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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

Paper Code: UN436

Solutions for Class : 12-PCB

BIOLOGY

1. **(B)** The unfertilized egg or zygote before cleavage is a single cell.

2. **(C)** With advancing age, calcium ions are found to accumulate in the peripheral cytoplasm of animal and plant cells. This is caused by changes in the permeability of cellembrane.

3. **(B)** Being dioecious, a dog cannot be self-fertilized.

4. **(C)** Because Datura has a haploid chromosome number 12.

5. **(A)** Archenteron is the primitive gut formed during gatrulation in embryonic development.

6. **(D)** RNA polymerase is required for RNA synthesis.

7. **(D)** UGG codes for the amino acid tryptophan.

8. **(D)** Regular gene codes for a repressor protein in inducible system and a co-repressor in repressible system.

9. **(A)** Red-green colour blindness is the most common sex-linked colour blindness.

10. **(B)** Jelly envelope of frog's egg also hold eggs together in masses, protect eggs from infection, make them tasteless and unappetising to predators.

11. **(C)** Neopilina galatheae is the most primitive mollusc having metamerism like annelids.

12. **(D)** New World comprises North and Souoth America.

13. **(A)** Aurochs was the extinct wild ox of Europe.

14. **(C)** Syphilis - Treponema pallidum.

15. **(D)** Yellow fever, transmitted by mosquitoes.

16. **(B)** R.Altmann introduced the term 'nucleic acid'.

17. **(B)** No major changes occur to brain of tadpole during metamorphosis.

18. **(D)** Mantoux test, after the French physician Charles Mantoux, is a tuberculin sking test.

19. **(D)** Antibody is a protein (immunoglobulin), consisting of two identical heavy chains and two identical light chains, that recognizes particular epitope on an antigen and facilitates clearance of that antigen.

20. **(B)** Anopheles-Malaria.

21. **(D)** Eczema is a superficial dermatitis. Utricaria is a skin eruption characterized by transient wheals of varying shapes and sizes.

22. **(D)** Rheumatic fever is an autoimmune disorder, primarily affecting women 40 to 60 years old, causing chronic inflammation of the joints.

23. **(A)** In tissue culture experiments, rapid celldivision in explant cytokinin. Thus a mass of undifferentiated tissue is produced called us. Callus formation shows growth and development without differentiation. Callus produces roots and shoots only when differentiation is induced using different combinations of auxin and cytokinin in culture medium and thereafter, it gives rise to new plants through plantler fomation.

24. **(B)** Best biofertilizer for paddy fields is Azolla and blue-green algae, Azolla possesses colonies of Anabaena or Nostoc as endophytic symbiont and helps in nitrogen fixation.

25. **(B)** Some predaceous fungi (Dactylella, Arthrobotrys) have the ability of trapping nematodes and then feeding over their organic matter. They help in reducing the level of soil pathogens especially the nematodes forming galls in roots of many crop plants.

26. **(C)** Due to petrol crisis and air pollution caused by petrol driven automobiles, alcohol is added intopetrol (nearly 10-15%) and then lused in automobiles without any major alteration.

27. **(D)** Botulism refers to food poisoning caused by exotoxin synthesized by Clostridium botulinum (-an anaerobic and saprophytic bacterium). Clostridium tetani causes tetanus and it is a facultative parasite found on dead and decaying organic matter. Salmonella causes typhoid and Pseudomonas causes black rot of potato.

28. **(A)** Gram+ve bacteria differ from Gram-ve forms in having excess of peptidoglycan in their cell wall which retains Gram staining even after through washing with alcohol. Gram-ve forms are often found associated with diseses (they are pathogenic in nature).

29. **(B)** For starting translation starting codon AUG is must. The termination codon (UAA, UAG, UGA) must be at 3' end.

30. **(B)** The organs which have the same fundamental structure but diferent function are called homologous organs.

31. **(A)** Photorespiration also known as C_2 cycle, is a light induced oxidation of photosynthetic intermediates with the help of oxygen. For this rubisco enxyme functions as RuBP oxigenase. The proess of photorespiration occurs in three different cell organelles viz, chloroplasts, peroxisomes and mitochondria.

