HILLCREST HIGH SCHOOL

PHYSICAL SCIENCE EXAM

GRADE 10 **JUNE 2021**
TIME: 2 HRS **TOTAL : 140**
EXAMINER: MRS SMITH **MODERATOR: MS BADENHORST**
MRS KNOX-WHITEHEAD

INSTRUCTIONS

1. This question paper consists of 12 pages and 2 SECTIONS:
   SECTION A (90) SECTION B (50)

2. Answer all the questions from SECTIONS A and SECTION B in the ANSWER BOOK provided.

3. Non-programmable calculators may be used.

4. Number the answers correctly according to the numbering system used in this question paper

6. Give brief motivations, discussions, et cetera where required.

7. Final answers to calculations must be rounded off to **two decimal** places where appropriate.

8. Data sheets and a periodic table are attached for your use.

9. Rule off after each question 1 - 13.

10. Write neatly and clearly.

11. Leave a line between each answer.

SECTION A : CHEMISTRY 90

QUESTION 1: (2 x 6 = 12)

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 – 1.6) in the answer book.

1.1 Which of the following methods would you use to separate out different colours in a black marker pen?

A. Filtration

B. Chromatography

C. Magnetic separation

D. Fractional distillation

1.2 Metal X forms a carbonate with the formula $X_2(CO_3)_3$. Which one of the following is the correct formula for the nitrate of X?

A. $X(NO_3)_2$

B. XNO_3

C. $X_2(NO_3)_3$

D. $X(NO_3)_3$

1.3 Which one of the following is described as a physical change?

A. burning (combustion) of propane from the gas taps in the laboratory

B. evaporation of alcohol

C. iron (III) oxide forming on the engine of a car

D. decomposition of hydrogen peroxide into water

1.4 In which one of the following compounds do both ions have the same electronic structure as neon ?

A. sodium sulphide

B. magnesium chloride

C. sodium fluoride

D. potassium chloride

1.5 Which statement is true?

As you move up and to the right of the Period Table

A atomic radius increases and electronegativity increases

B atomic radius decreases and electronegativity decreases

C atomic radius decreases and electronegativity increases

D atomic radius increases and electronegativity decreases

1.6 The intermolecular forces found between the molecules of ammonia holding the liquid together are called..

A. ion – ion forces

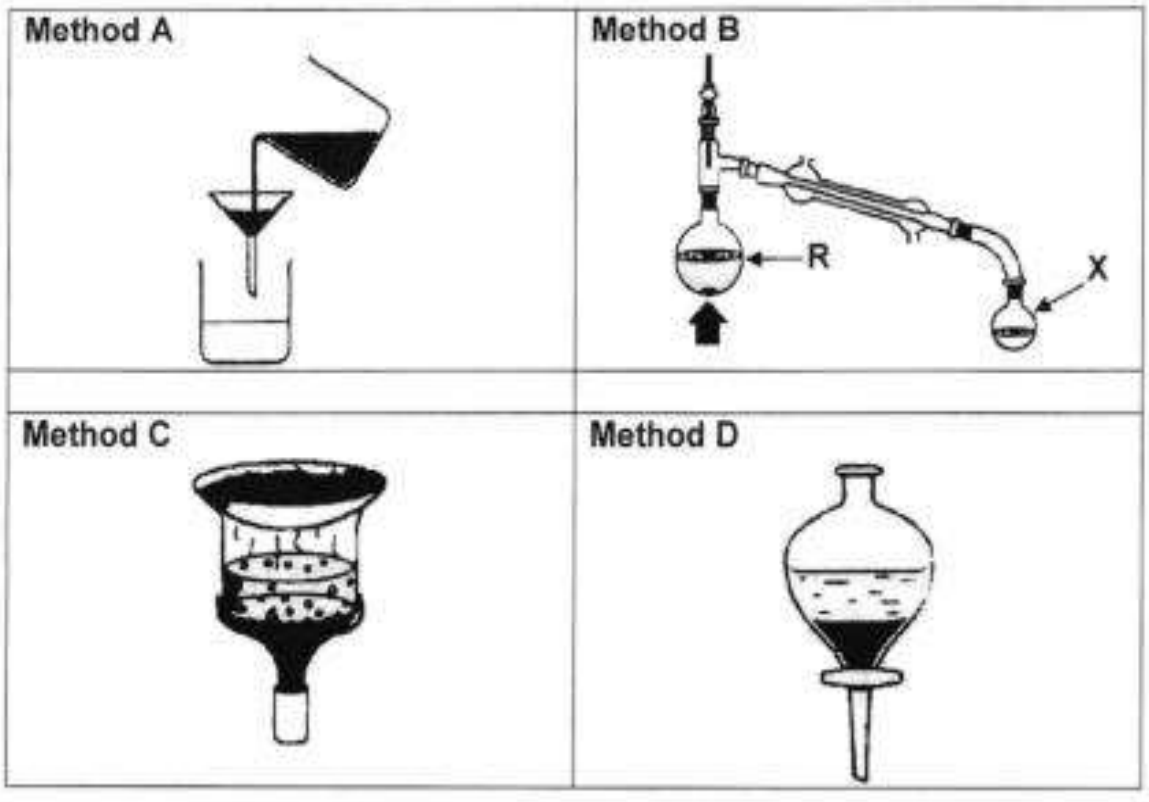
B. Hydrogen bonds

C. Van der Waals forces

D. London forces

QUESTION 2 (7)

Four methods of separations of mixtures are shown in the table below.



