

JEE Main 2019 Paper 1 (B.E./B.Tech) 12 January 2019 Shift 1 Question Paper



Conducted by the National Testing Agency (NTA)

Time Allowed: 3 Hours

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

Maximum Marks: 360

General Instructions

- (i) This paper is **Paper 1 (B.E./B.Tech.)** of **JEE (Main) 2019 - Session 1**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 12 January 2019, Shift 1. The total duration is **3 hours**.
- (ii) The paper has **90 questions** and a maximum of **360 marks**: Mathematics, Physics and Chemistry carry 30 questions (120 marks) each, in that order.
- (iii) Each subject has **30 multiple choice questions** (MCQs), with four options each. Select the most appropriate answer.
- (iv) **All questions are compulsory**. Use only the constants given in the question while calculating.
- (v) **Marking scheme**: **+4** for a correct answer, **-1** for an incorrect answer, and **0** for an unanswerd 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.

Mathematics - Multiple Choice Questions

1. The product of three consecutive terms of a G.P. is 512. If 4 is added to each of the first and the second of these terms, the three terms now form an A.P. Then the sum of the original three terms of the given G.P. is :

- (A) 36 (B) 28
(C) 32 (D) 24

2. Let $y = y(x)$ be the solution of the differential equation, $x \frac{dy}{dx} + y = x \log_e x$, ($x > 1$). If $2y(2) = \log_e 4 - 1$, then $y(e)$ is equal to :

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

3. Let $S = \{1, 2, 3, \dots, 100\}$. The number of non-empty subsets A of S such that the product of elements in A is even is :

- (A) $2^{50} - 1$ (B) $2^{50} (2^{50} - 1)$
(C) $2^{100} - 1$ (D) $2^{50} + 1$

4. In a random experiment, a fair die is rolled until two fours are obtained in succession. The probability that the experiment will end in the fifth throw of the die is equal to :

- (A) $\frac{200}{6^5}$
(B) $\frac{225}{6^5}$
(C) $\frac{150}{6^5}$
(D) $\frac{175}{6^5}$

5. A ratio of the 5th term from the beginning to the 5th term from the end in the binomial expansion of

$$\left(2^{1/3} + \frac{1}{2(3)^{1/3}}\right)^{10}$$

is :

- (A) $1 : 2(6)^{1/3}$ (B) $1 : 4(6)^{1/3}$
(C) $2(36)^{1/3} : 1$ (D) $4(36)^{1/3} : 1$

6. Let f and g be continuous functions on $[0, a]$ such that $f(x) = f(a - x)$ and $g(x) + g(a - x) = 4$, then

- $\int_0^a f(x) g(x) dx$ is equal to :
- (A) 4 $\int_0^a f(x) dx$
(B) $-3 \int_0^a f(x) dx$
(C) $\int_0^a f(x) dx$
(D) $2 \int_0^a f(x) dx$

7. If

$$\frac{z - \alpha}{z + \alpha} (\alpha \in R)$$

is a purely imaginary number and $|z| = 2$, then a value of α is :

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

8. Let S be the set of all points in $(-\pi, \pi)$ at which the function, $f(x) = \min\{\sin x, \cos x\}$ is not differentiable. Then S is a subset of which of the following ?

- (A) $\left\{-\frac{\pi}{2}, -\frac{\pi}{4}, \frac{\pi}{4}, \frac{\pi}{2}\right\}$
 (B) $\left\{-\frac{3\pi}{4}, -\frac{\pi}{2}, \frac{\pi}{2}, \frac{3\pi}{4}\right\}$
 (C) $\left\{-\frac{\pi}{4}, 0, \frac{\pi}{4}\right\}$
 (D) $\left\{-\frac{3\pi}{4}, -\frac{\pi}{4}, \frac{3\pi}{4}, \frac{\pi}{4}\right\}$

9. Let P(4, -4) and Q(9, 6) be two points on the parabola, $y^2 = 4x$ and let x be any point on the arc POQ of this parabola, where O is the vertex of this parabola, such that the area of ΔPXQ is maximum. Then this maximum area (in sq. units) is :

- (A) $\frac{625}{4}$
 (B) $\frac{125}{4}$
 (C) $\frac{75}{2}$
 (D) $\frac{125}{2}$

10. Consider three boxes, each containing, 10 balls labelled 1, 2, ..., 10. Suppose one ball is randomly drawn from each of the boxes. Denote by n_i , the label of the ball drawn from the i^{th} box, ($i = 1, 2, 3$). Then, the number of ways in which the balls can be chosen such that $n_1 < n_2 < n_3$ is :

