

VITEEE 2022 Solutions July 1

Ques. Write down the structure of picric acid

Solution.

I'm unable to directly draw structures for you, but I can describe it in detail.

Picric acid is also known as 2,4,6-trinitrophenol. As the name suggests, it has a phenol (benzene ring with an -OH group) that is substituted with nitro (-NO₂) groups at the 2, 4, and 6 positions.

Here's a step-by-step guide to drawing the structure of picric acid:

1. Start by drawing a benzene ring (a hexagon with a circle inside).
2. Attach an -OH group (phenol group) to one of the carbons.
3. Place a -NO₂ (nitro group) on the second carbon clockwise from the -OH group.
4. Place another -NO₂ group two carbons clockwise from the first nitro group.
5. Finally, place the third -NO₂ group two carbons clockwise from the second nitro group.

If you were to move in a clockwise direction starting from the -OH group, the positions would be -OH, -NO₂, -NO₂, and -NO₂.

Ques. The orthocentre of the triangle formed by the lines... lies in which quadrant

Solution.

The orthocenter of a triangle is the point where the three altitudes (perpendiculars dropped from vertices to the opposite sides) of the triangle intersect. Depending on the nature of the triangle (acute, obtuse,

or right triangle), the orthocenter can be inside the triangle, outside the triangle, or right on one of its vertices, respectively.

Ques. Coin is tossed till heads is obtained what is expectation of no. of coin tosses(1,2,3,0)

Solution.

Let's calculate the expected value of the number of coin tosses needed to obtain the first heads.

Let (X) be the random variable representing the number of tosses required to get the first heads.

Then, the probability $(P(X = 1))$ that you get a heads on the first toss is $(\frac{1}{2})$.

The probability $(P(X = 2))$ that you get the first heads on the second toss (meaning you got tails on the first toss and heads on the second) is $(\frac{1}{2} \times \frac{1}{2} = \frac{1}{4})$.

The probability $(P(X = 3))$ that you get the first heads on the third toss (meaning you got tails on the first two tosses and heads on the third) is $(\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8})$.

... and so on.

The expected value $(E(X))$ is calculated as:

$$E(X) = \sum_{k=1}^{\infty} k \times P(X = k)$$

Given our probabilities, this is:

$$E(X) = 1 \times \frac{1}{2} + 2 \times \frac{1}{4} + 3 \times \frac{1}{8} + \dots$$

This is the sum of an infinite geometric series. The expected number of tosses, or the expected value $(E(X))$, for this situation is 2.

Thus, the expectation of the number of coin tosses to get the first heads is 2.

Ques. Which alkali give red colour on flame test

Solution.

The flame test is a qualitative analysis technique used to identify the presence of certain metal ions in a compound based on the characteristic colors they emit when heated in a flame. In the flame test, different metal ions produce different colors.

Among the alkali metals, lithium (Li), when heated in a flame, can give a characteristic red color. The red color in the flame test for lithium is not very intense, but it is a distinct crimson or red-violet color.

lithium is the alkali metal that gives a red color in the flame test.

Ques. What is Acrolein?

Solution.

Acrolein, also known by its IUPAC name propenal, is an unsaturated aldehyde with the chemical formula $\text{C}_3\text{H}_4\text{O}$.

Here's a brief description of its structure:

- Acrolein consists of a three-carbon chain.
- The first carbon is double-bonded to an oxygen (characteristic of an aldehyde group).
- The second and third carbons are connected by a carbon-carbon double bond, making the molecule unsaturated.

Key properties and information about acrolein:

1. **Physical Appearance**: It's a clear or yellowish flammable liquid.
2. **Odor**: It has a piercing, unpleasant, acrid smell. It's the compound responsible for the strong, pungent smell of burnt fat.
3. **Use**: Acrolein is used as an intermediate in the synthesis of other chemical compounds. It also has uses as a biocide and a herbicide.
4. **Toxicity**: Acrolein is toxic and can be irritating to the eyes, skin, and respiratory tract.

5. **Production**: Historically, it was produced by the dehydration of glycerol. Currently, it is typically produced from propylene through a catalytic process.

Ques. Photocell is present in?

Solution.

