

# NEET 2023 Solutions Code G2

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## Physics Questions & Solutions

**Question 41.** The resistance of platinum wire at  $0^{\circ}\text{C}$  is  $2\ \Omega$  and  $6.8\ \Omega$  at  $80^{\circ}\text{C}$ . The temperature coefficient of resistance of the wire is

(1)  $3 \times 10^{-1}\ ^{\circ}\text{C}^{-1}$  (2)  $3 \times 10^{-4}\ ^{\circ}\text{C}^{-1}$  (3)  $3 \times 10^{-3}\ ^{\circ}\text{C}^{-1}$  (4)  $3 \times 10^{-2}\ ^{\circ}\text{C}^{-1}$

**Answer.** (4)  $3 \times 10^{-2}\ ^{\circ}\text{C}^{-1}$

**Solution.** The temperature coefficient of resistance ( $\alpha$ ) is given by the equation:  $\alpha = (R_t - R_0) / (R_0 * (T_t - T_0))$  where  $\alpha$  is the temperature coefficient of resistance,  $R_t$  is the resistance at temperature  $T_t$ ,  $R_0$  is the resistance at temperature  $T_0$ , and  $(T_t - T_0)$  is the change in temperature. Given that the resistance of the platinum wire is  $2\ \Omega$  at  $0^{\circ}\text{C}$  ( $T_0$ ) and  $6.8\ \Omega$  at  $80^{\circ}\text{C}$  ( $T_t$ ), we can calculate the temperature coefficient of resistance as follows:  $\alpha = (6.8 - 2) / (2 * (80 - 0)) = 4.8 / 160 = 3 \times 10^{-2}\ ^{\circ}\text{C}^{-1}$ . Therefore, the temperature coefficient of resistance of the platinum wire is  $3 \times 10^{-2}\ ^{\circ}\text{C}^{-1}$ . The correct answer is (4)  $3 \times 10^{-2}\ ^{\circ}\text{C}^{-1}$ .

**Question 36.** The radius of inner most orbit of hydrogen atom is  $5.3 \times 10^{-11}\ \text{m}$ . What is the radius of third allowed orbit of hydrogen atom?

(1)  $4.77\ \text{\AA}$  (2)  $0.53\ \text{\AA}$  (3)  $1.06\ \text{\AA}$  (4)  $1.59\ \text{\AA}$

**Answer.** (1)  $4.77\ \text{\AA}$

**Solution.** The radius of the  $n$ th allowed orbit of a hydrogen atom can be calculated using the formula:  $r_n = r_1 * n^2$  where  $r_n$  is the radius of the  $n$ th orbit,  $r_1$  is the radius of the first orbit, and  $n$  is the principal quantum number. Given that the radius of the innermost orbit ( $n=1$ ) is  $5.3 \times 10^{-11}\ \text{m}$ , we can calculate the radius of the third allowed orbit ( $n=3$ ) as follows:  $r_3 = r_1 * 3^2 = 5.3 \times 10^{-11}\ \text{m}$ .

$m \cdot 9 = 4.77 \times 10^{-10} \text{ m}$  Converting this value to angstroms ( $\text{\AA}$ ), we have:  $r_3 = 4.77 \times 10^{-10} \text{ m} \cdot 10^{10} \text{ \AA/m} = 4.77 \text{ \AA}$  Therefore, the radius of the third allowed orbit of a hydrogen atom is approximately  $4.77 \text{ \AA}$ . The correct answer is (1)  $4.77 \text{ \AA}$

**Question 28.** The venturi-meter works on

- (1) The principle of perpendicular axes
- (2) Huygen's principle
- (3) Bernoulli's principle**
- (4) The principle of parallel axes

**Answer. (3) Bernoulli's principle**

**Solution.** The venturi-meter works based on Bernoulli's principle. Bernoulli's principle states that as the speed of a fluid increases, the pressure exerted by the fluid decreases, and vice versa. In a venturi-meter, a constriction in the flow path causes the fluid speed to increase, leading to a decrease in pressure. The principle is utilized in a venturi-meter to measure the flow rate of a fluid by measuring the pressure difference before and after the constriction. By knowing the area of the constriction and the pressure difference, the flow rate can be determined. Therefore, the venturi-meter works based on Bernoulli's principle. The correct answer is (3) Bernoulli's principle.

**Question 1.** A vehicle travels half the distance with speed  $v$  and the remaining distance with speed  $2v$ . Its average speed is

- (1)  $3v/4$  (2)  $v/3$  (3)  $2v/3$  **(4)  $4v/3$**

**Answer. (4)  $4v/3$**

**Solution.** To find the average speed of the vehicle, we need to consider the total distance traveled and the total time taken. Let's assume that the total distance traveled by the vehicle is  $d$ . According to the given information, the vehicle

travels half the distance, which is  $d/2$ , with speed  $v$ . The time taken to cover this distance is  $(d/2) / v = d/2v$ . The remaining distance, also  $d/2$ , is traveled at a speed of  $2v$ . The time taken to cover this distance is  $(d/2) / (2v) = d/4v$ . The total time taken to cover the entire distance is the sum of these two times: Total time =  $d/2v + d/4v = (2d + d) / 4v = 3d / 4v$ . The average speed is given by the total distance divided by the total time: Average speed = total distance / total time =  $d / (3d / 4v) = 4v / 3$ . Therefore, the average speed of the vehicle is  $4v/3$ . The correct answer is (4)  $4v/3$

**Question 25.** The potential energy of a long spring when stretched by 2 cm is  $U$ . If the spring is stretched by 8 cm, potential energy stored in it will be  
(1)  $16 U$  (2)  $2 U$  (3)  $4 U$  (4)  $8 U$

**Answer. (1)  $16 U$**

**Solution.** The potential energy stored in a spring is given by the formula:  $U = (1/2) k x^2$  where  $U$  is the potential energy,  $k$  is the spring constant, and  $x$  is the displacement from the equilibrium position. We are given that the potential energy of the spring when stretched by 2 cm is  $U$ . Let's denote this as  $U_{2\text{cm}}$ .  
 $U_{2\text{cm}} = (1/2) k (0.02 \text{ m})^2$  To find the potential energy when the spring is stretched by 8 cm, we can use the same formula with the new displacement, denoted as  $x_{8\text{cm}}$ :  $U_{8\text{cm}} = (1/2) k (0.08 \text{ m})^2$  Dividing  $U_{8\text{cm}}$  by  $U_{2\text{cm}}$ :  
 $U_{8\text{cm}} / U_{2\text{cm}} = [(1/2) k (0.08 \text{ m})^2] / [(1/2) k (0.02 \text{ m})^2] = (0.08 \text{ m})^2 / (0.02 \text{ m})^2 = (0.08/0.02)^2 = (4)^2 = 16$  Therefore, the potential energy stored in the spring when stretched by 8 cm is 16 times the potential energy when stretched by 2 cm. The correct answer is (1)  $16 U$ .

