AIEEE 2004 Paper 1 (B.E./B.Tech) May 20 Single sitting (Offline) Question Paper

Conducted by the Central Board of Secondary Education (CBSE)

Time Allowed: Separate sittings **B.E./B.Tech.** **Maximum Marks: 675**

General Instructions

(i) This is the **All India Engineering Entrance Examination (AIEEE) 2004** engineering examination, conducted by the **Central Board of Secondary Education (CBSE)** on **20 May 2004**.

(ii) This edition combines the original **Physics and Chemistry paper** (150 questions, 450 marks) and the **Mathematics paper** (75 questions, 225 marks).

(iii) The original timings apply separately: **Physics and Chemistry: 2 hours 30 minutes**; **Mathematics: 1 hour 30 minutes**. The break between sittings is not examination time.

(iv) The subjects appear in this edition in the order **Mathematics, Physics and Chemistry**. Questions are numbered continuously. All questions have four options; select one correct response.

(v) Each correct response carries **+3 marks**; each incorrect response carries **-1 mark**. An unanswered question carries **0 marks**.

1. Let $R = \{(1,3),(4,2),(2,4),(2,3),(3,1)\}$ be a relation on the set $A = \{1,2,3,4\}$. The relation R is :

(1) a function

(2) transitive

(3) not symmetric

(4) reflexive

2. The range of the function f(x) $= {}^{7-x}P_{x-3}$ is

(1) {1, 2, 3, 4, 5}

(2) {1, 2, 3, 4, 5, 6}

(3) {1, 2, 3, 4}

(4) {1, 2, 3}

3. Let z and w be complex numbers such that $\overline{z} + i\overline{w} = 0$ and arg zw $= \pi$. Then arg z equals :

(1) $\frac{5\pi}{4}$

(2) $\frac{\pi}{2}$

(3) $\frac{3\pi}{4}$

(4) $\frac{\pi}{4}$

4. If $S_n = \sum_{r=0}^{n} \frac{1}{{}^nC_r}$ *and* $t_n = \sum_{r=0}^{n} \frac{r}{{}^nC_r}$, then $\frac{t_n}{S_n}$ is equal to

(1) $\frac{2n-1}{2}$

(2) $\frac{1}{2}n - 1$

(3) n - 1

(4) $\frac{1}{2}n$

5. If $|z^2 - 1| = |z|^2 + 1$, then z lies on :

(1) an ellipse

(2) the imaginary axis

(3) a circle

(4) the real axis

6. Let $A = \begin{pmatrix} 0 & 0 & -1 \\ 0 & -1 & 0 \\ -1 & 0 & 0 \end{pmatrix}$. The only correct statement about the matrix A is

(1) $A^2 = 1$

(2) $A = (-1)I$, where I is a unit matrix

(3) A^{-1} does not exist

(4) A is a zero matrix

7. Let $A = \begin{pmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{pmatrix}$. and 10 $B = \begin{pmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{pmatrix}$. if B is the inverse of matrix A, then α is

(1) 5

(2) -1

(3) 2

(4) -2

8. If $a_1, a_2, a_3, \ldots, a_n, \ldots$ are in G.P., then the value of the determinant $\begin{vmatrix} \log a_n & \log a_{n+1} & \log a_{n+2} \\ \log a_{n+3} & \log a_{n+4} & \log a_{n+5} \\ \log a_{n+6} & \log a_{n+7} & \log a_{n+8} \end{vmatrix}$, is

(1) 0

(2) -2

(3) 2

(4) 1

9. Let two numbers have arithmetic mean 9 and geometric mean 4. Then these numbers are the roots of the quadratic equation

(1) $x^2 - 18x - 16 = 0$

(2) $x^2 - 18x + 16 = 0$

(3) $x^2 + 18x - 16 = 0$

(4) $x^2 + 18x + 16 = 0$

10. If $(1-p)$ is a root of quadratic equation $x^2 + px + (1-p) = 0$ then its root are

(1) $-1, 2$

(2) $-1, 1$

(3) $0, -1$

(4) $0, 1$

11. Let $S(K) = 1 + 3 + 5... + (2K-1) = 3 + K^2$. Then which of the following is true

(1) Principle of mathematical induction can be used to prove the formula

(2) $S(K) \Rightarrow S(K+1)$

(3) $S(K) \neq S(K+1)$

(4) $S(1)$ is correct

12. How many ways are there to arrange the letters in the word GARDEN with vowels in alphabetical order

(1) 480

(2) 240

(3) 360

(4) 120

13. The number of ways of distributing 8 identical balls in 3 distinct boxes so that none of the boxes is empty is

(1) ${}^8C_3$

(2) 21

(3) 3^8

(4) 5

14. If one root of the equation $x^2 + px + 12 = 0$ is 4, while the equation $x^2 + px + q = 0$ has equal roots,
then the value of 'q' is

(1) 4

(2) 12

(3) 3

(4) $\frac{49}{4}$

15. The coefficient of the middle term in the binomial expansion in powers of x of $(1+\alpha x)^4$ and $(1-\alpha x)^6$ is the same if α equals

(1) $\frac{3}{5}$

(2) $\frac{10}{3}$

(3) $\frac{-3}{10}$

(4) $\frac{-5}{3}$

16. The coefficient of x^n in expansion of $(1+x)(1-x)^n$ is

(1) $(-1)^{n-1}n$

(2) $(-1)^n(1-n)$

(3) $(-1)^{n-1}(n-1)^2$

(4) $(n-1)$

17. If $S_n = \sum_{r=0}^{n} \frac{1}{{}^nC_r}$ and $t_n = \sum_{r=0}^{n} \frac{r}{{}^nC_r}$, then $\frac{t_n}{S_n}$ is equal to

(1) $\frac{1}{2}n$

(2) $\frac{1}{2}n - 1$

(3) $n - 1$

(4) $\frac{2n-1}{2}$

18. Let T_r be the rth term of an A.P. whose first term is a and common difference is d. If for some positive integers m, n, $m \neq n$, $T_m = \frac{1}{n}$ and $T_n = \frac{1}{m}$, then a - d equals

(1) $\frac{1}{m} + \frac{1}{n}$

(2) 1

(3) $\frac{1}{mn}$

(4) 0

19. The sum of the first n terms of the series $1^2 + 2.2^2 + 3^2 + 2.4^2 + 5^2 + 2.6^2 + ... is \frac{n(n+1)^2}{2}$ when n is even. When n is odd the sum is

(1) $\left[\frac{n(n+1)}{2}\right]^2$

(2) $\frac{n^2(n+1)}{2}$

(3) $\frac{n(n+1)^2}{4}$

(4) $\frac{3n(n+1)}{2}$

20. The sum of series $\frac{1}{2!} + \frac{1}{4!} + \frac{1}{6!} + ...$ is

(1) $\frac{(e^2-2)}{e}$

(2) $\frac{(e-1)^2}{2e}$

(3) $\frac{(e^2-1)}{2e}$

(4) $\frac{(e^2-1)}{2}$

21. Let α, β be such that $\pi < \alpha - \beta < 3\pi$. If $sin\alpha + \sin\beta = -\frac{21}{65}$ and $\cos\alpha + \cos\beta = -\frac{27}{65}$ then the value of $\cos\frac{\alpha-\beta}{2}$:

(1) $\frac{-6}{65}$

(2) $\frac{3}{\sqrt{130}}$

(3) $\frac{6}{65}$

(4) $-\frac{3}{\sqrt{130}}$

22. If $u = \sqrt{a^2\cos^2\theta + b^2\sin^2\theta} + \sqrt{a^2\sin^2\theta + b^2\cos^2\theta}$

then the difference between the maximum and minimum values of u^2 is given by :

(1) $(a-b)^2$

(2) $2\sqrt{a^2+b^2}$

(3) $(a+b)^2$

(4) $2\left(a^2+b^2\right)$

23. The sides of a triangle are $\sin\alpha$, $\cos\alpha$ and $\sqrt{1+\sin\alpha\cos\alpha}$ for some $0 < \alpha < \pi/2$. Then the greatest angle of the triangle is

(1) 60°

(2) 90°

(3) 120°

(4) 150°

24. A person standing on the bank of a river observes that the angle of elevation of the top of a tree on the opposite bank of the river is 60° and when he retires 40 meters away from the tree the angle of elevation becomes 30°. The breadth of the river is :

(1) 60 m

(2) 30 m

(3) 40 m

(4) 20 m

25. If $f : R \to S$, defined by $f(x) = \sin x - \sqrt{3}\cos x + 1$, is onto, then the interval of S is

(1) [-1, 3]

(2) [-1, 1]

(3) [0, 1]

(4) [0, 3]

26. The graph of the function y = f(x) is symmetrical about the line x = 2, then

(1) $f(x) = -f(-x)$

(2) $f(2+x) = f(2-x)$

(3) $f(x) = f(-x)$

(4) $f(x+2) = f(x-2)$

27. The domain of the function $f(x) = \frac{\sin^{-1}(x-3)}{\sqrt{9-x^2}}$

(1) [1, 2]

(2) [2, 3)

(3) [1, 2)

(4) [2, 3]

28.