2.1 What name is given to the method of separation in D? (1)

2.2 Which method could represent separating a mixture of salt and sand? (1)

2.2 Which method makes use of the property of

2.2.1 density, and (1)

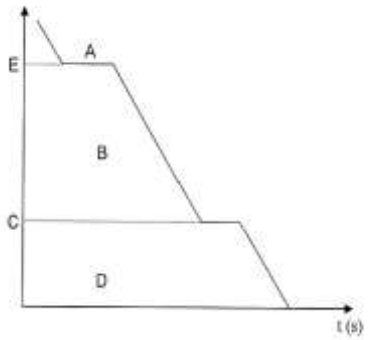
2.2.2 boiling point to separate the mixture? (1)

2.3 The round bottom flask in method B contains a mixture of alcohol and water. Is this a homogeneous or a heterogeneous mixture? Explain your answer. (2)

2.5 What substance is collected at X? (1)

QUESTION 3 (9)

The graph below represents the cooling curve of water



3.1 Identify the variable on the y axis. (1)

3.2 Explain why the curve flattens out at A. (3)

3.3 Which point represents freezing point on the graph? (1)

3.4 Is this an example of a physical or a chemical change? Explain your answer. (2)

3.5 Name the type of

3.5.1 bond that exists between the atoms of hydrogen and oxygen (1)

3.5.2 intermolecular force that occurs between the water molecules. (1)

QUESTION 4 (7)

The first ionisation energies of the first 18 elements are listed below.

ATOMIC NUMBER	IONISATION ENERGY	ATOMIC NUMBER	IONISATION ENERGY (kJ mol $^{-1}$)
1	1317	10	2087
2	2378	11	202
3	526	12	744
4	905	13	577
5	807	14	786
6	1092	15	1060
7	1049	16	996
8	1319	17	1256
9	1687	18	1520

4.1 Define the term 'first ionisation energy'. (2)

4.2 Use the Periodic Table together with the information given in the table to

4.2.1 **identify** which element between the one with an atomic number of 3 and the other with an atomic number of 9 has the higher first ionisation energy (1)

4.2.2 **explain** your answer in QUESTION 4.2.1 by making reference to

- valence electrons
- atomic radius
- energy needed to remove electrons. (3)

4.2.3 **predict** whether the first ionisation energy of the element with the atomic number of 19 has a higher or lower value than the element with the atomic number of 18. (1)

QUESTION 5 (25)

5.1 Write down the chemical formulae for the following substances.

5.1.1 sodium sulphate (2)

5.1.2 magnesium nitrite (2)

5.1.3 potassium dichromate (2)

5.1.4 lead (IV) oxide (2)

5.2 Write down the names of the following compounds, using Stock Notation where necessary

5.2.1 Li_2CO_3 (2)

5.2.2 Fe_2O_3 (2)

5.2.4 HNO_3 (2)

5.2.5 $CuCl_2$ (2)

5.3 Rewrite and balance the following equation:

5.3.1 $Pb(NO_3)_2 \rightarrow PbO + NO_2 + O_2$ (3)

5.3.2 $C_{12}H_{22}O_{11} \rightarrow C + H_2O$ (2)

5.4 Write the following reaction in symbol form and balance the equation (4)

glucose ($C_6H_{12}O_6$) combines with oxygen gas to form water and carbon dioxide gas

QUESTION 6 (23)

6.1 The table below shows the electron structure and mass numbers of elements found on the Periodic Table.
The elements are represented by the letters A – G.