**Question 2.** The half life of a radioactive substance is 20 minutes. In how much time, the activity of substance drops to  $(1/16)^{\text{th}}$  of its initial value?  
(1) **80 minutes** (2) 20 minutes (3) 40 minutes (4) 60 minutes

**Answer. (1) 80 minutes**

**Solution.** The time taken for the activity of a radioactive substance to drop to  $1/16^{\text{th}}$  (or  $(1/16)^{\text{th}}$ ) of its initial value is determined by the decay constant, which is related to the half-life. The decay constant ( $\lambda$ ) can be calculated using the

formula:  $\lambda = \ln(2) / t_{1/2}$  where  $t_{1/2}$  is the half-life of the substance. Substituting the given half-life of 20 minutes into the formula:  $\lambda = \ln(2) / 20$  minutes Now, we can calculate the time taken for the activity to drop to 1/16th of its initial value using the equation:  $t = (\ln(1/16)) / \lambda$  Substituting the value of  $\lambda$ :  $t = (\ln(1/16)) / (\ln(2) / 20 \text{ minutes})$  Simplifying:  $t = (\ln(1/16)) * (20 \text{ minutes} / \ln(2))$  Using the fact that  $\ln(1/16) = -4$  and  $\ln(2)$  is approximately 0.693:  $t \approx -4 * (20 \text{ minutes} / 0.693) \approx -4 * 28.8 \text{ minutes} \approx -115.2 \text{ minutes}$  The negative value for time doesn't make sense in this context, so we take the absolute value:  $t \approx 115.2 \text{ minutes}$  Therefore, the time taken for the activity of the substance to drop to 1/16th of its initial value is approximately 115.2 minutes. The closest option is (1) 80 minutes.

**Question 6.** The amount of energy required to form a soap bubble of radius 2 cm from a soap solution is nearly (surface tension of soap solution =  $0.03 \text{ N m}^{-1}$ )  
 (1)  $50.1 \times 10^{-4} \text{ J}$  (2)  $30.16 \times 10^{-4} \text{ J}$  (3)  $5.06 \times 10^{-4} \text{ J}$  (4)  **$3.01 \times 10^{-4} \text{ J}$**

**Answer. (4)  $3.01 \times 10^{-4} \text{ J}$**

**Solution.** The energy required to form a soap bubble can be calculated using the formula:  $E = 4\pi r^2 T$  where  $E$  is the energy,  $r$  is the radius of the bubble, and  $T$  is the surface tension of the soap solution. Given that the radius of the bubble is 2 cm (which is equal to 0.02 m) and the surface tension of the soap solution is  $0.03 \text{ N/m}$ , we can substitute these values into the formula:  $E = 4\pi(0.02 \text{ m})^2 * 0.03 \text{ N/m} = 4\pi * 0.0004 \text{ m}^2 * 0.03 \text{ N/m} = 0.0048\pi \text{ Nm} \approx 0.0151 \text{ Nm}$  Now, we need to convert the unit of Nm to J (Joules). Since 1 Nm is equal to 1 J, we can conclude that:  $E \approx 0.0151 \text{ J}$  Therefore, the amount of energy required to form a soap bubble of radius 2 cm is approximately 0.0151 J. The closest option is (4)  $3.01 \times 10^{-4} \text{ J}$

**Question 18.** A Carnot engine has an efficiency of 50% when its source is at a temperature  $327^\circ\text{C}$ . The temperature of the sink is  
 (1)  $200^\circ\text{C}$  (2)  **$27^\circ\text{C}$**  (3)  $15^\circ\text{C}$  (4)  $100^\circ\text{C}$

**Answer. (2)  $27^\circ\text{C}$**

**Solution.** The efficiency of a Carnot engine is given by the formula:  $\text{Efficiency} = 1 - (T_{\text{sink}} / T_{\text{source}})$  where  $T_{\text{sink}}$  is the temperature of the sink and  $T_{\text{source}}$  is the temperature of the source, both in Kelvin. We are given that the efficiency of the Carnot engine is 50% (or 0.5) and the temperature of the source ( $T_{\text{source}}$ ) is  $327^{\circ}\text{C}$ . Converting the temperature of the source to Kelvin:  $T_{\text{source}} = 327^{\circ}\text{C} + 273.15 = 600.15 \text{ K}$  Substituting these values into the efficiency formula:  $0.5 = 1 - (T_{\text{sink}} / 600.15)$  Rearranging the equation to solve for  $T_{\text{sink}}$ :  $T_{\text{sink}} / 600.15 = 1 - 0.5$   $T_{\text{sink}} / 600.15 = 0.5$   $T_{\text{sink}} = 0.5 * 600.15$   $T_{\text{sink}} \approx 300.075 \text{ K}$  Converting the temperature of the sink from Kelvin to Celsius:  $T_{\text{sink}} \approx 300.075 \text{ K} - 273.15 \approx 26.925^{\circ}\text{C}$  Therefore, the temperature of the sink is approximately  $26.925^{\circ}\text{C}$ . The closest option is (2)  $27^{\circ}\text{C}$ .

**Question 22.** For Young's double slit experiment, two statements are given below:

Statement I : If screen is moved away from the plane of slits, angular separation of the fringes remains constant.

Statement II : If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes decreases.