If $\lim_{x\to\infty}\left(1+\frac{a}{x}+\frac{b}{x^2}\right)^{2x} = e^2$, then the values of a and b, are

(1) $a \in \underline{R}, b \in \underline{R}$

(2) $a = 1,\ b \in \underline{R}$

(3) $a \in \underline{\underline{R}}, b = \overline{2}$

(4) $a = 1$ and $b = 2$

29. Let $f(x) = \frac{1-\tan x}{4x-\pi}$, $x \neq \frac{\pi}{4}$, $x \in \left[0, \frac{\pi}{2}\right]$.

If $f(x)$ is continuous in $\left[0, \frac{\pi}{2}\right]$, then $f\left(\frac{\pi}{4}\right)$ is

(1) -1

(2) $\frac{1}{2}$

(3) $-\frac{1}{2}$

(4) 1

30. If $x = e^{y+e^{y+\ldots\text{to}\infty}}$, $x > 0$, then $\frac{dy}{dx}$ is

(1) $\frac{x}{1+x}$

(2) $\frac{1}{x}$

(3) $\frac{1-x}{x}$

(4) $\frac{1+x}{x}$

31. A point on the parabola $y^2 = 18x$ at which the ordinate increases at twice the rate of the abscissa is

(1) $\left(\frac{9}{8}, \frac{9}{2}\right)$

(2) $(2, -4)$

(3) $\left(\frac{-9}{8}, \frac{9}{2}\right)$

(4) $(2, 4)$

32. A function $y = f(x)$ has a second order derivative $f''(x) = 6(x-1)$. If its graph passes through the point $(2, 1)$ and at that point the tangent to the graph is $y = 3x - 5$, then the function is :

(1) $(x+1)^2$

(2) $(x-1)^3$

(3) $(x+1)^3$

(4) $(x-1)^2$

33. The normal to the curve $x = a(1+\cos\theta)$, $y = a\sin\theta$ at 'θ' always passes through the fixed point

(1) (a, a)

(2) $(0, a)$

(3) $(0, 0)$

(4) $(a, 0)$

34. If $2a + 3b + 6c = 0$, then at least one root of the equation $ax^2 + bx + c = 0$ lies in the interval

(1) $(1, 3)$

(2) $(1, 2)$

(3) $(2, 3)$

(4) $(0, 1)$

35. $\lim_{n\to\infty}\sum_{r=1}^{n}\frac{1}{n}e^{\frac{r}{n}}$ is

(1) $e+1$

(2) $e-1$

(3) $1-e$

(4) e

36.

If $\int\frac{\sin x}{\sin(x-\alpha)}dx = Ax + B\log\sin(x-\alpha) + C$, then value of (A, B) is

(1) ($\sin\alpha$, $\cos\alpha$)

(2) ($\cos\alpha$, $\sin\alpha$)

(3) (- $\sin\alpha$, $\cos\alpha$)

(4) (- $\cos\alpha$, $\sin\alpha$)

37. $\int \frac{dx}{\cos x - \sin x}$ is equal to

(1) $\frac{1}{\sqrt{2}} \log \left|\tan\left(\frac{x}{2} - \frac{\pi}{8}\right)\right| + C$

(2) $\frac{1}{\sqrt{2}} \log \left|\cot\left(\frac{x}{2}\right)\right| + C$

(3) $\frac{1}{\sqrt{2}} \log \left|\tan\left(\frac{x}{2} - \frac{3\pi}{8}\right)\right| + C$

(4) $\frac{1}{\sqrt{2}} \log \left|\tan\left(\frac{x}{2} + \frac{3\pi}{8}\right)\right| + C$

38. The value of $\int_{-2}^{3} \left|1 - x^2\right| dx$ is

(1) $\frac{1}{3}$

(2) $\frac{14}{3}$

(3) $\frac{7}{3}$

(4) $\frac{28}{3}$

39. The value of $I = \int_0^{\pi/2} \frac{(\sin x + \cos x)^2}{\sqrt{1 + \sin 2x}} dx$ is

(1) 0

(2) 1

(3) 2

(4) 3

40. If $\int_0^{\pi} x f(\sin x)\, dx = A \int_0^{\pi/2} f(\sin x)\, dx$, then A is

(1) 0

(2) π

(3) $\pi/4$

(4) 2π

41. If $f(x) = \frac{e^x}{1 + e^x}, I_1 = \int_{f(-a)}^{f(a)} x g\{x(1-x)\} dx$ and $I_2 = \int_{f(-a)}^{f(a)} g\{x(1-x)\} dx$, then the value of $\frac{I_2}{I_1}$ is

(1) 1

(2) -3

(3) -1

(4) 2

42. The area of the region bounded by the curves $y = |x - 2|, x = 1, x = 3$ and the x-axis is :

(1) 4

(2) 2

(3) 3

(4) 1

43. The differential equation for the family of circle $x^2 + y^2 - 2ay = 0$, where a is an arbitrary constant is :

(1) $\left(x^2 + y^2\right) y' = 2xy$

(2) $2\left(x^2 + y^2\right) y' = xy$

(3) $\left(x^2 - y^2\right) y' = 2xy$

(4) $2\left(x^2 - y^2\right) y' = xy$

44. The solution of the differential equation y dx + $(x + x^2y)$ dy = 0 is

(1) $-\frac{1}{xy} = C$

(2) $-\frac{1}{xy} + \log y = C$

(3) $\frac{1}{xy} + \log y = C$

(4) log y = Cx

45. 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 :

(1) $3x - 2y = 3$

(2) $2x - 3y = 7$

(3) $3x + 2y = 5$

(4) $2x + 3y = 9$

46. The equation of the straight line passing through the point $(4, 3)$ and making intercepts on the co-ordinate axes whose sum is -1 is :

(1) $\frac{x}{2} - \frac{y}{3} = 1$ and $\frac{x}{-2} + \frac{y}{1} = 1$

(2) $\frac{x}{2} - \frac{y}{3} = -1$ and $\frac{x}{-2} + \frac{y}{1} = -1$

(3) $\frac{x}{2} + \frac{y}{3} = 1$ and $\frac{x}{2} + \frac{y}{1} = 1$

(4) $\frac{x}{2} + \frac{y}{3} = -1$ and $\frac{x}{-2} + \frac{y}{1} = -1$

47. If the sum of the slopes of the lines given by $x^2 - 2cxy - 7y^2 = 0$ is four times their product c has the value :

(1) -2

(2) -1

(3) 2

(4) 1

48. If one of the lines given by $6x^2 - xy + 4cy^2 = 0$ is $3x + 4y = 0$, then c equals :

(1) -3

(2) -1

(3) 3

(4) 1

49. If a circle passes through the point (a, b) and cuts the circle $x^2 + y^2 = 4$ orthogonally, then the locus of its centre is :

(1) $2ax - 2by - (a^2 + b^2 + 4) = 0$

(2) $2ax + 2by - (a^2 + b^2 + 4) = 0$

(3) $2ax - 2by + (a^2 + b^2 + 4) = 0$

(4) $2ax + 2by + (a^2 + b^2 + 4) = 0$

50. A variable circle passes through the fixed point A (p, q) and touches x-axis. The locus of the other end of the diameter through A is :

(1) $(y - q)^2 = 4px$

(2) $(x - q)^2 = 4py$

(3) $(y - p)^2 = 4qx$

(4) $(x - p)^2 = 4qy$

51. If the lines 2x + 3y + 1 + 0 and 3x - y - 4 = 0 lie along diameter of a circle of circumference 10π, then the equation of the circle is :

(1) $x^2 + y^2 + 2x - 2y - 23 = 0$

(2) $x^2 + y^2 - 2x - 2y - 23 = 0$

(3) $x^2 + y^2 + 2x + 2y - 23 = 0$

(4) $x^2 + y^2 - 2x + 2y - 23 = 0$

52. Intercept on the line y = x by the circle $x^2 + y^2 - 2x = 0$ is AB. Equation of the circle on AB as a diameter is :

(1) $x^2 + y^2 + x - y = 0$

(2) $x^2 + y^2 - x + y = 0$

(3) $x^2 + y^2 + x + y = 0$

(4) $x^2 + y^2 - x - y = 0$

53. If $a \neq 0$ and the line $2bx + 3cy + 4d = 0$ passes through the points of intersection of the parabolas $y^2 = 4ax$ and $x^2 = 4ay$, then :

(1) $d^2 + (3b - 2c)^2 = 0$

(2) $d^2 + (3b + 2c)^2 = 0$

(3) $d^2 + (2b - 3c)^2 = 0$

(4) $d^2 + (2b + 3c)^2 = 0$

54. The eccentricity of an ellipse, with its centre at the origin, is $\frac{1}{2}$. If one of the directrices is $x = 4$, then the equation of the ellipse is :

(1) $4x^2 + 3y^2 = 1$

(2) $3x^2 + 4y^2 = 12$

(3) $4x^2 + 3y^2 = 12$

(4) $3x^2 + 4y^2 = 1$

55. A line makes the same angle θ, with each of the x and z axis.

If the angle β , which it makes with y-axis, is such that $\sin^2\beta = 3\sin^2\theta$, then $\cos^2\theta$ equals :

