PAPER : IIT-JAM 2012
BIOTECHNOLOGY-BT

INSTRUCTIONS:

(*i*) This test paper has a total of 100 questions.

(*ii*) Each question has **4 choices** for its answer : (a), (b), (c) and (d). Only **one** of them is the correct answer.

(*iii*) For each correct answer, you will be awarded **3 (three)** marks.

(*iv*) For each wrong answer, you will be awarded **–1 (Negative one)** mark.

(*v*) Multiple answers to a question will be treated as a wrong answer.

(*vi*) For each un-attempted question, you will be awarded **0 (zero)** mark.

1. The % base pair values of four nucleic samples are provided below. Which one of the following samples has the highest T_m?
   (a) A = 31; T = 21; G = 20; C = 28
   (b) A = 26; T = 14; G = 34; C = 26
   (c) A = 17; T = 19; G = 33; C = 31
   (d) A = 20; T = 30; G = 25; C = 25

2. Which one of the following is **TRUE** regarding organization of human chromosomes? It is made up of
   (a) histones that are acidic proteins
   (b) extra-chromosomal circular DNA
   (c) chromatin that consists of DNA and basic proteins
   (d) non-chromosomal DNA

3. The melting point of unsaturated fatty acid
   (a) is not related to the number of double bonds
   (b) increases with increase in the number of double bonds
   (c) is higher than that of its corresponding saturated fatty acid
   (d) decreases with increase in the number of double bonds

4. Match the hormones in Group I with the metabolic processes in Group II

 | **Group I** | **Group II** |
   |---|---|
   | **P.** Progesterone | **1.** Increases gluconeogenesis in liver |
   | **Q.** Glucagon | **2.** Implantation of fertilized ovum |
   | **R.** Insulin | **3.** Stimulates spermatogenesis process |
   | **S.** Androgen | **4.** Stimulates glucose uptake and storage |

   (a) **P-2, Q-1, R-4, S-3**
   (b) **P-3, Q-2, R-1, S-4**
   (c) **P-1, Q-4, R-2, S-3**
   (d) **P-1, Q-2, R-4, S-3**

5. The most abundant immunoglobulin in human blood is
   (a) IgM
   (b) IgA
   (c) IgD
   (d) IgG

6. The process of purification and recovery of a product in biotechnology is known as
   (a) upstream processing
   (b) downstream processing
   (c) incubation
   (d) formulation

7. If the velocity of an enzyme catalyzed reaction is 60% of v_{max}, then the ratio of substrate concentration [S] to Michaelis-Menton constant K_M is
   (a) 1
   (b) 1.5
   (c) 2
   (d) 4

8. In a DNA replication experiment, 1μg of ^{15}N DNA is allowed to replicate till two generations with ^{14}N DNA. The amount (in μg) of ^{14}N DNA formed during the second replication process is

    (a) 1   (b) 2   (c) 3   (d) 4

9. Transport activities in cell membranes are carried by _____; whereas fluidity of membranes is maintained by _____.

    (a) lipids; proteins   (b) proteins; nucleic acids

    (c) lipids; nucleic acids   (d) proteins; lipids

10. Nodules of leguminous plants are a good source for the isolation of bacteria capable of

    (a) nitrogen fixation   (b) carbon fixation

    (c) cellulase production   (d) amylase production

11. Which of the following statements regarding techniques and their applications is **NOT** correct?

    (a) Recombinant DNA Technology : cloning genes and expression for proteins

    (b) Enzyme Linked Immuno Sorbent Assay: recognize antigen and antibody interactions

    (c) Polymerase Chain Reaction: amplify specific DNA sequences

    (d) Western Blot: detect DNA is given samples

12. Addition of casein to solid media and picking up bacterial colonies that form clear zone is termed as

    (a) differential enrichment   (b) streaking

    (c) serial dilution   (d) selective enrichment

13. Leishmaniasis is transmitted by

    (a) sand fly   (b) tsetse fly   (c) rodent fly (d) mosquitoes

14. The binding of oxygen to hemoglobin is affected by

    (a) hemoglobin concentration   (b) partial pressure of oxygen

    (c) bicarbonate concentration   (d) 2, 3-biphosphoglyceric acid

15. The Human Genome Project was aimed for

    (a) DNA sequencing and DNA mapping (b) protein and DNA sequencing

    (c) protein sequencing and DNA mapping (d) RNA sequencing and genome database

16. In photosynthesis, the light energy is used to

    (a) generate low energy electrons   (b) produce ATP and NADPH

    (c) generate chlorophyll   (d) form water from oxygen

17. In gram staining of gram negative bacteria, the crystal violet-iodine complex formed will be washed away after addition of

