HILLCREST HIGH SCHOOL

PHYSICAL SCIENCE **GRADE 11**

IMF AND GASES MAY 2020

INSTRUCTIONS:

- **Answers must be rounded off to TWO decimal places**
- **Leave no spaces between values and units**

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Avogadro's constant *Avogadro-konstante*	N_A	$6,02 \times 10^{23}$ mol^{-1}
Molar gas constant *Molêre gaskonstante*	R	8,31 J·K^{-1}·mol^{-1}
Standard pressure Standaarddruk	p^{θ}	$1,013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	22,4 dm^3·mol^{-1}
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K

Question 1

Multiple choice question. Write only the letter of the correct option

1.1 What is the molecular shape and polarity of a SF_6 molecule?

A Octahedral and polar

B Trigonal bipyramidal and non-polar

C Octadedral and non-polar

D Hexahedral and non-polar

1.2 Which of these combinations are miscible in each other?

i HCl in CCl_4

ii Ethanol (C_2H_5OH) in H_2O

iii N_2 in H_2O

iv H_2O in NH_3

A Only i

B Only ii

C ii and iv

D i and iv

1.3 In which one of the following compounds are the bonds **most pure** covalent?

A. $KC\ell$
B. $CaC\ell_2$
C. $C\ell_2$
D. $BeC\ell_2$

1.4

Which one of the following statements about hydrogen bonds is **correct**?

A. They occur between molecules of hydrogen
B. They are weaker than Van der Waals forces
C. They occur between molecules which contain hydrogen bonded to a small highly electronegative atom
D. They are bonds formed between hydrogen atoms.

Question 2

Substance	**Formula**	**Melting point (°C)**	**Boiling point (°C)**
hydrogen	H_2	-259,14	-252,87
methane	CH_4	-182,5	-161,5
water	H_20	0	100
ammonia	NH_3	-77.7	-33.3
hydrochloric acid	HCl	-114,22	-85,05
hydrogen fluoride	HF	-83,6	19,5

2.1 Which substance has the strongest intermolecular forces at room temperature? Refer to the table to explain your answer.

2.2 Which key words would you use to explain your answer in 2.1

Strongest IMF

Highest Boiling point

Weakest IMF

Lowest Boiling point

2.3 Name the type of intermolecular forces that exists between the following:

Choose from the following list of words

2.3.1 The molecules of NH_3 (1)

Hydrogen-bonding

Van der Waals: dipole-dipole

Van der Waals: London

Van der Waals: dipole-induced dipole

Ion-dipole

Ion-induced dipole

Covalent bonding

Ionic bonding

Metallic bonding

2.3.2 The molecules of H_2

Hydrogen-bonding

Van der Waals: dipole-dipole

Van der Waals: London

Van der Waals: dipole-induced dipole

Ion-dipole

Ion-induced dipole

Covalent bonding

Ionic bonding

Metallic bonding

2.3.3 The molecules of CH_4

Hydrogen-bonding

Van der Waals: dipole-dipole

Van der Waals: London

Van der Waals: dipole-induced dipole

Ion-dipole

Ion-induced dipole

Covalent bonding

Ionic bonding

Metallic bonding

2.4 Explain the difference between the melting and boiling points of HCl and HF, by selecting the correct key phrases. (4)

HCl has hydrogen bonding between molecules

HCl has Van der Waals, dipole-dipole forces between molecules

HCl has Van der Waals, London forces between molecules

HF has hydrogen bonding between molecules

HF has Van der Waals, dipole-dipole forces between molecules

HF has Van der Waals, London forces between molecules

Hydrogen bonding is stronger than Van der Waals, dipole-dipole forces

Hydrogen bonding is stronger than Van der Waals, London forces

Van der Waals, dipole-dipole forces are stronger than Van der Waals, London forces

HF thus has a higher boiling point

HCl thus has a higher boiling point

2.5 Give the formula of the substance (from the table) that would have the highest vapour pressure?

2.6 Give the formula of the substance (from the table) that would have the highest viscosity?

Question 3

Consider the following list of substances and answer the questions that follow.

