VITEEE 2022 Solutions July 2

Ques. In which of the following photoelectric effect is observed?

Ques. Which of the following is arranged in forwarding bias?

Ques. Arrange the following in order of their electronegativities?

Ques. Pinky's birthday is on 29th February 2016 which is on Monday. If she lived till 2099, how many birthdays would come on Monday?

Solution.
Pinky's birthday falls on 29th February, which is a leap day. Leap years occur every 4 years, so we need to identify all the leap years from 2016 to 2099 and then determine which of those fall on a Monday.

Given that 29th February 2016 is a Monday, the next possible 29th February would be in 2020. But the day of the week advances by more than one for each year due to the presence of the regular year's 365 days (which lead to a 1-day shift) and the extra day from the previous leap year.

Counting the days:
2017: +1 day (365 days)
2018: +1 day (365 days)
2019: +1 day (365 days)
2020: +1 day (Leap Year)

By 29th February 2020, the day of the week will have advanced by 4 days from Monday, which makes it a Friday.

From this pattern:
2024: Tuesday
2028: Sunday
2032: Friday
2036: Wednesday
2040: Monday (2nd birthday on a Monday)
2044: Saturday
2048: Thursday
2052: Tuesday
2056: Sunday
2060: Friday
2064: Wednesday
2068: Monday (3rd birthday on a Monday)
2072: Saturday
2076: Thursday
2080: Tuesday
2084: Sunday
2088: Friday
2092: Wednesday
2096: Monday (4th birthday on a Monday)

Pinky would celebrate her birthday on a Monday four times between 2016 and 2099.

Ques. What is glucose

Solution.
Glucose is a simple sugar (monosaccharide) with the molecular formula \(C_6H_{12}O_6\). It is an important carbohydrate in biology and serves as a primary energy source for cells. Here are some key points about glucose:

1. **Source**: Glucose is found in the sap of plants and is the end product of photosynthesis. It is also found in the blood of animals and is often referred to as blood sugar.

2. **Function in the body**: Once consumed and absorbed into the bloodstream, glucose can be used by cells for energy, stored in the liver and muscles as glycogen, or converted to fats.

3. **Regulation**: In humans, the level of glucose in the blood is regulated by the hormones insulin and glucagon, which are produced by the pancreas. Insulin promotes the uptake of glucose into cells and its storage as glycogen, while glucagon promotes the conversion of stored glycogen back into glucose when blood sugar levels drop.

4. **Clinical importance**: Monitoring and regulating blood glucose levels is crucial for individuals with diabetes. In this condition, the body either doesn't produce enough insulin (Type 1 diabetes) or doesn't respond properly to insulin (Type 2 diabetes), leading to elevated blood glucose levels.

5. **Physical properties**: Glucose is a crystalline white powder when pure and is very soluble in water. It has a sweet taste, but it's not as sweet as table sugar (sucrose).

6. **Other uses**: In addition to its biological role, glucose is used in various industries. For example, it is used in food production as a sweetener and in medical settings in IV solutions to provide hydration and nutrients to patients.

In biochemistry and physiology, glucose plays a fundamental role in the energy processes and metabolic pathways of living organisms.

Ques. The function of smooth endoplasmic reticulum

Solution.

The smooth endoplasmic reticulum (SER) is a component of the endoplasmic reticulum (ER), which is a network of membranous tubules and sacs within eukaryotic cells. The smooth endoplasmic reticulum lacks the ribosomes that are present on the rough endoplasmic reticulum

(RER). Here are the primary functions of the smooth endoplasmic reticulum:

1. **Lipid Synthesis**: The SER plays a crucial role in lipid metabolism. It is involved in the synthesis of phospholipids, cholesterol, and steroids. These lipids can be vital components of cell membranes or can serve as signaling molecules.

2. **Carbohydrate Metabolism**: The SER is involved in the synthesis and breakdown of glycogen in animal cells.

3. **Drug and Toxin Detoxification**: The liver is rich in SER, and one of its roles is to detoxify certain drugs and poisons. Enzymes within the SER modify these compounds to make them less toxic and more easily excreted.

4. **Calcium Ion Storage**: The SER in muscle cells is specialized to form the sarcoplasmic reticulum, which stores calcium ions. The release of these calcium ions from the sarcoplasmic reticulum triggers muscle contraction.

5. **Steroid Hormone Synthesis**: In endocrine organs like the adrenal glands, the SER is involved in the synthesis of steroid hormones from cholesterol.

6. **Metabolism of Carbohydrates**: The SER plays a role in various aspects of carbohydrate metabolism, including the conversion of glucose to stored glycogen.

The precise functions of the SER can vary depending on the specific cell type and its role in the organism. For instance, liver cells contain a significant amount of SER due to their role in detoxifying substances, while gonadal cells (e.g., in ovaries or testes) have SER that plays a critical role in steroid hormone production.

Ques. Density change in Schottky and Frenkel defect

Solution.
Schottky and Frenkel defects are types of point defects or imperfections observed in the crystal structures of ionic solids. Let's discuss the effects of these defects on the density of the crystal.

