

JEE Main 2026 Paper 1 (B.E./B.Tech) 21 January 2026 Shift 1 Question Paper



Conducted by the National Testing Agency (NTA)

Time Allowed: 3 Hours

Paper 1: B.E./B.Tech.

Maximum Marks: 300

General Instructions

- (i) This paper is **Paper 1 (B.E./B.Tech.)** of **JEE (Main) 2026 - Session 1**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 21 January 2026, Shift 1. The total duration is **3 hours**.
- (ii) The paper has **75 questions** and a maximum of **300 marks**: Mathematics, Physics and Chemistry carry 25 questions (100 marks) each, in that order.
- (iii) Each subject has **two sections**. **Section A** has **20 multiple choice questions** (MCQs) with four options each. Select the most appropriate answer. **Section B** has **5 numerical value questions**.
- (iv) **All questions are compulsory**. For Section B, the answer is an integer value; the answer should be **rounded off to the nearest integer**. Use only the constants given in the question while calculating.
- (v) **Marking scheme** (Sections A and B): **+4** for a correct answer, **–1** for an incorrect answer, and **0** for an unanswred or marked-for-review question.
- (vi) All calculations and rough work are to be done on the rough sheets only. Calculators, log tables, slide rules and electronic gadgets are not allowed.

1. Let the mean and variance of 7 observations 2, 4, 10, x , 12, 14, y , $x > y$, be 8 and 16 respectively. Two numbers are chosen from $\{1, 2, 3, x - 4, y, 5\}$ one after another without replacement, then the probability, that the smaller number among the two chosen numbers is less than 4, is :

- (A) $\frac{4}{5}$ (B) $\frac{3}{5}$
(C) $\frac{2}{5}$ (D) $\frac{1}{3}$

2. If $x^2 + x + 1 = 0$, then the value of

$$\left(x + \frac{1}{x}\right)^4 + \left(x^2 + \frac{1}{x^2}\right)^4 + \left(x^3 + \frac{1}{x^3}\right)^4 + \dots + \left(x^{25} + \frac{1}{x^{25}}\right)^4$$

is:

- (A) 162 (B) 145
(C) 128 (D) 175

3. Let a point A lie between the parallel lines L_1 and L_2 such that its distances from L_1 and L_2 are 6 and 3 units, respectively. Then the area (in sq. units) of the equilateral triangle ABC, where the points B and C lie on the lines L_1 and L_2 , respectively, is :

- (A) $21\sqrt{3}$ (B) $12\sqrt{2}$
(C) $15\sqrt{6}$ (D) 27

4. The value of $\operatorname{cosec} 10^\circ - \sqrt{3} \sec 10^\circ$ is equal to :

- (A) 2 (B) 6
(C) 8 (D) 4

5. Let $\vec{a} = -\hat{i} + 2\hat{j} + 2\hat{k}$, $\vec{b} = 8\hat{i} + 7\hat{j} - 3\hat{k}$ and $\vec{c}$ be a vector such that $\vec{a} \times \vec{c} = \vec{b}$. If $\vec{c} \cdot (\hat{i} + \hat{j} + \hat{k}) = 4$, then $|\vec{a} + \vec{c}|^2$ is equal to :

- (A) 30 (B) 33
(C) 27 (D) 35

6. The value of $\int_{-\pi/6}^{\pi/6} \left(\frac{\pi + 4x^{11}}{1 - \sin(|x| + \pi/6)} \right) dx$ is equal to:

- (A) 8π (B) 4π
(C) 2π (D) 6π

7. Let $y = y(x)$ be the solution curve of the differential equation $(1 + x^2) dy + (y - \tan^{-1} x) dx = 0$, $y(0) = 1$. Then the value of $y(1)$ is :

- (A) $\frac{4}{e^{\pi/4}} - \frac{\pi}{2} - 1$ (B) $\frac{2}{e^{\pi/4}} + \frac{\pi}{4} - 1$
(C) $\frac{4}{e^{\pi/4}} + \frac{\pi}{2} - 1$ (D) $\frac{2}{e^{\pi/4}} - \frac{\pi}{4} - 1$

8. The number of strictly increasing functions f from the set $\{1, 2, 3, 4, 5, 6\}$ to the set $\{1, 2, 3, \dots, 9\}$ such that $f(i) \neq i$ for $1 \leq i \leq 6$, is equal to :

- (A) 21 (B) 28
(C) 27 (D) 22

9. Let (α, β, γ) be the co-ordinates of the foot of the perpendicular drawn from the point $(5, 4, 2)$ on the line $\vec{r} = (-\hat{i} + 3\hat{j} + \hat{k}) + \lambda(2\hat{i} + 3\hat{j} - \hat{k})$. Then the length of the projection of the vector $\alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}$ on the vector $6\hat{i} + 2\hat{j} + 3\hat{k}$ is :

- (A) $\frac{18}{7}$ (B) $\frac{15}{7}$
(C) 4 (D) 3

10. Let $a_1, a_2, a_3, \dots$ be a G.P. of increasing positive terms such that $a_2 \cdot a_3 \cdot a_4 = 64$ and $a_1 + a_3 + a_5 = \frac{813}{7}$. Then $a_3 + a_5 + a_7$ is equal to :

- (A) 3256 (B) 3252
(C) 3248 (D) 3244

11. Let PQ and MN be two straight lines touching the circle $x^2 + y^2 - 4x - 6y - 3 = 0$ at the points A and B respectively. Let O be the centre of the circle and $\angle AOB = \pi/3$. Then the locus of the point of intersection of the lines PQ and MN is :

