

MATHEMATICS

1. Let z be a complex number and a is a real number such that $z^2 + az + a^2 = 0$. Then
 - A. locus of z is an ellipse
 - B. locus of z is a circle
 - C. $\arg(z) = \pm \frac{2\pi}{3}$
 - D. $|z| = \sqrt{3}|a|$

2. For the equation $3x^2 + px + 3 = 0$, $p > 0$, if one of the roots is square of the other, then p is equal to
 - A. $\frac{1}{3}$
 - B. 1
 - C. 3
 - D. $\frac{2}{3}$

3. The cube roots of unity
 - A. lie on the circle $|z| = 1$
 - B. are collinear
 - C. form an equilateral triangle
 - D. have same argument

4. If $\left| \frac{z-25}{z-1} \right| = 5$, then the value of $|z|$ is
 - A. 3
 - B. 4
 - C. 5
 - D. 6

5. The sum of first n terms of the series $1^2 + 2.2^2 + 3^2 + 2.4^2 + 5^2 + 2.6^2 + \dots$ is $\frac{n(n+1)^2}{2}$ when n is even. When n is odd, the sum is
- A. $\frac{3n(n+1)}{2}$
- B. $\frac{n^2(n+1)}{2}$
- C. $\frac{n(n+1)^2}{4}$
- D. $\left[\frac{n(n+1)}{2}\right]^2$
6. The HM of two numbers is 4 where as their AM is A and GM is G . If $2A + G^2 = 27$, then A is equal to
- A. 9
- B. $\frac{9}{2}$
- C. 2
- D. $\frac{2}{9}$
7. If the arithmetic mean of a and b is $\frac{a^n + b^n}{a^{n-1} + b^{n-1}}$, then the value of n is
- A. -1
- B. 0
- C. 1
- D. 2

8. If $a(b-c)x^2 + b(c-a)xy + c(a-b)y^2$ is a perfect square, then a, b, c are in
- A. AP
 - B. GP
 - C. HP
 - D. neither AP nor HP
9. The number of real solutions of the equation $\left(\frac{9}{10}\right)^x = -3 + x - x^2$ is
- A. 0
 - B. 1
 - C. 2
 - D. 3
10. Solutions of the equation $(3+2\sqrt{2})^{x^2-8} + (3+2\sqrt{2})^{8-x^2} = 6$ are
- A. $3+2\sqrt{2}$
 - B. ± 1
 - C. $\pm 3\sqrt{3}, \pm 2\sqrt{2}$
 - D. $\pm 7, \pm \sqrt{3}$
11. Product of any r consecutive natural numbers is always divisible by
- A. $r!$
 - B. $(r+4)!$
 - C. $(r+1)!$
 - D. $(r+2)!$

12. The value of the determinant $\begin{vmatrix} \sqrt{6} & \sqrt{3}-i\sqrt{2} & 2+i\sqrt{6} \\ \sqrt{3}+i\sqrt{2} & 0 & \sqrt{3}-i\sqrt{2} \\ \sqrt{2}-i\sqrt{6} & \sqrt{3}+i\sqrt{2} & \sqrt{11} \end{vmatrix}$ is
- A. a complex number z , where $\operatorname{Re}(z) \neq 0$
 B. a purely imaginary number
 C. a real number
 D. a complex number z , where $\operatorname{Re}(z) \neq 0$ and $\operatorname{Im}(z) \neq 0$
13. The pairs of straight lines $x^2 - 3xy + 2y^2 = 0$ and $x^2 - 3xy + 2y^2 + x - 2 = 0$ form a
- A. square but not rhombus
 B. rhombus
 C. parallelogram
 D. rectangle but not a square
14. The area enclosed within the curve $|x| + |y| = 2$ is
- A. 16 sq. units
 B. 24 sq. units
 C. 32 sq. units
 D. 8 sq. units
15. The number of normals drawn to the parabola $y^2 = 4x$ from the point $(1, 0)$ is
- A. 1
 B. 2
 C. 3
 D. 0

16. If $f(x) = \cot^{-1}\left(\frac{x^x - x^{-x}}{2}\right)$, then $f'(1)$ is equal to
- A. -1
 - B. 1
 - C. $\log 2$
 - D. $\log 4$
17. If $(x+y)\sin u = x^2y^2$, then $x\frac{\partial z}{\partial x}$ is equal to
- A. $\sin u$
 - B. $\operatorname{cosec} u$
 - C. $2 \tan u$
 - D. $3 \tan u$
18. If $\int f(x)dx = g(x)$, then $\int f(x)g(x)dx =$
- A. $\frac{1}{2}g^2(x)$
 - B. $\frac{1}{2}f^2(x)$
 - C. $\frac{1}{2}[g'(x)]^2$
 - D. $f'(x)g(x)$
19. A particular solution of $\log\left(\frac{dy}{dx}\right) = 3x + 4y$, $y(0) = 0$ is
- A. $e^{3x} + 3e^{-2y} = 4$
 - B. $4e^{3x} - 3e^{-4y} = 3$
 - C. $3e^{3x} + 4e^{-4y} = 7$
 - D. $4e^{3x} + 3e^{-4y} = 7$

20. The integrating factor of the differential equation $(y \log y) dx = (\log y - x) dy$ is

A. $\frac{1}{\log y}$

B. $\log(\log y)$

C. $1 + \log y$

D. $\log y$

21. The general solution of $\frac{dy}{dx} + 1 = e^{x+y}$ is

A. $e^{-(x+y)} + x + c = 0$

B. $e^{-(x+y)} - x + c = 0$

C. $e^{(x+y)} + x + c = 0$

D. $e^{(x+y)} - x + c = 0$

22. If the position vectors of A , B and C are respectively $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} - 3\hat{j} - 5\hat{k}$ and $3\hat{i} - 4\hat{j} - 4\hat{k}$, then $\cos^2 A$ is equal to

A. 0

B. $\frac{6}{41}$

C. $\frac{35}{41}$

D. 1

23. The value of $\lim_{n \rightarrow \infty} \frac{1}{\sqrt{n}} \left(\frac{1}{\sqrt{2} + \sqrt{4}} + \frac{1}{\sqrt{4} + \sqrt{6}} + \dots + \frac{1}{\sqrt{2n} + \sqrt{2n+2}} \right)$ is
- A. $\sqrt{2}$
 - B. $\frac{1}{\sqrt{2}}$
 - C. $\sqrt{2} + 1$
 - D. $\frac{1}{\sqrt{2} + 1}$
24. If a, b, c are the sides of a triangle such that $a : b : c = 1 : \sqrt{3} : 2$, then the ratio of the angles $A : B : C$ is
- A. 3:2:1
 - B. 3:1:2
 - C. 1:3:2
 - D. 1:2:3
25. The equation $z^2 = \bar{z}$ has
- A. no solution
 - B. two solutions
 - C. four solutions
 - D. infinite number of solutions
26. The locus of a complex number z in the Argand plane such that $\arg\left(\frac{z-1}{z+1}\right) = \frac{\pi}{4}$ is
- A. an ellipse
 - B. a circle
 - C. a straight line
 - D. bisector of a line

27. If $(1+i)(1+2i)(1+3i)\dots(1+ni) = x+iy$, then the value of $2 \times 5 \times 10 \times \dots \times (1+n^2)$ is
- A. $x^2 - y^2$
 - B. $(x^2 - y^2)^2$
 - C. $(x^2 + y^2)^2$
 - D. $x^2 + y^2$
28. The number $\sqrt{2}e^{\pi i}$ is
- A. a rational number
 - B. a transcendental number
 - C. an irrational number
 - D. an imaginary number
29. Let $A = \begin{bmatrix} 5 & 5\alpha & \alpha \\ 0 & \alpha & 5\alpha \\ 0 & 0 & 5 \end{bmatrix}$. If $|A^2| = 25$, then $|\alpha|$ is equal to
- A. $\frac{1}{5}$
 - B. 5
 - C. 5^2
 - D. 1
30. If $1000! = 2^n m$, where m is an odd integer, then the value of n is
- A. 993
 - B. 994
 - C. 997
 - D. 998

31. Let a_n be the n -th term of an A.P. If $\sum_{r=1}^{100} a_{2r} = \alpha$ and $\sum_{r=1}^{100} a_{2r-1} = \beta$, then the common difference of the A.P. is
- A. $\alpha - \beta$
 - B. $\frac{\alpha - \beta}{50}$
 - C. $\frac{\alpha - \beta}{100}$
 - D. $\frac{\beta - \alpha}{50}$
32. Three numbers are selected randomly between 1 to 20. Then the probability that they are consecutive numbers will be
- A. $\frac{7}{190}$
 - B. $\frac{3}{190}$
 - C. $\frac{5}{190}$
 - D. $\frac{1}{3}$
33. Let two events A and B have probability 0.25 and 0.50 respectively. If the probability that both A and B occur simultaneously is 0.14, then the probability that neither A nor B occurs is
- A. 0.75
 - B. 0.25
 - C. 0.11
 - D. 0.39

