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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION - 2013

SOLUTIONS FOR CLASS : 12 (PCB)

Biology

1. (B) The given figure is of amphitropous ovule. The embryo and the ovary are curved like horse shaped. The funicle is attached near the middle of the body of ovule. It is found in Capsella.

2. (D) Insect pollinated flowers are called entomophilous flowers. They are usually large, brightly coloured, scented and produce nectar to attract insects.

3. (A) Atavism is the reappearance of a remote ancestral organ in some individuals of a species. It is the tendency of animals to develop remote ancestral traits.

4. (B) Cochlea is not a vestigial organ. It is a functional organ.

   The cochlea is a bony tube lined with connective tissue and it is a coiled part of the periotic bone. It helps in the transformation of sound waves in an ear.

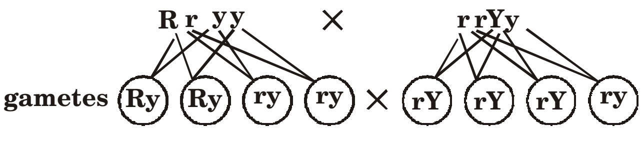
5. (D) The basal body of the sperm's flagellum divides and forms into two centrosomes (with centrioles) in the zygote. These generate the mitotic spindle for cleavage.

6. (B) Two French Microbiologists Jacob and Monad proposed operon hypothesis, for the regulation of gene action or gene expression.

7. (D) Placenta is formed by the chorion. Chorion that completly surrounds the embryo consists of trophoblast outside and mesoderm inside. It protects the embryo and forms placenta for metabolic exchange between the foetus and the mother.

8. (D) Kala-azar is a vehicle borne disease. It is caused by the bite of sandfly. Sandfly carries disease causing pathogen (protozoan) in their body and transmit them with bites.

9. (A)



	Ry	Ry	ry	ry
rY	RrYy	RrYy	rrYy	rrYy
ry	Rryy	Rryy	rryy	rryy
rY	RrYy	RrYy	rrYy	rrYy
ry	Rryy	Rryy	rryy	rryy

4 : 12

Percentage of white $\frac{{}^{1}\cancel{4}}{\cancel{16}_{4}} \times {}^{25}\cancel{100} = 25\%$

10. (D) Gottlieb Haberlandt, a German botanist gave an idea that every plant cell is totipotent, that is capable of giving rise to an entire new plant.

11. (A) Apiculture or bee keeping is concerned with the maintenance of hives of honey bees for commercial purposes. Fish farming in isolated water bodies is called pisciculture. Rearing of silkworms (Bombyx mori) is called sericulture and growing of fruits and ornamental plants for commercial purpose is called horticulture.

12. (A) Hybrid seeds are produced by hybridisation of two different genotypes. Hybridisation is the process of making a cross between the two genetically diverse parents to obtain a progeny with the desired traits or hybrid vigour or heterosis. Heterosis is lost by inbreeding hence hybrid seeds must be produced to obtain maximum advantage of hybrid vigour.

13. (A) Cannabinoids are the products obtained from hemp plant.

14. (C) Thorns and tendrils of passiflora, bougain villea and cucurbita are homologous organs in plants. They look different and help the plant in climbing in different manner but both arise in the axillary position and are modified branches.

15. (D) In sphenopsida, the sporangia lie in whorls at the top of the plants.

16. (B) Removal of the stamens, anthers and pollen grains of the flower without affecting the female reproductive organs is called emasculation.

17. (C) Aspergillus niger is used in the production of citric acid in industries.

18. (B) The given ecological pyramid is the pyramid of biomass in lake.

19. (B) Sciophytes are shade loving plants. Halophytes grow in saline environment, Pollination by ants is called myrmecophily. Heliophytes are sunplants.

i-q, ii-r, iii-s, iv-p

20. (D) Coralloid roots exhibit symbiotic association between nostoc and cycas root.

21. (B) Neopalina is a connecting linking between annelida and mollusca.

The living organisms which possess characters of two different groups of organisms are known as connecting links.

22. (B) Transabdominal aspiration of fluid from the amniotic sac of the foetus is called amniocentesis. It is used as a prenatal diagnostic technique to determine the genetic disorders, if any in the foetus.