    (a) safranin solution (b) ethyl acetate (c) water (d) alcohol

18. The oxidation of glycolate to glyoxylate during photorespiration occurs in

    (a) bundle sheath cells   (b) mesophyll cells

    (c) mesenchymal cells   (d) parenchymal cells

19. In higher plants, the light harvesting molecules are

    (a) vitamin D and cytochrome C   (b) cytochrome C and chlorophyll

    (c) anthocyanin and carotenoid   (d)   chlorophyll   and carotenoid

20. Match the cell organelles in Group I with their functions listed in Group II

    Group I | **Group II**

    P. Peroxisome | **1.** storage of starch granules

    Q. Mitochondria | **2.** detoxification

    R. Ribosome | **3.** proton gradient formation

    S. Leucoplast | **4.** protein synthesis

    (a) **P-3, Q-2, R-1, S-4** | (b) **P-2, Q-4, R-3, S-1**

    (c) **P-2, Q-3, R-4, S-1** | (d) **P-1, Q-3, R-4, S-2**

21. The effect of hypotonic solution on a plant cell and red blood cell are, respectively,

    (a) turgid and burst
    (b) shrink and burst
    (c) turgid and shrink
    (d) plasmolysed and burst

22. Which one of the following statements is **NOT** correct for the classification of carbohydrates?

    (a) Dihydroxyacetone and glyceraldehyde are trioses
    (b) Galactose and glucose are hexoses
    (c) Mannose and fructose are pentoses
    (d) Erythrose and threose are tetroses

23. The last stage of spermatozoa formation in spermatogenesis is

    (a) second meiotic division
    (b) first meiotic division
    (c) mitosis
    (d) differentiation

24. In plant tissue culture, differentiation of callus to root requires

    (a) high auxin and low cytokinin
    (b) low auxin and high cytokinin
    (c) low auxin and low cytokinin
    (d) high auxin and high cytokinin

25. Regenerative medicine aims at

    (a) discovering small molecules
    (b) generating therapeutic proteins
    (c) growing tissues and organs
    (d) identifying genetic mutations

26. Which of the following is **NOT** required in a Polymerase Chain Reaction?

    (a) DNA template
    (b) Mg^{++} ion
    (c) Primers
    (d) Restriction enzymes

27. Which one of the following processes allows introduction of gene of interest to a target site in genome?

    (a) Somatic embryogenesis
    (b) Organogenesis
    (c) Gene cloning
    (d) Southern

28. Based on the dissociation constant K_d, the protein - ligand pair that has the strongest interaction is

    (a) insulin and insulin receptor ($K_d = 1 \times 10^{-10}$)

    (b) avidin and biotin ($K_d = 1 \times 10^{-15}$)

    (c) HIV surface protein and anti-HIV IgG ($K_d = 4 \times 10^{-10}$)

    (d) calmodulin and calcium ($K_d = 3 \times 10^{-6}$)

29. In genetic code, the codon degeneracy occurs at _____ position (s)

    (a) first   (b) second   (c) third   (d) first and third

30. In pea plants, green pod color is dominant over yellow pod color. 1000 seeds taken from a pea plant germinated to produce 760 green pod plants and 240 yellow pod plants. The parental genotype and phenotype of the seed plants are

    (a) heterozygous and yellow   (b) homozygous and green

    (c) heterozygous and green   (d) homozygous and yellow

31. Which of the following is **FALSE** for DNA?

    (a) DNA strands do not contain Uracil

    (b) Two strands of DNA associate in parallel arrangement

    (c) Orientation of one strand is $3'$ to $5'$ and other strand is $5'$ to $3'$.

