Course: General Science (6404)
Semester: Autumn, 2021

Assignment No.2

Q.1 Fill in the blanks

i. A______ force moves something away from you. **(Pushing)**

ii. Along folded tubes in the abdomen which absorbs nutrients is called _______. **(Small Intestine)**

iii. The place where waste is stored before it leaves the body is called______. **(Large Intestine)**

iv. The part of the food which is not digested________. **(Fiber)**

v. The part of digestive system in which conversion of starch to sugar starts is _______. **(Mouth)**

vi. The finger like structures which absorbs nutrient are called_______. **(Villi)**

vii. Plasma contains _______ percent water**. (90%)**

viii. RBCs contain a pigment called________. **(Hemoglobin)**

ix. A turning fork produces a sound wave in air with frequency of 250 Hz Wavelength will be _______ when speed of sound is 450 m/sec. **(1.8)**

x. The value of K.E for the date: m=5kg, v=3m/s2 will be _______. **(22.5)**

Q.2 Describe law of conservation of energy.

All the forms of energy follow the law of conservation of energy. In brief, the law of conservation of energy states that in a closed system, i.e., a system that is isolated from its surroundings, the total energy of the system is conserved. In physics and chemistry, the **law of conservation of energy** states that the total energy of an isolated system remains constant; it is said to be conserved over time. This law, first proposed and tested by Émilie du Châtelet, means that energy can neither be created nor destroyed; rather, it can only be transformed or transferred from one form to another. For instance, chemical energy is converted to kinetic energy when a stick of dynamite explodes. If one adds up all forms of energy that were released in the explosion, such as the kinetic energy and potential energy of the pieces, as well as heat and sound, one will get the exact decrease of chemical energy in the combustion of the dynamite.

Classically, conservation of energy was distinct from conservation of mass; however, special relativity showed that mass is related to energy and vice versa by $E = mc^2$, and science now takes the view that mass-energy as a whole is conserved. Theoretically, this implies that any object with mass can itself be converted to pure energy, and vice versa. However this is believed to be possible only under the most extreme of physical conditions, such as likely existed in the universe very shortly after the Big Bang or when black holes emit Hawking radiation.

Conservation of energy can be rigorously proven by Noether's theorem as a consequence of continuous time translation symmetry; that is, from the fact that the laws of physics do not change over time.

A consequence of the law of conservation of energy is that a perpetual motion machine of the first kind cannot exist, that is to say, no system without an external energy supply can deliver an unlimited amount of energy to its surroundings.[4] For systems which do not have time translation symmetry, it may not be possible to define conservation of energy. Examples include curved spacetimes in general relativity[5] or time crystals in condensed matter physics.

Ancient philosophers as far back as Thales of Miletus c. 550 BCE had inklings of the conservation of some underlying substance of which everything is made. However, there is no particular reason to identify their theories with what we know today as "mass-energy" (for example, Thales thought it was water). Empedocles (490–430 BCE) wrote that in his universal system, composed of four roots (earth, air, water, fire), "nothing comes to be or perishes";[10] instead, these elements suffer continual rearrangement. Epicurus (c. 350 BCE) on the other hand believed everything in the universe to be composed of indivisible units of matter—the ancient precursor to 'atoms'—and he too had some idea of the necessity of conservation, stating that "the sum total of things was always such as it is now, and such it will ever remain."

In 1605, Simon Stevinus was able to solve a number of problems in statics based on the principle that perpetual motion was impossible.

In 1639, Galileo published his analysis of several situations—including the celebrated "interrupted pendulum"—which can be described (in modern language) as conservatively converting potential energy to kinetic energy and back again. Essentially, he pointed out that the height a moving body rises is equal to the height from which it falls, and used this observation to infer the idea of inertia. The remarkable aspect of this observation is that the height to which a moving body ascends on a frictionless surface does not depend on the shape of the surface.