- (A) 164 (B) 240
 (C) 82 (D) 120

11. The integral

$$\int$$

$\cos(\log_e x) dx$ is equal to : (where C is a constant of integration)

- (A) $\frac{x}{2} [\sin(\log_e x) - \cos(\log_e x)] + C$ (B) $x [\cos(\log_e x) + \sin(\log_e x)] + C$
 (C) $\frac{x}{2} [\cos(\log_e x) + \sin(\log_e x)] + C$ (D) $x [\cos(\log_e x) - \sin(\log_e x)] + C$

12. An ordered pair (α, β) for which the system of linear equations

$$(1 + \alpha)x + \beta y + z = 2$$

$$\alpha x + (1 + \beta)y + z = 3$$

$$\alpha x + \beta y + 2z = 2$$

has a unique solution, is :

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

13. Let $P =$

$$\begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ 9 & 3 & 1 \end{bmatrix}$$

and $Q = [q_{ij}]$ be two 3×3 matrices such that $Q - P^5 = I_3$.

Then

$$\frac{q_{21} + q_{31}}{q_{32}}$$

is equal to :

- (A) 15 (B) 9
 (C) 135 (D) 10

14. If λ be the ratio of the roots of the quadratic equation in x, $3m^2x^2 + m(m - 4)x + 2 = 0$, then the least value of m for which

$$\lambda + \frac{1}{\lambda} = 1,$$

is

- (A) $-2 + \sqrt{2}$
 (B) $4 - 3\sqrt{2}$
 (C) $2 - \sqrt{3}$
 (D) $4 - 2\sqrt{3}$

15. The maximum value of $3\cos\theta + 5\sin\left(\theta - \frac{\pi}{6}\right)$

for any real value of θ is :

- (A) $\sqrt{34}$
 (B) $\sqrt{31}$
 (C) $\sqrt{19}$
 (D) $\frac{\sqrt{79}}{2}$

16. Considering only the principal values of inverse functions, the set

$$A = \{x \geq 0 : \tan^{-1}(2x) + \tan^{-1}(3x) = \frac{\pi}{4}\}$$

- (A) contains two elements
 (B) contains more than two elements
 (C) is an empty set
 (D) is a singleton

17.

$$\lim_{x \rightarrow \pi/4} \frac{\cot^3 x - \tan x}{\cos\left(x + \frac{\pi}{4}\right)}$$

is :

- (A) $8\sqrt{2}$
 (B) 4
 (C) $4\sqrt{2}$
 (D) 8

18. For $x > 1$, if $(2x)^{2y} = 4e^{2x-2y}$, then $(1 + \log_e 2x)^2 \frac{dy}{dx}$ is equal to :

- (A) $\frac{x \log_e 2x - \log_e 2}{x}$
 (B) $\log_e 2x$
 (C) $x \log_e 2x$
 (D) $\frac{x \log_e 2x + \log_e 2}{x}$

19. If the vertices of a hyperbola be at $(-2, 0)$ and $(2, 0)$ and one of its foci be at $(-3, 0)$, then which one of the following points does not lie on this hyperbola?

- (A) $(6, 5\sqrt{2})$
 (B) $(2\sqrt{6}, 5)$
 (C) $(-6, 2\sqrt{10})$
 (D) $(4, \sqrt{15})$

20. If the sum of the deviations of 50 observations from 30 is 50, then the mean of these observations is :

- (A) 31
 (B) 50
 (C) 51
 (D) 30

21. If the straight line, $2x - 3y + 17 = 0$ is perpendicular to the line passing through the points $(7, 17)$ and $(15, \beta)$, then β equals :

- (A) $\frac{35}{3}$
 (B) -5
 (C) $\frac{35}{3}$
 (D) 5

22. The area (in sq. units) of the region bounded by the parabola, $y = x^2 + 2$ and the lines, $y = x + 1$, $x = 0$ and $x = 3$, is

- (A) $\frac{15}{4}$
 (B) $\frac{15}{2}$
 (C) $\frac{21}{2}$
 (D) $\frac{17}{4}$

23. The maximum area (in sq. units) of a rectangle having its base on the x-axis and its other two vertices on the parabola, $y = 12 - x^2$ such that the rectangle lies inside the parabola, is :

- (A) 36 (B) $20\sqrt{2}$
(C) $18\sqrt{3}$ (D) 32

24. The Boolean expression $((p \wedge q) \vee (p \vee \sim q)) \wedge (\sim p \wedge \sim q)$ is equivalent to :

- (A) $p \wedge q$ (B) $p \wedge (\sim q)$
(C) $p \vee (\sim q)$ (D) $(\sim p) \wedge (\sim q)$

