

**MATHEMATICS**

**Section - A (Single Correct Answer)**

1. Let  $f : \mathbb{R} \rightarrow \mathbb{R}$  be a function given by  $f(x) = \begin{cases} \frac{1 - \cos 2x}{x^2} & , x < 0 \\ \alpha & , x = 0, \text{ where } \alpha, \beta \in \mathbb{R}. \text{ If } f \text{ is continuous} \\ \frac{\beta\sqrt{1 - \cos x}}{x} & , x > 0 \end{cases}$

at  $x = 0$ , then  $\alpha^2 + \beta^2$  is equal to :

- (A) 48                                      (B) 12                                      (C) 3                                      (D) 6
2. Three urns A, B and C contain 7 red, 5 black; 5 red, 7 black and 6 red, 6 black balls, respectively. One of the urn is selected at random and a ball is drawn from it. If the ball drawn is black, then the probability that it is drawn from urn A is :

- (A)  $\frac{4}{17}$                                       (B)  $\frac{5}{18}$                                       (C)  $\frac{7}{18}$                                       (D)  $\frac{5}{16}$

3. The vertices of a triangle are  $A(-1, 3)$ ,  $B(-2, 2)$  and  $C(3, -1)$ . A new triangle is formed by shifting the sides of the triangle by one unit inwards. Then the equation of the side of the new triangle nearest to origin is :

- (A)  $x - y - (2 + \sqrt{2}) = 0$                                       (B)  $-x + y - (2 - \sqrt{2}) = 0$   
 (C)  $x + y - (2 - \sqrt{2}) = 0$                                       (D)  $x + y + (2 - \sqrt{2}) = 0$

4. If the solution  $y = y(x)$  of the differential equation  $(x^4 + 2x^3 + 3x^2 + 2x + 2)dy - (2x^2 + 2x + 3)dx = 0$  satisfies  $y(-1) = -\frac{\pi}{4}$ , then  $y(0)$  is equal to :

- (A)  $-\frac{\pi}{12}$                                       (B) 0                                      (C)  $\frac{\pi}{4}$                                       (D)  $\frac{\pi}{2}$

5. Let the sum of the maximum and the minimum values of the function  $f(x) = \frac{2x^2 - 3x + 8}{2x^2 + 3x + 8}$  be  $\frac{m}{n}$ , where  $\text{gcd}(m, n) = 1$ . Then  $m + n$  is equal to :

- (A) 182                                      (B) 217                                      (C) 195                                      (D) 201

6. One of the points of intersection of the curves  $y = 1 + 3x - 2x^2$  and  $y = \frac{1}{x}$  is  $(\frac{1}{2}, 2)$ . Let the area of the

region enclosed by these curves be  $\frac{1}{24}(\ell\sqrt{5} + m) - n \log_e(1 + \sqrt{5})$ , where  $\ell, m, n \in \mathbb{N}$ . Then  $\ell + m + n$  is equal to

- (A) 32                                      (B) 30                                      (C) 29                                      (D) 31

7. If the system of equations

$$x + (\sqrt{2} \sin \alpha)y + (\sqrt{2} \cos \alpha)z = 0$$

$$x + (\cos \alpha)y + (\sin \alpha)z = 0$$

$$x + (\sin \alpha)y - (\cos \alpha)z = 0$$

has a non-trivial solution, then  $\alpha \in \left(0, \frac{\pi}{2}\right)$  is equal to :

- (A)  $\frac{3\pi}{4}$                       (B)  $\frac{7\pi}{24}$                       (C)  $\frac{5\pi}{24}$                       (D)  $\frac{11\pi}{24}$

8. There are 5 points  $P_1, P_2, P_3, P_4, P_5$  on the side AB, excluding A and B, of a triangle ABC. Similarly there are 6 points  $P_6, P_7, \dots, P_{11}$  on the side BC and 7 points  $P_{12}, P_{13}, \dots, P_{18}$  on the side CA of the triangle. The number of triangles, that can be formed using the points  $P_1, P_2, \dots, P_{18}$  as vertices, is :

- (A) 776                      (B) 751                      (C) 796                      (D) 771

9. Let  $f(x) = \begin{cases} -2, & -2 \leq x \leq 0 \\ x-2, & 0 < x \leq 2 \end{cases}$  and  $h(x) = f(|x|) + |f(x)|$ . Then  $\int_{-2}^2 h(x) dx$  is equal to :

- (A) 2                      (B) 4                      (C) 1                      (D) 6

10. The sum of all rational terms in the expansion of  $\left(2^{\frac{1}{5}} + 5^{\frac{1}{3}}\right)^{15}$  is equal to :

- (A) 3133                      (B) 633                      (C) 931                      (D) 6131

11. Let a unit vector which makes an angle of  $60^\circ$  with  $2\hat{i} + 2\hat{j} - \hat{k}$  and an angle of  $45^\circ$  with  $\hat{i} - \hat{k}$  be  $\vec{C}$ . Then

$$\vec{C} + \left(-\frac{1}{2}\hat{i} + \frac{1}{3\sqrt{2}}\hat{j} - \frac{\sqrt{2}}{3}\hat{k}\right) \text{ is :}$$

(A)  $-\frac{\sqrt{2}}{3}\hat{i} + \frac{\sqrt{2}}{3}\hat{j} + \left(\frac{1}{2} + \frac{2\sqrt{2}}{3}\right)\hat{k}$                       (B)  $\frac{\sqrt{2}}{3}\hat{i} + \frac{1}{3\sqrt{2}}\hat{j} - \frac{1}{2}\hat{k}$

(C)  $\left(\frac{1}{\sqrt{3}} + \frac{1}{2}\right)\hat{i} + \left(\frac{1}{\sqrt{3}} - \frac{1}{3\sqrt{2}}\right)\hat{j} + \left(\frac{1}{\sqrt{3}} + \frac{\sqrt{2}}{3}\right)\hat{k}$                       (D)  $\frac{\sqrt{2}}{3}\hat{i} - \frac{1}{2}\hat{k}$