In 1669, Christiaan Huygens published his laws of collision. Among the quantities he listed as being invariant before and after the collision of bodies were both the sum of their linear momenta as well as the sum of their kinetic energies. However, the difference between elastic and inelastic collision was not understood at the time. This led to the dispute among later researchers as to which of these conserved quantities was the more fundamental. In his Horologium Oscillatorium, he gave a much clearer statement regarding the height of ascent of a moving body, and connected this idea with the impossibility of perpetual motion. Huygens' study of the dynamics of pendulum motion was based on a single principle: that the center of gravity of a heavy object cannot lift itself.

It was Leibniz during 1676–1689 who first attempted a mathematical formulation of the kind of energy that is associated with motion (kinetic energy). Using Huygens' work on collision, Leibniz noticed that in many mechanical systems (of several masses, m_i each with velocity v_i), It was conserved so long as the masses did not interact. He called this quantity the vis viva or living force of the system. The principle represents an accurate statement of the approximate conservation of kinetic energy in situations where there is no friction. Many physicists at that time, such as Newton, held that the conservation of momentum, which holds even in systems with friction, as defined by the momentum: was the conserved vis viva. It was later shown that both quantities are conserved simultaneously, given the proper conditions such as in an elastic collision. In 1687, Isaac Newton published his Principia, which was organized around the concept of force and momentum. However, the researchers were quick to recognize that the principles set out in the book, while fine for point masses, were not sufficient to tackle the motions of rigid and fluid bodies. Some other principles were also required. The law of conservation of vis viva was championed by the father and son duo, Johann and Daniel Bernoulli. The former enunciated the principle of virtual work as used in statics in its full generality in 1715, while the latter based his Hydrodynamica, published in 1738, on this single conservation principle. Daniel's study of loss of vis viva of flowing water led him to formulate the Bernoulli's principle, which asserts the loss to be proportional to the change in hydrodynamic pressure. Daniel also formulated the notion of work and efficiency for hydraulic machines; and he gave a kinetic theory of gases, and linked the kinetic energy of gas molecules with the temperature of the gas. This focus on the vis viva by the continental physicists eventually led to the discovery of stationarity principles governing mechanics, such as the D'Alembert's principle, Lagrangian, and Hamiltonian formulations of mechanics. Émilie du Châtelet (1706–1749) proposed and tested the hypothesis of the conservation of total energy, as distinct from momentum. Inspired by the theories of Gottfried Leibniz, she repeated and publicized an experiment originally devised by Willem 's Gravesande in 1722 in which balls were dropped from different heights into a sheet of soft clay. Each ball's kinetic energy—as indicated by the quantity of material displaced—was shown to be proportional to the square of the velocity. The deformation of the clay was found to be directly proportional to the height from which the balls were dropped, equal to the initial potential energy. Earlier workers, including Newton and Voltaire, had all believed that "energy" (so far as they understood the concept at all) was not distinct from momentum and therefore proportional to velocity.

Q.3 State Coulombs law. Derive relation of charges with attractive force.

Colomb's law states that the magnitude of the electrostatic force of attraction or repulsion between two electrically charged bodies is directly proportional to the product of the charge of the charged bodies and **inversely** proportional to the square of the distance between the center of the charged bodies**.**

Coulomb's law, or Coulomb's inverse-square law, is an experimental law of physics that quantifies the amount of force between two stationary, electrically charged particles. The electric force between charged bodies at rest is conventionally called electrostatic force or **Coulomb force**. Although the law was known earlier, it was first published in 1785 by French physicist Charles-Augustin de Coulomb, hence the name. Coulomb's law was essential to the development of the theory of electromagnetism, maybe even its starting point, as it made it possible to discuss the quantity of electric charge in a meaningful way.