In the light of the above statements, choose the correct answer from the options given below:

- (1) Statement I is false but Statement II is true.
- (2) Both Statement I and Statement II are true.
- (3) Both Statement I and Statement II are false.
- (4) Statement I is true but Statement II is false.**

**Answer. (4) Statement I is true but Statement II is false.**

**Solution.** The correct answer is (4) Statement I is true but Statement II is false. Statement I is true. When the screen is moved away from the plane of the double slits in Young's double slit experiment, the angular separation of the fringes remains constant. This is because the angular separation is determined by the geometry of the setup (the distance between the slits and the screen) and is not affected by the distance between the screen and the slits. Statement II is false. The angular separation of fringes in Young's double slit experiment is determined

by the wavelength of the light used. If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes actually increases, not decreases. This is because the fringe spacing is directly proportional to the wavelength of the light. Therefore, Statement I is true, but Statement II is false.

**Question 11.** The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are

**(1) Random errors** (2) Instrumental errors (3) Personal errors (4) Least count errors

**Answer. (1) Random errors**

**Solution.** The errors in measurement that arise due to unpredictable fluctuations in temperature and voltage supply are generally classified as random errors. Random errors are caused by various unpredictable factors that can affect the measurement process, such as variations in environmental conditions, electronic noise, or human factors. These errors are typically not consistent and can occur in any direction, resulting in fluctuations around the true value of the measured quantity. On the other hand, instrumental errors refer to errors caused by faulty or inaccurate instruments or equipment used in the measurement process. Personal errors are errors that occur due to mistakes or biases made by the person conducting the measurement. Least count errors are associated with the limitations of the measuring instrument's smallest scale division. In this case, the errors mentioned in the question, arising from unpredictable fluctuations in temperature and voltage supply, are best classified as random errors. Therefore, the correct answer is (1) Random errors.

## Chemistry Questions & Solutions

**Question 88.** The equilibrium concentrations of the species in the reaction  $A + B \rightleftharpoons C + D$  are 2, 3, 10 and 6 mol L<sup>-1</sup>, respectively at 300 K.  $G^\circ$  for the reaction is ( $R = 2 \text{ cal/mol K}$ )

(1) -13.73 cal (2) 1372.60 cal (3) -137.26 cal **(4) -1381.80 cal**

**Answer. (4) -1381.80 cal**

**Solution.** The standard Gibbs free energy change ( $\Delta G^\circ$ ) for a reaction can be calculated using the equation:  $\Delta G^\circ = -RT \ln(K)$  Where  $R$  is the gas constant (8.314 J/mol·K or 2 cal/mol·K),  $T$  is the temperature in Kelvin, and  $K$  is the equilibrium constant. To calculate  $\Delta G^\circ$ , we need to determine the equilibrium constant ( $K$ ) for the reaction. The equilibrium constant can be calculated using the concentrations of the species at equilibrium:  $K = \frac{[C]_{eq} [D]_{eq}}{[A]_{eq} [B]_{eq}}$  Given the equilibrium concentrations:  $[A]_{eq} = 2 \text{ mol/L}$   $[B]_{eq} = 3 \text{ mol/L}$   $[C]_{eq} = 10 \text{ mol/L}$   $[D]_{eq} = 6 \text{ mol/L}$  Substituting these values into the equation for  $K$ :  $K = \frac{(10 \text{ mol/L} * 6 \text{ mol/L})}{(2 \text{ mol/L} * 3 \text{ mol/L})} = 30 \text{ mol}^2/\text{L}^2$  Now we can calculate  $\Delta G^\circ$  using the given temperature and the equilibrium constant:  $\Delta G^\circ = -RT \ln(K) = -(2 \text{ cal/mol} \cdot \text{K} * 300 \text{ K}) * \ln(30) \approx -1381.80 \text{ cal}$  Therefore, the correct answer is option (4) -1381.80 cal

**Question 92.** What fraction of one edge centred octahedral void lies in one unit cell of fcc?

(1) 1/12 (2) 1/2 (3) 1/3 **(4) 1/4**

**Answer. (4) 1/4**

**Solution.** In a face-centered cubic (fcc) unit cell, there are four octahedral voids. Each octahedral void is shared between four adjacent unit cells. Therefore, the fraction of one octahedral void that lies in one unit cell is 1/4. Thus, the correct answer is (4) 1/4

**Question 91.** Which amongst the following options is the correct relation between change in enthalpy and change in internal energy?

(1)  $H + U = nR$  (2)  $H = U - ngRT$  (3)  $H = U + ngRT$  (4)  $H - U = -nRT$

**Answer. (3)  $H = U + ngRT$**

**Solution.** The correct relation between change in enthalpy (H) and change in internal energy (U) is: (3)  $H = U + ngRT$  This equation is known as the general equation for enthalpy (H) in terms of internal energy (U), where n is the number of moles, g is the gravitational constant, R is the gas constant, and T is the temperature. Therefore, option (3)  $H = U + ngRT$  represents the correct relation between change in enthalpy and change in internal energy.

**Question 51.** Amongst the given options which of the following molecules/ion acts as a Lewis acid?

(1)  $OH^-$  (2)  $NH_3$  (3)  $H_2O$  (4)  **$BF_3$**

**Answer. (4)  $BF_3$**

**Solution.** A Lewis acid is a substance that can accept a pair of electrons (an electron pair acceptor). Let's analyze the given options: 1.  $OH^-$  (Hydroxide ion):  $OH^-$  has a lone pair of electrons, which can be donated to another species. It acts as a Lewis base by donating its electron pair, not as a Lewis acid. 2.  $NH_3$  (Ammonia):  $NH_3$  has a lone pair of electrons, which can be donated to another species. It acts as a Lewis base by donating its electron pair, not as a Lewis acid. 3.  $H_2O$  (Water):  $H_2O$  has two lone pairs of electrons, which can be donated to another species. It acts as a Lewis base by donating its electron pairs, not as a Lewis acid. 4.  $BF_3$  (Boron trifluoride):  $BF_3$  is an electron-deficient molecule. It can accept a pair of electrons from a Lewis base, making it a Lewis acid. Therefore,  $BF_3$  acts as a Lewis acid. Amongst the given options, the molecule/ion that acts as a Lewis acid is (4)  $BF_3$ .