34. The number of positive divisors of 50,000 is
- A. 20
 - B. 50
 - C. 40
 - D. 30
35. If $y(t)$ is a solution of $(1+t)\frac{dy}{dt} - ty = 1$ and $y(0) = -1$, then $y(1)$ is equal to
- A. $\frac{-1}{2}$
 - B. $\frac{1}{2}$
 - C. 1
 - D. -1
36. If $y = \log(m \cos^{-1} x)$ is a solution of the differential equation $(1-x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} = ke^{-2y}$, then k is equal to
- A. m^2
 - B. $2m^2$
 - C. $-m^2$
 - D. $-2m^2$
37. The length of the longest rod that can be put in a hemispherical bowl of radius 10 cm such that no end of the rod is outside the bowl (Assume that the rod has negligible thickness) is
- A. $10\sqrt{2}$ cm
 - B. $10\sqrt{3}$ cm
 - C. $10\sqrt{4}$ cm
 - D. $10\sqrt{5}$ cm

38. A fruit vendor buys 120 Shimla apples at 4 for Rs. 100 and 120 Golden apples at 6 for Rs. 100. He decides to mix them and sell at 10 for Rs. 200. He will make
- A. a gain of 10%
 - B. a loss of 4%
 - C. a gain of 4%
 - D. a loss of 10%
39. The probability that a ticketless traveller is caught during a trip is 0.1. If the traveller makes 4 trips, the probability that he will be caught during at least one of the trips is
- A. $1 - (0.9)^4$
 - B. $(1 - 0.9)^4$
 - C. $1 - (1 - 0.9)^4$
 - D. $(0.9)^4$
40. If the rank of the matrix $\begin{bmatrix} \lambda & -1 & 0 \\ 0 & \lambda & -1 \\ -1 & 0 & \lambda \end{bmatrix}$ is 2, then λ is
- A. 1
 - B. 2
 - C. 3
 - D. 4

41. If $2f(x) + f(x^{-1}) = x$, where $x \neq 0$, then $f(x)$ is
- A. $\frac{2x^2 - 1}{3x}$
- B. $\frac{3x}{2x^2 - 1}$
- C. $2^x + \frac{1}{x}$
- D. $2^x - \frac{1}{x}$
42. If $N = m!$ (where m is a fixed positive integer > 2), then the value of $\frac{1}{\log_2 N} + \frac{1}{\log_3 N} + \frac{1}{\log_4 N} + \dots + \frac{1}{\log_m N}$ is
- A. -2
- B. 1
- C. 0
- D. -1
43. A function $f : N \rightarrow Z$ defined by
- $$f(x) = \frac{n-1}{2} \text{ when } n \text{ is odd}$$
- $$f(x) = -\frac{n}{2} \text{ when } n \text{ is even, is}$$
- A. one – one but not onto
- B. onto but not one-one
- C. one – one and onto
- D. neither one – one nor onto

44. If $f(x) = x + \sin x$ for every x , then $f(x)$ possesses
- infinite number of zeros
 - more than one but finite number of zeros
 - only one zero
 - more than three but finite number of zeros
45. If $\begin{vmatrix} 6i & -3i & 1 \\ 4 & 3i & -1 \\ 20 & 3 & i \end{vmatrix} = x + iy$, then
- $x = 3, y = 1$
 - $x = 1, y = 3$
 - $x = 0, y = 0$
 - $x = 0, y = 3$
46. The triangle formed by the points $1, \frac{1+i}{\sqrt{2}}$ and i as vertices in the Argand diagram, is
- scalane
 - equilateral
 - isosceles
 - right angled
47. If α and β are the roots of $x^2 + x + 1 = 0$, then the equation whose roots are α^{19}, β^7 is
- $19x^2 - x + 1 = 0$
 - $19x^2 + 7x + 1 = 0$
 - $7x^2 + 19x + 1 = 0$
 - $x^2 + x + 1 = 0$

48. If x is real, then the maximum value of $\frac{3x^2+9x+17}{3x^2+9x+7}$ is
- A. $\frac{17}{7}$
 - B. 1
 - C. 41
 - D. $\frac{7}{17}$
49. If A and B are two matrices such that $AB = A$ and $BA = B$, then $A^2 + B^2$ is
- A. $A+B$
 - B. $A-B$
 - C. I
 - D. 0
50. If $D = \begin{vmatrix} x^2 & x & x \\ x & 1+x & 1 \\ x & 1 & 1+y \end{vmatrix}$ for $x \neq 0$ and $y \neq 0$, then D is divisible
- A. by x and not by y
 - B. by y and not by x
 - C. both by x and y
 - D. neither by x nor by y

51. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$. If u_1 and u_2 are column matrices such that

$$Au_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \text{ and } Au_2 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, \text{ then } u_1 + u_2 \text{ is equal to}$$

A. $\begin{bmatrix} -1 \\ -1 \\ 0 \end{bmatrix}$

B. $\begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}$

C. $\begin{bmatrix} +1 \\ -1 \\ 0 \end{bmatrix}$

D. $\begin{bmatrix} -1 \\ 1 \\ -1 \end{bmatrix}$

52. The number of ways in which 6 men and 5 women can sit at a round table if no two women are to sit together, is given by

A. 30

B. $6! 5!$

C. $5! 4!$

D. $(6!)^2$

53. The number of divisors of the form $4n+2$ ($n \geq 0$) of the integer 240 is
- A. 4
B. 8
C. 3
D. 12
54. Statement 1: The sum of the series $1+(1+2+4)+(4+6+9)+(9+12+16)+\dots+(361+380+400)$ is 8000
Statement 2 : $\sum_{k=1}^n [k^3 - (k-1)^3] = n^3$, for any natural number n .
- A. Statement 1 is true, Statement 2 is true, Statement 2 is not a correct explanation for Statement 1
B. Statement 1 is true, Statement 2 is false
C. Statement 1 is false, Statement 2 is true
D. Statement 1 is true, Statement 2 is true, Statement 2 is correct explanation for Statement 1
55. $1 + \frac{3}{4} + \frac{3.5}{4.8} + \frac{3.5.7}{4.8.12} + \dots =$
- A. $\sqrt{2}$
B. $2\sqrt{2}$
C. 2
D. $\frac{1}{\sqrt{2}}$
56. Fifth term of a G.P. is 2, then the product of its first nine terms is
- A. 256
B. 512
C. 1024
D. 2048

57. $\lim_{x \rightarrow a} \frac{\sqrt{a+2x} - \sqrt{3x}}{\sqrt{3a+x} - 2\sqrt{x}} =$

A. $\frac{2}{\sqrt{3}}$

B. $\frac{1}{\sqrt{3}}$

C. $-\frac{2}{3\sqrt{3}}$

D. $\frac{2}{3\sqrt{3}}$

58. The value of $f(0)$ so that $f(x) = \frac{\sqrt{1+x}-1}{x}$ is continuous at $x = 0$ is

A. 1

B. 2

C. 0

D. $\frac{1}{2}$

59. If $y = (x + \sqrt{1+x^2})^n$, then $(1+x^2)\frac{d^2y}{dx^2} + x\frac{dy}{dx}$ is

A. n^2y

B. $-n^2y$

C. $-ny$

D. ny

60. The two curves $x^3 - 3xy^2 + 2 = 0$ and $3x^2y - y^3 - 2 = 0$
- A. touch each other
 - B. cut at right angles
 - C. cut at an angle $\frac{\pi}{3}$
 - D. cut at an angle $\frac{\pi}{4}$
61. A function is matched below against an interval where it is supposed to be increasing. The incorrectly matched pair is
- A. $(-\infty, \infty)$ $x^3 - 3x^2 + 3x + 3$
 - B. $(2, \infty)$ $2x^3 - 3x^2 - 12x + 6$
 - C. $\left(-\infty, \frac{1}{3}\right)$ $3x^2 - 2x + 1$
 - D. $(-\infty, -4)$ $x^3 + 6x^2 + 6$
62. If $x > 0$, $xy = 1$, then the minimum value of $x + y$ is
- A. 2
 - B. $\sqrt{2}$
 - C. 3
 - D. $\sqrt{3}$
63. If $\int \frac{\sin x}{\sin(x-\alpha)} dx = Ax + B \log \sin(x-\alpha) + C$, then $(A, B) =$
- A. $(-\sin \alpha, \cos \alpha)$
 - B. $(\sin \alpha, \cos \alpha)$
 - C. $(-\cos \alpha, \sin \alpha)$
 - D. $(\cos \alpha, \sin \alpha)$

