education

Department of
Education
FREE STATE PROVINCE

EXAMINATION

GRADE 10

PHYSICAL SCIENCES

JUNE 2017

MARKS: 150

TIME: 3 HOURS

This paper consists of 13 pages and two data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and other applicable information in the appropriate spaces on the ANSWER BOOK.

2. This paper consists of NINE 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 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 necessary.

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 – 1.10) in the ANSWER BOOK.

1.1 Dry air in which there is no pollution material like smoke particles, is an example of a/an ...

A element.

B compound.

C homogeneous mixture.

D heterogeneous mixture (2)

1.2 Which one of the following is a characteristic of a PHYSICAL change?

A The number of molecules does not stay the same during the change.

B Large energy changes usually occur.

C No new products are formed.

D New products are sometimes formed. (2)

1.3 Mpho melts a chocolate bar over low heat and observes the changes. Which one of the following is an accurate observation?

The chocolate ...

A undergoes no change.

B undergoes a physical change.

C undergoes a chemical change.

D decomposes into its constituent components. (2)

1.4 Which one of the following four elements does NOT have the same number of valency electrons than the other three?

A Be

B Mg

C Na

D Ca (2)

1.5 Which one of the following ions has an electron configuration that is DIFFERENT from that of a fluoride ion?

A Na^+

B $C\ell^-$

C Mg^{2+}

D $A\ell^{3+}$ (2)

1.6 Which one of the following electron configurations represents an ION of an ALKALI metal?

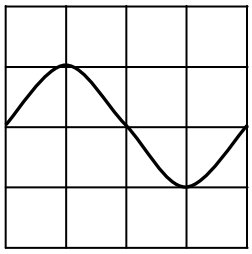
A $1s^2$

B $1s^2\ 2s^2$

C $1s^2\ 2s^2\ 2p^5$

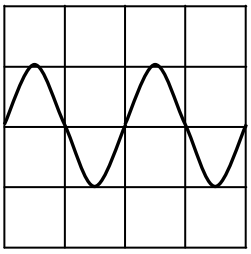
D $1s^2\ 2s^2\ 2p^6\ 3s^1$ (2)

1.7 The following is an image on an oscilloscope of a sound wave with a certain pitch and volume.

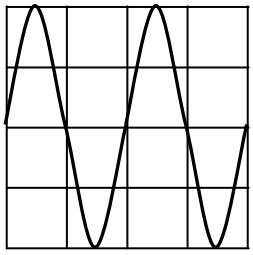


Which one of the following represents a sound wave with a HIGHER pitch, but the SAME VOLUME on the same scale?

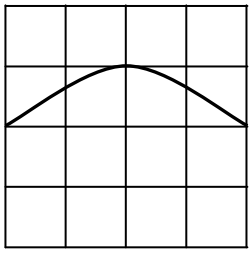
A



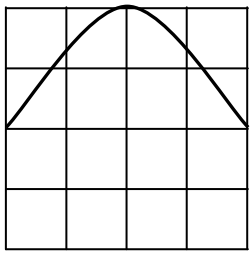
B



C



D



(2)

1.8 A wave in which the particles of the medium vibrate at right angles to the direction in which the wave travels through the medium, is produced by …

A a bat.

B a car's hooter.

C an ambulance.

D an X-ray machine. (2)

1.9 A wave has a speed *v*, frequency *f* and wavelength *λ*. The frequency is then changed to 2*f* while the speed remains the same. What is the magnitude of the wavelength in terms of *λ*?

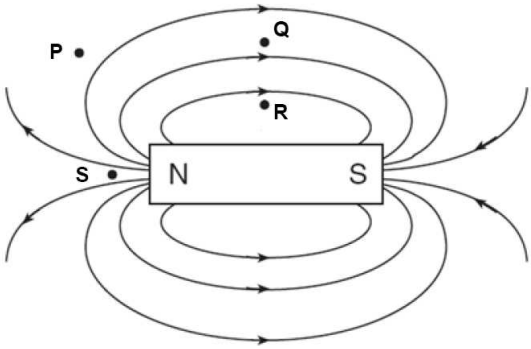
A ½ λ

B λ

C 2λ

D 4λ (2)

1.10 The diagram below represents the magnetic field around a bar magnet.



At which point is the magnetic field the strongest?

