

Q1) Why do isotopes of elements have similar chemical properties but different physical properties?

Solution:

Isotopes of elements have same atomic numbers but different atomic masses. The chemical properties of elements depend on the number of electrons present in an atom and not neutrons. Hence, isotopes have similar chemical properties as the number of electrons present in them is equal.

Q2) The temperature of day and night on the surface of the moon varies greatly. Comment on this statement.

Solution:

Since there is no atmosphere on the surface of the moon, there is a huge variation in the minimum and the maximum values of temperature, the minimum being -190°C and the maximum being 110°C .

Q3) What is the work done by the force of gravity on a satellite moving around the earth? Justify your answer.

Solution:

The work done in this case is zero since the displacement of a satellite revolving around the earth and the direction of gravitational force is perpendicular.

Q4) (a) What is the law of conservation of mass?

(b) Calculate the molecular mass of calcium carbonate. (Atomic mass of Ca = 40 u, C = 12 u, and O = 16 u)

Solution:

(a) The law of conservation of mass states that mass can be neither created nor destroyed during a chemical reaction. It means that the total mass of the reactants and the products involved in a reaction remains the same at all the times.

(b) Molecular mass of a substance is the sum of the atomic masses of all the atoms in the molecule of that substance.

The chemical formula of calcium carbonate is CaCO_3 .

Given: Atomic mass of Ca = 40 u

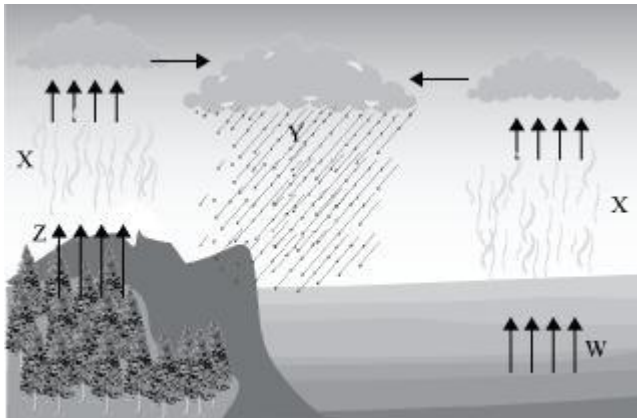
Atomic mass of C = 12 u

Atomic mass of O = 16 u

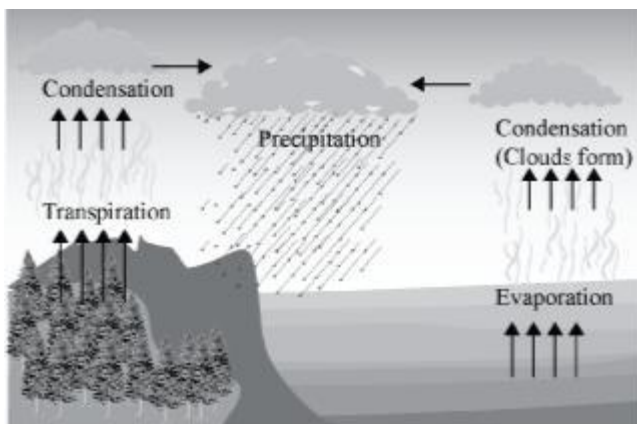
\therefore Molecular mass of $\text{CaCO}_3 = [(1 \times 40) + (1 \times 12) + (3 \times 16)] \text{ u} = 100 \text{ u}$

Thus, the molecular mass of CaCO_3 is 100 u.

Q5) In the given figure, which labels represent the processes of transpiration and precipitation?



Solution:



Label **Y** represents the process of precipitation by which water falls on earth in the form of rain, snow or sleet. Label **Z** represents the process of transpiration by which the water is released from the leaves of plants in the form of vapours in the atmosphere.

Q6) Derive the expression for gravitational potential energy using Newton's second law.

Solution:

From Newton's second law:

$$F = m \times a \text{ (Where } m = \text{Mass and } a = \text{Acceleration)}$$

Work done = Force \times Displacement

Work done by applying F force to lift an object of mass m to a height h ,

$$W = F \times h$$

$= mg \times h$ (since $a = g$, acceleration due to gravity)

Thus, potential energy possessed by the object = Work done in lifting it = mgh

Q7) Classification helps us in predicting the line of evolution. Justify.

Solution:

The slow change in the body design of an organism over a long period of time is termed as evolution. It helps an organism to survive in its surroundings. Classification allows things to be identified and categorised on the basis of structure and function of an organism and accordingly, they can be referred as primitive or advanced organisms. This helps in predicting the line of evolution.

Q8) (a) Calculate the number of molecules present in 0.1 mole of N_2 gas.

(b) What is the mass of 0.2 mole of NH_3 gas?

(Atomic mass of N = 14 u, H = 1 u).

