ALEXANDER ROAD HIGH SCHOOL

JUNE 2019 2 HOURS

PHYSICAL SCIENCE

CO / JA TOTAL = 100

GRADE 11

Instructions

- The question paper consists of 7 questions.
- Answer all the questions.
- Answer section A on the answer sheet provided.
- Answer section B on the folio sheets provided.
- A non-programmable calculator may be used.
- Number the answers correctly according to the numbering system used on this question paper.
- The data sheet is included at the end of the paper. The periodic table is on the back of the answer sheet.
- Round off to two (2) decimal places unless otherwise stated.

SECTION A

- Answer on the answer sheet -

1.1 Intermolecular forces

A Hold atoms into a molecule

B Are formed by sharing electrons

C Are formed by transferring electrons

D Hold molecules into the solid, liquid or gas phase

1.2 Van der Waals forces are

(a) Stronger than covalent bonds

(b) Weaker than hydrogen bonds

(c) Stronger between larger molecules

A a and b are true

B b and c are true

C a and c are true

D a and b and c are true

1.3 In which of the following will ion-dipole forces be found?

A Sodium fluoride (NaF) dissolved in water

B Oxygen dissolved in water

C Liquid oxygen

D Solid table salt

1.4 In which of the following cases will the solute dissolve in the solvent

A NaCl in CCl_4

B CCl_4 in H_2O

C C in H_2O

D $NaNO_3$ in H_2O

1.5 The number of particles in 80g of Calcium will be…

A $80 \div 6{,}02 \times 10^{23}$ atoms

B $2 \times 6{,}02 \times 10^{23}$ molecules

C $40 \div 6{,}02 \times 10^{23}$ molecules

D $2 \times 6{,}02 \times 10^{23}$ atoms

1.6 The empirical formula for a substance with 36,5% Sodium, 25,4% sulfur and 38,1 % oxygen per mass is

A $Na_2S_2O_3$ B Na_2SO_3

C Na_2SO_4 D $NaSO_2$

1.7 If you had 10g of each of the following compounds, which sample would have the largest number of moles

A ammonia

B methane

C carbon dioxide

D hydrogen sulfide

1.8 The heat content of a substance at constant pressure (e.g. reactants), represented by **H,** is known as

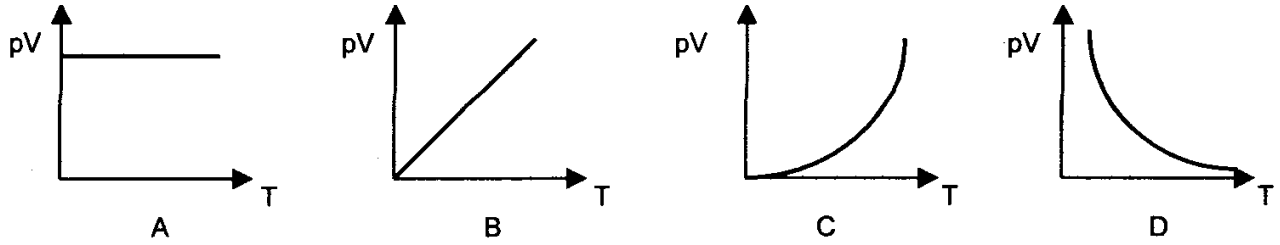
A. binding energy

B. enthalpy

C. activation energy

D. activated complex

1.9 A certain mass of an ideal gas is heated and the corresponding changes in pressure (p), volume (V) and Kelvin temperature (T) are recorded. Which one of the following graphs shows the correct relationship between p, V and T? B



1.10 The gas that would deviate the most from **ideal gas** behaviour, under high pressure, is…

A CO_2

B He

C N_2

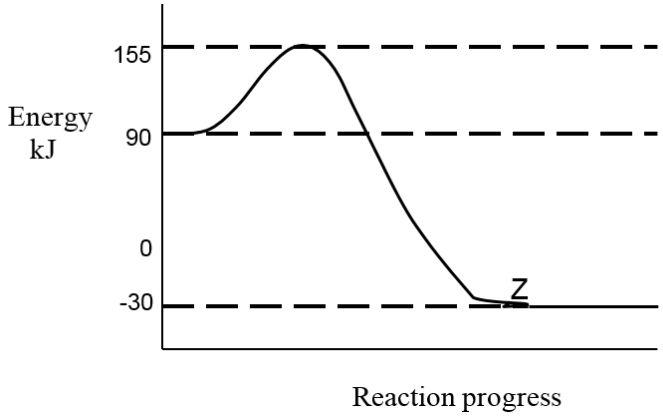
D H_2

[2 X 10 = 20]

QUESTION 2

The sketch below represents the potential energy graph for the reaction

$$X(g) + Y(\ell) \rightarrow Z(aq)$$



Refer to the diagram and answer the following.

