12/04/2024

CODE-A

Aakash
Medical | IIT-JEE | Foundations

***Corporate Office*:** Aakash Tower, 8, Pusa Road, New Delhi-110005, Ph.011-47623456

(*Advanced* INTENSIVE *Mastery for* 720)

MM : 720 **CST-6** **Time : 3 Hrs. 20 Min.**

Answers

1. (3)	41. (3)	81. (1)	121. (2)	161. (1)
2. (2)	42. (1)	82. (2)	122. (3)	162. (3)
3. (1)	43. (2)	83. (3)	123. (3)	163. (3)
4. (4)	44. (4)	84. (1)	124. (4)	164. (1)
5. (3)	45. (1)	85. (1)	125. (1)	165. (3)
6. (4)	46. (3)	86. (1)	126. (2)	166. (1)
7. (3)	47. (3)	87. (2)	127. (4)	167. (1)
8. (4)	48. (4)	88. (1)	128. (3)	168. (2)
9. (3)	49. (4)	89. (3)	129. (3)	169. (3)
10. (2)	50. (3)	90. (2)	130. (1)	170. (2)
11. (1)	51. (1)	91. (3)	131. (2)	171. (1)
12. (2)	52. (4)	92. (3)	132. (1)	172. (3)
13. (3)	53. (3)	93. (1)	133. (4)	173. (3)
14. (2)	54. (2)	94. (3)	134. (1)	174. (3)
15. (4)	55. (4)	95. (3)	135. (1)	175. (2)
16. (3)	56. (4)	96. (1)	136. (1)	176. (1)
17. (3)	57. (3)	97. (3)	137. (4)	177. (1)
18. (2)	58. (2)	98. (2)	138. (2)	178. (4)
19. (1)	59. (4)	99. (2)	139. (3)	179. (1)
20. (2)	60. (1)	100. (3)	140. (3)	180. (3)
21. (3)	61. (3)	101. (2)	141. (1)	181. (4)
22. (4)	62. (2)	102. (4)	142. (1)	182. (1)
23. (3)	63. (4)	103. (4)	143. (2)	183. (4)
24. (2)	64. (4)	104. (1)	144. (1)	184. (4)
25. (4)	65. (4)	105. (2)	145. (4)	185. (3)
26. (2)	66. (4)	106. (2)	146. (3)	186. (2)
27. (3)	67. (3)	107. (3)	147. (4)	187. (2)
28. (3)	68. (4)	108. (4)	148. (1)	188. (2)
29. (4)	69. (3)	109. (3)	149. (3)	189. (2)
30. (1)	70. (3)	110. (2)	150. (3)	190. (3)
31. (3)	71. (4)	111. (3)	151. (3)	191. (2)
32. (2)	72. (1)	112. (3)	152. (3)	192. (2)
33. (3)	73. (2)	113. (1)	153. (2)	193. (1)
34. (2)	74. (1)	114. (1)	154. (2)	194. (3)
35. (2)	75. (3)	115. (2)	155. (1)	195. (1)
36. (4)	76. (4)	116. (2)	156. (3)	196. (2)
37. (2)	77. (1)	117. (3)	157. (1)	197. (3)
38. (4)	78. (4)	118. (1)	158. (4)	198. (2)
39. (3)	79. (2)	119. (3)	159. (2)	199. (3)
40. (2)	80. (3)	120. (3)	160. (1)	200. (1)

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Answers & Solutions

CHEMISTRY

SECTION-A

1. Answer (3)

$$X_2 = \frac{n_2}{n_1+n_2} = \frac{1}{1+3} = \frac{1}{4}$$

$$\frac{P^o - P_1}{P^o} = X_2$$

$$\frac{P^o - P_1}{P^o} = \frac{n_2}{n_1+n_2}$$

$$P^o - P_1 = \frac{1}{4}P^o$$

$$P_1 = \frac{3}{4}P^o \Rightarrow \frac{P_1}{P^o} = \frac{3}{4}$$

2. Answer (2)

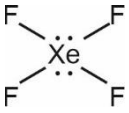
On dissolving non-volatile solute, the boiling point of solution, increases while melting point of solution decreases.

3. Answer (1)

N_2^+ : bond order = 2.5

O_2^- : bond order = 1.5

4. Answer (4)



XeF_4 has sp^3d^2 hybridisation and square planar shape.

5. Answer (3)

Atomic number (Z) = number of electrons = number of protons

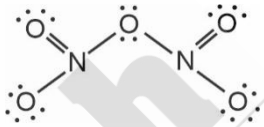
$\therefore$ Number of protons = number of electrons = 63

Number of neutrons = A – Z

= 152 – 63

= 89

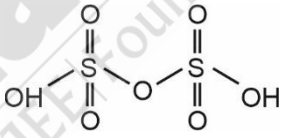
6. Answer (4)



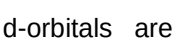
The covalency of nitrogen in N_2O_5 is 4.

7. Answer (3)

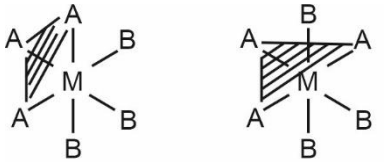
$H_2S_2O_7$ (oleum) contains S-O-S linkage



8. Answer (4)

- Tetrahedral complexes don't show geometrical isomerism because the relative positions of the unidentate ligands attached to the central metal atom are the same with respect to each other.
- $Zn^{2+} = 3d^{10}$ 

  Since all d-orbitals are filled completely, therefore it makes only outer orbital complexes.
- In metal carbonyls, (CO) ligand is directly coordinated with the metal by σ & π bonds and hence are organometallic compounds.
- $[MA_3B_3]$ shows fac-mer isomers as



Fac isomer Mer isomer

9. Answer (3)

The graph which has maximum area under the curve, represents maximum work done as –

$w = \int P\Delta V$

Graph (3) depicts pressure and change in volume to the highest.

$\therefore$ Maximum work is done in graph (3).

10. Answer (2)

Electron gain enthalpy of noble gases is positive.

Addition of e^- to an anion also is an endothermic process.

11. Answer (1)

2nd IE is always greater than 1st IE due to increased Z_{eff}.

12. Answer (2)

Deficiency of vitamin B_6 cause convulsions.

13. Answer (3)

Highest pH will be given by the salt which undergoes anionic hydrolysis

$CH_3COONa \rightarrow CH_3COO^- + Na^+$

$CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$

pH > 7 as OH^- ions are in the solution.

