

Physics

Section-A

1. (d)

2. (c)

$$V_s = 12 \text{ V}; P = 60 \text{ W}; V_p = 220 \text{ V}$$

$$i_s = \frac{60}{12} = 5$$

$$\frac{N_s}{N_p} = \frac{V_s}{V_p} = \frac{i_p}{i_s}$$

$$i_p = \frac{i_s V_s}{V_p} = \frac{5 \times 12}{220} \Rightarrow i_p = 0.27 \text{ A}$$

3. (a)

No current through galvanometer (G), i.e., potential drop across G is 2 V.

Potential difference at 400 Ω

$$i = \frac{V}{R} = \frac{8}{400} = \frac{1}{50}$$

At R potential difference = 2 V

$$V = i \times R \Rightarrow 2 = \frac{1}{50} \times R \Rightarrow R = 100 \Omega$$

4. (a)

Capacitor.

5. (c)

For photoelectric effect $E \geq \text{work function (W)}$

6. (d)

$$f_{\text{open}} = \frac{V}{2L}$$

$$f_{\text{closed}} = \frac{V}{4L}$$

$$\frac{f_{\text{open}}}{f_{\text{closed}}} = \frac{2}{1}$$

7. (a)

$$W = 8\pi R^2 T$$

$$W = T \times \Delta A$$

$$W = T \times 4\pi R^2 \times 2$$

$$W = 0.03 \times 4\pi \times 4 \times 10^{-4} \times 4$$

$$W = 3.0144 \times 10^{-4}$$

8. (d) $\frac{W}{A}$

9. (a)

$$\bar{v} = \frac{2v_1 v_2}{v_1 + v_2} = \frac{4v^2}{3v} = \frac{4v}{3}$$

10. (a)

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

$$\theta = \frac{\lambda}{d}$$

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

$$\beta \propto \lambda$$

11. (a)

$$\sin c = \frac{\mu_r}{\mu_D} = \frac{\frac{c}{v_1}}{\frac{c}{v_2}} = \frac{v_2}{v_1}$$

$$\sin c = \frac{\frac{10x}{t_2}}{\frac{x}{t_1}} = \frac{10t_1}{t_2} \Rightarrow c = \sin^{-1} \left[\frac{10t_1}{t_2} \right]$$

12. (a)

$$X_C \propto \frac{1}{f}$$

$$F \downarrow X_C \uparrow$$

$$I_D = \frac{V}{X_C} \text{ as } X_C \uparrow I_D \downarrow$$

13. (c)

$$C_{\text{eff}} = \frac{6 \times 3}{9} = 2 \mu\text{F}$$

14. (a)

$$E_0 = 48 \text{ Vm}^{-1}$$

$$E_0 = B_0 c$$

$$B_0 = \frac{E_0}{c} = \frac{48}{3 \times 10^8} = 16 \times 10^{-8} \Rightarrow 1.6 \times 10^{-7} \text{ T}$$

15. (d)

$$\frac{1}{\lambda} = RZ^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

$$\frac{1}{\lambda_1} = R \left[\frac{1}{4^2} - \frac{12^2}{2^2} \right]$$

$$\frac{1}{\lambda} = R \left[\frac{1}{2^2} - \frac{1}{2^2} \right]$$

$$\frac{\lambda}{\lambda'} = \frac{\frac{1}{16}}{\frac{1}{4}} = \frac{4}{16} = \frac{1}{4}$$

$$\lambda' = 4\lambda$$

16. (a)

$$\rho = \frac{m}{A \times l} = \frac{m}{\pi r^2 l}$$

$$\frac{\Delta \rho}{\rho} = \left(\frac{\Delta m}{m} + 2 \frac{\Delta r}{r} + \frac{\Delta l}{l} \right)$$

$$= \left(\frac{0.02}{0.14} + 2 \times \frac{0.001}{0.3} + \frac{0.02}{5} \right) = 1.6\%$$

17. (a)

$$F = \frac{m(\bar{v}_f - \bar{v}_i)}{\Delta t}$$

$$F = m \left[\frac{\hat{v}_i - v(-\hat{j})}{\Delta t} \right]$$

$$= \frac{mv[\hat{i} + \hat{j}]}{\Delta t}$$

18. (d)

$$v_{rms} \propto \sqrt{T}$$

$$V_1 = V, V_2 = V + 3 V = 4 V$$

$$\frac{V_2}{V_1} = \sqrt{\frac{T_2}{T_1}}$$

$$4 = \sqrt{\frac{T_2}{223}}$$

$$16 = \frac{T_2}{223} \Rightarrow T_2 = 3568 \Rightarrow t_2 = 3295^\circ \text{C}$$

19. (a)

$$22000 \pm 5\% \Rightarrow 22 \times 10^3 \pm 5\%$$

20. (a)

$$\lambda \propto \frac{1}{V}$$

$$H = \frac{u^2 \sin^2 \theta}{2g} = \frac{78400}{2 \times 9.8} \times \frac{1}{4} = 1000 \text{ m}$$

21. (c)

$$\eta = 1 - \frac{T_2}{T_1}$$

$$\frac{1}{2} = 1 - \frac{T_2}{600}$$

$$\frac{1}{2} = \frac{T_2}{600} \Rightarrow 27^\circ \text{C}$$

22. (b)

$$f = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi} \times \frac{1}{\sqrt{10 \times 10^{-3} \times 10^{-6}}} = 10^4$$

$$= \frac{10^4}{2\pi} = k \times \frac{10}{2\pi} = 1.5 \text{ kHz}$$

23. (c)

$$\oint \vec{E} \cdot d\vec{s} = 0$$

The number of flux lines entering the surface must be equal to the number of flux lines leaving it.

