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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

Paper Code: UN 415

Solutions for Class : 11 (PCB)

Biology

1. **(A)** Susruta studied anatomy by surgical work. He described some 121 different surgical instruments and gave an account of most of surgical operations known before modern times.

2. **(A)** Mucins are found in the secretions of the gastrointesticial, respiratory and reproductive tracts and also in membranes of various cells.

3. **(A)** It was originally thought that virions had only structural capsid proteins and lacked enzymes. Now we know that enzymes are associated with the envelope or capsid, e.g., influenza neuraminidase.

4. **(B)** Family is lower hierarchy possess more characters in common.

5. **(D)** Mucor is not a biofertilizer.

6. **(D)** Contractile vacuole is commonly found in freshwater protozoans.

7. **(D)** Neurospora is a pink bread mould which can be grown easily in laboratory. It was used extensively in studying nutritional mutation, crossing over and gene activities and is thus regarded as a laboratory weed or tool.

8. **(C)** The bordeaux mixture is a fungicide.

9. **(B)** Holdfast is meant for attachment. It is usually yellowish in colour due to lack of chloroplast and thus, it develops a symbiotic relationship with other cells of the filament.

10. **(A)** Mature sporogonium of Riccia is having only outer layer of calyptra as wall layer and spores (both haploid) Jacket layer disintegrate soon when sporogonium attains maturity.

11. **(C)** The seeds of Abrus precatorius are used as "Jeweller's weight" as their weight is always one 'Ratti'.

12. **(A)** Spongilla, the best known freshwater sponge, is found in ponds, lakes and slow streams.

13. **(B)** Dugesia is a common, free-living freshwater planarian.

14. **(D)** Ascaris monogenetic; its infection is through contaminated food and water.

15. **(D)** Epineurium is a connective tissue covering of the vertebrate nerve.

16. **(B)** Spider, scorpion and tick belong to class Arachnida.

17. **(B)** Housefly and mosquito belong to the same insect order Diptera.

18. **(B)** Slug (Limax) belongs to the class Gastropoda.

19. **(D)** Devil fish (Octopus) is a mollusc.

20. **(B)** Echinoderms show pentamerous radial symmetry.

21. **(B)** Garlic (Allium sativum) reproduces vegetatively, whereas, Onion (Allium cepa) by seeds.

22. **(B)** In Cruciferae and Solanaceae, calyx, corolla and placentation are all different, only they possess bicarpellary and syncarpous ovary in hypogynous flowers.

23. **(C)** Owing to the presence of fat globule, the cytoplasm is pushed to periphery in adipocytes, giving the shape of a signet ring.

24. **(B)** Sugarcane is a monocot, where scattered vascular bundles occur in stem and hence girdling experiments cannot be performed in it.

25. **(A)** Plant ash contains only inorganic substances or minerals.

26. **(C)** Balanophora is a total root parasite.

27. **(B)** Erythrose is a monosaccharide; others are disaccharides.

28. **(A)** A muscular, dome-shaped diaphragm is found in mammals which aids in breathing.

29. **(C)** Two common marine poisonous snakes are Enhydrina and Hydrophis.

30. **(C)** Atlantic salmon and Pacific salmon are the best examples of fishes showing anadromous migration.

31. **(C)** Ivan P. Pavlov (1910) demonstrated conditioned reflex in dog.

32. **(A)** Family is placed between order and genus.

33. **(A)** It is the merozoites which repeatedly attack the RBCs causing malaria, hence considered as a pathogenic form.

34. **(D)** In both bryophytes and pteridophytes, the antherozoids are motile and chemotactically attracted towards the neck of archegonium. They swim in watery medium and presence of water is essential for the act of fertilization in these plants. This is the main reason that bryophytes and pteridophytes are highly restricted in distribution and they always prefer moist and shady localities or waterlogged soils.

35. **(A)** Ginkgo biloba is an intermediate between cycads and conifers

36. **(C)** Spongicola is a shrimp; it belongs to the class Crustacea of the phylum Arthropoda.