12. Let the first three terms 2, p and q, with  $q \neq 2$ , of a G.P. be respectively the 7<sup>th</sup>, 8<sup>th</sup> and 13<sup>th</sup> terms of an A.P. If the 5<sup>th</sup> term of the G.P. is the n<sup>th</sup> term of the A.P., then n is equal to

- (A) 151                      (B) 169                      (C) 177                      (D) 163

13. Let  $a, b \in \mathbb{R}$ . Let the mean and the variance of 6 observations  $-3, 4, 7, -6, a, b$  be 2 and 23, respectively. The mean deviation about the mean of these 6 observations is :

(A)  $\frac{13}{3}$                       (B)  $\frac{16}{3}$

(C)  $\frac{11}{3}$                       (D)  $\frac{14}{3}$

14. If 2 and 6 are the roots of the equation  $ax^2 + bx + 1 = 0$ , then the quadratic equation, whose roots are  $\frac{1}{2a+b}$  and  $\frac{1}{6a+b}$ , is
- (A)  $2x^2 + 11x + 12 = 0$  (B)  $4x^2 + 14x + 12 = 0$   
 (C)  $x^2 + 10x + 16 = 0$  (D)  $x^2 + 8x + 12 = 0$
15. Let  $a$  and  $p$  be the sum and the product of all the non-zero solutions of the equation  $(\bar{z})^2 + |z| = 0$ ,  $z \in \mathbb{C}$ . Then  $4(\alpha^2 + \beta^2)$  is equal to :
- (A) 6 (B) 4 (C) 8 (D) 2
16. Let the point, on the line passing through the points  $P(1, -2, 3)$  and  $Q(5, -4, 7)$ , farther from the origin and at a distance of 9 units from the point  $P$ , be  $(\alpha, \beta, \gamma)$ . Then  $\alpha^2 + \beta^2 + \gamma^2$  is equal to :
- (A) 155 (B) 150  
 (C) 160 (D) 165
17. A square is inscribed in the circle  $x^2 + y^2 - 10x - 6y + 30 = 0$ . One side of this square is parallel to  $y = x + 3$ . If  $(x_i, y_i)$  are the vertices of the square, then  $\sum (x_i^2 + y_i^2)$  is equal to :
- (A) 148 (B) 156 (C) 160 (D) 152
18. If the domain of the function  $\sin^{-1}\left(\frac{3x-22}{2x-19}\right) + \log_e\left(\frac{3x^2-8x+5}{x^2-3x-10}\right)$  is  $(\alpha, \beta]$ , then  $3\alpha + 10\beta$  is equal to :
- (A) 97 (B) 100 (C) 95 (D) 98
19. Let  $f(x) = x^5 + 2e^{x^4}$  for all  $x \in \mathbb{R}$ . Consider a function  $g(x)$  such that  $(g \circ f)(x) = x$  for all  $x \in \mathbb{R}$ . Then the value of  $8g'(2)$  is :
- (A) 16 (B) 4 (C) 8 (D) 2
20. Let  $\alpha \in (0, \infty)$  and  $A = \begin{bmatrix} 1 & 2 & \alpha \\ 1 & 0 & 1 \\ 0 & 1 & 2 \end{bmatrix}$ . If  $\det(\text{adj}(2A - A^T) \cdot \text{adj}(A - 2A^T)) = 28$ , then  $(\det(A))^2$  is equal to :
- (A) 1 (B) 49 (C) 16 (D) 36

### SECTION-B

21. If  $\lim_{x \rightarrow 1} \frac{(5x+1)^{1/3} - (x+5)^{1/3}}{(2x+3)^{1/2} - (x+4)^{1/2}} = \frac{m\sqrt{5}}{n(2n)^{2/3}}$ , where  $\gcd(m, n) = 1$ , then  $8m + 12n$  is equal to \_\_\_\_\_
22. In a survey of 220 students of a higher secondary school, it was found that at least 125 and at most 130 students studied Mathematics; at least 85 and at most 95 studied Physics; at least 75 and at most 90 studied Chemistry; 30 studied both Physics and Chemistry; 50 studied both Chemistry and Mathematics; 40 studied both Mathematics and Physics and 10 studied none of these subjects. Let  $m$  and  $n$  respectively be the least and the most number of students who studied all the three subjects. Then  $m + n$  is equal to \_\_\_\_\_
23. Let the solution  $y = y(x)$  of the differential equation  $\frac{dy}{dx} - y = 1 + 4\sin x$  satisfy  $y(\pi) = 1$ . Then  $y\left(\frac{\pi}{2}\right) + 10$  is equal to \_\_\_\_\_