14. Answer (2)

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

  $\Delta n_g = 0$

  $K_p = K_c$

- $4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$

  $\Delta n_g = 1$

  $K_p = K_c (RT)$

- $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

  $\Delta n_g = -2$

  $K_p = K_c (RT)^{-2}$

- $2NO(g) + Cl_2(g) \rightleftharpoons 2NOCl(g)$

  $\Delta n_g = -1$

  $K_p = K_c (RT)^{-1}$

15. Answer (4)

H_2O is not gas at STP

Number of atoms $= \frac{18}{18} \times 3 \times N_A$

$= 3N_A$

16. Answer (3)

An empirical formula represents the simplest whole number ratio of various atoms present in a compound, whereas, the molecular formula shows the exact number of different types of atoms present in a molecule of a compound.

17. Answer (3)

$\frac{r_{340\,K}}{r_{300\,K}} = 2^{\frac{40}{10}} : 1$

$= 2^4 : 1$

$= 16 : 1$

18. Answer (2)

$FeCl_3 + [Fe(CN)_6]^{4-} \rightarrow \underset{\text{Prussian blue}}{Fe_4[Fe(CN)_6]_3}$

19. Answer (1)

$Cl^-(aq) + AgNO_3(aq) \rightarrow \underset{\text{White}}{AgCl\downarrow} + NO_3^-(aq)$

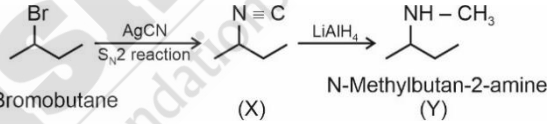
20. Answer (2)

Due to –I effect of '–Cl' $CH_2ClCOOH$ will be more acidic than CH_3COOH, so pK_a value of chloro acid decreases.

21. Answer (3)

CH_3CHO and CH_2ICHO will give yellow CHI_3 on reaction with I_2 + NaOH.

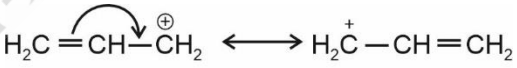
22. Answer (4)



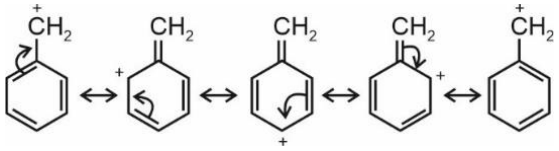
2-Bromobutane (X) N-Methylbutan-2-amine (Y)

23. Answer (3)

Allylic and benzylic carbocations are stabilised through resonance and show high reactivity towards S_N1 reaction.



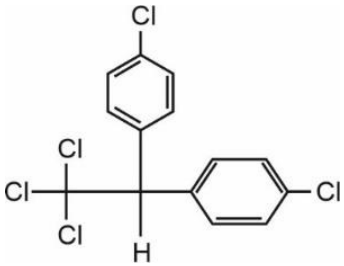
Allylic cation



Benzylic cation

24. Answer (2)

The correct structure of DDT is



p, p′ – Dichlorodiphenyltrichloroethane (DDT).

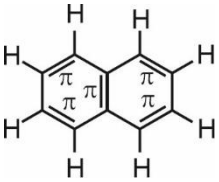
25. Answer (4)

The covalent character of hydroxides of lanthanoids **increases** as the size **decreases** from La^{3+} to Lu^{3+}. However the basic strength **decreases**.

$\therefore$ The correct order of basic strength is:

$Pr(OH)_3 > Tb(OH)_3 > Dy(OH)_3 > Er(OH)_3$

26. Answer (2)



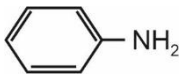
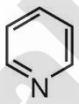
Total number of σ bonds = 19

Total number of π bonds = 5

Ratio – 19 : 5

27. Answer (3)

Kjeldahl's method is not applicable for estimation of nitrogen in the ring or nitrogen as nitro group or azo group.

So, it is applicable for $NH_2-\underset{\underset{O}{\|}}{C}-NH_2$ (urea),  (Aniline) and methanamine (CH_3NH_2) while not applicable for  (pyridine).

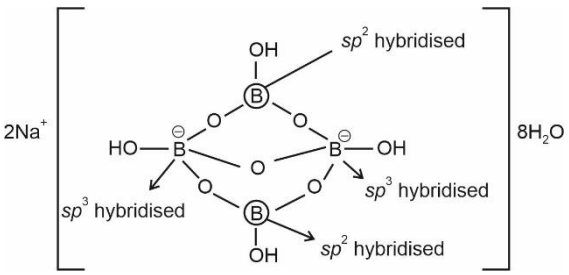
28. Answer (3)

$\overset{0}{K}+\overset{0}{O_2}\rightarrow \overset{+1}{K}\overset{-1/2}{O_2}$

29. Answer (4)

$E^\circ_{cell} = 0.80-(-0.13) = 0.93\ V$

30. Answer (1)

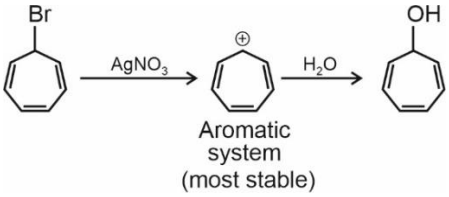


There is no banana bond in borax.

31. Answer (3)

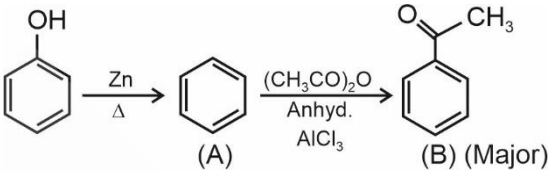
In DNA molecule, the sugar moiety is β-D-2-deoxyribose.

32. Answer (2)



Tropylium ion  is aromatic species hence, tropylium bromide reacts fastest with aqueous $AgNO_3$.

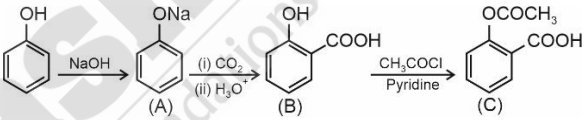
33. Answer (3)



34. Answer (2)

3° alcohols react fastest with $ZnCl_2$ and conc. HCl, as they form most stable carbocation.

35. Answer (2)



SECTION-B

36. Answer (4)

For A + B $\rightarrow$ Products

$Rate = PZ_{AB}e^{-E_a/RT}$

Z_{AB} = Collision frequency of reactants, A and B.

$e^{-E_a/RT}$ = Fraction of molecules with energies equal or greater than E_a.