- (A) $x^2 + y^2 - 18x - 12y - 25 = 0$
 (B) $x^2 + y^2 - 12x - 18y - 25 = 0$
 (C) $3(x^2 + y^2) - 12x - 18y - 25 = 0$
 (D) $3(x^2 + y^2) - 18x - 12y + 25 = 0$

12. The area of the region, inside the ellipse $x^2 + 4y^2 = 4$ and outside the region bounded by the curves $y = |x| - 1$ and $y = 1 - |x|$, is :

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

13. The sum of all the roots of the equation $(x - 1)^2 - 5|x - 1| + 6 = 0$, is :

- (A) 3 (B) 1
 (C) 4 (D) 5

14. If the coefficient of x in the expansion of $(ax^2 + bx + c)(1 - 2x)^{26}$ is -56 and the coefficients of x^2 and x^3 are both zero, then $a + b + c$ is equal to :

- (A) 1483 (B) 1300
 (C) 1500 (D) 1403

15. The number of relations, defined on the set $\{a, b, c, d\}$, which are both reflexive and symmetric, is equal to:

- (A) 16 (B) 64
 (C) 256 (D) 1024

16. Let the foci of a hyperbola coincide with the foci of the ellipse $\frac{x^2}{36} + \frac{y^2}{16} = 1$. If the eccentricity of the hyperbola is 5, then the length of its latus rectum is :

- (A) $\frac{96}{\sqrt{5}}$ (B) $24\sqrt{5}$
 (C) 12 (D) 16

17. If the domain of the function $f(x) = \cos^{-1}\left(\frac{2x-5}{11-3x}\right) + \sin^{-1}(2x^2 - 3x + 1)$ is the interval $[\alpha, \beta]$, then $\alpha + 2\beta$ is equal to :

- (A) 5 (B) 2
 (C) 3 (D) 1

18. Let O be the vertex of the parabola $x^2 = 4y$ and Q be any point on it. Let the locus of the point P, which divides the line segment OQ internally in the ratio 2 : 3 be the conic C. Then the equation of the chord of C, which is bisected at the point (1, 2), is :

- (A) $5x - 4y + 3 = 0$ (B) $x - 2y + 3 = 0$
 (C) $4x - 5y + 6 = 0$ (D) $5x - y - 3 = 0$

19. Let $\vec{c}$ and $\vec{d}$ be vectors such that $|\vec{c} + \vec{d}| = \sqrt{29}$ and $\vec{c} \times (2\hat{i} + 3\hat{j} + 4\hat{k}) = (2\hat{i} + 3\hat{j} + 4\hat{k}) \times \vec{d}$. If $\lambda_1, \lambda_2 (\lambda_1 > \lambda_2)$ are the possible values of $(\vec{c} + \vec{d}) \cdot (-7\hat{i} + 2\hat{j} + 3\hat{k})$, then the equation

$$K^2x^2 + (K^2 - 5K + \lambda_1)xy + (3K + \frac{\lambda_2}{2})y^2 - 8x + 12y + \lambda_2 = 0$$

represents a circle, for K equal to :

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

20. Let $f : \mathbf{R} \rightarrow (0, \infty)$ be a twice differentiable function such that $f(3) = 18, f'(3) = 0$ and $f''(3) = 4$.

Then $\lim_{x \rightarrow 1} \left(\log_e \left(\frac{f(2+x)}{f(3)} \right)^{\frac{18}{(x-1)^2}} \right)$ is equal to :

- (A) 9 (B) 18
 (C) 1 (D) 2

21. Let $f : \mathbf{R} \rightarrow \mathbf{R}$ be a twice differentiable function such that the quadratic equation $f(x)m^2 - 2f'(x)m + f''(x) = 0$ in m , has two equal roots for every $x \in \mathbf{R}$. If $f(0) = 1$, $f'(0) = 2$, and (α, β) is the largest interval in which the function $f(\log_e x - x)$ is increasing, then $\alpha + \beta$ is equal to _____.

22. Let $S = \{(m, n) : m, n \in \{1, 2, 3, \dots, 50\}\}$. If the number of elements (m, n) in S such that $6^m + 9^n$ is a multiple of 5 is p and the number of elements (m, n) in S such that $m + n$ is a square of a prime number is q , then $p + q$ is equal to _____.

23. Let $a_1 = 1$ and for $n \geq 1$, $a_{n+1} = \frac{1}{2}a_n + \frac{n^2 - 2n - 1}{n^2(n+1)^2}$. Then $|\sum_{n=1}^{\infty} (a_n - \frac{2}{n^2})|$ is equal to _____.

24. $6 \int_0^{\pi} |(\sin 3x + \sin 2x + \sin x)| dx$ is equal to _____.

25. For some $\alpha, \beta \in \mathbf{R}$, let $A = \begin{bmatrix} \alpha & 2 \\ 1 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 1 \\ 1 & \beta \end{bmatrix}$ be such that $A^2 - 4A + 2I = B^2 - 3B + I = O$. Then $(\det(\text{adj}(A^3 - B^3)))^2$ is equal to _____.

26. A conducting circular loop of area 1.0 m^2 is placed perpendicular to a magnetic field which varies as $B = \sin(100t)$ Tesla. If the resistance of the loop is 100Ω , then the average thermal energy dissipated in the loop in one period is ____ J.