Solution:

(a) 1 mole of any substance contains 6.022×10^{23} particles (molecules, atoms, or ions).

1 mole of N_2 gas contains 6.022×10^{23} N_2 molecules.

Therefore, 0.1 mole of N_2 gas contains 6.022×10^{22} N_2 molecules.

Thus, the number of molecules present in 0.1 mole of N_2 gas is 6.022×10^{22} .

(b) Atomic mass of Nitrogen (N) = 14 u

Atomic mass of hydrogen (H) = 1 u

Molecular mass of ammonia (NH_3) = $[(1 \times 14) + (3 \times 1)]u = 17 u$

1 mole of a substance is defined as the molecular mass of that substance in grams.

1 mole of NH_3 = 17 g

Therefore, 0.2 mole of NH_3 = (0.2×17) g = 3.4 g

Thus, the mass of 0.2 mole of NH_3 is 3.4 g.

Q9) Answer the following questions.

(i) Name the factors responsible for the formation of soil.

(ii) Explain the importance of ozone.

(iii) Explain the importance of nitrogen-fixing bacteria. Where are they found?

View Solution

Solution:

(i) The factors that influence the formation of soil are the sun, water, wind and living organisms such as lichens and mosses.

(ii) The ozone layer of the atmosphere absorbs the harmful ultraviolet radiations of the sun, and prevents them from reaching the earth's surface.

(iii) Plants cannot utilise atmospheric nitrogen as such. Nitrogen-fixing bacteria convert atmospheric nitrogen molecules into nitrates and nitrites. These are then utilised by plants.

Nitrogen-fixing bacteria can be found in the roots nodules of leguminous plants. These nitrogen-fixing bacteria may also be free living.

Q10) (a). What role is played by water in soil formation?

(b). How does plant help in maintaining the quality of top soil?

Solution:

(a). Water enters the rocks through the cracks in them. When temperatures fall, water freezes. As ice occupies more space than water, the crack expands when water freezes. This expansion eventually leads to breaking down of rocks. Another way in which water helps in the formation of soil is when running water flows along rocks. The flow of water along the rocks creates a friction between water and rocks, which results in the weathering of rocks. This leads to the formation of soil.

The soil thus formed may flow along with the water and get deposited elsewhere.

(b). Roots of plants hold the soil tightly and prevent soil erosion. Consequently, humus containing fertile top soil is not carried away by the action of moving air and water. Therefore, plants play a very important role in maintaining the quality of top soil.

Q11) Explain the hierarchy of classification.

Solution:

(i) The hierarchy of classification was developed by Carolus Linnaeus. It refers to the organisation or classification of organisms in the order of rank or importance.

(ii) According to this system, **kingdom** is the highest rank. It is divided into **phyla** or divisions, which are further subdivided into **classes**. Further divisions include **order**, **family**, **genus** and **species**, in that order.

(iii) Thus, species is the basic unit of classification.



Q12) Differentiate between cells composing unicellular and multicellular organisms on the basis of

- (a). Their shape
- (b). Their structure
- (c). Their interdependence and division of labour in them

Solution:

(a). The cell of unicellular organisms such as *Amoeba* can change its shape according to the environment whereas cells in multicellular organisms exhibit definite shape. For example, neuron has a definite and distinct shape, which does not change.

(b). Cells of unicellular organisms can or cannot have a definite nucleus or membrane-bound organelles whereas cells of multicellular organisms always have a definite nucleus and membrane-bound organelles.

(c). A unicellular organism is independent and does not require help from other such cells for its growth and development. There is division of labour present within the cell whereas cells in multicellular organisms depend upon other cells present in the organism for their growth and development and show division of labour.

Q13) The disease depends on the tissue or organ that has been targeted by microbes. Explain the statement with suitable examples.

Solution:

The microorganisms entering the body attack various organs of the body. The symptoms of the disease will depend on the organ targeted by the microorganism.

If the microbes attack the lungs, then symptoms may include cough and breathlessness.

If the microorganism affects the brain, then the common symptoms may be vomiting and headache. In severe cases, fits and spells of unconsciousness may also occur.

Jaundice is a common symptom observed when the liver of a person is attacked. The HIV/AIDS virus attacks the immune system of the person and makes it more susceptible to other diseases.

Q14) A teacher explained in his class about an element which exists in two isotopic forms, ^{14}X and ^{15}X . The average atomic mass of X was found to be 14.50. What would be the respective percentage of the two forms, ^{14}X and ^{15}X ?

Solution:

Let x be the percentage of ^{14}X . Then, the percentage of ^{15}X will be $(100 - x)$.