37. Answer (2)

Order of reactivity towards nucleophiles is

$HCHO > CH_3CHO > C_6H_5CHO > CH_3COCH_3$

38. Answer (4)

$\Lambda^\circ_{NH_4Cl} = \Lambda^\circ_{(NH_4OH)} + \Lambda^\circ_{(NaCl)} - \Lambda^\circ_{(NaOH)}$

$\Lambda^\circ_{NH_4Cl} = z + y - x\ S\ cm^2\ mol^{-1}$

39. Answer (3)

	$CO(g)+$	$H_2O(g)\rightleftharpoons$	$CO_2(g)+$	$H_2(g)$
$t=0$	0.2 M	0.2 M	–	–
$t=t_{eq}$	$0.2-x$	$0.2-x$	x	x

$K_c = \dfrac{[CO_2]_{eq}[H_2]_{eq}}{[CO]_{eq}[H_2O]_{eq}}$

$K_c = \dfrac{x^2}{(0.2-x)^2}$

$$4 = \left(\frac{x}{0.2 - x}\right)^2$$

$$2 = \frac{x}{0.2 - x}$$

$0.4 - 2x = x$

$0.4 = 3x$

$$x = \frac{0.4}{3}$$

$$[CO]_{eq} = 0.2 - \frac{0.4}{3}$$

$$= \frac{0.6 - 0.4}{3}$$

$$= \frac{0.2}{3}$$

$= 0.067$ M

40. Answer (2)

SO_4^{2-} has sp^3 hybridisation and forms two π bonds.

As the *p* orbitals of sp^3 are involved in hybridisation. Two π bonds formed are $p\pi$-$d\pi$ bond.

41. Answer (3)

n = 4, l = 3 represents 4f orbitals.

f-subshell can have maximum of 14 e^-.

42. Answer (1)

At 369 K both α and β-sulphur are stable. This temperature is called transition temperature.

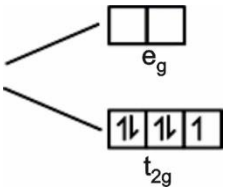
43. Answer (2)

$[Fe(CN)_6]^{3-}$

$Fe^{3+} = 3d^5\ 4s^0$

Since CN^- is a strong ligand,

$\therefore$ Pairing of five d-electrons will take place as



$\therefore$ Electronic configuration becomes $t_{2g}^5 e_g^0$ in octahedral complex.

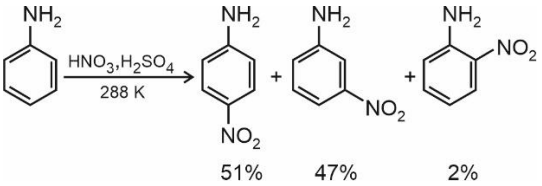
44. Answer (4)

As the process is isothermal, *i.e.*, temperature is constant. (For ideal gases)

We know $\Delta T = 0$

$\therefore \boxed{\Delta U = 0}$

45. Answer (1)



Aniline is protonated to anilinium ion, which is meta-directing. Hence significant amount of meta-derivative is also formed.

46. Answer (3)

Many Cu(I) compounds are unstable in aqueous solution and undergo disproportionation.

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

The stability of $Cu^{2+}(aq)$ rather than $Cu^+(aq)$ is due to the much more negative $\Delta_{hyd}H°$ of $Cu^{2+}(aq)$ than $Cu^+(aq)$, which more than compensates for the second ionisation enthalpy of Cu.

47. Answer (3)

The compounds having same molecular formula but different alkyl groups on either side of the functional group are called metamers & the phenomenon is called metamerism.

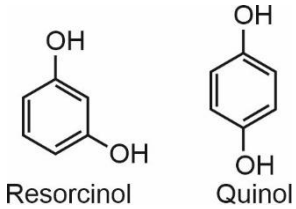
(i) $C_4H_{10}O \Rightarrow \underbrace{H_3C–O–C_3H_7 \text{ and } H_5C_2–O–C_2H_5}_{\text{Metamers}}$

(ii) $H_3C–O–CH_3 \Rightarrow$ Metamerism is not possible.

(iii) $CH_3 – CH_2 – O – CH_3 \Rightarrow$ Metamerism is not possible.

(iv) $C_5H_{12} \Rightarrow$ In absence of functional group metamerism is not possible.

48. Answer (4)



Resorcinol Quinol

49. Answer (4)

Magnitude of torsional strain depends upon the angle of rotation about C–C bond. This angle is also called dihedral angle or torsional angle.

50. Answer (3)

For electrochemical cells made up of same electrode.

$$E^o_{cell} = 0,\ E_{cell} = E^o - \frac{0.0591}{n}\log Q,\ E_{cell} = \frac{-0.0591}{n}\log Q$$

(a) $\underset{(0.1M)}{Zn}|Zn^{2+}||\underset{(0.01M)}{Zn^{2+}}|Zn$

$$E_{cell} = \frac{-0.0591}{2}\log\left(\frac{10^{-1}}{10^{-2}}\right)$$

E_{cell} = – 0.0295 V

(b) $\underset{(0.01M)}{Zn}|Zn^{2+}||\underset{(0.1M)}{Zn^{2+}}|Zn$

$$E_{cell} = \frac{-0.0591}{2}\log\left(\frac{10^{-2}}{10^{-1}}\right)$$

E_{cell} = + 0.0295 V

(c) $\underset{(0.1M)}{Zn}|Zn^{2+}||\underset{(0.1M)}{Zn^{2+}}|Zn$

$$E_{cell} = \frac{-0.0591}{2}\log\left(\frac{10^{-1}}{10^{-1}}\right)$$

E_{cell} = 0 V

(d) $\underset{(0.1M)}{Zn}|Zn^{2+}|\underset{(0.001M)}{Zn^{2+}}|Zn$

$$E_{cell} = \frac{-0.0591}{2}\log\left(\frac{10^{-1}}{10^{-3}}\right)$$

E_{cell} = – 0.0591 V

BOTANY

SECTION-A

51. Answer (1)

Na^+/K^+ pump allows the movement across the membrane against the concentration gradient.

52. Answer (4)

Mitochondria has 70S ribosomes.

53. Answer (3)

Centrosome is found in animal cells and absent in higher plant cells while the other cell organelles ER, mitochondria and ribosomes are found in animal cells as well as in plant cells.

54. Answer (2)

The final stage of meiotic prophase I is diakinesis and this is marked by terminalisation of chiasmata. Dissolution of synaptonemal complex and appearance of chiasmata occurs in diplotene stage. Crossing over occurs in pachytene stage.

55. Answer (4)

Bivalent is clearly appear as tetrad in pachytene stage. In pachytene stage, crossing over occurs with the help of enzyme recombinase.

56. Answer (4)

The bivalent chromosomes align on the equatorial plate in metaphase I of meiosis.

57. Answer (3)

The historic Convention on Biological Diversity ("The Earth Summit") held in Rio de Janeiro in 1992, called upon all the nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.

58. Answer (2)

The TCA cycle starts with the condensation of acetyl group with oxaloacetic acid and water to yield citric acid. It involves two successive steps of decarboxylation.

The continued oxidation of acetyl CoA via TCA cycle requires the continued replenishment of oxaloacetic acid.

59. Answer (4)

Turner's syndrome is caused due to the absence of one of the X chromosome, *i.e*. 45 with X0.