- (A) π^2 (B) $\frac{\pi}{2}$
(C) π (D) 2π

27. A 4 kg mass moves under the influence of a force $\vec{F} = (4t^3\hat{i} - 3t\hat{j})$ N where t is the time in second. If mass starts from origin at $t = 0$, the velocity and position after $t = 2$ s will be:

- (A) $\vec{v} = 3\hat{i} + \frac{3}{2}\hat{j}$ $\vec{r} = \frac{6}{5}\hat{i} + \hat{j}$
(B) $\vec{v} = 4\hat{i} - \frac{3}{2}\hat{j}$ $\vec{r} = \frac{6}{5}\hat{i} - \hat{j}$
(C) $\vec{v} = 4\hat{i} - \frac{3}{2}\hat{j}$ $\vec{r} = \frac{8}{5}\hat{i} - \hat{j}$
(D) $\vec{v} = 4\hat{i} + \frac{5}{2}\hat{j}$ $\vec{r} = \frac{8}{5}\hat{i} + 2\hat{j}$

28. In an experiment the values of two spring constants were measured as $k_1 = (10 \pm 0.2)\text{N/m}$ and $k_2 = (20 \pm 0.3)\text{N/m}$. If these springs are connected in parallel, then the percentage error in equivalent spring constant is :

- (A) 1.33% (B) 2.67%
(C) 1.67% (D) 2.33%

29. Consider a modified Bernoulli equation.

$$\left(P + \frac{A}{Bt^2}\right) + \rho g(h + Bt) + \frac{1}{2}\rho V^2 = \text{constant}$$

If t has the dimension of time then the dimensions of A and B are ____, ____, respectively.

- (A) $[\text{ML}^0 \text{T}^{-1}]$ and $[\text{M}^0 \text{LT}]$ (B) $[\text{ML}^0 \text{T}^{-2}]$ and $[\text{M}^0 \text{LT}^{-1}]$
(C) $[\text{ML}^0 \text{T}^{-2}]$ and $[\text{M}^0 \text{LT}^{-2}]$ (D) $[\text{ML}^0 \text{T}^{-1}]$ and $[\text{M}^0 \text{LT}^{-1}]$

30. An aluminium and steel rods having same lengths and cross-sections are joined to make total length of 120 cm at 30°C . The coefficient of linear expansion of aluminium and steel are $24 \times 10^{-6}/^\circ\text{C}$ and $1.2 \times 10^{-5}/^\circ\text{C}$, respectively. The length of this composite rod when its temperature is raised to 100°C , is ____ cm.

- (A) 120.20 (B) 120.06
(C) 120.15 (D) 120.03

31. Two strings (A, B) having linear densities $\mu_A = 2 \times 10^{-4} \text{ kg/m}$ and, $\mu_B = 4 \times 10^{-4} \text{ kg/m}$ and lengths $L_A = 2.5 \text{ m}$ and $L_B = 1.5 \text{ m}$ respectively are joined. Free ends of A and B are tied to two rigid supports C and D , respectively creating a tension of 500 N in the wire. Two identical pulses, sent from C and D ends, take time t_1 and t_2 , respectively, to reach the joint. The ratio t_1/t_2 is:

- (A) 1.90 (B) 1.18
(C) 1.08 (D) 1.67

32. The electric field in a plane electromagnetic wave is given by :

$$E_y = 69 \sin[0.6 \times 10^3 x - 1.8 \times 10^{11} t] \text{ V/m.}$$

The expression for magnetic field associated with this electromagnetic wave is ____ T.

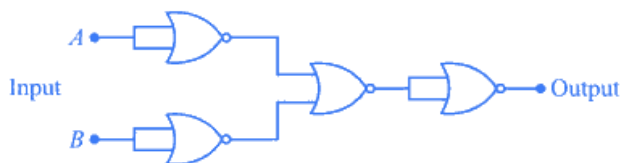
- (A) $B_z = 2.3 \times 10^{-7} \sin[0.6 \times 10^3 x - 1.8 \times 10^{11} t]$
(B) $B_z = 2.3 \times 10^{-7} \sin[0.6 \times 10^3 x + 1.8 \times 10^{11} t]$
(C) $B_y = 2.3 \times 10^{-7} \sin[0.6 \times 10^3 x - 1.8 \times 10^{11} t]$
(D) $B_y = 69 \sin[0.6 \times 10^3 x + 1.8 \times 10^{11} t]$

33. A parallel plate capacitor has capacitance C , when there is vacuum within the parallel plates. A sheet having thickness $(\frac{1}{3})^{\text{rd}}$ of the separation between the plates and relative permittivity K is introduced between the plates. The new capacitance of the system is :

- (A) $\frac{3CK^2}{(2K+1)^2}$ (B) $\frac{4KC}{3K-1}$
(C) $\frac{CK}{2+K}$ (D) $\frac{3KC}{2K+1}$

34.

The given circuit works as :



- (A) NOR gate (B) OR gate
(C) AND gate (D) NAND gate

35. A point charge of 10^{-8}C is placed at origin. The work done in moving a point charge $2\mu\text{C}$ from point $A(4, 4, 2)\text{m}$ to $B(2, 2, 1)\text{m}$ is ____ J. $\left(\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ in SI units}\right)$

- (A) 30×10^{-6} (B) 0
(C) 15×10^{-6} (D) 45×10^{-6}

36. A light wave described by $E = 60 [\sin(3 \times 10^{15}t) + \sin(12 \times 10^{15}t)]$ (in SI units) falls on a metal surface of work function 2.8 eV . The maximum kinetic energy of ejected photoelectron is (approximately) ____ eV. $(h = 6.6 \times 10^{-34} \text{ J.s. and } e = 1.6 \times 10^{-19} \text{ C})$

