St. Lawrence High School

A JESUIT CHRISTIAN MINORITY INSTITUTION

1 ST Term Examination – 2019

Sub: Physical Science **Class: 10** **F.M: 75**

Duration: 2 Hour 30 minutes **Date: 11.04.2019**

ANSWER KEY

Group A

I. **Choose the Correct answers** 1 x 13 = 13

1. If the pressure of a given mass of gas is reduced to half and temperature is doubled simultaneous the change in volume will be
   a. Same as before
   b. Twice as before
   c. ¼ the amount as before
   d. **None of the above**
2. A metal gas cylinder placed in a fire explodes. It is an example of which law?
   a. Charles' Law
   b. **Gay Lussac's Law**
   c. Boyle's Law
   d. Avogadro's Law
3. A diver reaches the surface of the ocean to quickly and becomes sick due to decrease of pressure. This is an example of
   a. Charles' Law
   b. Gay Lussac's Law
   c. **Boyle's Law**
   d. Avogadro's Law
4. What is the shape of a P-T curve for ideal gas?
   a. **Straight line**
   b. Parabola
   c. Hyperbola
   d. Ellipse
5. If the coefficient of linear expansion is A, the coefficient of superficial expansion is B and the coefficient of cubic expansion is C, which of the following is false?
   a. C = 3A
   b. A = B/2

  c. $B = 3/2\ C$

  d. $A = C/3$

6. If the area through which heat is transferred is increased by a factor of two then the rate of heat transfer is

  a. increased by a factor of 2

  b. decreased by a factor of 2

  c. increased by a factor of 4

  d. decreased by a factor of 4

7. If temperature difference between hold and cold faces of solids is greater, rate of flow of heat will be

  a. Greater

  b. Smaller

  c. Remains constant

  d. Becomes zero

8. Which of the following is equal to 290K?

  a. $30\ ^{\circ}C$

  b. $17\ ^{\circ}C$

  c. $0\ ^{\circ}C$

  d. $27\ ^{\circ}C$

9. An element has an atomic number of 15 with which of the following elements will it show similar chemical properties.

  a. Be (4)

  b. Ne (10)

  c. N (7)

  d. O (8)

10. Identify the group which is not a Dobereiner's triad

  a. Li, Na, K

  b. Be, Mg, Cr

  c. Ca, Sr, Ba

  d. Cl, Br, I

11. In electrolysis of pure ionic molten compounds, metal is formed at

  a. anode

  b. cathode

  c. inert electrode

  d. base of the apparatus

12. Atoms undergo bonding in order to ?

  a. Attain stability

  b. Loses stability

  c. Move freely

  d. increase energy

13. Which among the following is not a property of Ionic bond?

  a. Losing of electrons

  b. Gain of electrons

  c. Sharing of electrons

  d. Transfer of electrons

Group B

2. Very Short Answer type questions (All questions are compulsory)   **1 x 16 = 16**

2.1. group 3 and 12 contain elements known as TRANSITION ELEMENTS.

2.2. What is the SI unit of thermal conductivity?

Ans: $Jm^{-1}K^{-1}s^{-1}$ is the SI unit of thermal conductivity.

2.3. Can temperature in Kelvin scale be negative?

Ans: No, temperature in Kelvin scale cannot be negative as it would indicate negative volume.

2.4. Write down the relation among linear, surface and volume expansion coefficient of solid.

Ans: The relation among linear α, surface β and volume γ expansion coefficient of solid is obtained as :

$$\alpha: \beta: \gamma = 1: 2: 3$$

2.5. K(i.e. coefficient of thermal conduction) is the characteristic of the material of the solid substance. (True or false)

Ans: The statement is true.

2.6. 12g carbon on complete combustion produces how much volume of CO2 at STP?

ANS. 22.4 lit

2.7. Group 17 elements are known as HALOGENS

2.8. Mention the conditions for deviation of a real gas from ideal gas behaviour.

Ans: The conditions for deviation of a real gas from ideal gas behaviour are:

1. The molecules are not point masses

2. There exists intermolecular forces between the molecules.

2.9. What is the coefficient of real or absolute expansion of a liquid?

Ans: The absolute coefficient of expansion of liquid is defined as the actual increase in the volume of liquid (sum of the apparent increase in the volume of liquid in vessel and increase in the volume of the vessel) per unit original volume of liquid per unit rise in temperature. It is represented by $\gamma r = \gamma a + \gamma v$ where γa is the coefficient of apparent expansion of the liquid and γv is the coefficient of expansion of the vessel.