HF ; BCl_3 ; CF_4 ; NH_3 ; CO_2 ; SCl_6 ; PH_4^+; $MgCl_2$

3.1 From the list write down the formula/e of:

3.1.1 a substance that can sublime at room temperature

3.1.2 the compound that is MOST POLAR

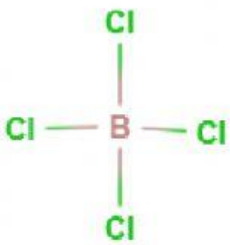
3.1.3 a molecule that contains dative covalent bond/s

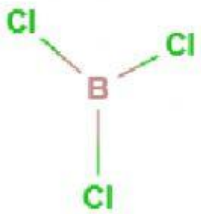
3.1.4 an ionic compound

3.1.5 which substance/s are most likely to dissolve in chloroform (CCl_4)

3.2

3.2.1 Select the correct couper structure for the BCl_3 molecule





3.2.2 What is the shape of the BCl_3 molecule called?

3.3 The bond polarity for CF4 is: polar non-polar

3.4 The molecular polarity for CF4 is: polar non-polar

3.4 Explain the above by choosing the correct key words

There is an electronegativity difference between carbon and fluorine

There is no electronegativity difference between carbon and fluorine

The bond between C and F is polar

The bond between C and F is non-polar

The molecule is symmetrical

The molecule is asymmetrical

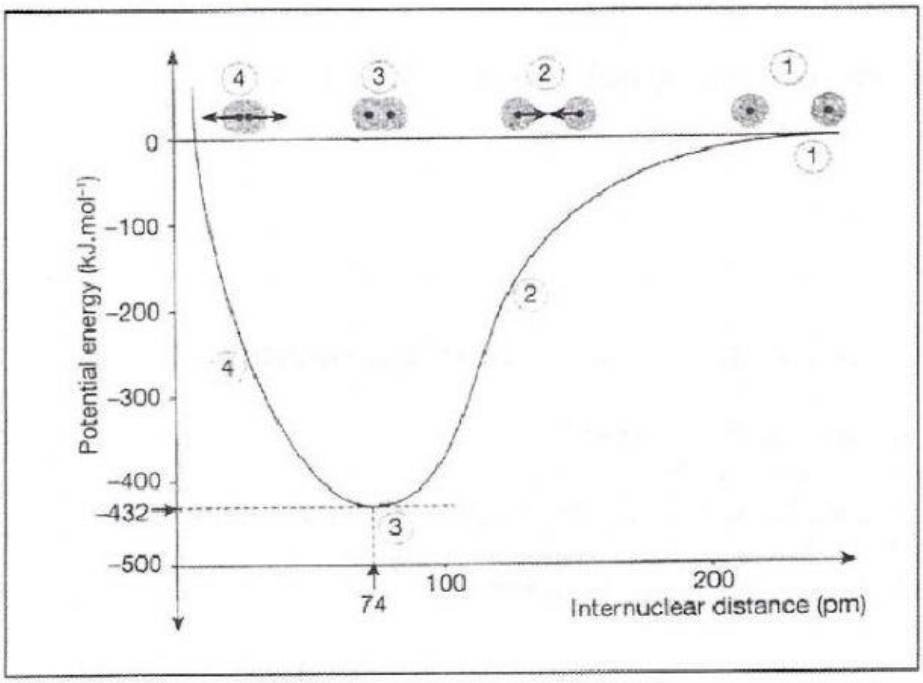
The distribution of charge is symmetrical

The distribution of charge is asymmetrical

Thus the molecule is polar

Thus the molecule is non-polar

Question 4



4.1 Using the graph:

4.1.1 Determine the potential energy of the two isolated atoms. $kJ.mol^{-1}$

4.1.2 Determine the bond energy (bond strength) of the H_2 molecule. $kJ.mol^{-1}$

4.1.3 Determine the bond length of the H_2 molecule. pm

4.2 What happens to the energy when the two atoms are exceedingly close to each other. Write down INCREASE, DECREASE or REMAIN THE SAME.