37. **(B)** Nematocyst is a part of the cell called cnidocyte.

38. **(B)** Interstitial cells are totipotent; these cells give rise to sperms and ova.

39. **(C)** Butterfly is a diurnal insect.

40. **(D)** Arrhenotoky is also known as haplo-diploidy.

Physics

41. **(D)** $\alpha = \frac{\omega_1 - \omega_2}{t}$

$= \left[\frac{1200 \times 2\pi}{60} - \frac{600 \times 2\pi}{60}\right]$ rad s^{-1}/10 s

$= 2\pi$ rad s^{-2}

42. **(A)** Interatomic forces are of electric origin. They are attractive if the separation between them is greater than normal distance and are repulsive if the distance between them is less than normal distance.

43. **(B)** Total energy at the time of projection

$= \frac{1}{2} m v^2 = \frac{1}{2} \times 0.1 (20)^2 = 20$ J.

Half way up, P.E. becomes half the P.E. at the top.

i.e. P.E. $= \frac{20}{2} = 10$ J

$\therefore$ K.E. $= 20 - 10 = 10$ J

44. **(D)** Unit of Planck's constant is joule second.

45. **(B)** Below the sea level the pressure is increasing with depth in mine due to presence of atmosphere air there. The acceleration due to gravity below the surface of the earth decreases with the distance from the surface of the earth, as

$g' = g\left(1 - \frac{d}{R}\right)$

46. **(C)** Applying work-energy theorem,

work done by all the forces = change in kinetic energy.

$W_{mg} + W_{air} = \frac{1}{2} mv^2$

$W_{air} = \frac{1}{2} mv^2 - W_{mg}$

$= \frac{1}{2} mv^2 - mgh$

$= \frac{1}{2} \times 5 \times (10)^2 - (5) \times (10) \times (20)$

$= -750$ J

47. **(B)** Rel. vel. of rain w.r.t. man

$= \sqrt{3^2 + 10^2} = \sqrt{109}$ km/h

48. **(D)** Surface tension of a liquid is due to force of attraction between like molecules of a liquid i.e. cohesive force between the molecules.

49. **(B)** According to Newton's first law of motion, the velocity of apple when dropped is equal to the velocity of train at that instant. As the velocity of train is decreasing but velocity of apple remains unchanged, the apple will fall ahead of his brother in the direction of motion of the train.

50. **(C)** Isothermal compression is reversible. The reverse is isothermal expansion. Heat required in this process is gained from the surroundings.

51. **(C)** $\frac{\Delta T}{T}\times 100 = \pm\left(\frac{1}{2}\times\frac{\Delta l}{l}\times 100 + \frac{1}{2}\times\frac{\Delta g}{g}\times 100\right)$

$= \pm\left(\frac{1}{2}\times 1 + \frac{1}{2}\times 2\right) = \pm 1.5\%$

52. **(C)** g = GM/(6400)^2 and

g' = GM / 6400 + 3200)^2

$g'/g = \left(\frac{6400}{6400+3200}\right)^2 = \frac{4}{9}$

53. **(D)** Centripetal force required for negotiating the curve is M v^2/R. When velocity is doubled, centripetal force required is quadrupled.

54. **(D)** Dipole moment = (charge) × (distance)

Electric flux = (electric field) × (area)

55. **(A)** m = 200 gm = 0.2 kg, u = 20 m s^{-1} , v = –10 m s^{-1}

The ball travels in the opposite direction after exerting force. So velocity is negative.

Impulse = F × t = m(v–u)

= 0.2 [–10 –20] = – 6 N s

Negative sign shows that the force exerted is in a direction opposite to the direction of initial velocity.

Driving force = $\frac{\text{Impulse}}{\text{time}} = \frac{6}{0.05}$ = 120 N.