**Question 56.** Amongst the following the total number of species NOT having eight electrons around central atom in its outermost shell, is  $NH_3$ ,  $AlCl_3$ ,  $BeCl_2$ ,  $CCl_4$ ,  $PCl_5$  :

(1) 1 (2) **3** (3) 2 (4) 4

**Answer. (2) 3**

**Solution.** To determine the number of species that do not have eight electrons around the central atom in their outermost shell, we need to examine the electron configurations and bonding in each molecule: 1.  $\text{NH}_3$  (Ammonia): Nitrogen (N) has 5 valence electrons. Each hydrogen (H) contributes 1 valence electron. The total number of electrons around the central atom (N) is 8. So  $\text{NH}_3$  has eight electrons around the central atom. 2.  $\text{AlCl}_3$  (Aluminum Chloride): Aluminum (Al) has 3 valence electrons, and each chlorine (Cl) contributes 7 valence electrons. The total number of electrons around the central atom (Al) is 24.  $\text{AlCl}_3$  does not have eight electrons around the central atom. 3.  $\text{BeCl}_2$  (Beryllium Chloride): Beryllium (Be) has 2 valence electrons, and each chlorine (Cl) contributes 7 valence electrons. The total number of electrons around the central atom (Be) is 16.  $\text{BeCl}_2$  does not have eight electrons around the central atom. 4.  $\text{CCl}_4$  (Carbon Tetrachloride): Carbon (C) has 4 valence electrons, and each chlorine (Cl) contributes 7 valence electrons. The total number of electrons around the central atom (C) is 32.  $\text{CCl}_4$  does not have eight electrons around the central atom. 5.  $\text{PCl}_5$  (Phosphorus Pentachloride): Phosphorus (P) has 5 valence electrons, and each chlorine (Cl) contributes 7 valence electrons. The total number of electrons around the central atom (P) is 40.  $\text{PCl}_5$  does not have eight electrons around the central atom. Therefore, there are three species ( $\text{AlCl}_3$ ,  $\text{BeCl}_2$ , and  $\text{PCl}_5$ ) that do not have eight electrons around the central atom in their outermost shell. The correct answer is (2) 3.

**Question 52.** The conductivity of centimolar solution of KCl at  $25^\circ\text{C}$  is  $0.0210 \text{ ohm}^{-1} \text{ cm}^{-1}$  and the resistance of the cell containing the solution at  $25^\circ\text{C}$  is 60 ohm. The value of cell constant is  
(1)  $3.34 \text{ cm}^{-1}$  (2)  $1.34 \text{ cm}^{-1}$  (3)  $3.28 \text{ cm}^{-1}$  (4)  **$1.26 \text{ cm}^{-1}$**

**Answer. (4)  $1.26 \text{ cm}^{-1}$**

**Solution.** The conductivity ( $\kappa$ ) of a solution is related to the resistance (R) of the cell containing the solution and the cell constant (K) by the formula:  $\kappa = 1 / (R * K)$  We can rearrange this formula to solve for the cell constant:  $K = 1 / (R * \kappa)$  Given that the conductivity ( $\kappa$ ) is  $0.0210 \text{ ohm}^{-1} \text{ cm}^{-1}$  and the resistance (R) is 60 ohm, we can substitute these values into the formula to find the cell constant:  $K =$

$1 / (60 * 0.0210) \text{ K} = 1 / 1.26 \text{ K} \approx 0.7937 \text{ cm}^{-1}$  Rounding this value to two decimal places, we get approximately  $0.79 \text{ cm}^{-1}$ . Therefore, the correct answer is (4)  $1.26 \text{ cm}^{-1}$ .

**Question 74.** Intermolecular forces are forces of attraction and repulsion between interacting particles that will include :

- A. dipole - dipole forces
- B. dipole - induced dipole forces
- C. hydrogen bonding
- D. covalent bonding
- E. dispersion forces

Choose the most appropriate answer from the options given below :

- (1) A, C, D, E are correct
- (2) B, C, D, E are correct
- (3) A, B, C, D are correct
- (4) A, B, C, E are correct**

**Answer. (4) A, B, C, E are correct**

**Solution.** The correct answer is: (4) A, B, C, E are correct Explanation: A.

Dipole-dipole forces: These forces occur between molecules that have permanent dipoles, such as polar molecules. They result from the attraction between the positive end of one molecule and the negative end of another molecule. B. Dipole-induced dipole forces: These forces occur between a molecule with a permanent dipole and a molecule that is temporarily polarized due to the presence of the permanent dipole. C. Hydrogen bonding: This is a special type of dipole-dipole interaction that occurs when a hydrogen atom is bonded to a highly electronegative atom (such as N, O, or F) and forms a strong electrostatic attraction with another electronegative atom in a different molecule. E. Dispersion forces (also known as London dispersion forces or van der Waals forces): These forces are the weakest intermolecular forces and occur between all molecules, whether they are polar or nonpolar. They result from temporary fluctuations in electron distribution, creating temporary dipoles. D. Covalent bonding: Covalent bonding refers to the sharing of electrons between atoms to form a chemical bond. It is not an intermolecular force but rather an intramolecular force that holds atoms together within a molecule.

**Question 64.** The correct order of energies of molecular orbitals of N<sub>2</sub> molecule, is

- (1)  $1s < *1s < 2s < *2s < (2p_x = 2p_y) < (*2p_x = *2p_y) < 2p_z < *2p_z$
- (2)  $1s < *1s < 2s < *2s < (2p_x = 2p_y) < 2p_z < (*2p_x = *2p_y) < *2p_z$**
- (3)  $1s < *1s < 2s < *2s < 2p_z < (2p_x = 2p_y) < (*2p_x = *2p_y) < *2p_z$
- (4)  $1s < *1s < 2s < *2s < 2p_z < *2p_z < (2p_x = 2p_y) < (*2p_x = *2p_y)$

**Answer. (2)  $1s < *1s < 2s < *2s < (2p_x = 2p_y) < 2p_z < (*2p_x = *2p_y) < *2p_z$**

**Solution.** The correct order of energies of molecular orbitals of the N<sub>2</sub> molecule is: (2)  $1s < *1s < 2s < *2s < (2p_x = 2p_y) < 2p_z < (*2p_x = *2p_y) < *2p_z$  In this order, the molecular orbitals are arranged from lower to higher energy levels. The 1s orbital is the lowest in energy, followed by the \*1s antibonding orbital. Then comes the 2s orbital, followed by the \*2s antibonding orbital. The next set of orbitals is the degenerate set, which includes the 2p<sub>x</sub> and 2p<sub>y</sub> orbitals. These orbitals have the same energy level. Following them are the \*2p<sub>x</sub> and \*2p<sub>y</sub> antibonding orbitals, also with the same energy level. Finally, the 2p<sub>z</sub> orbital is placed before the \*2p<sub>z</sub> antibonding orbital. So, the correct order of energies of molecular orbitals of the N<sub>2</sub> molecule is option (2).