(1) $\frac{2}{5}$

(2) $\frac{1}{5}$

(3) $\frac{3}{5}$

(4) $\frac{2}{3}$

56. Distance between two parallel planes

$2x + y + 2z = 8$ and $4x + 2y + 4z + 5 = 0$ is :

(1) $\frac{9}{2}$

(2) $\frac{5}{2}$

(3) $\frac{7}{2}$

(4) $\frac{3}{2}$

57. A line with direction cosines proportional to $2, 1, 2$ meets each of the lines $x = y + a = z$ and $x + a = 2y = 2z$. The co-ordinates of each of the points of intersection are given by :

(1) $(2a, 3a, 3a)\,, (2a, a, a)$

(2) $(3a, 2a, 3a)\,, (a, a, a)$

(3) $(3a, 2a, 3a)\,, (a, a, 2a)$

(4) $(3a, 3a, 3a)\,, (a, a, a)$

58. If the straight lines $x = 1 + s, y = -3 - \lambda s$, $z = 1 + \lambda s$ and $x = \frac{t}{2}, y = 1 + t, z = 2 - t$, with parameters s and t respectively, are co-planar, then λ equals :

(1) 0

(2) -1

(3) $-\frac{1}{2}$

(4) -2

59. The intersection of the spheres $x^2 + y^2 + z^2 + 7x - 2y - z = 13$ and $x^2 + y^2 + z^2 - 3x + 3y + 4z = 8$ is the same as the intersection of one of the sphere and the plane

(1) $2x - y - z = 1$

(2) $x - 2y - z = 1$

(3) $x - y - 2z = 1$

(4) $x - y - z = 1$

60. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three non-zero vectors such that no two of these are collinear. If the vector $\vec{a} + 2\vec{b}$ is collinear with $\vec{c}$ and $\vec{b} + 3\vec{c}$ is collinear with $\vec{a}$ (λ being some non-zero scalar) then $\vec{a} + 2\vec{b} + 6\vec{c}$ equals to :

(1) $\vec{0}$

(2) $\lambda\vec{b}$

(3) $\lambda\vec{c}$

(4) $\lambda\vec{a}$

61. A particle is acted upon by constant forces $4\hat{i} + \hat{j} - 3\hat{k}$ and $3\hat{i} + \hat{j} - \hat{k}$ which displace it from a point $\hat{i} + 2\hat{j} + 3\hat{k}$ to the point $5\hat{i} + 4\hat{j} + \hat{k}$. The work done in standard units by the forces is given by

(1) 40

(2) 30

(3) 25

(4) 15

62. If $\vec{a}$, $\vec{b}$, $\vec{c}$ are non-coplanar vectors and λ is a real number, then the vectors $\vec{a} + 2\vec{b} + 3\vec{c}$, $\lambda\vec{b} + 4\vec{c}$ and $(2\lambda - 1)\vec{c}$ are non coplanar for :

(1) no value of λ

(2) all except one value of λ

(3) all except two values of λ

(4) all values of λ

63. Let $\vec{u}, \vec{v}, \vec{w}$ be such that $\left|\vec{u}\right| = 1$, $\left|\vec{v}\right| 2$, $\left|\vec{w}\right| 3$. If the projection $\vec{v}$ along $\vec{u}$ is equal to that of $\vec{w}$ along $\vec{u}$ and $\vec{v}$, $\vec{w}$ are perpendicular to each other then $\left|\vec{u} - \vec{v} + \vec{w}\right|$ equals :

(1) 14

(2) $\sqrt{7}$

(3) $\sqrt{14}$

(4) 2

64. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be non-zero vectors such that $\left(\vec{a} \times \vec{b}\right) \times \vec{c} = \frac{1}{3}\left|\vec{b}\right|\left|\vec{c}\right|\vec{a}$. If θ is the acute angle between the vectors $\vec{b}$ and $\vec{c}$, then $sin\theta$ equals :

(1) $\frac{2\sqrt{2}}{3}$

(2) $\frac{\sqrt{2}}{3}$

(3) $\frac{2}{3}$

(4) $\frac{1}{3}$

65. Consider the following statements:
(a) Mode can be computed from histogram
(b) Median is not independent of change of scale
(c) Variance is independent of change of origin and scale.
Which of these is/are correct?

(1) only (a)

(2) only (b)

(3) only (a) and (b)

(4) (a), (b) and (c)

66. In a series of 2n observations, half of them equal a and remaining half equal $-a$. If the standard deviation of the observations is 2, then $|a|$ equals

(1) 2

(2) $\sqrt{2}$

(3) $\frac{1}{n}$

(4) $\frac{\sqrt{2}}{n}$

67. The probability that A speaks truth is $\frac{4}{5}$, while the probability for B is $\frac{3}{4}$. The probability that they contradict each other when asked to speak on a fact is :

(1) $\frac{4}{5}$

(2) $\frac{1}{5}$

(3) $\frac{7}{20}$

(4) $\frac{3}{20}$

68. A random variable X has the probability distribution :
X : 1, 2, 3, 4, 5, 6, 7, 8
$p(X)$: 0.15, 0.23, 0.12, 0.10, 0.20, 0.08, 0.07, 0.05
For the events $E = \{X \text{ is a prime number}\}$ and $F = \{X < 4\}$, the probability $P(E \cup F)$ is

(1) 0.87

(2) 0.77

(3) 0.35

(4) 0.50

69. The mean and the variance of a binomial distribution are 4 and 2 respectively. Then the probability of 2 successes is :

(1) $\frac{28}{256}$

(2) $\frac{219}{256}$

(3) $\frac{128}{256}$

(4) $\frac{37}{256}$

70. With two forces acting at a point, the maximum effect is obtained when their resultant is 4N. If they act at right angles, then their resultant is 3N. Then the forces are

(1) $(2+\sqrt{2})$N and $(2-\sqrt{2})$N

(2) $(2+\sqrt{3})$N and $(2-\sqrt{3})$N

(3) $(2+\frac{1}{2}\sqrt{2})$N and $(2-\frac{1}{2}\sqrt{2})$N

(4) $(2+\frac{1}{2}\sqrt{3})$N and $(2-\frac{1}{2}\sqrt{3})$N

71. In a right angle $\triangle ABC$, $\angle A = 90^\circ$ and sides a, b, c are respectively, 5 cm, 4 cm and 3 cm. If a force F has moments 0, 9 and 16 in N cm units respectively about vertices A, B and C, then magnitude of F is

(1) 3

(2) 4

(3) 5

(4) 9

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72. Three forces P, Q and R acting along IA, IB and IC, where I is the incentre of a $\triangle ABC$, are in equilibrium. Then P:Q:R is

(1) $\cos(A/2) : \cos(B/2) : \cos(C/2)$

(2) $\sin(A/2) : \sin(B/2) : \sin(C/2)$

(3) $\sec(A/2) : \sec(B/2) : \sec(C/2)$

(4) $\text{cosec}(A/2) : \text{cosec}(B/2) : \text{cosec}(C/2)$

73. A particle moves towards east from a point A to a point B at the rate of 4 km/h and then towards north from B to C at the rate of 5 km/h. If AB = 12 km and BC = 5 km, then its average speed for its journey from A to C and resultant average velocity direct from A to C are respectively

(1) 17/4, 13/4 km/h

(2) 13/4, 17/4 km/h

(3) 17/9, 13/9 km/h

(4) 13/9, 17/9 km/h

74. A velocity $\frac{1}{4}$ m/s is resolved into two components along OA and OB making angles 30° and 45° respectively with the given velocity. Then the component along OB is

(1) 1/8

(2) $\frac{1}{4}(\sqrt{3}-1)$

(3) 1/4

(4) $\frac{1}{8}(\sqrt{6}-\sqrt{2})$

75. If t_1 and t_2 are the times of flight of two particles having the same initial velocity u and range R on the horizontal, then $t_1^2 + t_2^2$ is equal to

(1) u^2/g

(2) $4u^2/g^2$

(3) $u^2/2g$

(4) 1

76. Which one of the following represents the correct dimensions of the coefficient of viscosity?

(1) $ML^{-1}T^{-1}$

(2) MLT^{-1}

(3) $ML^{-1}T^{-2}$

(4) $ML^{-2}T^{-2}$

77. A particle moves in a straight line with retardation proportional to its displacement. Its loss of kinetic energy for any displacement x is proportional to

(1) x

(2) e^x

(3) x^2

(4) $\log_e x$

78. A ball is released from the top of a tower of height h meters. It takes T seconds to reach the ground. What is the position of the ball in $\frac{T}{3}$ seconds?

(1) $\frac{8h}{9}$ meters from the ground

(2) $\frac{7h}{9}$ meters from the ground

(3) $\frac{h}{9}$ meters from the ground

(4) $\frac{7h}{18}$ meters from the ground

79. If $\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$, then the angle beetween A and B is

(1) $\frac{\pi}{2}$

(2) $\frac{\pi}{3}$

(3) π

(4) $\frac{\pi}{4}$

80. A projectile can have the same range 'R' for two angles of projection. If T_1 and T_2 be the time of flights in the two cases, then the product of the two time of flights is directly proportional to

(A) $\frac{1}{R^2}$

(B) $\frac{1}{R}$

(C) R

(D) R^2

81. Which of the following statements is **FALSE** for a particle moving in a circle with a constant angular speed?

(1) The velocity vector is tangent to the circle.