60. Answer (1)

The two alleles of a gene pair are located on homologous sites on homologous chromosomes.

61. Answer (3)

Bali, Javan and Caspian were subspecies of tiger. Quagga was not the subspecies of tiger.

62. Answer (2)

Phenylketonuria is inherited as an autosomal recessive trait. The affected individual lacks an enzyme that converts the amino acid phenylalanine into tyrosine.

63. Answer (4)

Based on observations regarding monohybrid cross, Mendel proposed law of dominance and law of segregation.

64. Answer (4)

Specificity decreases when we go from species to kingdom *i.e.*, the higher the category, lesser will be the number of similar characteristics of organisms belonging to that category.

For example *lupus*, *familiaris* and *aureus* belongs to genus *Canis* which shows more similarity than that of various group of related genera.

65. Answer (4)
In ascomycetes, asci are arranged in different types of fruiting bodies called ascocarps.

66. Answer (4)
Tobacco mosaic disease is caused by ssRNA virus.

67. Answer (3)
Pseudocarpic fruit is also known as false fruit because fruit formation occurs by other floral parts along with ovary, *e.g.,* apple, pear.

68. Answer (4)
In racemose inflorescence, the shoot axis continue to grow indefinitely and the flowers are borne in acropetal succession, i.*e*., young flowers at apex and older flowers at the base.
Examples- Radish, mustard.

69. Answer (3)
Plants that belongs to Solanaceae family are Tomato, Brinjal, Potato, Chilli, Belladonna, Tobacco, *Petunia*.

70. Answer (3)
In dicots, each stoma is composed of two bean shaped cells called guard cells which enclose stomatal pore but in grasses, guard cells are dumb-bell shaped.

71. Answer (4)
Tracheids have lignified wall thickenings. These are dead cells without protoplasm, elongated or tube like with tapering ends. These are present in angiosperms.

72. Answer (1)
Response of plants to the periods of light/dark is known as photoperiodism. The site of perception of light or dark duration are the leaves, for induction of flowering in plants.

73. Answer (2)
An event unique to flowering plants is double fertilization involving syngamy and triple fusion.

74. Answer (1)
Synergids having special cellular thickenings at the micropylar tip called filiform apparatus, which play an important role in guiding the pollen tubes into the synergid. Antipodal cells are present at the chalazal end in the mature embryo sac.

75. Answer (3)
The main plant body of pteridophyte is sporophyte and it is free living.

76. Answer (4)
Sex organs antheridia and archegonia are borne on same thalli in *Riccia* and on different thalli in *Marchantia.*

77. Answer (1)
Biogas consists of 50 – 70% methane,
20 – 30% CO_2, and
10% N_2, H_2 and H_2S

78. Answer (4)
Adaptation is an attribute of the organisms (morphological, physiological, behavioural) that enables the organism to survive and reproduce in its habitat. Body fluid of Antarctic fishes have antifreeze solutes. Kangaroo rat can concentrate its urine.

79. Answer (2)
Primary consumers are also known as key industry animals because they convert plant matter into animal matter.

80. Answer (3)

$$10N^{14}N^{14} \xrightarrow[N^{15}]{20\text{ min.}} 20N^{14}N^{15} \xrightarrow[N^{15}]{20\text{ min.}} 20N^{14}N^{15}$$

$$20N^{15}N^{15}$$

81. Answer (1)
DNA polymerase catalyzes the process of replication by considering both DNA strands as template. It utilises deoxyribonucleoside triphosphates as substrate.

82. Answer (2)
The *lac y* gene codes for permease, which increases permeability of the cell to β-galactosides.

83. Answer (3)
As carbon and nitrogen are present in both proteins and DNA thus, all the bacterial cells will show the radioactivity of both carbon and nitrogen.

84. Answer (1)
For each CO_2 molecule, 2ATP and 2NADPH are used during reduction phase of Calvin cycle. So 4ATP and 4NADPH will be used for the reduction phase of CO_2 fixation for 2 molecules of CO_2.

85. Answer (1)
Splitting of the water molecules takes place on the inner side of the thylakoid membrane.

SECTION-B

86. Answer (1)
Ribosome is the organelle that is common to both prokaryotic and eukaryotic cells. Ribosomes are made up of nucleic acids and proteins and found not only in the cytoplasm but also within other organelle as well. Smooth endoplasmic reticulum is involved in lipid synthesis.

87. Answer (2)

Recombination between homologous chromosomes is completed by the end of pachytene, leaving the chromosomes linked at the sites of crossing over.

88. Answer (1)

The gene '*I*' has three alleles I^A, I^B and *i*. The alleles I^A and I^B produce a slightly different form of the sugar while *i* does not produce any sugar.

89. Answer (3)

The value of RQ for fatty acid is less than 1.

90. Answer (2)

Bryophytes are the non-vascular terrestrial plants of moist habitat. They are the first embryophytes.

91. Answer (3)

Microbes involved in treatment of waste water are naturally present in sewage.

Flocs are masses of bacteria associated with fungal filaments to form mesh like structures.

92. Answer (3)

Commensalism is the interaction in which one species is benefitted and other is neither harmed nor benefitted.

Orchids growing on the branches of mango tree is an example of commensalism.

93. Answer (1)

Hydrarch succession occurs in aquatic habitat.

The successional series progress from hydric to mesic conditions. The correct sequence of seral community is as follows:

Submerged plant stage → Submerged free-floating plant stage → Reed-swamp stage → Marsh-meadow stage → Scrub stage.

94. Answer (3)

The bacterial pigments like bacteriochlorophyll, bacteriopurpurin and bacterioviridin are capable of entrapping solar energy and utilizing. It for the synthesis of complex food materials. It differs from plant photosynthesis as it does not liberate oxygen.

95. Answer (3)

Sunhemp is a member of Fabaceae family and its floral formula is $\%\,\Q\,K_{(5)}C_{1+2+(2)}A_{(9)+1}\underline{G}_1$ indicating five sepals, five petals, ten stamens, monocarpellary, superior ovary.

96. Answer (1)

- In dicot roots, vascular cambium is not present in the beginning so it is completely secondary in origin. It develops later at the time of secondary growth.
- Initially the cambial ring formed in dicot roots is wavy which later becomes circular.
- Pericycle cells which lie above the protoxylem form cambium.

97. Answer (3)

- Ethylene is a gaseous hormone which promotes internode elongation/petiole elongation in submerged rice plants.
- Ethylene induces flowering in mango.

98. Answer (2)

Large shield shaped cotyledon in monocots is called scutellum. The remains of second cotyledon is called epiblast, found in the seeds of some grasses.

99. Answer (2)

Prokaryotes have only one type of RNA polymerase.

100. Answer (3)

Chromosome Y has least number of genes (231).