25. A tetrahedron has vertices $P(1, 2, 1)$, $Q(2, 1, 3)$, $R(-1, 1, 2)$ and $O(0, 0, 0)$. The angle between the faces OPQ and PQR is :

- (A) $\cos^{-1} \left(\frac{17}{31} \right)$
(B) $\cos^{-1} \left(\frac{9}{35} \right)$
(C) $\cos^{-1} \left(\frac{19}{35} \right)$
(D) $\cos^{-1} \left(\frac{7}{31} \right)$

26. Let C_1 and C_2 be the centres of the circles $x^2 + y^2 - 2x - 2y - 2 = 0$ and $x^2 + y^2 - 6x - 6y + 14 = 0$ respectively. If P and Q are the points of intersection of these circles, then the area (in sq. units) of the quadrilateral PC_1QC_2 is :

- (A) 4 (B) 6
(C) 9 (D) 8

27. The sum of the distinct real values of μ , for which the vectors, $\mu\hat{i} + \hat{j} + \hat{k}$, $\hat{i} + \mu\hat{j} + \hat{k}$, $\hat{i} + \hat{j} + \mu\hat{k}$ are co-planar, is :

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

28. The perpendicular distance from the origin to the plane containing the two lines,

$$\frac{x+2}{3} = \frac{y-2}{5} = \frac{z+5}{7}$$

and

$$\frac{x-1}{1} = \frac{y-4}{4} = \frac{z+4}{7},$$

is :

- (A) $6\sqrt{11}$
(B) $\frac{11}{\sqrt{6}}$
(C) 11
(D) $11\sqrt{6}$

29. If a variable line, $3x + 4y - \lambda = 0$ is such that the two circles $x^2 + y^2 - 2x - 2y + 1 = 0$ and $x^2 + y^2 - 18x - 2y + 78 = 0$ are on its opposite sides, then the set of all values of λ is the interval :

- (A) (23, 31) (B) (2, 17)
(C) [13, 23] (D) [12, 21]

30. Let $S_k =$

$$\frac{1 + 2 + 3 + \dots + k}{k}.$$

If

$$S_1^2 + S_2^2 + \dots + S_{10}^2 = \frac{5}{12}$$

A, then A is equal to :

- (A) 283 (B) 156
(C) 301 (D) 303

31. A particle of mass m moves in a circular orbit in a central potential field $U(r) = \frac{1}{2} kr^2$. If Bohr's quantization conditions are applied, radii of possible orbits and energy levels vary with quantum number n as :

(A) $r_n \propto \sqrt{n}$, $E_n \propto n$

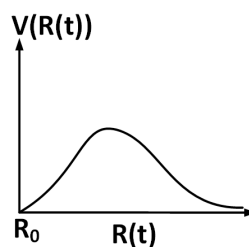
(B) $r_n \propto \sqrt{n}$, $E_n \propto$

$$\frac{1}{n}$$

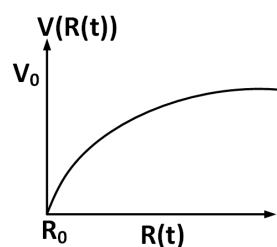
(C) $r_n \propto n$, $E_n \propto n$

(D) $r_n \propto n^2$, $E_n \propto \frac{1}{n^2}$

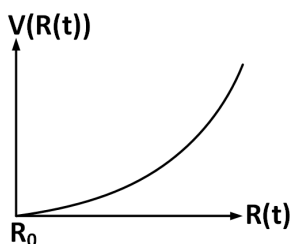
32. There is a uniform spherically symmetric surface charge density at a distance R_0 from the origin. The charge distribution is initially at rest and starts expanding because of mutual repulsion. The figure that represents best the speed $V(R(t))$ of the distribution as a function of its instantaneous radius $R(t)$ is :



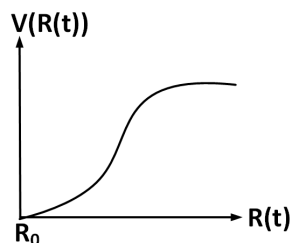
(A)



(B)