24. (a)

$$x = \frac{R}{\sqrt{\frac{9}{1} + 1}} = \frac{R}{4} \text{ from m}$$

$$m \bullet \frac{R}{4} \bullet \frac{3R}{4} \bullet 9m$$

$$V = \frac{-Gm}{\frac{R}{4}} - \frac{G \times 9m}{\frac{3R}{4}} = -\frac{4Gm}{R} - \frac{12Gm}{R} = -\frac{16Gm}{R}$$

25. (d)

$$I = \frac{E_1 - E_2}{R + r}$$

$$I = \frac{10 - 5}{10} \Rightarrow I = \frac{5}{10} = 0.5 \text{ A}$$

From A to B through E

26. (d) $\lambda \propto \frac{1}{V}$

27. (b)

$$\bar{a} = \bar{\alpha} \times \bar{r}$$

28. (b)

$$U = \frac{1}{2} \times L \times i^2$$

$$U = \frac{1}{2} \times 4 \times 10^{-6} \times 4 = 8 \mu\text{J}$$

29. (b)

$$T_{\frac{1}{2}} = 20 \text{ minutes}, n = 4$$

$$t = n \times T_{\frac{1}{2}} = 4 \times 20 = 80 \text{ minutes}$$

30. (b)

$$U \propto x^2$$

$$\frac{U_2}{U_1} = \left(\frac{x_2}{x_1} \right)^2 \Rightarrow U_2 = U \times \left(\frac{8}{2} \right)^2 \Rightarrow U_2 = 16U$$

31. (d)

Bernoulli's principle

32. (c)

zero

33. (c)

34. (b) Random error.

35. (b)

$$\tau = pE \sin \theta$$

$$4 = 2 \times 10^5 \times q \times 2 \times 10^{-2} \times \frac{1}{2}$$

$$Q = 2 \times 10^{-3} \text{ C} \Rightarrow q = 2 \text{ mC}$$

Physics

Section - B

36. (b)

$$x = A \sin \omega t, V = A \cos \omega t \times \omega$$

$$a = -A\omega^2 \sin \omega t$$

$$a = -1 \times \left(\frac{2\pi}{T} \right)^2 \sin \left(\frac{2\pi}{T} \right) t$$

$$a = -1 \times \frac{4\pi^2}{64} \times \sin \frac{2\pi}{8} \times 2$$

$$a = -\frac{\pi^2}{16} \times \sin 90^\circ \Rightarrow a = -\frac{\pi^2}{16} \text{ ms}^{-2}$$

37. (a)

$$-h = ut - \frac{1}{2}gt^2$$

$$h = -4(4) + \frac{1}{2}(10)(4)^2$$

$$h = -16 + 5(16) = 80 - 16 = 64 \text{ m}$$

38. (a)

$$\vec{F} = i(\vec{l} \times \vec{B})$$

$$\vec{F} = I(l \times (2\hat{i} + 3\hat{j} - 4\hat{k}))$$

$$\vec{F} = (3lk + 4lj) \Rightarrow F = i5l$$

39. (a)

$$\alpha = \frac{R_t - R_0}{R_0 t} = \frac{6.8 - 2}{2 \times 80} = \frac{4.8}{160} = 0.03$$

$$\alpha = 3 \times 10^{-2} \text{ }^\circ\text{C}^{-1}$$

40. (b)

$$r_n \propto 0.53 \text{ } \text{\AA}$$

$$r_3 = 9 \times 0.53 \text{ } \text{\AA} \Rightarrow r_3 = 4.77 \text{ } \text{\AA}$$

41. (d)

$$i_s = \frac{e}{10R} ; i_p = ni_s = \frac{e}{10}$$

$$ni_s = \frac{10e}{R}$$

$$n \frac{e}{10R} = \frac{10e}{R} \Rightarrow n = 100$$

42. (d)

$$F = \frac{GMm}{r^2} = m\omega^2 r \Rightarrow \omega^2 = \frac{GM}{r^3}$$

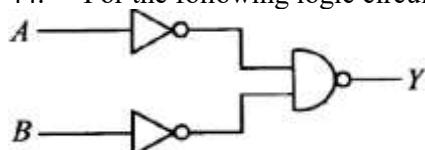
$$\left(\frac{2\pi}{T}\right)^2 = \frac{Gd \times 4\pi}{3} \times \frac{r^3}{r^3} \Rightarrow T^2 = \frac{3\pi}{Gd}$$

43. (b)

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{f} - \frac{1}{f} = 0$$

$$f = \infty$$

44. For the following logic circuit, the truth table is:



	A	B	Y		A	B	Y
	0	0	1		0	0	0
(a)	0	1	0	(b)	0	1	0
	1	0	1		1	0	0
	1	1	0		1	1	1
	A	B	Y		A	B	Y
	0	0	1		0	0	0
(c)	0	1	1	(d)	0	1	1
	1	0	1		1	0	1
	1	1	0		1	1	1

44.(d)

$$Y = \overline{A} \cdot \overline{B} = \overline{A+B} = A+B$$

45. (c)

$$v^2 - u^2 = 2as$$

Case 1: $\frac{u^2}{9} - u^2 = 2a \times 24 \quad \dots (a)$

Case 2: $0 - \frac{u^2}{9} = 2a \times x \quad \dots (b)$

Dividing (a) by (b), we get

$$\frac{-8u^2}{-u^2} = \frac{24}{x} \Rightarrow 8 = \frac{24}{x} \Rightarrow x = 3 \text{ cm}$$

$$\text{Total length} = 24 + 3 = 27 \text{ cm}$$

46.(a)

$$\frac{1}{f_1} = (1.6 - 1) \left(-\frac{1}{20} \right) = -\frac{6}{200}$$

$$\frac{1}{f_2} = (1.5 - 1) \left(+\frac{2}{20} \right) = \frac{10}{200}$$

$$\frac{1}{f_3} = (1.6 - 1) \left(-\frac{1}{20} \right) = -\frac{6}{200}$$

$$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} = -\frac{1}{100} = -100 \text{ cm}$$

47. (c)

$$V = kq \left(\frac{1}{2 \times 10^{-2}} - \frac{1}{8 \times 10^{-2}} \right)$$

$$V = kq \times 10^2 \left(\frac{8-2}{16} \right) = \frac{3}{8} qk$$

48. (a)

$$B = \frac{2\mu_0 i}{4\pi R} - \frac{\mu_0 i \pi}{4\pi R}$$

$$B = \frac{\mu_0 i}{2\pi R} - \frac{\mu_0 i}{4R} = \frac{\mu_0 i}{4R} \left[1 - \frac{2}{\pi} \right] \odot$$

49. (a)

$$\mu_{mg} = ma$$

$$a = \mu g = 0.15 \times 10 = 1.5 \text{ ms}^{-2}$$

50. (a)

$$X_L = 2\pi fL$$

$$X_L = 2\pi \times \frac{50}{\pi} \times 10^{-3} \times 50 = 5 \Omega$$

$$X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi \times 50 \times \frac{10^3 \pi}{10^{-6}}} \Rightarrow X_C = 10 \Omega$$

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

$$Z = \sqrt{10^2 + (10 - 5)^2}$$

$$Z = \sqrt{25 \times 5} = 5\sqrt{5} \Omega$$

Chemistry

Section - A

51. (c)

In AlCl_3 , BeCl_2 and PCl_5 the central atom having 6, 4, 10 electrons.