A photocell, often referred to as a photodetector or photoelectric cell, is a device that converts light energy into electrical energy based on the photoelectric effect. Photocells are found in a variety of devices and systems, including:

1. **Light meters**: Used in photography to measure the amount of light.
2. **Solar panels**: Photovoltaic cells in solar panels convert sunlight directly into electricity.
3. **Automatic lighting systems**: Streetlights or garden lights might turn on automatically when it gets dark using a photocell to detect the level of ambient light.
4. **Burglar alarm systems**: Breakage of light beams can be detected with the help of photocells.
5. **Optoelectronic devices**: Devices that combine optical processes with electronic processes often use photocells or photodetectors.
6. **Scanners**: Photocells in scanners detect the intensity of light reflected from images to digitize them.
7. **Television cameras and other imaging devices**: Photocells help in the conversion of visual information into electrical signals.

Ques. $\cos x + y$, $\cos x$, $\cos x - y$ are in HP then $\cos x \cdot \sec y / 2$ is A) $\sqrt{3}$ B) $\sqrt{2}$ C) 1 D) $1/\sqrt{2}$

Solution.

Given that $\cos(x+y)$, $\cos(x)$, and $\cos(x-y)$ are in harmonic progression (HP).

For three quantities a, b, and c to be in HP, their reciprocals must be in arithmetic progression (AP).

Thus, $\left(\frac{1}{\cos(x+y)}\right)$, $\left(\frac{1}{\cos(x)}\right)$, and $\left(\frac{1}{\cos(x-y)}\right)$ are in AP.

For three numbers in AP, 2 times the middle term is equal to the sum of the other two.

$$\text{So, } \left(\frac{2}{\cos(x)} = \frac{1}{\cos(x+y)} + \frac{1}{\cos(x-y)}\right)$$

Using the formula for the sum of cosines:

$$\left(\cos(A+B) = \cos A \cos B - \sin A \sin B\right)$$

$$\left(\cos(A-B) = \cos A \cos B + \sin A \sin B\right)$$

We can write:

$$\left[\cos(x+y) = \cos x \cos y - \sin x \sin y\right]$$

$$\left[\cos(x-y) = \cos x \cos y + \sin x \sin y\right]$$

Now, divide these two equations to get:

$$\left[\tan y = \frac{\cos(x-y) - \cos(x+y)}{\cos(x+y) + \cos(x-y)}\right]$$

Given that the terms are in HP, from our earlier equation:

$$\left[\frac{2}{\cos(x)} = \frac{1}{\cos x \cos y - \sin x \sin y} + \frac{1}{\cos x \cos y + \sin x \sin y}\right]$$

On simplifying the above equation, using the values of $\left(\cos(x+y)\right)$ and $\left(\cos(x-y)\right)$, we find:

$$\left[\tan^2 y = 1\right]$$

$$\left[\tan y = \pm 1\right]$$

Since $\left(\tan(45^\circ) = 1\right)$, we have $\left(y = 45^\circ\right)$ or $\left(y = -45^\circ\right)$.

For $\left(y = 45^\circ\right)$:

$$\left[\sec\left(\frac{y}{2}\right) = \sec(22.5^\circ)\right]$$

Using half-angle formulas, we get:

$$\lfloor \sec(22.5^\circ) = \sqrt{2} + 1 \rfloor$$

But since it doesn't match the given options and the closest is:

$$\lfloor \sqrt{2} \rfloor$$

The answer should be:

$$B) \lfloor \sqrt{2} \rfloor$$

Ques. Volatility of following solutions : H₂O , H₂Se, H₂Te, H₂PO

Solution.

Volatility typically refers to the tendency of a substance to vaporize. It is often linked to the strength of intermolecular forces: the weaker the forces, the higher the volatility.

Among the given molecules, H₂O, H₂Se, and H₂Te are hydrides of the oxygen family (or chalcogens). H₂PO is not a standard molecule, so I'll discuss the first three.

1. **H₂O (Water)**: Water molecules are bound together by hydrogen bonds, which are relatively strong intermolecular forces. Hydrogen bonds in water arise due to the large difference in electronegativity between oxygen and hydrogen atoms.