A P

B Q

C R

D S (2)
[20]

QUESTION 2

2.1 Consider the following mixtures:

liquid coffee without sugar and without milk; salt water; cereal in milk; garden soil

2.1.1 Write down two heterogeneous mixtures from this list. (2)

2.1.2 Write down two homogeneous mixtures from this list. (2)

2.2 Consider the following elements and compounds:

paper-clips made from copper; sodium hydrogen carbonate crystals; graphite in a pencil; table salt crystals;

2.2.1 Write down TWO compounds from this list. (2)

2.2.2 Write down TWO elements from this list. (2)

2.3 Oxygen gas is considered an element, although each oxygen molecule consists of two bonded oxygen atoms. Give a reason why it is considered an element. (2)

2.4 A learner investigates the separation of mixtures. During his investigation he comes across the following four separation techniques: evaporation, distillation, filtration and magnetic separation.

Choose the best technique from these four to separate the following mixtures:

2.4.1 Copper pieces and iron nails (1)

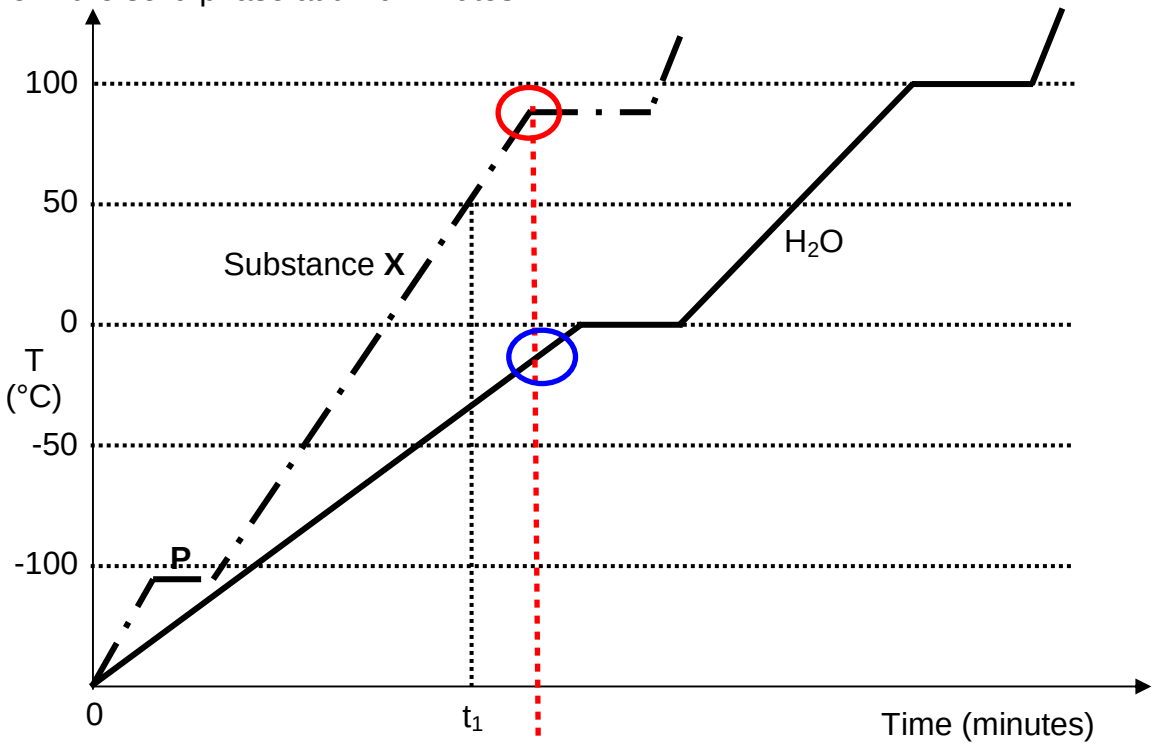
2.4.2 Sugar dissolved in water (it is not necessary to recover the water) (1)

2.4.3 Sand mixed with water (1)

2.4.4 Water and alcohol (1)
[14]

QUESTION 3

The two graphs (not drawn to scale) below represent the change in temperature of two substances, **X** and H_2O, when heated for a certain time. Both substances were in the solid phase at t = 0 minutes.