64.
$$\int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx =$$

A. $\frac{\pi}{4}$

B. $\frac{\pi}{2}$

C. 0

D. 1

65. If A is square matrix, then $(A + A^T)$ will be

A. unit matrix

B. skew symmetric matrix

C. symmetric matrix

D. invertible

66. Let $I = \int_0^1 \frac{\sin x}{\sqrt{x}}$ and $J = \int_0^1 \frac{\cos x}{\sqrt{x}}$. Then

A. $I < \frac{2}{3}$ and $J < 2$

B. $I < \frac{2}{3}$ and $J > 2$

C. $I > \frac{2}{3}$ and $J < 2$

D. $I > \frac{2}{3}$ and $J > 2$

67. The differential equation of all non-vertical lines is

A. $\frac{d^2y}{dx^2} = 0$

B. $\frac{d^2x}{dy^2} = 0$

C. $\frac{dy}{dx} = 0$

D. $\frac{dx}{dy} = 0$

68. The solution of the equation $\frac{d^2y}{dx^2} = e^{-2x}$ is

A. $y = \frac{1}{4}e^{-2x}$

B. $y = -\frac{1}{4}e^{-2x} + cx + d$

C. $y = \frac{1}{4}e^{-2x} + cx^2$

D. $y = \frac{1}{4}e^{-2x} + cx + d$

69. The solution of $\frac{dy}{dx} + x \sin 2y = x^3 \cos^2 y$ is

A. $\tan y = \frac{x^2}{2} + \frac{1}{2} + ce^{-x^2}$

B. $\tan y = \frac{x^2}{2} - \frac{1}{2} + ce^{-x^2}$

C. $\tan y = \frac{x^3}{2} - \frac{1}{2} + ce^{-x^2}$

D. $\tan y = \frac{x^3}{2} + \frac{1}{2} + ce^{-x^2}$

70. Let $A(2, -3)$ and $B(-2, 1)$ be vertices of a triangle ABC . If the centroid of this triangle moves on the line $2x + 3y = 1$, then the locus of the vertex C is the line
- A. $2x + 3y = 9$
 - B. $3x - 2y = 3$
 - C. $3x + 2y = 5$
 - D. $2x - 3y = 7$
71. If one of the lines given by $6x^2 - xy + 4cy^2 = 0$ is $3x + 4y = 0$, then c is
- A. 1
 - B. -3
 - C. 3
 - D. -1
72. The length of the diameter of the circle which touches the x-axis at the point $(1, 0)$ and passes through the point $(2, 3)$ is
- A. $\frac{6}{5}$
 - B. $\frac{5}{3}$
 - C. $\frac{10}{3}$
 - D. $\frac{3}{5}$
73. If $5x - 12y + 10 = 0$ and $12y - 5x + 16 = 0$ are two tangents to a circle, then the radius of the circle is
- A. 1
 - B. 2
 - C. 4
 - D. 6

74. Three normals to the parabola $y^2 = x$ through the point $(a, 0)$ are drawn. Then
- A. $a = \frac{1}{2}$
 - B. $a = \frac{1}{4}$
 - C. $a > \frac{1}{2}$
 - D. $a < \frac{1}{2}$
75. Equation of tangent to the hyperbola $2x^2 - 3y^2 = 6$ which is parallel to the line $y = 3x + 4$ is
- A. $y = 3x + 5$
 - B. $y = 3x - 5$
 - C. $y = 3x + 5$ and $y = 3x - 5$
 - D. $y = 3x + 6$
76. With respect to addition, the set $\{0, 1, -1\}$ does not form a group, since it fails to satisfy
- A. associativity
 - B. closure
 - C. existence of identity
 - D. existence of inverse
77. For the operation $*$ defined by $a * b = \frac{ab}{2}$, the identity element is
- A. 0
 - B. 1
 - C. 2
 - D. 4

78. Given $f_1(x) = x$, $f_2(x) = -x$, $f_3(x) = \frac{1}{x}$ and $f_4(x) = -\frac{1}{x}$ and \circ stands for composition of function. Then $(f_4 \circ f_2)(x)$ is
- A. $f_1(x)$
 - B. $f_2(x)$
 - C. $f_3(x)$
 - D. $f_4(x)$
79. Under addition, which one of the following statements is true?
- A. Z is a cyclic subgroup of $2Z$
 - B. Z is a subgroup of $2Z$
 - C. $2Z$ is a cyclic subgroup of Z
 - D. $2Z$ is a subgroup of Z but not cyclic
80. If α, β are the roots of the equation $x^2 - 2x + 4 = 0$, then the value of $\alpha^6 + \beta^6$ is
- A. 32
 - B. 128
 - C. 64
 - D. 256
81. If $\operatorname{Im}\left(\frac{z+2i}{z+2}\right) = 0$, then z lies on the curve
- A. $x^2 + y^2 + 2x + 2y = 0$
 - B. $x^2 + y^2 - 2x = 0$
 - C. $x + y + 2 = 0$
 - D. $x^2 + y^2 - 2y = 0$

82. Locus of the point z satisfying the equation $|iz - 1| + |z - i| = 2$ is
- A. an ellipse
 - B. a parabola
 - C. a circle
 - D. a straight line
83. The equation $z\bar{z} + (2 - 3i)z + (2 + 3i)\bar{z} + 4 = 0$ represents a circle of radius
- A. 2
 - B. 3
 - C. 4
 - D. 6
84. Sum of all terms of an infinite GP is $\frac{1}{5}$ times the sum of odd terms. The common ratio is
- A. 2
 - B. 3
 - C. $\frac{-4}{5}$
 - D. 5
85. If $\log_{0.5} \sin x = 1 - \log_{0.5} \cos x$, then the number of solutions of $x \in [-2\pi, 2\pi]$ is
- A. 1
 - B. 2
 - C. 3
 - D. 4

86. The number of points (x, y, z) in space, whose each coordinate is a negative integer such that $x + y + z + 12 = 0$ is
- A. 385
 - B. 55
 - C. 110
 - D. 220
87. If $x^2 - 3x + 2$ be one of the factors of the expression $x^4 - px^2 + q$, then
- A. $p = 4, q = 5$
 - B. $p = -5, q = -4$
 - C. $p = 5, q = 4$
 - D. $p = -5, q = 4$
88. If $x = 2 + 2^{\frac{1}{3}} + 2^{\frac{2}{3}}$, then the value of $x^3 - 6x^2 + 6x$ is
- A. 3
 - B. 2
 - C. 1
 - D. 4
89. The sides AB, BC, CA of a triangle ABC have 3, 4, 5 interior points on them. Total number of triangles that can be formed using these points as vertices is equal to
- A. 135
 - B. 145
 - C. 178
 - D. 205

90. If the coefficient of x^2 and x^3 in the expansion of $(3+kx)^9$ are equal, then the value of k is
- A. $\frac{-9}{7}$
- B. $\frac{9}{7}$
- C. $\frac{7}{9}$
- D. $\frac{-7}{9}$
91. If m is the harmonic mean of x and y , then the value of $\frac{m}{x} + \frac{m}{y}$ is
- A. 2
- B. $\frac{x+y}{y}$
- C. $\frac{x+y}{x}$
- D. 3
92. The middle term in the expansion of $\left(x - \frac{1}{x}\right)^{18}$ is
- A. ${}^{18}C_9$
- B. $-{}^{18}C_9$
- C. ${}^{18}C_{10}$
- D. $-{}^{18}C_{10}$

93. The solution set of the equation $\begin{vmatrix} 2 & 3 & x \\ 2 & 1 & x^2 \\ 6 & 7 & 3 \end{vmatrix} = 0$ is
- A. ϕ
 - B. $\{0,1\}$
 - C. $\{1,-1\}$
 - D. $\{1,-3\}$
94. The system of linear equations
 $x_1 + 2x_2 + x_3 = 3$
 $2x_1 + 3x_2 + x_3 = 3$
 $3x_1 + 5x_2 + 2x_3 = 1$ has
- A. infinite number of solutions
 - B. exactly 3 solutions
 - C. a unique solution
 - D. no solution
95. If the matrix $\begin{bmatrix} \lambda & -1 & 4 \\ -3 & 0 & 1 \\ -1 & 1 & 2 \end{bmatrix}$ is not invertible, then λ is
- A. 11
 - B. -11
 - C. -17
 - D. 17

96. If $f(x) = \cos(\log x)$, then $f(x)f(y) - \frac{1}{2} \left[f\left(\frac{x}{y} + f(xy)\right) \right]$ is equal to

A. 1

B. $\frac{1}{2}$

C. -2

D. 0

97. If $x^y y^x = 100$, then $\frac{dy}{dx}$ is equal to

A. $\frac{-y(x+y)\log x}{x(x\log y) + y}$

B. $\frac{y(y+x\log x)}{x(y\log x + x)}$

C. $\frac{-y}{x}$

D. $\frac{-x}{y}$

98. The value of $\lim_{x \rightarrow 2} \frac{e^{3x-6} - 1}{\sin(2-x)}$ is equal to

A. $\frac{3}{2}$

B. 3

C. -3

D. -1

99. If the expression in powers of x at the function $\frac{1}{(1-ax)(1-bx)} = a_0 + a_1x + \dots + a_nx^n \dots$, then a_n is

A. $\frac{a^{n+1} + b^{n+1}}{a - b}$

B. $\frac{a^{n+1} - b^{n+1}}{a - b}$

C. $\frac{a^n - b^n}{a - b}$

D. $\frac{b^n - a^n}{a - b}$

100. If α is a repeated root of $ax^2 + bx + c = 0$, then $\lim_{x \rightarrow \alpha} \frac{\sin(ax^2 + bx + c)}{(x - \alpha)^2} =$

A. 0

B. a

C. b

D. c

101. $\int_0^{\frac{\pi}{2}} \frac{\cos x - \sin x}{1 + \cos x \sin x} dx$ is equal to

A. 0

B. $\frac{\pi}{2}$

C. $\frac{\pi}{4}$

D. $\frac{\pi}{6}$

102. A curve through $(1,0)$ and satisfying the differential equation $(1+y^2)dx - xy dy = 0$ represents
- A. a circle
 - B. a parabola
 - C. an ellipse
 - D. a hyperbola
103. Let the vectors $\vec{A}, \vec{B}, \vec{C}$ and \vec{D} be such that $(\vec{A} \times \vec{B}) \times (\vec{C} \times \vec{D}) = 0$. Let P_1 and P_2 be the planes determined by the pair of vectors \vec{A}, \vec{B} and \vec{C}, \vec{D} . Then the angle between P_1 and P_2 is
- A. 0
 - B. $\frac{\pi}{2}$
 - C. $\frac{\pi}{3}$
 - D. $\frac{\pi}{4}$
104. The solution of the differential equation $x \frac{dy}{dx} = 2y + x^3 e^x$, where $y = 0$ when $x = 1$, is
- A. $y = x^2(e^x - e)$
 - B. $y = x^3(e - e^x)$
 - C. $y = x^2(e - e^x)$
 - D. $\tan x = (\sec x + c)y$