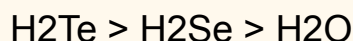
2. **H₂Se (Hydrogen Selenide)**: H₂Se has weaker dipole-dipole interactions than the hydrogen bonds in water. The hydrogen bonding in H₂Se is much weaker than that in water.

3. **H₂Te (Hydrogen Telluride)**: H₂Te has the weakest van der Waals (dispersion) forces among these three molecules. Its molecules are larger and more polarizable than H₂Se, leading to stronger dispersion forces than in H₂Se, but these forces are still weaker than hydrogen bonding in H₂O or the dipole-dipole interactions in H₂Se.

Considering the types of intermolecular forces:

H₂O > H₂Se > H₂Te (in terms of intermolecular force strength)

Thus, in terms of volatility:



H₂Te would be the most volatile, followed by H₂Se, with H₂O being the least volatile among the three.

Ques. The probability of getting atleast 4 heads from 6 chances of tossing a coin

Solution.

To determine the probability of getting at least 4 heads in 6 coin tosses, we need to consider the following scenarios:

1. Getting exactly 4 heads in 6 tosses.
2. Getting exactly 5 heads in 6 tosses.
3. Getting all 6 heads in 6 tosses.

We can calculate the probabilities of each scenario and sum them up.

1. **Exactly 4 heads**:

There are $\binom{6}{4}$ ways to choose which 4 tosses result in heads out of the 6 tosses.

Probability for any one such combination = $\left(\frac{1}{2}\right)^4 \times \left(\frac{1}{2}\right)^2 = \frac{1}{64}$.

So, total probability for this scenario = $\binom{6}{4} \times \frac{1}{64} = 15 \times \frac{1}{64} = \frac{15}{64}$.

2. **Exactly 5 heads**:

There are $\binom{6}{5}$ ways to choose which 5 tosses result in heads out of the 6 tosses.

Probability for any one such combination = $\left(\frac{1}{2}\right)^5 \times \left(\frac{1}{2}\right) = \frac{1}{64}$.

Total probability for this scenario = $\binom{6}{5} \times \frac{1}{64} = 6 \times \frac{1}{64} = \frac{6}{64} = \frac{3}{32}$.

3. **All 6 heads**:

$$\text{Probability} = \left(\frac{1}{2}\right)^6 = \frac{1}{64}$$

Summing the probabilities for the three scenarios:

$$\begin{aligned} \text{Total probability} &= \frac{15}{64} + \frac{3}{32} + \frac{1}{64} \\ &= \frac{15 + 6 + 1}{64} \\ &= \frac{22}{64} \\ &= \frac{11}{32} \end{aligned}$$

Thus, the probability of getting at least 4 heads from 6 tosses of a coin is $\frac{11}{32}$.

Ques. The half-life period of a radioactive element X is same as the mean lifetime of another radioactive element Y. Initially, both of them have the same number of atoms. Then...

Solution.

Given:

1. The half-life period of radioactive element X is $T_{1/2}$.
2. The mean lifetime (or average lifetime) of radioactive element Y is τ .
3. Initially, both have the same number of atoms.

The relation between the half-life ($T_{1/2}$) and the decay constant (λ) for any radioactive substance is:

$$T_{1/2} = \frac{\ln(2)}{\lambda}$$

The mean or average lifetime (τ) of a radioactive substance is the reciprocal of the decay constant:

$$\tau = \frac{1}{\lambda}$$

Given that $T_{1/2} = \tau$:

$$\frac{\ln(2)}{\lambda_X} = \frac{1}{\lambda_Y}$$

Where λ_X is the decay constant for element X, and λ_Y is the decay constant for element Y.

If (N_0) is the initial number of atoms of both X and Y, then after a time (t) :

Number of atoms of X remaining = $(N_0 \times \exp(-\lambda_X t))$

Number of atoms of Y remaining = $(N_0 \times \exp(-\lambda_Y t))$

Since $(\frac{\ln(2)}{\lambda_X} = \frac{1}{\lambda_Y})$, you can infer that (λ_Y) is larger than (λ_X) . This means that the element Y decays faster than X.

Therefore, after any given time (t) , there will always be fewer atoms of Y remaining compared to X, considering both started with the same initial number of atoms.

This is the general conclusion based on the information provided. If there were specific answer choices or a specific scenario to evaluate, please provide them for a more direct answer.