(2) The acceleration vector is tangent to the circle.

(3) The acceleration vector points to the centre of the circle.

(4) The velocity and acceleration vectors are perpendicular to each other.

82. An automobile travelling with speed of 60 km/h, can brake to stop within a distance of 20 m. If the car is going twice as fast, i.e 120 km/h, the stopping distance will be

(1) 60 m

(2) 40 m

(3) 20 m

(4) 80 m

83. A machine gun fires a bullet of mass 40 g with a velocity $1200 ms^{-1}$. The man holding it can exert a maximum force of 144 N on the gun. How many bullets can he fire per second at the most?

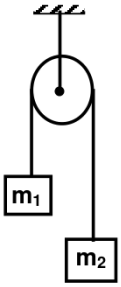
(1) Two

(2) Four

(3) One

(4) Three

84. Two masses $m_1 = 5$ kg and $m_2 = 4.8$ kg tied to a string are hanging over a light frictionless pulley. What is the acceleration of the masses when lift free to move?



($g = 9.8$ m/s^2)
(A) 0.2 m/s^2
(C) 5 m/s^2
(B) 9.8 m/s^2
(D) 4.8 m/s^2

85. A uniform chain of length 2 m is kept on a table such that a length of 60 cm hangs freely from the edge of the table. The total mass of the chain is 4 kg. What is the work done in pulling the entire chain on the table?

(1) 12 J

(2) 3.6 J

(3) 7.2 J

(4) 1200 J

86. A block rests on a rough inclined plane `making an angle of 30° with the horizontal. The coefficient of static friction between the block and the plane is 0.8. If the frictionless force on the block is 10 N, the mass of the block (in kg) is $(take\ g = 10\ m/s^2)$

(1) 1.6

(2) 4.0

(3) 2.0

(4) 2.5

87. A force $\vec{F} = \left(5\vec{i} + 3\vec{j} + 2\vec{k}\right) N$ is applied over a particle which displaces it from its origin to the point $\vec{r} = \left(2\vec{i} - \vec{j}\right) m$. The work done on the particle in joules is

(1) +10

(2) +7

(3) −7

(4) +13

88. A body of mass 'm', acceleration uniformly from rest to 'v_1' in time T. The instantaneous power delivered to the body as a function of time is given by

(1) $\frac{mv_1t^2}{T}$

(2) $\frac{mv_1^2t}{T^2}$

(3) $\frac{mv_1t}{T}$

(4) $\frac{mv_1^2t}{T}$

89. A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle, the motion of the particles takes place in a plane. It follows that

(1) its kinetic energy is constant

(2) is acceleration is constant

(3) its velocity is constant

(4) it moves in a straight line

90. A solid sphere is rotating in free space. If the radius of the sphere is increased keeping mass same which on of the following will not be affected ?

(1) Angular velocity

(2) Angular momentum

(3) Moment of inertia

(4) Rotational kinetic energy

91. A ball is thrown from a point with a speed v_0 at an angle of projection θ. From the same point and at the same instant person starts running with a constant speed $\frac{v_0}{2}$ to catch the ball. Will the person be able to catch the ball? If yes, what should be the angle of projection θ?

(1) No

(2) Yes, 30°

(3) Yes, 60°

(4) Yes, 45°

92. One solid sphere A and another hollow sphere B are of same mass and same outer radii. Their moment of inertia about their diameters are respectively I_A and I_B such that

(1) $I_A < I_B$

(2) $I_A > I_B$

(3) $I_A = I_B$

(4) $\frac{I_A}{I_B} = \frac{d_A}{d_B}$ where d_A and d_B are their densities.

93. A satellite of mass m revolves around the earth of radius R at a height x from its surface. If g is the acceleration due to gravity on the surface of the earth, the orbital speed of the satellite is

(1) $\frac{gR^2}{R+x}$

(2) $\frac{gR}{R-x}$

(3) gx

(4) $\left(\frac{gR^2}{R+x}\right)^{1/2}$

94. The time period of an earth satellite in circular orbit is independent of

(1) both the mass and radius of the orbit

(2) radius of its orbit

(3) the mass of the satellite

(4) neither the mass of the satellite nor the radius of its orbit

95. If g is the acceleration due to gravity on the earth's surface, the gain in the potential energy of an object of mass m raised from the surface of the earth to a height equal to the radius R of the earth is

(1) $\frac{1}{4}mgR$

(2) $2mgR$

(3) $\frac{1}{2}mgR$

(4) mgR

96. Suppose the gravitational force varies inversely as the nth power of distance. Then the time period of a planet in circular orbit of radius R around the sun will be proportional to

(1) R^n

(2) $R^{\left(\frac{n-1}{2}\right)}$

(3) $R^{\left(\frac{n+1}{2}\right)}$

(4) $R^{\left(\frac{n-2}{2}\right)}$

97. A wire fixed at the upper end stretches by length l by applying a force F. The work done in stretching is

(1) $2Fl$

(2) Fl

(3) $\frac{F}{2l}$

(4) $\frac{Fl}{2}$

98. Spherical balls of radius R are falling in a viscous fluid of viscosity η with a velocity v. The retarding viscous force acting on the spherical ball is

(1) inversely proportional to both radius R and velocity v

(2) directly proportional to both radius R and velocity v

(3) directly proportional to R but inversely proportional to v

(4) inversely proportional to R, but directly proportional to velocity v

99. If two soap bubbles of different radii are connected by a tube

(1) air flows from the smaller bubble to the bigger

(2) air flows from bigger bubble to the smaller bubble till the sizes are interchanged

(3) air flows from the bigger bubble to the smaller bubble till the sizes become equal

(4) there is no flow of air.

100. The bob of a simple pendulum executes simple harmonic motion in water with a period t, while the period of oscillation of the bob is t_0 in air. Neglecting frictional force of water and given that the density of the bob is $(4/3) \times 1000\ kg/m^3$. What relationship between t and t_0 is true

(1) $t = 2t_0$

(2) $t = t_0/2$

(3) $t = t_0$

(4) $t = 4t_0$

101. A particle at the end of a spring executes $S.H.M$ with a period t_1. While the corresponding period for another spring is t_2. If the period of oscillation with the two springs in series is T then

(1) $T^{-1} = t_1^{-1} + t_2^{-1}$

(2) $T^2 = t_1^2 + t_2^2$

(3) $T = t_1 + t_2$

(4) $T^{-2} = t_1^{-2} + t_2^{-2}$

102. The total energy of particle, executing simple harmonic motion is

(1) independent of x

(2) $\propto x^2$

(3) $\propto x$

(4) $\propto x^{1/2}$

103. The displacement y of a particle in a medium can be expressed as, $y = 10^{-6}$ sin $\left(100t + 20x + \frac{\pi}{4}\right)$ m where t is in second and x in meter. The speed of the wave is

(1) 20 m/s

(2) 5 m/s

(3) 2000 m/s

(4) 5 π m/s

104. A particle of mass m is attached to a spring (of spring constant k) and has a natural angular frequency ω_0. An external force $F(t)$ proportional to cos ωt ($\omega \neq \omega_0$) is applied to the oscillator. The time displacement of the oscillator will be proportional to

(1) $\frac{1}{m\left(\omega_0^2 + \omega^2\right)}$

(2) $\frac{1}{m\left(\omega_0^2 - \omega^2\right)}$

(3) $\frac{m}{\omega_0^2 - \omega^2}$

(4) $\frac{m}{\omega_0^2 + \omega^2}$

105. In forced oscillation of a particle the amplitude is maximum for a frequency ω_1 of the force while the energy is maximum for a frequency ω_2 of the force; then

(1) $\omega_1 < \omega_2$ when damping is small and $\omega_1 > \omega_2$ when damping is large

(2) $\omega_1 > \omega_2$

(3) $\omega_1 = \omega_2$

(4) $\omega_1 < \omega_2$

106. One mole of ideal monatomic gas ($\gamma = 5/3$) is mixed with one mole of diatomic gas ($\gamma = 7/5$). What is γ for the mixture? γ Denotes the ratio of specific heat at constant pressure, to that at constant volume

(1) 35/23

(2) 23/15

(3) 3/2

(4) 4/3

107. If the temperature of the sun were to increase from T to $2T$ and its radius from R to $2R$, then the ratio of the radiant energy received on earth to what it was previously will be

(1) 32

(2) 16

(3) 4

(4) 64

108. Which of the following statements is **correct** for any thermodynamic system ?

(1) The change in entropy can never be zero

(2) Internal energy and entropy and state functions

(3) The internal energy changes in all processes

(4) The work done in an adiabatic process is always zero,

109. Two thermally insulated vessels 1 and 2 are filled with air at temperatures (T_1, T_2), volume (V_1, V_2) and pressure (P_1, P_2) respectively. If the value joining the two vessels is opened, the temperature inside the vessel at equilibrium will be