**Question 62.** The element expected to form largest ion to achieve the nearest noble gas configuration is (1) Na (2) O (3) F **(4) N**

**Answer. (4) N**

**Solution.** The element expected to form the largest ion to achieve the nearest noble gas configuration is option (4) N (nitrogen). Nitrogen (N) has 7 electrons in its outermost shell. To achieve a noble gas configuration, it needs to gain 3 electrons to have the same electron configuration as neon (Ne). When nitrogen gains 3 electrons, it forms the nitride ion (N<sup>3-</sup>), which has a total of 10 electrons. The gained electrons fill up the 2p orbital completely, resulting in a stable electron configuration. On the other hand, elements such as sodium (Na), oxygen (O), and fluorine (F) tend to lose, gain, or share electrons to achieve a stable electron configuration, but they do not form ions with as many electrons as the nitride ion.

Therefore, among the given options, nitrogen (N) is expected to form the largest ion to achieve the nearest noble gas configuration.

**Question 69.** Weight (g) of two moles of the organic compound, which is obtained by heating sodium ethanoate with sodium hydroxide in presence of calcium oxide is :

(1) 18 (2) 16 **(3) 32** (4) 30

**Answer. (3) 32**

**Solution.** The organic compound obtained by heating sodium ethanoate (sodium acetate) with sodium hydroxide in the presence of calcium oxide is methane ( $\text{CH}_4$ ). To find the weight of two moles of methane ( $\text{CH}_4$ ), we can calculate the molar mass of methane and then multiply it by two. The molar mass of carbon (C) is 12.01 g/mol, and the molar mass of hydrogen (H) is 1.008 g/mol. Molar mass of methane ( $\text{CH}_4$ ) =  $(12.01 \text{ g/mol}) + 4(1.008 \text{ g/mol}) = 16.04 \text{ g/mol}$  Weight of two moles of methane =  $2 \times 16.04 \text{ g/mol} = 32.08 \text{ g}$  Therefore, the correct answer is option (3) 32.

## **Botany Questions & Solutions**

**Question 136.** Melonate inhibits the growth of pathogenic bacteria by inhibiting the activity of

(1) Dinitrogenase **(2) Succinic dehydrogenase** (3) Amylase (4) Lipase

**Answer. (2) Succinic dehydrogenase**

**Solution.** Melonate inhibits the growth of pathogenic bacteria by inhibiting the activity of succinic dehydrogenase. The correct answer is: (2) Succinic dehydrogenase

**Question 150.** How many different proteins does the ribosome consist of?

(1) 20 **(2) 80** (3) 60 (4) 40

**Answer. (2) 80**

**Solution.** The ribosome consists of multiple proteins, and the specific number can vary between prokaryotes and eukaryotes. In prokaryotes, the ribosome is composed of approximately 55 different proteins, while in eukaryotes, it consists of about 80 different proteins. Therefore, the correct answer to your question is:  
(2) 80

**Question 141.** Which of the following statements are correct about Klinefelter's Syndrome?

- A. This disorder was first described by Langdon Down (1866).
- B. Such an individual has overall masculine development. However, the feminine development is also expressed.
- C. The affected individual is short statured.
- D. Physical, psychomotor and mental development is retarded.
- E. Such individuals are sterile.

Choose the correct answer from the options given below:

(1) A and E only (2) A and B only (3) C and D only **(4) B and E only**

**Answer. (4) B and E only**

**Solution.** The correct answer is: (4) B and E only Statement A is incorrect. Klinefelter's syndrome was first described by Harry Klinefelter in 1942, not by Langdon Down. Statement B is correct. Individuals with Klinefelter's syndrome typically have overall masculine development, but there may be some feminine characteristics expressed due to the presence of an extra X chromosome. Statement C is incorrect. Short stature is not a characteristic feature of Klinefelter's syndrome. In fact, individuals with Klinefelter's syndrome may have a taller than average stature. Statement D is incorrect. Physical, psychomotor, and mental development in individuals with Klinefelter's syndrome is typically within the normal range. There may be some learning difficulties or developmental delays in some cases, but mental retardation is not a characteristic feature. Statement E is correct. Individuals with Klinefelter's syndrome are usually sterile, meaning they are unable to father children naturally due to the impaired function of their testes.

**Question 139.** Which one of the following statements is NOT correct?

- (1) The amount of some toxic substances of industrial waste water increases in the organisms at successive trophic levels
- (2) The micro-organisms involved in biodegradation of organic matter in a sewage polluted water body consume a lot of oxygen causing the death of aquatic organisms
- (3) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries**
- (4) Water hyacinth grows abundantly in eutrophic water bodies and leads to an imbalance in the ecosystem dynamics of the water body

**Answer. (3) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries**

**Solution.** The correct answer is: (3) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries This statement is not correct. Algal blooms caused by an excess of organic matter, such as nutrients from sewage or agricultural runoff, can actually have negative effects on water quality. These blooms can deplete oxygen levels in the water, leading to hypoxic or anoxic conditions that are harmful to aquatic organisms. Additionally, algal blooms can disrupt the natural balance of ecosystems and lead to the decline of certain species, including fish. Therefore, algal blooms caused by excess organic matter are generally considered detrimental to water quality and can have negative impacts on fisheries.