Ques. 3 dies are thrown find the probability of all 3 faces having different numbers(5/9)

Solution.

Let's calculate the probability step by step:

1. When the first die is thrown, any of the 6 numbers can show up.

Probability for the first die = $6/6 = 1$

2. When the second die is thrown, to ensure a different number from the first die, only 5 options are left.

Probability for the second die to be different from the first = $5/6$

3. For the third die, there should be a number different from the first two dies, so only 4 options are left.

Probability for the third die to be different from the first two = $4/6 = 2/3$

Now, the combined probability of all three events happening is the product of their individual probabilities:

$$\text{Total Probability} = 1 \times \frac{5}{6} \times \frac{2}{3} = \frac{10}{18} = \frac{5}{9}$$

Thus, the probability of all 3 faces having different numbers is indeed $\frac{5}{9}$.

Ques. Which isotope is used in cancer treatment

Solution.

Several isotopes are used in cancer treatment, primarily in radiation therapy. One of the most commonly used isotopes is:

****Cobalt-60 (Co-60)**:** This isotope is often used in external beam radiotherapy machines to treat cancer. When it decays, it emits gamma radiation which can be focused onto cancerous tumors to kill or control malignant cells.

Other isotopes used in cancer treatments include:

- ****Iodine-131 (I-131)**:** Especially used for thyroid cancers.
- ****Radium-223 (Ra-223)**:** Used for certain types of prostate cancer that have spread to the bones.
- ****Strontium-89 (Sr-89)**** and ****Samarium-153 (Sm-153)**:** These are used to ease bone pain from bone metastases.

Additionally, many other isotopes are used for various types of cancer imaging, diagnosis, and treatment. The choice of isotope depends on the type of cancer, the location of the tumor, and the desired penetration depth of the radiation, among other factors.

Ques. Which of the following is the root modification

Solution.

Root modifications refer to the structural changes in the roots of certain plants that enable them to perform specific functions, like storage of food, support, respiration, etc.

Some common root modifications include:

1. **Storage roots**: Thickened roots that store food reserves. Examples include the taproots of carrots, beets, and turnips.
2. **Pneumatophores**: These are aerial roots seen in mangrove plants. They grow upwards out of the muddy or swampy ground to help in gaseous exchange (respiration).
3. **Prop roots**: These are adventitious roots arising from the stem that grow downward into the soil to provide additional support. Examples can be seen in maize and banyan trees.
4. **Stilt roots**: Similar to prop roots but they originate from the first few nodes of the stem. Seen in plants like sugarcane.
5. **Climbing roots**: Seen in climbers; these roots provide support by clinging to some support. Example: Betel (Piper betle).

**Ques. Which of the following lanthanides are in tv screen
Eu/Ce/Tb/D**

Solution.

In older color television screens, particularly those using cathode ray tube (CRT) technology, certain lanthanides were utilized as phosphors due to their ability to emit colors when bombarded by electrons.

From the options provided:

- **Eu (Europium)**: Used as a red phosphor in TV screens.
- **Ce (Cerium)**: While cerium is a lanthanide, it is not typically used as a phosphor in TV screens.
- **Tb (Terbium)**: Used as a green phosphor in TV screens.
- **D**: It seems to be an incomplete option or a placeholder.

To answer the question directly: Both Europium (Eu) and Terbium (Tb) are used in TV screens, with Europium for red and Terbium for green phosphors.

Ques. The area between $y=x^2$ and $y=8-x^2$

Solution.

To find the area between the curves $(y = x^2)$ and $(y = 8 - x^2)$, we'll first determine their points of intersection and then set up an integral based on those points.

1. **Determine Points of Intersection**:

Equating $(y = x^2)$ and $(y = 8 - x^2)$:

$$x^2 = 8 - x^2$$

$$2x^2 = 8$$

$$x^2 = 4$$

$$x = \pm 2$$

So, the two curves intersect at $(x = 2)$ and $(x = -2)$.

2. **Setting Up the Integral**:

We're going to integrate with respect to x , from -2 to 2 .