105. If $\vec{a}, \vec{b}, \vec{c}$ are coplanar vectors and $\lambda (\neq 0)$ is a real number, then $[\lambda(\vec{a} + \vec{b}), \lambda^2 \vec{b}, \lambda \vec{c}] = [\vec{a}, \vec{b} + \vec{c}, \vec{c}]$ for
- A. exactly one value of λ
 - B. exactly two values of λ
 - C. exactly three values of λ
 - D. no value of λ
106. $\int_{-2}^2 |[x]| dx$ is equal to
- A. 1
 - B. 2
 - C. 4
 - D. 5
107. A man has 7 relatives, 4 women and 3 men. His wife has 7 relatives 3 women and 4 men. The number of ways in which they can invite 3 men and 3 women so that 3 of them are from the man's side and 3 from his wife's side, is
- A. 485
 - B. 720
 - C. 1024
 - D. 294
108. The product $(32)(32)^{\frac{1}{6}}(32)^{\frac{1}{36}} \dots \infty$ is equal to
- A. 16
 - B. 64
 - C. 32
 - D. 0

109. Let $f(2) = 4$ and $f'(2) = 4$. Then $\lim_{x \rightarrow 2} \frac{xf'(2) - 2f(x)}{x - 2}$ is

- A. 2
- B. -2
- C. -4
- D. 4

110. The PDF of a continuous random variate is

$$f(x) = \begin{cases} 0, & x < 2 \\ \frac{(3+2x)}{18} & 2 \leq x \leq 4 \\ 0 & x > 4 \end{cases}$$

Then, probability that x satisfies $2 \leq x \leq 3$ is

- A. $\frac{4}{9}$
- B. $\frac{2}{9}$
- C. $\frac{5}{9}$
- D. $\frac{-2}{9}$

111. The point on the curve $y = \frac{x}{1+x^2}$ at which the tangent to the curve has greatest slope, is

- A. (0, 1)
- B. (1, $\frac{1}{2}$)
- C. (1, 0)
- D. (0, 0)

112. If $I_n = \int_0^{\pi/4} \tan^n x \, dx$, then $\lim_{n \rightarrow \infty} n[I_n + I_{n+2}] =$

A. $\frac{1}{2}$

B. 1

C. ∞

D. 0

113. The shortest distance between the line $y - x = 1$ and curve $x = y^2$, is

A. $\frac{3\sqrt{2}}{8}$

B. $\frac{2\sqrt{3}}{8}$

C. $\frac{3\sqrt{2}}{5}$

D. $\frac{\sqrt{3}}{4}$

114. Area bounded by the lines $y = x + 2$, $y = 2 - x$ and $x = 2$ is

A. 3

B. 4

C. 8

D. 16

115. Angle of intersection of the curves $r = \sin \theta + \cos \theta$ and $r = 2 \sin \theta$ is equal to
- A. $\frac{\pi}{2}$
 - B. $\frac{\pi}{3}$
 - C. $\frac{\pi}{4}$
 - D. $\frac{\pi}{6}$
116. The equation of bisector of the acute angle between the lines $3x - 4y + 7 = 0$ and $5y + 12x - 2 = 0$ is
- A. $5x + 5y + 3 = 0$
 - B. $10x - 3y + 7 = 0$
 - C. $5x - 2y + 1 = 0$
 - D. $11x - 3y + 9 = 0$
117. The angle between the tangent drawn from the point $(1, 4)$ to the parabola $y^2 = 4x$ is
- A. $\frac{\pi}{6}$
 - B. $\frac{\pi}{4}$
 - C. $\frac{\pi}{3}$
 - D. $\frac{\pi}{2}$

118. If the direction cosines at two lines are such that $l + m + n = 0$ and $l^2 + m^2 - n^2 = 0$, then the angle between them is
- A. $\frac{\pi}{2}$
 - B. $\frac{\pi}{3}$
 - C. $\frac{\pi}{4}$
 - D. $\frac{\pi}{6}$
119. In the group $(\{1, -1, i, -i\}, \cdot)$, the order of the element $-i$, is
- A. 8
 - B. 2
 - C. 4
 - D. 6
120. If every element of group G is its own inverse, then G is
- A. abelian
 - B. infinite
 - C. cyclic
 - D. finite
121. The generators of the cyclic group $G = \{8^n \mid n \in \mathbb{Z}\}$ are
- A. 2 and $\frac{1}{2}$
 - B. 4 and $\frac{1}{4}$
 - C. 6 and $\frac{1}{6}$

- D. 8 and $\frac{1}{8}$
122. For the hyperbola $\frac{x^2}{\cos^2 \alpha} - \frac{y^2}{\sin^2 \alpha} = 1$ which of the following remains constant when α varies?
- A. Abscissac of vertices
 - B. Abscissac at foci
 - C. Directrix
 - D. Eccentricity
123. For two data sets, each of size 5, the variances are given to be 4 and 5 and the corresponding means are given to be 2 and 4 respectively. The variance of the combined data set is
- A. $\frac{5}{2}$
 - B. $\frac{11}{2}$
 - C. $\frac{13}{2}$
 - D. $\frac{15}{2}$
124. Three groups of children contain 3 girls and 1 boy, 2 girls and 2 boys, 1 girl and 3 boys. One child is selected at random from each group. The probability that the three selected consist one girl and two boys is
- A. $\frac{13}{32}$
 - B. $\frac{19}{32}$
 - C. $\frac{13}{19}$
 - D. $\frac{6}{19}$

125. The locus of the centres of the circles which touch both axes is given by
- A. $x^2 - y^2 = 0$
 - B. $x^2 + y^2 = 0$
 - C. $x^2 - y^2 = 1$
 - D. $x^2 + y^2 = 1$

PHYSICS

126. The electric field intensity from a point charge q , at a distance of 200 cm is, 400Vm^{-1} . At what distance, the electric field intensity will be equal to 100Vm^{-1} ?
- A. 0.5 m
 - B. 1.0 m
 - C. 2.0 m
 - D. 4.0 m
127. Electric lines of force
- A. travel in straight line
 - B. travel in zigzag path
 - C. intersects
 - D. never intersects
128. A parallel plate capacitor having two conducting plates is separated by a distance of 0.2 cm and has the capacitance of $0.2\ \mu\text{F}$ in air. When it is immersed in transformer oil of dielectric constant 5 then its capacitance value is,
- A. $1\ \mu\text{F}$
 - B. $2\ \mu\text{F}$
 - C. $4\ \mu\text{F}$
 - D. $5\ \mu\text{F}$

129. Find the current density, if a current of 5A flows through a silver wire of diameter 2 cm.
- A. 250 A/m
 - B. 500 A/m
 - C. 1000 A/m
 - D. 15909 A/m
130. A galvanometer can be converted into voltmeter by connecting a _____ resistance in _____ with it.
- A. high, series
 - B. high, parallel
 - C. low, series
 - D. low, parallel
131. A choke coil has a self induction of 330 H. When the current in the coil changes at the rate of 33 mA/s then the e.m.f developed is,
- A. 100 V
 - B. 0.1 V
 - C. 10 V
 - D. 10.89 V
132. Find the magnetic flux passing through the coil of 50 turns having area 10^{-2} cm^2 , when it is placed perpendicular to a magnetic field of induction $10^{-3} \text{ weber/m}^2$
- A. $5 \times 10^{-9} \text{ wb}$
 - B. $5 \times 10^{-8} \text{ wb}$
 - C. $5 \times 10^{-4} \text{ wb}$
 - D. zero

133. In a magnetic field of induction 0.05 wb/m^2 , a rectangular coil (100 turns) of size $5 \text{ cm} \times 2 \text{ cm}$ is placed perpendicularly. When the magnetic field of induction is changed to 0.005 wb/m^2 in 0.1 second, then the e.m.f induced is
- A. 45 mV
 - B. 0.45 V
 - C. 4.5 V
 - D. 45 V
134. Find the effective current flowing in the circuit of a capacitor of capacitance $1 \mu\text{F}$ connected in an a.c. circuit of frequency 50 Hz and the rms value of the applied voltage is 150 V.
- A. 3.184 A
 - B. 0.0318 A
 - C. 0.471 A
 - D. 0.047 A
135. In an experiment, Raman shift is found to be 7 \AA , when He-Ne laser of wavelength 632.8 nm is used. Then the wavelength of stokes and anti stokes lines will be _____ respectively
- A. 632.1 and 633.5 nm
 - B. 633.5 and 632.1 nm
 - C. 639.8 and 625.8 nm
 - D. 625.8 and 639.8 nm
136. Newton's rings are formed by placing a convex lens over a glass plate. When a drop of water is introduced between them, then the ring system
- A. remains the same
 - B. expand
 - C. contracts
 - D. first contracts and then expands