2.1 Define activation energy. (1)

2.2 What is the value of the activation energy in the graph above? (1)

2.3 How much energy was released when Z formed? (2)

2.4 Calculate the value of the heat of reaction (change in heat)? (2)

2.5 Is the forward reaction EXOTHERMIC or ENDOTHERMIC? Give a reason for your answer. (2)

2.6 Draw a potential energy graph indicating the reaction path with a catalyst present for a reaction where $\Delta H > 0$. (2)

[10]

QUESTION 3

One of the stages in the industrial production of nitric acid is to prepare NO gas.
The **balanced** equation for this process is

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$

It is given that there are 750g of **each** reactant. The reaction occurs at STP.

3.1 Give the physical values associated with STP. (2)

3.2 Determine the limiting reactant. Clearly show your working. (4)

3.3 Calculate the mass of NO that will be produced. (3)

[9]

QUESTION 4

Acetylcylic acid ($C_9H_8O_4$) is found in aspirin tablets. A group of pharmacists at Aspen are tasked with determining the percentage purity of an aspirin tablet. They dissolve a 7 g aspirin tablet in 50 cm^3 of water and add sodium hydroxide (NaOH) pellets to the solution. The sodium hydroxide reacts completely with the acetycylic acid according to the following BALANCED chemical equation:

$$C_9H_8O_4 + NaOH \rightarrow C_9H_7O_4Na + H_2O$$

At the end of the reaction, the pharmacists measure the concentration of sodium acetylsalicylate ($C_9H_7O_4Na$) and find it to be 0,7 $mol.dm^{-3}$.

4.1 Define *concentration*. (1)

4.2 Determine the percentage purity of acetylcylic acid. (8)

4.3 In a separate experiment, the pharmacists find the molecular mass of acetylcylic acid to be 360 $g.mol^{-1}$. Use this information to determine the molecular formula of acetylcylic acid. (3)

[12]

QUESTION 5

The bond energies for numerous bonds are given in $kJ.mol^{-1}$. Answer the questions that follow:

1	2	3	4	5	6
H – H	436	C – C	348	F – F	155
H – C	413	C – Cl	326	Cl – Cl	243
H – N	389	C – O	335	Br – Br	190
H – O	463	Cl – O	205	I – I	149
H – Cl	431	H – S	338	H – Br	346

Double bonds (bond order 2)		Triple bonds (bond order 3)	
O = O	498	N ≡ N	941
C = C	619	C ≡ C	845
C = O	707		

5.1 Why is there an increase in the bond energies of C - C, C = C and C ≡ C? (2)

5.2 Explain the difference in the bond energies between H - O and H - S. (2)

5.3 Calculate the total amount of energy released when the CO_2 molecule forms. (3)

5.4 Which type of bonding is found in the CO_2 molecule? (1)

5.5 Define the type of bonding mentioned in question 5.4. (2)

5.6 Determine, by **calculation**, whether the reaction of $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ is exo- or endothermic. (5)

5.7 In the event of the H_2 molecule forming, there are different forces acting. These forces have different energies involved. Draw a **labeled** graph of the **potential energy** versus the **atomic distance** between the nuclei as two hydrogen atoms approach each other to form the molecule. Show and label the significant points (bond energy and bond length) on the axes. (4)

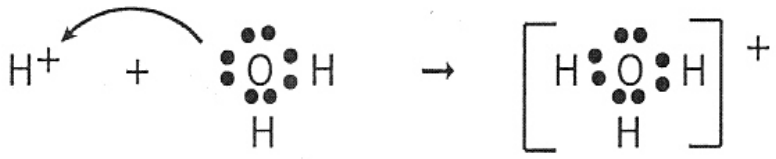
5.8 Why will the molecule Ar_2 not form? Fully explain, by referring to electron configuration and interatomic forces. (3)