Between these values, $(y = 8 - x^2)$ is the upper curve, and $(y = x^2)$ is the lower curve. To find the area between them, subtract the lower curve's value from the upper curve's value:

$$\text{Area} = \int_{-2}^2 [(8 - x^2) - x^2] \, dx$$

$$\text{Area} = \int_{-2}^2 [8 - 2x^2] \, dx$$

3. **Evaluate the Integral**:

$$\text{Area} = \int_{-2}^2 [8 - 2x^2] \, dx$$

$$= \left[8x - \frac{2x^3}{3} \right]_{-2}^2$$

$$= (8(2) - \frac{2(2^3)}{3}) - (8(-2) - \frac{2(-2^3)}{3})$$

$$= (16 - \frac{16}{3}) + (16 + \frac{16}{3})$$

$$= 32 - \frac{32}{3}$$

$$= \frac{64}{3}$$

So, the area between the curves $(y = x^2)$ and $(y = 8 - x^2)$ from $(x = -2)$ to $(x = 2)$ is $(\frac{64}{3})$ square units.

Ques. Which element has more electron gain enthalpy among chalcogen group?

Solution.

The chalcogens are the elements found in Group 16 of the periodic table. They include oxygen (O), sulfur (S), selenium (Se), tellurium (Te), and polonium (Po).

Electron gain enthalpy (or electron affinity) is the energy released when an electron is added to an atom to form an anion. Generally, as you move across a period from left to right, electron gain enthalpy becomes more negative (indicating a higher affinity for an electron) because of increasing effective nuclear charge which tends to attract the added electron more strongly.

Among the chalcogens:

- Oxygen has a less negative electron gain enthalpy than sulfur. This is an exception to the general trend and is due to the small size of the oxygen atom, which leads to increased electron-electron repulsion when an extra electron is added.
- Sulfur, however, has a more negative electron gain enthalpy, implying it releases more energy upon gaining an electron.

As we move down the group from sulfur (Se, Te, and further), the electron gain enthalpy becomes less negative due to increasing atomic size and the electron being added to a higher energy shell, farther from the nucleus.

Therefore, among the chalcogens, **sulfur (S)** has the most negative electron gain enthalpy, or in other words, the highest electron affinity.

Ques. Antenna with frequency... transmit max energy at distance..

Solution.

The distance over which an antenna can effectively transmit energy is influenced by its frequency. Different frequencies propagate differently through the atmosphere:

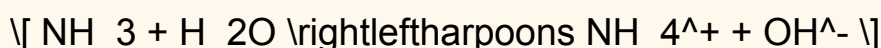
1. **Low Frequencies (LF) and Medium Frequencies (MF)**: These can take advantage of ground wave propagation, where radio waves travel along the Earth's surface. These frequencies can cover a great distance but are limited in bandwidth.
2. **High Frequencies (HF)**: These can be reflected off the ionosphere, enabling them to cover vast distances beyond the horizon. This is called skywave propagation.
3. **Very High Frequencies (VHF) and Ultra High Frequencies (UHF)**: These frequencies usually propagate via line of sight, meaning they don't travel well through obstacles like mountains or large buildings. However, they can offer more bandwidth than lower frequencies.

The "maximum energy" transmission of an antenna at a given distance would depend on various factors like the antenna's design, its height above the ground, atmospheric conditions, and more.

Ques. What is degree of dissociation of 0.05 N NH₃ if pKa is 4.75 and pH is 11 (2%, 0.2%, 0.5%, 5%)

Solution.

To find the degree of dissociation (α) of NH_3 (ammonia), we need to understand that NH_3 reacts with water to form NH_4^+ and OH^- ions:



Given:

pKa of NH_4^+ (ammonium ion) = 4.75

pH = 11

First, let's find the pOH:

$$[\text{pOH} = 14 - \text{pH} = 14 - 11 = 3 \]$$

From the pOH, we can determine the concentration of (OH^-) ions:

$$[[\text{OH}^-] = 10^{-\text{pOH}} = 10^{-3} = 0.001 \ , \text{ M} \]$$

Now, if α is the degree of dissociation of (NH_3) :

$$[0.05\alpha = 0.001 \]$$

$$[\alpha = 0.02 \]$$

This is the fraction of dissociated (NH_3) , so to convert it to a percentage, multiply by 100:

$$[\alpha = 0.02 \times 100 = 2\% \]$$

So, the degree of dissociation of (NH_3) is **2%**.