3.1 What is the melting point, in °C, of H_2O? (1)

3.2 Is the boiling point of **X** HIGHER THAN, LOWER THAN or THE SAME AS the boiling point of H_2O? (1)

3.3 Explain the difference between EVAPORATION and BOILING POINT. (4)

3.4 What process takes place in substance **X** that is represented by the flat part of the graph at **P**? (1)

3.5 In what phase is each substance when the temperature is -10°C? (2)

3.6 In what phase is H_2O when substance **X** begins to change into a gas? (1)

3.7 How does the average kinetic energy of the particles of substance **X** compare with the average kinetic energy of the particles of H_2O at time t_1? (1)

[11]

QUESTION 4

A periodic table is attached at the end of this question paper. Use it to answer the following questions.

4.1 How many electrons does one potassium atom have? (1)

4.2 Write down the formula of a potassium ion. (1)

4.3 How many neutrons are there in one sodium ion? (1)

4.4 Give the name of the element with the symbol N. (1)

4.5 In which group do you find carbon? (1)

4.6 Give the name of the group in which you find fluorine, chlorine and bromine. (1)

4.7 Which one of sodium or argon has the smaller atomic radius? Explain your answer by referring to the period in which the elements occur. (3)

4.8 Explain what is meant by the *first ionisation energy* of an atom. (3)

4.9 A certain element is in group II and period 3 of the periodic table. Write down the following for this element:

4.9.1 Number of valence electrons (1)

4.9.2 Chemical equation that shows the formation of the ion (2)

4.10 Consider the element sulphur.

4.10.1 Write down the name of a metalloid in the same period as sulphur. (1)

4.10.2 Write down the electron configuration of sulphur. (2)

4.11 Consider the element neon.

4.11.1 Draw the Aufbau diagram of neon. (3)

4.11.2 Write down neon's information in the form ${}^{A}_{Z}X$. (2)

4.12 75,8% of the chlorine in nature is the isotope $^{35}C\ell$. The other 24,2% is the $^{x}C\ell$ isotope of chlorine.

4.12.1 Explain what an *isotope* is. (2)

4.12.2 Calculate the approximate relative atomic mass of $^{x}C\ell$. In this case, round off your answer to a whole number. (4)

4.12.3 How many neutrons are there in one atom of $^{x}C\ell$? (2)
[31]

QUESTION 5

Consider a carbon dioxide molecule.

5.1 Explain what a *molecule* is. (2)

5.2 Explain what a *compound* is. (2)

5.3 How many carbon atoms are there in one carbon dioxide molecule? (1)

5.4 How many oxygen atoms are there in one carbon dioxide molecule? (1)

5.5 Draw the Lewis structures of:

5.5.1 A carbon atom (2)

5.5.2 An oxygen atom (2)

5.6 Name the type of bond that exists between the atoms in a carbon dioxide molecule and briefly explain on what principle this type of bond keeps atoms together. (2)
[12]

QUESTION 6

6.1 Aluminium atoms can bond with oxygen atoms to form aluminium oxide.

6.1.1 Name the type of bond that exists between the particles of aluminium and oxygen and briefly explain on what principle this type of bond keeps the particles together. (2)

6.1.2 Subsequently, use Lewis structures to show the bond formation between aluminium and oxygen. Show all the steps and write down the chemical formula of aluminium oxide. (4)