- (A) 3.8 (B) 7.8
(C) 6.0 (D) 5.1

37. Initially a satellite of 100 kg is in a circular orbit of radius $1.5R_E$. This satellite can be moved to a circular orbit of radius $3R_E$ by supplying $\alpha \times 10^6 \text{ J}$ of energy. The value of α is ____ . (Take Radius of Earth $R_E = 6 \times 10^6 \text{ m}$ and $g = 10 \text{ m/s}^2$)

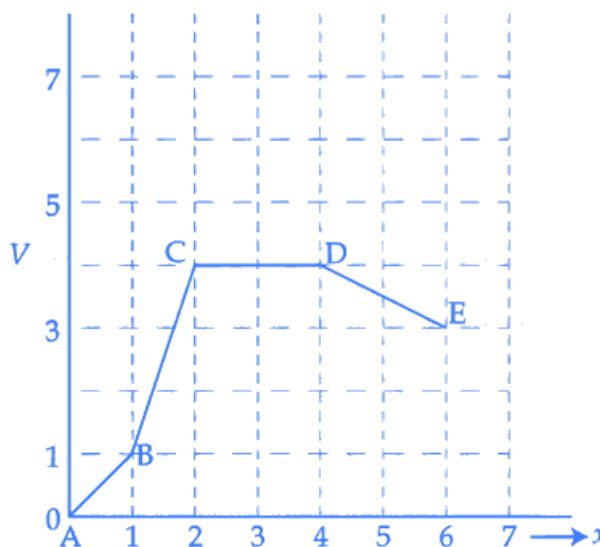
- (A) 500 (B) 1000
(C) 100 (D) 150

38. A gas based geyser heats water flowing at the rate of $5.0 \text{ litres per minute}$ from 27°C to 87°C . The rate of consumption of the gas is ____ g/s.

(Take heat of combustion of gas $= 5.0 \times 10^4 \text{ J/g}$)
specific heat capacity of water $= 4200 \text{ J/kg} \cdot ^\circ\text{C}$

- (A) 4.2 (B) 2.1
(C) 0.21 (D) 0.42

39. Potential energy (V) versus distance (x) is given by the graph. Rank various regions as per the magnitudes of the force (F) acting on a particle from high to low.



- (A) $F_{BC} > F_{AB} > F_{DE} > F_{CD}$
(B) $F_{BC} > F_{CD} > F_{DE} > F_{AB}$
(C) $F_{CD} > F_{AB} > F_{BC} > F_{DE}$
(D) $F_{CD} > F_{DE} > F_{AB} > F_{BC}$

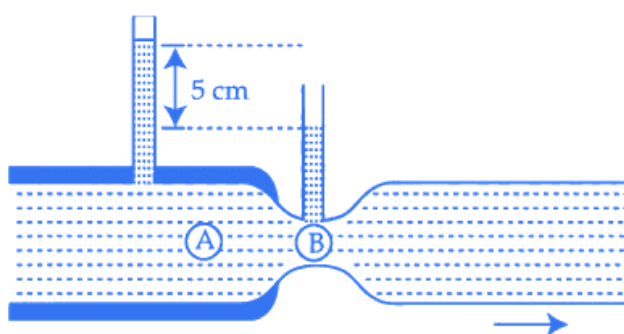
40. If an alpha particle with energy 7.7 MeV is bombarded on a thin gold foil, the closest distance from nucleus it can reach is ____ m. (Atomic number of gold $= 79$ and $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ in SI units}$)

- (A) 2.95×10^{-16} (B) 3.85×10^{-14}
(C) 2.95×10^{-14} (D) 3.85×10^{-16}

41. A current carrying solenoid is placed vertically and a particle of mass m with charge Q is released from rest. The particle moves along the axis of solenoid. If g is acceleration due to gravity then the acceleration (a) of the charged particle will satisfy :

- (A) $a > g$ (B) $a = 0$
(C) $0 < a < g$ (D) $a = g$

42. Water flows through a horizontal tube as shown in the figure. The difference in height between the water columns in vertical tubes is 5 cm and the area of cross-sections at A and B are 6 cm^2 and 3 cm^2 respectively. The rate of flow will be ____ cm^3/s . (take $g = 10 \text{ m/s}^2$)



- (A) $100\sqrt{3}$ (B) $\frac{200}{\sqrt{3}}$
(C) $200\sqrt{6}$ (D) $200\sqrt{3}$

43. In a double slit experiment the distance between the slits is 0.1 cm and the screen is placed at 50 cm from the slits plane. When one slit is covered with a transparent sheet having thickness t and refractive index $n(= 1.5)$, the central fringe shifts by 0.2 cm. The value of t is ____ cm.

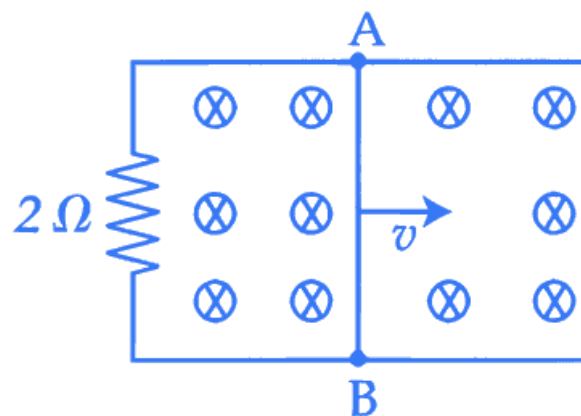
- (A) 6.0×10^{-3} (B) 8×10^{-4}
(C) 5.0×10^{-3} (D) 5.6×10^{-4}

44. A uniform rod of mass m and length l suspended by means of two identical inextensible light strings as shown in figure. Tension in one string immediately after the other string is cut, is ____ . (g acceleration due to gravity)



- (A) mg/s (B) $mg/4$
(C) mg (D) $mg/2$

45. A 1 m long metal rod AB completes the circuit as shown in figure. The area of circuit is perpendicular to the magnetic field of 0.10 T. If the resistance of the total circuit is 2Ω then the force needed to move the rod towards right with constant speed (v) of 1.5 m/s is ____ N.