52. (b)

Veronal, amytal, neumbutal, luminal and Seconal are barbiturates

53. (d)

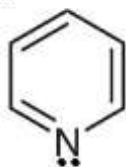
A chemical reaction may have zero activation energy and reason is definition of activation energy.

54. (a)

When a halogen atom is attached to sp^3 carbon which is connected with sp^2 hybridised carbon.

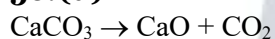
55. (a)

Pyridine



116, 3π, 1LP

56. (d)



20 gm $\rightarrow$?

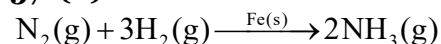
$$\frac{20}{100} \times 44 = 8.8 \text{ g}$$

100% pure $\rightarrow$ 8.8 g of CO_2

20% $\rightarrow$?

$$\frac{20}{100} \times 8.8 = 1.76 \text{ gm}$$

57. (b)



58. (a)

A: Metallic sodium dissolves in liquid ammonia giving a deep blue solution which is paramagnetic.

R: The deep blue colour solution due to ammoniated electrons.

59. (c)

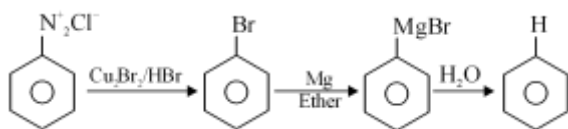
Daily requirement of Mg and Ca are

200 mg to 300 mg

$200 \times 10^{-3} \text{ g}$ to $300 \times 10^{-3} \text{ g}$

0.2 g to 0.3 g

60. (d)



61. (a)

$$r = k[A]^2[B]$$

$$r_i = [A]^2 \quad \dots (a)$$

$$r_f = [3A]^2 \quad \dots (b)$$

$$\frac{r_f}{r_i} = \frac{(3)^2[A]^2}{[A]^2}$$

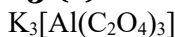
$$\frac{r_f}{r_i} = 9 \therefore r_f = 9r_i$$

62. (a)

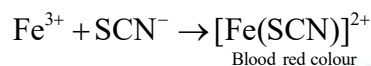
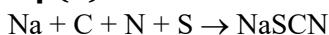
D: Due to small size, s-s overlap H_2 has high dissociation enthalpy.

E: Standard Electrode Potential of hydrogen is more than metals below Fe

63. (c)



64. (b)



Blood red colour

65. (c)

A: $\Delta_r G = -nFE_{cell}$ value of $\Delta_r G$ depends on n.

R: E_{cell} is an intensive property, $\Delta_r G$ is an extensive property.

66. (c)

Keto group converted into methylene group in presence Zn/Hg and conc. HCl according to Clemenson reduction.

67. (c)

$$n_m = 2l + 1$$

$$2l = n_m - 1$$

$$l = \frac{n_m - 1}{2}$$

68. (a)

Cu^{2+} is more stable than Cu^+ in Aq. Solution. Hydration energy due to small ionic size.

$$\Delta H_{hyd} \propto \frac{\text{charge}}{\text{size}}$$

69. (a)

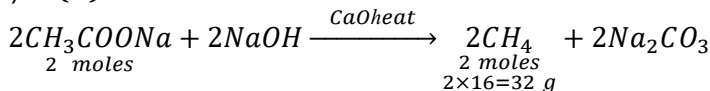
A: Coke: used as a reducing agent.

B: Diamond: Carbon atoms are sp^3 hybridised

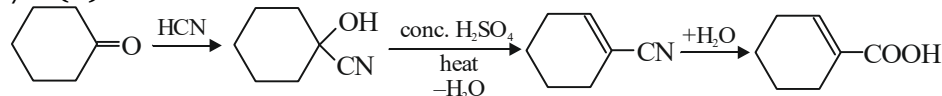
C: Fulleren: Cage like molecules

D: Graphite: used as dry lubricant.

70. (d)



71. (b)



72. (a)

Conceptual.

73. (d)

According to Boyle's law

$$P \propto \frac{1}{V} \Rightarrow P = K \left(\frac{1}{V} \right)$$

$$y = m(x)$$

74. (c)

For ccp, Z = 4, Octahedral voids = 4 Tetrahedral voids = 8

A	B	A:B
$\frac{1}{3} \times 8$	4	$\frac{8}{3} : 4$
		$\frac{2}{3} : 1$
		2 : 3

$$A : B = 2 : 3 \quad (x + y = 2 + 3 = 5)$$

75. (a)

Covalent bonding is inter-atomic force

Ionic bond is inter-ionic force

H-bonding, dipole - dipole interactions, dipole induced dipole interactions, dispersion forces are intermolecular forces.

76. (c)

Order of energies of molecular orbital of N₂ molecule is

$$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$$

77. (b)

TlI > TlI₃ inter pair effect of TlI is more stable in +1 oxidation state.

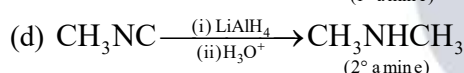
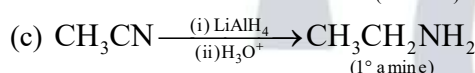
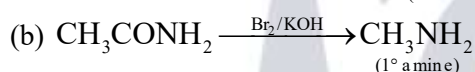
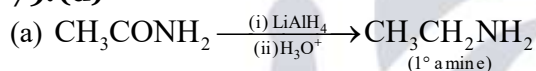
78. (a)

$$\text{Cell constant} = \text{Conductivity} \times \text{Resistance}$$

$$\text{Cell constant} = 0.021 \times 60 \text{ cm}^{-1}$$

$$\text{Cell constant} = 1.26 \text{ cm}^{-1}$$

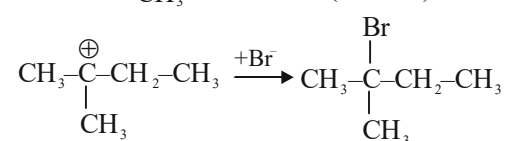
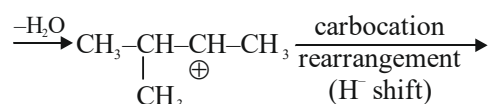
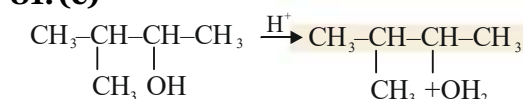
79. (d)



80. (a)

$$\text{Order of size: N}^{3-} > \text{O}^{2-} > \text{F}^- > \text{Na}^+$$

81. (c)



82. (b)

A: Atoms of all elements are composed of three fundamental particles, except hydrogen.