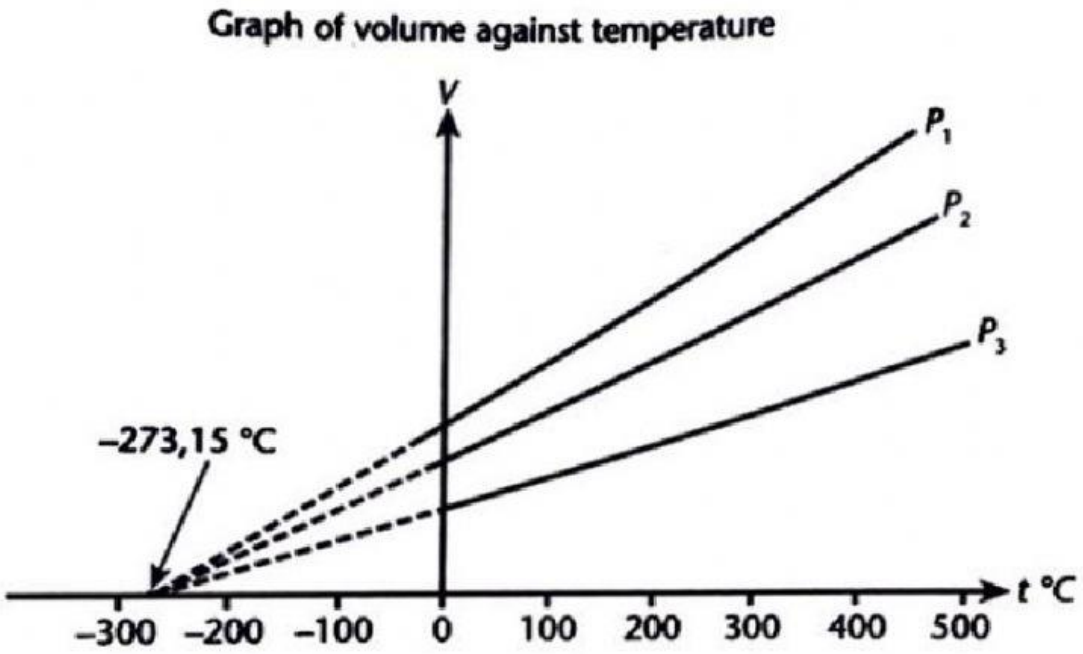
4.3 Explain the reason for your answer in 4.2, by selecting the correct key phrase

There is an increase in repulsion between molecules

There is a decrease in repulsion between molecules

Question 5

The graph below shows the relationship between the volume and Celsius temperature of an enclosed gas maintained at a constant pressure P_1. The experiment is repeated for different constant pressures P_2 and P_3.



5.1.1 Give the name of the law illustrated in the graph

5.1.2 Apart from pressure, state one other variable that must be kept constant for each experiment.

5.1.3 What is the relationship between volume and temperature of the gas

Volume and temperature has a directly proportional relationship

Volume and temperature has a inversely proportional relationship

5.1.4 Which one of the pressures, P_1; P_2 or P_3 is the Highest?

5.2 A $10dm^3$ steel vessel that holds a sample of oxygen gas at 25°C and 100kPa develops a leak. Some of the oxygen gas escapes before the leak is repaired. The pressure of the O_2 in the vessel after the leak is repaired is 55 kPa. The temperature remains at 25°C.

Calculate the mass of the oxygen gas that **leaked**.