6.2 Write down the chemical formula of the following:

6.2.1 Calcium chloride (2)

6.2.2 Ammonium sulphate (2)

6.2.3 Beryllium nitrate (2)

6.3 Write the following equation in your answer book and balance it:

$CH_4 + O_2 \rightarrow CO_2 + H_2O$ (2)

6.4 When sodium hydroxide (NaOH) and sulphuric acid (H_2SO_4) react, two products, Na_2SO_4 and **X**, are formed. The incomplete equation for the reaction is as follows:

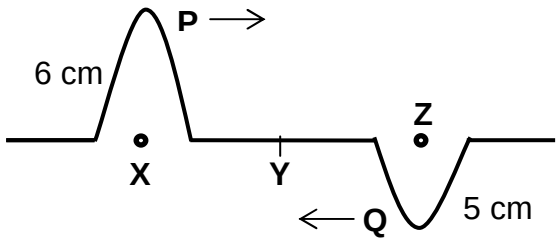
$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + \mathbf{X}$

Use the relative atomic masses on the periodic table and calculate the relative molecular mass of product **X**. (5)

[19]

QUESTION 7

7.1 Two pulses, **P** and **Q**, in a string, approach each other at the same speed. Pulse **P** has an amplitude of 6 cm when it is at point **X**. Pulse **Q** has an amplitude of 5 cm when it is at point **Z**. Points **X** and **Z** are the same distance from point **Y** where the pulses meet. Assume that no energy is lost.



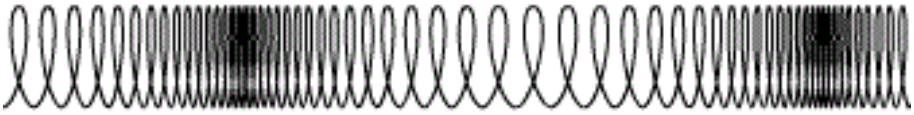
7.1.1 Write down the definition of a *pulse*. (2)

7.1.2 Give the name of the phenomenon that occurs when the two pulses meet at **Y**. (1)

7.1.3 Draw a sketch to show what happens when **P** and **Q** meet at **Y**. Indicate the magnitude of the resultant amplitude in your sketch. (3)

7.1.4 Draw a sketch of the two pulses when pulse **P** reaches point **Z**. Give labels to the pulses to distinguish **P** from **Q** and indicate the magnitudes of their amplitudes. (3)

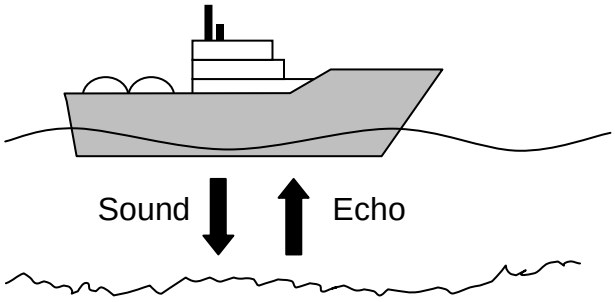
7.2 The following diagram represents a wave in a spring.



7.2.1 What type of wave (longitudinal or transverse) is this? Give a reason for your answer? (3)

7.2.2 The distance from one compression to the next is equal to 10 cm. Calculate the frequency of the wave, in Hz, if the speed of the wave is equal to 20 $cm \cdot s^{-1}$. (4)

7.3 Scientists on a ship at sea must determine the depth of the sea at a specific point. They send a sound wave with a frequency of 18 000 Hz from the ship to the bottom of the sea and receives the echo after 2,4 s.



Calculate the depth of the sea if the wavelength of the sound in the water is 0,085 m. (4)

[20]

QUESTION 8

8.1 Different types of electromagnetic radiation have different frequencies. This can influence both their properties and uses. Consider the information in the following table.