- (A) 5.7×10^{-2} (B) 7.5×10^{-3}
(C) 5.7×10^{-3} (D) 7.5×10^{-2}

46. 10 mole of oxygen is heated at constant volume from 30°C to 40°C . The change in the internal energy of the gas is ____ cal. (The molecular specific heat of oxygen at constant pressure, $C_P = 7\text{cal/mol}\cdot^{\circ}\text{C}$ and $R = 2\text{cal/mol}\cdot^{\circ}\text{C}$.)

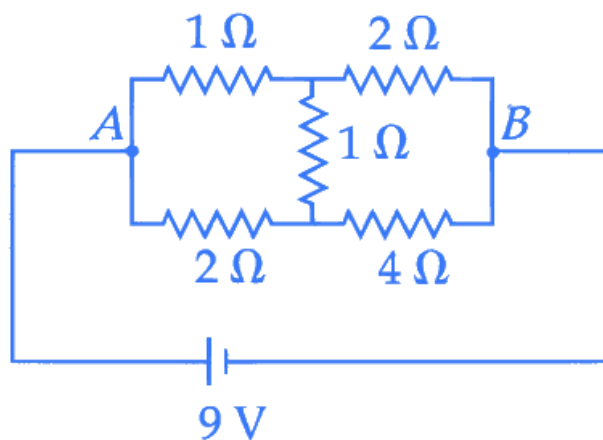
47. In a microscope the objective is having focal length $f_o = 2\text{ cm}$ and eye-piece is having focal length $f_e = 4\text{ cm}$. The tube length is 32 cm . The magnification produced by this microscope for normal adjustment is ____ .

48. Two identical thin rods of mass $M\text{ kg}$ and length $L\text{ m}$ are connected as shown in figure. Moment of inertia of the combined rod system about an axis passing through point P and perpendicular to the plane of the rods is $\frac{x}{12}ML^2\text{ kg m}^2$. The value of x is ____ .

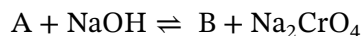
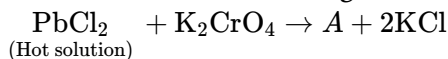


49. A collimated beam of light of diameter 2 mm is propagating along x -axis. The beam is required to be expanded in a collimated beam of diameter 14 mm using a system of two convex lenses. If first lens has focal length 40 mm , then the focal length of second lens is ____ mm.

50. The heat generated in 1 minute between points A and B in the given circuit, when a battery of 9 V with internal resistance of 1Ω is connected across these points is ____ J.



51. Consider the following reactions.



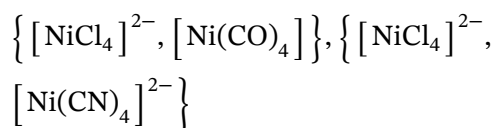
In the above reactions, A, B and X are respectively.

- (A) $\text{Na}_2[\text{Pb}(\text{OH})_2]$, PbCrO_4 and $[\text{Pb}(\text{NH}_3)_4]\text{SO}_4$
 (B) $\text{Na}_2[\text{Pb}(\text{OH})_2]$, PbCrO_4 and $(\text{NH}_4)_2[\text{Pb}(\text{CH}_3\text{COO})_4]$
 (C) PbCrO_4 , $\text{Na}_2[\text{Pb}(\text{OH})_4]$ and $(\text{NH}_4)_2[\text{Pb}(\text{CH}_3\text{COO})_4]$
 (D) PbCrO_4 , $\text{Na}_2[\text{Pb}(\text{OH})_4]$ and $[\text{Pb}(\text{NH}_3)_4]\text{SO}_4$

52. Given below are two statements :

Statement I : Among $[\text{Cu}(\text{NH}_3)_4]^{2+}$, $[\text{Ni}(\text{en})_3]^{2+}$, $[\text{Ni}(\text{NH}_3)_6]^{2+}$ and $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$, $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ has the maximum number of unpaired electrons.

Statement II : The number of pairs among



and $\{[\text{Ni}(\text{CO})_4], [\text{Ni}(\text{CN})_4]^{2-}\}$ that contain only diamagnetic species is two.

In the light of the above statements, choose the correct answer from the options given below :

- (A) Statement I is false but Statement II is true
 (B) Both Statement I and Statement II are false
 (C) Both Statement I and Statement II are true
 (D) Statement I is true but Statement II is false

53. An organic compound (P) on treatment with aqueous ammonia under hot condition forms compound (Q) which on heating with Br_2 and KOH forms compound (R) having molecular formula $\text{C}_6\text{H}_7\text{N}$. Names of P, Q and R respectively are.

- (A) Toluic acid, methylbenzamide, 2-methylaniline
 (B) Benzoic acid, benzamide, aniline
 (C) Benzoic acid, 4-methylbenzamide, 4-methylaniline
 (D) Phenylethanoic acid, phenylethanamide, benzamine

54.

From the following, the least stable structure is :

- (A)
- (B)
- (C)
- (D)

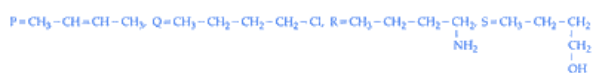
55. Identify the correct statements.

- A. Arginine and Tryptophan are essential amino acids.
- B. Histidine does not contain heterocyclic ring in its structure.
- C. Proline is a six membered cyclic ring amino acid.
- D. Glycine does not have chiral centre.
- E. Cysteine has characteristic feature of side chain as $\text{MeS} - \text{CH}_2 - \text{CH}_2 -$.

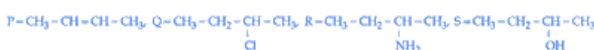
Choose the correct answer from the options given below :

- (A) C and D Only
- (B) A and D Only
- (C) C and E Only
- (D) B and E Only

56. A hydrocarbon 'P' (C_4H_8) on reaction with HCl gives an optically active compound 'Q' ($\text{C}_4\text{H}_9\text{Cl}$) which on reaction with one mole of ammonia gives compound 'R' ($\text{C}_4\text{H}_{11}\text{N}$). 'R' on diazotization followed by hydrolysis gives 'S'. Identify P, Q, R and S.



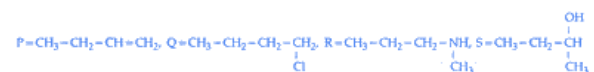
(A)



(B)



(C)



(D)

57. Given below are two statements :

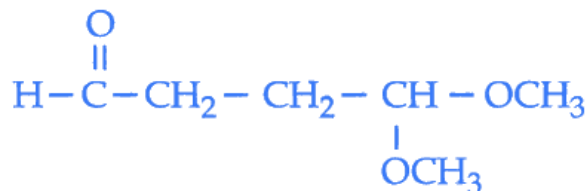
Statement I : The number of pairs among $[\text{SiO}_2, \text{CO}_2]$, $[\text{SnO}, \text{SnO}_2]$, $[\text{PbO}, \text{PbO}_2]$ and $[\text{GeO}, \text{GeO}_2]$, which contain oxides that are both amphoteric is 2.

Statement II : BF_3 is an electron deficient molecule, can act as a Lewis acid, forms adduct with NH_3 and has a trigonal planar geometry.

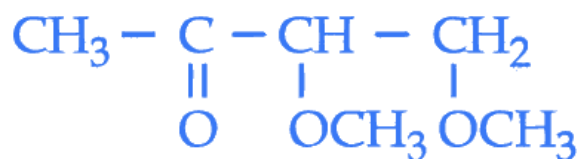
In the light of the above statements, choose the correct answer from the options given below :

- (A) Both Statement I and Statement II are false
- (B) Statement I is false but Statement II is true
- (C) Both Statement I and Statement II are true
- (D) Statement I is true but Statement II is false

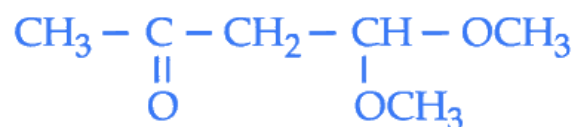
58. An organic compound "P" of molecular formula $\text{C}_6\text{H}_{12}\text{O}_3$ gives positive Iodoform test but negative Tollen's test. When "P" is treated with dilute acid, it produces "Q". "Q" gives positive Tollen's test and also iodoform test. The structure of "P" is :



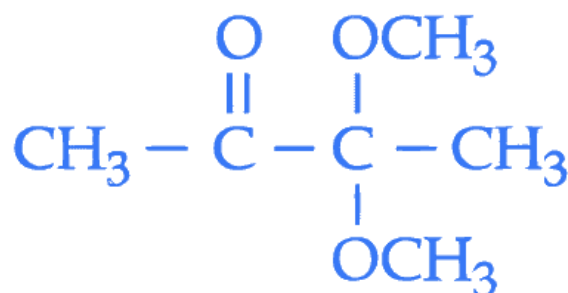
(A)



(B)



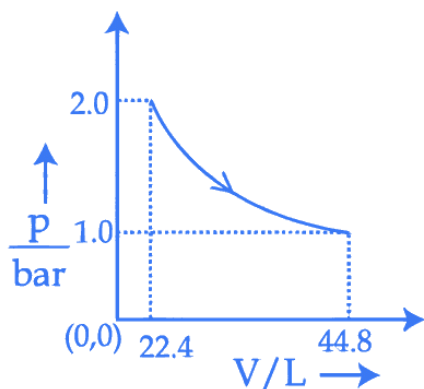
(C)



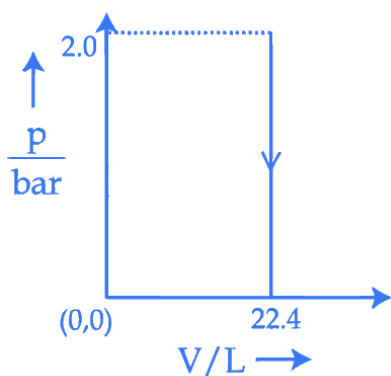
(D)

59. Which of the following graphs between pressure 'p' versus volume 'V' represents the maximum work done?

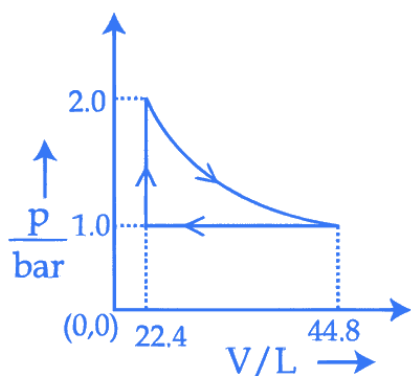
59. (continued)