2.10 Lewis dot structure of C_2H_4 is:
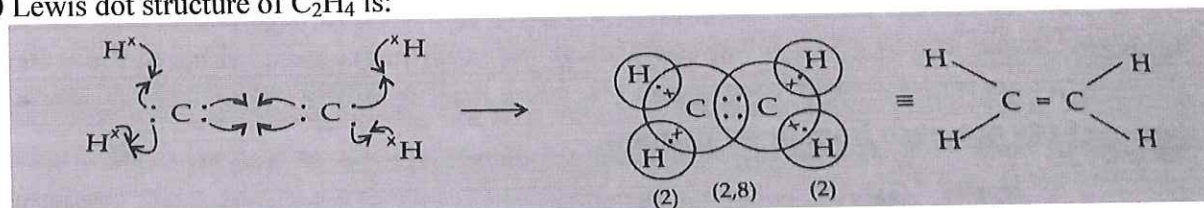
2.11 Due to presence of cations and anions in ionic compounds they are good conductors of electricity.

2.12   Covalent radius<ionic radius<V.D.W radius

2.13   After uranium the elements are known as transuranic elements.mainly f block elements, Period 7

2.14   For Al^{+3}: 2,8   and for P^{-3}: 2,8,8

2.15   Cl>F>Br>I

2.16   Define coefficient of thermal conductivity of a substance.

Ans: The coefficient of thermal conductivity is "k", and what it means, is the amount of heat energy any material allows to get transferred per metre length for per unit change in temperature. And its value is different for different materials.

Group C

Short Answer type questions (Answer all the questions)   8x2 = 16

Explanations and diagrams are needed if applicable.

   i)   What type of walls should be preferable for one air-conditioning room-wall made up of iron or walls made up of wood of the same thickness? Give reason.
         Ans: For the same thickness the wooden wall will conduct far less heat than the iron wall and is the preferable option to keep the air conditioned room cool and to allow optimum use of the device.

  ii)   Write down the equation of state of 56 lit of any ideal gas.
         Ans: The ideal gas equation of state is given as PV =nRT where
         P, pressure (absolute)
         V, volume
         n, number of moles of a substance
         T, absolute temperature
         R, ideal gas constant $\approx$ 8.3144621 J/mol·K
         According to Avogadro's law 1 mole of an ideal gas occupies 22.4 l at STP. So 56 litre of an ideal gas at STP contains (56/22.4) moles= 2.5 moles. Thus ideal gas equation becomes:
                                PV =2.5 RT

 iii)   Define coefficient of superficial expansion of solid.
         Ans: Coefficient of superficial expansion. The amount by which unit area of a material increases when the temperature is raised by one degree is called the coefficient of superficial (i.e. area) expansion and is represented by β

  iv)   What is the origin of pressure exerted by certain amount of ideal gas on the walls of a container?
         Ans: The molecules of a gas are in a state of random motion. They continuously collide against the walls of the container. Due to this continuous collision, the walls experience a continuous force which is equal to the total momentum imparted to the walls per second. The force experienced per unit area of the walls of the container determines the pressure exerted by the gas.

   v)   How does the volume of elements change in a period and in a group?
         ANS. along the period volume decreases and along the group volume increases.

  vi)   What do you mean by electronegativity?
         ANS. it is the tendency of an atom to attract a shared pair of electrons towards itself.

 vii)   Write down two important characteristics of covalent compounds.
         Ans. normal covalent compounds are liquid or gas at room temperature,having low mp and bp,bad conductors of electricity.

viii) Ionic compounds are in general solid but covalent compounds are in general liquid or gas – why?

Ans. In ionic compounds ions are held fixed cannot move freely ,having high negative lattice energy so solids in nature.

Covalent compounds are directional in nature lattice energy low ,low electrostatic attraction so liquid or gaseous in nature.
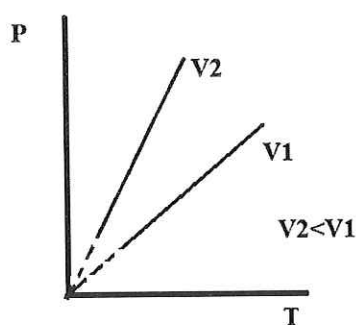
Group D   **3 x 10=30**

Answer the following questions: any 10 (explanations and diagrams are needed if applicable):

1. Plot P vs T for an ideal gas at two different volume V_1 and V_2 ($V_1 > V_2$), Plot P vs V for an ideal gas at trwo different temperatures t_1 °C and t_2 °C ($t_2 > t_1$)

   Ans: P vs T plot for an ideal gas at two different volume V_1 and V_2 ($V_1 > V_2$) is as follows:

   P vs V plot for an ideal gas at trwo different temperatures t_1 °C and t_2 °C ($t_2 > t_1$) is as follows:
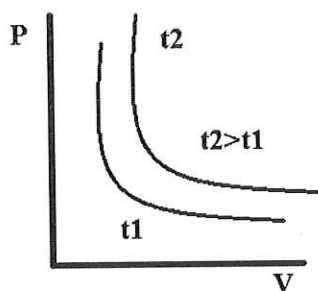
2. From Charle's law arrive at the concept of absolute temperature scale. A brass rod of 1 m long is heated from 0°C to 50 °C. What will be the increase of length? $\alpha = 24 \times 10^{-6}$ °C^{-1}.