137. Find the angle of refraction, when an unpolarised light incident on a medium of refractive index 1.732 at the polarising angle.
- A. 30°
 - B. 45°
 - C. 60°
 - D. 90°
138. _____ X- ray spectra consists of definite, well defined, monochromatic wave length.
- A. hard
 - B. soft
 - C. continuous
 - D. characteristic
139. When the half life period of neutron is 758 seconds, then its mean life is
- A. 525 s
 - B. 33 s
 - C. 1093 s
 - D. 1313 s
140. In nuclear reactors the coolant material should have the characteristic of _____ specific heat capacity and _____ boiling point.
- A. low, low
 - B. low, high
 - C. high, low
 - D. high, high
141. In amplitude modulation _____ of the carrier wave remains constant.
- A. width
 - B. frequency
 - C. phase
 - D. frequency and phase

142. The susceptibility of a diamagnetic material is
- A. negative and small
 - B. negative and large
 - C. positive and small
 - D. positive and large
143. A two wheeler moves with a speed of 72 km/h and the brakes are applied for 3 s. If the deceleration is 6 m/s^2 , find the distance travelled during this time.
- A. 21 m
 - B. 30 m
 - C. 36 m
 - D. 33 m
144. Which is the essential condition for producing stationary interference pattern due to two sources of light?
- A. Coherent
 - B. Incoherent
 - C. Monochromatic
 - D. Both A and C
145. Sodium has 11 electrons. If the sequence in which the energy levels are filled is 1s, 2s, 2p, 3s, 3p, 4s, 3d, ..., the ground state of sodium is
- A. $^3\text{P}_{1/2}$
 - B. $^2\text{P}_{1/2}$
 - C. $^1\text{P}_{1/2}$
 - D. $^2\text{S}_{1/2}$

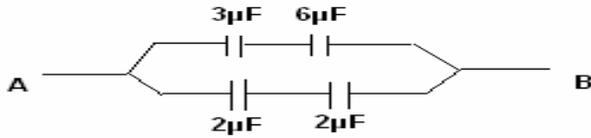
146. The de Broglie wave length of an electron of kinetic energy 500 eV is
- A. 14.82 Å
 - B. 24.82 Å
 - C. 34.82 Å
 - D. 44.82 Å
147. If a charged particle is moving in a uniform magnetic field, then
- A. its momentum changes but total energy remains same
 - B. both momentum and total energy remain the same
 - C. its total energy changes but momentum remains same
 - D. both momentum and total energy will change
148. An object is projected upwards with a velocity of 10 m/sec. If $g = 10 \text{ m/sec}^2$, then it will strike the ground in approximately
- A. 1 sec
 - B. 2 sec
 - C. 3 sec
 - D. 5 sec
149. Magnetic field does not cause deflection in
- A. γ -rays
 - B. β^- -rays
 - C. β^+ -rays
 - D. α -rays
150. The unit of Poynting vector is
- A. Watt per second
 - B. Watt per square metre
 - C. Watt per square metre per second
 - D. Watt per metre cube per second

151. A body completes one round of a circle of radius R in 20 seconds. The ratio of displacement to distance after 10 seconds is
- A. 11:7
 - B. $2R:R$
 - C. 7:11
 - D. $R:2R$
152. A convex lens focuses sunlight on white paper and black paper kept at focus. Which would start burning first?
- A. Black paper
 - B. White paper
 - C. Both burn at the same time
 - D. Depends on the material of the paper
153. Plane mirror always forms
- A. real and erect image
 - B. real and inverted image
 - C. virtual and erect image
 - D. virtual and inverted image
154. $1001\ 0110_{(2)} =$
- A. $96_{(10)}$
 - B. $150_{(10)}$
 - C. $128_{(10)}$
 - D. $256_{(10)}$

155. For production of beats the two sound sources must have
- A. different frequencies and same amplitude
 - B. different frequencies
 - C. different frequencies, same amplitude and same phase
 - D. different frequencies and same phase
156. Melting point of ice
- A. increases with increasing pressure
 - B. decreases with increasing pressure
 - C. is independent of pressure
 - D. is proportional to pressure
157. A particle executes SHM given by $y = 0.02 \sin(100 t)$. The amplitude and frequency are
- A. 0.02 and 100
 - B. 0.02 and $50/\pi$
 - C. 0.01 and 50
 - D. $1/0.02$ and $\pi/50$
158. If a body possesses velocities 3m/s, 6m/s, 9m/s, and 12m/s at the end of first, second, third and fourth seconds, then the body moves
- A. with uniform velocity
 - B. with uniform acceleration
 - C. with non-uniform acceleration
 - D. All of the above
159. Real image can be located on the screen
- A. true
 - B. false
 - C. depends on the object
 - D. depends on the screen

160. The Davisson and Germer's experiment proves the
- A. electromagnetic nature of light
 - B. particle nature of electron
 - C. wave nature of electron
 - D. free motion of electron
161. A current I flows along the length of an infinitely long straight, thin-walled pipe. Then
- A. the magnetic field at all points inside the pipe is the same, but not zero
 - B. the magnetic field at any point inside the pipe is zero
 - C. the magnetic field is zero only on the axis of the pipe
 - D. the magnetic field is different at different points inside the pipe
162. Two airplanes headed for the same destination leave an airport an hour apart. The one that leaves first travels at 300km/hr and the other travels at 400km/hr. The latter will overtake the former in
- A. 45min
 - B. 80min
 - C. 3hr
 - D. 4hr
163. The dimensional formula of angular momentum is
- A. $M L^2 T^{-2}$
 - B. $M L T^{-2}$
 - C. $M L^{-1} T^{-2}$
 - D. $M L^2 T^{-1}$

164. In the given circuit, the effective capacitance between A and B will be

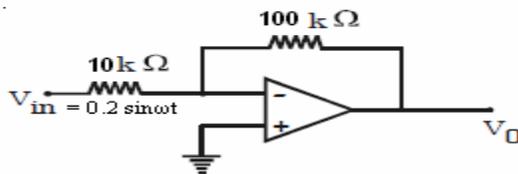


- A. $3 \mu\text{F}$
- B. $36/13 \mu\text{F}$
- C. $13 \mu\text{F}$
- D. $7 \mu\text{F}$

165. The colour of light emitted by a LED depends on

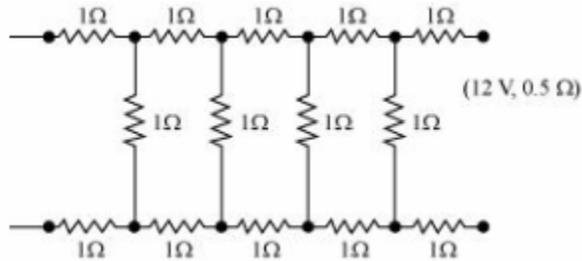
- A. its reverse bias
- B. amount of forward current
- C. its forward bias
- D. type of semiconductor material

166. The output of the given operational amplifier is



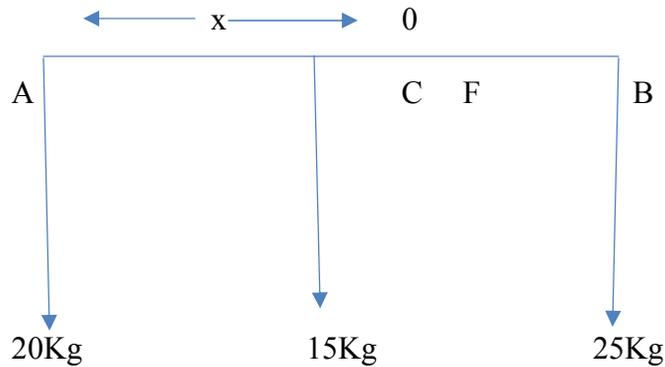
- A. $-2 \sin \omega t$
- B. $2 \sin \omega t$
- C. $-2 \sin (\omega t + 10^\circ)$
- D. $2 \sin (\omega t + 10^\circ)$

167. Determine the current drawn from a 12 V supply with internal resistance 0.5Ω by the infinite network shown in the given Fig. Each resistor has 1Ω resistance.



- A. 3.72 A
 B. 2.72 A
 C. 1.72 A
 D. 0.72 A
168. A closely wound solenoid of 2000 turns and area of cross section $1.6 \times 10^{-4} \text{ m}^2$ carrying a current of 4.0 A , is suspended through its centre allowing it to turn in a horizontal plane. What is the magnetic moment associated with the solenoid?
- A. 11.28 Am^2
 B. 0.28 Am^2
 C. 1.28 Am^2
 D. 2.28 Am^2
169. The head of a drop hammer is raised 2.5 m and then falls freely to strike the die. If the net mass of the hammer is 350 kg and the penetration of the hot metal is 17.5 mm , what is the average force?
- A. 490 N
 B. 490 kN
 C. 590 N
 D. 590 kN

170. A uniform rod of 4 m long weighing 15Kg is supported in a horizontal position on a fulcrum with weights of 20Kg and 25Kg suspended from its ends. The position of the fulcrum from 20Kg weight is