(1) $T_1T_2\,(P_1V_1 + P_2V_2)\,/\,(P_1V_1T_2 + P_2V_2T_1)$

(2) $(T_1 + T_2)\,/2$

(3) $T_1 + T_2$

(4) $T_1T_2\,(P_1V_1 + P_2V_2)\,/\,(P_1V_1T_1 + P_2V_2T_2)$

110. A radiation of energy E falls normally on a perfectly reflecting surface. The momentum transferred to the surface is

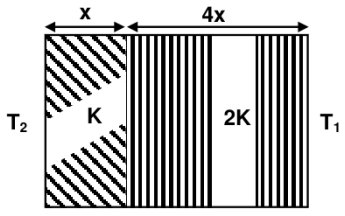
(1) Ec

(2) $2E/c$

(3) E/c

(4) E/c^2

111. The temperature of two outer surfaces of a composite slab, consisting of two materials having coefficients of thermal conductivity K and 2K and thickness x and 4x, respectively are T_2 and T_1 ($T_2 > T_1$). The rate of heat transfer through the slab, in a steady state is $\left(\frac{A(T_2 - T_1)K}{x}\right)f$, with f equal to



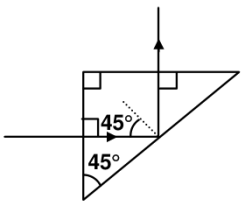
(A) 1

(B) ½

(C) 2/3

(D) 1/3

112. A light ray is incident perpendicular to one face of a 90 ° prism and is totally internally reflected at the glass-air interface. If the angle of reflection is 4 5 ° , we conclude that the refractive index n



(A) $n < \frac{1}{2}$

(B) $n > \sqrt{2}$

(C) $n > \frac{1}{\sqrt{2}}$

(D) $n < \sqrt{2}$

113. A plano convex lens of refractive index 1.5 and radius of curvature 30 cm. Is silvered at the curved surface. Now this lens has been used to form the image of an object. At what distance from this lens an object be placed in order to have a real image of size of the object

(1) 60 cm

(2) 30 cm

(3) 20 cm

(4) 80 cm

114. The angle of incidence at which reflected light is totally polarized for reflection from air to glass (refractive index n) is :

(1) $\tan^{-1}(1/n)$

(2) $\sin^{-1}(1/n)$

(3) $\sin^{-1}(n)$

(4) $\tan^{-1}(n)$

115. The maximum number of possible interference maxima for slit-separation equal to twice the wavelength in Young's double-slit experiment, is :

(1) three

(2) five

(3) infinite

(4) zero

116.An electromagnetic wave of frequency $v = 3.0\ MHz$ passes from vacuum into a dielectric medium with permittivity $\in = 4.0$. Then

(1) wave length is halved and frequency remains unchanged

(2) wave length is doubled and the frequency becomes half

(3) wave length is doubled and the frequency remains unchanged

(4) wave length and frequency both remain unchanged.

117.Two spherical conductors B and C having equal radii and carrying equal charges on them repel each other with a force F when kept apart at some distance. A third spherical conductor having same radius as that B but uncharged is brought in contact with B, then brought in correct with C and finally removed away from both. The new force of repulsion between B and C is

(1) $F/8$

(2) $3\ F/4$

(3) $F/4$

(4) $3\ F/8$

118.A charge particle $'q'$ is shot towards another charged particle $'Q'$ which is fixed, with a speed $'v'$. It approaches $'Q'$ upto a closest distance r and then returns. If q were given a speed of $'2v'$ the closest distances of approaches would be

(1) $r/2$

(2) $2r$

(3) r

(4) $r/4$

119.Four charges equal to -Q are placed at the four corners of a square and a charge q is at its center. If the system is in equilibrium the value of q is

(1) $-\frac{Q}{2}\left(1+2\sqrt{2}\right)$

(2) $\frac{Q}{4}\left(1+2\sqrt{2}\right)$

(3) $-\frac{Q}{4}\left(1+2\sqrt{2}\right)$

(4) $\frac{Q}{2}\left(1+2\sqrt{2}\right)$

120.Alternating current can not be measured by $D.C.$ ammeter because

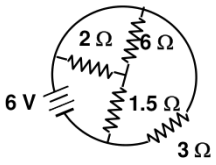
(1) Average value of current for complete cycle is zero

(2) $A.C.$ Changes direction

(3) $A.C.$ can not pass through $D.C.$ Ammeter

(4) $D.C.$ Ammeter will get damaged.

121.The total current supplied to the circuit by the battery is



(A) 1 A

(B) 2 A

(C) 4 A

(D) 6 A

122.The resistance of the series combination of two resistances is S. When they are jointed in parallel the total resistance is P. If $S = nP$ then the Minimum possible value of n is

(1) 2

(2) 3

(3) 4

(4) 1

123.An electric current is passed through a circuit containing two wires of the same material, connected in parallel. If the lengths and radii are in the ratio of $\frac{4}{3}$ and $\frac{2}{3}$, then the ratio of the current passing through the wires will be

(1) $8/9$

(2) $1/3$

(3) 3

(4) 2

124.In a meter bridge experiment null point is obtained at 20 cm, from one end of the wire when resistance X is balanced against another resistance Y. If $X < Y$, then where will be the new position of the null point from the same end, if one decides to balance a resistance of 4 X against Y

(1) 40 cm

(2) 80 cm

(3) 50 cm

(4) 70 cm

125.Thermistors are usually made of

(1) metal oxides with high temperature coefficient of resistivity

(2) metals with high temperature coefficient of resistivity

(3) metals with low temperature coefficient of resistivity

(4) semiconducting materials having low temperature

126.Time taken by a 836 W heater to heat one litre of water from $10^{\circ}C$ to $40^{\circ}C$ is

(1) 150 s

(2) 100 s

(3) 50 s

(4) 200 s

127.The thermo emf of a thermocouple varies with temperature θ of the hot junction as $E = a\theta + b\theta^2$ in volts where the ratio a/b is $700^{\circ}C$. If the cold junction is kept at $0^{\circ}C$, then the neutral temperature is

(1) $1400^{\circ}C$

(2) $350^{\circ}C$

(3) $700^{\circ}C$

(4) No neutral temperature is possible for this termocouple.

128.The electrochemical equivalent of a metal is 3.35109^{-7} kg per Coulomb. The mass of the metal liberated at the cathode when a $3A$ current is passed for 2 seconds will be

(1) $6.6 \times 10^{57}/kg$

(2) $9.9 \times 10^{-7}\,kg$

(3) $19.8 \times 10^{-7}\,kg$

(4) $1.1 \times 10^{-7}\,kg$

129.A current i ampere flows along an infinitely long straight thin walled tube, then the magnetic induction at any point inside the tube is

(1) $\frac{\mu_0}{4\pi}, \frac{2i}{r}$ tesla

(2) zero

(3) infinite

(4) $\frac{2i}{r}$ tesla

130.A long wire carries a steady current. It is bent into a circle of one turn and the magnetic field at the centre of the coil is B. It is then bent into a circular loop of n turns. The magnetic field at the center of the coil will be

(1) $2n\ B$

(2) $n^2\ B$

(3) nB

(4) $2n^2\ B$

131.The magnetic field due to a current carrying circular loop of radius 3 cm at a point on the axis at a distance of 4 cm from the centre is 54 μT. What will be its value at the center of loop?

(1) 125 μT

(2) 150 μT

(3) 250 μT

(4) 75 μT

132.Two long conductors, separated by a distance d carry current I_1 and I_2 in the same direction. They exert a force F on each other. Now the current in one of them is increased to two times and its direction is reversed. The distance is also increased to $3d$. The new value of the force between them is

(1) $-\frac{2F}{3}$

(2) $\frac{F}{3}$

(3) $-2F$

(4) $-\frac{F}{3}$

133.The length of a magnet is large compared to its width and breadth. The time period of its oscillation in a vibration magnetometer is $2s$. The magnet is cut along its length into three equal parts and these parts are then placed on each other with their like poles together. The time period of this combination will be

(1) $2\sqrt{3}\,s$

(2) $\frac{2}{3}\,s$

(3) $2\,s$

(4) $\frac{2}{\sqrt{3}}\,s$

134.The materials suitable for making electromagnets should have

(1) high retentivity and low coercivity

(2) low retentivity and low coercivity

(3) high retentivity and high coercivity

(4) low retentivity and high coercivity

135.In an LCR series $a.c.$ circuit, the voltage across each of the components, L, C and R is $50V$. The voltage across the $L.C$ combination will be :

(1) $100V$

(2) $50\sqrt{2}$

(3) $50\ V$

(4) $0\ V$ (zero)

136.A coil having n turns and resistance $R\Omega$ is connected with a galvanometer of resistance $4R\Omega$. This combination is moved in time t seconds from a magnetic field W_1 weber to W_2 weber. The induced current in the circuit is

(1) $\frac{(W_2 - W_1)}{Rnt}$

(2) $-\frac{n\,(W_2 - W_1)}{5\ Rt}$

(3) $-\frac{(W_2 - W_1)}{5\ Rnt}$

(4) $-\frac{n\,(W_2 - W_1)}{Rt}$

137.In a uniform magnetic field of induction B a wire in the form of a semicircle of radius r rotates about the diameter of the circle with an angular frequency ω. The axis of rotation is perpendicular to the field. If the total resistance of the circuit is R, the mean power generated per period of rotation is

(1) $\frac{(B\pi r\omega)^2}{2R}$

(2) $\frac{\left(B\pi r^2\omega\right)^2}{8R}$

(3) $\frac{B\pi r^2\omega}{2R}$

(4) $\frac{\left(B\pi r\omega^2\right)^2}{8R}$

138.In a LCR circuit capacitance is changed from C to 2 C. For the resonant frequency to remain unchaged, the inductance should be changed from L to

(1) $L/2$

(2) $2L$

(3) $4L$

(4) $L/4$

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139. A metal conductor of length 1 m rotates vertically about one of its ends at angular velocity 5 radians per second. If the horizontal component of earth's magnetic field is 0.3×10^{-4} T, then the e.m.f. developed between the two ends of the conductor is

(A) depends on the nature of the metal used

(B) depends on the intensity of the radiation

(C) depends both on the intensity of the radiation and the metal used

(D) is the same for all metals and independent of the intensity of the radiation.