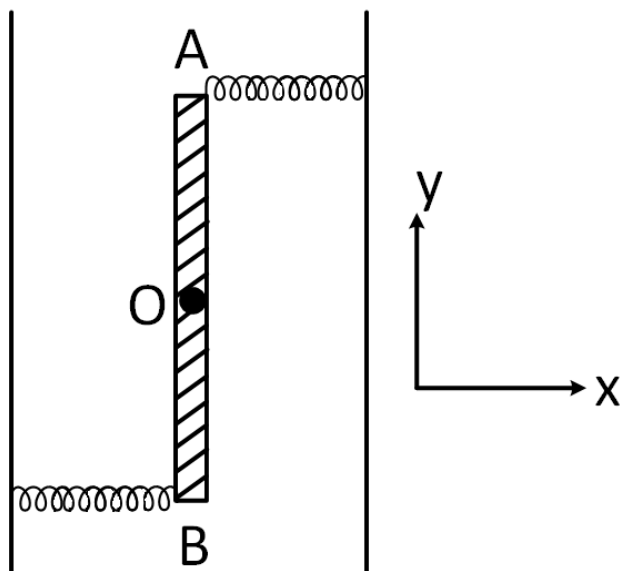


(C)



(D)

33. Two light identical springs of spring constant k are attached horizontally at the two ends of a uniform horizontal rod AB of length ℓ and mass m . The rod is pivoted at its centre 'O' and can rotate freely in horizontal plane. The other ends of the two springs are fixed to rigid supports as shown in figure. The rod is gently pushed through a small angle and released. The frequency of resulting oscillation is :



- (A) $\frac{1}{2\pi} \sqrt{\frac{3k}{m}}$
 (B) $\frac{1}{2\pi} \sqrt{\frac{6k}{m}}$
 (C) $\frac{1}{2\pi} \sqrt{\frac{k}{m}}$
 (D) $\frac{1}{2\pi} \sqrt{\frac{2k}{m}}$

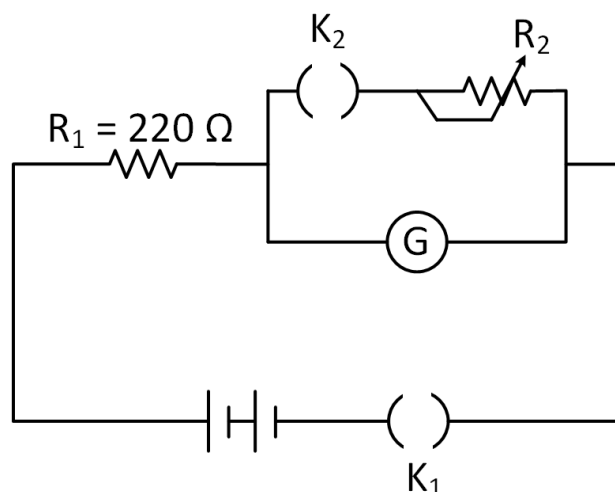
34. A proton and an α -particle (with their masses in the ratio of 1 : 4 and charges in the ratio of 1 : 2) are accelerated from rest through a potential difference V . If a uniform magnetic field (B) is set up perpendicular to their velocities, the ratio of the radii $r_p : r_\alpha$ of the circular paths described by them will be ;

- (A) $1 : \sqrt{3}$
 (B) 1 : 3
 (C) $1 : \sqrt{2}$
 (D) 1 : 2

35. A passenger train of length 60 m travels at a speed of 80 km/hr. Another freight train of length 120 m travels at a speed of 30 km/hr. The ratio of times taken by the passenger train to completely cross the freight train when : (i) they are moving in the same direction , and (ii) in the opposite direction is :

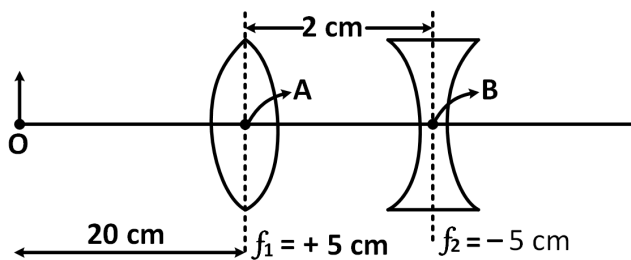
- (A) $\frac{25}{11}$
 (B) $\frac{3}{2}$
 (C) $\frac{11}{5}$
 (D) $\frac{5}{2}$

36. The galvanometer deflection, when key K_1 is closed but K_2 is open, equals θ_0 (see figure). On closing K_2 also and adjusting R_2 to 5Ω , the deflection in galvanometer becomes $\frac{\theta_0}{5}$. The resistance of the galvanometer is, then, given by [Neglect the internal resistance of battery] :