[22]

QUESTION 6

6.1 Draw the Lewis **and** Couper structures for the oxygen molecule. (2)

6.2 Consider the following and answer the questions that follow:

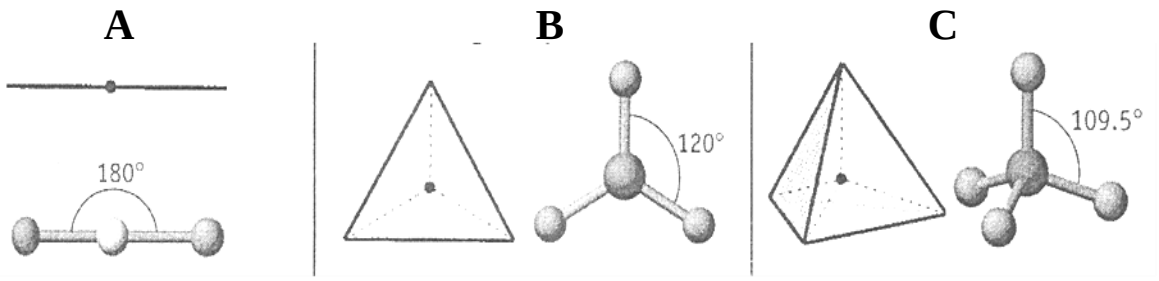


6.2.1 Give the name of the product. (1)

6.2.2 What is this type of bonding called? (1)

6.2.3 Name the two conditions that must be satisfied for this type of bonding to take place. (2)

6.3.1 Give the names of the molecule shapes labeled A, B and C. (3)



6.3.2 Give the CHEMICAL FORMULA of a substance that has the shape of B. (1)

6.3.3 Shape A has a 180º angle. Why can it not be more than 180º? (1)

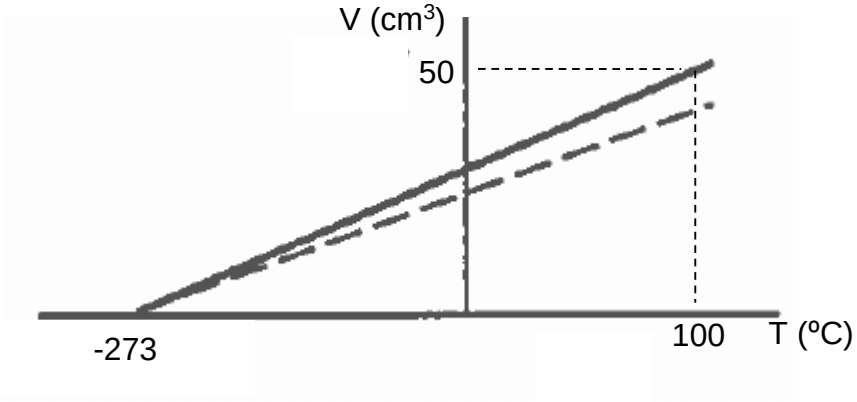
6.3.4 What is the theory which allows us to predict molecular shapes?
You may write out the full name OR give the abbreviation. (1)

[12]

QUESTION 7

7.1 The pressure on a certain amount of gas is 20 kPa and the volume of the gas is V. If the container's volume is increased **by** 2dm^3, what will be the new pressure on the gas at a constant temperature, **in terms of V?** (4)

7.2 The following solid line graph was obtained by plotting the change between the volume and the temperature of an enclosed amount of ideal gas. The gas pressure is 101 kPa.



7.2.1 Name the law that was formulated from this graph. (1)

7.2.2 State the law mentioned in 7.2.1. (2)

7.2.3 Calculate the **amount of mole** of gas present. (4)

7.2.4 Does the dotted line graph represent a gas with more or less moles of gas?
Only write down MORE or LESS. (1)

7.2.5 Redraw the solid line graph on a **labelled absolute** temperature scale. Show, with a dotted line, how a real gas will deviate from this graph (a rough free-hand drawing is acceptable). (3)

[15]

TOTAL: 100 MARKS