ZOOLOGY

SECTION-A

101. Answer (2)

Repeated activation of the muscles can lead to the accumulation of lactic acid due to anaerobic breakdown of glycogen in them causing fatigue.

102. Answer (4)

'Saheli' is a non-steroidal preparation, developed at CDRI, Lucknow. It is 'once a week' pill with very few side effects and high contraceptive value.

103. Answer (4)

The forebrain of frog includes olfactory lobes, paired cerebral hemispheres and unpaired diencephalon. The midbrain is characterised by a pair of optic lobes.

104. Answer (1)

During pregnancy, a mucus plug is formed in the cervix due to secretion of thick mucus under the effect of progesterone and prevents foetus from vaginal infection. Yolk sac does not participate in the formation of placenta. The outer layer of blastomeres is called trophoblast. Inner cell mass is differentiated into embryo.

105. Answer (2)

Cardiac muscle fibres are striated, cylindrical, branched, involuntary and uninucleated.

They have intercalated discs which have gap junctions.

106. Answer (2)

The walls of blood vessels consists of three layers: an inner lining of squamous endothelium, the **tunica intima**, a middle layer of smooth muscle and elastic fibres, **the tunica media**, and an external layer of fibrous connective tissue with collagen fibres, the **tunica externa**.

107. Answer (3)

Steroidal oral contraceptive pills are made of either progestogens or progestogen-estrogen combinations. They have to be taken daily for a period of 21 days. They alter the quality of cervical mucus to prevent or retard entry of sperms.

108. Answer (4)

Bryophytes are evolved from chlorophyte ancestors while horsetails, ferns, Ginkgo's, conifers, gnetales and progymnosperms are evolved from Psilophyton.

109. Answer (3)

Red muscle fibres are dark red in colour due to the presence of high quantity of myoglobin. They possess more number of mitochondria and less sarcoplasmic reticulum.

110. Answer (2)

The first successful clinical gene therapy was given to a four year old girl with deficiency of adenosine deaminase. ADA enzyme is crucial for the function of immune system.

111. Answer (3)

100 mL of deoxygenated blood delivers 4 mL CO_2.

1 mL = $\frac{4}{100}$ mL CO_2

4 L or 4000 mL = $\frac{4}{100} \times 4000$

= 160 mL of CO_2.

112. Answer (3)

The renal tubule begins with a double walled cup-like structure called Bowman's capsule, which encloses the glomerulus. Glomerulus along with Bowman's capsule is called the Malpighian body or renal corpuscle.

113. Answer (1)

The diffusion membrane is made up of three major layers namely, the thin squamous epithelium of alveoli, the endothelium of alveolar capillaries and the basement substance in between them.

114. Answer (1)

A chemosensitive area is situated adjacent to the respiratory rhythm centre which is highly sensitive to CO_2 and hydrogen ions.

115. Answer (2)

The mode of action of implants/injections is similar to that of pills and their effective periods are much longer.

116. Answer (2)

According to Hardy-Weinberg equilibrium:

$p + q = 1$

$\because \quad p = 0.6 \Rightarrow q = 1 - 0.6 = 0.4$

Thus, $p^2 = 0.36$

$q^2 = 0.16$

$2pq = 0.48$

117. Answer (3)

According to Hugo deVries, mutation causes evolution and not the minor variations (heritable) that Darwin talked about.

Evolution for Darwin was gradual while deVries believed that mutation caused speciation and hence, called it saltation (single step large mutation).

According to Darwin, evolution is caused due to small and directional variations.

118. Answer (1)

The chorionic villi and uterine tissue become interdigitated with each other to form placenta which is the structural and functional unit between maternal body and developing embryo (foetus).

119. Answer (3)

Widal test is used for confirmation of typhoid fever. Techniques like radiography (use of X-rays), CT (Computed Tomography) and MRI (Magnetic Resonance Imaging) are very useful to detect cancers of the internal organs.

120. Answer (3)

After attachment of blastocyst with endometrium of uterus, the blastocyst becomes embedded in the endometrium of the uterus. This is called implantation and it leads to pregnancy.

121. Answer (2)

Vasa efferentia are 10-12 in number that arise from testes. They enter the kidneys on their side and open into the Bidder's canal.

122. Answer (3)

During resting conditions, the axonal membrane is comparatively more permeable to K^+ and nearly impermeable to Na^+. It is completely impermeable to negatively charged proteins present in axoplasm.

123. Answer (3)

Bt-toxin proteins exist as inactive protoxins and they are activated into the gut of insect due to alkaline pH. Most Bt-toxins are insect-group specific and they are digested in acidic medium within the stomach in humans.

124. Answer (4)

Natural cannabinoids are obtained from the inflorescence of the plant *Cannabis sativa*. The flower tops, leaves and the resin of cannabis plant are used in various combinations to produce marijuana, hashish, charas and ganja. Heroin is an opioid.

125. Answer (1)

Crocodilus belongs to the class Reptilia. Heart is usually three-chambered in reptiles but in crocodiles there is a four-chambered heart.

126. Answer (2)

hCG, hPL and relaxin are synthesized in human females only during pregnancy but progesterone is secreted after puberty in human females upto the menopause.

127. Answer (4)

The cerebrum wraps around a structure called thalamus, which is a major coordinating center for sensory and motor signaling. Hypothalamus is present at the base of thalamus. Cerebellum is a part of hindbrain.

128. Answer (3)

Digestive system is complete in arthropods, *Aascaris* and *Ancylostoma* but incomplete in *Pleurobrachia*.

129. Answer (3)

Recombinant DNA technology involves several steps in specific sequence such as:

a. Isolation of DNA

b. Fragmentation of DNA by RE

c. Isolation of a desired DNA fragment

d. Ligation of the DNA fragment into a vector

e. Transferring the rDNA into the host

f. Culturing of host cells in a medium at large scale

g. Extraction of the desired product.

130. Answer (1)

	Column I		**Column II**
(a)	Porifera		Presence of water canal system
(b)	Platyhelminthes		Organ level of organisation
(c)	Arthropoda		Triploblastic and coelomate
(d)	Echinodermata		Spiny-skinned invertebrates

131. Answer (2)

Exonucleases remove nucleotides from the ends of the DNA and they are not required in PCR.

132. Answer (1)

Hypothyroidism during pregnancy causes defective development and maturation of the growing baby leading to stunted growth (cretinism), mental retardness, low intelligence quotient, abnormal skin, deaf mutism, *etc*. Exopthalmic goitre is a form of hyperthyroidism and is also called the Graves' disease.

133. Answer (4)

Covalent bonds are present in fatty acids.

A fatty acid has a carboxyl group attached to an R group. The R group could be a methyl ($-CH_3$), or ethyl ($-C_2H_5$) or higher number of $-CH_2$ groups (1 carbon to 19 carbons).