- (A) 5 Ω (B) 25 Ω
 (C) 12 Ω (D) 22 Ω

37. What is the position and nature of image formed by lens combination shown in figure ? (f_1 , f_2 are focal lengths)

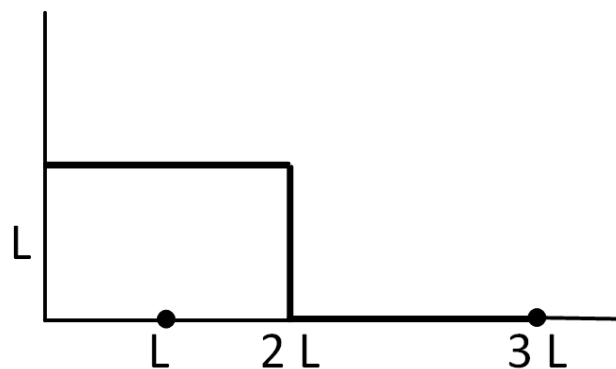


- (A) $\frac{20}{3}$ cm from point B at right, real
 (B) 70 cm from point B at right; real
 (C) 40 cm from point B at right; real
 (D) 70 cm from point B at left; virtual

38. A straight rod of length L extends from $x = a$ to $x = L + a$. The gravitational force it exerts on a point mass ' m ' at $x = 0$, if the mass per unit length of the rod is $A + Bx^2$, is given by :

- (A) $Gm \left[A \left(\frac{1}{a} - \frac{1}{a+L} \right) - BL \right]$
 (B) $Gm \left[A \left(\frac{1}{a} - \frac{1}{a+L} \right) + BL \right]$
 (C) $Gm \left[A \left(\frac{1}{a+L} - \frac{1}{a} \right) + BL \right]$
 (D) $Gm \left[A \left(\frac{1}{a+L} - \frac{1}{a} \right) - BL \right]$

39. The position vector of the centre of mass $\vec{r}_{cm}$ of an asymmetric uniform bar of negligible area of crosssection as shown in figure is :

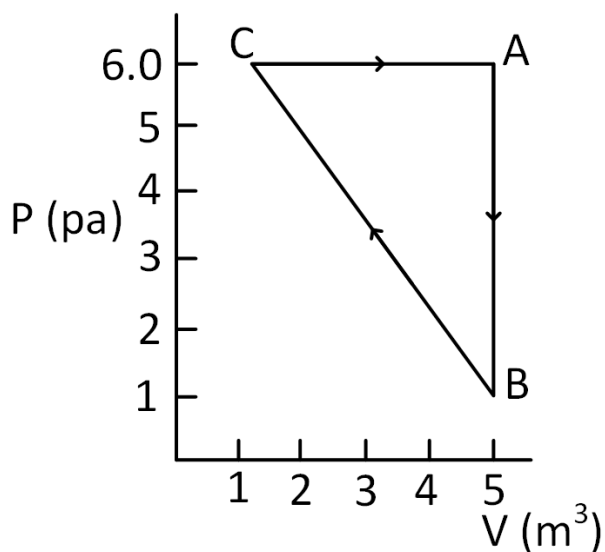


- (A) $\vec{r}_{cm} = \frac{11}{8}L \hat{x} + \frac{8}{8}L \hat{y}$
 (B) $\vec{r}_{cm} = \frac{5}{8}L \hat{x} + \frac{13}{8}L \hat{y}$
 (C) $\vec{r}_{cm} = \frac{13}{8}L \hat{x} + \frac{5}{8}L \hat{y}$
 (D) $\vec{r}_{cm} = \frac{3}{8}L \hat{x} + \frac{11}{8}L \hat{y}$

40. A travelling harmonic wave is represented by the equation $y(x,t) = 10^{-3} \sin(50t + 2x)$, where, x and y are in meter and t is in seconds. Which of the following is a correct statement about the wave ?

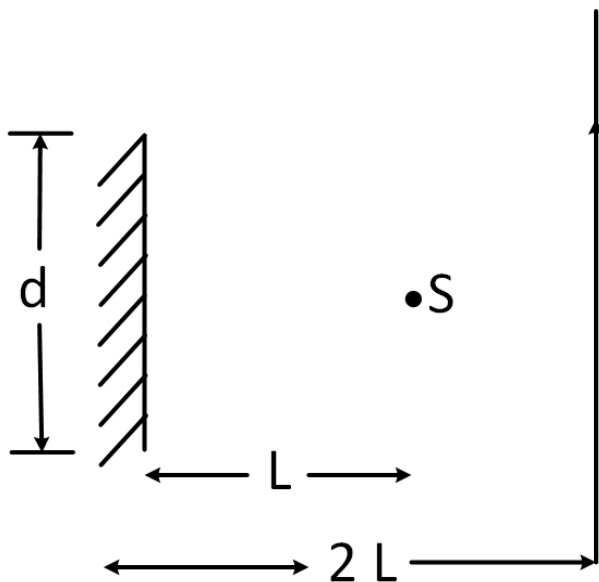
- (A) The wave is propagating along the positive x -axis with speed 100 ms^{-1}
 (B) The wave is propagating along the positive x -axis with speed 25 ms^{-1}
 (C) The wave is propagating along the negative x -axis with speed 25 ms^{-1}
 (D) The wave is propagating along the negative x -axis with speed 100 ms^{-1}