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140. According to Einstein's photoelectric equation, the plot of the kinetic energy of the emitted photo electrons from a metal Vs the frequency, of the incident radiation gives as straight the whose slope

(1) depends both on the intensity of the radiation and the metal used

(2) depends on the intensity of the radiation

(3) depends on the nature of the metal used

(4) is the same for the all metals and independent of the intensity of the radiation

---

141. The work function of a substance is 4.0 eV. The longest wavelength of light that can cause photo-electron emission from this substance is approximately.

(1) 310 nm

(2) 400 nm

(3) 540 nm

(4) 220 nm

---

142. A charged oil drop is suspended in a uniform field of 3×10^4 v/m so that it neither falls nor rises. The charge on the drop will be (Take the mass of the charge $= 9.9 \times 10^{-15}$ kg and $g = 10\, m/s^2$)

(1) $1.6 \times 10^{-18}\, C$

(2) $3.2 \times 10^{-18}\, C$

(3) $3.3 \times 10^{-18}\, C$

(4) $4.8 \times 10^{-18}\, C$

---

143. A nucleus disintegrates into two nuclear parts which have their velocities in the ratio 2 : 1. The ratio of their nuclear sizes will be

(A) $2^{1/3} : 1$

(B) $1 : 3^{1/2}$

(C) $3^{1/2} : 1$

(D) $1 : 2^{1/3}$

---

144. The binding energy per nucleon of deuteron $\left({}_1^2 H\right)$ and helium nucleus $\left({}_2^4 He\right)$ is 1.1 MeV and 7 MeV respectively. If two deuteron nuclei react to form a single helium nucleus, then the energy released is

(1) 23.6 MeV

(2) 26.9 MeV

(3) 13.9 MeV

(4) 19.2 MeV

---

145. An α-particle of energy 5 MeV is scattered through 180° by a fixed uranium nucleus. The distance of closest approach is of the order of

(1) $10^{-12}\, cm$

(2) $10^{-10}\, cm$

(3) $1A$

(4) $10^{-15a}\, cm$

---

146. When npn transistor is used as an amplifer

(1) electrons move from collector to base

(2) holes move from emitter to base

(3) electrons move from base to collector

(4) holes move from base to emitter

---

147. For a transistor amplifier in common emitter configuration for load impedance of $1k\,\Omega$ ($h_{fe} = 50$ and $h_{oe} = 25$) the current gain is

(1) -24.8

(2) -15.7

(3) -5.2

(4) -48.78

148.A piece of copper and another of germanium are cooled from room temperature to $77K$, the resistance of

(1) copper increases and germanium decreases

(2) each of them decreases

(3) each of them increases

(4) copper decreases and germanium increases

149.The manifestation of band structure in solids is due to

(1) Bohr's correspondence principle

(2) Pauli's exclusion principle

(3) Heisenberg's uncertainty principle

(4) Boltzmann's law

150.When p-n junction diode is forward biased then

(1) both the depletion region and barrier height are reduced

(2) the depletion region is widened and barrier height is reduced

(3) the depletion region is reduced and barrier height is increased

(4) both the depletion region and barrier height are increased

151.Which of the following sets of quantum numbers is correct for an electron in 4f orbital?

(1) n = 4, l = 3, m = +1, s = + 1/2

(2) n = 4, l = 4, m = -4, s = - 1/2

(3) n = 4, l = 3, m = +4, s = + 1/2

(4) n = 3, l = 2, m = -2, s = + 1/2

152.Consider the ground state of Cr atom (Z = 24). The number of electrons with the azimuthal quantum numbers, l = 1 and 2 are respectively

(1) 16 and 4

(2) 12 and 5

(3) 12 and 4

(4) 16 and 5

153.Which one of the following ions has the highest value of ionic radius?

(1) O^{2-}

(2) B^{3+}

(3) Li^{+}

(4) F^{-}

154.The wavelength of the radiation emitted when in a hydrogen atom electron falls from infinity to stationary state 1, would be (Rydberg constant = $1.097 \times 10^{7}\ m^{-1}$)

(1) 406 nm

(2) 192 nm

(3) 91 nm

(4) 9.1×10^{-8} nm

155.The correct order of bond angles (smallest first) in H_2S, NH_3, BF_3 and SiH_4 is

(1) $H_2S < SiH_4 < NH_3 < BF_3$

(2) $H_2S < NH_3 < BF_3 < SiH_4$

(3) $H_2S < NH_3 < SiH_4 < BF_3$

(4) $NH_3 < H_2S < SiH_4 < BF_3$

156.Which one of the following sets of ions represents the collection of isoelectronic species?

(1) K^{+}, Ca^{2+}, Sc^{3+}, Cl^{-}

(2) Na^{+}, Mg^{2+}, Al^{3+}, Cl^{-}

(3) K^{+}, Cl^{-}, Mg^{2+}, Sc^{3+}

(4) Na^{+}, Ca^{2+}, Sc^{3+}, F^{-}

157.Among Al_2O_3, SiO_2, P_2O_3 and SO_2 the correct order of acid strength is

(1) $SO_2 < P_2O_3 < SiO_2 < Al_2O_3$

(2) $Al_2O_3 < SiO_2 < P_2O_3 < SO_2$

(3) $Al_2O_3 < SiO_2 < SO_2 < P_2O_3$

(4) $SiO_2 < SO_2 < Al_2O_3 < P_2O_3$

158.The bond order in NO is 2.5 while that in NO^{+} is 3. Which of the following statements is true for these two species?

(1) Bond length in NO^{+} is greater than in NO

(2) Bond length is unpredictable

(3) Bond length in NO^{+} in equal to that in NO

(4) Bond length in NO is greater than in NO^{+}

159.The formation of the oxide ion $O^{2-}(g)$ requires first an exothermic and then an endothermic step as shown below

$O_{(g)} + e^{-} = O^{-}_{(g)}$ $\Delta H^{o} = -142\ kJmol^{-1}$

$O^{-}_{(g)} + e^{-} = O^{2-}_{(g)}$ $\Delta H^{o} = 844\ kJmol^{-1}$

This because

(1) O^{-} ion will tend to resist the addition of another electron

(2) Oxygen has high electron affinity

(3) Oxygen is more electronegative

(4) O^{-} ion has comparatively larger size than oxygen atom

160.The states of hybridization of boron and oxygen atoms in boric acid (H_3BO_3) are respectively

(1) sp^2 and sp^2

(2) sp^3 and sp^3

(3) sp^3 and sp^2

(4) sp^2 and sp^3

161.Which one of the following has the regular tetrahedral structure?

(1) XeF_4

(2) $[Ni(CN)_4]^{2-}$

(3) BF_4^-

(4) SF_4

162.Of the following outer electronic configurations of atoms, the highest oxidation state is achieved by which one of them?

(1) $(n-1)\,d^8ns^2$

(2) $(n-1)\,d^5ns^2$

(3) $(n-1)\,d^3ns^2$

(4) $(n-1)d^5ns^{-1}$

163.As the temperature is raised from 2 0 ° C to 4 0 ° C , the average kinetic energy of neon atoms changes by a factor of which of the following?

(1) ½

(2) 2

(3) $\frac{313}{293}$

(4) $\sqrt{\frac{313}{293}}$

164.The maximum number of 90° angles between bond pair of electrons is observed in

(1) dsp^3 hybridization

(2) sp^3d^2 hybridization

(3) dsp^2 hybridization

(4) sp^3d hybridization

165.Which one of the following aqueous solutions will exhibit highest boiling point?

(1) 0.01 M Na_2SO_4

(2) 0.015 M glucose

(3) 0.015 M urea

(4) 0.01 M KNO_3

166.Which among the following factors is the most important in making fluorine the strongest oxidizing halogen?

