

52. For the Zn-Cu cell,  $E^\circ = 1.10$  V. If the reduction potential of the  $\text{Cu}^{2+}(\text{aq})/\text{Cu}(\text{s})$  couple is 0.34 V, then that of the  $\text{Zn}^{2+}(\text{aq})/\text{Zn}(\text{s})$  couple is
- (A)  $-0.76$  V  
(B)  $0.76$  V  
(C)  $1.44$  V  
(D)  $1.10$  V
53. The geometry of the complex  $[\text{Ni}(\text{CN})_4]^{2-}$  is
- (A) Tetrahedral  
(B) Square planar  
(C) Octahedral  
(D) Distorted tetragonal
54. The increasing order of stability of  $\text{O}_2^{2-}$ ,  $\text{O}_2^-$ ,  $\text{O}_2$ ,  $\text{O}_2^+$  species is
- (A)  $\text{O}_2^+$ ,  $\text{O}_2^-$ ,  $\text{O}_2^{2-}$ ,  $\text{O}_2$   
(B)  $\text{O}_2^{2-}$ ,  $\text{O}_2^-$ ,  $\text{O}_2$ ,  $\text{O}_2^+$   
(C)  $\text{O}_2^-$ ,  $\text{O}_2^{2-}$ ,  $\text{O}_2$ ,  $\text{O}_2^+$   
(D)  $\text{O}_2^+$ ,  $\text{O}_2^{2-}$ ,  $\text{O}_2^-$ ,  $\text{O}_2$
55. The average distance of an electron from the nucleus in the ground state of hydrogen atom (in units of Bohr radius  $a_0$ ) is
- (A) 1  
(B) 2  
(C)  $3/2$   
(D)  $1/2$

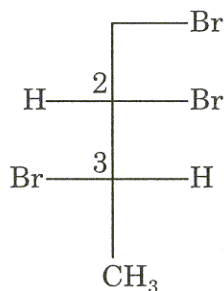
56. Phthalimide on treatment with base will undergo Hoffman rearrangement to give

- (A) aniline
- (B) benzylamine
- (C) 2-aminobenzoic acid
- (D) 3-aminobenzoic acid

57. Which one of the following compounds is *antiaromatic*?

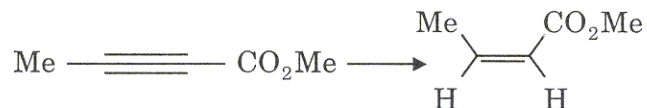
- (A) Cyclopentadiene
- (B) Cyclobutadiene
- (C) Azulene
- (D) Cycloheptatrienyl cation

58. Choose the correct absolute configuration for the following compound.



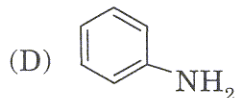
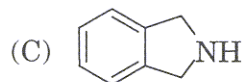
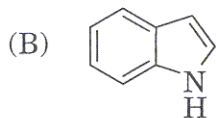
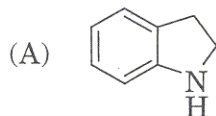
- (A)  $2R, 3R$
- (B)  $2S, 3R$
- (C)  $2S, 3S$
- (D)  $2R, 3S$

59. Nylon-6,6 is made from
- (A) caprolactam
  - (B) adipic acid and hexamethylenetetramine
  - (C) phenol and formaldehyde
  - (D) terephthalic acid and ethylene glycol
60. Which one of the following is not a heterocyclic amino acid?
- (A) Proline
  - (B) Tyrosine
  - (C) Histidine
  - (D) Tryptophan
61. Carbylamine test is usually carried out to confirm the presence of
- (A) nitro group
  - (B) primary amine
  - (C) secondary amine
  - (D) tertiary amine
62. The following reduction is best achieved by



- (A)  $\text{H}_2/\text{Pd-C}$
- (B)  $\text{H}_2/\text{Lindlar catalyst}$
- (C)  $\text{LiAlH}_4$
- (D)  $\text{Na/liq. NH}_3$

63. Which is the strongest base among the following compounds?



64. The correct match between **Group I** and **Group II** is

<b>Group I</b>	<b>Group II</b>
P. $\text{AlCl}_3$	1. Cope rearrangement
Q. Salicylaldehyde	2. $\text{S}_{\text{N}}2$ reaction
R. 2-Allylvinylether	3. Friedal-Crafts reaction
S. 2-bromobutane	4. Reimer-Teiman reaction
	5. Claisen rearrangement
	6. Kolbe reaction