24. If the shortest distance between the lines  $\frac{x+2}{2} = \frac{y+3}{3} = \frac{z-5}{4}$  and  $\frac{x-3}{1} = \frac{y-2}{-3} = \frac{z+4}{2}$  is  $\frac{38}{3\sqrt{5}}k$  and  $\int_0^k [x^2] dx = \alpha - \sqrt{\alpha}$ , where  $[x]$  denotes the greatest integer function, then  $6\alpha^3$  is equal to \_\_\_\_\_
25. Let A be a square matrix of order 2 such that  $|A| = 2$  and the sum of its diagonal elements is  $-3$ . If the points  $(x, y)$  satisfying  $A^2 + xA + yI = 0$  lie on a hyperbola, whose transverse axis is parallel to the x-axis, eccentricity is  $e$  and the length of the latus rectum is  $\ell$ , then  $e^4 + \ell^4$  is equal to \_\_\_\_\_
26. Let  $a = 1 + \frac{{}^2C_2}{{}^3!} + \frac{{}^3C_2}{{}^4!} + \frac{{}^4C_2}{{}^5!} + \dots$   $b = 1 + \frac{{}^1C_0 + {}^1C_1}{{}^1!} + \frac{{}^2C_0 + {}^2C_1 + {}^2C_2}{{}^2!} + \frac{{}^3C_0 + {}^3C_1 + {}^3C_2 + {}^3C_3}{{}^3!} + \dots$  Then  $\frac{2b}{a^2}$  is equal to \_\_\_\_\_
27. Let A be a  $3 \times 3$  matrix of non-negative real elements such that  $A \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = 3 \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ . Then the maximum value of  $\det(A)$  is \_\_\_\_\_
28. Let the length of the focal chord PQ of the parabola  $y^2 - 12x$  be 15 units. If the distance of PQ from the origin is  $p$ , then  $10p^2$  is equal to \_\_\_\_\_
29. Let ABC be a triangle of area  $15\sqrt{2}$  and the vectors  $\overline{AB} = \hat{i} + 2\hat{j} - 7\hat{k}$ ,  $\overline{BC} = a\hat{i} + b\hat{j} + c\hat{k}$  and  $\overline{AC} = 6\hat{i} + d\hat{j} - 2\hat{k}$ ,  $d > 0$ . Then the square of the length of the largest side of the triangle ABC is \_\_\_\_\_
30. If  $\int_0^{\frac{\pi}{4}} \frac{\sin^2 x}{1 + \sin x \cos x} dx = \frac{1}{a} \log_e \left( \frac{a}{3} \right) + \frac{\pi}{b\sqrt{3}}$ , where  $a, b \in \mathbb{N}$ , then  $a + b$  is equal to \_\_\_\_\_

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**PHYSICS**
**Section - A (Single Correct Answer)**


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31. An electron is projected with uniform velocity along the axis inside a current carrying long solenoid. Then:
- (A) the electron will be accelerated along the axis.  
 (B) the electron will continue to move with uniform velocity along the axis of the solenoid.  
 (C) the electron path will be circular about the axis.  
 (D) the electron will experience a force at  $45^\circ$  to the axis and execute a helical path.
32. The electric field in an electromagnetic wave is given by  $\vec{E} = \hat{i}40 \cos \omega \left( t - \frac{z}{c} \right) \text{NC}^{-1}$ . The magnetic field induction of this wave is (in SI unit):
- (A)  $\vec{B} = \hat{i} \frac{40}{c} \cos \omega \left( t - \frac{z}{c} \right)$                       (B)  $\vec{B} = \hat{j}40 \cos \omega \left( t - \frac{z}{c} \right)$   
 (C)  $\vec{B} = \hat{k} \frac{40}{c} \cos \omega \left( t - \frac{z}{c} \right)$                       (D)  $\vec{B} = \hat{j} \frac{40}{c} \cos \omega \left( t - \frac{z}{c} \right)$

33. Which of the following nuclear fragments corresponding to nuclear fission between neutron ( ${}^1_0\text{n}$ ) and uranium isotope ( ${}^{235}_{92}\text{U}$ ) is correct:

- (A)  ${}^{144}_{56}\text{Ba} + {}^{89}_{36}\text{Kr} + 4{}^1_0\text{n}$  (B)  ${}^{140}_{56}\text{Xe} + {}^{94}_{38}\text{Sr} + 3{}^1_0\text{n}$   
 (C)  ${}^{153}_{51}\text{Sb} + {}^{99}_{41}\text{Nb} + 3{}^1_0\text{n}$  (D)  ${}^{144}_{56}\text{Ba} + {}^{89}_{36}\text{Kr} + 3{}^1_0\text{n}$

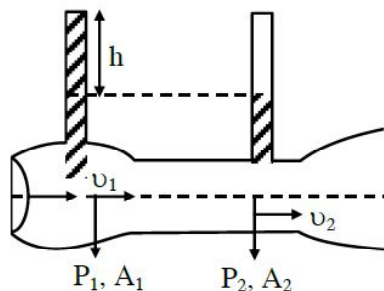
34. In an experiment to measure focal length ( $f$ ) of convex lens, the least counts of the measuring scales for the position of object ( $u$ ) and for the position of image ( $v$ ) are  $\Delta u$  and  $\Delta v$ , respectively. The error in the measurement of the focal length of the convex lens will be :

- (A)  $\frac{\Delta u}{u} + \frac{\Delta v}{v}$  (B)  $f^2 \left[ \frac{\Delta u}{u^2} + \frac{\Delta v}{v^2} \right]$  (C)  $2f \left[ \frac{\Delta u}{u} + \frac{\Delta v}{v} \right]$  (D)  $f \left[ \frac{\Delta u}{u} + \frac{\Delta v}{v} \right]$

35. Given below are two statements :

**Statement I :** When speed of liquid is zero everywhere, pressure difference at any two points depends on equation  $P_1 - P_2 = \rho g (h_2 - h_1)$

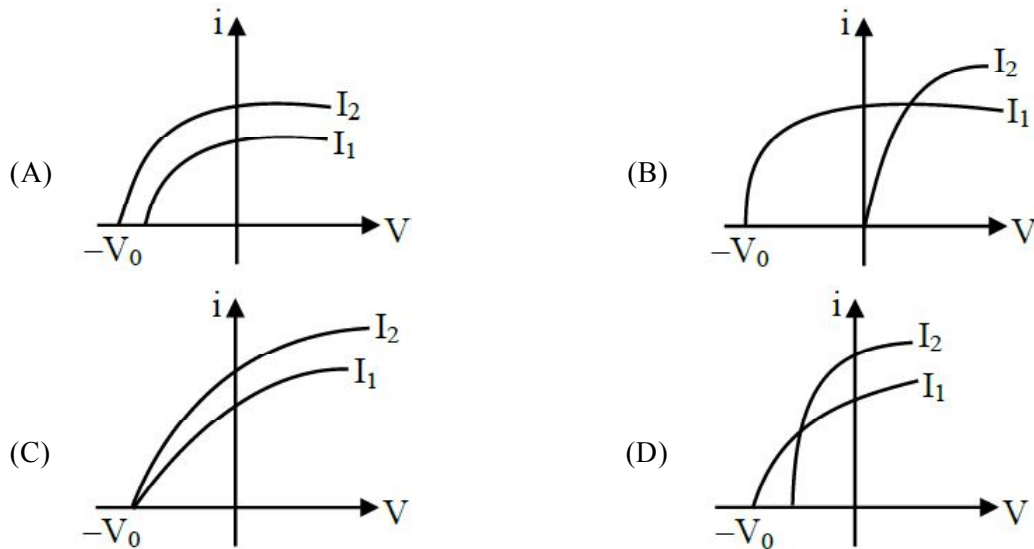
**Statement II :** In ventury tube shown  $2gh = v_1^2 - v_2^2$