23. (D) Klinefelter's syndrome is an aneuploid condition with 3 sex chromosomes. (Trisomy)

XXY (genotype) (Numerical abnormality in sex chromosomes) 44 + XXY

24. (C) Inversion involves a reverse order of genes in a part of chromosome.

P Q R S T and P S T Q R

25. (A) Amphetamines are stimulants.

Nikethamide, Caffeine, cocaine are stimulants.

26. (C) Species is the smallest unit in an ecosystem followed by population, community, ecosystem, biome and biosphere.

27. (D) The association between bacteria and human skin is an example of commensalism. Commensalism is the relationship between individuals of two species of which one is benefitted and other is almost unaffected, i.e., neither benefitted nor harmed.

28. (C) Central Rice Research Institute at Cuttack is an important plant breeding centre in India.

29. (A) India is rich in biodiversity due to diversified climatic conditions and has 10 biogeographical regions. The country is rich in endemic flora and fauna at western ghats and eastern Himalayas. Maximum biodversity is found in tropical rain forests.

30. (C) CH_4 is a hydrocarbon. It is produced by the incomplete decomposition of organic matter due to the activity of methanogens (a group of bacteria) under anaerobic conditions.

31. (B) Blue baby disease (Methemoglobinemia) is due to the accumulation of excess nitrates in drinking water.

Due to the heavy use of nitrogenous fertilisers in an area contaminates drinking water.. Nitrates are reduced to nitrites which combines with haemoglobin and reduces the oxygen carrying capacity of the blood. It is fatal in children hence the name blue baby syndrome.

32. (C) Herbivores are called primary consumers. Insects and cattle are primary consumers.

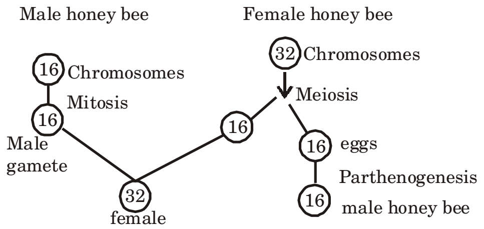
33. (D) Pneumatophores are also called breathing roots found in plants growing in marshy areas. These have lenticels for gaseous exchange. Such adaptation help them to cope with saline and anaerobic conditions in wet lands.

34. (A) t - RNA is also known as soluble RNA. It has amino acidbinding site at 3 end having CCA codon. The main function of t - RNA is to recognise the codon on m - RNA and bring the matching amino acid to the m - RNA ribosome complex i.e., site of protein synthesis.

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 due to the adaptation for flying habitat which reduces the body weight.

36. (C) Bacterias are prokaryotes. Membrane bound organelles are absent in prokaryotes. Circular and free DNA is found in prokaryotes.

37. (C) The sex ratio of the offspring is controlled by the queen of honeybees. She lays more fertilized eggs that produces worker female and unfertilized eggs produce haploid males by parthenogenesis.



38. (C) Antibiotics are produced from other organisms. They are taken or consumed orally or by injection.

39. (D) Cyclosporin - A is an important bioactive chemical produced by the fungus trichoderma polysporum. This chemical is used as an immuno suppressive agent in organ transplantation.

40. (C) Biogenetic law or Recapitulation theory states that an animal during its development (ontogeny) repeats certain ancestral stages of its evolution (Phylogeny) for eg.: In the developmental history of

mammalian heart, it is observed that it passes through a two chambered heart as in fishes, three chambered heart as in frogs and finally the four stage heart.

Physics

41. (D) A potentiometer is preferred for measurement of the e.m.f of a cell. Potentiometer draws no current from cell while voltmeter draws some current. Therefore, e.m.f. measured by voltmeter is slightly less than the actual value of e.m.f. of a cell. Further, a potentiometer is used with a galvanometer which is set to null reading when the experiment is performed. This method of null reading avoids many errors.