(A) P-3, Q-5, R-1, S-2

(B) P-2, Q-4, R-5, S-6

(C) P-3, Q-4, R-1, S-2

(D) P-3, Q-4, R-5, S-2

65. Three lines  $y = 0$ ,  $y = x$  and  $x = -4$  constitute a triangle. Its area is

(A) 8 sq. units

(B) 16 sq. units

(C) - 8 sq. units

(D) - 16 sq. units

66. The order and degree of the differential equation

$$k = \frac{\left\{1 + \left(\frac{dy}{dx}\right)^2\right\}^{2/3}}{\frac{d^2y}{dx^2}}$$

are, respectively

- (A) 2, 2  
(B) 2, 3  
(C) 3, 2  
(D) 2, 4
67. For what value of  $p$ , the vectors  $2\mathbf{i} - \mathbf{j} + \mathbf{k}$ ,  $\mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$  and  $3\mathbf{i} + p\mathbf{j} + 5\mathbf{k}$  are coplanar?
- (A) 4  
(B) 0  
(C)  $22/5$   
(D)  $-4$
68. If  $f(x) = 3$ , when  $-3 \leq x \leq -1$   
 $= -6x - 3$ , when  $-1 \leq x \leq 0$   
 $= 3x - 3$ , when  $0 \leq x \leq 1$ ,
- then the values of  $x$  for which  $2f(x) + 3 = 0$  are
- (A)  $1/4, 1/2$   
(B)  $-1/4, 1/2$   
(C)  $1/4, -1/2$   
(D)  $-1/4, -1/2$

69. The values of  $x$  in the following equation are

$$[x \ 1] \begin{bmatrix} 1 & 0 \\ -4 & -3 \end{bmatrix} \begin{bmatrix} x \\ 5 \end{bmatrix} = 6$$

- (A) 7, -3  
(B) -7, 3  
(C) -7, -3  
(D) 7, 3
70.  $A$ ,  $B$  and  $C$  toss a coin in succession on the understanding that the first one to throw a head wins. The probability that  $C$  wins is

- (A)  $1/7$   
(B)  $2/7$   
(C)  $4/7$   
(D)  $1/8$

71. If  $x^y = e^{x-y}$ , then  $\frac{dy}{dx}$  is

- (A)  $\frac{\log x}{[\log(ex)]^2}$   
(B)  $\frac{\log x}{[\log(ex)]}$   
(C)  $\frac{x \log x}{[\log(ex)]^2}$   
(D)  $\frac{x \log x}{[\log(ex)]}$

72. The shortest distance between the lines

$$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4} \quad \text{and} \quad \frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5} \quad \text{is}$$

- (A)  $1/\sqrt{6}$
- (B)  $5/\sqrt{6}$
- (C)  $11/\sqrt{6}$
- (D)  $15/\sqrt{6}$

73. The curves  $2x^2 + 3y^2 = 1$  and  $px^2 + 6y^2 = 1$  intersect orthogonally if  $p$  is

- (A)  $1/3$
- (B)  $3$
- (C)  $4$
- (D)  $2/3$

74. If the profit function  $p(x) = 41 - 24x - 18x^2$ , then the maximum profit that a company can make is

- (A) 49
- (B) 65
- (C) 33
- (D) 17

75. A particle is in equilibrium under the action of three forces  $P$ ,  $Q$  and  $R$ . If the angle between  $P$  and  $Q$  is  $120^\circ$  and that between  $Q$  and  $R$  is  $135^\circ$ , then the ratio of their magnitudes  $P : Q : R$  is

- (A)  $2 : \sqrt{3} + 1 : \sqrt{6}$
- (B)  $2 : \sqrt{3} + 1 : \sqrt{2}$
- (C)  $\sqrt{6} : \sqrt{3} + 1 : 2$
- (D)  $2 : \sqrt{6} : \sqrt{3} + 1$

76. A man can throw a stone to a maximum distance of 50 m. The time in seconds for which the stone remains in the air is
- (A)  $\sqrt{(10/g)}$   
(B)  $5/\sqrt{g}$   
(C)  $10/\sqrt{g}$   
(D)  $5/(2\sqrt{g})$
77. If  $A + B = \pi/4$ , then  $(1 + \tan A)(1 + \tan B)$  is equal to
- (A) 1  
(B) 2  
(C)  $\sqrt{3}$   
(D) 0
78. If  $1, w, w^2$  are the cube roots of unity, then the value of  $(1 + w)^3 - (1 + w^2)^3$  is
- (A)  $2w$   
(B) 2  
(C)  $-2$   
(D) 0
79. If the arithmetic mean of the roots of a quadratic in  $x$  is 8 and geometric mean is 5, then the quadratic is
- (A)  $x^2 - 8x + 25 = 0$   
(B)  $x^2 - 16x + 5 = 0$   
(C)  $x^2 - 16x + 25 = 0$   
(D)  $x^2 - 8x + 5 = 0$



80. The sum of the binomial coefficients of the odd terms in the expansion of  $(1+x)^{50}$  is

- (A)  $2^{51}$
- (B)  $2^{50}$
- (C)  $2^{49}$
- (D) 0

81. If  $x = 3 + \frac{2^2}{2!} + \frac{2^3}{3!} + \frac{2^4}{4!} + \dots \infty$ , then  $1/x$  is equal to

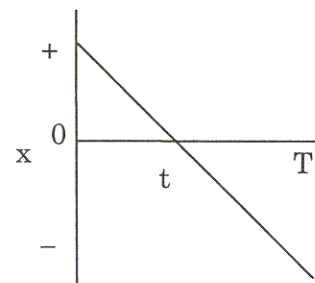
- (A)  $e^{-2}$
- (B)  $e^2$
- (C)  $e^{1/2}$
- (D)  $e^{-1/2}$

82. If  $\frac{{}^{n+2}C_8}{{}^{n-2}P_4} = \frac{1}{48}$ , then the value of  $n$  is

- (A) 7
- (B) 6
- (C) 5
- (D) 4

83. The displacement  $x$  of a particle as a function of time  $t$  is given in the figure. The acceleration of the particle is

- (A) always positive
- (B) always negative
- (C) always zero
- (D) positive during time 0 to  $t$  and negative during  $t$  to  $T$



84. A ball is dropped from a height of 20 m. After its impact with the ground, it rebounds with a velocity half of its velocity just before the impact. The maximum height reached after impact is

- (A) 20 m
- (B) 15 m
- (C) 10 m
- (D) 5 m

85. The electric potential at a distance  $r$ , far off from an electric dipole of moment  $p$ , is

(A)  $\frac{1}{4\pi\epsilon_0} \left( \frac{\vec{p} \cdot \vec{r}}{|\vec{r}|} \right)$

(B)  $\frac{1}{4\pi\epsilon_0} \left( \frac{\vec{p} \cdot \vec{r}}{|\vec{r}|^2} \right)$

(C)  $\frac{1}{4\pi\epsilon_0} \left( \frac{\vec{p} \cdot \vec{r}}{|\vec{r}|^3} \right)$

(D)  $\frac{1}{4\pi\epsilon_0} \left( \frac{\vec{p} \times \vec{r}}{|\vec{r}|^3} \right)$

86. An ideal heat engine operating between a source and an intermediate sink has 50% efficiency. Another ideal heat engine operating between this intermediate sink and a final sink has 40% efficiency. The efficiency of an ideal engine operating between the same source and same final sink is

- (A) 90%
- (B) 70%
- (C) 45%
- (D) 10%

87. A current of 20 A flows through a copper rod of diameter 2 cm. The magnetic field at a distance 5 mm from the axis of the rod is

(A)  $\frac{\mu_0}{2\pi} \times 10^3 \text{ T}$

(B)  $\frac{2\mu_0}{2\pi} \times 10^3 \text{ T}$

(C)  $\frac{4\mu_0}{2\pi} \times 10^3 \text{ T}$

(D)  $\frac{10\mu_0}{2\pi} \text{ T}$

88. A thin convex lens is placed between a mirror and an object in such a way that the image of the object falls on to itself. The separation between the object and the lens is 20 cm. Now, if another thin lens is placed between mirror and convex lens in contact with the convex lens, the object is to be moved by 10 cm away from convex lens in order that the image of the object falls on to itself. The new lens is a concave lens of focal length

(A) 10 cm

(B) 30 cm

(C) 40 cm

(D) 60 cm

89. The half life of two elements  $A$  and  $B$  is 5 and 15 yrs, respectively. If equal numbers of atoms of  $A$  and  $B$  are present in an alloy initially, then the time when the number of  $B$  atoms is twice that of  $A$  atoms is

(A) 2.5 yrs

(B) 7.5 yrs

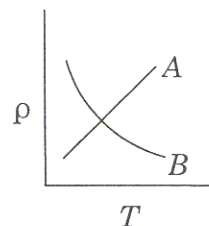
(C) 10 yrs

(D) 20 yrs

90. An optical fibre has a core of diameter  $20\ \mu\text{m}$  and refractive index 1.5. If the fibre has maximum entrance angle of  $\pm 60^\circ$ , the refractive index of the cladding is
- (A)  $\sqrt{2}/2$
  - (B)  $\sqrt{3}/2$
  - (C)  $\sqrt{6}/2$
  - (D)  $\sqrt{9}/2$
91. The SI unit of the permittivity of free space  $\epsilon_0$  is
- (A)  $\text{m}^{-3}\ \text{kg}^{-1}\text{s}^4\ \text{A}^2$
  - (B)  $\text{m}^{-2}\ \text{kg}^{-1}\text{s}^4\ \text{A}^2$
  - (C)  $\text{m}^{-3}\ \text{kg}^{-1}\text{s}^4\ \text{A}^{-2}$
  - (D)  $\text{m}^{-2}\ \text{kg}^{-1}\text{s}^4\ \text{A}^{-2}$
92. A meter bridge is used for the measurement of
- (A) length
  - (B) potential
  - (C) resistance
  - (D) current
93. The role of graphite in a nuclear reactor is
- (A) to increase the energy of neutrons
  - (B) to decrease the energy of neutrons
  - (C) to act as a catalyst in uranium fission
  - (D) to act as a source of neutron

94. In a PNP transistor, base is at a
- (A) lower potential than emitter
  - (B) higher potential than emitter
  - (C) lower potential than collector
  - (D) higher potential than both collector and emitter

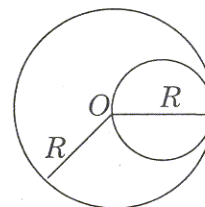
95. The variation of resistivity  $\rho$  as a function of temperature  $T$  is shown in the figure.



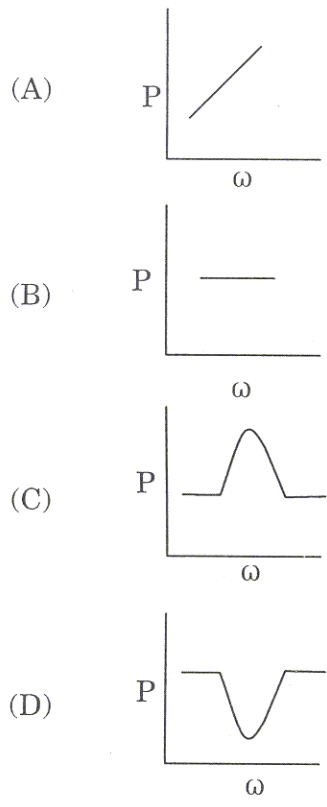
- (A) Curve  $A$  is for metal and  $B$  for a semiconductor
- (B) Curve  $A$  is for semiconductor and  $B$  for metal
- (C) Curve  $A$  is for undoped semiconductor and  $B$  for doped semiconductor
- (D) Curve  $A$  is for doped semiconductor and  $B$  for undoped semiconductor

96. A disk of mass  $m$  and radius  $R/2$  is attached to a disk of mass  $M$  and radius  $R$  as shown in the figure. The moment of inertia of the system about an axis passing through center of the bigger disk and perpendicular to the disk is

- (A)  $\frac{1}{2}MR^2 + \frac{3}{2}m(R/2)^2$
- (B)  $\frac{1}{2}MR^2 + \frac{1}{2}m(R/2)^2$
- (C)  $\frac{1}{2}(M + m)R^2$
- (D)  $(M + m)R^2$



97. A series LCR circuit is driven with a constant voltage ac source of variable frequency  $\omega$ . The power  $P$  dissipated in the circuit is graphically represented by



98. A series combination of two capacitors  $C_1$  and  $C_2$  is charged by a voltage source.  $C_1$  is then discharged through an electrolytic cell liberating  $m_1$  g of a metal. Now, the parallel combination of  $C_1$  and  $C_2$  is charged by the same source and  $C_1$  is discharged through the same cell liberating  $m_2$  g of the metal. The ratio  $m_1/m_2$  is

- (A)  $(C_1 + C_2)/C_1$
- (B)  $(C_1 + C_2)/C_2$
- (C)  $C_1/(C_1 + C_2)$
- (D)  $C_2/(C_1 + C_2)$

99. The intensity at the mid point on the line connecting two light sources has a maximum value of 36 units. At a point  $x$  distance (from the mid point) towards either source, it has a minimum value of 4 units. The intensity at a distance  $x/2$  is
- (A) 25 units
  - (B) 20 units
  - (C) 12 units
  - (D) 6 units
100. Two electric bulbs rated 120 W and 80 W are connected in series to mains (240 V) supply. The net power consumed is closest to
- (A) 200 W
  - (B) 80 W
  - (C) 50 W
  - (D) 40 W

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