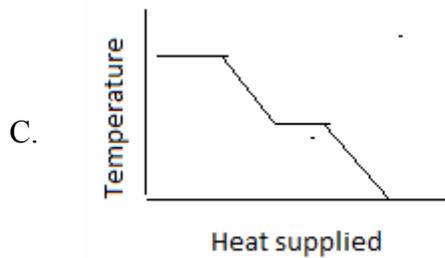
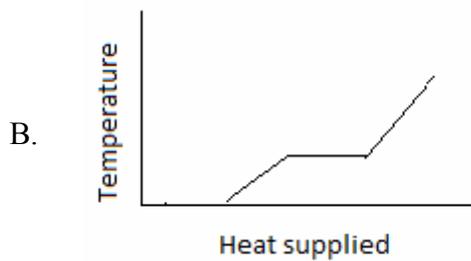
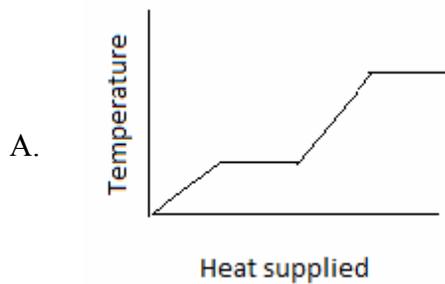


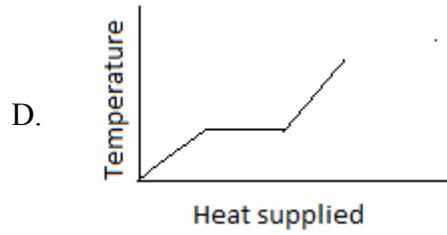
- A. 2.167m
 B. 1.167m
 C. 2.617m
 D. 1.617m
171. A river is flowing from west to east at a speed of 5m/min. A man on the south bank of the river capable of swimming at 10m/min in still water, wants to swim across the river in shortest time. He should swim in a direction
- A. Due north
 B. 30° west of north
 C. 30° east of north
 D. 60° east of north
172. A ball is thrown vertically upwards with an initial velocity of 19.6 m/s. The maximum height reached, when the air resistance is negligible, is
- A. 9.6 m
 B. 19.6 m
 C. 29.6 m
 D. 9.26 m

173. A tank is filled with water to a height of 12.5 cm. The apparent depth of a needle lying at the bottom of the tank is measured by a microscope to be 9.4 cm. What is the refractive index of water?
- A. 1.13
 - B. 1.23
 - C. 1.33
 - D. 1.43
174. In an npn transistor circuit, the collector current is 10mA. If 90% of the electrons emitted reach the collector,
- A. the emitter current will be nearly 9mA
 - B. the emitter current will be nearly 11mA
 - C. the base current will be nearly 9mA
 - D. the base current will be nearly -1mA
175. Two amplifiers are connected one after the other in series (cascaded). The first amplifier has a voltage gain of 10 and the second has a voltage gain of 20. If the input signal is 0.01 volt, calculate the output ac signal.
- A. 2V
 - B. 0.2V
 - C. 0.1V
 - D. 0.02V
176. A 30 g of aluminium plate is heated to 100° C and then transferred to 150 g of water at a temperature of 20° C. The final temperature of water was 25° C. Determine the specific heat of aluminium . (Specific heat of water is $4.2 \times 10^3 \text{ J/kg/K}$)
- A. 1.4 kJ/kg/K
 - B. 1.4 J/kg/K
 - C. 1.4 kJ/g/K
 - D. $1.4 \times 10^3 \text{ kJ/kg/K}$

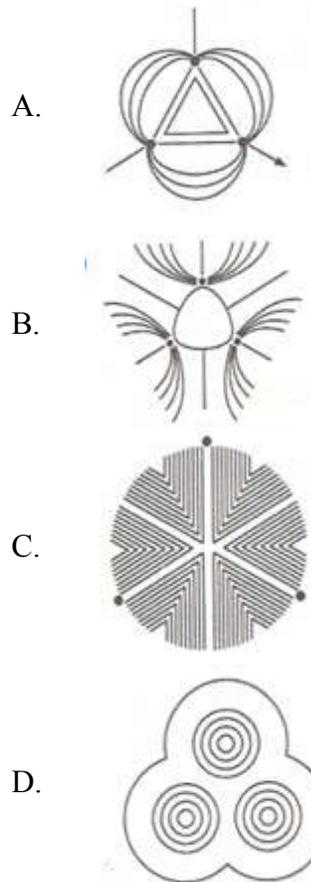
177. A Carnot engine whose low temperature reservoir is at 7°C has an efficiency of 50%. It is desired to increase the efficiency to 70%. By how many degrees should the temperature of the high temperature reservoir be increased?
- A. 473°C
 - B. 373.3°C
 - C. 473.3K
 - D. 373K
178. An open pipe has a fundamental frequency of 300 Hz. The first overtone of this organ pipe is the same as the first overtone of a closed organ pipe. The length of the closed organ pipe is
- A. 10 cm
 - B. 41 cm
 - C. 82 cm
 - D. 164 cm
179. Most suitable element for nuclear fission is the element with atomic number near
- A. 11
 - B. 21
 - C. 52
 - D. 92
180. In the relation $X = 3YZ^2$, X and Z represent the dimensions of capacitance and magnetic induction respectively. The dimensions of Y is
- A. $\text{M}^{-1}\text{T}^2\text{L}^{-2}\text{Q}^2$
 - B. $\text{MT}^{-1}\text{Q}^{-1}$
 - C. $\text{MT}^2\text{L}^{-2}\text{Q}^2$
 - D. $\text{M}^{-3}\text{T}^4\text{L}^{-2}\text{Q}^4$

181. A particle moves half the distance with velocity 'u' and the other half with velocity 'v' in the same straight line. Average velocity is
- A. $u + v$
 - B. $(2uv)/(u+v)$
 - C. $u+v/2$
 - D. $(uv)/(u+v)$
182. A block of ice at -10°C is slowly heated and converted to steam at 100°C . Which of the following curves represents the phenomenon qualitatively?





183. Three positive charges of equal value are placed at the vertices of an equilateral triangle. The resulting lines of forces should be sketched as



184. A transformer connected to a 120 V AC line is to supply 12V. The total equivalent resistance is 2Ω . What is the current supplied by secondary coil?

- A. 6A
 B. 5.5A
 C. 4.5A
 D. 3.8A

185. To get three images of a single object, one should have two plane mirrors at an angle of
- A. 90°
 - B. 120°
 - C. 30°
 - D. 160°
186. Reverse bias applied to a junction diode
- A. increases the minority carrier current
 - B. lowers the potential barrier
 - C. raises the potential barrier
 - D. increases the majority carrier current
187. When a potential of 30,000 V is applied in an X- ray tube, then the minimum wavelength of the emitted X- ray radiation is,
- A. 0.211 \AA
 - B. 0.413 \AA
 - C. 0.821 \AA
 - D. 1.54 \AA
188. A gas will behave as an ideal gas at
- A. High pressure and low temperature
 - B. High temperature and high pressure
 - C. At very low pressure and high temperature
 - D. None of the above
189. According to Bohr's model of hydrogen atom
- A. the angular velocity of the electron is quantized
 - B. the velocity of the electron is quantized
 - C. the liner momentum of the electron is quantized
 - D. momentum of the electron is quantized

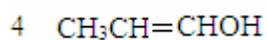
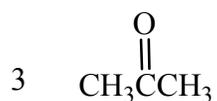
190. Bending of light around an obstacle is known as
- A. Diffraction
 - B. Reflection
 - C. Polarization
 - D. None of the above
191. The total mass of ions liberated at an electrode is proportional to the strength of the current and time of conduction of the current in electrolyte, according to
- A. Faraday's law
 - B. Joule's law
 - C. Thomson's law
 - D. None of the above
192. Two particles A and B having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of the mass of A to that of B is
- A. $(R_1/R_2)^{0.5}$
 - B. R_2/R_1
 - C. $(R_1/R_2)^2$
 - D. R_1/R_2
193. Which of the following quantity has the same dimensions as the latent heat?
- A. Work per unit mass
 - B. Specific heat per unit mass
 - C. Force per unit velocity
 - D. Acceleration per unit displacement

194. Which of the waves does not belong to electromagnetic wave spectrum?
- A. X-rays
 - B. Visible light
 - C. Sound waves
 - D. Infra-red rays
195. The resistance of the coil is ___ in tangent galvanometer in comparison with moving coil galvanometer
- A. same
 - B. low
 - C. high
 - D. None of the above
196. Which of the following is not a moderator in an atomic pile?
- A. Heavy water
 - B. Graphite
 - C. Beryllium
 - D. Boron
197. While measuring the thermal conductivity of a liquid, we keep the upper part hot and lower part cool, so that
- A. convection may be stopped
 - B. radiation may be stopped
 - C. heat conduction is easier downwards
 - D. it is easier and more convenient to do so
198. A spring of force constant k cut into three equal parts. The force constant of each part is
- A. k
 - B. $2k$
 - C. $3k$

- D. $k/3$
199. Two capillary tubes of different diameter are placed vertically in water. The rise of water is
- greater in tube of smaller diameter
 - greater in tube of larger diameter
 - same in both
 - zero in both
200. The magnitude and direction of the magnetic Lorentz force is given by
- $\vec{F} = (\vec{v} \times \vec{B})$
 - $\vec{F} = q / (\vec{v} \times \vec{B})$
 - $\vec{F} = q (\vec{v} \times \vec{B})$
 - $\vec{F} = V (\vec{q} \times \vec{B})$

CHEMISTRY

201. Which of the following is an isomer of compound 1?

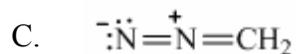
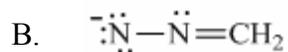
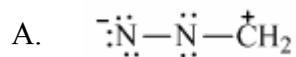


- 2
- 4

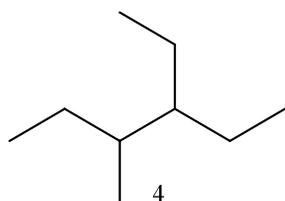
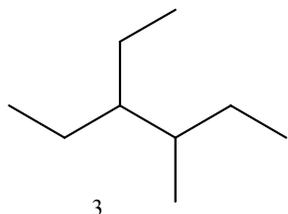
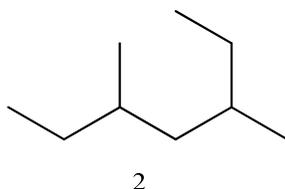
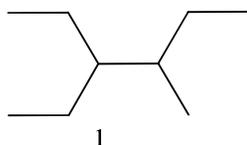
C. 2 and 3

D. All are isomers

202. Which one of the following is the most stable Lewis structure? The answer must be correct in terms of bonds, unshared pairs of electrons, and formal charges.