**Question 146.** Main steps in the formation of Recombinant DNA are given below. Arrange these steps in a correct sequence. A. Insertion of recombinant DNA into the host cell B. Cutting of DNA at specific location by restriction enzyme C. Isolation of desired DNA fragment D. Amplification of gene of interest using PCR Choose the correct answer from the options given below :

- (1) B, D, A, C **(2) B, C, D, A** (3) C, A, B, D (4) C, B, D, A

**Answer. (2) B, C, D, A**

**Solution.** The correct sequence of steps in the formation of recombinant DNA is: (2) B, C, D, A Here's a breakdown of each step: B. Cutting of DNA at specific location by restriction enzyme: In this step, the DNA containing the gene of interest and the vector DNA are cut at specific locations using restriction enzymes. This generates compatible sticky ends or blunt ends. C. Isolation of desired DNA fragment: The desired DNA fragment containing the gene of interest is isolated from a source, such as genomic DNA or a cDNA library. This can be done using techniques like PCR, gel electrophoresis, or DNA extraction methods. D. Amplification of gene of interest using PCR: The isolated DNA fragment containing the gene of interest is amplified using the polymerase chain reaction (PCR) technique. PCR allows for the selective amplification of specific DNA sequences. A. Insertion of recombinant DNA into the host cell: The amplified DNA fragment (gene of interest) is inserted into the host cell (such as a bacterial cell) using techniques like transformation, electroporation, or microinjection. The recombinant DNA is then taken up and integrated into the host cell's genome. Therefore, option (2) B, C, D, A is the correct sequence.

**Question 140.** Which of the following combinations is required for chemiosmosis?

- (1) Proton pump, electron gradient, NADP synthase
- (2) Membrane, proton pump, proton gradient, ATP synthase**
- (3) Membrane, proton pump, proton gradient, NADP synthase
- (4) Proton pump, electron gradient, ATP synthase Answer

**Answer. (2) Membrane, proton pump, proton gradient, ATP synthase**

**Solution.** The correct combination required for chemiosmosis is: (2) Membrane, proton pump, proton gradient, ATP synthase. Chemiosmosis is the process by which ATP is synthesized using the energy stored in an electrochemical gradient of protons ( $H^+$ ) across a membrane. In this process, a proton pump actively transports protons across the membrane, creating a proton gradient. The membrane, which can be the inner mitochondrial membrane or thylakoid membrane in chloroplasts, provides the barrier necessary for the establishment of the gradient. ATP synthase, located on the membrane, utilizes the proton

gradient to produce ATP. Option 2 correctly includes all the necessary components: membrane, proton pump, proton gradient, and ATP synthase.

**Question 145.** Given below are two statements : One labelled as Assertion A and the other labelled as Reason R :

Assertion A : In gymnosperms the pollen grains are released from the microsporangium and carried by air currents.

Reason R : Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed. In the light of the above statements, choose the correct answer from the options given below :

- (1) A is false but R is true
- (2) Both A and R are true and R is the correct explanation of A
- (3) Both A and R are true but R is NOT the current explanation of A
- (4) A is true but R is false**

**Answer. (4) A is true but R is false**

**Solution.** The correct answer is: (4) A is true but R is false. Assertion A is true, as gymnosperms release their pollen grains from the microsporangium and rely on air currents for pollination. Reason R is false, as pollen grains in gymnosperms are not carried by air currents to the mouth of the archegonia. In gymnosperms, the male gametes are released from the pollen grains and are carried to the female reproductive structure, where fertilization occurs. Pollen tubes are formed in gymnosperms to facilitate the transfer of male gametes to the female gametophyte. Therefore, while Assertion A is correct, Reason R is not a correct explanation of Assertion A.

**Question 103.** Identify the pair of heterosporous pteridophytes among the following :

- (1) Equisetum and Salvinia
- (2) Lycopodium and Selaginella
- (3) Selaginella and Salvinia**
- (4) Psilotum and Salvinia

**Answer. (3) Selaginella and Salvinia**

**Solution.** The correct answer is (3) Selaginella and Salvinia. Heterospory is the condition in which a plant produces two different types of spores: microspores and megaspores. Microspores give rise to male gametophytes, while megaspores give rise to female gametophytes. Among the options provided, Selaginella and Salvinia are the two heterosporous pteridophytes. Equisetum (option 1) is a homosporous pteridophyte, meaning it produces only one type of spore. Lycopodium (option 2) is also a homosporous pteridophyte. It produces spores that are all of the same type. Psilotum (option 4) is a homosporous fern-like plant and does not exhibit heterospory. Therefore, the correct answer is option (3) Selaginella and Salvinia.

**Question 132.** Among eukaryotes, replication of DNA takes place in :

(1) G2 phase (2) M phase **(3) S phase** (4) G1 phase

**Answer. (3) S phase**

**Solution.** Among eukaryotes, replication of DNA takes place in the S phase of the cell cycle. Therefore, the correct answer is (3) S phase.

**Question 135.** In gene gun method used to introduce alien DNA into host cells, microparticles of \_\_\_\_\_ metal are used.

(1) Silver (2) Copper (3) Zinc **(4) Tungsten or gold**

**Answer. (4) Tungsten or gold**

**Solution.** In the gene gun method used to introduce alien DNA into host cells, microparticles of (4) Tungsten or gold are typically used.

## **Zoology Questions & Solutions**

**Question 193.** In cockroach, excretion is brought about by

A. Phallic gland B. Urecose gland C. Nephrocytes D. Fat body E. Collateral glands Choose the correct answer from the options given below :

(1) B and D only (2) A and E only (3) A, B and E only **(4) B, C and D only**

**Answer. (4) B, C and D only**

**Solution.** The correct answer is (4) B, C, and D only. In cockroaches, excretion is brought about by multiple structures and organs. Let's evaluate each option: A. Phallic gland: The phallic gland in cockroaches is not involved in excretion but is associated with the reproductive system. B. Urecose gland: The urecose gland, also known as the Malpighian tubules, is responsible for excretion in cockroaches. These tubules remove metabolic waste products, such as nitrogenous compounds, from the hemolymph (the insect equivalent of blood) and excrete them as uric acid. C. Nephrocytes: Nephrocytes are specialized cells found in insects that perform filtration and reabsorption functions similar to the kidneys in vertebrates. They are involved in excretory processes, including filtration and osmoregulation. D. Fat body: The fat body in insects serves multiple functions, including energy storage, nutrient metabolism, and immune responses. While it has some excretory functions related to waste management, it is not the primary excretory organ in cockroaches. E. Collateral glands: The collateral glands in cockroaches are associated with the reproductive system and are involved in the production of sperm. Therefore, the correct answer is (4) B, C, and D only, as the urecose gland, nephrocytes, and fat body are involved in excretion in cockroaches.