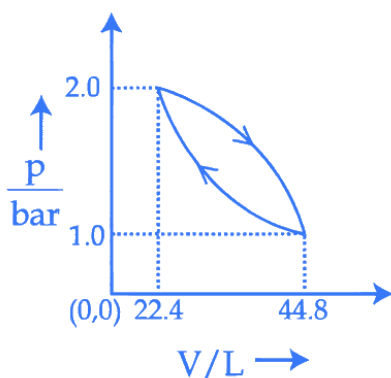
(A)



(B)



(C)



(D)

60. For the reaction, $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$, graph is plotted as shown below. Identify correct statements.

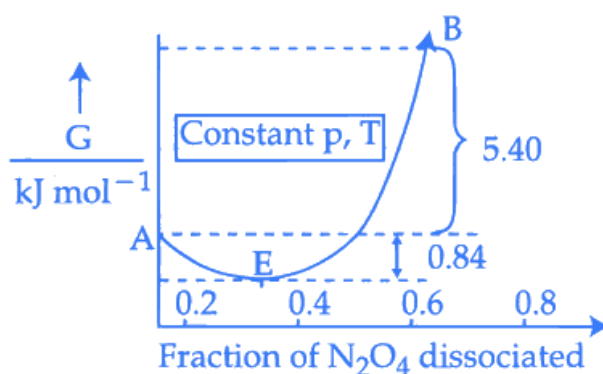
A. Standard free energy change for the reaction is $-5.40 \text{ kJ mol}^{-1}$.

B. As $\Delta G^\ominus$ in graph is positive, N_2O_4 will not dissociate into NO_2 at all.

C. Reverse reaction will go to completion.

D. When 1 mole of N_2O_4 changes into equilibrium mixture, value of $\Delta G^\ominus = -0.84 \text{ kJ mol}^{-1}$.

E. When 2 mole of NO_2 changes into equilibrium mixture, $\Delta G^\ominus$ for equilibrium mixture is $-6.24 \text{ kJ mol}^{-1}$.



Choose the correct answer from the options given below :

(A) C and E only

(B) D and E only

(C) A and D only

(D) B and C only

61. Given below are two statements :

Statement I :

The number of species among SF_4 , NH_4^+ , $[\text{NiCl}_4]^{2-}$, XeF_4 , $[\text{PtCl}_4]^{2-}$, SeF_4 and $[\text{Ni}(\text{CN})_4]^{2-}$, that have tetrahedral geometry is 3 .

Statement II :

In the set $[\text{NO}_2, \text{BeH}_2, \text{BF}_3, \text{AlCl}_3]$, all the molecules have incomplete octet around central atom.

In the light of the above statements, choose the correct answer from the options given below:

- | | |
|---|---|
| (A) Both Statement I and Statement II are true | (B) Statement I is true but Statement II is false |
| (C) Statement I is false but Statement II is true | (D) Both Statement I and Statement II are false |

62. Identify **correct** statements from the following :

A. Propanal and propanone are functional isomers.

B. Ethoxyethane and methoxypropane are metamers.

C. But-2-ene shows optical isomerism.

D. But-1-ene and but-2-ene are functional isomers.

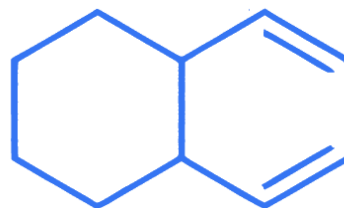
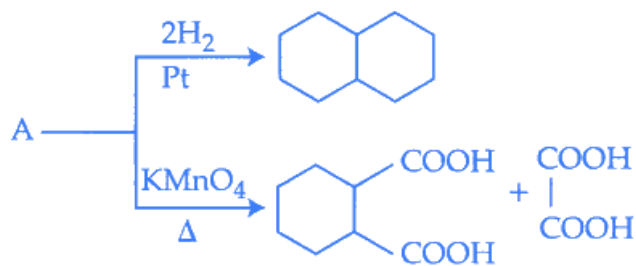
E. Pentane and 2, 2-dimethyl propane are chain isomers.

Choose the **correct** answer from the options given below :

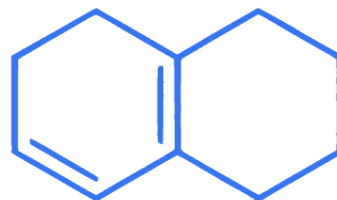
- | | |
|---------------------|---------------------|
| (A) A, B and E only | (B) A, B and C only |
| (C) C, D and E only | (D) B, C and D only |

63.

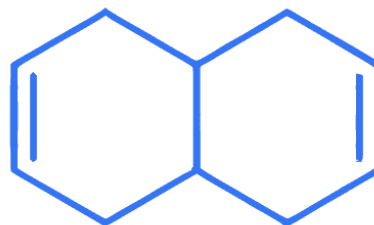
Identify A in the following reaction.



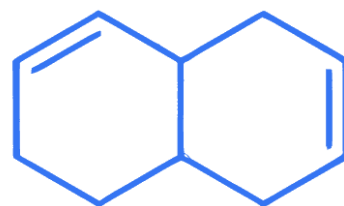
(A)



(B)



(C)



(D)

64. 14.0 g of calcium metal is allowed to react with excess HCl at 1.0 atm pressure and 273 K. Which of the following statements is incorrect? [Given : Molar mass in g mol^{-1} of Ca – 40, Cl – 35.5, H – 1]

- (A) The limiting reagent is calcium metal. (B) 33.3 g of CaCl_2 is produced.
(C) 7.84 L of H_2 gas is evolved. (D) 0.35 mol of H_2 gas is evolved.

