GRADE 10

PROVINCIAL FORMAL ASSESSMENT TASK

PHYSICAL SCIENCES
(PHYSICS AND CHEMISTRY)

JUNE 2015

TIME: 3 HOURS

MARKS: 150

This paper consists of 14 pages and 2 information sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate spaces on the ANSWER BOOK.

2. The QUESTION paper consists of TEN 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 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 given 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 What is the formula for sodium thiosulphate if the formula for the thiosulphate ion is $S_2O_3^{2-}$?

    A $S_2S_2O_3$

    B NaS_2O_3

    C $Na(S_2O_3)_2$

    D $Na_2S_2O_3$ (2)

1.2 What is the correct formula for iron(II) oxide?

    A Fe_2O

    B Fe_2O_3

    C FeO

    D FeO_2 (2)

1.3 Which one of the following groups of elements contains METALLOIDS only?

    A   boron, germanium and antimony

    B   boron, bromine and gallium

    C   tin, antimony and tellurium

    D   selenium, arsenic and germanium   (2)

1.4 Consider the following heating curve for ice. The starting temperature **P** is –10°C.
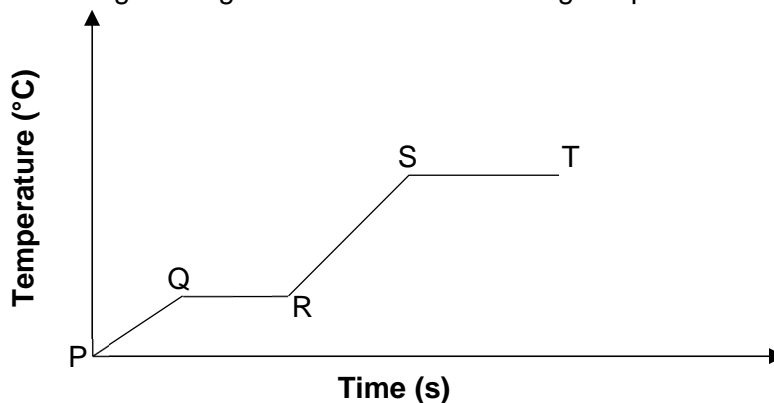
Choose the correct description of the processes taking place during PQ, QR and TS (in this order).

|	PQ	QR	TS
A	Ice melts	Intermolecular forces remain unchanged	Condensation
B	Ice does not melt	Intermolecular forces remain unchanged	Condensation
C	Ice melts	Intermolecular forces are weakened	Evaporation
D	Ice does not melt	Intermolecular forces are weakened	Condensation

        (2)

1.5   Which one of the following is the correct electron configuration for a sulphide ion?

    A   [Ar]

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

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

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

1.6   Study the illustration below.
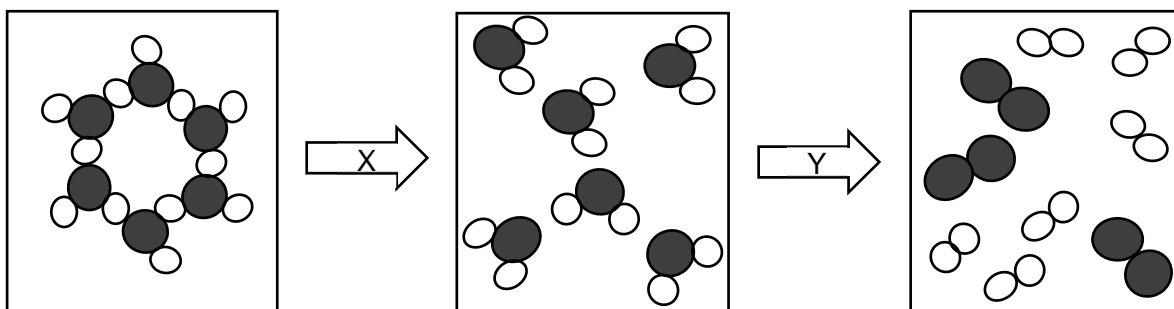
    Which changes are represented by **X** and **Y**?

	X	Y
A	Chemical	Chemical
B	Physical	Physical
C	Physical	Chemical
D	Chemical	Physical

(2)

1.7   Which one of the following is a balanced chemical equation?

    A $Mg(s) + O_2(g) \rightarrow MgO(s)$

    B $N_2(g) + 2H_2(g) \rightarrow 2NH_3(g)$

    C $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$

    D $AgNO_3 + Cu \rightarrow Cu(NO_3)_2 + Ag$ 2)

1.8   A good pair of sunglasses protects our eyes mainly against harmful …

    A   micro waves.

    B   ultraviolet rays.

    C   gamma rays.

    D   infrared radiation.   (2)

1.9   If the air is pumped out off a bell glass, the doorbell hanging inside can be seen
       but not heard. From this can be derived that …

    A   sound waves can propagate through a vacuum, but not light waves.

    B   both sound and light waves can propagate through a vacuum.

    C   light waves can propagate through a vacuum, but not sound waves.

   D   neither sound nor light waves can propagate through a vacuum.   (2)

1.10 Which one of the following statements regarding magnetic field lines is TRUE?

    A   Magnetic field lines are always parallel to each other

    B   Magnetic field lines are drawn closer to each other where the magnetic field is weaker

    C   Magnetic field lines inside a bar magnet are directed from the north pole to the south pole

    D   The arrows drawn on the magnetic field lines indicate the direction of the magnetic field   (2)

[20]

QUESTION 2 (Start on a new page.)

DID YOU KNOW?

According to statistics, 58 billion hamburgers are consumed in the USA per year. As you know, a cheeseburger consists of a bun, a ground beef patty, a slice of cheese, lettuce, onion, pickles and some condiments like tomato sauce and mayonnaise.
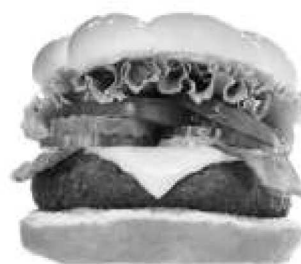

Two grade 10 learners, Phy and Chem, want to make a cheeseburger from scratch. To make the bun for the cheeseburger they mix flour, sugar, salt, yeast and water to form smooth dough.

2.1 Is the dough a heterogeneous or homogeneous mixture?
Give a reason for your answer. (2)

They knead the dough and leave it to rise. While the yeast reacts with the sugar, carbon dioxide forms. The dough rises and doubles in size until it is bloated and soft. They also observe that the temperature of the dough increases.

2.2 Is the process of rising a physical or a chemical change?
Give TWO reasons for your answer. (3)

2.3 Is the process of rising an endothermic or exothermic reaction?
Motivate your answer. (2)

2.4 Is the risen, bloated dough a heterogeneous or homogeneous mixture?
Explain your answer. (2)

2.5 Which type of chemical bond holds together the atoms in a carbon dioxide molecule? (1)

2.6 Draw a Lewis diagram for a carbon dioxide molecule. (2)

**[12]**

QUESTION 3 (Start on a new page.)

Phy and Chem realise that without a proper beef patty, a cheeseburger is not a burger. Fresh ground meat has a red colour because it contains the protein myoglobin. Study the structure of myoglobin below.
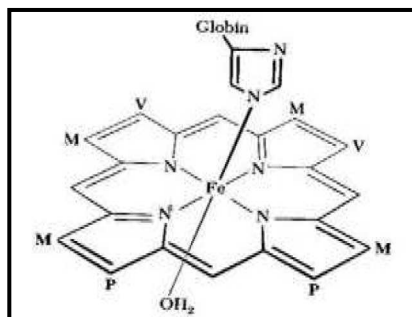
3.1   Explain why myoglobin is a compound.   (2)

Before they grill the beef patty, the meat is red, because of the presence of Fe^{3+} ions in the myoglobin. After the patty is grilled, the meat has a brown colour because of the presence of Fe^{2+} ions.

3.2   Consider the following information for the two ions Fe^{2+} and Fe^{3+}:

$^{56}_{26}Fe^{2+}$ $^{56}_{26}Fe^{3+}$
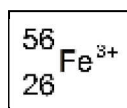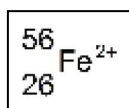
3.2.1   How many electrons are there in Fe^{2+}?   (1)

3.2.2   Are there MORE, LESS or THE SAME number of electrons in Fe^{3+}?   (1)

3.3   When the two learners put the beef patty onto a hot grill, they hear a sizzling sound. This is because the water inside the patty turns into steam.

3.3.1   Give ONE word for the underlined parts in the sentence above.   (1)

3.3.2   Complete the equation to indicate what happens to the water:

         $H_2O(...) \rightarrow ... (...)$ (2)

3.4   When they put a slice of cheese onto the hot patty, the cheese starts to melt almost immediately. Use the kinetic model of matter to explain this observation.   (3)

        Before they put some pickled cucumber on the cheeseburger, they read on the label of the bottle that the cucumber is pickled in brine. Brine is a solution of water and sodium chloride (table salt).

3.5   On the periodic table the electronegativity of sodium is indicated as 0,9 and the electronegativity of chlorine is indicated as 3. Refer to electronegativity and explain why it is most probable that the bond between sodium and chlorine is an ionic bond.   (3)

3.6   Draw the Aufbau diagram (orbital box diagram) for a chlorine atom.   (3)

3.7   How many valence electrons does chlorine have? Use the answer in QUESTION 3.6 to motivate your answer.   (2)

3.8   Write down the electron configuration for sodium, using the *sp*-notation.   (1)

3.9   Use Lewis structures to illustrate how the ionic bond forms between sodium and chlorine.   (3)

3.10   Study the illustration of sodium chloride below.
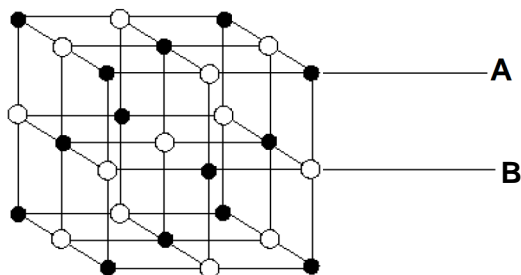
      3.10.1   Identify this structure.   (1)

      3.10.2   Give the name of the forces between particles **A** and **B**.   (1)

     [24]

QUESTION 4 (Start on a new page.)

4.1   Gold is MONO-ISOTOPIC, consisting completely of $^{197}_{79}$**Au**. On the other hand silver occurs naturally as $^{107}_{47}$**Ag** and $^{109}_{47}$**Ag.**

      4.1.1   Rutherford used gold foil in an experiment that made an important contribution to the development of the atomic model. Write down TWO conclusions from his experiment.   (2)

      4.1.2   What is indicated by the numbers **107** and **109**?   (1)

      4.1.3   Explain in detail the reasons for the difference between the numbers mentioned in QUESTION 4.1.2.   (2)

      4.1.4   Calculate the relative atomic mass of silver if it is known that $^{107}_{47}$**Ag** has a 51,8% occurrence in nature and $^{109}_{47}$**Ag** has a 48,2% occurrence.   (4)

4.2   Study the graph below. Indicated on the **x-axis** are the **atomic numbers** of the first 20 elements. Indicated on the **y-axis** are the **first ionisation energies** (kJ·mol^{-1}) and the **atomic radii** (pm) of these elements.

First ionisation energy and atomic radii versus atomic number
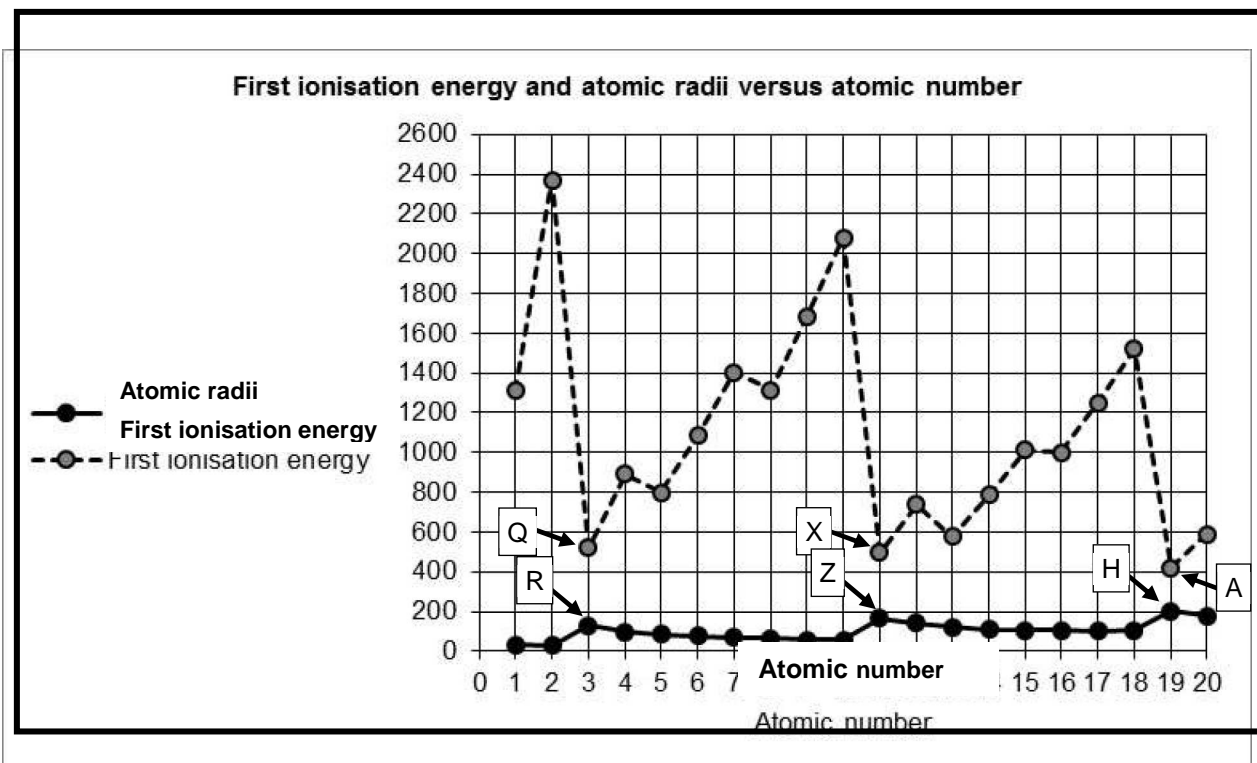
4.2.1   Define *first ionisation energy*.   (2)

4.2.2   What is the magnitude of the first ionisation energy of magnesium in kJ·mol^{-1}?   (1)

4.2.3   What tendency is observed when the following values are compared?
        Q and **R**, **X** and **Z**, **A** and **H**   (2)

4.2.4   Refer to atomic composition and explain the observation made in QUESTION 4.2.3.   (3)

                                                                              [17]

**QUESTION 5 (Start on a new page.)**

Peppy and Luna pours a small amount of hydrochloric acid in test tube **A**. They add a few zinc granules to the hydrochloric acid and then seal off the test tube with a rubber stopper attached to a delivery tube. Test tube **B** is turned upside down and put over the open end of the delivery tube.
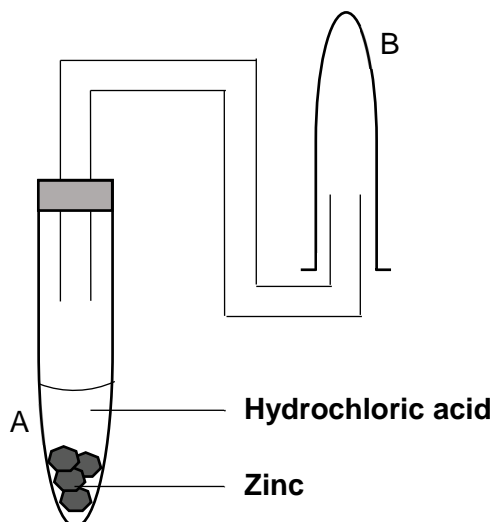
5.1   Which type of bond is present in a zinc granule?   (1)

5.2   The moment the acid and the zinc granules start to react, the temperature of the reaction mixture in test tube **A** increases. Name ONE other observation.   (1)

5.3   Explain why they are holding test tube **B** upside down.   (2)

5.4   Peppy and Luna want to IDENTIFY the gas in test tube **B**. When they ignite the gas, they hear a popping sound. Write down the NAMES of the TWO products that form during the reaction in test tube **A**.   (2)

5.5   Write down a BALANCED chemical equation for the reaction taking place in test tube **A**. Indicate the phases for all reactants and products.   (4)

5.6   After the gas in test tube **B** was identified, they examine the cooled down test tube from close by and discover little water droplets clinging to the inside of test tube **B**. Write down a balanced chemical equation to show how the water droplets have formed.   (3)

5.7   Is the reaction in QUESTION 5.6 an example of a decomposition reaction or a synthesis reaction?   (1)

5.8   Explain why they could only see the droplets of water after the test tube has cooled down.   (1)

[15]

QUESTION 6 (Start on a new page.)

The reaction between sodium hydroxide and sulphuric acid is investigated. One beaker contains sodium hydroxide and another beaker contains sulphuric acid. A few drops of bromothymol blue are added to the contents of each beaker. The solutions are mixed together by pouring them into a third beaker. The colour of the solution in the third beaker turns to green as the solutions are mixed.
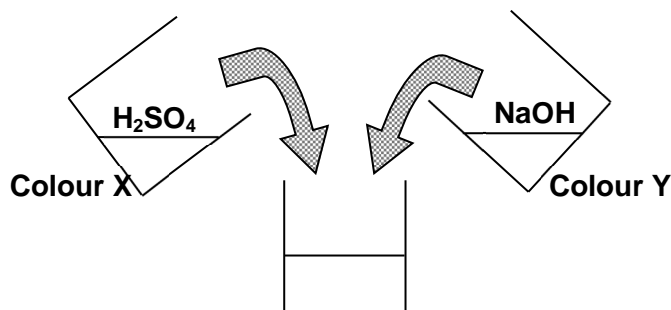
6.1 Identify colours **X** and **Y**. (2)

6.2 Briefly explain why the colour of the mixture in the third beaker turns green as the two solutions are mixed. (2)

6.3 Rewrite the equation for the reaction in your ANSWER BOOK and BALANCE it.

$NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$ (1)

6.4 Prove that the Law of Conservation of Mass is applicable to the reaction above. Show all calculations. (5)

6.5 Which one of statements **A** or **B** below is TRUE for the chemical reaction in QUESTION 6.3?

A During a chemical reaction, molecules are conserved but not atoms.
B During a chemical reaction, atoms are conserved but not molecules.

Write down either **A** or **B** and give a reason for your answer. (2)

[12]

QUESTION 7 (Start on a new page.)

Propane gas (C_3H_8) is used for cooking food. When propane is ignited, it reacts with the oxygen gas in the atmosphere to form carbon dioxide and water.

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

7.2 What is the SIMPLEST mass ratio in which carbon and hydrogen are bond together in propane? Show your calculation. (2)

7.3 How many grams of carbon are there in a 76 g sample of propane? Show your calculations. (4)

7.4 Name the law you used to determine your answer to QUESTION 7.3. (1)

[8]

QUESTION 8 (Start on a new page.)

Learners are investigating the effect sound waves have on each other. They connect two speakers, which are several meters apart, to a signal generator and play the same signal with a single frequency through both speakers. One of the learners walks from speaker 1 to speaker 2, while listening carefully to the sound. At point **A** between the speakers, the learner observes that the sound is LOUDER than at any other point at either side of point **A**.
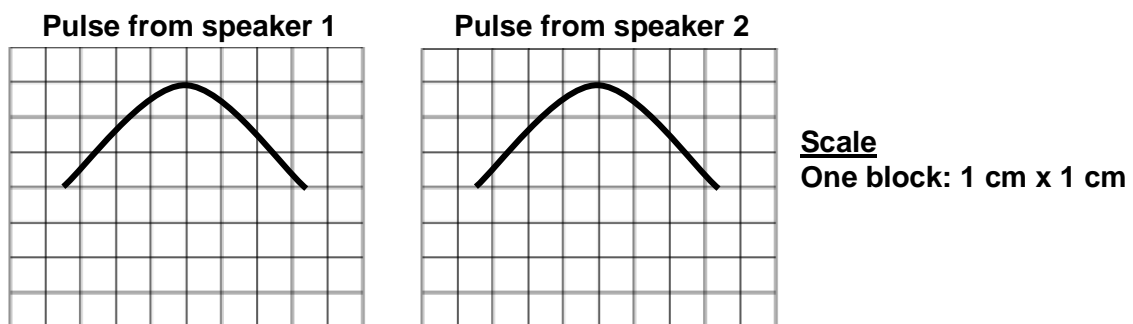

Point **A**
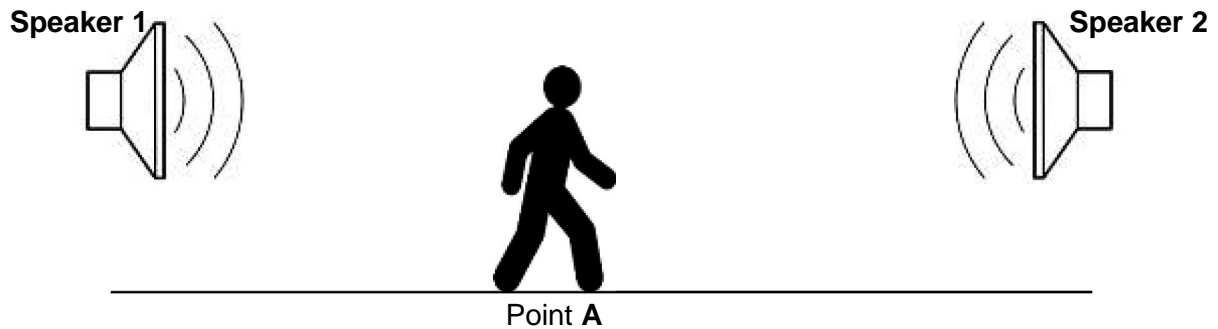
8.1 What type of wave is a SOUND wave? (1)

8.2 Consider the following statement: *The addition of two pulses that occupy the same space at the same moment.*

Which PRINCIPLE is referred to here? (1)

8.3 On an oscilloscope, pulses from speaker 1 and speaker 2 are as illustrated below.

Pulse from speaker 1   **Pulse from speaker 2**

**Scale
One block: 1 cm x 1 cm**

8.3.1 Draw the wave pattern that will appear on the oscilloscope the moment the two pulses reach point **A** simultaneously. The drawing does not have to be to scale, but the magnitude of the amplitude of the pulse at **A** must be indicated on the drawing. (2)

8.3.2 Identify the phenomenon in QUESTION 8.3.1. (2)

8.4 The learners change the frequency of the signal by adjusting the frequency on the signal generator. The image on the oscilloscope will be as follows:
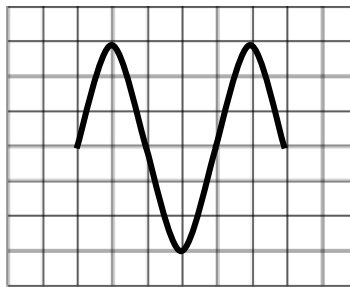
8.4.1 Is the pitch of the signal LOWER, HIGHER or THE SAME? (1)

8.4.2 Motivate your answer to QUESTION 8.4.1. (3)

8.5 If the frequency of the signal generator is set on 457 Hz and the speed of sound in air is 340 m·s^{-1}, calculate the wavelength of the sound. (3)

[13]

QUESTION 9 (Start on a new page.)

9.1 The diagram below shows a boy in a kayak on the ocean.
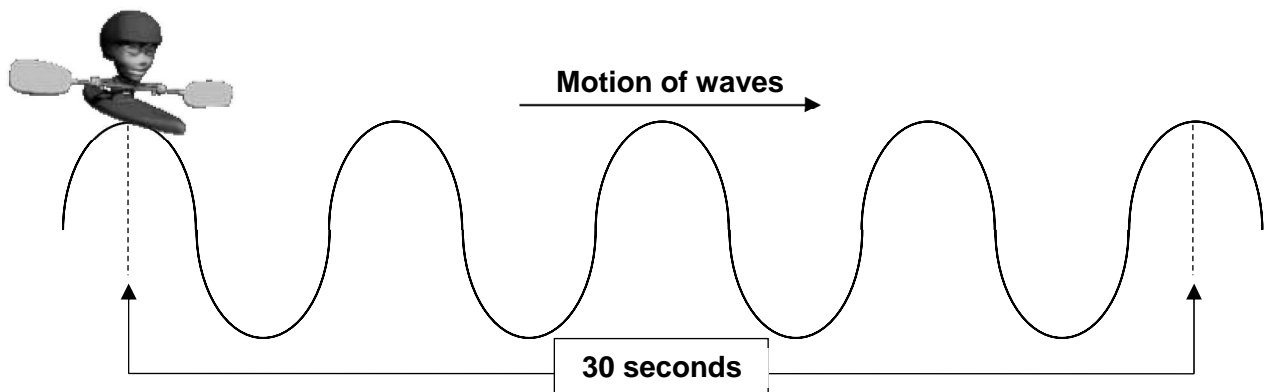
9.1.1 Describe the motion of the boy in the kayak while he is NOT rowing. (1)

9.1.2 If the amplitude of a wave is 1,2 m, how far does the boy and the kayak drop from the crest of a wave to the trough of a wave? (1)

9.1.3 Define the *frequency* of a wave. (2)

9.1.4 Calculate the frequency of the sea wave. Round off your answer to THREE decimals. (2)

9.1.5 If the waves cover 60 m in 30 seconds, determine the wavelength of the waves. Show your calculations. (2)

9.1.6 Calculate the speed of the waves. (3)

9.1.7 After a while, the boy in the kayak finds himself between a fishing boat and a cliff. The fishing boat sends out a sound signal by blowing its foghorn ONCE. The boy though hears TWO sound signals. It takes 7 s for the sound to move from the fishing boat until the boy hears the signal for a SECOND time. The speed of sound in air is 340 m·s^{-1}. The boy is 500 m from the cliff.
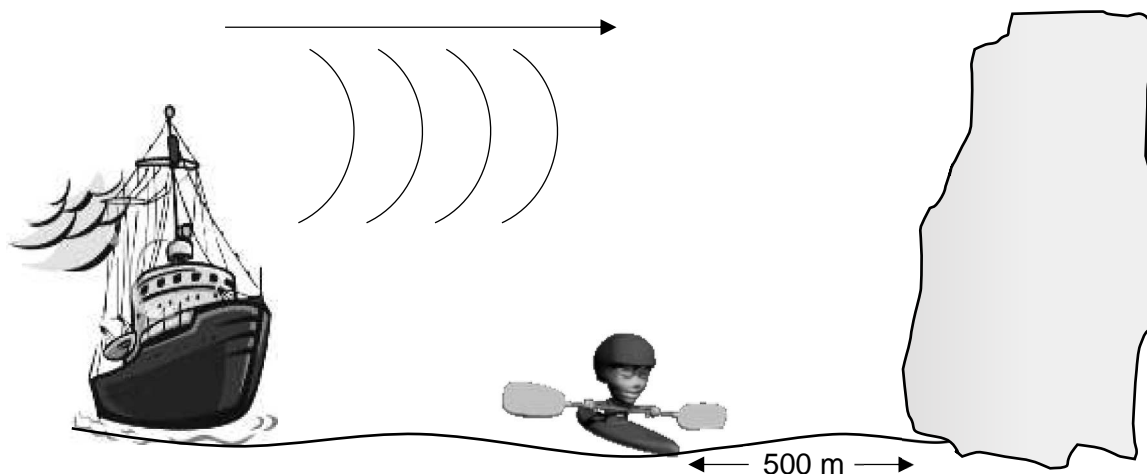
Calculate how far the fishing boat is from the cliff. (5)

9.2 Study the table below.

RADIATION	WAVELENGTH (M)	ENERGY (J)
Gamma-rays	1 x 10^{-12}	1,99 x 10^{-13}
Infrared	1 x 10^{-4}	1,99 x 10^{-21}
Ultraviolet	**QUESTION 9.2.3**	1,33 x 10^{-18}

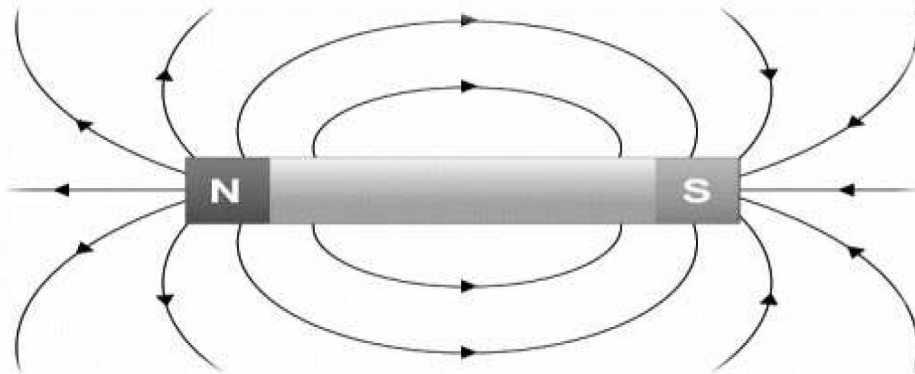9.2.1 What type of radiation is featured in the table? (1)

9.2.2 Which ONE of the listed radiations is used to sterilise medical instruments? Motivate your answer. (2)

9.2.3 Calculate the wavelength of ultraviolet light. (4)

[23]

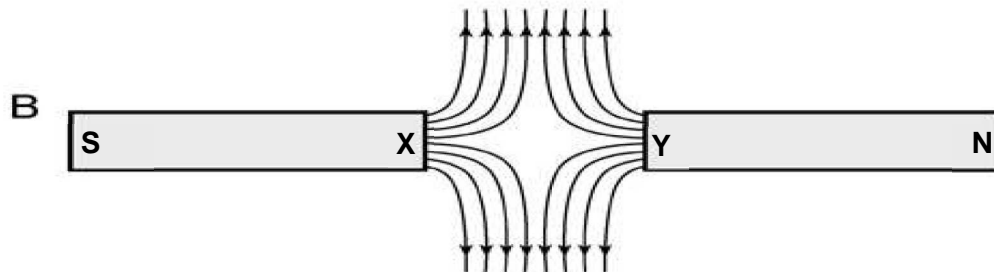**QUESTION 10 (Start on a new page.)**

Shown below is the magnetic field around a bar magnet.

10.1   Define *magnetic field*.   (2)

10.2   The magnet is dropped and it breaks into two pieces. The pieces land on the floor with the poles in the positions indicated below. What will the magnetic field between the two pieces look like? Choose between **A** or **B**.
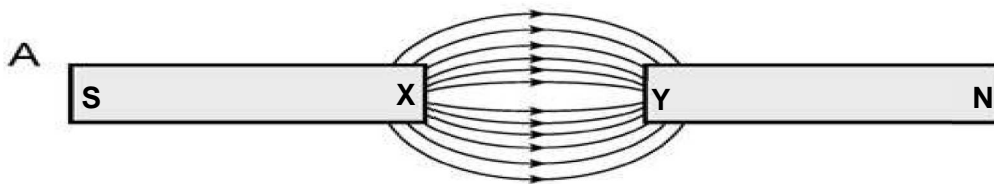
                                                                                             (1)

10.3   Motivate your answer to QUESTION 10.2 by doing the following:

   •   Write the letters **X** and **Y** underneath each other. Next to each letter write either NORTH or SOUTH to indicate the polarity represented by the letter.

   •   Give a brief explanation in words.   (2)

10.4   What protects the earth from solar winds?   (1)
                                                                                          [6]

                                                          GRAND TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10
VRAESTEL 1 (FISIKA)

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*

$v = f\lambda$	$f = \dfrac{1}{T}$ or/*of* $T = \dfrac{1}{f}$
$E = hf = h\dfrac{c}{\lambda}$	

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

KEY/*SLEUTEL*

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

^{1,9} **Cu** 29
63,5

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

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 3 7	1,5 Be 4 9											2,0 B 5 11	2,5 C 6 12	3,0 N 7 14	3,5 O 8 16	4,0 F 9 19	Ne 10 20
0,9 Na 11 23	1,2 Mg 12 24											1,5 Aℓ 13 27	1,8 Si 14 28	2,1 P 15 31	2,5 S 16 32	3,0 Cℓ 17 35,5	Ar 18 40
0,8 K 19 39	1,0 Ca 20 40	1,3 Sc 21 45	1,5 Ti 22 48	1,6 V 23 51	1,6 Cr 24 52	1,5 Mn 25 55	1,8 Fe 26 56	1,8 Co 27 59	1,8 Ni 28 59	1,9 Cu 29 63,5	1,6 Zn 30 65	1,6 Ga 31 70	1,8 Ge 32 73	2,0 As 33 75	2,4 Se 34 79	2,8 Br 35 80	Kr 36 84
0,8 Rb 37 86	1,0 Sr 38 88	1,2 Y 39 89	1,4 Zr 40 91	Nb 41 92	1,8 Mo 42 96	1,9 Tc 43	2,2 Ru 44 101	2,2 Rh 45 103	2,2 Pd 46 106	1,9 Ag 47 108	1,7 Cd 48 112	1,7 In 49 115	1,8 Sn 50 119	1,9 Sb 51 122	2,1 Te 52 128	2,5 I 53 127	Xe 54 131
0,7 Cs 55 133	0,9 Ba 56 137	La 57 139	1,6 Hf 72 179	Ta 73 181	W 74 184	Re 75 186	Os 76 190	Ir 77 192	Pt 78 195	Au 79 197	Hg 80 201	1,8 Tℓ 81 204	1,8 Pb 82 207	1,9 Bi 83 209	2,0 Po 84	2,5 At 85	Rn 86
0,7 Fr 87	0,9 Ra 88 226	Ac 89															

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