   Ans: According to Charles's law if a volume of a fixed mass of gass is V_0 at a particular pressure then its volume will decrease by an amount $V_0/273$ for each degree decrease in temperature. Suppose the temperature of some gas is decreased to $-t$ °C, its volume at that temperature will be

   $V' = V_0 (1 - t/273)$.

   When temperature is -273 we see that the volume is theoretically equal to zero. This gives rise to a new scale of temperature called the Absolute temperature scale.

From the definition of Linear expansion

$L_2 = L_1[1+ \alpha(t_2-t_1)]$ where L2 and L1 are the final and initial lengths, t2 is the final temperature and t1 is the initial temperature. Here $L_1 = 1$ m, $t_1 = 0$ °C, $t_2 = 50$ °C and $\alpha = 24$ x 10^{-6} °C^{-1}.

Thus L2 becomes:

$L_2 = 1[1+ 24$ x 10^{-6} x$(50-0)]$ m $= 1.0012$ m

$L_2-L_1 = 1.0012$ m $= 1.2$ x 10^{-3} m

3. The value of α for iron is 1.2 x 10^{-5} °C^{-1}. What do you mean by that? Why small amount of acid is added to water during its electrolysis?

   Ans: The statement means that for 1 degree rise in temperature a 1 m rod will increase in length by 1.2 x 10^{-5} m.

1. Pure water is bad conductor of electricity but when acid is added to it it becomes a good conductor. Here acid acts as a catalyst.

4. Why NaCl conduct electricity in its molten state-explain. The atomic numbers of X, Y, Z are 11, 17, 19 respectively .which two elements will show similar chemical properties?

   Ans. In molten state NaCl dissociates giving free Na^+ and Cl^-, thus conducting electricity. In valence shells X and Z have same number of electrons. So they will show similar chemical properties.

5. 6g of an impure sample of potassium chlorate give 1.9g oxygen on heating in presence of a catalyst. What is the %purity of the potassium chlorate sample?

   Ans. $2KClO_3 \rightarrow 3O_2 + 2KCl$

   96g O_2 is obtained from   245.2g of $KClO_3$

   1.9g O_2 is obtained from 4.853g $KClO_3$

   6g sample contained 4.853g of pure $KClO_3$

   Thus, % purity is 80.9%

6. Calculate the actual weight of a molecule of methane and CO_2.

   Ans. Mol weight of CH_4 is 16g

   Thus 1molecule CH_4 weighs $16/6.023*10^{23} = 2.656*10^{-23}$ g

   Similarly for CO_2, $44/6.023*10^{23} = 7.305*10^{-23}$ g

7. Discuss briefly the factors on which the increase in length of a rod when heated depends? How much will a bar of Al of 100 cm long expand when it is heated from 20 °C to 100 °C ? $\alpha_{Al} = 24$ x 10^{-6} °C^{-1}.

   Ans: the factors on which the increase in length of a rod when heated depends are:

   i.   Original length: the increase in length is a fractional increase. So the more is the original length the greater is the increase.

   ii.   The change in temperature. The expansion is cumulative over temperature. So the more is the rise in temperature the greater is the expansion.

   iii.   The material of the rod has its own specific expansion coefficient and the expansion depends on it.

   From the definition of Linear expansion

   $L_2 = L_1[1+ \alpha(t_2-t_1)]$ where L2 and L1 are the final and initial lengths, t2 is the final temperature and t1 is the initial temperature. Here $L_1 = 100$ cm, $t_1 = 20$ °C, $t_2 = 100$ °C and $\alpha = 24$ x 10^{-6} °C^{-1}.

Thus L2 becomes:

$L_2 = 100[1 + 24 \times 10^{-6} \times (100-20)]$ cm $= 100.192$ cm

$L_2 - L_1 = 0.192$ cm $= 1.92 \times 10^{-1}$ cm $= 1.92 \times 10^{-3}$ m

8. Calculate the volume of 1 mole of hydrogen at 27 °C and 4 atm pressure. A given mass of a gas has a volume of 240 cm³ at 30 °C and 75 cm of Hg pressure. Keeping the temperature unchanged the pressure is changed to 80 cm Hg. What will be the volume of the gas?