B: The mass of electron is $9.10939 \times 10^{-31} \text{ kg}$.

C: Isotopes having same number protons and electrons but have different mass

number.

D: Protons and neutrons are collectively called nucleons.

E: According to Dalton's Atomic Theory atoms are ultimate particle of matter

83.(a)

A: Helium is used to dilute oxygen in diving apparatus.

R: Helium has low solubility in O_2 .

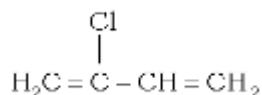
84. (a)

Boron in BF_3 contain six electrons.

BF_3 is electron deficient, act as Lewis acid.

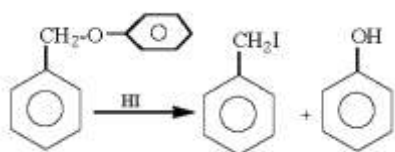
85.(d)

Monomer of neoprene is



(chloroprene)

86. (a)



87.(a)

$A + B \rightleftharpoons C + D$

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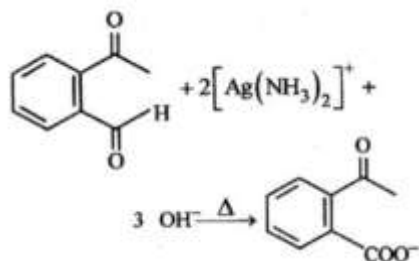
$$K_c = \frac{10 \times 6}{2 \times 3} = 10$$

$$\Delta G^0 = -2.303RT \log K_c$$

$$\Delta G^0 = -2.303 \times 2 \times 300 \times \log 10$$

$$\Delta G^0 = -1381.8 \text{ cal}$$

88. (a)



89. (a)

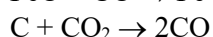
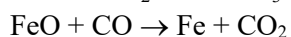
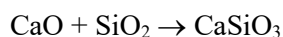
solid

90. (d)

$$\Delta H = \Delta U + \Delta n_g RT$$

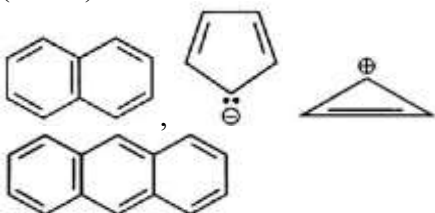
91. (c)

At 900 – 1500 K



92.(c)

$(4n + 2)\pi$ electrons



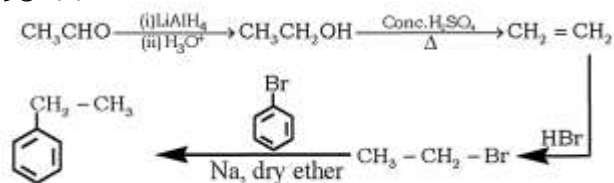
93.(d)

Option (a), (b), (c) –I effect destabilises the carbocation.

94.(a)

At edge centre, contribution is $\frac{1}{4}$

95.(c)



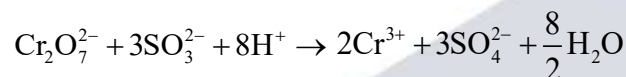
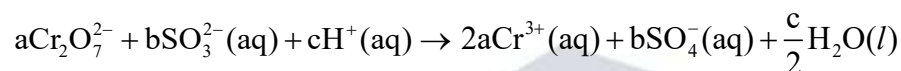
96.(b)

97.(a)

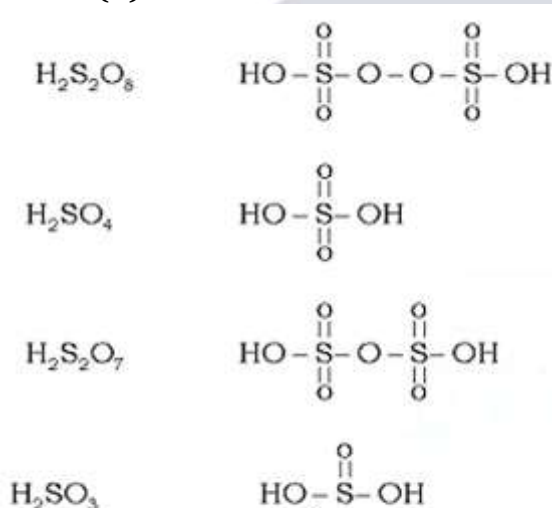
98. (a)

[CoCl₂(en)₂]₂NO₃ Bidentate ligand chelate and forms more stable complexes.

99.(c)



100. (d)



A – III B – IV C – I D – II

101. (c)

Synergids are the cells of gametophyte and hence these are haploid Zygote is formed by fusion of two gametes and thus it is diploid.

Primary endosperm nucleus is formed by the fusion of diploid secondary nucleus with a male gamete. Therefore, it is triploid.

102. (d)

Movement and accumulation of ions across a membrane against their concentration gradient can be explained by active transport. It uses energy to transport molecules from lower concentration to a higher concentration.

103. (a)

Large, colourful, fragrant flowers with nectar attract biotic pollinators (insects), thus, they are seen in insect pollinated plants.

104. (c)

When a single gene affects multiple phenotypic expression, the gene is called pleiotropic gene and the phenomenon is called pleiotropism.

105. (c)

Ethylene promotes rapid internode/petiole elongation in deep water rice plants.

106. (a)

Habitat loss and fragmentation is the most important cause driving animals and plants to extinction.

107. (d)

Option (d) is the correct answer because in recombinant DNA technology the separated DNA fragments can be visualised only after staining the DNA with a substance known as ethidium bromide followed by exposure to U.V. radiation. You can see bright orange coloured bands of DNA in an ethidium bromide stained gel exposed to U.V. light.

108. (a)

Manganese plays a major role in the splitting of water to liberate oxygen during photosynthesis. Copper is essential for the overall metabolism in plants. Molybdenum is included in nitrogen metabolism.

Magnesium activates several enzymes involved in photosynthesis and respiration.

109. (d)

China rose, Tomato, *Petunia* and Lemon show axile placentation. *Dianthus* and *Primrose* show free central placentation. Pea, Lupin and Beans show marginal placentation. Cucumber and mustard show parietal placentation.