(1) Electron affinity

(2) Bond dissociation energy

(3) Hydration enthalpy

(4) Ionization enthalpy

167.In Van der Waals equation of state of the gas law, the constant 'b' is a measure of

(1) intermolecular repulsions

(2) intermolecular collisions per unit volume

(3) Volume occupied by the molecules

(4) intermolecular attraction

168.The conjugate base of $H_2PO_4^-$ is :

(1) PO_4^{3-}

(2) HPO_4^{2-}

(3) H_3PO_4

(4) P_2O_5

169.6.02×10^{20} molecules of urea are present in 100 ml of its solution. The concentration of urea solution is
(Avogadro constant, $N_A = 6.02 \times 10^{23}$ mol^{-1})

(1) 0.02 M

(2) 0.01 M

(3) 0.001 M

(4) 0.1 M

170.To neutralise completely 20 mL of 0.1 M aqueous solution of phosphorous acid (H_3PO_3), the volume of 0.1 M aqueous KOH solution required is

(1) 40 mL

(2) 20 mL

(3) 10 mL

(4) 60 mL

171.For which of the following parameters the structural isomers C_2H_5OH and CH_3OCH_3 would be expected to have the same values? (Assume ideal behaviour)

(1) Heat of vaporization

(2) Gaseous densities at the same temperature and pressure

(3) Boiling points

(4) Vapour pressure at the same temperature

172.Which of the following liquid pairs shows a positive deviation from Raoult's law?

(1) Water – hydrochloric acid

(2) Acetone – chloroform

(3) Water – nitric acid

(4) Benzene – methanol

173.Which one of the following statements is false?

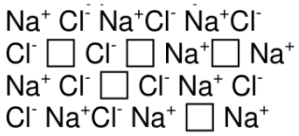
(1) Raoult's law states that the vapour pressure of a components over a solution is proportional to its mole fraction

(2) Two sucrose solutions of same molality prepared in different solvents will have the same freezing point depression

(3) The correct order of osmotic pressure for 0.01 M aqueous solution of each compound is $BaCl_2 > KCl > CH_3COOH >$ sucrose

(4) The osmotic pressure (π) = MRT, where M is the molarity of the solution

174.What type of crystal defect is indicated in the diagram below?



(1) Frenkel defect

(2) Frenkel and Schottky defects

(3) Interstitial defect

(4) Schottky defect

175.An ideal gas expands in volume from 1×10^{-3} m^3 to 1×10^{-2} m^3 at 300 K against a constant pressure of 1×10^5 Nm^{-2}. The work done is :

(1) -900 J

(2) 900 kJ

(3) 270 kJ

(4) -900 kJ

176.In a hydrogen – oxygen fuel cell, combustion of hydrogen occurs to :

(1) generate heat

(2) remove adsorbed oxygen from electrode surfaces

(3) produce high purity water

(4) create potential difference between the two electrodes

177.In a first order reaction, the concentration of the reactant decreases from 0.8 M to 0.4 M in 15 minutes. The time taken for the concentration to change from 0.1 M to 0.025 M is

(1) 30 minutes

(2) 60 minutes

(3) 7.5 minutes

(4) 15 minutes

178.What is the equilibrium expression for the reaction
P_4 (s) + $5O_2 \leftrightharpoons P_4O_{10}$ (s)?

(1) $K_c = [P_4O_{10}] / [P_4] [O_2]^5$

(2) $K_c = 1/[O_2]^5$

(3) $K_c = [O_2]^5$

(4) $K_c = [P_4O_{10}] / 5[P_4] [O_2]$

179.For the reaction, $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$ the $\frac{K_p}{K_c}$ is equal to

(1) $\frac{1}{RT}$

(2) 1.0

(3) $\sqrt{RT}$

(4) RT

180.The equilibrium constant for the reaction $N_2(g) + O_2(g) \leftrightharpoons 2NO(g)$ at temperature T is 4×10^{-4}. The value of K_c for the reaction $NO(g) \leftrightharpoons \frac{1}{2} N_2(g) + \frac{1}{2} O_2(g)$ at the same temperature is :

(1) 2.5×10^2

(2) 4×10^{-4}

(3) 50

(4) 0.02

181.The rate equation for the reaction $2A + B \rightarrow C$ is found to be: rate k[A][B]. The correct statement in relation to this reaction is that the

(1) unit of K must be s^{-1}

(2) values of k is independent of the initial concentration of A and B

(3) rate of formation of C is twice the rate of disappearance of A

(4) $t_{1/2}$ is a constant

182.Consider the following E^o values

$E^o_{Fe^{3+}/Fe^{2+}} = 0.77$ V;

$E^o_{Sn^{2+}/Sn} = -0.14$ V

Under standard conditions the potential for the reaction

$Sn(s) + 2Fe^{3+}(aq) \rightarrow 2Fe^{2+}(aq) + Sn^{2+}(aq)$ is :

(1) 1.68 V

(2) 0.63 V

(3) 0.91 V

(4) 1.40 V

183.The molar solubility (in ol L^{-1}) of a sparingly soluble salt MX_4 is "s". The corresponding solubility product is K_{sp}. 's' is given in term of K_{sp} by the relation :

(1) $s = (256\ K_{sp})^{1/5}$

(2) $s = (128\ K_{sp})^{1/4}$

(3) $s = (K_{sp} / 128)^{1/4}$

(4) $s = (K_{sp} / 256)^{1/5}$

184.The standard e.m.f of a cell, involving one electron change is found to be 0.591 V at 25°C. The equilibrium constant of the reaction is (F = 96,500 C mol^{-1}: R = 8.314 JK^{-1} mol^{-1})

(1) 1.0×10^1

(2) 1.0×10^{30}

(3) 1.0×10^{10}

(4) 1.0×10^5

185.The enthalpies of combustion of carbon and carbon monoxide are -393.5 and -283 kJ mol-1 respectively. The enthalpy of formation of carbon monoxide per mole is :

(1) 110.5 kJ

(2) -110.5 kJ

(3) -676.5 kJ

(4) 676.5 kJ

186.The limiting molar conductivities Λ° for NaCl, KBr and KCl are 126, 152 and 150 S cm^2 mol^{-1} respectively. The Λ° for NaBr is

(1) 128 S cm^2 mol^{-1}

(2) 302 S cm^2 mol^{-1}

(3) 278 S cm^2 mol^{-1}

(4) 176 S cm^2 mol^{-1}

187.In a cell that utilises the reaction Zn(s) + $2H^+$ (aq) → Zn2+(aq) + H2(g) addition of H_2SO_4 to cathode compartment, will

(1) lower the E and shift equilibrium to the left

(2) increases the E and shift equilibrium to the left

(3) increase the E and shift equilibrium to the right

(4) Lower the E and shift equilibrium to the right

188.Which one the following statement regarding helium is incorrect?

(1) It is used to fill gas balloons instead of hydrogen because it is lighter and non–inflammable

(2) It is used in gas – cooled nuclear reactors

(3) It is used to produce and sustain powerful superconducting reagents

(4) It is used as cryogenic agent for carrying out experiments at low temperatures

189.Identify the correct statements regarding enzymes

(1) Enzymes are specific biological catalysts that can normally function at very high temperature (T ~ 1000 K)

(2) Enzymes are specific biological catalysts that the posses well – defined active sites

(3) Enzymes are specific biological catalysts that can not be poisoned

(4) Enzymes are normally heterogeneous catalysts that are very specific in their action

190.One mole of magnesium nitride on the reaction with an excess of water gives :

(1) one mole of ammonia

(2) two moles of nitric acid

(3) two moles of ammonia

(4) one mole of nitric acid

191.Which one of the following ores is best concentrated by froth – floatation method?

(1) Magnetite

(2) Malachite

(3) Galena

(4) Cassiterite

192.Beryllium and aluminium exhibit many properties which are similar. But the two elements differ in :

(1) exhibiting maximum covalency in compound

(2) exhibiting amphoteric nature in their oxides

(3) forming covalent halides

(4) forming polymeric hydrides

193.Aluminium chloride exists as dimer, Al_2Cl_6 in solid state as well as in solution of non-polar solvents such as benzene. When dissolved in water, it gives :

(1) $Al^{3+} + 3Cl^-$

(2) $Al_2O_3 + 6HCl$

(3) $[Al(OH)_6]^{3-}$

(4) $[Al(H_2O)_6]^{3+} + 3Cl^-$

194.The soldiers of Napolean army while at Alps during freezing winter suffered a serious problem as regards to the tin buttons of their uniforms. White metallic tin buttons got converted to grey power. The transformation is related to :

(1) a change in the partial pressure of oxygen in the air

(2) a change in the crystalline structure of tin

(3) an interaction with nitrogen of the air at very low temperature

(4) an interaction with water vapor contained in the humid air

195.The $E^o_{M^{3+}/M^{2+}}$ values for Cr, Mn, Fe and Co are – 0.41, +1.57, + 0.77 and +1.97 V respectively. For which one of these metals the change in oxidation state form +2 to +3 is easiest?

(1) Fe

(2) Mn

(3) Cr

(4) Co

196.Excess of KI reacts with $CuSO_4$ solution and then $Na_2S_2O_3$ solution is added to it. Which of the statements is incorrect for this reaction?

(1) Cu_2I_2 is reduced

(2) Evolved I_2 is reduced

(3) $Na_2S_2O_3$ is oxidized

(4) CuI_2 is formed

197.Among the properties (a) reducing (b) oxidising (c) complexing, the set of properties shown by CN^- ion towards metal species is :

(1) c, a

(2) b, c

(3) a, b

(4) a, b, c

198.The coordination number of central metal atom in a complex is determined by :

(1) the number of ligands around a metal ion bonded by sigma bonds

(2) the number of only anionic ligands bonded to the metal ion

(3) the number of ligands around a metal ion bonded by sigma and pi- bonds both

(4) the number of ligands around a metal ion bonded by pi-bonds

199.Which one of the following complexes in an outer orbital complex?

(1) $[Fe(CN)_6]^{4-}$

(2) $[Ni(NH_3)_6]^{2+}$

(3) $[Co(NH_3)_6]^{3+}$

(4) $[Mn(CN)_6]^{4-}$

200.Coordination compound have great importance in biological systems. In this context which of the following statements is incorrect?

(1) Chlorophylls are green pigments in plants and contains calcium

(2) Carboxypeptidase – A is an enzyme and contains zinc

(3) Cyanocobalamin is B_{12} and contains cobalt

(4) Haemoglobin is the red pigment of blood and contains iron

201.Cerium (Z = 58) is an important member of the lanthanoids. Which of the following statements about cerium is incorrect?

(1) The common oxidation states of cerium are +3 and +4

(2) Cerium (IV) acts as an oxidizing agent

(3) The +4 oxidation state of cerium is not known in solutions

(4) The +3 oxidation state of cerium is more stable than the +4 oxidation state

202.Which one the following has largest number of isomers? (R = alkyl group, en = ethylenediamine)

(1) $[Ru(NH_3)_4Cl_2]^+$

(2) $[Co(en)_2Cl_2]^+$

(3) $[Ir(PR_3)_2\ H(CO)]^{2+}$

(4) $[Co(NH_3)_5Cl]^{2+}$

203.The correct order of magnetic moments (spin only values in B.M.) among is :
(Atomic numbers: Mn = 25; Fe = 26, Co =27)

(1) $[MnCl_4]^{2-} > [CoCl_4]^{-2} > [Fe(CN)_6]^{-4}$

(2) $[Fe(CN)_6]^{-4} > [CoCl_4]^{2-} > [MnCl_4]^{2-}$

(3) $[Fe(CN)_6]^{4-} > [MnCl_4]^{2-} > [CoCl_4]^{2-}$

(4) $[MnCl_4]^{2-} > [Fe(CN)_6]^{4-} > [CoCl_4]^{2-}$

204.Consider the following nuclear reactions
$^{238}_{92}M \rightarrow {}^{X}_{Y}N + 2^4_2He$
$^{X}_{Y}N \rightarrow {}^{A}_{B}L + 2\beta^+$
The number of neutrons in the element L is

(1) 140

(2) 144

(3) 142

(4) 146

205.The half – life of a radioisotope is four hours. If the initial mass of the isotope was 200 g, the mass remaining after 24 hours undecayed is

(1) 1.042 g

(2) 4.167 g

(3) 3.125 g

(4) 2.084 g

206.The compound formed in the positive test for nitrogen with the Lassaigne solution of an organic compound is

(1) $Fe_4[Fe(CN)_6]_3$

(2) $Na_4[Fe(CN)_5NOS]$

(3) $Fe(CN)_3$

(4) $Na_3[Fe(CN)_6]$

207.The ammonia evolved from the treatment of 0.30 g of an organic compound for the estimation of nitrogen was passed in 100 mL of 0.1 M sulphuric acid. The excess of acid required 20 mL of 0.5 M sodium hydroxide solution for complete neutralization. The organic compound is

(1) urea

(2) benzamide

(3) acetamide

(4) thiourea

208.Which one of the following has the minimum boiling point?

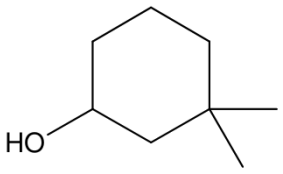
(1) n-butane

(2) isobutane

(3) 1- butene

(4) 1- butyne

209.The IUPAC name of the compound



(1) 3, 3- dimethyl -1- hydroxy cyclohexane

(2) 1,1 – dimethyl -3- cyclohexanol

(3) 3,3- dimethyl -1- cyclohexanol

(4) 1,1 – dimethyl -3- hydroxy cyclohexane

210.Which one the following does not have sp^2 hybridized carbon?

(1) Acetone

(2) Acetamide

(3) Acetonitrile

(4) Acetic acid

211.Which of the following will have meso-isomer also?

(1) 2- chlorobutane

(2) 2- hydroxyopanoic acid

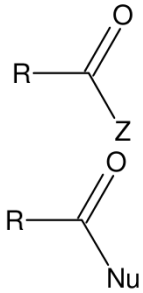
(3) 2,3 – dichloropentane

(4) 2-3- dichlorobutane

212.Rate of the reaction

$^{+} + Nu^{-} \longrightarrow + Z^{-}$

is fastest when Z is



(1) Cl

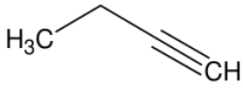
(2) $OCOCH_3$

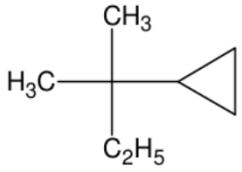
(3) OC_2H_5

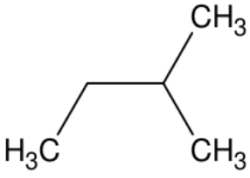
(4) NH_2

213.Amongst the following compounds, the optically active alkane having lowest molecular mass is

(1) 

(2) 

(3) 

(4) 

214.Consider the acidity of the carboxylic acids:

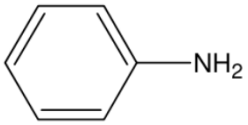
(1) PhCOOH

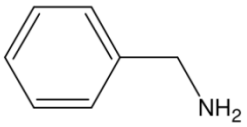
(2) o – $NO_2C_6H_4COOH$

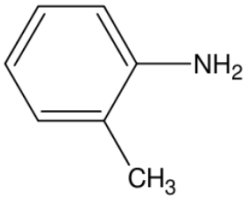
(3) p – $NO_2C_6H_4COOH$

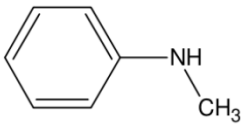
(4) m – $NO_2C_6H_4COOH$

215.Which of the following is the strongest base?

(1) 

(2) 

(3) 

(4) 

216.Which base is present in RNA but not in DNA?

(1) Uracil

(2) Thymine

(3) Guanine

(4) Cytosine

217.The compound formed on heating chlorobenzene with chloral in the presence concentrated sulphuric acid is

(1) gammexene

(2) hexachloroethane

(3) Freon

(4) DDT

218.On mixing ethyl acetate with aqueous sodium chloride, the composition of the resultant solution is

(1) $CH_3COOC_2H_5 + NaCl$

(2) $CH_3Cl + C_2H_5COONa$

(3) $CH_3COCl + C_2H_5OH + NaOH$

(4) $CH_3COONa + C_2H_5OH$

219.Acetyl bromide reacts with excess of CH_3MgI followed by treatment with a saturated solution of NH_4Cl given

(1) acetone

(2) acetyl iodide

(3) 2- methyl -2- propanol

(4) acetamide

220.Which one of the following reduced with zinc and hydrochloric acid to give the corresponding hydrocarbon?

(1) Ethyl acetate

(2) Butan -2-one

(3) Acetamide

(4) Acetic acid

221.Which of the following undergoes reaction with 50% sodium hydroxide solution to give the corresponding alcohol and acid?

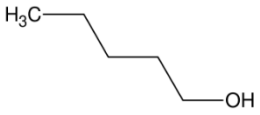
(1) Phenol

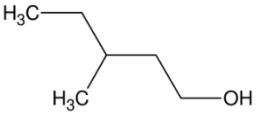
(2) Benzoic acid

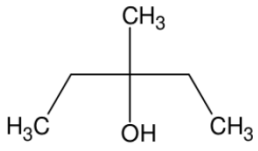
(3) Butanal

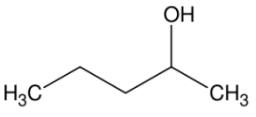
(4) Benzaldehyde

222.Among the following compounds, which can be dehydrated very easily?

(1) 

(2) 

(3) 

(4) 

collegedunia

223. Which of the following compound is not chiral?

(1) 1- chloropentane

(2) 3-chloro-2- methyl pentane

(3) 1-chloro -2- methyl pentane

(4) 2- chloropentane

224. Insulin production and its action in human body are responsible for the level of diabetes. This compound belongs to which of the following categories?

(1) A co- enzyme

(2) An antibiotic

(3) An enzyme

(4) A hormone

225. The smog is essentially caused by the presence of :

(1) O_2 and O_3c

(2) O_3 and N_2

(3) Oxides of sulphur and nitrogen

(4) O_2 and N_2