1. **Schottky Defect**:
   - In a Schottky defect, there is a missing pair of oppositely charged ions from the crystal lattice. For instance, in an ionic crystal like NaCl, one Na^+ cation and one Cl^- anion might be missing from their regular positions in the lattice, leaving behind a vacancy.
   - Because the number of positive and negative ions missing is equal, electrical neutrality is maintained.
   - However, since some ions are missing from the crystal, the overall mass of the crystal decreases.
   - Given that density (ρ) is defined as mass (m) divided by volume (V), and the volume of the crystal remains largely unchanged but the mass decreases, the density of the crystal with a Schottky defect will be **lower** than that of a perfect crystal.

2. **Frenkel Defect**:
   - In a Frenkel defect, an ion (usually a cation) is displaced from its regular position in the crystal lattice to an interstitial site. The ion doesn't leave the crystal but merely occupies a different position in it.
   - As a result, there's a vacancy in the original position of the ion and an extra ion in an interstitial site, but the overall number of ions (and thus, the mass) in the crystal remains unchanged.
   - Since both mass and volume of the crystal remain largely the same, the density of the crystal with a Frenkel defect will remain **approximately the same** as that of a perfect crystal.

In summary, the density of a crystal with a Schottky defect decreases, while the density of a crystal with a Frenkel defect remains largely unchanged.

Ques. Series of 6,9_, 12,24

Solution.

Let's observe the pattern of the given series:

6, 9, _, 12, 24

The difference between 6 and 9 is 3.
If we continue this pattern and add 3 to 9, we get 12. However, this doesn't match the series since the number after 9 is not 12 but an unknown number.

Looking at it differently:
If we think of a multiplication pattern:
6 multiplied by something gives 9.
9 multiplied by something gives 12.
If the multiplier is 1.5:
6 * 1.5 = 9
9 * 1.5 = 13.5 (This is not 12, so this pattern doesn't fit.)

If we think of a combination of multiplication and addition/subtraction:
From 6 to 9 is an addition of 3.
From 12 to 24 is a multiplication by 2.

Using this logic:
If we add 3 to 9, we get 12. This matches the pattern.
But then if we multiply 12 by 2, we get 24.

Therefore, the series follows this logic:
6 (add 3) → 9 (multiply by 2) → 18 (subtract 6) → 12 (multiply by 2) → 24

Thus, the missing number in the series 6, 9, _, 12, 24 is 18.

Ques. Disproportion reaction A) aldol B) Cannizzaro reaction

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Solution.

A disproportionation reaction is a type of redox reaction in which one species is simultaneously oxidized and reduced, leading to the formation of two different products.

Given the two options:

A) **Aldol Reaction**:
- The aldol reaction involves the formation of a β-hydroxy carbonyl compound from two molecules of an aldehyde or ketone, typically in the presence of a base. This reaction is not a disproportionation reaction as it doesn't involve a single species being simultaneously oxidized and reduced.

B) **Cannizzaro Reaction**:
- The Cannizzaro reaction occurs when an aldehyde without an α-hydrogen is treated with a strong base. In this reaction, one molecule of the aldehyde is reduced to form an alcohol, while another molecule of the aldehyde is oxidized to form a salt of a carboxylic acid. Since one species (the aldehyde) is simultaneously oxidized and reduced, the Cannizzaro reaction is a disproportionation reaction.

So, among the given choices, the answer is:

B) Cannizzaro reaction.

Ques. Rhizome gives rise to?

Solution.
A rhizome is a modified subterranean stem of a plant that sends out roots and shoots from its nodes. Rhizomes are different from roots; they have nodes, internodes, and scaly leaves. They grow horizontally under the soil surface.

Rhizomes give rise to:

1. **New Shoots**: Rhizomes produce new shoots at the nodes which can emerge from the ground and develop into a new plant. This is one of the primary ways many rhizomatous plants spread vegetatively.

2. **Roots**: Rhizomes also produce roots from their nodes, which help anchor the plant and absorb nutrients and water from the soil.

3. **Adventitious Buds**: These buds develop into shoots under favorable conditions.

Plants that possess rhizomes can colonize new territories and can spread rapidly, often making them effective ground covers. Some common plants with rhizomes include ginger, turmeric, bamboo, and many types of ferns and grasses.

Ques. What is a saccharide?

Solution.
A saccharide is a carbohydrate molecule, and the term is often used to refer to sugars, starches, and cellulose. The name "saccharide" comes from the Greek word "sakcharon," meaning "sugar." Saccharides can be categorized based on their complexity:

1. **Monosaccharides**: These are the simplest form of carbohydrates and cannot be hydrolyzed to smaller carbohydrates. They are the building blocks of more complex carbohydrates. Examples include glucose, fructose, and galactose.

2. **Disaccharides**: These are composed of two monosaccharide units covalently linked together. Upon hydrolysis, they yield two monosaccharide molecules. Common examples include sucrose (glucose + fructose), lactose (glucose + galactose), and maltose (glucose + glucose).

3. **Oligosaccharides**: These are composed of a few (typically 3 to 10) monosaccharide units linked together. They can be found on the surface of cell membranes, and they play roles in cell recognition and adhesion.

4. **Polysaccharides**: These are complex carbohydrates made up of more than ten monosaccharide units. They often serve as energy storage molecules or structural components in plants and animals. Examples include starch, glycogen, and cellulose.

Overall, saccharides play vital roles in energy storage and transfer, structural support, and cellular communication in living organisms.