110. (b)

The process of recombination occurs at Pachytene stage of prophase I. This stage is characterised by the appearance of recombination nodules.

111. (a)

In PS-I, the reaction centre chlorophyll a has an absorption peak at 700 nm, while in PS-II, reaction center has an absorption maxima at 680 nm.

112. (b)

The unequivocal proof that DNA is the genetic material came from the experiment of Alfred Hershey and Martha Chase.

Avery, Macleoid and McCarty gave the biochemical characterization of Transforming Principle. The transformation experiments by using *Pneumococcus* was conducted by Frederick Griffith. Wilkins and Franklin produced X-ray diffraction data of DNA

113. (b)

Replication of DNA takes place in S-phase of cell cycle in eukaryotes. Most of the cell organelles duplicate in G₁ phase.

114. (b)

In tissue culture experiments, leaf mesophyll cells are put in a culture medium to form callus. This phenomenon may be called as dedifferentiation.

Dedifferentiation is a phenomenon by which the living differentiated plant cells, that by now have lost the capacity to divide can regain the capacity of division under certain conditions.

115. (c)

Option (c) is the correct answer because cellulose does not contain complex helices and hence cannot hold iodine molecules. Option (a), (b) and (d) are not correct as cellulose is a polysaccharide.

116. (b)

Spraying juvenile conifers with gibberellins (GAs) hastens the maturity period, thus leading to early seed production.

117. (a)

Statement I is correct as measurements reveal that the forces generated by transpiration can create pressures sufficient to lift a xylem sized column of water up to 130 meters high.

Statement II is also correct as transpiration cools leaf surfaces, sometimes 10 to 15 degrees, by evaporative cooling.

118. (a)

Fabaceae → Diadelphous and ditheous anther.

Solanaceae → Polyandrous, epipetalous and ditheous anther.

Liliaceae → Polyandrous, epiphyllous and ditheous anther.

119. (a)

All the genes that are expressed as RNA are referred to as Expressed Sequence Tags (ESTs).

120. (a)

The detritus food chain begins with detritus that is dead organic matter. The saprotrophic bacteria and fungi breakdown detritus into simpler inorganic substances by a process called catabolism.

121. (a)

The thickness of the ozone in a column of air from the ground to the top of the atmosphere is measured in terms of Dobson units (DU). Noise is measured in decibels.

122. (a)

In winter, the cambium is less active and forms fewer xylary elements that have narrow vessels, and this wood is called autumn wood or late wood.

123. (c)

Splitting of centromere occurs during anaphase of mitosis or anaphase II of meiosis. During Metaphase I and II, chromosomes align at the equator. During telophase, chromosomes reach the respective poles.

124. (b)

The historic convention on Biological Diversity, "The Earth Summit" was held in Rio de Janeiro in the year 1992. It called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilization of its benefits

125. (b)

For every CO₂ molecule entering the Calvin cycle, 3 molecules of ATP and 2 of NADPH₂ are required. To make one molecule of glucose, 6 turns of the cycle are required. Thus, ATP and NADPH₂ molecules required for synthesis of one molecule of glucose during Calvin cycle will be

$$\rightarrow 6 \times \begin{bmatrix} 3\text{ATP} \\ 2\text{NADPH}_2 \end{bmatrix} = \begin{bmatrix} 18\text{ATP} \\ 12\text{NADPH}_2 \end{bmatrix}$$

126. (c)

A considerable amount of GPP is utilized by plants in respiration. Gross primary productivity minus respiration losses (R), is the net primary productivity.

So R = Respiratory loss

127. (b)

Option (b) is the correct answer as, during isolation of the genetic material, purified DNA ultimately precipitates out after the addition of chilled ethanol.

Option (c) is not the answer as, proteins can be removed by treatment with proteases.

Option (a) is not the answer as RNA can be removed by treatment with ribonuclease.

128. (b)

In eukaryotes there are three major types of RNA polymerases. RNA polymerase I transcribes : 5.8S, 18S, 28S rRNAs
RNA polymerase II transcribes : hnRNAs (precursor of mRNA)
RNA polymerase III transcribes : tRNAs, ScRNA, 5S rRNA and snRNA

129. (b)

Tassels in the com cob represents stigma and style which wave in the wind to trap pollen grains.

130. (b)

Selaginella and Salvinia are heterosporous pteridophytes. They produces two different kind of spores.

Psilotum, Lycopodium and Equisetum are homosporous pteridophytes.

131. (c)

Option (c) is the correct answer because in gene gun method, microparticles of tungsten or gold are used. Gold or tungsten are inert in nature so they do not alter the chemical composition of cells.

132. (d)

Endarch and exarch are the terms often used for describing the position of primary xylem in the plant body.

Primary xylem is of two types protoxylem and metaxylem. On the basis of relative position of protoxylem and metaxylem in the organ the arrangement of primary xylem can be endarch or exarch.

Exarch type of primary xylem is seen in roots. Therefore, Statement I is false and Statement II is true.

133. (c)

Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and 'mapped' their position on the chromosome.

Sutton and Boveri proposed chromosomal theory of inheritance.

Henking discovered X-chromosome

Thomas Hunt Morgan proved chromosomal theory of inheritance and proposed the concept of linkage.

134. (a)

ATP in glycolysis is used at two steps of conversion that are Glucose $\rightarrow$ Glucose-6-phosphate Fructose-6-phosphate $\rightarrow$ Fructose-1, 6-bisphosphate The reason of the utilisation of ATP is for phosphorylation the substrates.

135. (a)

The predominant stage of the life cycle of a moss is the gametophyte which consists of two stages. The first stage is the protonema stage, which develops directly from a spore. Capsule of the sporophyte contains spore which gives rise to protonema. Thus, reason correctly explains the assertion.

SECTION-B

136. (a)

The ribosome consists of structural RNAs and about 80 different proteins.

137. (c)

Klinefelter's syndrome is caused due to the presence of an additional copy of X-chromosome resulting into a karyotype of 47, XXV. Such an individual has overall masculine development, however, the feminine development is also expressed. Such individuals are sterile. Thus, statement B and E are correct regarding Klinefelter's syndrome.

138. (d)

Pyruvate, which is formed by the glycolytic catabolism of carbohydrates in the cytosol, after it enters mitochondrial matrix undergoes oxidative decarboxylation by a complex set of reactions catalyzed by pyruvate dehydrogenase. The scheme of glycolysis was given by Gustav Embden, Otto Meyrhopf and J. Parnas, and is often referred to as the EMP pathway.