The law states that the magnitude of the electrostatic force of attraction or repulsion between two point charges is directly proportional to the product of the magnitudes of charges and inversely proportional to the square of the distance between them,

Here, K or k_e is Coulomb's constant ($k_e \approx 8.988\times10^9\ N{\cdot}m^2{\cdot}C^{-2}$),[1] q_1 and q_2 are the signed magnitudes of the charges, and the scalar r is the distance between the charges. The force is along the straight line joining the two charges. If the charges have the same sign, the electrostatic force between them is repulsive; if they have different signs, the force between them is attractive.

Being an inverse-square law, the law is analogous to Isaac Newton's inverse-square law of universal gravitation, but gravitational forces are always attractive, while electrostatic forces can be attractive or repulsive.[2] Coulomb's law can be used to derive Gauss's law, and vice versa. In the case of a single stationary point charge, the two laws are equivalent, expressing the same physical law in different ways.[5] The law has been tested extensively, and observations have upheld the law on the scale from 10^{-16} m to 10^{8} m. Coulomb's law states that the force between two static point electric charges is **proportional to the inverse square of the distance between them, acting in the direction of a line connecting them. If the charges are of opposite sign**, the force is attractive and if the charges are of the same sign, the force is repulsive.

Coulomb's law is often one of the first quantitative laws encountered by students of electromagnetism. It describes the force between two point electric charges. It turns out that it is equivalent to Gauss's law. Coulomb's law states that the force between two static point electric charges is proportional to the inverse square of the distance between them, acting in the direction of a line connecting them. If the charges are of opposite sign, the force is attractive and if the charges are of the same sign, the force is repulsive. Mathematically, Coulomb's law is written as

(43)ℑF=qQ4πε0|r−r′|2 r―^,

where F is the force between the two charges q and Q, |r−r′| is the distance between the charges and r―^ is a unit vector in the direction of the line separating the two charges.

Having defined Coulomb's law, one might next naturally ask the question how would a standard reference charge behave in the presence of any distribution of electric charge we might dream up? Answering this question brings us to the concept of the electric field. We follow the presentation of [Gri99]. We can define the electric field of an arbitrary charge Q as the force experienced by a unit charge q due to Q

(44)ℑe=Fq.

Dividing both sides of Coulomb's law by q and substituting the definition of e, we get that the electric field of a point charge Q is

(45)ℑe(r)=Q4πε0|r−r′|2 r―^.

It is important to note here that the electric field obeys the principle of superposition, meaning that the electric field of an arbitrary collection of point charges is equal to the sum of the electric fields due to each individual charge.

Q.4 Write characteristics features of phylum Echinodermata and Chordata.

The organisms belonging to the phylum Echinodermata are exclusively marine. Till date, there have been no traces of any terrestrial or freshwater Echinoderms. These are multicellular organisms with well-developed organ systems. All the animals belonging to this phylum share the same characteristics features. They are colourful organisms with unique shapes. They are ecologically and geologically very important. The Echinoderms are found in sea-depths as well as in the intertidal zones. An interesting feature of the phylum

Echinodermata is that all the organisms belonging to this phylum are marine. None of the organisms is freshwater or marine. The water vascular system present in echinoderms accounts for gaseous exchange, circulation of nutrients and waste elimination.

Characteristics of Echinodermata

1. They have a star-like appearance and are spherical or elongated.
2. They are exclusively marine animals.
3. The organisms are spiny-skinned.
4. They exhibit organ system level of organization. Most members have a circulatory system as well as a digestive system.
5. They are triploblastic and have a coelomic cavity.
6. The skeleton is made up of calcium carbonate.
7. They have an open circulatory system.
8. They respire through gills or cloacal respiratory tree.
9. They have a simple radial nervous system and the excretory system are absent.
10. The body is unsegmented with no distinct head. The mouth is present on the ventral side while the anus is on the dorsal side.
11. The tube feet aids in locomotion.
12. They reproduce sexually through gametic fusion and asexually through regeneration. Fertilization is external.
13. The development is indirect.
14. They possess the power of regeneration.
15. They have poorly developed sense organs. These include chemoreceptors, tactile organs, terminal tentacles, etc.