	MASS NUMBER	ELECTRON STRUCTURE
A	7	$1s^2\ 2s^1$
B	36	$1s^2\ 2s^2\ 2p^6 3s^2 3p^5$
C	11	[He] $2s^2\ 2p^1$
D	9	$1s^2\ 2s^2$
E	28	[Ne] $3s^2 3p^2$
F	39	$1s^2\ 2s^2\ 2p^6\ 3s^2 3p^6 4s^1$
G	16	$1s^2\ 2s^2\ 2p^4$

6.1.1 Write down the name of element E (2)

6.1.2. Which element (A - G)

6.1.2.1 has 20 neutrons (2)

6.1.2.2 is an isotope of Cl (2)

6.1.2.3 is an alkali-earth metal (2)

6.1.3 Write down the formula of the compound formed by combining atoms

6.1.3.1 of B and C (1)

6.1.3.2 of F and G (1)

6.1.4 What type of bonding takes place between atoms of :

6.1.4.1. A (1)

6.1.4.2. D and B (1)

6.1.5 Draw a Lewis Diagram for a **molecule** of element G (2)

6.1.6 Write down the electron structure (s p notation) for an ion of element F. (2)

6.2 Element B exists in two isotopic forms by mass: namely B-35 and B- 37. It also has a relative atomic mass of 35,5 amu.

Calculate the percentage abundance of these two isotopes of B. (5)

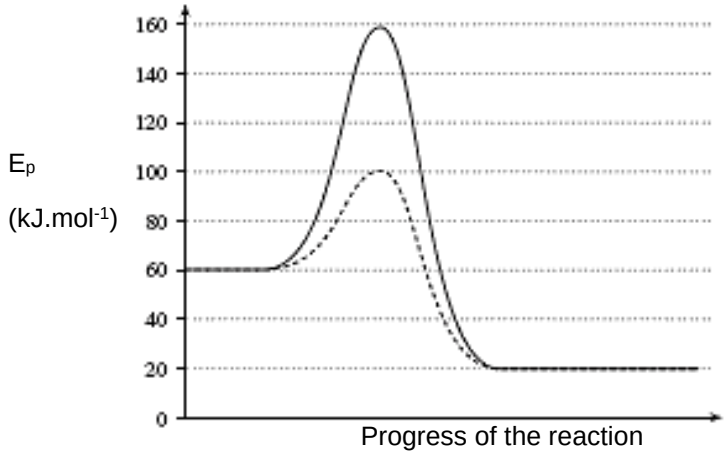
6.3 State the type of intermolecular forces found between molecules of

6.3.1 ammonia (1)

6.3.2 HCl (1)

QUESTION 7 (7)

Consider the following potential energy diagram for a chemical reaction.



7.1 Calculate the heat of the reaction (ΔH) (3)

7.2 What is the value for the activation energy for the reaction? (2)

7.3 What change was made to the reaction in order for the activation energy to decrease (1)

7.4 Is the reverse reaction endothermic or exothermic? (1)

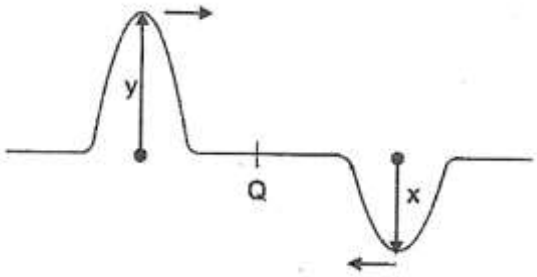
SUB TOTAL (90)

SECTION B : PHYSICS (50)

QUESTION 8 (4 X 2 = 8)

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 (6.1 – 6.4) in the answer book.

8.1 Two pulses are travelling towards each other along a string, as shown in the diagram below.



When the centres of the two pulses meet at Q, the amplitude of the resultant pulse will be…..

A. X + Y

B. 2(x + y)

C. y – x

E. 2(y – x)

8.2 Consider the following three statements concerning ultraviolet radiation

(i) it cannot be reflected

(ii) it has a longer wavelength than gamma radiation

(iii) it is radiated from the sun and may be harmful to humans

Which one of the following combinations is CORRECT?

A. (i) and (ii) only

B. (ii) and (iii) only

C. (i) and (iii) only

D. (i) , (ii) and (iii)

8.3 Which one of the following combinations below concerning the pitch and loudness of sound is correct?

The pitch depends on:

	PITCH	LOUDNESS
A.	amplitude of vibration	frequency
B.	frequency	amplitude of vibration
C.	frequency	speed of vibration
D.	Speed of vibration	frequency

8.4 Two photons of electromagnetic radiation travelling through a vacuum have different energies because they have different