Type of radiation	Wavelength (m)
Ultraviolet	10^{-07}
Gamma	10^{-12}
Infrared	10^{-04}

8.1.1 Write down ONE use of infrared radiation. (1)

8.1.2 Arrange the above-mentioned three types of radiation in order of INCREASING wavelength; i.e. the one with shortest wavelength on the left and the one with the longest wavelength on the right. (2)

8.1.3 Calculate the energy of a photon of ultraviolet light. (4)

8.1.4 Which type of electromagnetic radiation, which is not mentioned in the table, do we use to cook food? (1)

8.2 When doctors need to establish the seriousness of a fracture, a picture is taken of the broken bone. The picture below shows a fracture of someone's forearm.

8.2.1 What the type of electromagnetic radiation is used for taking this picture. (1)

8.2.2 What property of this radiation makes it possible to take the picture? (2)

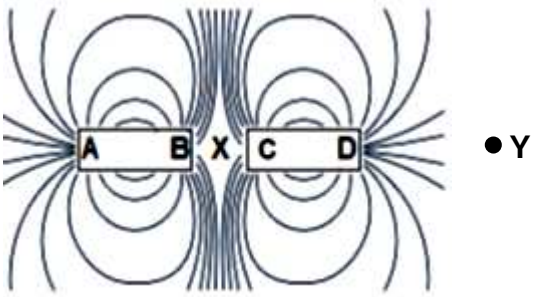
8.2.3 Why is overexposure to this type of radiation dangerous? (1)
[12]

QUESTION 9

9.1 Explain what a *magnetic field* is. (2)

9.2 What general term is used to describe materials that are easily magnetised? (1)

9.3 The diagram below shows the magnetic field pattern of two identical bar magnets with poles **AB** and **CD**.

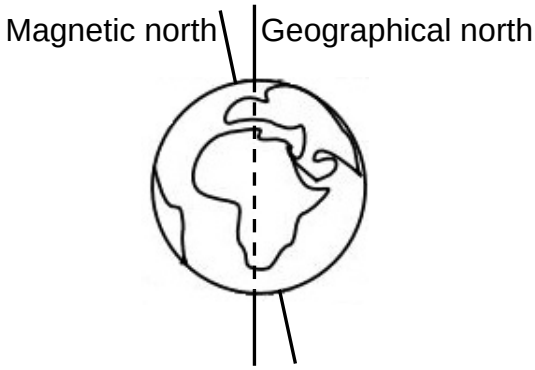


9.3.1 What important information about the polarities of **B** and **C** is obtained from the diagram? (1)

9.3.2 A small piece of magnetic material is placed at point **X**, exactly in the middle between **B** and **C**. Will the material move? Write down only YES, NO or CANNOT TELL. (1)

9.3.3 A small compass is placed at point **Y**. The NORTH POLE of the compass points AWAY from **D**. Do the field lines of bar magnet **CD** point from **C** to **D**, or from **D** to **C**? Give a reason for your answer. (2)

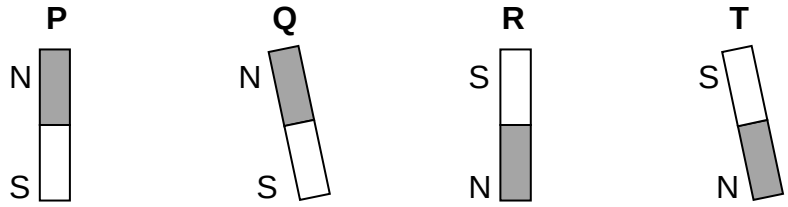
9.4 Earth has a geographical north pole and a magnetic north pole as indicated in the following diagram.



9.4.1 Explain what the *geographical north pole* is. (1)

9.4.2 Explain what the *magnetic north pole* is. (1)

9.4.3 Suppose you have an imaginary bar magnet inside the earth. Which one of the following four pictures, **P**, **Q**, **R** or **T**, represents the correct orientation of such a bar magnet?



(2)
[11]

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	$3,0 \times 10^{8}\ m \cdot s^{-1}$
Planck's constant Planck se konstante	h	$6,63 \times 10^{-34} J \cdot s$
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*

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

TABLE 3: THE PERIODIC TABLE OF ELEMENTS
TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE