



**COMBINED ENTRANCE EXAMINATION (CEE)
EXAM - 2021
SET : A**

INSTRUCTIONS

1. Answer the Questions in the Answer Sheet (OMR SHHET) Provided.
2. **Do not Fold the OMR Sheet.**
3. Open the Booklet after the Bell rings at 11 A.M.
4. **Write your Roll Number** carefully in the OMR Sheet SIDE-1.
5. **Darken the Right Answer in the OMR Sheet using BLACK BALL PEN.**
6. **Please darken the right option as shown :**
Correct : Incorrect :
7. **Write and darken your Question Booklet set Series [A/B/C/D]** carefully in the OMR Sheet.
8. There are altogether **120 Questions** and 48 pages in the Question Booklet.
9. **Please check the total number of Questions and Page Numbers of the Question Booklet. In case of discrepancy in this regard, please inform the Invigilator for replacement of the Question Booklet.**
10. All Questions are Multiple Choice Questions (MCQ).
11. **Four Marks will be awarded for every Right Answer and for every wrong answer One mark will be deducted.**
12. No candidate can leave the Examination Hall till 2 P.M.
13. **Candidates need to maintain discipline before, during and after the Examination.**
14. **Use of Calculators, Cell Phones (mobiles) and other Electronic Gadgets are strictly prohibited inside the Examination Hall.**
15. The blank spaces and blank sheets attached at the end of the Question Booklet are to be used for rough calculations.
16. You will be asked by the Invigilator to put your signature and your Left Hand Thumb Impression on the Attendance Sheet & OMR Sheet. Please sign the Attendance Sheet in the same way as you signed during Online Application which is appearing in your Admit Card.
17. Please submit the Answer Sheet to the Invigilator before leaving the examination hall.

1. If one of the root of the quadratic equation $ax^2 + bx + c = 0$ is equal to the n th power of the other, then $(ac^n)^{\frac{1}{n+1}} + (a^n c)^{\frac{1}{n+1}} =$
 (A) 0 (B) $1 - b$
 (C*) $-b$ (D) b

Ans:- (C) $-b$

2. The set of values of λ for which the equation $(x - \lambda)(x - 4) = 1$ has integral roots is
 (A*) $\{4\}$ (B) $\{3, 5\}$
 (C) $\{-4\}$ (D) $\{4, -4\}$

Ans:- (A) $\{4\}$

3. If a, b, c and x are non zero real numbers, then $(a^2 + b^2)x^2 - 2b(a + c)x + b^2 + c^2 = 0$ holds
 (A) Only when a, b, c are in A.P.
 (B*) Only when a, b, c are in G.P.
 (C) Only when a, b, c are in H.P.
 (D) Always

Ans:- (B) Only when a, b, c are in G.P.

4. The probability that the roots of the equation $x^2 + nx + \frac{n}{2} = 0$ are real, where $n \in \mathbb{N}$ and $n \leq 5$ is
 (A) $\frac{1}{5}$ (B) $\frac{2}{5}$
 (C) $\frac{3}{5}$ (D*) $\frac{4}{5}$

Ans:- (D) $\frac{4}{5}$

5. $1 + \frac{1}{4} + \frac{1}{4} \cdot \frac{3}{8} + \frac{1.3.5}{4.8.12} =$
 (A*) $\sqrt{2}$ (B) $\frac{1}{\sqrt{2}}$
 (C) $\sqrt{3}$ (D) $\frac{1}{\sqrt{3}}$

Ans:- (A) $\sqrt{2}$

6. If $y = \sin mx$ and $y_n = \frac{d^n y}{dx^n}$, then
 (A) m^3 (B) m^6
 (C) m^9 (D*) 0

Ans:- (D) 0

7. The system of linear equation $x + y + z = 2, 2x + y - z = 3, 3x + 2y + kz = 4$ has a unique solution if
 (A*) $k \neq 0$ (B) $-1 < k < 1$
 (C) $-2 < k < 2$ (D) $k = 0$

Ans:- (A) $k \neq 0$

8. Points D, E are taken on the side BC of a triangle ABC such that $BD = DE = EC$. If $\angle BAD = x, \angle DAE = y, \angle EAC = z$ then the value of $\frac{\sin(x+y)\sin(y+z)}{\sin x \sin z}$ is
 (A) -4 (B) 1
 (C) 2 (D*) 4

Ans:- (D) 4

9. If $k = \lim_{x \rightarrow -2} \frac{\tan \pi x}{x+2} + \lim_{x \rightarrow \infty} \left(1 + \frac{1}{x^2}\right)^x$, then
 (A*) $k > 4$ (B) $k = 4$
 (C) $k < 4$ (D) $k = 2$

Ans:- (A) $k > 4$

10. The value of k^2 if $y^2 = 4x$ and $xy = k$ ($k \neq 0$) cut orthogonally is
 (A) 16 (B) 36
 (C*) 32 (D) 8

Ans:- (C) 32

11. The function $f(x) = x^{1/x}$ is
 (A) increasing in $(1, \infty)$
 (B) decreasing in $(1, \infty)$
 (C*) increasing in $(0, e)$ and decreasing in (e, ∞)
 (D) decreasing in $(0, e)$ and increasing in (e, ∞)

Ans:- (C) increasing in $(0, e)$ and decreasing in (e, ∞)

12. The maximum possible area that can be enclosed by a wire of length 20 cm by bending it into the form of a sector is
 (A*) 25 cm^2 (B) 10 cm^2
 (C) 30 cm^2 (D) 15 cm^2

Ans:- (A) 25 cm^2

13. $\int |x| dx =$

- (A) $\frac{x^2}{2}$ (B) $-\frac{x^2}{2}$
 (C) 0 (D*) $\frac{x|x|}{2}$

Ans:- (D) $\frac{x|x|}{2}$

14. $\lim_{n \rightarrow \infty} \frac{\sqrt{1} + 2\sqrt{2} + 3\sqrt{3} + \dots + n\sqrt{n}}{n^{5/2}} =$

- (A) 0 (B) 1
 (C) $\frac{5}{2}$ (D*) $\int_0^1 x\sqrt{x} dx$

Ans:- (D) $\int_0^1 x\sqrt{x} dx$

15. Solution of the equation $(x + 2y^3) \frac{dy}{dx} - y = 0 (y > 0)$ is

- (A*) $x = y^3 + Ay$ (B) $x(1 - xy) = Ax$
 (C) $x(1 - xy) = Ay$ (D) $x(1 + xy) = Ay$

Ans:- (A) $x = y^3 + Ay$

16. If G is the centroid of a triangle ABC and O is any point, then $\overline{OA} + \overline{OB} + \overline{OC} =$

- (A) \overline{OG} (B*) $3\overline{OG}$
 (C) \overline{O} (D) $2\overline{OG}$

Ans:- (B) $3\overline{OG}$

17. If $F_1 = (0, 0)$, $F_2 = (3, 4)$ and $|PF_1| + |PF_2| = 10$, then the locus of P is

- (A*) an ellipse (B) a straight line
 (C) a hyperbola (D) a parabola

Ans:- (A) an ellipse

18. The projection of the point (1, 3, 4) in the plane $\vec{r} \cdot (2\hat{i} - \hat{j} + \hat{k}) + 3 = 0$ is

- (A) (1, 3, 4) (B) (-3, 5, 2)
 (C*) (-1, 4, 3) (D) (-1, 4, -3)

Ans:- (C) (-1, 4, 3)

19. The angle between a line with direction ratios 2, 2, 1 and the line joining (3, 1, 4) to (7, 2, 12) is

- (A*) $\cos^{-1} \frac{2}{3}$ (B) $\cos^{-1} \frac{3}{2}$
 (C) $\tan^{-1} \left(\frac{-2}{3} \right)$ (D) $\tan^{-1} \left(\frac{2}{3} \right)$

Ans:- (A) $\cos^{-1} \frac{2}{3}$

20. If P be the point (1, 0) and Q be the point on $y^2 = 8x$. Then, the locus of mid-point of PQ is

- (A) $x^2 - 4y + 2 = 0$
 (B) $x^2 + 4y + 2 = 0$
 (C) $y^2 + 4x + 2 = 0$
 (D*) $y^2 - 4x + 2 = 0$

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

21. The value of $\lim_{x \rightarrow 0} (\cos x)^{\cot^2 x}$ is

- (A) e^{-1} (B*) $e^{\frac{1}{2}}$
 (C) 1 (D) e

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

22. Let f(x) be differentiable for all x. If $f(1) = -2$ and $f'(x) \geq 2$ for $x \in [1, 6]$, then

- (A) $f(6) = 5$ (B) $f(6) < 5$
 (C) $f(6) < 8$ (D*) $f(6) \geq 8$

Ans:- (D) $f(6) \geq 8$

23. $\int \frac{x^{49} \tan^{-1}(x^{50})}{(1+x^{100})} dx = K [\tan^{-1}(x^{50})]^2 + C$, then K is equal to

- (A) $\frac{1}{50}$ (B) $-\frac{1}{50}$
 (C*) $\frac{1}{100}$ (D) $-\frac{1}{100}$

Ans:- (C) $\frac{1}{100}$

24. $\int_0^{\pi} \sqrt{1 + 4\sin^2 \frac{x}{2}} - 4\sin \frac{x}{2} dx$ is equal to
- (A) $\pi - 4$ (B) $\frac{2\pi}{3} - 4 - 4\sqrt{3}$
- (C) $4\sqrt{3} - 4$ (D*) $4\sqrt{3} - 4 - \frac{\pi}{3}$

Ans:- (D) $4\sqrt{3} - 4 - \frac{\pi}{3}$

25. If $z = \frac{7-i}{3-4i}$, then z^{14} is equal to
- (A) -2^7 (B) $2^7 \cdot i$
- (C) $2^{14} \cdot i$ (D*) $-2^7 \cdot i$

Ans:- (D) $-2^7 \cdot i$

26. If α and β are the roots of $x^2 - a(x - 1) + b = 0$, then the value of $\frac{1}{a^2 + a\alpha} + \frac{1}{\beta^2 - a\beta} + \frac{2}{a+b}$ is
- (A) $\frac{4}{a+b}$ (B) $\frac{1}{a+b}$
- (C*) 0 (D) -1

Ans:- (C) 0

27. Number of solutions of the equation $\tan^{-1}\left(\frac{1}{2x+1}\right) + \tan^{-1}\left(\frac{1}{4x+1}\right) = \tan^{-1}\left(\frac{2}{x^2}\right)$ is
- (A*) 1 (B) 2
- (C) 3 (D) 4

Ans:- (A) 1

28. $\int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx =$
- (A) $\frac{\pi}{2}$ (B) 0
- (C*) $\frac{\pi}{4}$ (D) π

Ans:- (C) $\frac{\pi}{4}$

29. If $f(x) = \sum_{k=2}^n \left(x - \frac{1}{k-1}\right) \left(x - \frac{1}{k}\right)$, then the product of the roots of $f(x) = 0$ as $n \rightarrow \infty$ is
- (A) -1 (B*) 0
- (C) 1 (D) $\frac{1}{2}$

Ans:- (B) 0

30. If the sum of the first $2n$ terms of the A.P. 2, 5, 8, ... is equal to the sum of the first n terms of the A.P. 57, 59, 61, ..., Then n equals
- (A) 9 (B) 10
- (C*) 11 (D) 12

Ans:- (C) 11

31. If $2f(x) - 3f\left(\frac{1}{x}\right) = x^2, x \neq 0$, then $f(2) =$
- (A) $\frac{5}{2}$ (B*) $-\frac{7}{4}$
- (C) -1 (D) $-\frac{5}{2}$

Ans:- (B) $-\frac{7}{4}$

32. Let $f\left(\frac{x+y}{2}\right) = \frac{f(x)+f(y)}{2}$ for all real x and y . Let $f'(0) = 1$ and $f(0) = -1$. Then $f(2) =$
- (A*) 1 (B) -1
- (C) 2 (D) 0

Ans:- (A) 1

33. The order and degree of the differential equation $\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^{1/3} + x^{1/4} = 0$ are respectively
- (A*) 2, 3 (B) 3, 3
- (C) 2, 4 (D) 2, 1

Ans:- (A) 2, 3

34. Let a, b, c be three distinct real numbers. Then the points with position vectors

$$a\hat{i} + b\hat{j} + c\hat{k}, \quad b\hat{i} + c\hat{j} + a\hat{k}, \quad c\hat{i} + a\hat{j} + b\hat{k}$$

- (A) are collinear
 (B*) form an equilateral triangle
 (C) form a right angled triangle
 (D) form an isosceles triangle

Ans:- (B) form an equilateral triangle

35. Seven white balls and three black balls are randomly placed in a row. The probability that no two black balls are placed adjacently equals

- (A) $\frac{1}{2}$ (B*) $\frac{7}{15}$
 (C) $\frac{2}{15}$ (D) $\frac{1}{15}$

Ans:- (B) $\frac{7}{15}$

36. Let N denote the set of all natural numbers and R be the relation on $N \times N$ defined by

$(a, b)R(c, d)$ if $ad(b + c) = bc(a + d)$. Then R is

- (A) symmetric only
 (B) symmetric and reflexive
 (C) transitive only
 (D*) an equivalence relation

Ans:- (D) an equivalence relation

37. Number of solutions of $\log_4(x - 1) = \log_2(x - 3)$

- (A) 0 (B*) 1
 (C) 2 (D) 3

Ans:- (B) 1

38. The value of $\sqrt{\frac{1}{2}} \cdot \sqrt{\frac{1}{2} + \frac{1}{2}\sqrt{\frac{1}{2}}} \cdot \sqrt{\frac{1}{2} + \frac{1}{2}\sqrt{\frac{1}{2} + \frac{1}{2}\sqrt{\frac{1}{2}}}} \cdots \infty$ is

- (A) $\frac{1}{\pi}$ (B*) $\frac{2}{\pi}$
 (C) $\frac{3}{\pi}$ (D) $\frac{4}{\pi}$

Ans:- (B) $\frac{2}{\pi}$

39. The sides AB, BC and CA of a triangle ABC have 3, 4 and 5 points respectively. The total number of triangles that can be constructed from these points as vertices is

- (A) 225 (B) 220
 (C) 210 (D*) 205

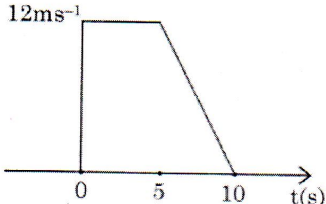
Ans:- (D) 205

40. The number of values of c such that the straight line $Y = 4X + c$ touches the curves

$$\frac{x^2}{4} + y^2 = 1 \text{ is}$$

- (A) 0 (B) 1
 (C*) 2 (D) infinite

Ans:- (C) 2

41. β -decay is related to
 (A) Gravitational force
 (B) Electromagnetic force
 (C) Strong nuclear force
 * (D) Weak nuclear force
Ans : (D) Weak nuclear force
42. The speed-time graph of a particle along a fixed direction is shown below. The distance traversed by the particle between $t = 0$ s and $t = 10$ s will be
- 
- (A) 120 m
 (C) 60 m
Ans : (B) 90 m
43. A body constrained to move along the z-axis of a co-ordinate system is subject to a constant force \vec{F} given by $\vec{F} = (-\hat{i} + 2\hat{j} + 3\hat{k})$ N. The work done by this force in moving the body a distance 4m along the z-axis is
 (A) $(-4\hat{i} + 8\hat{j} + 12\hat{k})$ N
 * (C) 12N
Ans : (C) 12 N
44. A comet orbits the sun in a highly elliptical orbit. The quantities that remain constant through out its orbit are
 (A) Angular speed and angular momentum
 (B) Kinetic energy and potential energy
 * (C) Angular momentum and total energy
 (D) Angular speed and total energy
Ans : (C) Angular momentum and total energy
45. The volume contraction of a solid copper cube, 10 cm on an edge, when subjected to a hydraulic pressure of 7.0×10^6 Pa is
 (B for copper = 140×10^9 Nm^{-2})
 (A) 0.058 cm^3
 (C) $6.0 \times 10^{-2} \text{ cm}^3$
 * (B) $5 \times 10^{-2} \text{ cm}^3$
 (D) $5 \times 10^{-3} \text{ m}^3$
Ans : (B) $5 \times 10^{-2} \text{ cm}^3$
46. The dimensions of Reynold's number are
 (A) $\text{M}^0\text{L}^{-1}\text{T}^{-1}$
 (C) $\text{M}^1\text{L}^0\text{T}^{-2}$
 * (B) $\text{M}^0\text{L}^0\text{T}^0$
 (D) $\text{M}^1\text{L}^{-2}\text{T}^{-1}$
Ans : (B) $\text{M}^0\text{L}^0\text{T}^0$
47. In anomalous behaviour water exhibits
 (A) an expansion when temperature is raised from 0°C to 4°C
 (B) a contraction when temperature is decreased from 4°C to 0°C
 (C) an expansion when temperature is raised from 0°C onwards
 * (D) contraction when temp is raised from 0°C to 4°C
Ans : (D) contraction when temp is raised from 0°C to 4°C
48. The coefficient of volume expansion of glycerine is $49 \times 10^{-5} \text{K}^{-1}$. The fractional change in its density for a 30°C rise in temperature is
 (A) 4.17×10^{-2}
 (C) 7.14×10^{-2}
 * (B) 1.47×10^{-2}
 (D) 1.74×10^{-2}
Ans : (B) 1.47×10^{-2}
49. A wooden block of mass 1 kg is fastened to a spring of spring constant 50 Nm^{-1} . If the block is pulled to a distance $x = 10$ cm from its equilibrium position at $x = 0$, its displacement at any time t will be
 * (A) $0.1 \cos(7.07t)$
 (C) $0.5 \cos(7.07t)$
 (B) $0.1 \sin(7.07t^2)$
 (D) $0.5 \sin(7.07t^2)$
Ans : (A) $0.1 \cos(7.07t)$

50. The displacement of a particle executing SHM is described by $x(t) = A \cos(\omega t + \phi)$. If at $t = 0$ the position of the particle is 1 cm and its initial velocity is $\omega \text{ cm s}^{-1}$, its amplitude and initial phase angle are
 (A) 2, 75° (B) 2, 45°
 *(C) $\sqrt{2}$, -45° (D) $\sqrt{2}$, 30°
Ans : (C) $\sqrt{2}$, -45°
51. Two sitar strings A and B playing the note 'Ga' are slightly out of tune and produce beats of frequency 6 Hz. Then tension in the string A is slightly reduced and the beat frequency is found to reduce to 3 Hz. If the original frequency of A is 324 Hz, the frequency of B is
 *(A) 318 Hz (B) 321 Hz
 (C) 330 Hz (D) 381 Hz
Ans : (A) 318 Hz
52. A parallel plate air capacitor has a capacitance of 8 pF. If the separation between the plates is reduced by half and the space is filled up with a material of dielectric constant 6, then its capacitance will be
 (A) 69 pF (B) 86 pF
 (C) 68 pF *(D) 96 pF
Ans : (D) 96 pF
53. A storage battery of emf 8.0 V and internal resistance 0.5Ω is being charged by a 120 V dc supply using a series resistor of 15.5Ω . The potential drop across the series resistor is
 *(A) 108.5 V (B) 180.5 V
 (C) 801.5 V (D) 810.5 V
Ans : (A) 108.5 V
54. A closely wound solenoid 80 cm long has 5 layers of windings of 400 turns each. The diameter of the solenoid is 1.8 cm. If the current carried is 8.0 A, the magnetic field near the centre is
 (A) $5\pi \times 10^{-4} \text{ t}$ (B) $8\pi \times 10^{-2} \text{ t}$
 (C) $4\pi \times 10^{-3} \text{ t}$ (D) $6\pi \times 10^3 \text{ t}$
Ans : Bonus
55. A galvanometer coil has a resistance of 12Ω and the metre shows full scale deflection for a current of 3 mA. It may be converted into a voltmeter of range 0 to 18 V if a resistance of value _____ Ω is connected in _____.
 (A) 5898, parallel (B) 5889, series
 (C) 8859, parallel *(D) 5988, series
Ans : (D) 5988, series
56. A plane electromagnetic wave of frequency 25 MHz travels in free space along the x-direction. If \vec{E} at a particular point in space and time is $6.3 \hat{j} \text{ V m}^{-1}$, \vec{B} at that point is (Given $c = (\epsilon_0 \mu_0)^{-1/2}$)
 *(A) $2.1 \times 10^{-8} \text{ T}$ (B) $3.5 \times 10^{-5} \text{ T}$
 (C) $2.6 \times 10^{-6} \text{ T}$ (D) $3.1 \times 10^{-6} \text{ T}$
Ans : (A) $2.1 \times 10^{-8} \text{ T}$
57. A beam of light of wavelength 650 nm is used to obtain interference fringes in a Young's double-slit experiment. The distance of the third bright fringe on the screen from the central maximum is
 *(A) $1950 \left(\frac{D}{d}\right) \text{ nm}$ (B) $1950 \left(\frac{d}{D}\right) \text{ nm}$
 (C) $1590 \left(\frac{D}{d}\right) \text{ nm}$ (D) $1590 \left(\frac{d}{D}\right) \text{ nm}$
Ans : (A) $1950 \left(\frac{D}{d}\right) \text{ nm}$
58. The work function for a certain metal is 4.2 eV. If a radiation of wavelength 330 nm is incident on the metal, will this metal give photoelectric emission and why?
 (A) Yes, because $\nu < \nu_0$
 (B) No, because $\nu > \nu_0$
 *(C) No, because $\nu < \nu_0$
 (D) yes, because $\nu = \nu_0$
Ans : (C) No, because $\nu < \nu_0$

59. The dimensions of stopping potential is

- (A) $[ML^{-1}T^{-2}A^3]$
 (B) $[M^{-1}L^{-2}T^3A^2]$
 (C) $[M^{-2}LT^{-3}A^{-1}]$
 *(D) $[ML^2T^{-3}A^{-1}]$

Ans : (D) $[ML^2T^{-3}A^{-1}]$

60. The radius of the innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. The radii of the $n = 2$ and $n = 3$ orbits are

- *(A) 2.12×10^{-10} m; 4.77×10^{-16} m
 (B) 2.12×10^{-11} m; 4.77×10^{-11} m
 (C) 4.77×10^{-10} m; 2.12×10^{-16} m
 (D) 4.77×10^{-11} m; 2.12×10^{-11} m

Ans : (A) 2.12×10^{-10} m; 4.77×10^{-16} m

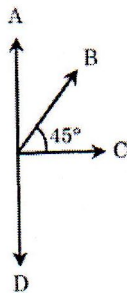
61. The following integral is carried over a length to obtain certain property, where ρ and P are density and pressure, respectively. What is dimension of the integral ?

$$\int \frac{dl}{\sqrt{P/\rho}}$$

- *(A) T (B) $L^{-1}T$
 (C) $M^{-1}L^{-1}T$ (D) T^{-1}

Ans : (A) T

62. In the following figure four vectors of magnitude R are oriented as shown. The magnitude of the resultant is approximately



- *(A) 1.85 R (B) 2.85 R
 (C) -1.85 R (D) 0

Ans : (A) 1.85 R

63. A time dependent force is acting on a body for which the velocity of body can be expressed as $\alpha t^{3/2}$. The displacement of the body between time $t = 2$ and 5 sec is about

- *(A) 20α (B) 22α
 (C) 6α (D) 0

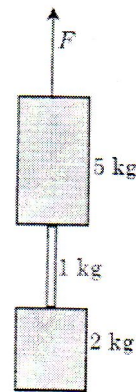
Ans : (A) 20α

64. A particle is moving with a velocity $\vec{v} = \alpha(y\hat{i} - x\hat{j})$. Which of the following can probably be the equation for its orbit ?

- *(A) $x^2 + y^2 = 0$ (B) $x^2 - y^2 = 0$
 (C) $xy = \text{const.}$ (D) $x/y = \text{const.}$

Ans : (A) $x^2 + y^2 = 0$

65. As shown in the figure below, two blocks each of mass 5 and 2 kg, respectively are connected through a rigid iron rod of mass 1 kg. The whole assembly is being pulled upward against gravity with a net acceleration of 2 m/s^2 . What is the tension at the middle point of the iron rod ? Assume acceleration due to gravity be 10 m/s^2 .

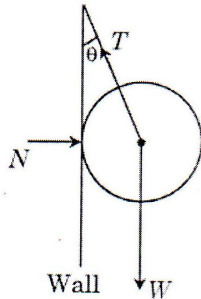


- (A) 20 N (B) 25 N
 *(C) 30 N (D) 35 N

Ans : (C) 30 N

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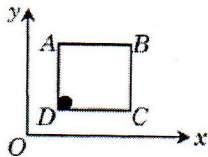
66. In the following figure, a sphere is hung by a massless string from a pivot point and the sphere is resting against the wall. For this diagram, which of the following statement is correct ?



- *(A) $W = N \tan \theta$ (B) $N = W \tan \theta$
 (C) $N = W \sin \theta$ (D) $W = N \sin \theta$

Ans : (A) $W = W \tan \theta$

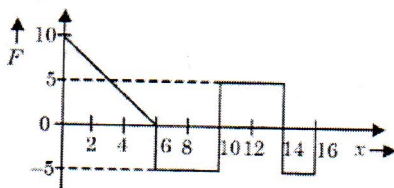
67. In the figure below, a solid sphere of mass 3 kg is resting inside a cube ABCD. The cube is moving at the velocity $\vec{v} = 5t\hat{x} - 2t\hat{y}$. The magnitude of total force applied by the sphere on the cube is ($g \sim 10\text{m/s}^2$)



- (A) 39 N (B) $\sqrt{89}\text{N}$
 *(C) $3\sqrt{89}\text{N}$ (D) $3\sqrt{39}\text{N}$

Ans : (C) $3\sqrt{89}\text{N}$

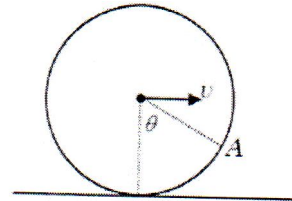
68. As shown in the figure below, the force F on a particle varies with position in a certain manner. The kinetic energy of the particle at $x = 0$ is 12J. What is its kinetic energy at $x = 14$?



- *(A) 42 J (B) 70 J
 (C) 40 J (D) 0 J

Ans : (A) 42 J

69. As shown in the figure a circular loop is rolling without slipping horizontally with a linear speed v . What is the speed of the point A?



- (A) $v \sin \theta$ (B) $v \cos \theta$
 (C) $2v \cos(\theta/2)$ *(D) $2v \sin(\theta/2)$

Ans : (D) $2v \sin(\theta/2)$

70. Assume that the speedometer of a car measures its speed on the basis of revolution of its wheels. If we now replace the wheels of the car with a wheel with diameter twice that of the original wheel, what the ratio of the speeds of the car as measured by the speedometer to the actual speed ?

- (A) 1 *(B) $\frac{1}{2}$
 (C) 2 (D) $\frac{1}{3}$

Ans : (B) $\frac{1}{2}$

71. The moment of inertia of a hollow square cube of side length a and mass M about an axis passing through the center of the cube is a

- (A) $\frac{1}{18} M\alpha^2$ (B) $\frac{1}{6} M\alpha^2$
 (C) $\frac{5}{6} M\alpha^2$ *(D) $\frac{5}{18} M\alpha^2$

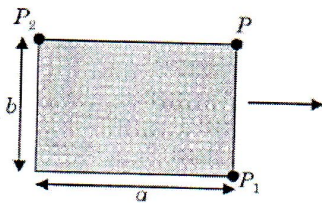
Ans : (D) $\frac{5}{18} M\alpha^2$

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72. On a certain planet of radius R , the weight of a body decreases by about 1.5%, when raised to height of h from its surface. Which of the following is true for the weight of the body, if it is taken down to a depth of h from the surface ?
- (A) Increase by 1.5%
 (B) Decrease by 1.5 %
 (C) Increase by 0.75%
 *(D) Decrease by 0.75%

Ans : (D) Decrease by 0.75%

73. As shown in the figure, a rectangular box, which is filled with water of density ρ is accelerating horizontally with an acceleration α . The acceleration due to gravity is g . The pressure difference ($P_1 - P_2$), between the two corners shown is



- *(A) $\rho(gb - \alpha a)$ (B) $\rho(g\alpha + \alpha b)$
 (C) $\rho\alpha^2 b / g$ (D) $\rho g^2 \alpha / \alpha$

Ans : (A) $\rho(gb - \alpha a)$

74. A rectangular block of wood of density 800 kg / m^3 falls in a lake from the height of 20 cm. To what depth, the block will sink ?
 (Assume $g = 10 \text{ m / s}^2$)
- (A) 3.2 m (B) 1.6 m
 (C) 1 m (D) 0.16 m

Ans : Bonus

75. An elevator of mass 2000 kg is hanging on a steel cable of diameter of 2 cm. What is the maximum acceleration with which the elevator can move up before the cable snaps, if the maximum stress the cable can withstand is 10^8 N/m^2
- (A) 5π (B) $5(\pi + 2)$
 *(C) $5(\pi - 2)$ (D) $10(2\pi - 1)$

Ans : (C) $5(\pi - 2)$

76. A brass block is tightly fitted in a cubical hole in an iron block. Which of the following processes will loosen the block so that it can be removed easily ?
- (A) Heating and then cooling
 (B) Cooling and then heating
 *(C) Cooling
 (D) Heating

Ans : (C) Cooling

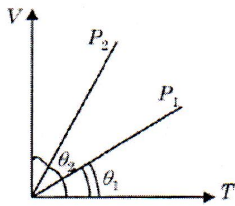
77. A sphere of radius R containing a monatomic gas of molar mass M at temperature T is allowed to fall freely through a height of h under gravity with an acceleration due to gravity g , before hitting a surface. where it stopped completely. The increase in temperature of the gas inside is (universal gas constant R)

- *(A) $\frac{2Mgh}{3R}$ (B) $\frac{Mgh}{R}$
 (C) $\frac{Mgh}{RT} R$ (D) $\frac{2Mgh}{3R} R$

Ans : (A) $\frac{2Mgh}{3R}$

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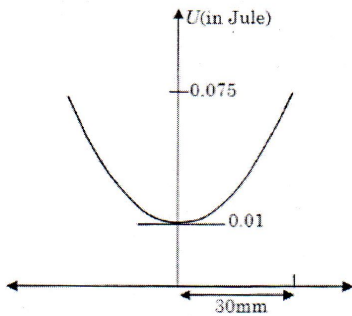
78. For the T-V relation shown in the figure below, which of the following statements is true ?



- *(A) $P_1 > P_2$
- (B) $P_1 < P_2$
- (C) $P_1 = P_2$
- (D) None of these

Ans : (A) $P_1 > P_2$

79. During a simple harmonic oscillation, the potential varies as shown in the figure below. The value of the spring constant is.



- (A) 4.3 N/m
- (B) 72.2 N/m
- *(C) 144.4 N/m
- (D) 166.7 N/m

Ans : (C) 144.4 N/m

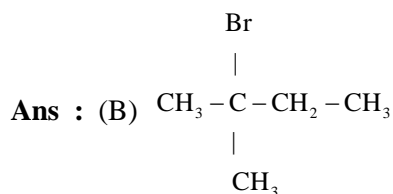
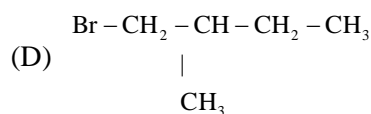
80. A particle is moving along the x-axis and has potential energy $U = 1 + 12x + 6x^2$. If the particle is now released at $x = -5$, the maximum value of x can be

- (A) -1
- (B) 0
- (C) 1
- *(D) 3

Ans : (D) 3

81. The number of electrons, protons and neutrons in phosphide ion (P^{3-}) is
 (A) 15, 15, 16 (B) 15, 16, 15
 *(C) 18, 15, 16 (D) 15, 16, 18
Ans : (C) 18, 15, 16
82. Surface Tension of a liquid becomes zero at
 (A) Boiling point
 *(B) Critical Point
 (C) Condensation point
 (D) Tripplle Point
Ans : (B) Critical Point
83. Which of the following changes does not involve any electron transfer?
 (A) $Na \rightarrow Na^+$
 (B) $Zn^{2+} \rightarrow Zn$
 *(C) $Cr_2O_7^{2-} \rightarrow CrO_4^{2-}$
 (D) $VO^{2+} \rightarrow V_2O_3$
Ans : (C) $Cr_2O_7^{2-} \rightarrow CrO_4^{2-}$
84. Which one of the following is not considered green chemistry technique?
 (A) Use of microwave
 *(B) Use of Benzene
 (C) Use of ultrasound
 (D) Enzyme as catalyst
Ans : (B) Use of Benzene
85. Which one of the following will show both Frenkel and Schottky Defect?
 (A) NaCl (B) AgBr
 (C) CsCl (D) KCl
Ans : (B) AgBr
86. The Oxidation number of phosphorous in orthophosphorous acid is
 (A) +1 (B) +2
 (C) +5 *(D) +3
Ans : (D) +3
87. 12.3 g of 1-bromopropane is treated with alcoholic KOH. What mass of propene is obtained if yield is 50%
 (A) 6.05g (B) 12.3g
 (C) 4.2g *(D) 2.1 g
Ans : (D) 2.1 g
88. The correct increasing order of boiling points is
 (A) Pentan-1-ol < butane-1-ol < butan-2-ol < ethanol
 *(B) Ethanol < butan-2-ol < butan-1-ol < pentan-1-ol
 (C) Pentan-1-ol < butan-2-ol < butan-1-ol < ethanol
 (D) Butan-2-ol < butan-1-ol < ethanol < pentan-1-ol
Ans : (B) Ethanol < butan-2-ol < butan-1-ol < pentan-1-ol
89. The product obtained for the following reaction is

$$CH_3 - \underset{\substack{| \\ CH_3}}{CH} - \underset{\substack{| \\ CH_3}}{CH} - CH_3 \xrightarrow{HBr} ?$$
 (A)
$$CH_3 - \underset{\substack{| \\ CH_3}}{CH} - CH - CH_3 \xrightarrow{HBr} ?$$
 *(B)
$$CH_3 - \underset{\substack{| \\ CH_3}}{C} - CH_2 - CH_3$$
 (C)
$$CH_3 - \underset{\substack{| \\ CH_3}}{CH} - CH_2 - CH_2 - Br$$



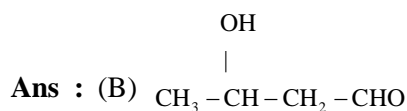
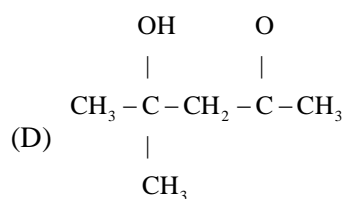
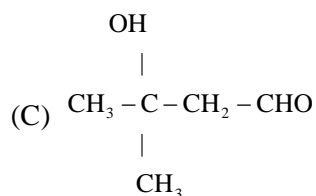
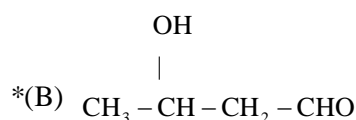
90. By passing the vapour of acetic acid over heated MnO at 300^o C, we obtain 300^o C

- (A) Acetaldehyde *(B) Acetone
(C) Ethyl Alcohol (D) Formaldehyde

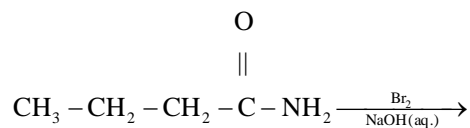
Ans : (B) Acetone

91. Acetaldehyde upon treated with dil. NaOH forms

- (A) $\text{CH}_3-\text{CH}_2-\text{OH}$



92. The Product of the following transformation is



- (A) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{NH}_2$
*(B) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{NH}_2$
(C) $\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Br}$
(D) $\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{COOH}$

Ans : (B) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{NH}_2$

93. An aromatic compound 'A' on treatment with aqueous ammonia and heating forms compound 'B' which on heating with Br₂ and KOH forms a compound 'C' of Molecular formula C₆H₇N. The compound A is

- (A) Benzonitrile *(B) Benzoic Acid
(C) Nitrobenzene (D) Benzaldehyde

Ans : (B) Benzoic Acid

94. Nylon-6 is obtained by

- (A) polymerization of hexamethylene diamine and adipic acid
*(B) Heating caprolactum with water at high temperature
(C) Interaction of ethylene glycol and terephthalic acid
(D) Crosslinking of formaldehyde

Ans : (B) Heating caprolactum with water at high temperature

95. Number of atom in 5.586 g Fe (M = 55.86 gmol⁻¹) is 5.586 g Fe (M 55.86 gmol⁻¹)

- (A) Twice of 60.0 g of C
*(B) Twice of 0.6 g of C
(C) Twice of 6.0 g of C
(D) Twice of 600 g of C

Ans : (B) Twice of 0.6 g of C

96. The correct order of non-metallic character of B, Al, Mg and K is
 (A) $Al > Mg > B > K$
 (B) $K > Mg > Al > B$
 *(C) $B > Al > Mg > K$
 (D) $Mg > Al > K > B$

Ans : (C) $B > Al > Mg > K$

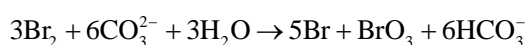
97. For a reaction, $K = 100$ the value of ΔG^0 will be
 (A) $-2.303 RT$ *(B) $-4.606 RT$
 (C) $-RT$ (D) RT

Ans : (B) $-4.606 RT$

98. Which of the following will react with hex-2-yne to produce trans-hex-2-ene?
 (A) $LiAlH_4$ (B) pt/H_2
 *(C) Li/NH_2 (D) $Pd/BaSO_4$

Ans : (C) Li/NH_2

99. In the following reaction



- (A) Bromine is reduced and carbonate is oxidised
 (B) Bromine is oxidised and carbonate is reduced
 (C) Bromine is Neither oxidised nor reduced
 *(D) Bromine is reduced and oxidised

Ans : (D) Bromine is reduced and oxidised

100. A mixed oxide having cubic closed packed structure has $\frac{1}{8}$ part of the tetrahedral holes

occupied by X^{2+} ions and $\frac{1}{2}$ part of the octahedral holes of Y^{3+} ions. The formula of the compound is

- (A) XYO (B) X_2Y_2O
 (C) XY_2O *(D) XY_2O_4

Ans : (D) XY_2O_4

101. The degree of dissociation for a 0.1 M $Al_2(SO_4)_3$ solution having Van't Hoff factor value of 4.2 will be

- *(A) 80% (B) 90%
 (C) 75% (D) 85%

Ans : (A) 80%

102. Copper matte contains

- (A) only Cu_2S *(B) Cu_2S and FeS
 (C) Cu_2S and Cu_2O (D) Cu_2O and FeS

Ans : (B) Cu_2S and FeS

103. The oxidation state of phosphorous in H_3PO_3 , $H_4P_2O_6$ and $H_4P_2O_7$, respectively are

- (A) +1, +3, +4 *(B) +3, +4, +5
 (C) +3, +4, +4 (D) +3, +5, +4

Ans : (B) +3, +4, +5

104. Which of the following does not show geometrical isomerism ?

- (A) $[Co(NH_3)_4Cl_2]^+$ (B) $[CoCl_2(en)_2]$
 (C) $[Pt(NH_3)_2Cl_2]$ *(D) $[Cr(NH_3)_5Cl]^{2+}$

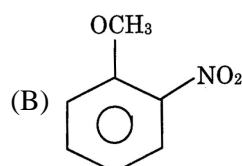
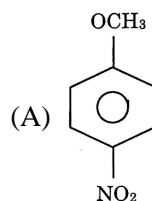
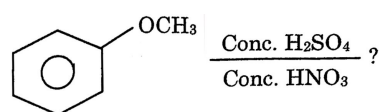
Ans : (D) $[Cr(NH_3)_5Cl]^{2+}$

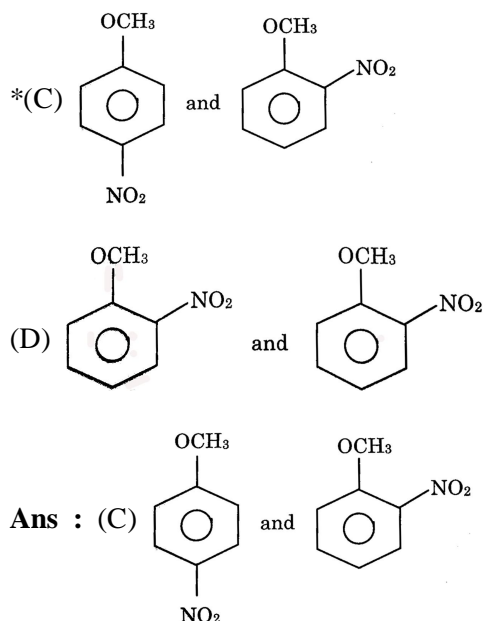
105. 2-Bromopropane is heated with ethanol and sodium ethoxide. The major product obtained is

- (A) 2-methylpentane *(B) propene
 (C) cis-pent-2-ene (D) trans-pent-2-ene

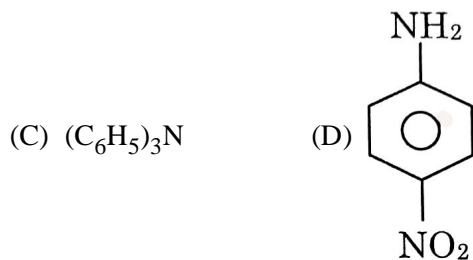
Ans : (B) propene

106. The product(s) of the following reaction will be



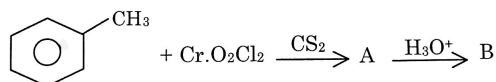


107. The reagent used to differentiate acetophenone and benzophenone is
 *(A) $I_2 + NaOH$ (B) Fehling's solution
 (C) Brady's reagent (D) Tollen's reagent
 Ans : (A) $I_2 + NaOH$
108. Which of the following is more basic than aniline?
 *(A) $C_6H_6CH_2NH_2$ (B) $(C_6H_5)_2NH$



Ans : (A) $C_6H_6CH_2NH_2$

109. The compound 'B' in the following reaction is



- *(A) Benzaldehyde (B) Toluene
 (C) Benzene (D) Benzalchloride

Ans : (A) Benzaldehyde

110. The number of electrons presents in 2.3g of NO_2 is

- *(A) 6.92×10^{23} (B) 6.92×10^{22}
 (C) 1.38×10^{23} (D) 6.023×10^{23}

Ans : (A) 6.92×10^{23}

111. At the top of a mountain the thermometer reads $0^\circ C$ and the barometer reads 710 mmHg. At the bottom of the mountain the temperature is $30^\circ C$ and the pressure is 760 mm Hg. The ratio of density of the air at the top with that of the bottom is

- *(A) 1.04 : 1 (B) 1 : 1.04
 (C) 1 : 09 (D) 1.10 : 1

Ans : (A) 1.04 : 1

112. For the reaction $I_2(g) + H_2(g) \leftrightarrow 2HI(g)$; $K_c = 57$ at 700 K. The composition of the reaction mixture after 15 min of start of the reaction is $[I_2] = 0.20M$, $[H_2] = 0.10M$ and $[HI] = 0.40M$. Then

- *(A) net reaction goes from left to right
 (B) net reaction goes from right to left
 (C) no net reaction occurs
 (D) reactions stops after 15 min of start

Ans : (A) net reaction goes from left to right

113. If s is the solubility of $Zr_3(PO_4)_4$ in pure water then

- (A) $K_{sp} = s^7$ (B) $K_{sp} = 12s^7$
 (C) $K_{sp} = 5184s^7$ *(D) $K_{sp} = 6912s^7$

Ans : (D) $K_{sp} = 6912s^7$

114. V is a volume of a solution in litres containing W_2 grams of solute, of molar mass, M_2 is present in the solution. Suppose a semipermeable membrane is placed between the solvent and solution, the pressure that just stops the flow of the solvent is

(A) $P = \frac{W_2 RT}{M_2 V}$ *(B) $\pi = \frac{W_2 RT}{M_2 V}$

(C) $P = \frac{M_2 RT}{W_2 V}$ (D) $\pi = \frac{M_2 RT}{W_2 V}$

Ans : (B) $\pi = \frac{W_2 RT}{M_2 V}$

115. For strong electrolyte, the plot of Λ_m against $\frac{1}{C}$ is a straight line with

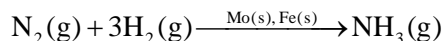
- (A) intercept Λ_m° and slope (A)
 (B) intercept (A) and slope (Λ_m°)

*(C) intercept Λ_m° and slope $(-A)$

(D) intercept $\Lambda_m^{\frac{1}{2}}$ and slope (Λ_m°)

Ans : (C) intercept Λ_m° and slope $(-A)$

116. In the Haber's process



(A) Fe and Mo are catalyst

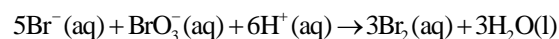
*(B) Fe is catalyst and Mo is promoter

(C) Mo is catalyst and Fe is promoter

(D) Fe is catalyst and Mo is poison

Ans : (B) Fe is catalyst and Mo is promoter

117. For the reaction



the rate of the reaction can be defined as

(A) $\text{Rate} = \frac{1}{5} \frac{d[\text{BrO}_3^-]}{dt}$

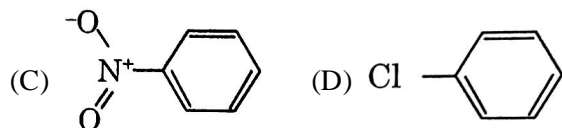
*(B) $\text{Rate} = -\frac{1}{5} \frac{d[\text{Br}^-]}{dt}$

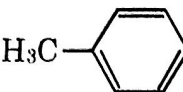
(C) $\text{Rate} = -\frac{1}{3} \frac{d[\text{Br}_2]}{dt}$

(D) $\text{Rate} = \frac{1}{6} \frac{d[\text{H}^+]}{dt}$

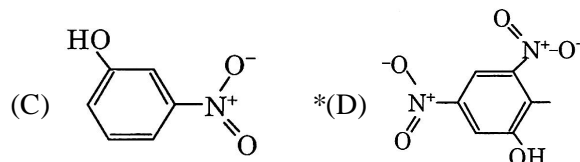
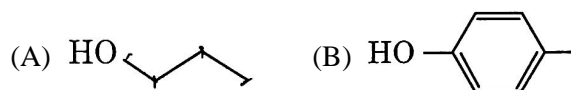
Ans : (B) $\text{Rate} = -\frac{1}{5} \frac{d[\text{Br}^-]}{dt}$

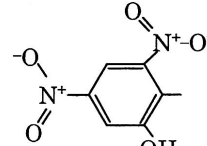
118. Which of the following molecule will undergo nitration most easily ?



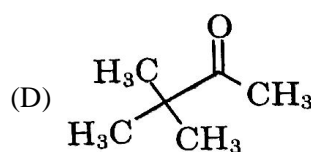
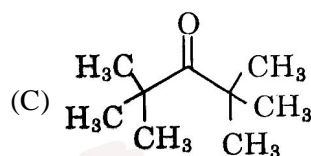
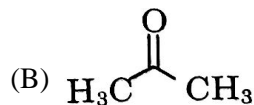
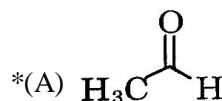
Ans : (A) 

119. Which of the following compound is most acidic ?



Ans : (D) 

120. Which of the following compound is most reactive towards HCN ?



Ans : (A) 