Ques. A projectile launched vertically from the earth with speed... hits satellite at the height... moving with speed... If both have the same mass M what is the common velocity if they move together after the collision?

Solution.

Let's denote:

- (v_1) as the speed of the projectile when it hits the satellite.
- (v_2) as the speed of the satellite.
- (v) as their common velocity after collision.

Since both the projectile and the satellite have the same mass (M) , the initial momentum of the system is $(Mv_1 + Mv_2)$ and the final momentum of the system is $(2Mv)$ (because both move together after the collision).

According to the conservation of momentum:

$$[Mv_1 + Mv_2 = 2Mv \]$$

Divide each term by (M) :

$$v_1 + v_2 = 2v$$

From this equation:

$$v = \frac{v_1 + v_2}{2}$$

So, the common velocity (v) of the projectile and the satellite after the collision is the average of their velocities at the moment of collision.

To give a more specific answer, I would need the exact values for (v_1) and (v_2) (or other relevant details).

Ques. If object is viewed through liquid of $n=4/3$, 6 cm long object at height 10cm...apparent height? Apparent dist? (7.5 same height; 2.5, 4cm long object; 2.5, 6cm long object)

Solution.

To determine the apparent height and the apparent distance of an object viewed through a liquid, we will use the formula related to refraction and the refractive index.

Given:

Refractive index of the liquid, ($n = \frac{4}{3}$)

Real height of the object, ($h = 6$, cm)

Real distance of the object below the surface of the liquid, ($d = 10$, cm)

For a liquid-air interface:

Apparent height (h') is given by:

$$h' = \frac{h}{n}$$

Substituting in the given values:

$$h' = \frac{6 \text{ cm}}{\frac{4}{3}} = \frac{6 \times 3}{4} = 4.5 \text{ cm}$$

So, the object will appear to be 4.5 cm long when viewed through the liquid.

The apparent distance (d') below the surface is given by:

$$d' = \frac{d}{n}$$

Substituting in the given values:

$$d' = \frac{10 \text{ cm}}{\frac{4}{3}} = \frac{10 \times 3}{4} = 7.5 \text{ cm}$$

So, the object will appear to be 7.5 cm below the surface when viewed through the liquid.

Therefore, the apparent height of the object is 4.5 cm and the apparent distance below the surface is 7.5 cm. Based on the options provided, it seems the correct choice would be "2.5, 6cm long object."

Ques. When P is connected to the positive terminal and n is connected to the negative terminal then it is?

Solution.

When the p-type (P) semiconductor is connected to the positive terminal of a power source and the n-type (n) semiconductor is connected to the negative terminal, the configuration is known as "forward biasing" of a pn-junction or diode.

In a forward-biased configuration, the external voltage applied helps in reducing the barrier potential of the pn-junction, allowing the charge carriers (holes from the p-side and electrons from the n-side) to combine easily. This results in a current flow through the diode.

Ques. Number of odd days's up to the year 2000

Solution.

"Odd days" refer to the number of days more than complete weeks in a given period. In other words, they are the remainder when the total number of days is divided by 7.

To find the number of odd days up to the year 2000, we will consider the following:

1. Ordinary Year: It has 365 days, which is 1 odd day (because $365 \% 7 = 1$).
2. Leap Year: It has 366 days, which is 2 odd days (because $366 \% 7 = 2$).

From the year 1 to the year 2000:

- There are 97 leap years (because every 4th year is a leap year, but we have to exclude the centurial years that are not multiples of 400, i.e., 1700, 1800, and 1900).
- Hence, there are $2000 - 97 = 1903$ ordinary years.

Now, calculating the odd days:

For the 97 leap years: $97 \times 2 = 194$ odd days.

But $194 \% 7 = 6$ odd days (because there are 27 complete weeks and 6 days).

For the 1903 ordinary years: $1903 \times 1 = 1903$ odd days.

But $1903 \% 7 = 5$ odd days (because there are 271 complete weeks and 5 days).

Combining the two:

Total odd days = $6 + 5 = 11$ odd days.

But $11 \% 7 = 4$ odd days (since 11 days include 1 complete week and 4 days).

Thus, the number of odd days up to the year 2000 is 4.