56. **(C)** 15 g = 0.015 kg. 3 cm = 0.03 m

Due to the conservation of energy,

input energy - output energy

Decrease in kinetic energy = work done against friction

$\frac{1}{2}mu^2 - \frac{1}{2}mv^2$ = frictional force × distance travelled

$\frac{1}{2}(0.015)(300)^2 - \frac{1}{2}(0.015)(0)^2$

= F × (0.03)

F= 22 500 N

57. **(A)** Distance = speed × time

∴ Total distance =

(2 × 2)+(3) (3) + (5)(4) + (5)(2) = 43 m

Total time taken is 15 s Hence,

Average speed = $\frac{\text{Total distance}}{\text{Total time}} = \frac{43}{15}$

= 2.87 m s^{-1}

58. **(B)** $v^2_{es} = \frac{2GM_e}{R} = 2G\frac{4}{3}\pi R^3\rho\times\frac{1}{R} = \frac{8}{3}\pi GR^2\rho$.

When radius R becomes 2R, v_{es} will become 4 times. It will be = 22 km s^{-1}

59. **(D)** In isothermal process, T = 0

⇒ Δ U = 0

⇒ U = constant

60. **(C)** l = 3.230 m, b = 1.49 m

thickness h = 1.99 cm = 0.0199 m

Total surface area = 2(lb + lh + bh)

= 2[3.230 × 1.49 + 3.230 × 0.0199 + 1.49 × 0.0199] =

= 4.8127 + 0.064277 + 0.029651

= 4.906628 × 2 = 9.81 m^2

Volume = l × b × h

= 3.230 × 1.49 × 0.0199

= 0.09577 m^3

61. **(A)** $Y = \frac{FL}{\pi r^2\Delta L}$ or $\Delta L = \frac{L}{r^2}$

Here L/r^2 is maximum when L = 40 cm and r = 0.20 mm as compared to other cases.

62. **(B)** Momentum is given by :

p = mv

if p = constant

⇒ mv = constant

⇒ v = constant

63. **(C)** Average velocity

$= \frac{\text{displacemet}}{\text{time}} = \frac{2r}{t} = \frac{2\times 40}{40} = 2$ m/s

64. **(B)** $h = \left(\frac{T^2R^2g}{4\pi^2}\right)^{1/3} - R$

$= \left(\frac{(24\times 60\times 60)^2\times(6.4\times 10^6)^2\times 9.8}{4\times(22/7)^2}\right)^{1/3} - 6.4\times 10^6$

= 3.6 × 10^7 m = 36000 km

65. **(D)** $\omega = \frac{2\pi}{T} = \frac{2\pi}{12\times 60\times 60}$ rad/s

$= \frac{\pi}{6\times 60\times 60}$ rad/s

Chemistry

66. **(D)** Half the nuclear distance between two covalently bonded chlorine atoms is its covalent radius 1.98/2 = 0.99 $\overset{0}{A}$.

67. **(C)** Magnalium contains Al = 95% and Mg = 5%.

68. **(B)** According to equation

$H_2(g) + Cl_2(g) \rightarrow 2HCl(g) \quad \Delta H = -184.6$ kJ

Formation of 2 moles of HCl gas releases 184.6 kJ of heat to the surroundings

Formation of 5.67 moles of HCl gas releases $\frac{184.6 \times 5.67}{2} = 523$ kJ of heat to the surroundings. So ΔH for the formation of 5.67 moles of HCl gas is – 523 kJ.

69. **(C)** H_2O exhibits higher boiling point because of intermolecular hydrogen bonding.

70. **(A)** O.N. of Cr in $K_2Cr_2O_7$ is

$2 \times (+1) + 2x - (2 \times 7) = 0$ or $x = +6$

Similarly, O.N. of Cr in K_2CrO_4 is

$2 \times (+1) + x - (2 \times 4) = 0$ or $x = +6$.

71. **(D)** X-rays and microwaves (in fact, all electromagnetic waves) travel with the velocity of light.

72. **(C)** Thiophene contains S in addition to C-atoms in the ring and hence is not a carbocyclic but is a heterocyclic compound.