41. For the given cyclic process CAB as shown for a gas, the work done is :



- (A) 1 J (B) 10 J
(C) 5 J (D) 30 J

42. A point source of light, S is placed at distance L in front of the centre of plane mirror of width d which is hanging vertically on a wall. A man walks in front of the mirror along a line parallel to the mirror, at a distance $2L$ as shown below. The distance over which the man can see the image of the light source in the mirror is



- (A) d (B) $d/2$
(C) $3d$ (D) $2d$

43. An ideal gas occupies a volume of 2m^3 at a pressure of 3×10^6 Pa. The energy of the gas is :

- (A) 6×10^4 J (B) 9×10^6 J
(C) 3×10^2 J (D) 10^8 J

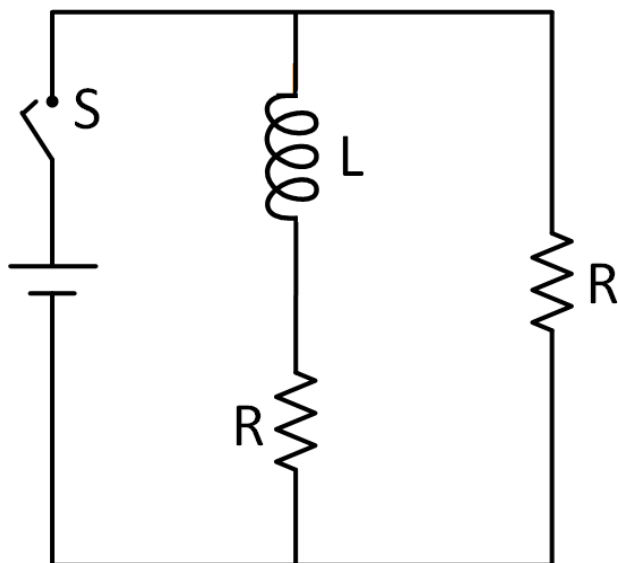
44. The least count of the main scale of a screw gauge is 1 mm. The minimum number of divisions on its circular scale required to measure $5 \mu\text{m}$ diameter of a wire is :

- (A) 500 (B) 100
(C) 200 (D) 50

45. A simple pendulum, made of a string of length ℓ and a bob of mass m , is released from a small angle θ_0 . It strikes a block of mass M , kept on a horizontal surface at its lowest point of oscillations, elastically. It bounces back and goes up to an angle θ_1 . Then M is given by :

- (A) $\frac{m}{2} \left(\frac{\theta_0 + \theta_1}{\theta_0 - \theta_1} \right)$
(B) $\frac{m}{2} \left(\frac{\theta_0 - \theta_1}{\theta_0 + \theta_1} \right)$
(C) $m \left(\frac{\theta_0 + \theta_1}{\theta_0 - \theta_1} \right)$
(D) $m \left(\frac{\theta_0 - \theta_1}{\theta_0 + \theta_1} \right)$

46. In the figure shown, a circuit contains two identical resistors with resistance $R = 5\Omega$ and an inductance with $L = 2\text{mH}$. An ideal battery of 15 V is connected in the circuit. What will be the current through the battery long after the switch is closed ?



- (A) 6 A (B) 7.5 A
(C) 3 A (D) 5.5 A

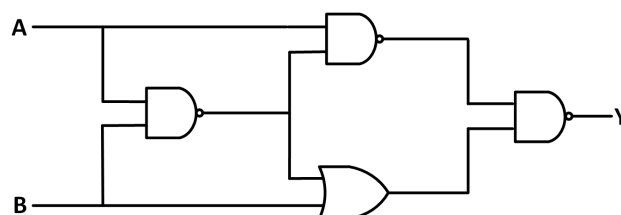
47. A light wave is incident normally on a glass slab of refractive index 1.5. If 4 % of light gets reflected and the amplitude of the electric field of the incident light is 30 V/m, then the amplitude of the electric field for the wave propagating in the glass medium will be :