65. Which of the following represents the correct trend for the mentioned property?

- A. $F > P > S > B$ - First Ionization Energy
B. $Cl > F > S > P$ - Electron Affinity
C. $K > Al > Mg > B$ - Metallic character
D. $K_2O > Na_2O > MgO > Al_2O_3$ - Basic character

Choose the **correct** answer from the options given below :

- (A) B and C only (B) A, B and D only
(C) A and B only (D) A, B, C and D

66. 80 mL of a hydrocarbon on mixing with 264 mL of oxygen in a closed U-tube undergoes complete combustion. The residual gases after cooling to 273 K occupy 224 mL. When the system is treated with KOH solution, the volume decreases to 64 mL. The formula of the hydrocarbon is :

- (A) C_2H_2 (B) C_2H_4
(C) C_4H_{10} (D) C_2H_6

67. MnO_4^{2-} , in acidic medium, disproportionates to :

- (A) MnO_4^- and MnO (B) MnO_4^- and MnO_2
(C) Mn_2O_7 and MnO_2 (D) Mn_2O_7 and MnO

68. In Carius method, 0.75 g of an organic compound gave 1.2 g of barium sulphate, find percentage of sulphur (molar mass 32 g mol^{-1}). Molar mass of barium sulphate is 233 g mol^{-1} .

- (A) 4.55% (B) 16.48%
(C) 10.30% (D) 21.97%

69. Given below are two statements :

Statement I : When an electric discharge is passed through gaseous hydrogen, the hydrogen molecules dissociate and the energetically excited hydrogen atoms produce electromagnetic radiation of discrete frequencies.

Statement II : The frequency of second line of Balmer series obtained from He^+ is equal to that of first line of Lyman series obtained from hydrogen atom.

In the light of the above statements, choose the correct answer from the options given below :

- (A) Both Statement I and Statement II are true (B) Statement I is true but Statement II is false
(C) Statement I is false but Statement II is true (D) Both Statement I and Statement II are false

70. Elements P and Q form two types of non-volatile, non-ionizable compounds PQ and PQ_2 . When 1 g of PQ is dissolved in 50 g of solvent 'A', ΔT_b was 1.176 K while when 1 g of PQ_2 is dissolved in 50 g of solvent 'A', ΔT_b was 0.689 K. (K_b of 'A' = 5 K kg mol^{-1}). The molar masses of elements P and Q (in g mol^{-1}) respectively, are :

- (A) 25, 60 (B) 60, 25
(C) 65, 145 (D) 70, 110

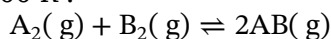
71. Pre-exponential factors of two different reactions of same order are identical. Let activation energy of first reaction exceeds the activation energy of second reaction by 20 kJ mol^{-1} . If k_1 and k_2 are the rate constants of first and second reaction respectively at 300 K , then $\ln \frac{k_2}{k_1}$ will be _____. (nearest integer) [$R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$]

72.

Use the following data :

Substance	$\Delta_f H^\ominus(500 \text{ K})$ kJ mol^{-1}	$S^\ominus(500 \text{ K})$ $\text{JK}^{-1} \text{mol}^{-1}$
AB(g)	32	222
$\text{A}_2(\text{g})$	6	146
$\text{B}_2(\text{g})$	x	280

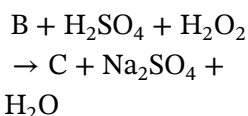
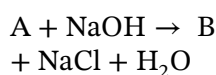
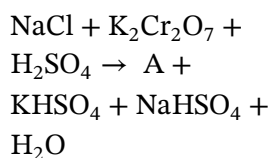
One mole each of $\text{A}_2(\text{g})$ and $\text{B}_2(\text{g})$ are taken in a 1 L closed flask and allowed to establish the equilibrium at 500 K .



The value of x (kJ mol^{-1}) is _____. (Nearest integer)

(Given : $\log K = 2.2$ $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$)

73. Consider the following reactions :

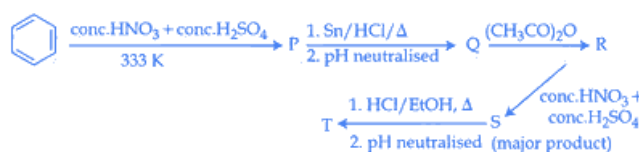


In the product 'C', 'X' is the number of O_2^{2-} units, 'Y' is the total number oxygen atoms present and 'Z' is the oxidation state of Cr. The value of $X + Y + Z$ is _____.

74. The pH and conductance of a weak acid (HX) was found to be 5 and $4 \times 10^{-5} \text{ S}$, respectively. The conductance was measured under standard condition using a cell where the electrode plates having a surface area of 1 cm^2 were at a distance of 15 cm apart. The value of the limiting molar conductivity is ____ $\text{Sm}^2 \text{mol}^{-1}$. (nearest integer)

(Given : degree of dissociation of the weak acid (α) $\ll 1$)

75. Consider the following reaction sequence



The percentage of nitrogen in product 'T' formed is ____%. (Nearest integer)

(Given molar mass in gmol^{-1} : H : 1, C : 12, N : 14, O : 16)

- End of Question Paper -