73. **(B)** Non-polar molecules have momentary dipole-induced dipole, i.e., dispersive interactions.

74. **(A)** In CO and CO_2, the two elements combining are C and O to form two compounds.

75. **(D)** Both hydrogen and alkali metals are liberated at the cathode when their halides are electrolysed. Thus hydrogen resembles alkali metals.

76. **(D)** From Lithium to Caesium stabilities of peroxide and superoxides increases due to high lattice energy. CsO_2 is the most stable superoxide.

77. **(A)** $N_2 + 3H_2 \rightleftharpoons 2NH_3$ 2

1 3

Partial pressure at 725 K

$$Q_c = \frac{(P_{NH_3})^2}{(P_{N_2})(P_{H_2})^3} = \frac{3 \times 3}{2(1)^3} = 4.5 \text{ atm}^{-2}$$

$Q_c > K_c$ net reaction goes in backward direction.

78. **(B)** Benzene-1, 2, 3, 4, 5, 6-hexol

79. **(B)** The reaction, $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$, is reverse of the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$. So, the equilibrium constant of the former is reciprocal of the latter.

Therefore,

$K(2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

$$= \frac{1}{K\left(H_2(g) + I_2(g) \rightleftharpoons 2HI(g)\right)} = \frac{1}{48} = 0.02$$

80. **(C)** $Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$

Bleaching powder

Bleaching powder is a mixed salt of calcium hypochlorite, $CaOCl_2$ and basic calcium chloride, $CaCl_2 \cdot Ca(OH)_2 \cdot H_2O$

81. **(C)** H_2O_2 decomposes into water and oxygen in presence of light.

82. **(C)** Empirical formula is CH_4

	C	H
% Mass	75	25
A_r	12	1
% Mass/A_r	6.25	25
Divide by smallest ratio	1	4

83. **(A)** $P \propto d$ and also $P \propto T$.

Hence, $P \propto d \times T$

or $\frac{P_1}{P_2} = \frac{d_1}{d_2} \times \frac{T_1}{T_2}$

$= \frac{1}{2} \times \frac{2}{1} = 1$.

84. **(C)** A liquid which is immiscible to water and has a vapour pressure of 10 – 15 mm of Hg at 373 K can be conveniently purified by steam distillation.

85. **(A)** $c = v\lambda$ or $\lambda = \frac{c}{v} = \frac{3\times10^{8}\ m\ s^{-1}}{589\times10^{-9}m}$

$= 5.1\times10^{14}\ s^{-1}$ (or Hz)

86. **(A)** More negative or less positive is the value of the standard reduction potential, greater is the reducing power of the metal, Here,

$-3.03\ V < -1.18\ V < 0.52\ V$

So, Y > Z > X

87. **(B)** Electronegativity decreases down a group but increases across a period but remains almost same along a diagonal. Therefore atoms A and Y have little difference in their electronegativities and hence AY bond is least polar.

88. **(D)** The thermal stabilities of the hydrides of carbon family decrease down the group as is evident from their thermal dissociation temperatures:

CH_4	SiH_4	GeH_4	SnH_4	PbH_4
1073 K	723 K	558 K	423 K	273 K

Thus plumbane (PbH_4) gives H_2 even at 273 K and hence has the maximum reducing character while CH_4 decomposes only at a very high temperature (1073 K) and hence has the least reducing character.

89. **(C)** $W = -P(V_2 - V_1)$

$= -10^{5}\ Nm^{-2}\ (10^{-2} - 10^{-3})m^3$

$= -10^{5} \times 10^{-2}\ (1 - 0.1)Nm$

$= -0.9 \times 10^{3}\ Nm$

$= -0.9 \times 10^{3}\ J$ = the 0.9 kJ

90. **(C)** During Na fusion, N of organic compound is converted into CN^-, but not to NO_3^-.S is converted to S^{2-} and to CNS^-, if both N and S are present.