For example, palmitic acid has 16 carbons including carboxyl group carbon. Arachidonic acid has 20 carbon atoms including the carboxyl carbon.

134. Answer (1)

1. Acidic amino acid – Glutamic acid
2. Basic amino acid – Lysine, arginine
3. Neutral amino acid – Valine

135. Answer (1)

All the elements present in a sample of Earth's crust are also present in a sample of living tissue. However, a closer examination reveals that the relative abundance of carbon and hydrogen with respect to other elements is higher in any living organism than in Earth's crust.

SECTION-B

136. Answer (1)
Synovial joints are characterised by the presence of a fluid filled synovial cavity between the articulating surfaces of two bones. Ball and socket joint is present between humerus and pectoral girdle as well as between femur and pelvic girdle (hip joint).
Knee joint is an example of hinge joint.
Saddle joint is present between carpal and metacarpal of human thumb.

137. Answer (4)
PTH is a hypercalcemic hormone, *i.e*., it increases the blood Ca^{2+} levels.
Thyrocalcitonin hormone released by thyroid gland is a hypocalcemic hormone, *i.e.*, it decreases the blood Ca^{2+} levels.

138. Answer (2)
Salpa – Urochordata
Chelone – Reptilia
Petromyzon – Cyclostomata
Felis – Mammalia

139. Answer (3)
Ramachandran plot is used to confirm the structure of protein.
Adenine and guanine are purines
Lecithin is an example of a phospholipid.

140. Answer (3)
Bones have hard and non-pliable ground substance rich in calcium salts and collagen fibres which give bone its strength.

141. Answer (1)
The chronological order of human evolution from the older to recent is
Ramapithecus → *Australopithecines* → *Homo habilis* → *Homo erectus* → Neanderthal man → Modern *Homo sapiens*

142. Answer (1)
- The Schwann cells form myelin sheath in the PNS and oligodendrocytes form myelin sheath in the CNS.
- Astrocytes are star shaped cells which are a type of neuroglia and provide support to neurons.
- Neurolemmocyte is the other name of Schwann cells.

143. Answer (2)
Each restriction endonuclease functions by inspecting the length of DNA sequence. They are also called molecular scissors.
Ligases are called molecular glue.

144. Answer (1)
- There is always a time-lag between the infection and appearance of AIDS symptoms. This period may vary from a few months to many years (usually 5-10 years).
- Tobacco has been used by human beings for more than 400 years.
- Common cold is characterised by nasal congestion and discharge *etc*, which usually lasts for 3-7 days.
- The period between 12-18 years of age may be thought of as adolescence period.

145. Answer (4)
Insulin used for diabetes mellitus was earlier extracted from pancreas of slaughtered cattle and pigs. Though, insulin from animal sources caused some patients to develop allergy or other type of reactions to the foreign protein. Insulin consists of two short polypeptide chains : chain A and B. In mammals including humans, insulin is synthesised as a pro-hormone. In 1983, Eli Lilly, an American company, prepared human insulin.

146. Answer (3)
Administration of IUDs within 72 hours of unprotected coitus have been found very effective as an emergency contraceptive as they could be used to avoid possible pregnancy due to rape or casual unprotected intercourse. IUDs make uterus unsuitable for implantation and the cervix hostile to the sperm.

147. Answer (4)
Network of threads called fibrins are formed by the conversion of inactive fibrinogens in the plasma by the enzyme thrombin.
Thrombins, in turn are formed from another inactive substance present in the plasma called prothrombin.

148. Answer (1)
Increase in breathing rate increases O_2 supply to tissues to compensate O_2 demand of the body. Neural system and endocrine system function in a synchronised fashion.

149. Answer (3)
Eco RV produces blunt ends.
The purified DNA precipitates after the addition of chilled ethanol.

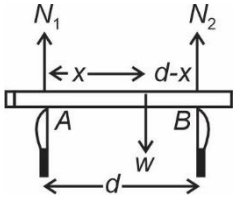
150. Answer (3)
When cut by the same restriction enzyme, the resultant DNA fragments have the same kinds of 'sticky ends' and these can be joined together using DNA ligases.

PHYSICS

SECTION-A

151. Answer (3)
- Light year is the unit of distance
- Any physical quantity is represented by $Q = nu$, so higher the unit lesser will be its magnitude.
- 1 nm = 10^{-9} m = 10^{-6} mm

152. Answer (3)



From FBD of rod :–

Taking torques about 'B'

$N_1(d) = W(d - x)$

$\therefore \quad N_1 = \dfrac{W(d-x)}{d}$

153. Answer (2)

We know,

$$\text{Compressibility } K = \frac{1}{B} = \frac{\Delta V/V}{\Delta P}$$

$\therefore \quad \dfrac{\Delta V}{V} = K\Delta P = Kh\rho g \qquad [\because P = h\rho g]$

$\dfrac{\Delta V}{V} = (45.4\times10^{-11})\,(10^3)\,(10)\,(2700)$

$\dfrac{\Delta V}{V} = 1.2258 \times 10^{-2}$

154. Answer (2)

We know, due to rotation of earth

$g' = g - R\omega^2\cos^2\theta$

$\therefore \quad g_{eq} = g - R\omega^2 \qquad [\because \cos0° = 1]$

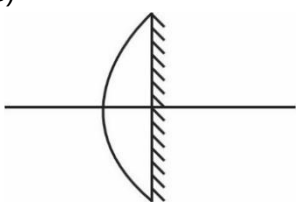
and $g_{poles} = g \qquad [\because \cos90° = 0]$

$\therefore \quad g_{eq} < g_{poles}$

155. Answer (1)

The role played by mass in translational mechanics is analogous to the role of moment of Inertia (Rotational inertia) in rotational mechanics

156. Answer (3)



$$\Rightarrow \quad \frac{1}{f_{eq}} = \frac{1}{f_m} - \frac{2}{f_L}$$

$$\Rightarrow \quad f_{eq} = \frac{-f_L}{2} = \frac{-40}{2} = -20 \text{ cm}$$

157. Answer (1)

$B_0 = \dfrac{E_0}{C}$

$B_0 = \dfrac{9\times10^4}{3\times10^8}$

$B_0 = 3 \times 10^{-4}$ T

158. Answer (4)

Concave mirror can produce real image for real object.

159. Answer (2)

$\tan\theta_P = \mu$

$\tan\theta_P = \sqrt{3}$

$\theta_P = \tan^{-1}\left(\sqrt{3}\right)$

$\theta_P = 60°$

160. Answer (1)

For, 0 – 4 s $\Rightarrow$ Slope of $v - t$ curve is constant

For, 4 – 6 s $\Rightarrow$ Slope of $v - t$ curve is zero

For, 6 – 8 s $\Rightarrow$ Slope of $v - t$ curve is constant and negative.

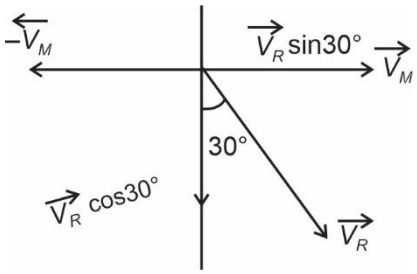
161. Answer (1)

Relative acceleration = Zero

Relative velocity = 5 m s^{-1}

$\Rightarrow$ Separation = 5 × 1 = 5 m

162. Answer (3)



For the rain to fall vertically w.r.t to man

$\left|\vec{V_M}\right| = \left|\vec{V_R}\sin30°\right|$

$= 20 \times \dfrac{1}{2}$

$= 10$ m s^{-1}

163. Answer (3)

Normal reaction is a pushing force while tension in string always pulls a body, it cannot push a body.

164. Answer (1)

Average translational Kinetic energy $\propto T$

$$\Rightarrow \frac{6.21\times10^{-21}}{x} = \frac{300}{600}$$

$$\Rightarrow x = 6.21 \times 2 \times 10^{-21}$$

$$= 12.42 \times 10^{-21} \text{ J}$$

165. Answer (3)

$Kx = 10$ N

$$K = \frac{10}{10^{-3}} \frac{\text{N}}{\text{m}} = 10^4 \text{ N m}^{-1}$$

$$W = \frac{1}{2} K x^2$$

$$= \frac{1}{2} \times 10^4 \times 4 \times 10^{-6}$$

$$= 2 \times 10^{-2} \text{ J}$$

$$= 20 \text{ mJ}$$

166. Answer (1)

Linear momentum is conserved and

$$KE = \frac{P^2}{2m_1} + \frac{P^2}{2m_2} = 2400 \text{ J}$$

$$\frac{P^2}{2}\left[1+\frac{1}{2}\right] = 2400 \text{ J}$$

$$\frac{P^2}{2} \times \frac{3}{2} = 2400 \text{ J} \Rightarrow P^2 = 3200$$

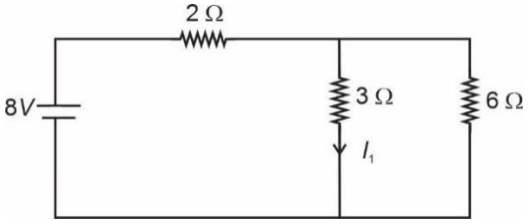
$$P = 40\sqrt{2} \text{ N s}$$

$$KE_1 = \frac{P^2}{2m_1} = \frac{3200}{2\times1} = 1600 \text{ J}$$

$$KE_2 = \frac{P^2}{2m_2} = \frac{3200}{4} \text{J} = 800 \text{ J}$$

167. Answer (1)

Current through inductor at steady state



$$I_1 = \frac{4}{3} \text{ A}$$

$$U = \frac{1}{2} \times 3 \times \left(\frac{4}{3}\right)^2 \text{ J}$$

$$= \frac{3}{2} \times \frac{16}{9} \text{ J}$$

$$= \frac{8}{3} \text{ J}$$

168. Answer (2)

$$Z = \sqrt{R^2 + X_C^{\ 2}}$$

$$Z = \sqrt{R^2 + \frac{1}{4\pi^2 f^2 C^2}}$$

169. Answer (3)

$T_1 = 927 + 273 = 1200$ K

$T_2 = 300$ K

$U \propto T, \quad \therefore \frac{U_1}{U_2} = \frac{T_1}{T_2}$

$$\frac{U_1 - U_2}{U_1} = \frac{T_1 - T_2}{T_1}$$

$$\Rightarrow \text{ \% change in energy} = \frac{1200-300}{1200} \times 100\%$$

$$= 75\%$$

170. Answer (2)

$\Delta Q = \Delta U + \Delta W$

for adiabatic process $\Delta Q = 0$

$\Delta U = -W$

$$P \propto \frac{1}{V^\gamma}, \quad T \propto \frac{1}{V^{\gamma-1}}$$

$\gamma > 1$, if volume increases then P and T will decrease.

171. Answer (1)

$W = S \times 8\pi R^2$

$= 4.8 \times 10^{-2} \times 8 \times 3.14 \times (4 \times 10^{-2})^2$

$= 1929.216 \times 10^{-6}$ J

$= 19.29 \times 10^{-4}$ J

172. Answer (3)

Case-1

$$\frac{\theta_1 - \theta_2}{t} = K\left[\frac{\theta_1 + \theta_2}{2} - \theta_0\right]$$

$$\frac{45-30}{30} = K\left[\frac{75}{2} - 20\right]$$

$$\frac{45-30}{30} = K\left[\frac{35}{2}\right]$$

$$K = \frac{1}{35}$$

Case-2

$$\frac{60-50}{t} = \frac{1}{35}\left[\frac{110}{2} - 20\right]$$

$$\frac{10}{t} = \frac{110-40}{2\times 35}$$

$$\frac{10}{t} = \frac{70}{2\times 35}$$

t = 10 minutes

173. Answer (3)

$$\frac{1}{2}mv^2_{max} = h\nu - h\nu_0$$

$$\frac{1}{2}m\,(6\times 10^5)^2 = h\,(9\nu_0 - \nu_0)$$

$$\frac{1}{2}m \times 36 \times 10^{10} = 8h\nu_0 \quad \text{__ (1)}$$

$$\frac{1}{2}mv_2^2 = h\,(3\nu_0 - \nu_0) = 2h\nu_0 \quad \text{__ (2)}$$

$$\frac{(1)}{(2)} \Rightarrow \frac{36\times 10^{10}}{v_2^2} = \frac{8}{2}$$

$v_2 = 3 \times 10^5$ m/s

174. Answer (3)

$$K\alpha = \left(\frac{A-4}{A}\right)Q$$

$$K\alpha = \left(\frac{200-4}{200}\right)4.6$$

$K\alpha$ = 4.5 MeV

175. Answer (2)

$$E = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{E_g} = \frac{12400}{0.5}\ \text{Å}$$

$\lambda = 2.48 \times 10^{-6}$ m

176. Answer (1)

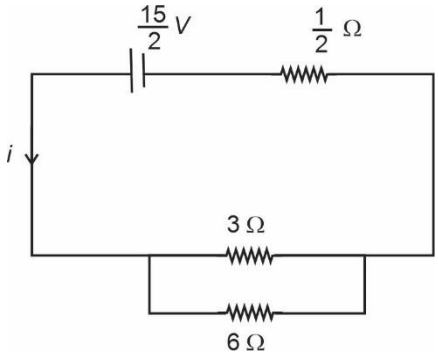
In n-type semiconductor electrons are majority carriers and it is electrically neutral.

177. Answer (1)

Both the batteries are in parallel combination

$$E_{eq} = \frac{\frac{E_1}{r_1} + \frac{E_2}{r_2}}{\frac{1}{r_1} + \frac{1}{r_2}} = \frac{\frac{10}{1} + \frac{5}{1}}{\frac{1}{1} + \frac{1}{1}} = \frac{15}{2}\ \text{V}$$

$$r_{eq} = \frac{1\times 1}{1+1} = \frac{1}{2}\ \Omega$$



$$R_{eq} = \frac{3\times 6}{3+6} = 2\ \Omega$$

$$i = \frac{V}{R} = \frac{\frac{15}{2}}{2+\frac{1}{2}} = \frac{\frac{15}{2}}{\frac{5}{2}}$$

i = 3 A

$\therefore$ current through 3 Ω resistor

$$i' = 3 \times \frac{6}{9} = 2\ \text{A}$$

178. Answer (4)

$I = neA\,V_d$

$5 = 10^{25} \times 1.6 \times 10^{-19} \times \pi\,(1.5\times 10^{-3})^2 \times V_d$

$5 = 1.6 \times 10^6 \times \pi \times 2.25 \times 10^{-6} \times V_d$

$5 = 11.3 \times V_d$

$$V_d = \frac{5}{11.3} = 44.2\ \text{cm/s}$$

179. Answer (1)

Inside a long solenoid, magnetic field lines are in the form of straight lines.

180. Answer (3)

- A charged particle must have variable speed in presence of uniform electric field only
- A charged particle must have constant speed in presence of magnetic field only
- A charged particle may have constant speed in presence of combined electric and magnetic fields.

181. Answer (4)

Magnetic susceptibility (χ) is positive for paramagnetic and ferromagnetic materials.

182. Answer (1)

Frequency of sound wave increases with increase in temperature.

$\left(v \propto \sqrt{T} \propto f\right)$

183. Answer (4)

Average acceleration = $\frac{\Delta v}{\Delta T}$

$= \frac{0}{T}$

$= 0$

184. Answer (4)

Due to symmetry, net electric field is zero at centre.

185. Answer (3)

$C_{AB} = \frac{6}{3}$

$= 2\mu F$

SECTION-B

186. Answer (2)

[Pressure] = $[ML^{-1}T^{-2}]$

[Work] = $[ML^2T^{-2}]$

[Angular momentum] = $[ML^2T^{-1}]$

[Force] = $[ML^1T^{-2}]$

187. Answer (2)

We know,

$L = mr^2\omega$

$= 2 \times (0.6)^2 \times 12$

$= 8.64$ kg m^2 s^{-1}

188. Answer (2)

According to Kepler's law:

Planets revolve around sun in elliptical orbits. Thus statement (II) is incorrect.

189. Answer (2)

Fringe width $\propto \lambda$

$\lambda_R > \lambda_y$

$\therefore$ Less number of fringes will form on the screen

190. Answer (3)

$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_1} = \frac{2}{f_1}$

$\frac{1}{f} = \frac{2}{f_1} \Rightarrow f_1 = 2f$

191. Answer (2)

From FBD of man, $T - mg = ma \Rightarrow T = m$ (a + g)

In order to lift the block from ground, $T \geq Mg$

$\Rightarrow \; m(a + g) \geq Mg, \Rightarrow ma \geq (M - m)\, g$

$\Rightarrow \; a \geq \frac{(M-m)}{m} g$

$\Rightarrow \; a_{min} = \frac{(M-m)}{m} g$

192. Answer (2)

$\eta = \frac{P_0}{P_{in}} = \frac{V_s I_S}{V_P I_P}$

$0.8 = \left(\frac{V_s}{V_P}\right)\left(\frac{I_s}{I_P}\right)$

$0.8 = \left(\frac{100}{I_P}\right)\left(\frac{1}{20}\right)$

$I_P = \frac{1}{0.8} \times \frac{100}{20}$

$I_P = \frac{100}{16} = \frac{25}{4}$ A

$= 6.25$ A

193. Answer (1)

$V_A - I\,(1\Omega) + 15\text{ V} - L\frac{di}{dt} - V_B = 0$

$V_A - V_B - I\,(1\Omega) + 15\text{ V} = L\frac{di}{dt}$

$10 - 5 + 15 = L\frac{di}{dt}$

$20 = 5 \times \frac{di}{dt}$

$4 = \frac{di}{dt}$

194. Answer (3)

$\frac{1}{2}\rho_w v^2 = \rho_m gh$

$\frac{v^2}{2g} = 13.6 \times 13.6$

$v = \sqrt{13.6 \times 13.6 \times 2 \times 1000}$

$v = 272\sqrt{5}$ cm/s

195. Answer (1)

Latent heat of fusion is the quantity of heat required to convert unit mass of a substance from solid to liquid.

196. Answer (2)

$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

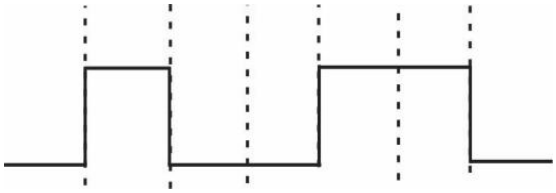
$n_1 = 3,\ n_2 = \infty$

$\frac{1}{\lambda} = 1.1 \times 10^7\left(\frac{1}{(3)^2}\right) = 1.2 \times 10^6$ m^{-1}

197. Answer (3)

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

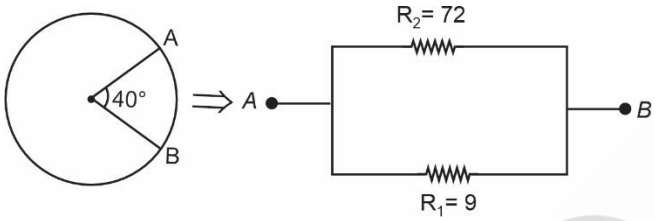
So, correct output waveform is



198. Answer (2)

Resistance $\propto$ (length)^2

$\frac{R'}{9} = \left(\frac{3\ell_0}{\ell_0}\right)^2 \Rightarrow R' = 9 \times 9 = 81\ \Omega$



$R_{eq} = \frac{R_1R_2}{R_1+R_2} = \frac{72\times9}{72\times9} = 8\ \Omega$

199. Answer (3)

$E_X = -4\hat{i}$

$E_y = 3\hat{j}$

$E_2 = -5\hat{k}$

$\vec{E} = -4\hat{i} + 3\hat{j} - 5\hat{k}$

$|\vec{E}| = \sqrt{4^2+3^2+5^2}$

$= 5\sqrt{2}$ N/C

200. Answer (1)

$F = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$

$F_1 = F_2 = \frac{q^2}{4\pi\varepsilon_0 a^2}$ and $\theta = 120^o$

$\therefore \quad F = \frac{q^2}{4\pi\varepsilon_0 a^2}$

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