- (A) 6 V/m (B) 10 V/m
(C) 30 V/m (D) 24 V/m

48. A person standing on an open ground hears the sound of a jet aeroplane, coming from north at an angle 60° with ground level. But he finds the aeroplane right vertically above his position. If v is the speed of sound, speed of the plane is :

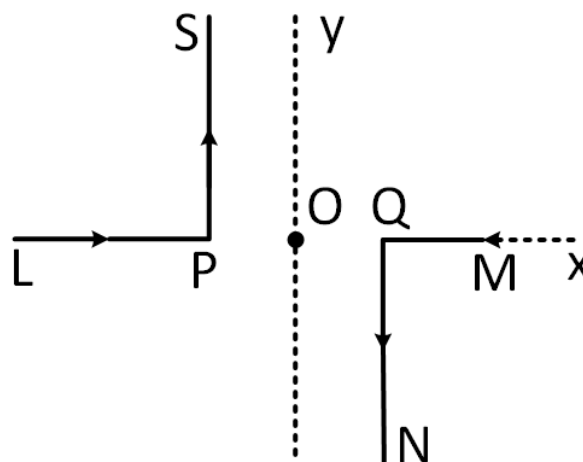
- (A) $\frac{\sqrt{3}}{2}v$
(B) $\frac{2v}{\sqrt{3}}$
(C) v
(D) $\frac{v}{2}$

49. The output of the given logic circuit is :



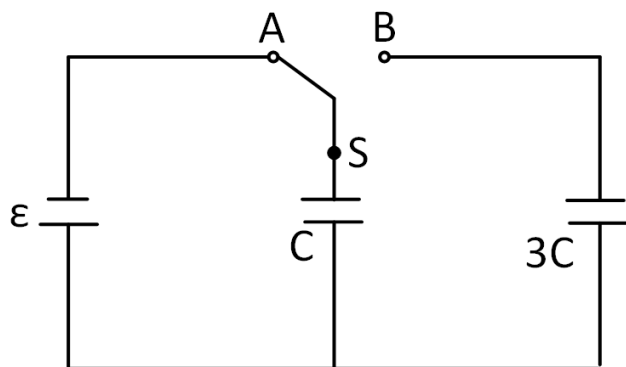
- (A) AB
(B) $AB + AB$
(C) $AB + AB$
(D) AB

50. As shown in the figure, two infinitely long, identical wires are bent by 90° and placed in such a way that the segments LP and QM are along the x-axis, while segments PS and QN are parallel to the y-axis. If $OP = OQ = 4\text{cm}$, and the magnitude of the magnetic field at O is 10^{-4} T , and the two wires carry equal currents (see figure), the magnitude of the current in each wire and the direction of the magnetic field at O will be ($\mu_0 = 4\pi \times 10^{-7}\text{ NA}^{-2}$) :



- (A) 40 A, perpendicular into the page (B) 40 A, perpendicular out of the page
(C) 20 A, perpendicular into the page (D) 40 A, perpendicular out of the page

51. In the figure shown, after the switch 'S' is turned from position 'A' to position 'B', the energy dissipated in the circuit in terms of capacitance 'C' and total charge 'Q' is :

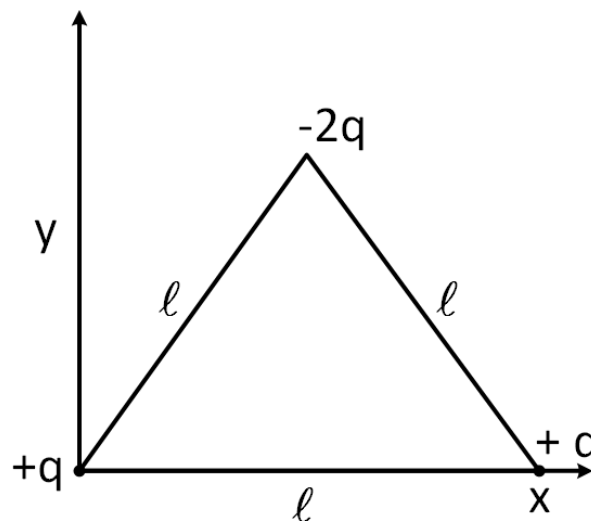


- (A) $\frac{1}{8} \frac{Q^2}{C}$
 (B) $\frac{5}{8} \frac{Q^2}{C}$
 (C) $\frac{3}{4} \frac{Q^2}{C}$
 (D) $\frac{3}{8} \frac{Q^2}{C}$

52. Let the moment of inertia of a hollow cylinder of length 30 cm (inner radius 10 cm and outer radius 20 cm), about its axis be I. The radius of a thin cylinder of the same mass such that its moment of inertia about its axis is also I, is :