In electron transport system, the energy of oxidation-reduction is utilized for the production of proton gradient required for phosphorylation, thus, this process is also called oxidative phosphorylation.

The TCA (tricarboxylic acid cycle) starts with the condensation of acetyl group with oxaloacetic acid (OAA) and water to yield citric acid. The reaction is catalysed by the enzyme citrate synthase. Thus, option (d) is correct.

139. (a)

A flower is a modified shoot wherein the shoot apical meristem changes to floral meristem.

Internodes do not elongate and the axis gets condensed. The apex produces different kinds of floral appendages laterally at the successive nodes instead of leaves.

Therefore, both A and R are true and R is correct explanation of A.

140. (c)

Assertion is correct but reason is false as in gymnosperms the pollen grains are released from the microsporangium and they are carried in air currents. They come in contact with the opening of the ovules borne on mega sporophylls. The *pollen tube* carrying the male gametes grows towards archegonia in the ovules and discharge their contents near the mouth of the archegonia.

141. (a)

Cohesion represents mutual attraction between water molecules. Adhesion represents attraction of water molecules to polar surfaces Surface tension represents water molecules are attracted to each other in the liquid phase more than to water in the gas phase. Guttation represent loss of water in liquid phase. Thus, option (a) is correct.

142. (a)

Chemiosmosis requires a membrane, a proton pump, a proton gradient and ATP synthase.

143. (a)

Option (a) is correct answer of this question because malonate is a competitive inhibitor of enzyme succinate dehydrogenase.

Inhibition of succinic dehydrogenase by malonate occurs due to close resemblance of malonate with substrate succinate in structure. Competitive inhibitors are often used in the control of bacterial pathogens

144. (b)

Lenticels are lens shaped opening permitting exchange of gases between the outer atmosphere and internal tissue of the stem.

Bark that is formed early in the season is called early or soft bark. Towards the end of the season late or hard bark is formed.

Bark is non-technical term that refer to all tissues exterior to vascular cambium. Bark refers to a number of tissue types, viz periderm and secondary phloem. Phellogen is

couple of layers thick Therefore, only statement A and D are correct.

145. (c)

M phase or mitosis is the phase where the actual cell division occurs. Mitosis is also called equational division.

During G₂ phase DNA synthesis stops but cell synthesises RNA, proteins, etc. for next phase.

Quiescent stage is inactive phase in which non-dividing cells enter.

G₁ phase is the interval between mitosis and initiation of DNA replication.

Therefore, option (c) is correct.

146. (b)

(+, +) Mutualism : In this interaction, both the interacting species are benefitted.

(+, 0) Commensalism : Only one species is benefitted and the other species remains unharmed. (-, 0) Amensalism : Neither species is benefitted. One remains unharmed and the

other is harmed. (+, -) Parasitism : One species is benefitted and other is negatively affected.

147. (c)

Cause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually. Thus, statement I is correct.

Statement II is incorrect as in general, herbivores and plants appear to be more adversely affected by competition than carnivores.

148. (c)

Iron activates catalase enzyme.

Zinc is needed in the synthesis of auxin.

Boron is required for cell elongation and cell differentiation.

Molybdenum is component of nitrogenase and nitrate reductase enzyme.

Therefore, option (c) is correct.

149. (a)

The correct answer is option (a) because recombinant DNA technology involves several steps in specific sequence such as isolation of DNA, fragmentation of DNA by restriction endonucleases, isolation of desired DNA fragment, ligation of the DNA fragment into a vector, transferring the recombinant DNA into the host, culturing the host cells in a medium at large scale and extraction of the desired product.

150. (b)

SA Algal bloom imparts a distinct colour to the water bodies. It causes deterioration of the water quantity and fish mortality.

ZOOLOGY SECTION-A

151. (a)

Option (a) is the correct answer to this question because statement I and statement II both are

correct. Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct. The cavity of cervix is called cervical canal which along with vagina forms the birth canal.

152. (b)

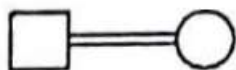
Increase in the concentration of the toxicant at successive trophic level is called biomagnification.

Large amount of nutrients in water promotes growth of algal bloom. Algal bloom increases fish mortality.

Eutrophication refers to the natural aging of a lake by nutrient enrichment of its water.

153. (b)

The symbol representing mating between relatives (consanguineous mating) in human pedigree analysis is



154. (b)

The correct answer is option (b) because except for hepatitis-B, genital herpes and HIV infection other STIs are completely curable if detected early and treated properly.

Gonorrhoea is a bacterial disease which can be treated and cured completely, other diseases mentioned are viral diseases.

155. (a)

The correct answer is option (a) as

- Heroin belongs to the category of opioids and it is a depressant that slows down body functions.
- Marijuana is known for its effect on the cardiovascular system of the body.
- Cocaine interferes with the transport of the neurotransmitter dopamine.

Morphine is used as a sedative and painkiller.

156. (b)

Option (b) is the correct answer because cartilaginous joint is present in between the adjacent vertebrae in the vertebral column.

Option (c) is not the answer because cartilaginous joint is not present between flat skull bones.

Option (d) is not the answer because fibrous joint is not present in between the carpal and metacarpal of thumb.

Option (a) is not the answer because saddle joint is not present in between humerus and pectoral girdle.

157. (d)

The correct answer is option (d) as a protein is imagined as a line, the left end represented by the first amino acid and the right end is represented by the last amino acid. The first amino acid is also called N-terminal amino acid. The last amino acid is called the C-terminal amino acid.

158. (b)

The endomembrane system includes endoplasmic reticulum (ER), golgi complex, lysosomes and vacuoles.

Since the functions of the mitochondria, chloroplast and peroxisomes are not coordinated with the above components, these are not considered as part of endomembrane system.

159. (a)

RNA being unstable, mutates at a faster rate. Consequently, viruses having RNA genome and having shorter life span mutate and evolve faster.

160. (a)

Cholecystokinin (CCK) acts on both gall bladder and pancreas and stimulates the secretion of bile juice and pancreatic enzymes respectively.

GIP inhibits gastric secretion and motility.

Atrial Natriuretic Factor (ANF) is released from the atrial wall of our heart.

Anti-diuretic hormone (ADH) acts mainly on the kidney and stimulates resorption of water and electrolytes by the distal tubules.