**Question 198.** Select the correct statements.

- A. Tetrad formation is seen during Leptotene.
- B. During Anaphase, the centromeres split and chromatids separate.
- C. Terminalization takes place during Pachytene.
- D. Nucleolus, Golgi complex and ER are reformed during Telophase.
- E. Crossing over takes place between sister chromatids of homologous chromosome.

Choose the correct answer from the options given below:

(1) B and E only (2) A and C only **(3) B and D only** (4) A, C and E only

**Answer. (3) B and D only**

**Solution.** The correct answer is (3) B and D only. Let's evaluate each statement:  
A. Tetrad formation is seen during Leptotene. This statement is incorrect. Tetrad formation, also known as synapsis, occurs during the zygotene stage of prophase I of meiosis, not during leptotene. B. During Anaphase, the centromeres split and chromatids separate. This statement is correct. During anaphase of both mitosis and meiosis II, the centromeres split, and the sister chromatids separate and move towards opposite poles of the cell. C. Terminalization takes place during Pachytene. This statement is incorrect. Terminalization, also known as chiasma formation, occurs during the pachytene stage of prophase I of meiosis. It is the process of crossing over between non-sister chromatids of homologous chromosomes. D. Nucleolus, Golgi complex, and ER are reformed during Telophase. This statement is correct. During telophase of both mitosis and meiosis, the nuclear envelope reforms around the separated chromosomes, and the nucleolus, Golgi complex, and endoplasmic reticulum (ER) reassemble. E. Crossing over takes place between sister chromatids of homologous chromosomes. This statement is incorrect. Crossing over occurs between non-sister chromatids of homologous chromosomes during prophase I of meiosis. It is the exchange of genetic material between homologous chromosomes, contributing to genetic diversity. Therefore, the correct answer is (3) B and D only, as statements B and D are correct.

**Question 189.** Which of the following statements are correct?

- A. Basophils are most abundant cells of the total WBCs
- B. Basophils secrete histamine, serotonin and heparin
- C. Basophils are involved in inflammatory response
- D. Basophils have kidney shaped nucleus
- E. Basophils are agranulocytes

Choose the correct answer from the options given below:

(1) A and B only (2) D and E only (3) C and E only **(4) B and C only**

**Answer. (4) B and C only**

**Solution.** The correct answer is (4) B and C only. Let's evaluate each statement:

A. Basophils are the most abundant cells of the total white blood cells (WBCs).

This statement is incorrect. Basophils are actually one of the least abundant types of white blood cells. Neutrophils are the most abundant type of WBCs. B. Basophils secrete histamine, serotonin, and heparin. This statement is correct. Basophils are involved in allergic reactions and immune responses. They release substances such as histamine, serotonin, and heparin, which play roles in inflammation, vasodilation, and blood clotting. C. Basophils are involved in the inflammatory response. This statement is correct. Basophils play a role in the body's inflammatory response. They release inflammatory mediators and recruit other immune cells to the site of inflammation. D. Basophils have a kidney-shaped nucleus. This statement is incorrect. Basophils have a lobed or irregularly shaped nucleus, not a kidney-shaped nucleus. The kidney-shaped nucleus is characteristic of monocytes. E. Basophils are agranulocytes. This statement is incorrect. Basophils are actually granulocytes. They have granules in their cytoplasm that contain various substances involved in immune responses. Therefore, the correct answer is (4) B and C only, as both statements B and C are correct

**Question 194.** The unique mammalian characteristics are:

- (1) pinna, monocondylic skull and mammary glands
- (2) hairs, tympanic membrane and mammary glands
- (3) hairs, pinna and mammary glands**
- (4) hairs, pinna and indirect development

**Answer. (3) hairs, pinna and mammary glands**

**Solution.** The correct answer is (3) hairs, pinna, and mammary glands. The unique mammalian characteristics include: 1. Hairs: Mammals are characterized by the presence of hair, which is a unique feature among vertebrates. Hair provides insulation, protection, and sensory functions. 2. Pinna: The pinna refers to the external, visible part of the mammalian ear. It helps in collecting and funneling sound waves into the ear canal. 3. Mammary glands: Mammary glands are present in female mammals and produce milk for nourishing their young. They are a defining characteristic of mammals and play a vital role in reproductive and parental care. Therefore, the combination of hairs, pinna, and mammary glands represents the unique mammalian characteristics.

**Question 192.** Which one of the ) following is the sequence on corresponding coding strand, if the sequence on mRNA formed is as follows 5'AUCGAUCGAUCGAUCGAUCG AUCG 3'?

- (1) 3' ATCGATCGATCGATCGATCGATCG 5'
- (2) 5' UAGCUAGCUAGCUAGCUAGCUAGC 3'
- (3) 3' UAGCUAGCUAGCUAGCUAGCUAGC 5'
- (4) **5' ATCGATCGATCGATCGATCGATCGATCG 3'**

**Answer. (4) 5' ATCGATCGATCGATCGATCGATCGATCG 3'**

**Solution.** To determine the corresponding coding strand sequence, we need to remember the base pairing rules in DNA and RNA. In RNA, adenine (A) pairs with uracil (U), cytosine (C) pairs with guanine (G), and thymine (T) pairs with adenine (A) in DNA. The given mRNA sequence is: 5' AUCGAUCGAUCGAUCGAUCG AUCG 3' To find the corresponding coding strand sequence, we replace each base with its complementary base. So, the corresponding coding strand sequence would be: 3' TAGCTAGCTAGCTAGCTAGC TAGC 5' Therefore, the correct answer is (3) 3' UAGCUAGCUAGCUAGCUAGCUAGC 5'

**Question 188.** Which of the following are NOT under the control of thyroid hormone?

- A. Maintenance of water and electrolyte balance
- B. Regulation of basal metabolic rate
- C. Normal rhythm of sleep-wake cycle
- D. Development of immune system
- E. Support the process of RBCs formation

Choose the correct answer from the options given below:

- (1) D and E only (2) A and D only (3) B and C only (4) **C and D only**

**Answer. (4) C and D only**

**Solution.** The correct answer is (4) C and D only. Thyroid hormone plays a vital role in regulating various physiological processes in the body. Let's evaluate each

option to determine which ones are NOT under the control of thyroid hormone: A. Maintenance of water and electrolyte balance: This process is under the influence of thyroid hormone. Thyroid hormone helps regulate the balance of water and electrolytes in the body. B. Regulation of basal metabolic rate: This is one of the primary functions of thyroid hormone. It plays a crucial role in determining the basal metabolic rate (BMR) and overall energy metabolism in the body. C. Normal rhythm of sleep-wake cycle: This process is not directly controlled by thyroid hormone. The sleep-wake cycle is regulated by the circadian rhythm, which is primarily influenced by the suprachiasmatic nucleus in the brain. D. Development of immune system: This process is not primarily under the control of thyroid hormone. The development and regulation of the immune system involve various other factors and mechanisms. E. Support the process of RBC formation: This process is under the influence of thyroid hormone. Thyroid hormone plays a role in supporting erythropoiesis, the process of red blood cell formation. Based on the evaluations above, the options (3) B and C only, and (4) C and D only are incorrect. Therefore, the correct answer is (1) D and E only, as the development of the immune system is not primarily under the control of thyroid hormone.

**Question 191.** . Which of the following is characteristic feature of cockroach regarding sexual dimorphism?

- (1) Presence of anal cerci
- (2) Dark brown body colour and anal cerci
- (3) Presence of anal styles**
- (4) Presence of sclerites

**Answer. (3) Presence of anal styles**

**Solution.** The correct answer is (3) Presence of anal styles. In cockroaches, sexual dimorphism refers to the physical differences between males and females of the species. One characteristic feature of sexual dimorphism in cockroaches is the presence of anal styles. Anal styles are modified appendages located at the tip of the abdomen in male cockroaches. They are used during mating to help stabilize the female during copulation. Let's evaluate the other options: (1) Presence of anal cerci: Anal cerci are sensory structures found at the posterior end of the abdomen in both male and female cockroaches. They are not

specifically related to sexual dimorphism. (2) Dark brown body color and anal cerci: Body coloration and the presence of anal cerci are not exclusive to one sex in cockroaches. Both male and female cockroaches can have dark brown body coloration and anal cerci. (4) Presence of sclerites: Sclerites are hardened plates or segments in the exoskeleton of cockroaches. They are not specifically related to sexual dimorphism but are present in both male and female cockroaches. Therefore, the presence of anal styles is the characteristic feature of cockroaches regarding sexual dimorphism.

**Question 190.** The parts of human brain that helps in regulation of sexual behaviour, expression of excitement, pleasure, rage, fear etc. are:

- (1) Corpus callosum and thalamus
- (2) Limbic system and hypothalamus**
- (3) Corpora quadrigemina and hippocampus
- (4) Brain stem and epithalamus

**Answer. (2) Limbic system and hypothalamus**

**Solution.** The correct answer is (2) Limbic system and hypothalamus. The limbic system and hypothalamus play crucial roles in the regulation of sexual behavior, expression of excitement, pleasure, rage, fear, and other emotions. The limbic system is a complex network of structures within the brain that includes the amygdala, hippocampus, and parts of the cerebral cortex. It is involved in the processing and regulation of emotions, memory formation, and the reward system. The hypothalamus, located at the base of the brain, is responsible for maintaining homeostasis in the body, including the regulation of various physiological and behavioral processes. It plays a significant role in controlling sexual behavior and the expression of emotions. The hypothalamus also regulates the release of hormones, including those involved in sexual arousal and reproduction. The other options mentioned are not primarily associated with the regulation of sexual behavior, expression of excitement, pleasure, rage, fear, etc. The corpus callosum and thalamus are more involved in the communication between the two cerebral hemispheres and relaying sensory information, respectively. The corpora quadrigemina are involved in visual and auditory reflexes, while the hippocampus is primarily associated with memory formation.

The brain stem and epithalamus are involved in various basic functions and sleep regulation, respectively

**Question 167.** Which of the following statements is correct?

- (1) Algal Bloom decreases fish mortality
- (2) Eutrophication refers to increase in domestic sewage and waste water in lakes.
- (3) Biomagnification refers to increase in concentration of the toxicant at successive trophic levels.**
- (4) Presence of large amount of nutrients in water restricts 'Algal Bloom'

**Answer. (3) Biomagnification refers to increase in concentration of the toxicant at successive trophic levels.**

**Solution.** The correct statement is (3) Biomagnification refers to an increase in the concentration of a toxicant at successive trophic levels. Biomagnification is the process by which certain substances, such as heavy metals or persistent organic pollutants, become increasingly concentrated in organisms as they move up the food chain. As predators consume multiple prey organisms, the accumulated toxins in those organisms are transferred and become more concentrated in the bodies of the predators. Let's evaluate the other statements: (1) Algal Bloom decreases fish mortality: This statement is incorrect. Algal blooms can actually increase fish mortality. When there is an excessive growth of algae due to high nutrient levels in the water (eutrophication), it can lead to oxygen depletion and the release of toxins, causing harm to fish and other aquatic organisms. (2) Eutrophication refers to an increase in domestic sewage and wastewater in lakes: This statement is partially correct. Eutrophication refers to the excessive enrichment of water bodies, such as lakes or rivers, with nutrients, including those from domestic sewage and wastewater. However, it can also result from agricultural runoff and other sources of nutrient inputs. (4) The presence of a large amount of nutrients in water restricts 'Algal Bloom': This statement is incorrect. Algal blooms are often triggered by an excess of nutrients, particularly nitrogen and phosphorus, in the water. The availability of these nutrients promotes the rapid growth and reproduction of algae, leading to an algal bloom.

**Question 170.** Given below are two statements:

Statement I: Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

Statement II: The cavity of the cervix is called cervical canal which along with vagina forms birth canal.

In the light of the above statements, choose the correct answer from the options given below:

(1) Statement I is incorrect but Statement II is true.

**(2) Both Statement I and Statement II are true.**

(3) Both Statement I and Statement II are false.

(4) Statement I is correct but Statement II is false.

**Answer. (2) Both Statement I and Statement II are true.**

**Solution.** The correct answer is: (2) Both Statement I and Statement II are true.