42. (D) For total internal reflection to take place at AB $i > \theta_c$, i.e., $\sin i > \sin \theta_c$

$i = 45^\circ$ and $\sin \theta_c = (1/\mu)$

$$\frac{1}{\sqrt{2}} > \frac{1}{\mu}, \text{ i.e., } \mu > \sqrt{2}$$

So, $(\mu)_{min} = \sqrt{2}$

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

$$C = \frac{C_1C_2C_3}{C_1C_2 + C_2C_3 + C_3C_1}$$

$$= \frac{{}^{3}\cancel{9}\times\cancel{9}\times\cancel{9}}{\cancel{3}\times\cancel{81}_{9}} = 3\,\mu F$$

In parallel (maximum value of capacitance)

$C = C_1 + C_2 + C_3$

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

44. (B) $f_m = 20$ kHz; $f_c = 1$MHz $= 1{,}000$ kHz

side bands are produced at,

$f_{min} = f_c - f_m = 1{,}000 - 20 = 980$ kHz

$f_{max} = f_c + f_m = 1{,}000 + 20 = 1{,}020$ kHz

45. (B) When slit is wide (i.e. $a >> \lambda$), bending of light becomes so small that it cannot be detected upto a certain distance of screen from the slit. Hence, practically, no diffraction occurs.

In diffraction pattern, all the bright bands are not of the same intensity.

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

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

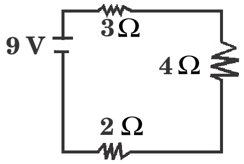
$$L = \frac{e}{(dI/dt)} = \frac{18\times10^{-3}}{6} = 3\times 10^{-3}\,H = 3\,mH$$

47. (B) As both diodes are forward biased, only for one half cycle of a.c., lamps X and Y do not get lighted up.

During the positive half of the input a.c., one of the diodes is forward biased and the other diode is reverse biased. Hence, no current flows through the circuit.

Similarly, during the negative half of the input a.c., one of the diodes is reverse biased and the other diode is forward biased. Hence, no current flows through the circuit.

48. (C)



$$\Rightarrow I = \frac{9}{9} = 1A$$

So, $I_{AB} = 1A = I_{EH}$

$$I_{BE} = \frac{1}{2} I_{AB} = 0.5A = I_{BC} = I_{EF}$$

$$I_{CF} = \frac{1}{2} I_{BE} = 0.25A = I_{GH} = I_{CD} = I_{DG}$$

$\therefore$ Current through $3\,\Omega$ resistor in DG is 0.25 A.

49. (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.

50. (C) $R = R_o A^{1/3}$

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

51. (C) Force on A due to B is F_1

$$= \frac{(1\times10^{-6})(1\times10^{-6})C^2}{4\pi\epsilon_o\,(8cm)^2}$$

$$= 9\times10^9\,\frac{Nm^2}{C^2}\times10^{12}C^2\times\frac{1}{64\times10^{-4}m^2}$$

$= 14.06$ N

This force acts along BA. Similarly, the force on A due to C is F_2

$$= \frac{(1\times10^{-6})(1\times10^{-6})C^2}{4\pi\epsilon_o\,(6cm)^2}$$

$$= 9\times10^9\,\frac{Nm^2}{C^2}\times10^{-12}C^2\times\frac{1}{36\times10^{-4}m^2}$$

$= 0.25 \times 10 = 2.5$ N

$$F = \frac{\sqrt{F_1^{\,2} + F_2^{\,2}}}{\sqrt{(14.06)^2 + (2.5)^2}} = 14.3\,N$$

52. (D) (i) The first prism has split the white light incident on it into its component colours.

(ii) The component colours were recombined by the inverted prism to give out white light as emergent ray.

53. (B) Since, force on any section of wire will be outwards, the loop will have a tendency to expand.

54. (B) Frequency $\nu = \frac{w}{2\pi}$

$$K_{max} = h\nu - \phi = \frac{h\omega}{2\pi} - \phi$$

$$= \left(\frac{h\omega - \phi(2\pi)}{2\pi}\right)$$

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

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

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

56. (B) The frequency of the electron is given by

$$\nu = \frac{v}{2\pi r} = \frac{mvr}{2\pi\ mr^2} = \frac{nh}{2\pi\left(2\pi\ mr^2\right)}$$

$$= \frac{nh}{4\pi^2 mr^2}$$

Hence $V_1 = \frac{h}{4\pi^2\ mr^2}$

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

From Gauss' theorem, electric flux

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

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

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

59. (B) All colours in the visible spectrum propagate with the same speed in a non-dispersive medium. The colour of light can be differentiated either by their frequencies or their wavelengths.