    (d) Ability of nucleotide in two strands to form specific base pairs is due to hydrogen bonds

32. In 2009, the swine flu outbreak was _____ in nature.

    (a) sporadic   (b) pandemic   (c) chronic   (d) endemic

33. In angiosperms, the microsporangia develops to form

    (a) stigma   (b) ovule   (c) endosperm   (d) pollen sacs

34. Given the pK_a values of different acidic sites in cysteine, the principal ionic form in which it exists at pH 7.0, is
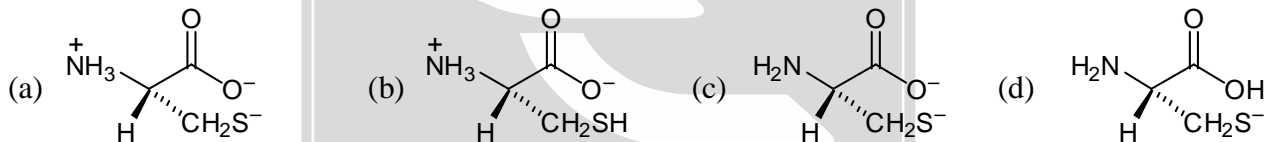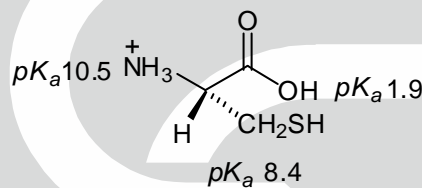
35. In _____ evolution, _____ anatomical structures develop in different directions to adapt different functions

    (a) convergent, homologous   (b)   divergent, homologous

    (c) convergent, analogous   (d) divergent, analogous

36. A model of gene control for the *lac* operon is shown below

I	P	O	Z	Y	A
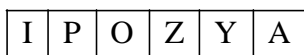
    Match the component of *lac* operon in Group I with the function listed in Group II

Group I	Group II
K. O	**1.** Encodes protein β-galactoside permease
L. P	**2.** Provides binding site for RNA polymerase
M. Y	**3.** Initiates *lac* mRNA synthesis
N. A	**4.** Encodes protein thiogalactoside transacetylase

    (a) **K-2, L-3, M-4, N-1**   (b) **K-3, L-2, M-4, N-1**

    (c) **K-3, L-2, M-1, N-4**   (d) **K-2, L-3, M-1, N-4**

37. Venkatraman Ramakrishnan was awarded noble prize in 2009 in chemistry for studying the structure and functions of
  (a) ribosome   (b) nucleosome   (c) spliceosome   (d) graphine

38. The formation of 3-phosphoglyceric acid from 1, 3-diphosphoglyceric acid in presence of phosphoglycerokinase is an example of
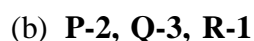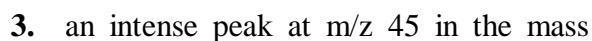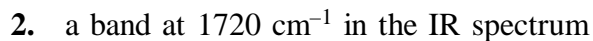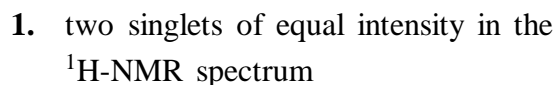 (a) substrate level phosphorylation   (b) oxidative phosphorylation
  (c) dehydrogenation   (d) isomerization

39. During replication helicase enzyme separates parental strands of DNA in physiological conditions. In a Polymerase Chain Reaction, the function of helicase is achieved by
  (a) taq polymerase   (b) high temperature   (c) primase   (d) Mg^{++} ions

40. In cats, white skin is dominant over grey, black eye is dominant over grey, and curl tail is dominant over straight. A cat homozygous for white skin, grey eye, curl tail mates with another cat homozygous for white skin, black eye, straight tail. What percentage of F1 generation will have white skin, black eye, curl tail phenotype?
  (a) 25%   (b) 100%   (c) 50%   (d) 75%

41. Which given pair of greenhouse gases has highest contribution towards global warming?
  (a) CO_2 and CH_4 (b) CO_2 and CFC   (c) CO_2 and N_2O (d) CFC and CH_4

42. The **INCORRECT** statement regarding second messenger, adenosine $3',5'$-cyclic nucleotide monophosphate (cAMP), is
  (a) it acts as a second messenger for many regulatory molecules
  (b) it acts as an intracellular second messenger in neurons
  (c) it activates specific cyclic nucleotide dependent protein kinases
  (d) it provides source of energy for cells