***hint –determine the mass of oxygen before and after the leak**

This is a 2 step question

Type the answer to the first part into the first block and the second into the 2nd block

n = {3 decimals}

m = {3 decimals}

Question 6

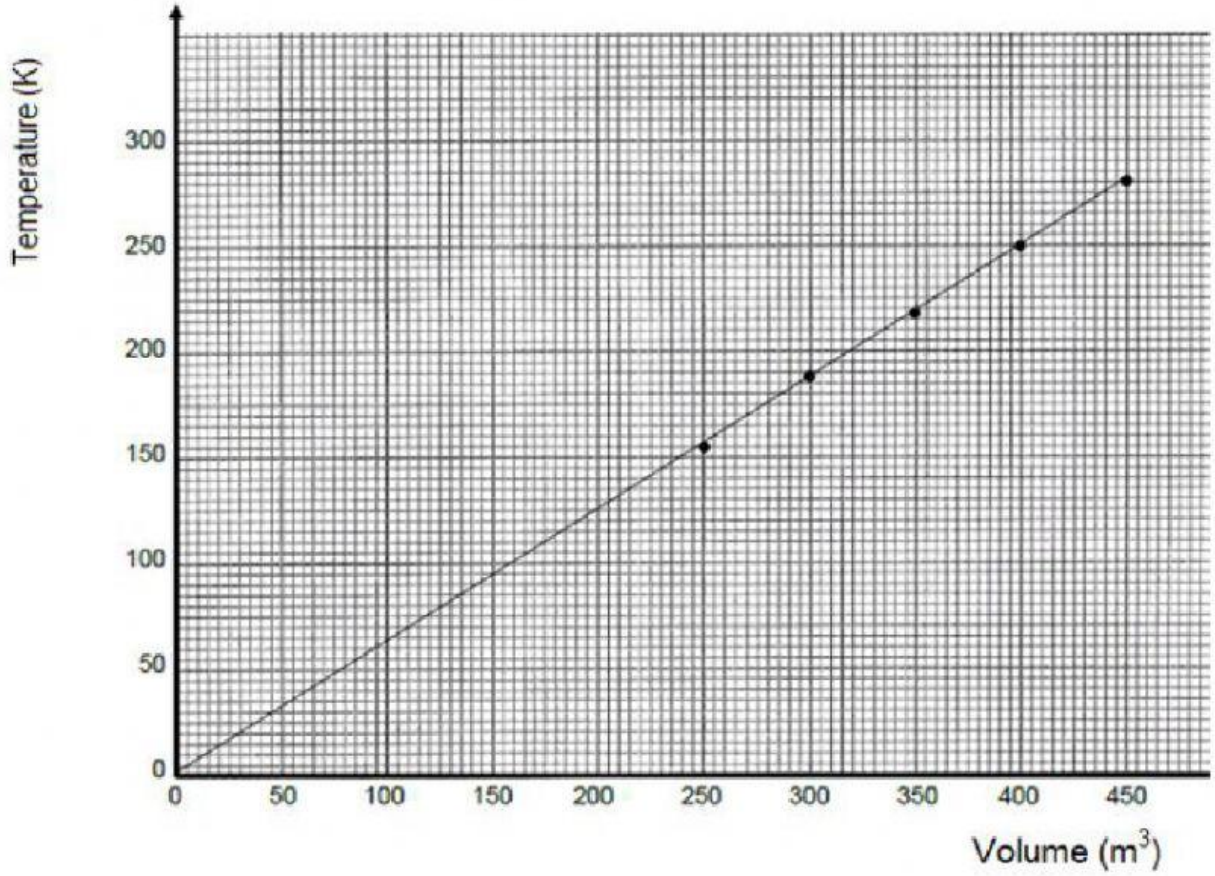
When the temperature of a system is doubled, the pressure changes from 102 kPa to 300 kPa. If the original volume was $5dm^3$, calculate the volume (in dm^3) at the new temperature.

V =

Question 7

The relationship between Temperature and volume is investigated and a graph drawn

The gas is at atmospheric pressure.



7.1 What does the gradient of the graph represent?

_____

7.2 Calculate the gradient of the graph {2 decimal places)

7.3 Calculate the number of moles of the gas by using the gradient calculated

n =