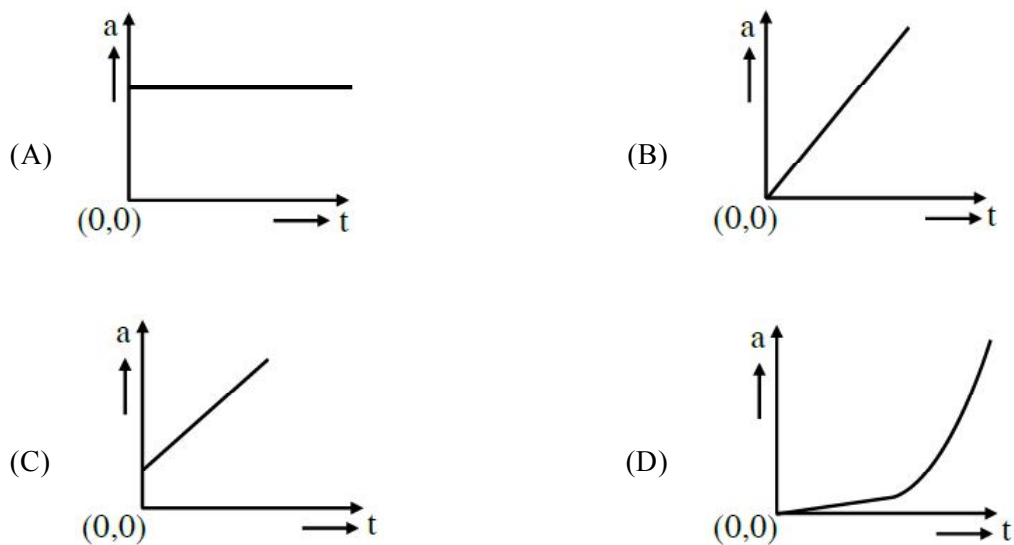
In the light of the above statements, choose the most appropriate answer from the options given below.

- (A) Both Statement I and Statement II are correct.  
 (B) Statement I is incorrect but Statement II is correct.  
 (C) Both Statement I and Statement II are incorrect.  
 (D) Statement I is correct but Statement II is incorrect.
36. The resistances of the platinum wire of a platinum resistance thermometer at the ice point and steam point are  $8 \Omega$  and  $10 \Omega$  respectively. After inserting in a hot bath of temperature  $400^\circ\text{C}$ , the resistance of platinum wire is :
- (A)  $2 \Omega$  (B)  $16 \Omega$  (C)  $8 \Omega$  (D)  $10 \Omega$
37. A metal wire of uniform mass density having length  $L$  and mass  $M$  is bent to form a semicircular arc and a particle of mass  $m$  is placed at the centre of the arc. The gravitational force on the particle by the wire is:
- (A)  $\frac{GMm\pi}{2L^2}$  (B)  $0$  (C)  $\frac{GmM\pi^2}{L^2}$  (D)  $\frac{2GmM\pi}{L^2}$
38. On celcius scale the temperature of body increases by  $40^\circ\text{C}$ . The increase in temperature on Fahrenheit scale is:
- (A)  $70^\circ\text{F}$  (B)  $68^\circ\text{F}$  (C)  $72^\circ\text{F}$  (D)  $75^\circ\text{F}$
39. An effective power of a combination of 5 identical convex lenses which are kept in contact along the principal axis is  $25 \text{ D}$ . Focal length of each of the convex lens is :
- (A)  $20 \text{ cm}$  (B)  $50 \text{ cm}$  (C)  $500 \text{ cm}$  (D)  $25 \text{ cm}$

40. Which figure shows the correct variation of applied potential difference (V) with photoelectric current (I) at two different intensities of light ( $I_1 < I_2$ ) of same wavelengths :



41. A wooden block, initially at rest on the ground, is pushed by a force which increases linearly with time  $t$ . Which of the following curve best describes acceleration of the block with time :



42. If a rubber ball falls from a height  $h$  and rebounds upto the height of  $h/2$ . The percentage loss of total energy of the initial system as well as velocity ball before it strikes the ground, respectively, are :

- (A) 50%,  $\sqrt{\frac{gh}{2}}$       (B) 50%,  $\sqrt{gh}$       (C) 40%,  $\sqrt{2gh}$       (D) 50%,  $\sqrt{2gh}$

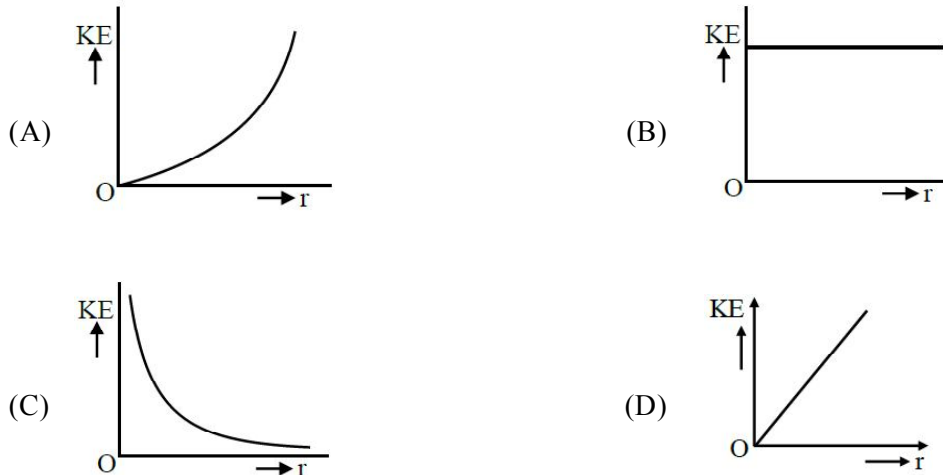
43. The equation of stationary wave is :

$$y = 2a \sin\left(\frac{2\pi nt}{\lambda}\right) \cos\left(\frac{2\pi x}{\lambda}\right)$$