161. (b)

Option (b) is the correct answer because both Assertion and Reason are true.

Implantation is embedding of the blastocyst into endometrium of uterus. Correct explanation of reason is

Corpus luteum secretes large amount of progesterone which is essential for maintenance of endometrium of uterus. In absence of fertilization, the corpus luteum degenerates hence the decrease in the level of progesterone hormone will cause disintegration of endometrium leading to menstruation.

162. (a)

Option (a) is the correct answer because:

- (i) Ringworm is caused by Trichophyton.
- (ii) Filariasis is caused by Wuchereria bancrofti.
- (iii) Malaria is caused by Plasmodium species.
- (iv) Pneumonia is caused by Hemophilus influenzae

163. (a)

The correct answer is option (a) as low temperature preserves the enzyme in a temporarily inactive state whereas high

temperature destroys enzymatic activity because proteins are denatured by heat.

Competitive inhibitor due to its close structural similarity with the substrate, competes with the substrate for the substrate-binding site of the enzyme

164. (c)

Sol. Option (c) is the correct answer because protonephridia or flame cells are the excretory structures in platyhelminthes. Nephridia are the tubular excretory structures of earthworms (*Pheretima*) and other annelids. Single celled organisms like *Paramoecium* have contractile vacuoles for excretion. Ureose glands are present in cockroach

165. (b)

The correct answer is option (b) because using conventional methods of diagnosis like serum and urine analysis, etc, do not help in early diagnosis. Recombinant DNA technology, Polymerase Chain Reaction [PCR] and Enzyme Linked Immuno-Sorbent Assay (ELISA) are some of the techniques that serve the purpose of early diagnosis.

166. (a)

A leopard and a lion in a forest/grassland exemplify competition where both the species are competing for the same resources.

A cuckoo laying egg in a crow's nest is brood parasitism where cuckoo is the parasitic bird that lays its egg in the nest of crow (host bird).

Fungi and root of a higher plant in mycorrhizae exemplify mutualism where both the species are benefitted. The fungi help the plant in the absorption of essential nutrients from the soil while the plant in turn provides the fungi with energy yielding carbohydrates.

A cattle egret and a cattle in a field exemplify commensalism where one species benefits and the other remains unaffected.

The egrets always forage close to where cattle are grazing because the cattle, as they move, stir up and flush out insects from the vegetation that otherwise might be difficult for the egrets to find and catch.

167. (b)

Option (b) is the correct answer because ligament is an example of dense regular connective tissue so Statement I is incorrect and cartilage is an example of specialised connective tissue and not dense regular tissue. Therefore Statement II is also incorrect.

168. (d)

In prokaryotes, the negatively charged DNA is held with some positively charged proteins in a region termed as nucleoid.

In eukaryotes, the negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called nucleosome.

169. (a)

Option (a) is the correct answer because

(i) Fovea is the point of greatest visual acuity or resolution.

(ii) Iris is the visible coloured portion of the eye that regulates diameter of pupil.

(iii) Blind spot is the point where optic nerve leaves the eye-ball and photoreceptor cells are absent.

(iv) Sclera is the external layer of eye formed of dense connective tissue.

170. (b)

Option (b) is the correct answer because numbat, spotted cuscus and flying phalanger are Australian marsupials exhibiting adaptive radiation.

Option (c) is incorrect because mole and flying squirrel are placental mammals. Option (d) is incorrect because lemur and wolf are placental mammals. Option (a) is incorrect because bobcat is a placental mammal.

171. (d)

The correct answer is option (d) as first menstrual cycle that begins at puberty is called menarche.

Cyclic menstruation is an indicator of normal reproductive phase and extends between menarche and menopause.

In primates, cyclical changes during reproduction are called menstrual cycle

172. (d)

Option (d) is the correct answer because vital capacity is the maximum volume of air a person can breathe in after forced expiration. This includes ERV, TV and IRV.

173. (a)

The correct answer is option (a) as in a standard ECG, P-wave represents the electrical excitation (or depolarisation) of the atria which leads to the contraction of both the atria.

QRS complex represents the depolarisation of ventricles which initiates the ventricular

contraction. T-wave represents the return of the ventricles from excited to normal state.

174. (d)

The correct answer is option (d) as 'Reproductive and Child Health Care (RCH) programme' deals with creating awareness among people about various reproduction related aspects and providing facilities and support for building up a reproductively healthy society.

Amniocentesis is basically used to test for the presence of certain genetic disorders such as Down's syndrome, haemophilia, *etc.*, to determine the survivability of the foetus.

Amniocentesis is not a sex determination technique in India and is not a strategy of RCH.

175. (b)

Option (b) is the correct answer because the undigested food (faeces) enters into caecum of the large intestine through ileo-caecal valve, which prevents the backflow of the faecal matter.

Option (c) is not the answer because a muscular sphincter i.e., the gastro-oesophageal sphincter regulates the opening of oesophagus into the stomach.

Option (d) is not the answer because pyloric sphincter regulates the opening in between stomach and duodenum.

Option (a) is not the answer because the opening of common hepato-pancreatic duct is guarded by sphincter of Oddi.

176. (b)

In a *lac* operon,

Gene *a* codes for enzyme transacetylase.

Gene *y* codes for enzyme permease.

Gene *i* codes for repressor protein

Gene *z* codes for enzyme β -galactosidase

177. (c)

Option (c) is the correct answer because gastric glands have three major types of cells namely

(i) Mucus neck cells which secrete mucus

(ii) Peptic or chief cells which secrete the proenzyme pepsinogen

(iii) Parietal or oxyntic cells which secrete HCl and intrinsic factor for absorption of vitamin B₁₂.

178. (c)

An elaborate network of filamentous proteinaceous structures consisting of microtubules, microfilaments and intermediate filaments present in cytoplasm is collectively referred to as the cytoskeleton. It is involved in many functions such as mechanical support, motility, maintenance of the shape of the cell.

179. (c)

The correct answer is option (c) because Assertion is true as there are two types of nephrons, i.e., cortical nephrons and juxtamedullary nephrons based on their relative position in the cortex and medulla. Reason is not correct as loop of Henle in juxtamedullary nephrons is very long and runs deep into the medulla. Therefore, Assertion is true but Reason is false.

180. (c)

Electrostatic precipitator is most widely used in thermal power plants

It can remove over 99 percent particulate matter present in the exhaust from a thermal power plant.