32. **(B)** The growth of superficial and middle layer of endometrium ocurs fromthe 5th to 14 days of the cycle under the enfluence of estrogen. Release of egg ovulation occurs roughly 14 days after the firt day of the start of a period of fertilization.

33. **(D)** Keystone species deserve protection because these have a significant and disproportionately large on the other species living in a community. The number of key stone species often low as compared to other species but they limit the population of other species.

34. **(C)** Plasmodium malariae has the logest incubation period, i.e, 27-37 days. In P. ovale and P. virax is 10-17 days. In P. falciparum 8-12 days.

35. **(C)** Restriction endonuclease enzymes are used to cut DNA molecule at specific sites. These are the main enzymes in genetic engineering which cleave the DNA to generate a nick of with a 5' phosphoryl and 3' hydroxyl terminus for the insertion of desired foreign DNA segment.

36. **(A)** Turner's syndrome was discovered by Turner in 1938. It is a case of monosomy (2n-1) in which one chromosome (sex chromosome) is misssing (XO). Thus, an affected person contains only 45 chromosomes instead of 46. Symptoms of Turner's syndrome include infertility, short statured,small uterus webbed neck, puffy fingers, finger nails more convex and hairline at the black of the head is lower than normal.

37. **(C)** Releasing of industrial wastes containing mercury in fishing water causes Minimata disease. It occurred in Minimata city, Japan in suffered serious nervous damage due to eating fish taken from Minimata bay.

38. **(B)** In the root nodules of leguminous plants Rhizobium (a nitrogen fixing bacateria) lives in symbiotic association. Yeast helps in alcohol productin not in bio-gas (by methanogenic bacteria). Myxomycetes (slime moulds) do not cause ringworm diease, it is caused by Microsporum audouini fungus, Mycorrhizae is a mutualistic relationship between some soil higher plants provide the fungi with carbohydrates and in return the fungi provide the plants minerals (especially phosphorus) which the plants cannot absorb from soil.

39. **(A)** Entry of pollen tube into the ovule may be possible through micropyle (porogamy), through chalaza (chalazogamy) and through integuments (mesogamy). But in most cases pollen tube enters through micropyle. Irrespective of the place of entry of pollen tube into the ovule, the tube invariably enters the embryo sac at micropylar end in between the egg cell and synergid.

40. **(A)** Regeneration is the phenomenon of restoration of body parus which have been removed either by injury or autotomy. It is extensively found in planarians and common feature in polychaetes, crustaceans and echinoderms. Morgan (1901) distinguished the following two basic types of regeneration:

 (a) **Morphallactic regeneration or morphollaxis:** In morphollaxis type of regeneration new individual is produced not by addition of parts to the residue of the animals body but by remodelling the entire available, mass of cells into a new one. It is found in lower animals.

 (b) **Epimorphic regeneration or epimorphosis:** It is common type of renegeration found in higher animals. The regenerated organ is an addition to the other parts of the animal's body. e.g., Renewal of limbs in salamander.

PHYSICS

41. **(C)** If the plane of the coil makes an angle with the magnetic field, the magnitude of the torque exerted on it is given by $\tau = nIAB \sin\theta$. For the given value of θ, when A is doubled τ value doubles.

42. **(A)** Let half life of sample be $t_{1/2}$. If $\frac{7}{8}$ of the radioactive atoms had decayed.

 Atoms remaining $= 1 - \frac{7}{8} = \frac{1}{8}$

 $\therefore$ For $\frac{1}{8}^{th}$ $\left(i.e., \frac{1}{2^3}\right)$ the no. of half lives undergone are 3.

 $\therefore$ 3 $T_{1/2}$ = 60 days

 $T_{1/2}$ = 20 days

43. **(C)** The dispersion of light in a medium imply:

 (i) Lights of different wavelengths travel with different speeds in the medium.

 (ii) Lights of all frequencies does not travel with the same speed in the medium.

 (iii) The refractive index of the medium is different for different wavelengths of light.

44. **(A)** The phase angle between voltage V and current I is $\pi/2$. Therefore, power factor cos = cos $(\pi/2)$ = 0. Hence the power consumed is zero.