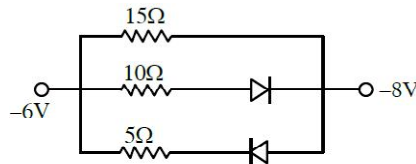
Which of the following is NOT correct

- (A) The dimensions of  $nt$  is [L]      (B) The dimensions of  $n$  is  $[LT^{-1}]$   
 (C) The dimensions of  $n/\lambda$  is [T]      (D) The dimensions of  $x$  is [L]

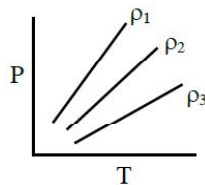
44. A body travels 102.5 m in  $n^{\text{th}}$  second and 115.0 m in  $(n + 2)^{\text{th}}$  second. The acceleration is :  
 (A)  $9 \text{ m/s}^2$                       (B)  $6.25 \text{ m/s}^2$                       (C)  $12.5 \text{ m/s}^2$                       (D)  $5 \text{ m/s}^2$
45. To measure the internal resistance of a battery, potentiometer is used. For  $R = 10 \Omega$ , the balance point is observed at  $l = 500 \text{ cm}$  and for  $R = 1 \Omega$  the balance point is observed at  $l = 400 \text{ cm}$ . The internal resistance of the battery is approximately :  
 (A)  $0.2 \Omega$                       (B)  $0.4 \Omega$                       (C)  $0.1 \Omega$                       (D)  $0.3 \Omega$
46. An infinitely long positively charged straight thread has a linear charge density  $\lambda \text{ Cm}^{-1}$ . An electron revolves along a circular path having axis along the length of the wire. The graph that correctly represents the variation of the kinetic energy of electron as a function of radius of circular path from the wire is :



47. The value of net resistance of the network as shown in the given figure is :



- (A)  $\left(\frac{5}{2}\right)\Omega$                       (B)  $\left(\frac{15}{4}\right)\Omega$                       (C)  $6\Omega$                       (D)  $\left(\frac{30}{11}\right)\Omega$
48. P-T diagram of an ideal gas having three different densities  $\rho_1, \rho_2, \rho_3$  (in three different cases) is shown in the figure. Which of the following is correct :

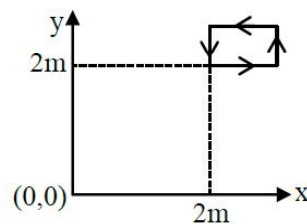


- (A)  $\rho_2 < \rho_3$                       (B)  $\rho_1 > \rho_2$                       (C)  $\rho_1 < \rho_2$                       (D)  $\rho_1 = \rho_2 = \rho_3$

49. The co-ordinates of a particle moving in x-y plane are given by :  
 $x = 2 + 4t, y = 3t + 8t^2$ .  
 The motion of the particle is :  
 (A) non-uniformly accelerated.  
 (B) uniformly accelerated having motion along a straight line.  
 (C) uniform motion along a straight line.  
 (D) uniformly accelerated having motion along a parabolic path.
50. In an ac circuit, the instantaneous current is zero, when the instantaneous voltage is maximum. In this case, the source may be connected to :  
 A. pure inductor. B. pure capacitor.  
 C. pure resistor. D. combination of an inductor and capacitor.  
 Choose the correct answer from the options given below :  
 (A) A, B and C only (B) B, C and D only  
 (C) A and B only (D) A, B and D only

**SECTION - B**

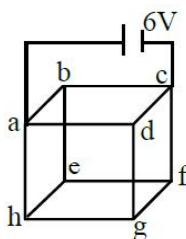
51. An infinite plane sheet of charge having uniform surface charge density  $+\sigma_s$  C/m<sup>2</sup> is placed on x-y plane. Another infinitely long line charge having uniform linear charge density  $+\lambda_c$  C/m is placed at  $z = 4$  m plane and parallel to y-axis. If the magnitude values  $|\sigma_s| = 2 |\lambda_c|$  then at point (0, 0, 2), the ratio of magnitudes of electric field values due to sheet charge to that of line charge is  $\pi \sqrt{n} : 1$ . The value of n is \_\_\_\_\_.
52. A hydrogen atom changes its state from  $n = 3$  to  $n = 2$ . Due to recoil, the percentage change in the wave length of emitted light is approximately  $1 \times 10^{-n}$ . The value of n is \_\_\_\_\_.  
 [Given  $Rhc = 13.6$  eV,  $hc = 1242$  eV nm,  $h = 6.6 \times 10^{-34}$  J s, mass of the hydrogen atom =  $1.6 \times 10^{-27}$  kg]
53. The magnetic field existing in a region is given by  $\vec{B} = 0.2(1 + 2x)\hat{k}$ T. A square loop of edge 50 cm carrying 0.5 A current is placed in x-y plane with its edges parallel to the x-y axes, as shown in figure. The magnitude of the net magnetic force experienced by the loop is \_\_\_\_\_ mN.



54. A alternating current at any instant is given by  $i = \left[ 6 + \sqrt{56} \sin \left( 100\pi t + \frac{\pi}{3} \right) \right]$  A. The rms value of the current is \_\_\_\_\_ A.



55. Twelve wires each having resistance  $2\Omega$  are joined to form a cube. A battery of 6 V emf is joined across point a and c. The voltage difference between e and f is \_\_\_\_\_ V.