Ans: The ideal gas equation of state is given as PV =nRT where

P, pressure = 4 atm

V, volume

n, number of moles of a substance=1 mole

T, absolute temperature = (27 + 273) K = 300 K

R, ideal gas constant ≈ 0.082 litre-atm/(mol·K)

Using this equation we obtain the value of V as:

V=nRT/P = 1 x 0.082 x 300/4 = 6.15 litre

At constant temperature the pressure is varied with Volume. Thus we can use Boyle's law which states that

$P_1V_1 = P_2V_2$

Where P_1=initial pressure = 75 cm Hg

V_1= initial volume= 240 cm³

P_2 = final pressure = 80 cm Hg

V_2= Final volume = P_1V_1/P_2 = 75 x 240/ 80 cm³ = 225 cm³

9. Compare the physical properties of ionic compound and covalent compounds. Discuss the bonding in LiH, C₂H₂.

Ans.

IONIC COMPOUNDS	COVALENT COMPOUNDS
Solids,having high mp and bp.	Gaseous or liquid,having low mp and bp.
Conducts electricity,soluble in solvents having high dielectric constant	Do not conduct electricity and soluble in solvents having low dielectric constant.
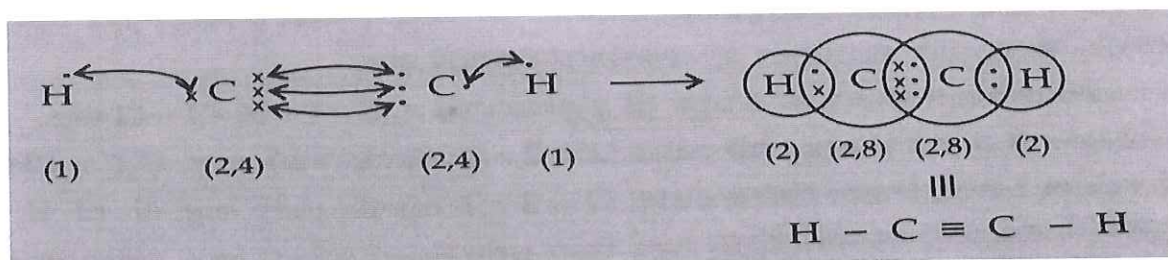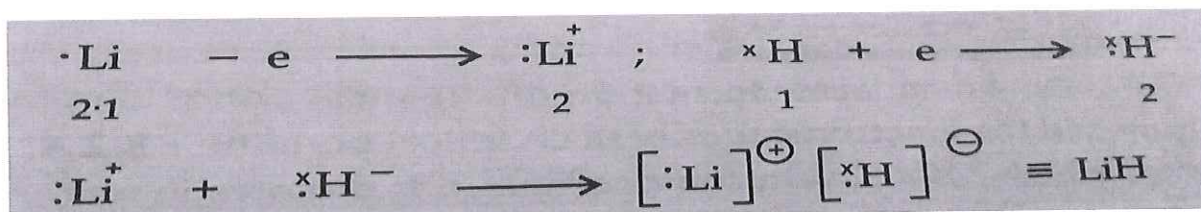
10. An element say X, has mass number 40 and contains 21 neutrons in its nucleus. To which group in the modern periodic table does it belong? Briefly discuss about the position of hydrogen in the periodic table.

Ans. Gr I.

Considering valency and other chemical properties, H can be put into Gr I or Gp VII B.

For Gr I:

i) Valency 1 like Li, Na, K

ii) Stable oxide H_2O like Li_2O, Na_2O etc.

iii) Like alkali metals, H is a reducing agent.

For Gr VIII B:i) H forms H- like F-, Cl- etc.

ii) Non-metallic gaseous diatomic molecule like F_2, Cl_2 etc.

iii) Metal hydrides are ionic compounds like metal hydrides. In electrolysis of NaH and NaCl, Cl_2 and H_2 are liberated at anodes respectively.

11. What is electro-plating? Mention the reactions taking place at cathode and anode during electrolysis of acidified water with Pt electrodes.

Ans. Electroplating is a process that uses an electric current to reduce dissolved metal salts, so that a thin coherent layer of the metal in the salt can be coated at the desired electrode.

Cathode rxn. $H^+ + e^- \rightarrow H$; $H + H = H_2$

Anode rxn. $OH^- - e- \rightarrow OH$; $4OH = 2H_2O + O_2$

Overall: $2H_2O \rightarrow 2H_2 + O_2$