45. **(C)**
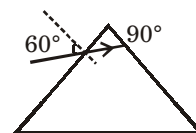
 Given, A = 30°

 i_1 = 60° & r_2 = 0

 Since A = $r_1 + r_2$

 A = r_1 = 30°

 $\mu = \frac{\sin i_1}{\sin r_1} = \frac{\sin 60°}{\sin 30°} = \frac{(\sqrt{3}/2)}{(1/2)} = \sqrt{3}$

46. (C) If the junction is forward biased in a p – n junction diffusion current is greater than the drift current in magnitude.

47. (A) The following statements reason out that photo electric effect supports quantum nature of light,

(i) Electric charge of the photo electrons is quantized.

(ii) The maximum KE of photo electrons depends only on the frequency of light and not on intensity.

(iii) There is a minimum frequency.

48. (B) Here, $A = 5^\circ$; $\delta = 3.2^\circ$

Now, for a prism of small angle,

$$\delta = A(\mu - 1)$$

or $\mu = 1 + \dfrac{\delta}{A} = 1 + \dfrac{3.2^\circ}{5^\circ} = 1.64$

49. (D) $d = 0.20$ m, $\theta = 45^\circ$

$F = B_H \tan\theta$, $\dfrac{\mu_0}{4\pi} \times \dfrac{2M}{d^3} = B_H \tan\theta$

$$M = \dfrac{4\pi}{\mu_0} \times \dfrac{d^3}{2} B_H \tan\theta$$

$$= 10^7 \times \dfrac{(0.20)^3}{2} \times 0.4 \times 10^{-4} \times \tan 45^\circ$$

$$= 1.6 \text{ A m}^{-2}$$

50. (A) Let R be the radius of curvature of the refracting surface. When object lies in the rarer medium,

$$-\dfrac{\mu_1}{u} + \dfrac{\mu_2}{v} = \dfrac{\mu_2 - \mu_1}{R}$$

Here, $\mu_1 = 1$; $\mu_2 = 1.5$; $u = -10$ cm;

$v = -40$ cm

$\therefore \quad -\dfrac{1}{-10} + \dfrac{1.5}{-40} = \dfrac{1.5 - 1}{R}$

or $\dfrac{0.5}{R} = \dfrac{1}{10} - \dfrac{1.5}{40}$

$R = +8$ cm (convex)

51. (D) Here, d = 0.12 mm = 0.012 cm; D = 1 m = 100 cm;

$\lambda = 6000$ Å $= 6000 \times 10^{-8}$ cm

For $(n + 1)^{th}$ dark fringe, $y'_n = (2n + 1)\dfrac{D\lambda}{2d}$

For, third dark fringe, n = 2

$\therefore y_2^1 = (2 \times 2 + 1) \times \dfrac{100}{2 \times 0.012} \times 6000 \times 10^{-8}$

$= 1.25$ cm

52. (B) Let L_1 and L_2 be the self-inductances of two inductors and M, the mutual inductance between them. Further, let e_1 and e_2 be the induced e.m.f.s produced in two inductors and e, the total e.m.f. produced in two inductors and e, the total e.m.f. produced. Then,

$e = e_1 + e_2$ ...... (i)

If $\dfrac{dI}{dt}$ is the rate of change of current through the two inductors in series, then

$e_1 = -L_1 \dfrac{dI}{dt} - M\dfrac{dI}{dt}$ and

$e_2 = -L_2 \dfrac{dI}{dt} - M\dfrac{dI}{dt}$

If L is the self-inductance of the two inductors in series, then

$e = -L\dfrac{dI}{dt}$

Therefore, the equation (i) becomes

$$-L\dfrac{dI}{dt} = \left(-L_1 \dfrac{dI}{dt} - M\dfrac{dI}{dt}\right) + \left(-L_2 \dfrac{dI}{dt} - M\dfrac{dI}{dt}\right)$$

$$L = L_1 + L_2 + 2M$$

53. (A) $Z = \sqrt{R^2 + (X_L - X_C)^2}$

On added a capacitor in series $(X_L - X_C)$ decreases and the value of 'Z' decreases.

54. (D) Phase modulation is required for digital communication using a fibre optic link set up.

55. (D) In series (minimum value of capacitance) :

$$C = \dfrac{C_1 C_2 C_3}{C_1 C_2 + C_2 C_3 + C_3 C_1}$$

$$= \dfrac{3\cancel{9} \times \cancel{9} \times \cancel{9}}{\cancel{3} \times \cancel{81}\cancel{9}} = 3\,\mu F$$

In parallel (maximum value of capacitance)

$C = C_1 + C_2 + C_3$

$= 9 + 9 + 9 = 27\,\mu F$

56. (C) Here, $\dfrac{dI}{dt} = 6A\,s^{-1}$; e = 18 mV = 18×10^{-3} V

$$e = \dfrac{\angle dI}{dt}$$

$$L = \dfrac{e}{(dI/dt)} = \dfrac{18 \times 10^{-3}}{6} = 3 \times 10^{-3}\,H = 3\,mH$$

57. (A) Radio waves are electromagnetic waves whose wavelength ranges from 10^{-3} m to 10^5 m and has the longest wavelength compared to X - rays, ultraviolet rays and visible light.

58. (B) Given : q = 1 C, $E_0 = 8.854 \times 10^{-12}\,C^2N^{-1}m^{-2}$

From Gauss' theorem, electric flux

$$\phi = \dfrac{q}{E_o}$$

Electric lines of force originating from a charge of 1 C, $\phi = \dfrac{1}{8.854 \times 10^{-12}} = 1.129 \times 10^{11}$.

59. (C) If e is the magnitude of charge on an electron or a proton, then

$$F = 9 \times 10^9\,\dfrac{e^2}{r^2} = 9 \times 10^9 \times \dfrac{\left(1.6 \times 10^{-19}\right)^2}{\left(0.53 \times 10^{-10}\right)^2}$$

$$= 8.2 \times 10^{-8} N$$

60. (A) A thermistor is a heat sensitive resistor, whose value varies appreciably with temperature more so than in standard resistors. Therefore, its temperature coefficient of resistivity should be high. Thermistors are usually made up of metal oxides.

61. (B) Binding energy = $\Delta m \times$ 931.5 MeV
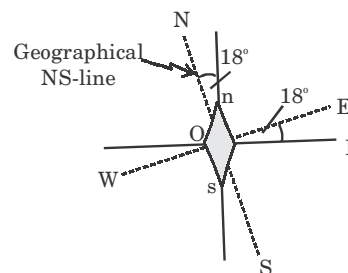
$\Delta m = 3 \times 4.0026032 - 12$ a.m.u.

$\quad = 0.007806$ a.m.u.

As 1 a.m.u. = 931.5 MeV

$\quad = 0.007806 \times 931.5$ MeV

$\quad = 7.27$ MeV

62. (A) The compass needle *n s* points along the magnetic N S-line and the ship is sailing along OP i.e., towards east (as indicated by compass needle). As the declination of that place is 18° east of north, the geographical N-S line is shown by a dotted N-S line. Thus, the true direction of ship is 18° south of east.

63. (A) de-Broglie wavelength,

$$\lambda = \dfrac{h}{m\upsilon} = \dfrac{6.62 \times 10^{-34}}{3 \times 2} = 1.1 \times 10^{-34}\,m$$

64. (B) As the image formed is erect and hence virtual, the magnification produced by the lens is positive i.e. m = + 4.

Also, f = + 20 cm

Now, $m = \dfrac{f}{u+f}$

$\therefore$ 4 $= \dfrac{20}{u+20}$ or u + 20 = 5

or u = −15 cm

Again, $m = \dfrac{f-v}{f}$ $\quad \therefore 4 = \dfrac{20-v}{20}$

or v = 20 − 80 = − 60 cm

65. (A) Four charges q_1, q_2, q_3 and q_4 are placed at the four corners of the square PQRS as shown below.

Here,
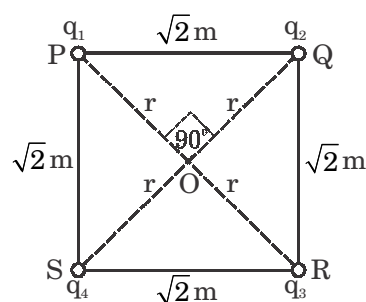
$q_1 = 2\,\mu C = 2 \times 10^{-6}$ C;

$q_2 = -2\,\mu C = -2 \times 10^{-6}$ C;

$q_3 = -3\,\mu C = -3 \times 10^{-6}$ C;

$q_4 = 6\,\mu C = 6 \times 10^{-6}$ C;

and PQ = QR = RS = PS = $\sqrt{2}$ m

Let r be the distance of each charge from the centre O of the square.

Then, $\sqrt{r^2 + r^2} = \sqrt{2}$ or r = 1 m

Potential at point O due to charges at the four corners,

$$V = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1}{r} + \frac{q_2}{r} + \frac{q_3}{r} + \frac{q_4}{r}\right)$$

$$\frac{1}{4\pi\varepsilon_0}\cdot\frac{1}{r}(q_1 + q_2 + q_3 + q_4)$$

$$\frac{9\times10^9}{1}\left(2\times10^{-6} + (-2\times10^{-6}) + (-3\times10^{-6}) + 6\times10^{-6}\right)$$

$$= 2.7\times10^4 \text{ V}$$

CHEMISTRY

66. (A) Two 'α' Amino acids on condensation between COOH and NH_2 groups form dipeptide which further reacts with other amino acids forming polypeptides which are called proteins when there are 100 or more amino acids.

67. (A) From the given structure, it is p - p[1] dichlorodiphenyl trichloroethane (DDT) and it was the first chlorinated insecticide.

68. (A) Metals liberated readily react with active carbon under hot conditions to form their carbides.

69. (A) Acetone and carbon disulphide pair shows positive deviation from Raoult's law.

70. (B) In ZnS, S^{-2} ions are present in FCC packing while Zn^{+2} ions occupy alternate tetrahedral voids.

71. (A) Lowering of temperature, increases the rate of physisorption.

72. (A) Let π be the osmotic pressure exerted by the two solutions. Then

π = 0.01 × RT (Glucose)

π = i × (0.004) RT (i is the vant-Hoff's factor) (Na_2SO_4)

This gives $i = \dfrac{0.01}{0.004} = 2.5$
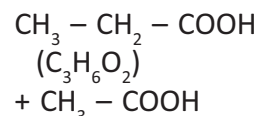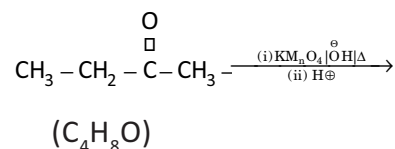
The degree of dissociation (α) is related to i, by the relation,

$$\alpha = \frac{i-1}{n-1} = \frac{2.5-1}{3-1} \text{ (for } Na_2SO_4, n = 3)$$

$$\alpha = \frac{1.5}{2} = 0.75$$

or % α = 75%

73. (D) X must be an ketone.

$$CH_3 - CH_2 - \overset{\overset{O}{\|}}{C} - CH_3 \xrightarrow[\text{(ii) } H\oplus]{\text{(i)}KM_nO_4|\overset{\ominus}{O}H|\Delta}$$

(C_4H_8O)

$CH_3 - CH_2 - COOH$
$(C_3H_6O_2)$
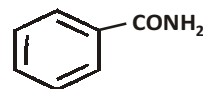$+ CH_3 - COOH$

When ketones get oxidised, we get carboxylic acids with lesser number of carbon atoms than the original ketone.

**74. (A)** A catalyst does not change the value of equilibrium constant.

75. (D) The following represents an amide

—CONH₂

76. (C) Amorphous solids do not melt. They simply soften on heating, and gradually begin to flow on further heating. These solids are, therefore considered as super cooled liquids.

77. (D) $[Fe(CN)_6]^{3-}$ is an octahedral complex ion and is paramagnetic in nature. Secondly it is an inner orbital complex ion with the presence of only one unpaired electron in it.

78. (D) (i) **Conversion of glucose into ethyl alcohol:** The zymasc enzyme converts glucose into ethyl alcohol and CO_2.

$$\underset{\text{Glucose}}{C_6H_{12}O_6} \xrightarrow{\text{Zymase}} \underset{\text{Ethyl alcohol}}{2C_2H_5OH} + 2CO_2$$
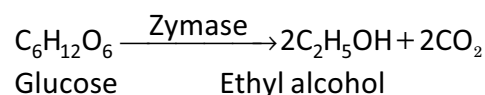
(ii) **Conversion of milk into curd:** It is an enzymatic reaction brought about by lacto bacilli enzyme present in curd.

(iii) **Decomposition of urea into ammonia and CO_2:** The enzyme urease catalyses this decomposition.

$$NH_2 CONH_2 + H_2O \xrightarrow{\text{Urease}} 2NH_3 + CO_2$$
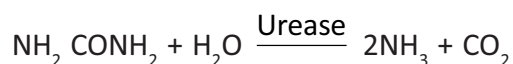
79. (D) In the complex ion,

$[Co(NH_3)_3Cl_3]$, both the NH_3 molecule and Cl^- ions are the ligands.

80. (B) The given cubic solid belongs to the body centred cubic lattice. Since, each corner atom Y is shared by 8 cubes, hence no. of Y atoms per cube $= 8\times\dfrac{1}{8} = 1$.

Atom X is at the body centre. So, there is only one X atom per cube. Therefore, formula of the compound is XY.

81. **(C)** Acetylation of salicylic acid produces aspirin.

82. **(A)**
(i) $CH_3CH_2COONa + NaOH$

$\xrightarrow{CaO, 630K}$

$CH_3CH_3 + Na_2CO_3$
Ethane

(ii) $CH_3CH_2COOH + 6 HI \xrightarrow[\Delta]{Red\,P}$

$CH_3CH_2CH_3 + 3 I_2 + 2 H_2O$
Propane

(iii) $CH_3CH_2COONa \xrightarrow[electrolysis]{Kolbe's}$

$CH_3CH_2CH_2CH_3$
Butane

Hence, methane cannot be obtained by any of the above reactions.

83. **(C)** Sucrose on hydrolysis gives equimolar mixture of D (+) glucose and D(−) fructose.

$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$
    D(+)Glucose D(−)Fructose
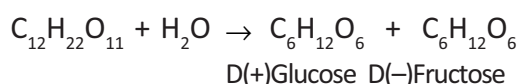
84. **(C)** The colour of the complexes of any metal ion depends on the nature of ligands, oxidation state of the metal and the geometry of the complex.

85. **(D)** AgBr shows both Schottky defect and Frenkel defect.

86. **(D)** When o- or p-phenolsulphonic acid is treated with HNO_3, nitration occurs at o, p-positions with simultaneous replacement of SO_3H group by NO_2 group to give ultimately 2, 4, 6-trinitrophenol.

87. **(C)** Since, the compound is optically active and does not rotate the plane of polarized light, therefore, the compound must be a racemic mixture.

88. **(A)** Van-Arkel method involves converting the metal to a volatile stable compound.

$Ti + 2 I_2 \xrightarrow{500\,K} TiI_4$ (volatile stable) ;
Impure

$TiI_4 \xrightarrow{1700\,K} Ti + 2 I_2$
                    Pure

89. **(C)** Reducing character of hydrides increases down the group.

90. **(C)** $Al^{3+} + 3e^- \rightarrow Al$

$Cu^{2+} + 2e^- \rightarrow Cu$

$Na^+ + e^- \rightarrow Na$

Thus, 1 F will deposit $\frac{1}{3}$ mol, Al, $\frac{1}{2}$ mol, Cu and 1 mol Na, i.e., moles deposited are in the ratio

$\frac{1}{3} : \frac{1}{2} : 1$ i.e., 2 : 3 : 6 or 1 : 1.5 : 3.

GENERAL AWARENESS

91. **(D)**	92. **(D)**	93. **(D)**
94. **(A)**	95. **(D)**	96. **(A)**
97. **(D)**	98. **(C)**	99. **(C)**
100. **(A)**		

The End