56. A soap bubble is blown to a diameter of 7 cm. 36960 erg of work is done in blowing it further. If surface tension of soap solution is 40 dyne/cm then the new radius is \_\_\_\_\_ cm. Take :  $\left(\pi = \frac{22}{7}\right)$
57. Two wavelengths  $\lambda_1$  and  $\lambda_2$  are used in Young's double slit experiment  $\lambda_1 = 450$  nm and  $\lambda_2 = 650$  nm. The minimum order of fringe produced by  $\lambda_2$  which overlaps with the fringe produced by  $\lambda_1$  is n. The value of n is \_\_\_\_\_.
58. An elastic spring under tension of 3 N has a length a. Its length is b under tension 2 N. For its length  $(3a - 2b)$ , the value of tension will be \_\_\_\_\_ N.
59. Two forces  $\vec{F}_1$  and  $\vec{F}_2$  are acting on a body. One force has magnitude thrice that of the other force and the resultant of the two forces is equal to the force of larger magnitude. The angle between  $\vec{F}_1$  and  $\vec{F}_2$  is  $\cos^{-1}\left(\frac{1}{n}\right)$ . The value of |n| is \_\_\_\_\_.
60. A solid sphere and a hollow cylinder roll up without slipping on same inclined plane with same initial speed v. The sphere and the cylinder reaches upto maximum heights  $h_1$  and  $h_2$ , respectively, above the initial level. The ratio  $h_1 : h_2$  is n/10. The value of n is \_\_\_\_\_.

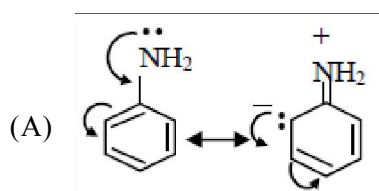
## CHEMISTRY

### Section - A (Single Correct Answer)

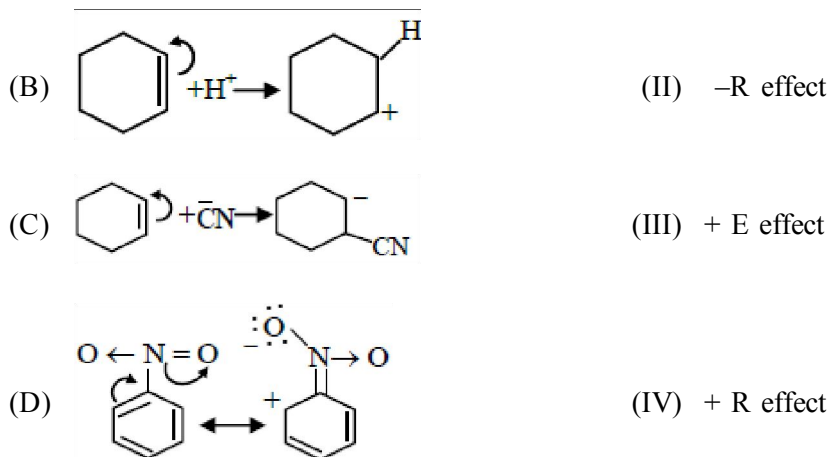
61. What pressure (bar) of  $H_2$  would be required to make emf of hydrogen electrode zero in pure water at 25 °C ?  
 (A)  $10^{-14}$  (B)  $10^{-7}$  (C) 1 (D) 0.5
62. The correct sequence of ligands in the order of decreasing field strength is :  
 (A)  $CO > H_2O > F^- > S^{2-}$  (B)  $-OH > F^- > NH_3 > CN^-$   
 (C)  $NCS^- > EDTA^{4-} > CN^- > CO$  (D)  $S^{2-} > -OH > EDTA^{4-} > CO$
63. Match List -I with List II:

#### List - I (Mechanism steps)

#### List - II (Effect)



(I) -E effect



Choose the correct answer from the options given below :

- (A) (A) - (IV), (B) - (III), (C) - (I), (D) - (II)  
 (B) (A) - (III), (B) - (I), (C) - (II), (D) - (IV)  
 (C) (A) - (II), (B) - (IV), (C) - (III), (D) - (I)  
 (D) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)

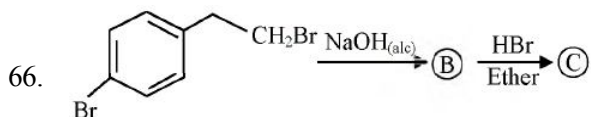
64. What will be the decreasing order of basic strength of the following conjugate bases ?



- (A)  $\text{C}\bar{\text{I}} > \text{OH} > \text{R}\bar{\text{O}} > \text{CH}_3\text{CO}\bar{\text{O}}$   
 (B)  $\text{R}\bar{\text{O}} > {}^{-}\text{OH} > \text{CH}_3\text{CO}\bar{\text{O}} > \text{C}\bar{\text{I}}$   
 (C)  ${}^{-}\text{OH} > \text{R}\bar{\text{O}} > \text{CH}_3\text{CO}\bar{\text{O}} > \text{C}\bar{\text{I}}$   
 (D)  $\text{C}\bar{\text{I}} > \text{R}\bar{\text{O}} > {}^{-}\text{OH} > \text{CH}_3\text{CO}\bar{\text{O}}$

65. In the precipitation of the iron group (III) in qualitative analysis, ammonium chloride is added before adding ammonium hydroxide to :

- (A) prevent interference by phosphate ions  
 (B) decrease concentration of  ${}^{-}\text{OH}$  ions  
 (C) increase concentration of  $\text{Cl}^{-}$  ions  
 (D) increase concentration of  $\text{NH}_4^{+}$  ions



Identify **B** and **C** and how are **A** and **C** related?

	(B)	(C)	
(1)			functional group isomers
(2)			Derivative
(3)			position isomers
(4)			chain isomers

67. One of the commonly used electrode is calomel electrode. Under which of the following categories calomel electrode comes ?
- (A) Metal - Insoluble Salt - Anion electrodes  
 (B) Oxidation - Reduction electrodes  
 (C) Gas - Ion electrodes  
 (D) Metal ion - Metal electrodes
68. Number of complexes from the following with even number of unpaired "d" electrons is \_\_\_\_.
- $[V(H_2O)_6]^{3+}$ ,  $[Cr(H_2O)_6]^{2+}$ ,  $[Fe(H_2O)_6]^{3+}$ ,  $[Ni(H_2O)_6]^{3+}$ ,  $[Cu(H_2O)_6]^{2+}$   
 [Given atomic numbers : V = 23, Cr = 24, Fe = 26, Ni = 28, Cu = 29]
- (A) 2                      (B) 4                      (C) 5                      (D) 1
69. Which one of the following molecules has maximum dipole moment ?
- (A)  $NF_3$                       (B)  $CH_4$                       (C)  $NH_3$                       (D)  $PF_5$
70. Number of molecules/ions from the following in which the central atom is involved in  $sp^3$  hybridization is \_\_\_\_.
- $NO_3^-$ ,  $BCl_3$ ,  $ClO_2^-$ ,  $ClO_3$
- (A) 2                      (B) 4                      (C) 3                      (D) 1
71. Which among the following is incorrect statement?
- (A) Electromeric effect dominates over inductive effect  
 (B) The electromeric effect is, temporary effect  
 (C) The organic compound shows electromeric effect in the presence of the reagent only  
 (D) Hydrogen ion ( $H^+$ ) shows negative electromeric effect

72. Given below are two statements :

**Statement I :** Acidity of  $\alpha$ -hydrogens of aldehydes and ketones is responsible for Aldol reaction.

**Statement II :** Reaction between benzaldehyde and ethanal will NOT give Cross – Aldol product.

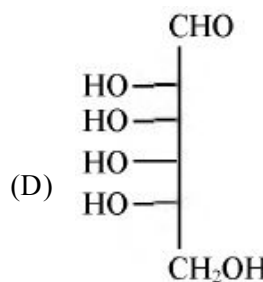
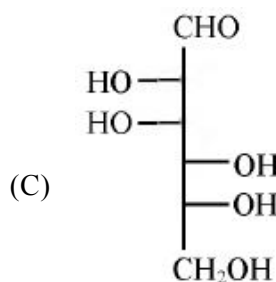
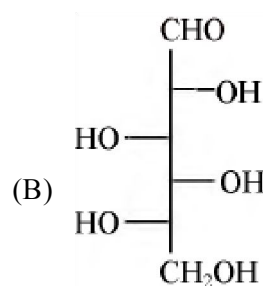
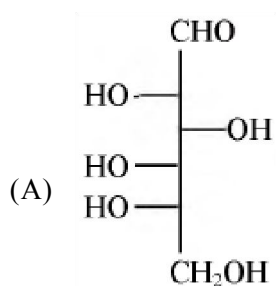
In the light of above statements, choose the **most appropriate** answer from the options given below.

- (A) Both Statement I and Statement II are correct.  
 (B) Both Statement I and Statement II are incorrect.  
 (C) Statement I is incorrect but Statement II is correct.  
 (D) Statement I is correct but Statement II is incorrect.

73. Which of the following nitrogen containing compound does not give Lassaigne's test ?

- (A) Phenyl hydrazine (B) Glycine (C) Urea (D) Hydrazine

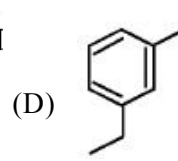
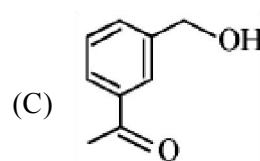
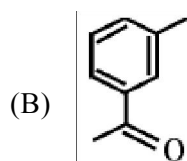
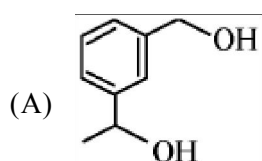
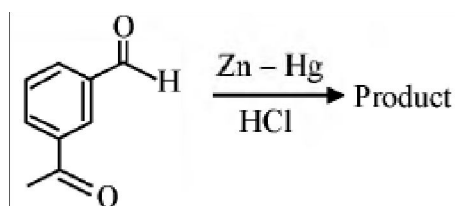
74. Which of the following is the correct structure of L-Glucose ?



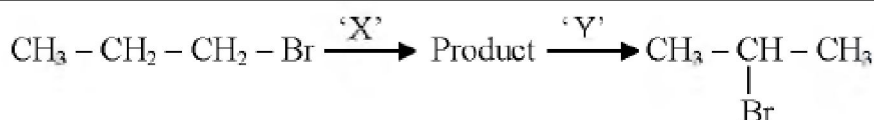
75. The element which shows only one oxidation state other than its elemental form is :

- (1) Cobalt (2) Scandium (3) Titanium (4) Nickel

76. Identify the product in the following reaction :



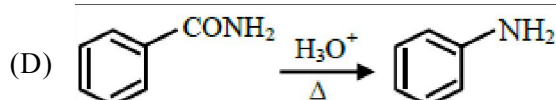
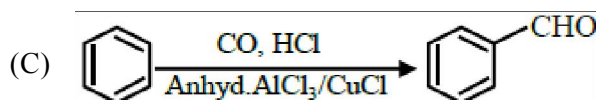
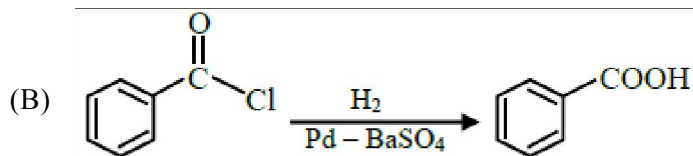
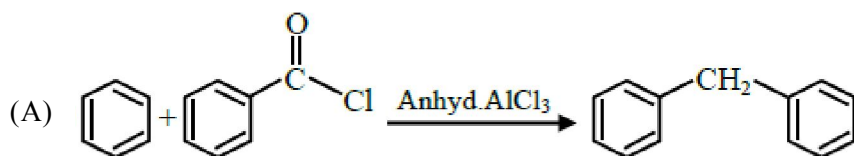
77. Number of elements from the following that CANNOT form compounds with valencies which match with their respective group valencies is \_\_\_\_\_  
 B, C, N, S, O, F, P, Al, Si  
 (1) 7 (2) 5 (3) 6 (4) 3
78. The Molarity (M) of an aqueous solution containing 5.85 g of NaCl in 500 mL water is :  
 (Given : Molar Mass Na : 23 and Cl : 35.5 gmol<sup>-1</sup>)  
 (1) 20 (2) 0.2 (3) 2 (4) 4
79. Identify the correct set of reagents or reaction conditions 'X' and 'Y' in the following set of transformation.



- (A) X = conc. alc. NaOH, 80 °C, Y = Br<sub>2</sub>/CHCl<sub>3</sub>  
 (B) X = dil.aq. NaOH, 20 °C, Y = HBr/acetic acid  
 (C) X = conc. alc. NaOH, 80 °C, Y = HBr/acetic acid  
 (D) X = dil.aq. NaOH, 20 °C, Y = Br<sub>2</sub>/CHCl<sub>3</sub>
80. The correct order of first ionization enthalpy values of the following elements is  
 (A) O (B) N (C) Be (D) F  
 (E) B
- Choose the correct answer from the options given below:  
 (A) B < D < C < E < A (B) E < C < A < B < D  
 (C) C < E < A < B < D (D) A < B < D < C < E

### Section - B (Numerical Value Type)

81. The enthalpy of formation of ethane (C<sub>2</sub>H<sub>6</sub>) from ethylene by addition of hydrogen where the bond-energies of C – H, C – C, H – H are 414 kJ, 347 kJ, 615 kJ and 435 kJ respectively is - \_\_\_\_\_ kJ.
82. The number of correct reaction(s) among the following is \_\_\_\_\_.



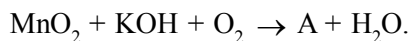
83. X g of ethylamine is subjected to reaction with  $\text{NaNO}_2/\text{HCl}$  followed by water; evolved dinitrogen gas which occupied 2.24 L volume at STP.

X is \_\_\_\_\_  $\times 10^{-1}$  g.

84. The de-Broglie's wavelength of an electron in the 4<sup>th</sup> orbit is \_\_\_\_\_  $\pi a_0$  ( $a_0$  = Bohr's radius)

85. Only 2 mL of  $\text{KMnO}_4$  solution of unknown molarity is required to reach the end point of a titration of 20 mL of oxalic acid (2 M) in acidic medium. The molarity of  $\text{KMnO}_4$  solution should be \_\_\_\_\_ M.

86. Consider the following reaction

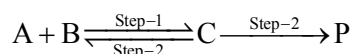


Product 'A' in neutral or acidic medium disproportionate to give products 'B' and 'C' along with water.

The sum of spin-only magnetic moment values of B and C is \_\_\_\_\_ BM.

(nearest integer) (Given atomic number of Mn is 25)

87. Consider the following transformation involving first order elementary reaction in each step at constant temperature as shown below.



Some details of the above reaction are listed below.

Step	Rate constant ( $\text{sec}^{-1}$ )	Activation energy ( $\text{kJ mol}^{-1}$ )
1	$k_1$	300
2	$k_2$	200
3	$k_3$	$E_{a_3}$

If the overall rate constant transformation (k) is given as  $k = \frac{k_1 k_2}{k_3}$  and the overall activation energy ( $E_a$ ) is

400  $\text{kJ mol}^{-1}$ , then the value of  $E_{a_3}$  is \_\_\_\_\_  $\text{kJ mol}^{-1}$  (nearest integer)

88. 2.5 g of a non-volatile, non-electrolyte is dissolved in 100 g of water at 25°C. The solution showed a boiling point elevation by 2°C. Assuming the solute concentration is negligible with respect to the solvent concentration, the vapour pressure of the resulting aqueous solution is \_\_\_\_\_ mm of Hg (nearest integer)

[Given : Molal boiling point elevation constant of water ( $K_b$ ) = 0.52  $\text{K. kg mol}^{-1}$ , 1 atm pressure = 760 mm of Hg, molar mass of water = 18  $\text{g mol}^{-1}$ ]

89. The number of different chain isomers for  $\text{C}_7\text{H}_{16}$  is \_\_\_\_\_.

90. Number of molecules/species from the following having one unpaired electron is \_\_\_\_\_.

$\text{O}, \text{O}_2^{-1}, \text{NO}, \text{CN}^{-1}, \text{O}_2^{2-}$



**MATHEMATICS****Single Choice Correct**

1. B	2. A	3. C	4. C	5. D
6. B	7. C	8. B	9. A	10. A
11. D	12. D	13. A	14. D	15. B
16. A	17. D	18. A	19. A	20. C

**Numerical Value**

21. 100	22. 45	23. 7	24. 48	25. 25
26. 8	27. 27	28. 72	29. 54	30. 8

**PHYSICS****Single Choice Correct**

31. B	32. D	33. D	34. D	35. D
36. B	37. D	38. C	39. A	40. C
41. B	42. D	43. C	44. B	45. D
46. B	47. C	48. B	49. D	50. D

**Numerical Value**

51. 16	52. 7	53. 50	54. 8	55. 1
56. 7	57. 9	58. 5	59. 6	60. 7

**CHEMISTRY****Single Choice Correct**

61. C	62. A	63. A	64. B	65. B
66. C	67. A	68. A	69. C	70. A
71. D	72. D	73. D	74. A	75. B
76. D	77. D	78. B	79. C	80. B

**Numerical Value**

81. 125	82. 1	83. 45	84. 8	85. 8
86. 4	87. 100	88. 707	89. 9	90. 2