2.1 Define the term *wavelength*. (2)

7.2.2 In which direction is object **Q** moving? (1)

7.2.3 Calculate the frequency of the wave. (3)

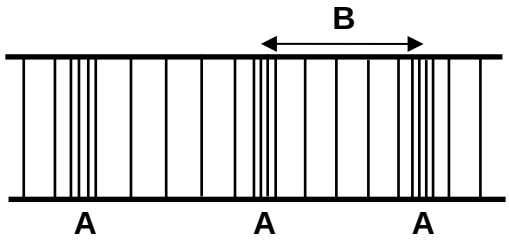
7.2.4 Calculate the speed of the wave. (3)

[15]

QUESTION 8

Diagram 1 represents a sound wave that is produced by a musical instrument.

DIAGRAM 1



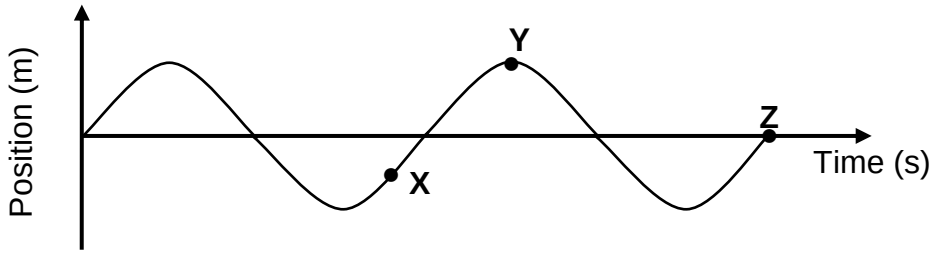
8.1 What is represented by the sections marked with:

8.1.1 **A** (1)

8.1.2 **B** (1)

8.2 The position-time graph in DIAGRAM 2 represents the same sound wave produced by the musical instrument.

DIAGRAM 2



8.2.1 Which ONE of points **X**, **Y** or **Z** in DIAGRAM 2 corresponds to the section labelled **A** in DIAGRAM 1? (2)

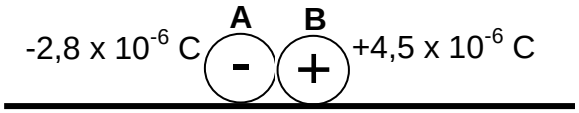
8.2.2 The same note is now played on the instrument, but much LOUDER than before. How will this change affect the graph in DIAGRAM 2? Refer to an aspect that remains the same and an aspect that will be different. (2)

8.3 A sound wave travels from Peter toward a mountain cliff which is 250 m high and 225 m away from him. After a while, he hears the echo. Calculate how long it takes for Peter to hear the echo if the speed of sound in air is 340 $m.s^{-1}$. (4)

[10]

QUESTION 9

Two small, identical metal spheres, **A** and **B**, on an insulated surface, carry charges of -2,8 x 10^{-6} C and +4,5 x 10^{-6} C respectively. The spheres are brought into contact with each other and is then released.



9.1 It is observed that the spheres move apart when they are released. Explain this observation. (4)

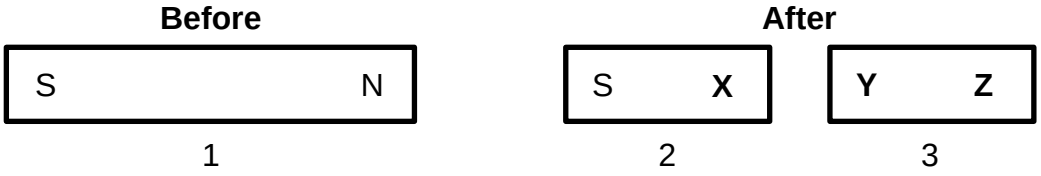
9.2 Calculate the new charge on sphere **A** after they have moved apart (assume that no charge was lost). (3)

9.3 Calculate the number of electrons transferred from one sphere to the other during contact. (3)

[10]

QUESTION 10

Sello was carrying a bar magnet, like the one shown below (before), when it accidentally fell and broke into two equal pieces (after). When he tried to bring the two pieces together, they REPELLED each other.



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

10.2 Identify the poles labelled **X** and **Y** and explain your choice for the pole at **X**. (4)

10.3 Draw the magnetic field pattern for the magnet BEFORE it fell. (3)

10.4 Draw the magnetic field pattern BETWEEN the two smaller magnets (between **X** and **Y**). (3)

[12]

GRAND TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 10
GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10

TABLE 1: PHYSICAL CONSTANTS / *TABEL 1: FISIESE KONSTANTES*

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

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

WAVES, SOUND AND LIGHT / *GOLWE, KLANK EN LIG*

$v = \lambda f$	$E = hf = h\frac{c}{\lambda}$
$Speed = \frac{distance}{time}$ $Spoed = \frac{afstand}{tyd}$	$T = \frac{1}{f}$ OR/OF $f = \frac{1}{T}$

TABLE 3: THE PERIODIC TABLE 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)
2,1 H 1																	2 He 4
1,0 Li 7	1,5 Be 9											2,0 B 11	2,5 C 12	3,0 N 14	3,5 O 16	4,0 F 19	10 Ne 20
0,9 Na 23	1,2 Mg 24											1,5 Aℓ 27	1,8 Si 28	2,1 P 31	2,5 S 32	3,0 Cℓ 35,5	18 Ar 40
0,8 K 39	1,0 Ca 40	1,3 Sc 45	1,5 Ti 48	1,6 V 51	1,6 Cr 52	1,5 Mn 55	1,8 Fe 56	1,8 Co 59	1,8 Ni 59	1,9 Cu 63,5	1,6 Zn 65	1,6 Ga 70	1,8 Ge 73	2,0 As 75	2,4 Se 79	2,8 Br 80	36 Kr 84
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	41 Nb 92	1,8 Mo 96	1,9 Tc	2,2 Ru 101	2,2 Rh 103	2,2 Pd 106	1,9 Ag 108	1,7 Cd 112	1,7 In 115	1,8 Sn 119	1,9 Sb 122	2,1 Te 128	2,5 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

29
1,9 Cu
63,5

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa