



UNIFIED COUNCIL

An ISO 9001:2008 Certified Organisation



NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

Paper Code: **UN439 (UPDATED)**

Solutions for Class : 12 PCB

BIOLOGY

1. (C) Pomato was produced by fusion of potato and tomato protoplasts through somatic hybridization technique.
2. (C) Human embryo is called as a fetus after 11th week.
3. (B) Prototherians are egg laying mammals. Their eggs resemble to that of reptiles containing a large amount of yolk.
4. (B) According to immunity theory (pacemaker theory), there is a progressive breakdown of the immunological system with increasing age.
5. (C)

$$\begin{array}{ccccccc}
 & & Rr & & x & & Rr \\
 & & | & & | & & | \\
 RR & & Rr & & Rr & & rr
 \end{array}$$
6. (A) Photorespiration also known as C_2 cycle, is a light induced oxidation of photosynthetic intermediates with the help of oxygen. For this rubisco enzyme functions as RuBP oxygenase. The process of photorespiration occurs in three different cell organelles viz., chloroplasts, peroxisomes and mitochondria.
7. (C) The first step in the gastrulation of birds involves separation of an outer epiblast (presumptive ectoderm and mesoderm) from an inner hypoblast (presumptive endoderm).
8. (C) Chimaera is composed of genetically diverse tissues, in most cases in a plant, more rarely in an animal.
9. (B) When a person consume curd/yoghurt, it would be considered in the top or apex (i.e., 2nd trophic level) of detritus food chain. Yoghurt or curd is a commercial fermented dairy product. It is produced by a starter culture of *Streptococcus thermophilus* and *Lactobacillus* in 1:1 ratio at 40 - 60°C and then partial fermentation by yeast. *Streptococcus* produced acid and *Lactobacillus* forms aroma.
10. (D) Golgi complex - acrosome, DNA synthesis - Okazaki fragments.
11. (C) Structural gene determines the primary structure of a protein by genetic transcription and translation.
12. (C) Gametes are always haploid because these are formed from the diploid mother cells by the meiosis (Reductional) division.

Due to meiosis division gametes contain only one set of chromosomes.

Gametes take part in the process of sexual reproduction. Two gametes of different sexes unite and form a diploid structure called zygote which germinates and gives rise to a new diploid individual.
13. (D) The process of gastrulation, the notochord formation, takes place immediately after gastrulation.
14. (B) Haemophilia is a genetically linked disease.

15. **(D)** Limulus, sphenodon and coelacanth are living fossils.
16. **(A)** Ramapithecus was the most primitive hominid; the fossils were from Africa and Asia, belonging to later Miocene and Pliocene. Only jaws, teeth and fragments of the skull have been found. The extinct apes, genus Ramapithecus, have features suggesting that they were the beginning of the linkage leading to humans.
17. **(B)** In order to provide more milk for the people of India, a massive cross breeding programme has been initiated to Friesian-Sahiwal cross breeds as a base for the evolution of a new milch strain "Frieswal" through interbreeding, selection and progeny testing of bulls.
18. **(A)** Natural silk contains two proteins sericin and fibroin, hence the element nitrogen.
19. **(C)** Oil and petroleum exporting countries
20. **(D)** There is no vector or secondary host for hookworm. Larvae penetrate through the skin of hand and feet.
21. **(D)** Frederick Griffith discovered the phenomenon of transformation
22. **(B)** Multiple sclerosis is an auto-immune disease in which the immune system attacks the central nervous system, leading to demyelination. Disease onset usually occurs in young adults, and it is more common in females. It was first described in 1868 by Jean-Martin Charcot.
23. **(D)** HIV attaches to CD4 receptor site of helper T-cells by the help of GP120 on the protein coat of the virus.
24. **(C)** Hay fever also known as allergic rhinitis results from the reaction of air borne allergens with sensitized mast cells in conjunctiva and nasal mucosa. The symptoms include watery exudation of the conjunctiva, nasal mucosa and upper respiratory tract, as well as sneezing and coughing.
25. **(B)** The Human Leucocyte Antigen System (HLA) is the name of the Major Histocompatibility Complex (MHC) in humans.
26. **(A)** Coconut milk contains nutrients along with natural hormones like cytokinin. When it is added in culture medium, the growth of callus is enhanced considerably. Coconut milk is in fact free nuclear endosperm and thus it is a very rich and nutritive drink.
27. **(B)** Bacillus thuringiensis produces toxic substances to kill insects. Its Bt-genes are responsible for this peculiar behaviour. When Bt-genes of the bacterium were transferred to crop plants, such as cotton, brinjal, cauliflower, etc., through recombinant DNA technology, insect repelling properties were developed in the crop thus produced (transgenic crops) and they do not need any pesticidal spray while growing in cropfields, Bt-cotton is the first commercially produced genetically modified crop carrying Bt-genes.
28. **(C)** Biogas is produced by anaerobic decomposition of organic matter in presence of methanogenic bacteria belonging to archaebacteria. Archaebacteria differ from eubacteria (true bacteria) in not having mucopolysaccharide substances in their cell wall. They are found in very unusual environment such as strictly anaerobic environment, sulphur rich environment, salt rich environment. They are considered to be the oldest amongst the living organisms oldest living fossils.
29. **(C)** Nitrifying bacteria, Nitrosomonas and Nitrobacter, are capable of oxidizing ammonia to produce nitrites and then nitrates. They are chemoautotrophs and they derive energy through oxidation reactions for synthesizing their own food. Since they are utilizing inorganic raw materials (carbon dioxide and H_2S) in their photosynthesis, they are placed under chemolithotrophs.

30. **(B)** Plasmids are circular DNA rings found in bacterial cells as extranuclear genes or genetic traits and showing endosymbiosis with bacterial cell. They carry important genetic characteristics such as fertility factor, resistance against antibiotics, nitrogen fixing ability etc, Plasmids can be taken out or can be reinserted into bacterial cells without killing bacteria or without altering their characteristic behaviour.
31. **(A)** The age of earth is about 4.6 billion years. The history of earth has been divided into a number of eras. The eras are subdivided into periods. The modern periods are subdivided into epochs.
32. **(C)** Haemocoel is found in cockroach and pila.
33. **(C)** Condition reflexes are also known as acquired reflexes because these reflexes are first learned (experienced) and then cause reflex action. Conditional reflexes were first demonstrated by Russian scientist, Pavlov on dogs. This type of reflex is controlled by both brain and spinal cords.
34. **(C)** Klinefelter's syndrome was described by Dr H.F Klinefelter in 1942. It is due to an extra X chromosome instead of normal XY i.e., XXY. In other words it is a case of trisomy of sex chromosomes or allosomes in males. Down's syndrome is due to trisomy of 21st chromosome (autosomes).
35. **(A)** In the females of most birds, only the left ovary is developed while right ovary becomes reduced to vestigial form. It is most probably adaptation for flying habitat which reduced the body weight.
36. **(D)** The trophic level includes all organisms of a food chain. That is autotrophs, herbivores and carnivores. e.g; In a terrestrial food chain, all green plants form primary trophic level and all herbivores which eat these plants form 2nd trophic level. Third trophic level is formed by primary carnivores or secondary consumers which eat herbivores and next trophic level i.e.
- IVth is formed by tertiary consumers which feed on secondary consumers, 5th trophic level is formed by top consumers which feed on carnivores.
37. **(A)** Chromosomes are of following types on the basis of position of centromere on them
- Telocentric : Centromere occurs at one end. These chromosomes look like T shaped during anaphase.
38. **(B)** Biological Oxygen Demand (BOD) is a measure of polluting organic matter present in a sample of water. BOD is higher in polluted sewage water and is connected with both microbes and organic matter. When larger amount of sewage is dumped into water, the BOD will increase.
39. **(A)** Mosses and ferns require presence of water for fertilization that is why they are found in moist and shady habitat. Other similarities between both these groups are:
- (i) Development of embryo occurs within the archegonium.
 - (ii) Presence of heterogenous alternation of generation.
 - (iii) presence of cuticle.
 - (iv) Presence of multicellular sex organs with a jacket of sterile cells.
 - (v) Presence of multicellular sporangia.
 - (vi) Presence of flagellated male gametes.
40. **(D)** Plastids are small bodies found free in most plant cells. These are found absent in fungi, certain bacteria, algae and multicellular animals. The plastids can be categorized to:
- Chromoplasts : Coloured (other than green) plastids.
- Chloroplasts: Green coloured plastids:
- Leucoplasts : Colourless plastids. All these three are double membrane bound structures which are mainly used for trapping radiation and storage purposes. New plastids arise from proplastids by a fission like process.

PHYSICS

41. (A) A parallel plate capacitor is charged and the battery used for charging is then disconnected. The voltage across the plates increases.
42. (C) The magnitude of the e.m.f. across the secondary of a transformer depends upon.
- (a) the magnitude of the emf applied across the primary.
- (b) the number of turns in the primary and the secondary.
- $$\therefore e_s = \frac{N_s}{N_p} \cdot e_p$$
43. (D) The scattering of α -particles by a gold foil explains the experimental evidences of the existence of the nucleus in an atom.
44. (A) When the refractive index of both lens and transparent liquid are equal, then the lens becomes invisible when immersed in the liquid.
45. (B) There will be no loss of energy if the potential of spheres is the same i.e., if
- $$V = \frac{q}{4\pi\epsilon_0 r} = \frac{Q}{4\pi\epsilon_0 R} \quad (\text{or}) \quad \frac{q}{r} = \frac{Q}{R}, qR = QR$$
46. (B) Acceptor impurity is group III like boron, gallium, indium. It forms p-type semiconductor.
47. (B) We know that, $E = \alpha\theta + \frac{1}{2}\beta\theta^2$,
Given that $E = 14\theta - 0.02\theta^2$
Comparing the two equations,
 $\alpha = 14 \mu\text{V}^\circ\text{C}$, $\beta = (-0.04) \mu\text{V}^\circ\text{C}^2$
Neutral temperature =
 $\theta_n = \frac{\alpha}{\beta} = \frac{14}{0.04} = 350^\circ\text{C}$
 $\theta_0 = 10^\circ\text{C}$, $\theta_n = 350^\circ\text{C}$, $\theta_i = ?$
 $\theta_0 = 2\theta_n - \theta_i = 2 \times 350 - 10 = 690^\circ\text{C}$.
48. (B) Electromagnetic waves are transverse waves. They can produce interference and can travel through vacuum.
49. (B) The concentration decreases to half of its initial amount is from nearly 6000 to 3000.

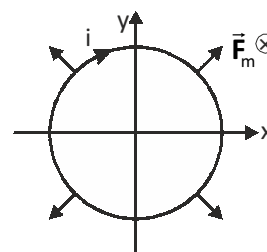
50. (C) A current I flows along the length of an infinitely long, straight, thin walled pipe. The magnetic field at any point inside the pipe is zero.

51. (B) $f_m = 20 \text{ kHz}$; $f_c = 1\text{MHz} = 1,000 \text{ kHz}$
side bands are produced at,
 $f_{\min} = f_c - f_m = 1,000 - 20 = 980 \text{ kHz}$
 $f_{\max} = f_c + f_m = 1,000 + 20 = 1,020 \text{ kHz}$

52. (C) $R = R_0 A^{1/3}$

$$\frac{R_1}{R_2} = \left(\frac{A_1}{A_2} \right)^{1/3} = \left(\frac{1}{27} \right)^{1/3} = \left(\frac{1}{3^3} \right)^{1/3} = \frac{1}{3}$$

53. (B) Net force on a current carrying loop in uniform magnetic field is zero. Hence, the loop cannot translate. From Fleming's left hand rule we can see that if magnetic field is perpendicular to paper inwards and current in the loop is clockwise (as shown) the magnetic force \vec{F}_m on each element of the loop is radially outwards, or the loops will have a tendency to expand.



54. (D) According to the given information substance 'X' is ferromagnetic in nature which is gadolinium.

A paramagnetic substance is feebly attracted by a magnet. When a rod of paramagnetic substance is suspended in a magnetic field, it slowly sets itself parallel to the direction of the magnetic field. It also moves from a weaker part of the magnetic field to its stronger part, but it is feebly attracted by the magnet.

When a rod of diamagnetic substance is suspended in a magnetic field, it slowly sets itself at right angles to the direction of field. It moves from stronger part of the magnetic field to its weaker part i.e., it is feebly repelled by the magnet.

Aluminium and oxygen are paramagnetic. Gold is diamagnetic. Gadolinium is ferromagnetic. So, substance X is gadolinium.

55. (A) Given $I = 20 \text{ A}$, $n = 9 \times 10^{30} \text{ m}^{-3}$; $A = 10^{-4} \text{ m}^2$
and $e = 1.6 \times 10^{-19} \text{ C}$

$$V_d = \frac{I}{neA} = \frac{20}{9 \times 10^{30} \times 1.6 \times 10^{-19} \times 10^{-4}} \\ = 0.138 \times 10^{-6} \text{ m s}^{-1}$$

56. (B) Here, $\lambda = 600 \text{ nm} = 600 \times 10^{-9} \text{ m}$;
 $a = 2 \text{ mm} = 2 \times 10^{-3} \text{ m}$

Now, the required distance

$$Z_F = \frac{a^2}{\lambda} = \frac{(2 \times 10^{-3})^2}{600 \times 10^{-9}} = 6.67 \text{ m}$$

57. (C) We know, $1.6 \times 10^{-19} \text{ J}$

$$\text{Therefore, } 1 \text{ J} = \frac{1}{1.6 \times 10^{-19}} = 6.25 \times 10^{18} \text{ eV}$$

58. (A) Amplitude of the magnetic field

$$= B_o = \frac{E_o}{c} = \frac{48}{3 \times 10^8} = 1.6 \times 10^{-7} \text{ T}$$

59. (A) When the cells are connected in series, the total e.m.f. is equal to sum of their e.m.fs.

Therefore, total e.m.f. of the cells,
 $E = 2.0 \times 6 = 12.0 \text{ V}$

Also, total internal resistance,
 $r = 0.015 \times 6 = 0.09 \Omega$

External resistance, $R = 8.5 \Omega$

Therefore, the current drawn from the supply,

$$I = \frac{E}{R+r} = \frac{12.0}{8.5+0.09} = 1.397 \text{ A}$$

Terminal voltage, $V = I R = 1.397 \times 8.5$
 $= 11.875 \text{ V}$

60. (C) $l = 20.0 \text{ cm} = 0.20 \text{ m}$

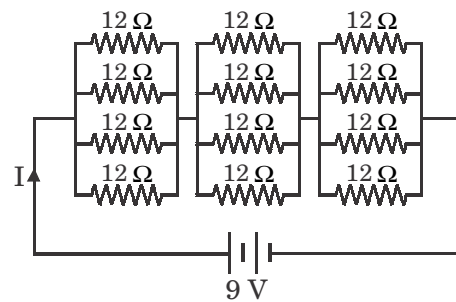
$A = 4.00 \times 10^{-4} \text{ m}^2$, $\rho = 2.82 \times 10^{-8} \Omega \cdot \text{m}$

$$\text{Resistance} = R = \frac{\rho l}{A} = \frac{2.82 \times 10^{-8} \times 0.20}{4.00 \times 10^{-4}}$$

$$= 1.41 \times 10^{-5} \Omega$$

61. (A) The network of resistors connected to the battery of e.m.f. 9 V is shown below. Let I be the total current in the circuit. If R' is the effective resistance of the four resistors of 12Ω each connected in parallel, then

$$\frac{1}{R'} = \frac{1}{12} + \frac{1}{12} + \frac{1}{12} + \frac{1}{12} = \frac{4}{12} \text{ or } R' = 3 \Omega$$



Therefore, the effective resistance of the network of resistors,

$$R = R' + R' + R' = 3 + 3 + 3 = 9 \Omega$$

The current in the circuit

$$I = \frac{E}{R} = \frac{9}{9} = 1 \text{ A}$$

Since all the four resistors are of the same resistance, same current will pass through the each resistor, Therefore, the current through each resistor =

$$\frac{1}{4} I = \frac{1}{4} \times 1 = 0.25 \text{ A}$$

- 62 (C) $e B \times \pi r^2 \times v = \frac{1}{2} B r^2 \omega$

Here, $r = 200 \text{ cm} = 2 \text{ m}$; $B = 0.05 \text{ Wb m}^{-2}$
and $\omega = 60 \text{ rad s}^{-1}$

$$\therefore e = \frac{1}{2} \times 0.05 \times (2)^2 \times 60 = 6 \text{ V}$$

63. (D) Here, $h = 6.62 \times 10^{-34} \text{ J s}$

de-Broglie wavelength of electron :

Here, $m_e = 9.1 \times 10^{-31} \text{ kg}$; $v_e = 10^5 \text{ m s}^{-1}$

$$\therefore \lambda_e = \frac{h}{m_e v_e} = \frac{6.62 \times 10^{-34}}{9.1 \times 10^{-31} \times 10^5} \\ = 7.27 \times 10^{-9} \text{ m}$$

64. (D) $\text{K.E.} = \frac{e^4 m}{8 \epsilon_0^2 n^2 h^2} = 13.6 \text{ eV},$

$$\text{P.E.} = \frac{-Ze^2}{8 \pi \epsilon_0 r} = -2 \times \text{K.E.} = -27.2 \text{ eV}$$

65. (B) $\frac{1}{v} + \frac{1}{9} = \frac{1}{10}$

i.e., $v = -90 \text{ cm}$

Magnitude of magnification =

$$\frac{90}{9} = 10 \text{ cm}$$

CHEMISTRY

66. (B) In the addition of HCN to carbonyl group of a ketone, nucleophilic nitride or cyanide ion attacks the carbonyl atom with simultaneous transfer of π -electrons to the oxygen atom of the carbonyl group
67. (C) Radius of Hf^{4+} should be greater than that of Zr^{4+} by at least 20 pm, but the lanthanoid contraction of about the same magnitude almost cancels the expected increase. As a result, Hf^{4+} and Zr^{4+} have almost equal radii, being 80 pm and 81 pm respectively.
68. (B) $\Delta H = (E_a)_f - (E_a)_b$
 $(E_a)_b = (E_a)_f - \Delta H$
 $\therefore (E_a)_b > (E_a)_f$ and
 Given $E_{af} = 50 \text{ kcal}$ (from options)
 ΔH must be negative
 $\therefore (E_a)_b = (50 + 10) \text{ kcal} = 60 \text{ kcal}$
69. (B) $W = \frac{ItE}{96500}$
 $= \frac{1.4 \times 31.75 \times 500}{96500} = 0.23 \text{ g.}$
70. (A) Addition of HCl to acetylene in the presence of mercuric salt leads to formation of vinyl chloride which is the monomer for poly vinyl chloride.
71. (A) The ideal conditions for the manufacture of H_2SO_4 by contact process are low temperature, high pressure and high concentration of reactants.
72. (B) The process of heating the quenched steel to a temperature much below redness and cooling it slowly.
73. (D) $\text{CH}_3\text{NC} + 4\text{H} \xrightarrow[\text{C}_2\text{H}_5\text{OH}]{\text{Na}} \text{CH}_3\text{NHCH}_3$
74. (B) Benzoic acid in benzene exists as dimer.
75. (B) It reacts with KCl to give Cu_2Cl_2 is not correct regarding copper sulphate.
76. (C) Daniel cell is an electrochemical cell that converts chemical energy of a spontaneous redox reaction into electrical energy. But from the given redox reactions, the following can be concluded:

- (i) A redox reaction is a combination of two half reactions whose addition gives the given overall reaction.
- (ii) The reduction half reaction occurs on the copper electrode.
- (iii) The oxidation half reaction occurs on the zinc electrode.
77. (B) On reduction, aldehydes give primary alcohols, while ketones give secondary alcohols. e.g.,
- (i) $\text{CH}_3\text{CHO} + \text{H}_2 \xrightarrow{\text{Ni}} \text{CH}_3\text{CH}_2\text{OH}$
 acetaldehyde (ethyl alcohol)
- (ii) $\text{CH}_3\text{COCH}_3 + \text{H}_2 \xrightarrow{\text{Ni}} \text{CH}_3\text{CH(OH)CH}_3$
 acetone (propan-2-ol)
78. (A) Molality is a preferred unit for measuring concentration because it is temperature independent.
- $$n_{\text{solvent}} = \frac{\text{Mass of solute}(w)}{\text{Molar mass of solute}(M)}$$
- $$\text{Molality}(m) = \frac{w/M}{W}$$
- Molality (m) of a solution does not change with temperature.
79. (B) All (copper, lead and chromium) have higher standard reduction potentials than Mn except Mg, which has lower standard reduction potential than Mn.
- \therefore Mg will displace Mn from its salt solution (MnSO_4).
80. (D) $\Delta T_f = k_f m$
 $k_f = \frac{\Delta T_f}{m} = \frac{4 \text{ deg}}{0.25 \text{ mol kg}^{-1}}$
 $= 16 \text{ deg kg mol}^{-1}$
81. (D) Secondary amine is formed by the replacement of two hydrogen atoms of NH_3 by alkyl groups i.e.,
- $$\begin{array}{c} \text{R} \\ \diagdown \\ \text{NH} \\ \diagup \\ \text{R} \end{array}$$
82. (C) $150 \text{ mL C}_2\text{H}_5\text{OH} = 150 \times 0.78 \text{ g} = 117.0 \text{ g}$
 $= \frac{117}{46} \text{ mol}$
 Water = 850 g
 $\text{Molality} = \frac{117}{46} \times \frac{1}{850} \times 1000 = 2.99$

83. (B) All the given uses are of helium.
(Refer) Pg: 205 of NCERT book XII chemistry, Part - I - Uses of helium).

84. (B) Potassium ethyl xanthate acts as a collector. KCN and NaOH depress the floatation property of ZnS and FeS₂ particles. Thus, only PbS particles go into the froth. Now copper sulphate is added to the tank (mixture) which activates floating character of ZnS and this time only ZnS comes along with froth. The remaining slurry is acidified and FeS₂ floats alongwith the froth.

85. (C) $100 \text{ g Zn} = \frac{100}{65} \text{ mole} = 1.53 \text{ mole}$
1 L of 1 M CuSO₄ sol contains 1 mole of CuSO₄.

∴ In $\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$, CuSO₄ is the limiting reagent.

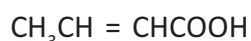
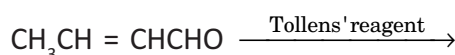
To deposit completely 1 mole of Cu, electricity required = $2 \times 96500 \text{ C}$

Time taken =

$$t = \frac{Q}{I} = \frac{2 \times 96500}{1} \text{ s} = \frac{2 \times 96500}{3600} \text{ h}$$

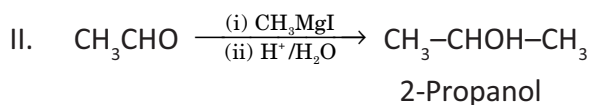
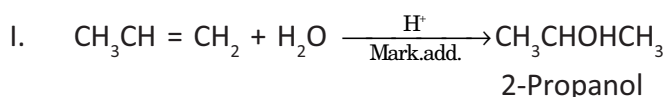
$$= 53.6 \text{ h}$$

86. (C) Aldehydes are easily oxidised to the corresponding acids by Tollens' reagent while all others are strong oxidising agents and hence, cleave the molecule at the site of the double bond yielding a mixture of products.

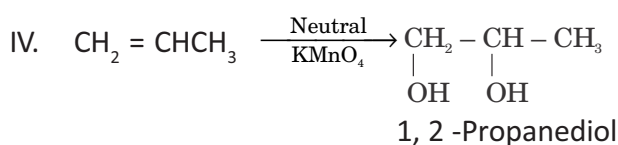
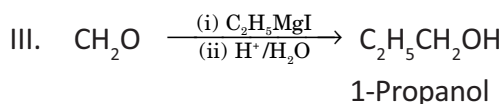


87. (D) Order may or may not be equal to molecularity.

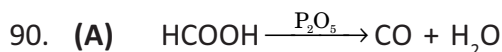
88. (A) Reactions I and II give 2-propanol, i.e.,



In contrast, reaction III gives 1-propanol and IV gives 1, 2-propanediol.



89. (D) Copper ferrocyanide ppt. acts as a semipermeable membrane.



GENERAL AWARENESS

91. (C) 92. (A) 93. (B) 94. (C)

95. (C) 96. (D) 97. (B) 98. (D)

99. (A) 100. (A)

===== The End =====