43. In lactic acid fermentation, lactate dehydrogenase gene becomes non-functional due to mutation. The product that will accumulate at the end of this process is
  (a) pyruvate   (b) lactic acid   (c) acetaldehyde   (d) ethyl alcohol

44. The deficiency of vitamin A in humans leads to
  (a) sterility   (b) rickets   (c) night blindness   (d) scurvy

45. 2-Butyne can be selectively reduced to *trans*-2-butene using
  (a) H_2, Pd/C   (b) H_2, $Pd/CaCO_3$, quinoline
  (c) $LiAlH_4$ (d) Na/liq. NH_3

46. The correct Fischer projection representation of the following compound, is
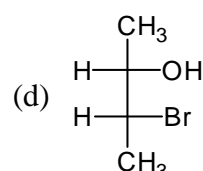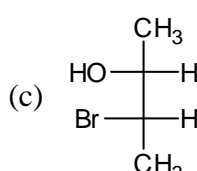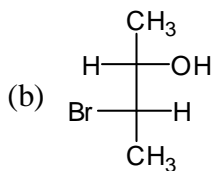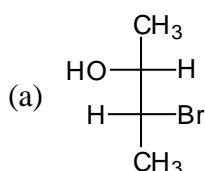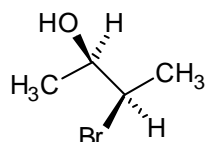
47. Match the compounds in Group I with their appropriate spectroscopic data in Group II.

   Group I   **Group II**

   P. CH_3COCH_3 **1.** two singlets of equal intensity in the ^1H-NMR spectrum

   Q. CH_3CH_2COOH **2.** a band at 1720 cm^{-1} in the IR spectrum

   R. CH_3COOCH_3 **3.** an intense peak at m/z 45 in the mass spectrum
   spectrum

   (a) **P-1, Q-2, R-3**   (b) **P-2, Q-3, R-1**

   (c) **P-1, Q-3, R-2**   (d) **P-2, Q-1, R-3**
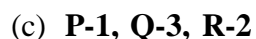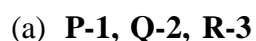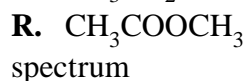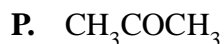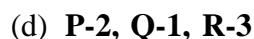
48. Among the following compounds, the one that is soluble in aqueous NaOH but not in aqueous $NaHCO_3$, is
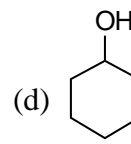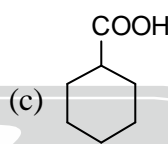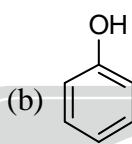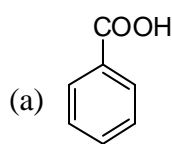
49. The major product of the following reaction sequence, is
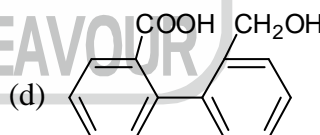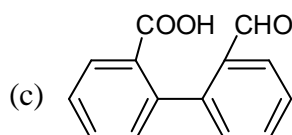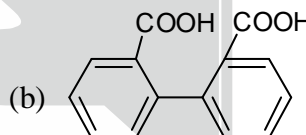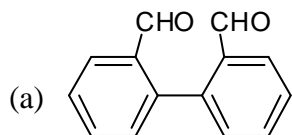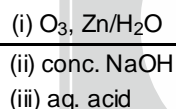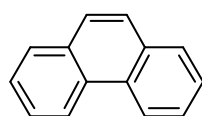
50. The major product formed in the E-2 elimination reaction of the following compound, is
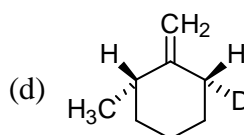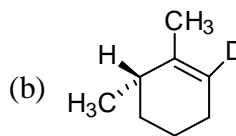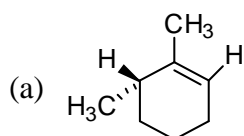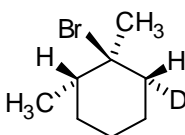
51. The most reactive diene towards Diels-Alder reaction, among the following, is

(a)   (b)   (c)   (d)
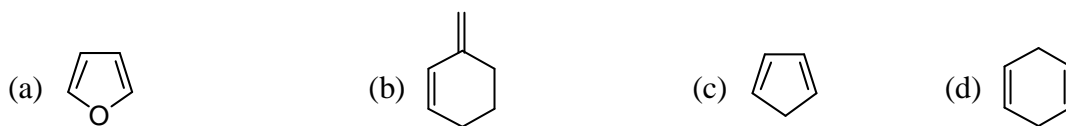
52. The correct structure of pyrophosphorus acid is

(a)   (b)

(c)   (d)
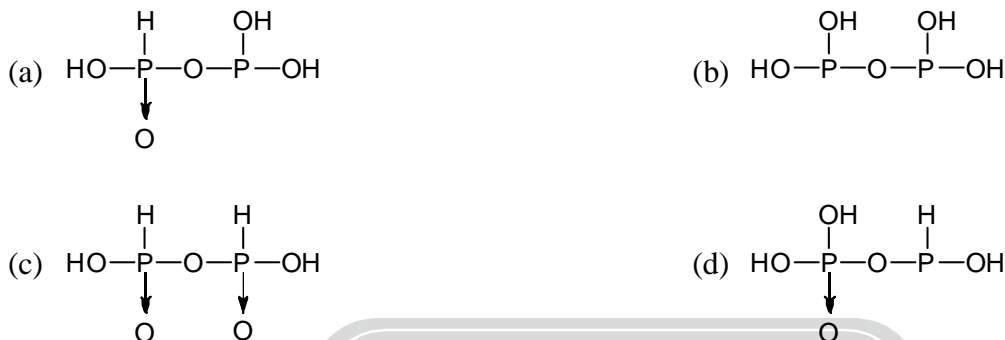
53. Among the following complexes, the one which exhibits optical isomerism, is (note: *en* = ethylenediamine)

(a) *cis*-[Co(en)$_2$Cl$_2$]$^+$ (b) *cis*-[Pt(NH$_3$)$_2$Cl$_2$]
(c) *trans*-[Co(en)$_2$Cl$_2$]$^+$ (d) *trans*-[Pt(NH$_3$)$_2$Cl$_2$]

54. The gas that is produced on treating NaCl with conc. H$_2$SO$_4$ is

(a) O$_2$ (b) Cl$_2$ (c) SO$_2$ (d) HCl

55. The correct order of the atoms in terms of their first ionization energy is

(a) Li < B < Be < C   (b) Li < Be < B < C
(c) Li > B > Be > C   (d) Li > Be > B > C

56. The compound with square planar geometry is

(a) [Ni(CO)$_4$]   (b) [Ni(CN)$_4$]$^{2-}$
(c) [Ni(PPh$_3$)$_2$Cl$_2$]   (d) [NiCl$_4$]$^{2-}$

57. Match the molecules in Group I with their shape in Group II

Group I   **Group II**
P. ICl$_2^-$ **1.** trigonal bipyramid
Q. H$_2$O   **2.** linear
R. PCl$_5$ **3.** V-shaped
                                     4. square pyramid

(a) **P-3, Q-2, R-4**   (b) **P-4, Q-3, R-1**
(c) **P-2, Q-3, R-1**   (d) **P-4, Q-3, R-2**

58. The spin-only magnetic moment of [Fe(CN)$_6$]$^{4-}$ is

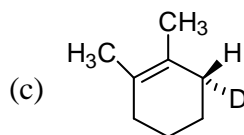(a) 4.9D   (b) 0D   (c) 5.92D   (d) 2.82D

59. One mole of a gas absorbs 40J of heat. If the work done on the surrounding by the gas is 20J, then ΔU (in J) for the gas is

(a) 60   (b) 20   (c) –20   (d) –60

60. For the reaction, $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, taking place in a closed container at a constant temperature, the rate constant k in terms of P_0(pressure at time $t = 0$) and P_t (pressure at time t) is given by

    (a) $\dfrac{1}{t}\ln\dfrac{P_0}{2P_0 - P_t}$ (b) $\dfrac{1}{t}\ln\dfrac{P_0}{P_t}$ (c) $\dfrac{1}{t}\ln\dfrac{P_0}{P_0 - P_t}$ (d) $\dfrac{1}{t}\ln\dfrac{P_0}{P_0 - 2P_t}$

61. pK_a of acetic acid is 4.80. A 10mL of 1M solution of acetic acid is mixed with 5mL of 1M solution of NaOH. The pH of the resulting solution is

    (a) 3.2   (b) 7.0   (c) 4.8   (d) 2.4

62. The series that corresponds to transition from higher levels to $n = 4$ in the hydrogen spectrum is

    (a) Paschen   (b) Balmer   (c) Pfund   (d) Brackett

63. For the reaction, $A \to product$, match the order of the reaction in Group I with their corresponding linear plots in Group II

Group I	Group II
P. Zero	**1.** ln[A] versus time
Q. First	**2.** 1/[A] versus time
R. Second	**3.** [A] versus time

    (a) **P-1, Q-2, R-3**   (b) **P-2, Q-1, R-3**

    (c) **P-3, Q-1, R-2**   (d) **P-1, Q-3, R-2**

64. If $E^{\Phi}_{Au^{3+}/Au^+} = -0.29V$ and $E^{\Phi}_{Fe^{3+}/Fe^{2+}} = 0.77V$, then E^{Φ} for the reaction

    $2Fe^{2+}(aq) + Au^{3+}(aq) \Leftrightarrow 2Fe^{3+}(aq) + Au^+(aq)$ is
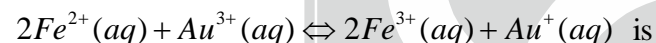
    (a) +1.06V   (b) –1.06V   (c) –0.48V   (d) –1.83V

65. The depth of a swimming pool filled with clean water (refractive index = 4/3) appears to be 3m to a person standing near it. Its actual depth is

    (a) 2.25m   (b) 4m   (c) 5.3m   (d) 9m

66. A semiconductor device that has two p-n junctions is

    (a) rectifier-diode   (b) photo-diode   (c) transistor   (d) solar-cell

67. The resolution of a microscope is directly proportional to the wavelength of the radiation used for its operation. Among the following, maximum possible resolution can be achieved from

    (a) optical microscope with blue light source

    (b) optical microscope with yellow light source

    (c) electron microscope operating at 100kV

    (d) electron microscope operating at 200kV

68. Longitudinal waves can travel through

    (a) gas only   (b) gas and liquid only

    (c) gas and solid only   (d) gas, liquid and solid

69. The waves, $y_1 = A\sin(\omega t + kx)$ and $y_2 = A\cos(\omega t + kx)$,

    (a) are in same phase   (b) have a phase difference of $\pi/4$

    (c) have a phase difference of $\pi/2$ (d) have a phase difference of π

70. A vertical spring is fixed at its upper end. Same sized blocks of wood (W), glass (G) and copper (Cu) are attached to its lower end one at a time and the system is set into vertical oscillations. The three measured time periods are in the order

    (a) $T_{Cu} > T_G > T_W$ (b) $T_W > T_G > T_{Cu}$

    (c) $T_G > T_{Cu} > T_W$ (d) $T_{Cu} > T_W > T_G$

71. A neutron collides head-on with a He-atom at rest. Collision is elastic and He-atom recoils with a speed of 2×10^5 m/s. Then, the initial speed of the neutron is
(a) 0.5×10^5 m/s
(b) 2×10^5 m/s
(c) 5×10^5 m/s
(d) 8×10^5 m/s

72. The two ends of a composite slab consisting of three layers of different thermal conductivities and different widths (as shown in figure) but **same length and breadth** are maintained at temperatures T_1 and T_2 $(T_1 > T_2)$. Then the heat flow rate through
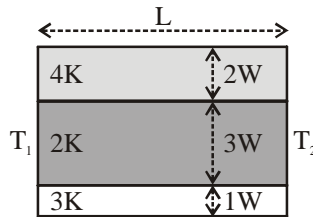
(a) all the three layers is same
(b) top layer is maximum
(c) middle layer is maximum
(d) bottom layer is maximum

73. Match the actions in Group II that will produce radiations listed in Group I

Group I	Group II
P. γ-rays	**1.** H-atom in 1st excited state returns to ground state
Q. UV radiation	**2.** A body at 600K emitting radiation
R. IR radiation	**3.** Fusion of two light nuclei

(a) **P-3, Q-1, R-2**
(b) **P-3, Q-2, R-1**
(c) **P-1, Q-3, R-2**
(d) **P-1, Q-2, R-3**

74. A rigid conducting wire PQ is moving on conducting rails (as shown in figure) with constant s p e e d $v = 6$m/s in a region of uniform field $B = 0.2$ Wb/m². The magnitude of induced *emf* and direction of induced current are
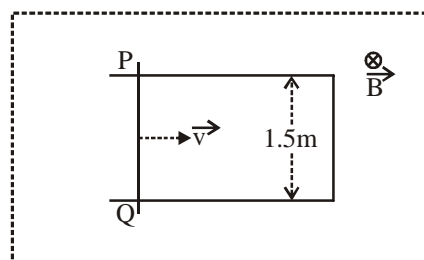
(a) 1.8 V, clockwise
(b) 1.8 V, anti-clockwise
(c) 3.6 V, clockwise
(d) 3.6 V, anti-clockwise

75. A ball is projected at 30º from ground with an initial velocity of 10 m/s. Taking $g = 10$ m/s², the horizontal range of the ball is
(a) 2.5m
(b) 5m
(c) 8.66m
(d) 10m

76. Consider equidistant points P, Q and R between two current carrying infinite straight parallel wires (as shown in figure) with current induced magnetic fields $\vec{B}_P, \vec{B}_Q$ and $\vec{B}_R$, respectively. Then
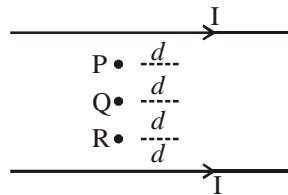
   (a) $\vec{B}_P = -\vec{B}_R$
   (b) $\vec{B}_P = \vec{B}_R$
   (c) $\left|\vec{B}_Q\right| \neq 0$
   (d) $\left|\vec{B}_P\right| > \left|\vec{B}_Q\right|$

77. An object weighs 50N on Earth (g = 10m/s²). Its mass on a planet having g = 2 m/s² will be
   (a) 1kg
   (b) 2.5kg
   (c) 5kg
   (d) 10kg

78. An 80W fan, a 60W bulb and a 500W washing machine are operated for 15, 20 and 1hr, respectively. The total electrical power units consumed are
   (a) 1.2
   (b) 1.7
   (c) 2.4
   (d) 2.9

79. An electron having a velocity $\vec{v}$ enters a region of uniform magnetic field $\vec{B}$ as shown in figure. The effect of $\vec{B}$ on the motion of electron is that it will
   (a) continue to move without any deflection
   (b) be reflected back
   (c) be deflected up
   (d) be deflected down

80. In the given circuit, an ideal battery of 15V and resistances of 4 ohm each are connected as shown below. The current (in amperes) through the ammeter A is
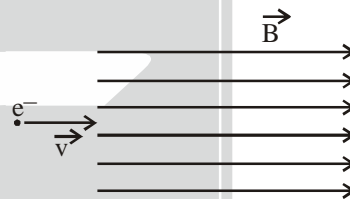
   (a) 18.8
   (b) 3
   (c) 2.5
   (d) 1.9

81. In a series LR circuit connected to an alternating source V_s, the measured voltage across L (ideal inductor) is 20V and across R is 15V. Then the value of V_s is
   (a) 20V
   (b) 25V
   (c) 30V
   (d) 35V

82. How does the electric field of a uniformly charged infinite metal sheet depend on the distance 'R' from the sheet?
   (a) R^{-2}
   (b) R^{-1}
   (c) $R^{-1/2}$
   (d) Independent of R

83. The value of $\int_{-1}^{1}(x|x|+x^4)dx$ is

   (a) 0
   (b) $\dfrac{1}{5}$
   (c) $\dfrac{2}{5}$
   (d) $\dfrac{2}{3}$

84. The radius of the circle $x^2 + y^2 - 4x - 6y + 4 = 0$ is
   (a) 2
   (b) 3
   (c) 4
   (d) 9

85. For a complex number z, $\overline{z}$ denotes its complex conjugate. Let $z_1 = x + iy$ and $z_2 = y + ix$ be two complex numbers such that $|z_1| = |z_2| = 1$. Then $\overline{z}_1 \overline{z}_2$ is equal to

   (a) $2xy - i$ (b) $2xy$ (c) $-i$ (d) i

86. If 1 and 2 are roots of $x^2 + px + q = 0$, then p and q, respectively, are
   (a) -3 and 2   (b) 2 and -3 (d) 3 and -2 (d) -2 and 3

87. The area of the region lying in the first quadrant bounded by the curve $y^2 = 4x$ and the line $x = 2$ is

   (a) $\dfrac{32}{3}$ (b) $\dfrac{8\sqrt{2}}{3}$ (c) $\dfrac{16}{3}$ (d) $\dfrac{2\sqrt{2}}{3}$

88. Let α and β be two real numbers. If a matrix $\begin{pmatrix} \alpha & \alpha \\ -1 & \beta \end{pmatrix}$ is symmetric and non-invertible, then

   $\alpha + \beta$ is equal to
   (a) 2   (b) 1   (c) 0   (d) -2

89. If the sum of the infinite series $1 + (1 + x) + \dfrac{(1+x)^2}{2!} + \dfrac{(1+x)^3}{3!} + \ldots$ is $e^{\frac{1}{2}}$, then x is

   (a) $-\dfrac{1}{2}$ (b) 0   (c) 1   (d) $\dfrac{1}{2}$

90. The minimum value of the function $f(x) = x^4 - 2x^2 + 2$ in $[-1, 2]$ is
   (a) 1   (b) 2   (c) 0   (d) -2

91. Two ants P and Q are initially at a distance 148m apart. They decide to meet. At the end of the first day, P covers a distance of 10m towards Q while Q covers a distance of 5m towards P. On each subsequent day, the distance covered by P reduces by 1m and that by Q increases by 2m of the previous day. The two ants will meet at the end of
   (a) 9th day   (b) 8th day   (c) 7th day   (d) 6th day

92. The equation of the line that makes an intercept of 2 with x-axis and is perpendicular to the line $x + y - 1 = 0$ is

   (a) $x + y - 2 = 0$ (b) $x + y + 2 = 0$ (c) $x - y - 2 = 0$ (d) $x - y + 2 = 0$

93. 3 Mathematics, 2 Physics and 2 Chemistry books, all 7 by different authors, are to be arranged on a book shelf such that all the books of the same subject are together on the shelf. The total number of possible arrangements is
   (a) 5040   (b) 720   (c) 144   (d) 24

94. If the point $(1, 0, 1)$ is one extremity of the diameter of the sphere

   $$x^2 + y^2 + z^2 + 2x - 4y + 2z - 6 = 0,$$

   then its other extremity is
   (a) $(1, 4, 1)$ (b) $(-3, 0, -3)$ (c) $(3, -4, 3)$ (d) $(-3, 4, -3)$

95. Let f be the function defined for real x as $f(x) = \begin{cases} \frac{x}{|x|}, & x \neq 0 \\ 1, & x = 0 \end{cases}$. Then, f is

    (a) continuous for all real x (b)   right continuous at $x = 0$

    (c) a non-negative function for all real x (d) left continuous at $x = 0$

96. An urn consists of 10 items out of which 4 are defective. Three items are chosen randomly from the urn. The probability that exactly 2 from the chosen items are defective, is

    (a) $\dfrac{1}{20}$ (b) $\dfrac{2}{3}$ (c) $\dfrac{7}{10}$ (d) $\dfrac{3}{10}$

97. The eccentricity of the ellipse $\dfrac{x^2}{16} + \dfrac{y^2}{9} = 1$ is

    (a) $\dfrac{3}{4}$ (b) $\dfrac{1}{2}$ (c) $\dfrac{\sqrt{7}}{3}$ (d) $\dfrac{\sqrt{7}}{4}$

98. Suppose the statement

    "If the flower smells sweet then I will buy it",

    is given to be **FALSE**. Then which one of the following is correct.

    (a) The flower does not smell sweet and I bought it

    (b) The flower does not smell sweet and I did not buy it

    (c) The flower smells sweet and I bought it

    (d) The flower smells sweet and I did not buy it

99. The values obtained in 20 throws of a die are given in the following frequency table

Value	1	2	3	4	5	6
Frequency	3	3	4	4	2	4

    The sample median is

    (a) 3   (b) 3.5   (c) 4   (d) 4.5

100. The equation of the normal to the curve $x^2 y^3 = 4$ at the point $(2, 1)$ is

    (a) $y = 3x - 5$ (b) $5y = 3x - 1$ (c) $3y = 5 - x$ (d) $5y = -x + 7$