181. (a)

Down's syndrome is caused by an additional copy of chromosome number 21. Its symptoms include-

a. Broad palm with characteristic palm crease

b. Short statured with small round head

c. Furrowed tongue and partially open mouth, etc.

182. (b)

Option (b) is the correct answer because hemichordates are bilaterally symmetrical animals.

Option (c) is not the answer because coelenterates are radially symmetrical organisms.

Option (d) is not the answer

because adult echinoderms are radially symmetrical in adult stage Option (a) is not the answer because ctenophores are radially symmetrical organisms.

183. (a)

The correct answer is option (a) because HIV enters into helper T-lymphocytes (TH), replicates and produces progeny viruses. The progeny viruses released into blood attack other helper lymphocytes.

184. (d)

Option (d) is correct answer because a single stranded DNA or RNA tagged with a radioactive molecule is called a probe and it helps in the detection of mutated gene. Option (b), (c) and (a) are not correct because YAC, BAC, pBR322 are vectors

185. (b)

Option (b) the correct answer because

- (i) Vasectomy is a surgical method of contraception
- (ii) Coitus interruptus is a natural method of contraception
- (iii) Cervical cap is a barrier method of contraception
- (iv) Saheli is an oral method of contraception which is a non-steroidal pill

SECTION-B

186. (b)

Option (b) is the correct answer because statements B and C only are correct. Option (a), (c) and (d) are not correct. The chordate characters are presence of closed circulatory system and presence of pharyngeal gill slits. Nerve cord is dorsal, hollow and single. Heart is ventral. They are triploblastic and coelomate

187. (a)

Option (a) is the correct answer because limbic system along with hypothalamus regulate the sexual behaviour, expression of excitement, pleasure, rage, fear, *etc.* Option (b), (c) and (d) are not correct because corpora quadrigemina is a part of the midbrain and consists of four round swellings. Corpus callosum is a tract of nerve fibres that connects right and left cerebral hemispheres. Thalamus is a major coordinating centre in the forebrain for sensory and motor signalling. Midbrain, pons and medulla oblongata together form the brain stem.

188. (b)

Option (b) is correct answer because presence of hairs, pinna and mammary glands are unique features of mammals.

Options (a), (c) and (d) are not correct because, monocondylic skull is present in reptiles and aves whereas mammals have dicondylic skull. Tympanic membrane is present in amphibians also, so it is not considered as unique feature.

Indirect development is not seen in mammals.

189. (c)

Option (c) is the correct answer because thyroid hormones play an important role in the regulation of basal metabolic rate, maintenance of water and electrolyte balance and support the process of RBCs formation, whereas this hormone is not involved in regulating normal rhythm of sleep-wake cycle and development of immune system.

190. (b)

- Tetrad formation is seen during zygotene stage
- During Anaphase, the centromeres split and chromatids separate.
- Terminalisation of chiasmata takes place during diakinesis.
- Nucleolus, golgi complex and ER are reformed during telophase.
- Crossing over takes place between non-sister chromatids of homologous chromosomes.

191. (c)

Option (c) is the correct answer because,

- Areolar connective tissue contains fibroblasts (cells that produce and secrete fibres), macrophages and mast cells.
- Inner surface of bronchioles is lined by ciliated epithelium.
- Blood is a specialised connective tissue.
- Tubular parts of nephron are lined by cuboidal epithelium.

192. (b)

Option (b) is the correct answer because anal styles are present in male cockroaches and absent in female cockroaches.

Option (a), (c) and (d) are not the correct answers because sclerites, anal cerci and dark brown body colour are common features of both male and female cockroaches.

193. (c)

The sequence of coding strand is same as RNA except thymine at the place of uracil.

Template strand → 3'-TAGCTAGCTAGCTAGCTAGCTAGC-5'

Coding strand → 5'-ATCGATCGATCG ATCGATCGATCGATCG-3'

↓ Transcription

mRNA → 5' AUCGAUCGAUCGAUCGAUCGAUCG AUCG 3'

194. (c)

Option (c) is the answer because

In cockroach, excretion is brought about by Malpighian tubules, fat body, nephrocytes and urecose glands.

Urecose glands are present in male cockroach of some species. They synthesise uric acid. Nephrocytes are large, colourless, ovoid, binucleate cells attached to the dorsal diaphragm in the body cavity. Fat body accumulates, produces and stores uric acid.

Phallic gland is the structure of male reproductive system of cockroach and it secretes the outer layer of spermatophore. Collateral gland is the structure of female reproductive system of cockroach and it secretes the hard egg-case or ootheca around fertilised eggs.

195. (d)

Cells in the Go stage remain metabolically active but no longer proliferate unless called on to do so depending on the requirement of the organism.

In animal cells, during the S-phase, DNA replication begins in the nucleus, and the centriole duplicates in the cytoplasm.

196. (d)

Option (d) is the correct answer because decreasing the productivity of inbred population is not an advantage of inbreeding.

Options (b) and (c) are not the answers because they are the advantages of inbreeding.

Option (a) is an incorrect statement.

197. (b)

Option (b) is the correct answer because statements B, C and D are true statements. ADH facilitates water reabsorption from DCT of nephron to prevent diuresis, which causes increase in blood pressure. ANF which is secreted by the heart is a vasodilator.

Options (c), (d) and (a) are not correct because statements A and E are false. Excessive loss of body fluid from the body switches on the osmoreceptors.

198. (b)

Option (b) is the correct answer because statements B and C are only correct statements while A and D are incorrect statements.

Muscle bundles are held together by collagenous connective tissue layer called fascia.

Muscle bundles are called fascicles. The portion of the myofibril between two successive 'Z' lines is considered as functional unit of contraction called sarcomere.

199. (c)

Option (c) is the answer because, basophils secrete histamine, serotonin, heparin *etc.* and are involved in inflammatory response.

Option (b) is not the answer because, basophils are granulocytes.

Option (d) is not the answer because, neutrophils are the most abundant cells (60-65 %) of the total WBCs whereas basophils are least (0.5-1%) abundant of all WBCs.

Option (a) is not the answer because, monocytes have a kidney-shaped nucleus.

200. (a)

Logistic growth occurs when there is limited resource availability condition.

Exponential growth occurs when there is unlimited resource availability condition.

Expanding age pyramid reflects growing population where the percent individuals of pre-reproductive age is largest followed by reproductive and post-reproductive age

groups.

Stable age pyramid shows stable population where the percent individuals of pre-reproductive and reproductive age group are same.