203. Choose the response that best describes the following compounds:



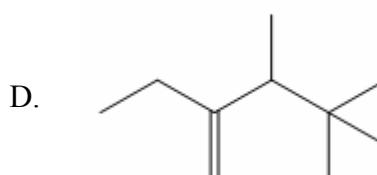
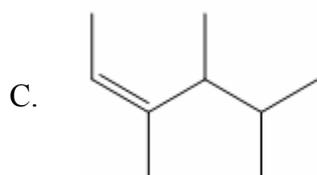
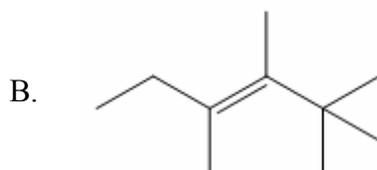
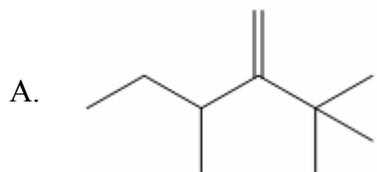
A. 1, 3 and 4 represent the same compound

B. 1 and 3 are isomers of 2 and 4

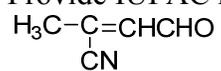
C. 1 and 4 are isomers of 2 and 3

D. All the structures represent the same compound

204. Which one of the alkenes shown below has the Z configuration of its double bond?

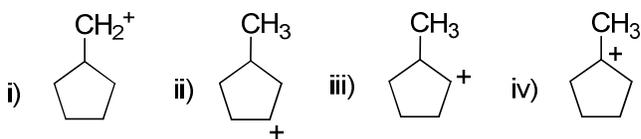


205. Provide IUPAC name of the compound



- A. 2-Methyl-4-oxobutenonitrile
- B. 2-Cyano-2-butenal
- C. 3-Cyano-2-butenal
- D. 3-Methyl-1-oxobutenonitrile

206. Arrange the following in the increasing order of stability of carbocations



A. $i > ii > iii > iv$

B. $i < ii < iii < iv$

C. $iv > iii > ii > i$

D. $iv < iii < ii < i$

207. Hydroboration oxidation of 1-methylcyclopentene will give

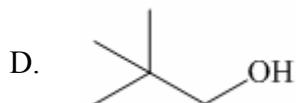
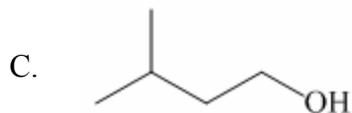
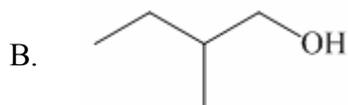
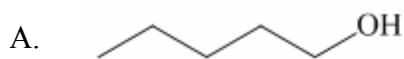
A. 1-methylcyclopentan-1-ol

B. trans-1-methylcyclopentan-2-ol

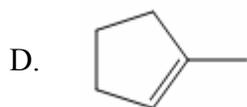
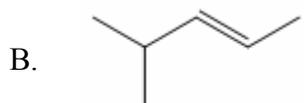
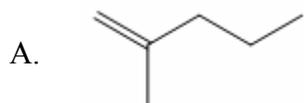
C. cis-1-methylcyclopentan-2-ol

D. mixture of B and C

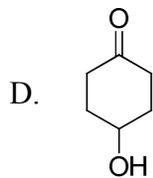
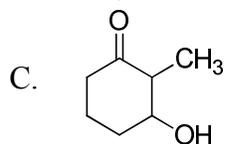
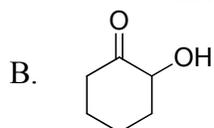
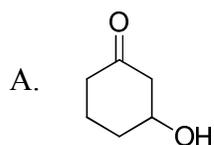
208. Which, if any, of the following alcohols cannot be prepared from an alkene?



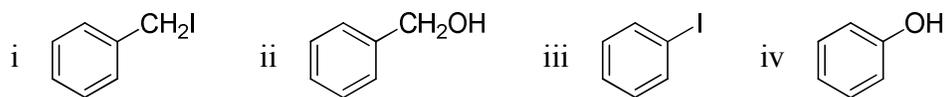
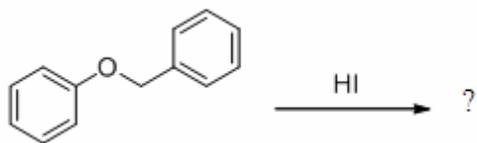
209. Which one of the following compounds gives acetone ($\text{CH}_3)_2\text{C}=\text{O}$ as one of the products of its ozonolysis?



210. Which of the following alcohol will have the faster rate of dehydration?



211. What are the products of the following reaction?

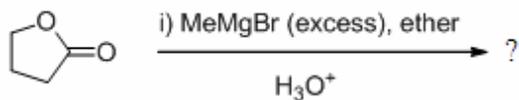


- A. i and iv
 B. ii and iii
 C. i and ii
 D. iii and iv

212. The compound is formed by an intramolecular aldol condensation of

- A.
- B.
- C. $\text{OHC}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CHO}$
- D. $\text{OHC}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CHO}$

213. The product of the following reaction is



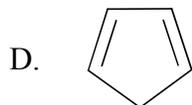
- A.
- B.
- C.
- D.

214. The amine which will give positive carbylamine test is

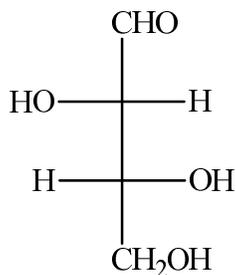
- A. p-methylamine
- B. N-methyl-o-methyl-aniline
- C. N, N – dimethylaniline
- D. diethylamine

215. Of the following molecular species, which is expected to show the greater stability?

- A.
- B.
- C.



216. The configurations of the chirality centers in D-threose (shown) are



- A. 2R, 3R
 B. 2R, 3S
 C. 2S, 3R
 D. 2S, 3S
217. Which phrase correctly completes the statement? “Except for glycine, which is achiral, all the amino acids present in proteins.....”
- A. are chiral, but racemic
 B. are meso forms
 C. have the L configuration at their α carbon
 D. have the R configuration at their α carbon
218. Which of the following process is responsible for the formation of delta at a place where rivers meet the sea?
- A. Emulsification
 B. Colloid formation
 C. Coagulation
 D. Peptisation

219. Match the following

(i) X-rays	(a) $\nu = 10^0 - 10^4$ Hz
(ii) UV	(b) $\nu = 10^{10}$ Hz
(iii) Long radio waves	(c) $\nu = 10^{16}$ Hz
(iv) Microwave	(d) $\nu = 10^{18}$ Hz

A. (i) \rightarrow (d); (ii) \rightarrow (c); (iii) \rightarrow (a); (iv) \rightarrow (b)

B. (i) \rightarrow (b); (ii) \rightarrow (c); (iii) \rightarrow (d); (iv) \rightarrow (a)

C. (i) \rightarrow (a); (ii) \rightarrow (b); (iii) \rightarrow (c); (iv) \rightarrow (d)

D. (i) \rightarrow (c); (ii) \rightarrow (b); (iii) \rightarrow (a); (iv) \rightarrow (d)

220. Which of the following terms are dimensionless?

(i) Molality

(ii) Molarity

(iii) Mole fraction

(iv) Mass percent

A. (iii) and (iv)

B. (iii) and (i)

C. (iii) and (ii)

D. (i) and (ii)

221. The number of radial nodes for 3p orbital is

A. 3

B. 4

C. 2

D. 1

222. Which of the following sets of quantum numbers are correct?

	<i>n</i>	<i>l</i>	<i>ml</i>
(i)	1	1	+2
(ii)	2	1	+1
(iii)	3	2	-2
(iv)	3	4	-2

- A. (i), (iii)
 B. (ii), (iv)
 C. (i), (iv)
 D. (ii), (iii)

223. Match the following rules with their statements:

Rules	Statements
(i) Hund's Rule	(a) No two electrons in an atom can have the same set of four quantum numbers.
(ii) Aufbau Principle	(b) Half-filled and completely filled orbitals have extra stability
(iii) Pauli Exclusion Principle	(c) Pairing of electrons in the orbitals belonging to the same subshell does not take place until each orbital is singly occupied.
(iv) Heisenberg's Uncertainty Principle	(d) It is impossible to determine the exact position and exact momentum of a subatomic particle simultaneously.
	(e) In the ground state of atoms, orbitals are filled in the order of their increasing energies.