Classification of Echinodermata

Asteroidea

- They have a flattened, star-shaped body with five arms.
- They have tube feet with suckers.
- They respire through papulae.
- The body comprises of calcareous plates and movable spines.
- Pedicellaria is present.
- Eg., Asterias, Zoroaster

Ophiuroidea

- The body is flat with pentamerous discs.
- The tube feet are devoid of suckers.
- They respire through Bursae.

- The long arms are demarcated from the central disc.
- Eg., Ophiderma, Amphuria

Echinoidea

- The body is hemispherical.
- The tube feet contains suckers.
- The body does not have arms.
- The body has a compact skeleton and movable spines.
- Eg., Echinus, Cidaris

Holothuroidea

- The body is long and cylindrical.
- The arms, spines, and pedicellariae are absent.
- They respire through the cloacal respiratory tree.
- They possess tube feet with suckers.
- Eg., Cucumaria, Holothuria

Crinoidea

- The body is star-shaped.
- The tube feet have no suckers.
- The arms are bifurcated.
- Spines and pedicellariae are absent.
- Eg., Neometra, Antedon

Q.5 Write disorders of heart and lungs. Give suggestions to avoid these diseases.

Pulmonary Vascular Disease Pulmonary vascular disease (PVD) is a broad term including any condition that affects the blood vessels within the lungs. These vessels take blood that is depleted of oxygen to the lungs from the right side of the heart. Deoxygenated blood travels through the pulmonary arteries where oxygen is taken up.

Pulmonary vascular disease (PVD) is a broad term including any condition that affects the blood vessels within the lungs. These vessels take blood that is depleted of oxygen to the lungs from the right side of the heart. Deoxygenated blood travels through the pulmonary arteries where oxygen is taken up. The pulmonary veins leave the lungs and take blood rich with oxygen to the left side of the heart where oxygenated blood is distributed throughout the body. This process continually replenishes the blood with oxygen, and lets carbon dioxide be exhaled. A pulmonary vascular disorder can lead to cardiovascular problems as well as impairing the quality of the patient's life.

The Pulmonary Vascular Disease Program a collaborative venture between the Brigham and Women's Hospital Lung Center and the Heart & Vascular Center—offers personalized care and coordinated management for all types of PVD, including pulmonary arterial hypertension, right heart failure, and chronic thromboembolic pulmonary hypertension (CTEPH). Our pulmonologists and cardiologists work closely together. This expertise and collaboration helps patients manage symptoms and have an improved quality of life. The research on PVD which is conducted at the Brigham provides greater understanding of these diseases and is translated directly into exceptional patient care.

The only definitive treatment is lung transplantation.

The causes of pulmonary vascular disease vary according to which of the lungs' blood vessels are affected.

In addition to taking a full medical history, your physician will conduct a variety of tests to diagnose PVD, as well as determine the specific disorder.

These tests can include:

- CT Scan
- Echocardiogram
- Chest X-ray
- Right Heart Catheterization and Vasodilator Testing
- Pulmonary Angiogram

In treating PVD, your physician aims to lessen the severity of symptoms, which will help improve your quality of life. This will also lessen the strain on your heart and decrease your risk for heart failure. You and your healthcare team will develop a personalized plan (based on your specific condition, age, and other factors) that may include a variety of medications and surgery.

When you become a patient, our team of experts develops a personalized, multidisciplinary care plan based on your specific condition. Our **Pulmonary Vascular Disease Program** provides long-term care and support to help patients manage their disease. We emphasize patient education, give patients access to research opportunities and offer a support group for patients and families to share personal experiences.

The **Pulmonary Vascular Disease Program**—joint venture between the Brigham and Women's Hospital Lung Center and the Heart & Vascular Center—offers highly specialized, multidisciplinary evaluation and care for patients with complex pulmonary vascular conditions. Our pulmonologists and cardiologists, work closely together and with cardiac and thoracic surgeons, and other cardiovascular specialists.