60. (A) In a series RLC circuit, resonance takes place when $X_L = X_C$ i.e., inductive reactance is equal to capacitive reactance. They are opposite as well as equal.

61. (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.

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

$$V_d = \frac{I}{neA} = \frac{20}{9\times 10^{30}\times 1.6\times 10^{-19}\times 10^{-4}}$$

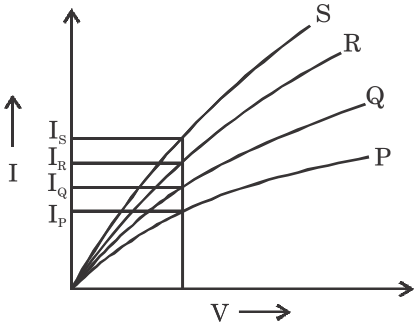
$$= 0.138 \times 10^{-6}\ m\ s^{-1}$$

63. (A) Suppose that 4 wires P, Q, R, S possess resistances R_P, R_Q, R_R and R_S respectively and their resistivities be ρ_P, ρ_Q, ρ_R and ρ_S respectively. Secondly, all the four wires have same length l and area of cross section A,

$$R_P = \rho_P\frac{l}{A},\ R_Q = \rho_Q\frac{l}{A},\ R_R = \rho_R\frac{l}{A},$$

$$R_S = \rho_S\frac{l}{A},$$

When a potential difference V is applied across each of the four wires P, Q, R and S as shown below.



$$R_P = \frac{V}{I_P};\ R_Q = \frac{V}{I_Q};\ R_R = \frac{V}{I_R};\ R_S = \frac{V}{I_S};$$

$$I_S > I_R > I_Q > I_P \Rightarrow R_s < R_R < R_Q < R_P$$

$$\rho_S\frac{l}{A} < \rho_R\frac{l}{A} < \rho_Q\frac{l}{A} < \rho_P\frac{l}{A}$$

This implies that P has greater resistivity.

64. (A) Flux density due to full circular line $= \frac{\mu_o i}{2a}$

The arc AC is only $\frac{1}{3}$ of the circular line

$$B = \frac{1}{3}\times\frac{\mu_o i}{2a} = \frac{\mu_o i}{6a}$$

$$= \frac{4\pi\times 10^{-7}\times 6}{0.6} = 4\ \pi\times 10^{-6}$$

$$= 3.14 \times 4\times 10^{-6}$$

$$= 1.26\times 10^{-5}\ T$$

65. (B) Fringe width,

$$\omega = \frac{\lambda D}{d} = \frac{(6000\times10^{10})(2)}{6\times10^{-3}}$$

$$= 0.2 \text{ mm}$$

Chemistry

66. (B) For reaction 3A $\rightarrow$ 2B.

$$\text{Rate} = \frac{-1}{3}\frac{d(A)}{dt} = \frac{+1}{2}\frac{d(B)}{dt}$$

$$\therefore \frac{d[B]}{dt} = \frac{-2}{3}\frac{d[A]}{dt}$$

67. (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.

68. (D) Terylene is a polyester of ethylene glycol and terephthalic acid.

69. (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 = $8\times\frac{1}{8}$ =1.

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

70. (A) The FNH_3^+ is more acidic than NH_3^+ because of the presence of electron withdrawing (–I) F atom on the ring.

71. (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.

72. (B) On reduction, aldehydes give primary alcohols, while ketones give secondary alcohols. e.g.,

(i) $CH_3\,CHO + H_2 \xrightarrow{Ni} CH_3CH_2OH$

acetaldehyde (ethyl alcohol)

(ii) $CH_3.CO.CH_3 + H_2 \xrightarrow{Ni} CH_3CHOH.CH_3$

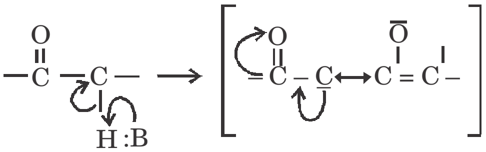
acetone (propan - 2 - ol)

73. (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.