A. frequencies

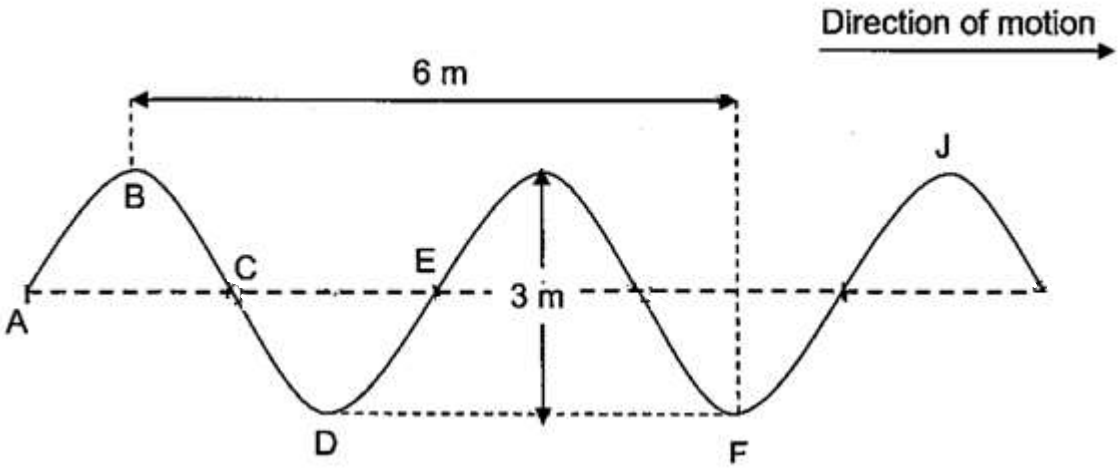
B. intensities

C. amplitudes

D. velocities

QUESTION 9 (12)

The diagram below represents a water wave moving from left to right. The time between two consecutive crests is 0,5 s.



9.1 What type of wave is a water wave? (1)

9.2 Write down the amplitude for this wave. (1)

9.3 Determine the wavelength of the wave. (2)

9.4 Identify any TWO points on the waveform that are in phase. (1)

Calculate

9.5 The time taken for FOUR crests to move past a certain point in the path of the wave. (3)

9.6 The speed at which the wave is moving. (4)

QUESTION 10 (6)

Luke is fishing from a pier and observes a train of waves approaching him and moving towards the shore.

He also notices that the crest of each new wave passes him every 5 seconds and that the distance between two successive wave crests is 4 m.

10.1 Define the term 'crest'. (1)

10.2 Calculate the frequency of the waves observed by Luke. (2)

10.3 Calculate the speed at which the waves are approaching the shore. (3)

QUESTION 11 (5)

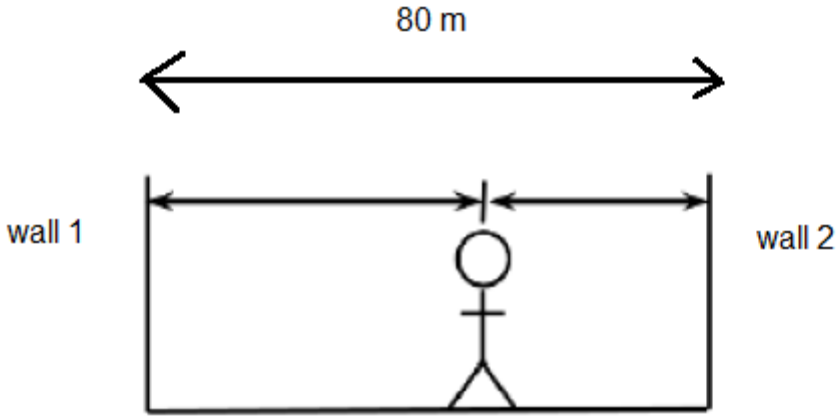
A local East Coast radio station broadcasts radio waves at a frequency of 94 MHz.

11.1 What is the <u>nature</u> of the waves generated by the radio station? (1)

11.2 Calculate the wavelength of the radio waves produced. (4)

QUESTION 12 (9)

Aya stands in the middle of a large hall and decides to send out an ultrasonic sound wave to determine how far each wall is away from him. The total distance from wall 1 to wall 2 is 80m.



12.1 What is an ultrasonic wave? (1)

12.2 Each wall is fitted with a receiver that measures how long the sound takes to hit it.
The sound waves takes 0,01 s longer to reach wall 1 than it takes to reach wall 2.
If the speed of sound in air is 340 $m.s^{-1}$, calculate the distance from Aya to wall 1.
(Hint- use simultaneous equations.) (8)

QUESTION 13 (10)

13.1 An electromagnetic wave with a wavelength of 5.5 mm moves through space at a speed of 3×10^8 $m.s^{-1}$.
Calculate the energy of one photon of the above electromagnetic wave. (5)

13.2 The above electromagnetic wave is an example of a **gamma** ray.
This type of wave is very dangerous and can cause serious damage.
By referring to frequency, wavelength, penetrating ability and the energy of the photons, explain the above statement and state the serious side effects of exposure. (5)

SUB TOTAL (50)

TOTAL (140)

FORMULAE WAVES / SOUND/ LIGHT : $v = f\ \lambda$ $f = \frac{1}{T}$ $E = h\ f$

$\Delta x = v.\ \Delta t$ $E = h\ \frac{c}{\lambda}$

CONSTANTS	
speed of light in a vacuum	C = 3 x 10^{8} $m.s^{-1}$
Planck's constant	h= 6,63 x 10^{-34} J.s