- A. (i) → (a); (ii) → (b); (iii) → (c); (iv) → (d)
 B. (i) → (c); (ii) → (e); (iii) → (d); (iv) → (a)
 C. (i) → (c); (ii) → (e); (iii) → (a); (iv) → (d)
 D. (i) → (c); (ii) → (a); (iii) → (e); (iv) → (d)

224. The order of screening effect of electrons of s, p, d and f orbitals of a given shell of an atom on its outer shell electrons is
- A. $s > p > d > f$
 - B. $f > d > p > s$
 - C. $p < d < s > f$
 - D. $f > p > s > d$
225. Which of the following sets contain only isoelectronic ions?
- (i) $\text{Zn}^{2+}, \text{Ca}^{2+}, \text{Ga}^{3+}, \text{Al}^{3+}$
 - (ii) $\text{K}^+, \text{Ca}^{2+}, \text{Sc}^{3+}, \text{Cl}^-$
 - (iii) $\text{P}^{3-}, \text{S}^{2-}, \text{Cl}^-, \text{K}^+$
 - (iv) $\text{Ti}^{4+}, \text{Ar}, \text{Cr}^{3+}, \text{V}^{5+}$
- A. (ii) and (i)
 - B. (ii) and (iv)
 - C. (ii) and (iii)
 - D. (i) and (iv)
226. Which of the following have identical bond order?
- (i) CN^-
 - (ii) NO^+
 - (iii) O_2^-
 - (iv) O_2^{2-}
- A. (i) and (iii)
 - B. (i) and (iv)
 - C. (ii) and (iii)
 - D. (i) and (ii)
227. Metal hydrides are ionic, covalent or molecular in nature. Among LiH, NaH, KH, RbH, CsH, the correct order of increasing ionic character is
- A. $\text{LiH} > \text{NaH} > \text{CsH} > \text{KH} > \text{RbH}$
 - B. $\text{LiH} < \text{NaH} < \text{KH} < \text{RbH} < \text{CsH}$
 - C. $\text{RbH} > \text{CsH} > \text{NaH} > \text{KH} > \text{LiH}$

- D. $\text{NaH} > \text{CsH} > \text{RbH} > \text{LiH} > \text{KH}$
228. Hydrogen peroxide is
- A. an oxidising agent
 - B. a reducing agent
 - C. both an oxidising and a reducing agent
 - D. neither oxidising nor reducing agent
229. The order of decreasing ionisation enthalpy in alkali metals is
- A. $\text{Na} > \text{Li} > \text{K} > \text{Rb}$
 - B. $\text{Rb} < \text{Na} < \text{K} < \text{Li}$
 - C. $\text{Li} > \text{Na} > \text{K} > \text{Rb}$
 - D. $\text{K} < \text{Li} < \text{Na} < \text{Rb}$
230. Ionisation enthalpy for the elements of Group 13 follows the order.
- A. $\text{B} > \text{Al} > \text{Ga} > \text{In} > \text{Tl}$
 - B. $\text{B} < \text{Al} < \text{Ga} < \text{In} < \text{Tl}$
 - C. $\text{B} < \text{Al} > \text{Ga} < \text{In} > \text{Tl}$
 - D. $\text{B} > \text{Al} < \text{Ga} > \text{In} < \text{Tl}$
231. Which of the following statements is not true about classical smog?
- A. Its main components are produced by the action of sunlight on emissions of automobiles and factories.
 - B. Produced in cold and humid climate.
 - C. It contains compounds of reducing nature.
 - D. It contains smoke, fog and sulphur dioxide.

232. The consequences of global warming may be
- (i) increase in average temperature of the earth
 - (ii) melting of Himalayan Glaciers.
 - (iii) increased biochemical oxygen demand.
 - (iv) eutrophication
- A. (i) and (iii)
B. (i) and (iv)
C. (i) and (ii)
D. (ii) and (iii)
233. Glycerol is added to soap. It functions
- A. as a filler
B. to increase lathering
C. to prevent rapid drying
D. to make soap granules
234. Which of the following statements are incorrect about penicillin?
- (i) It is an antibacterial fungus.
 - (ii) Ampicillin is its synthetic modification.
 - (iii) It has bacteriostatic effect.
 - (iv) It is a broad spectrum antibiotic.
- A. (iii) and (iv)
B. (iii) and (i)
C. (iii) and (ii)
D. (i) and (ii)
235. What type of radiation decay causes the atomic number of a nucleus to be increased by one unit?
- A. electron capture
B. β emission
C. α emission

- D. γ -ray emission
236. The most radioactive of the isotopes of an element will be the one with the largest value of
- half life
 - neutron number
 - mass number
 - decay constant
237. Electrolytic refining is used to purify
- Cu and Zn
 - Ge and Si
 - Zr and Ti
 - Zn and Hg
238. Arrange the following complexes in the increasing order of crystal field splitting $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Co}(\text{CN})_6]^{3-}$, $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
- $[\text{Co}(\text{CN})_6]^{3-} > [\text{Co}(\text{NH}_3)_6]^{3+} > [\text{Co}(\text{H}_2\text{O})_6]^{3+}$
 - $[\text{Co}(\text{NH}_3)_6]^{3+} > [\text{Co}(\text{H}_2\text{O})_6]^{3+} > [\text{Co}(\text{CN})_6]^{3-}$
 - $[\text{Co}(\text{H}_2\text{O})_6]^{3+} > [\text{Co}(\text{NH}_3)_6]^{3+} > [\text{Co}(\text{CN})_6]^{3-}$
 - $[\text{Co}(\text{CN})_6]^{3-} > [\text{Co}(\text{NH}_3)_6]^{3+} > [\text{Co}(\text{H}_2\text{O})_6]^{3+}$
239. For a square planar complex, the order of energy of the d orbitals will be
- $d_{x^2-y^2} < d_{xy} < d_{z^2} < d_{xz} = d_{yz}$
 - $d_{xy} < d_{x^2-y^2} < d_{xz} = d_{yz} < d_{z^2}$
 - $d_{xz} = d_{yz} < d_{z^2} < d_{xy} < d_{x^2-y^2}$
 - $d_{xz} = d_{yz} < d_{z^2} < d_{xy} \ll d_{x^2-y^2}$

240. How does the surface tension of a liquid vary with increase in temperature?
- A. Remains same
 - B. Decreases
 - C. Increases
 - D. No regular pattern is followed
241. The processes which occur spontaneously are
- (i) flow of heat from colder to warmer body
 - (ii) the ionization of hydrogen chloride when $\text{HCl}(\text{g})$ dissolves in water.
 - (iii) the formation of sodium and chlorine from a vigorously stirred aqueous solution of NaCl
 - (iv) burning carbon in oxygen to give carbon dioxide
- A. (ii) and (iv)
 - B. (ii) and (iii)
 - C. (ii) and (i)
 - D. (i) and (iii)
242. Acidity of BF_3 can be explained on the basis of which of the following concepts?
- A. Arrhenius concept
 - B. Bronsted Lowry concept
 - C. Lewis concept
 - D. Bronsted Lowry as well as Lewis concept

243. At a particular temperature and atmospheric pressure, the solid and liquid phases of a pure substance can exist in equilibrium. Which of the following term defines this temperature?
- (i) Normal melting point
 - (ii) Equilibrium temperature
 - (iii) Boiling point
 - (iv) Freezing point
- A. (i) and (ii)
B. (i) and (iv)
C. (i) and (iii)
D. (ii) and (iii)
244. Which of the following electrodes will act as anodes, when connected to Standard Hydrogen Electrode?
- (i) Al/Al^{3+} $E = -1.66\text{V}$
 - (ii) Fe/Fe^{2+} $E = -0.44\text{V}$
 - (iii) Cu/Cu^{2+} $E = +0.34\text{V}$
 - (iv) $\text{F}_2(\text{g})/2\text{F}^-(\text{aq})$ $E = +2.87\text{V}$
- A. (i) and (iii)
B. (i) and (iv)
C. (ii) and (iii)
D. (i) and (ii)
245. Colligative properties depend on
- A. the nature of the solute particles dissolved in solution.
 - B. the number of solute particles in solution.
 - C. the physical properties of the solute particles dissolved in solution.
 - D. the nature of solvent particles.

246. The percentage of empty space in a body centred cubic arrangement is
- A. 74
 - B. 68
 - C. 32
 - D. 26
247. Rate law for the reaction $A + 2B \rightarrow C$ is found to be $\text{Rate} = k [A][B]$. If concentration of reactant 'B' is doubled, keeping the concentration of 'A' constant, the value of rate constant will be
- A. the same
 - B. doubled
 - C. quadrupled
 - D. halved
248. Unit of first order reaction is
- A. $\text{mol L}^{-1}\text{s}^{-1}$
 - B. s^{-1}
 - C. $\text{mol}^{-1} \text{L s}^{-1}$
 - D. $\text{mol L}^{-2}\text{s}^{-2}$
249. Which one of the following is **not** applicable to the phenomenon of adsorption?
- A. $\Delta H > 0$
 - B. $\Delta G < 0$
 - C. $\Delta S < 0$
 - D. $\Delta H < 0$

250. Which of the following substances will precipitate the negatively charged emulsions?

- (i) KCl
- (ii) glucose
- (iii) urea
- (iv) NaCl

- A. (i) and (ii)
- B. (i) and (iii)
- C. (ii) and (iii)
- D. (i) and (iv)