74. (B) The genetic information of the cell is contained in the sequence of bases A, T, G and C in DNA molecule. When the cell divides, DNA molecules replicate and make exact copies of themselves so that each daughter cell will have DNA identical to that of the parent cell.

75. (B) If the forward reaction of a reversible reaction is exothermic, the activation energy for forward reaction is less than the backward reaction.

76. (D) The acidity of $\propto$ - hydrogen atoms of carbonyl compounds is due to the strong electron withdrawing effect of the carbonyl group and resonance stabilisation of the conjugate base.



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

$$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2C_2H_5OH + 2CO_2$$

Glucose Ethyl alcohol

(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.

$$NH_2\,CONH_2 + H_2O \overset{\text{Urease}}{\overline{\hspace{3em}}} 2NH_3 + CO_2$$

78. (C) The elements belonging to 3d series are titanium, iron, because the valence electronic configuration of these elements are $3d^2\,4s^2$, $3d^6\,4s^2$ respectively.

79. (B) Polystyrene is a thermoplastic polymer.

80. (A) Molality is a preferred unit for measuring concentration because it is temperature independent.

$$n_{\text{solvent}} = \frac{\text{Mass of solute(w)}}{\text{Molar mass of solute (M)}}$$

$$\text{Molality (m)} = \frac{w / M}{W}$$

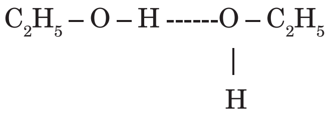
Molality (m) of a solution does not change with temperature.

81. (D) Xenon oxy tetra fluoride ($XeOF_4$) can be obtained by partial hydrolysis of XeF_6.

$$Xe\,F_6 + H_2O \rightarrow XeOF_4 + 2HF$$

82. (B) Ethyl alcohol shows H–bonding and thus has higher boiling point. No H–bonding occurs between molecules of dimethyl

ether, hence it exists as a gas.



$$C_2H_5-O-H\text{------}\underset{\displaystyle H}{\underset{|}{O}}-C_2H_5$$

The high boiling points of alcohols are mainly due to the presence of intermolecular hydrogen bonding in them which is lacking in ethers.

83. (B) Smelting is a process of adding a suitable fusible material (flux) to lower the melting point of the ore and reducing the ore into molten metal.

$$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$$

84. (D) In the complex ion,

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

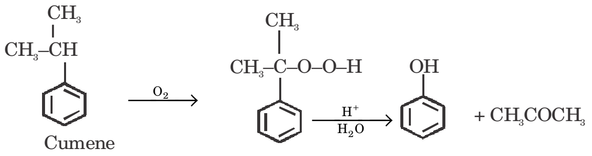
85. (D) $\Delta T_f = k_f m$

$$k_f = \frac{\Delta T_f}{m} = \frac{4\,\text{deg}}{0.25\,\text{mol kg}^{-1}}$$

$$= 16 \text{ deg kg mol}^{-1}$$

86. (A) Soap coats the drops of an emulsion and checks them from coming together and the emulsion is thus stabilised.

87. (C) Phenol is manufactured from the hydrocarbon, cumene. Cumene (isopropyl benzene) is oxidised in the presence of air to cumene hydroperoxide. It is converted to phenol and acetone by treating it with dilute acid. Acetone, a by - product of this reaction is also obtained in large quantities by this method.



88. (A) Fats and oils are glycerides as they are triesters of glycerol with higher fatty acids.

89. (B) All (copper, lead and chromium) have higher standard reduction potentials than Mn except Mg, which has lower standard reduction potential than Mn.

∴ Mg will displace Mn from its salt solution ($MnSO_4$).

90. (A) In aryl - alkyl ketones, the carbonyl group (>C=O) is attached to an alkyl and an aryl group. For example, acetophenone (C_6H_5. CO. CH_3) is an aryl - alkyl ketone.