Since the mass of an atom of any natural element is taken as the average mass of all the naturally occurring atoms of that element, mass of X is:

$$\left(14 \times \frac{x}{100}\right) + \left[15 \times \frac{(100-x)}{100}\right] = 14.50$$

$$\frac{14x}{100} + \frac{1500 - 15x}{100} = 14.50$$

$$14x - 15x + 1500 = 1450$$

$$-x = 1450 - 1500$$

$$-x = -50$$

$$x = 50$$

Percentage of $^{14}\text{X} = x = 50\%$

Percentage of $^{15}\text{X} = 100 - x$

$$= 100 - 50$$

$$= 50\%$$

Q15) How do we hear sound?

Solution:

Sound enters through the outer part of the ear. It travels through the ear canal and reaches the other end, called the eardrum. The eardrum is like a stretched membrane. It vibrates in response to the sound waves. The eardrum sends these vibrations to the brain through the middle ear and the inner ear respectively. The brain recognizes the vibrations as sound, which then we are able to hear.

Q16) What are ultrasonic sounds? Write some applications of ultrasonic waves.

Solution:

Ultrasonic waves are sound waves of frequency greater than the human audible frequency. Ultrasound refers to the sound with frequency higher than 20 kHz. Ultrasound is commonly used for the ultrasound scanning purpose.

Ultrasound finds its uses in many fields, some of them are:

- (1) Fluid Science – For measuring fluid flow
- (2) Material Science - For measure material thickness of various types
- (3) Dental Science – For treating and cleansing of teeth
- (4) Surgery – For removing fatty tissues, liposuction
- (5) Chemistry – For producing consumable alcohol, ethanol

Q17) What are the differences between Class Reptilia and Class Aves?

Solution:

Class Reptilia includes various reptiles such as turtles, lizards, snakes and crocodiles. The reptiles are cold blooded as their body temperature changes with a change in the surrounding temperature. Their bodies are covered with scales. They breathe through lungs. The reptiles have a three-chambered heart except for crocodiles that have a four-chambered heart. Unlike the amphibians, reptiles do not need water for laying eggs. Their eggs have protective shells around them.

Class Aves includes all the birds. Birds are warm blooded animals. All birds have a four-chambered heart. Their bodies are covered with feathers and they breathe through lungs. Their forewings are modified for flight.

Q18) Name the devices or machines which convert:

- (i) Chemical energy into heat energy
- (ii) Light energy into heat energy
- (iii) Heat energy into kinetic energy

Solution:

(i) In a gas stove, chemical energy is converted into heat energy. Cooking gas is burnt in a gas stove to produce heat energy.

(ii) In a solar water heater, light energy is converted into heat energy. Solar water heater traps sunlight and produces heat.

(iii) In a steam engine, heat energy is converted into kinetic energy. In a steam engine, heat is used for boiling water and for obtaining steam under high pressure to turn a shaft and drive the wheels.

Q19) A cliff is situated 0.6 km away. A child hears an echo after 4 s. What is the speed of sound in air?

Solution:

It is given that:

Time, $t = 4 \text{ s}$

Distance, $d = 0.06 \text{ km} = 0.6 \times 1,000 \text{ m} = 600 \text{ m}$

Applying the formula:

$$2d = v \times t \text{ (where } v \text{ is velocity)}$$

$$2 \times 600 = v \times 4$$

$$v = \frac{2 \times 600}{4}$$

$$= 300 \text{ m/s}$$

Therefore, the speed of sound is 300 m/s.

Q20) (a) Write the postulates of Bohr's model of an atom?

(b) What would be the structure of an atom of sodium?

(c) How many valence electrons are present in an atom of oxygen?

Solution:

(a) Postulates of Bohr's model of the atom are:

(i) Electrons revolve only in certain special orbits known as 'discrete orbits' that are allowed inside the atom.

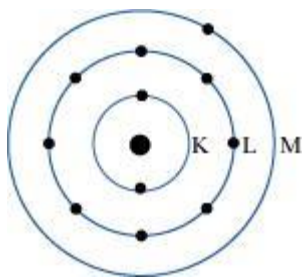
(ii) Electrons do not radiate energy while revolving in discrete orbits.

(b) The atomic number of sodium is 11. Thus, an atom of sodium contains 11 electrons and 11 protons.

According to the Bohr and Bury law, the maximum number of electrons present in a shell is given by $2n^2$ (where $n = 1, 2, 3 \dots$) Also, electrons are not accommodated in a given shell unless the inner shells are completely filled.

Thus, 11 electrons are distributed in K, L, and M shells as 2, 8, and 1 respectively.

Hence, the atomic structure of sodium can be represented as:



(c) The number of electrons present in the outermost shell of an atom is called the valence electrons of that atom.

Atomic number of oxygen is 8. Thus, an atom of oxygen contains 8 electrons and 8 protons. Eight electrons are distributed in K and L shells of oxygen atom as 2 and 6 respectively. The L shell is the outermost shell of an oxygen atom. Thus, the number of valence electrons in an atom of oxygen is 6.