- (A) 16 cm (B) 12 cm
 (C) 14 cm (D) 18 cm

53. Determine the electric dipole moment of the system of the three charges, placed on the vertices of an equilateral triangle, as shown in the figure :



- (A) $2q\ell\hat{j}$
 (B) $(q\ell) \frac{\hat{i} + \hat{j}}{\sqrt{2}}$
 (C) $\sqrt{3} q\ell \frac{\hat{j} - \hat{i}}{\sqrt{2}}$
 (D) $-\sqrt{3} q\ell\hat{j}$

54. A particle A of mass 'm' and charge 'q' is accelerated by a potential difference of 50 V. Another particle B of mass '4 m' and charge 'q' is accelerated by a potential difference of 2500 V. The ratio of de-Broglie wavelengths $\frac{\lambda_A}{\lambda_B}$ is close to :

- (A) 4.47 (B) 10.00
 (C) 14.14 (D) 0.07

55. A satellite of mass M is in a circular orbit of radius R about the centre of the earth. A meteorite of the same mass, falling towards the earth, collides with the satellite completely inelastically. The speeds of the satellite and the meteorite are the same, just before the collision. The subsequent motion of the combined body will be :

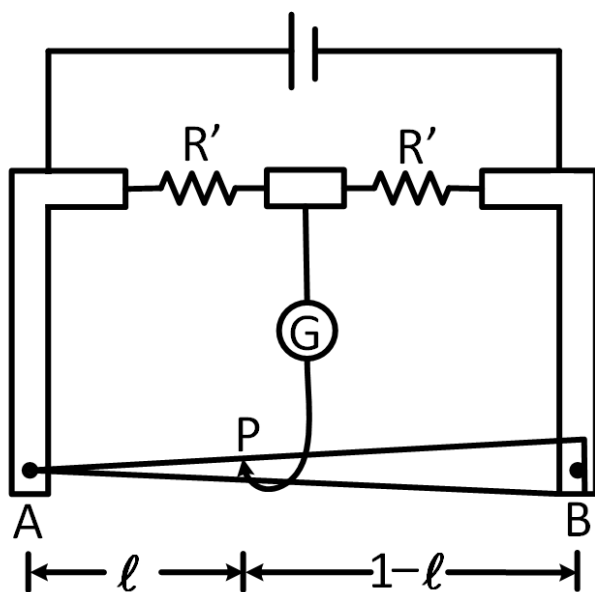
- (A) in the same circular orbit of radius R (B) such that it escapes to infinity
(C) in a circular orbit of a different radius (D) in an elliptical orbit

56. In a meter bridge, the wire of length 1 m has a non-uniform cross-section such that, the variation

of its resistance R with length ℓ is

$$\propto \frac{1}{\sqrt{\ell}}$$

. Two equal resistances are connected as shown in the figure. The galvanometer has zero deflection when the jockey is at point P . What is the length AP ?



- (A) 0.3 m (B) 0.25 m
(C) 0.35 m (D) 0.2 m

57. Two electric bulbs, rated at (25 W, 220 V) and (100 W, 220 V), are connected in series across a 220 V voltage source. If the 25 W and 100 W bulbs draw powers P_1 and P_2 respectively, then :

- (A) $P_1 = 4W, P_2 = 16W$ (B) $P_1 = 16W, P_2 = 4W$
(C) $P_1 = 9W, P_2 = 16W$ (D) $P_1 = 16W, P_2 = 9W$

58. A cylinder of radius R is surrounded by a cylindrical shell of inner radius R and outer radius $2R$. The thermal conductivity of the material of the inner cylinder is K_1 and the of the outer cylinder is K_2 . Assuming no loss of heat, the effective thermal conductivity of the system for heat flowing along the length of the cylinder is :

- (A) $K_1 + K_2$
(B) $\frac{K_1 + 3K_2}{4}$
(C) $\frac{K_1 + K_2}{2}$
(D) $\frac{2K_1 + 3K_2}{5}$

59. A 100 V carrier wave is made to vary between 160 V and 40 V by a modulating signal. What is the modulation index ?

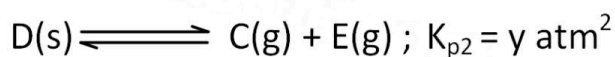
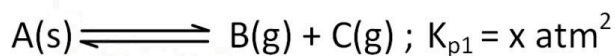
- (A) 0.5 (B) 0.6
(C) 0.4 (D) 0.3

60. An ideal battery of 4 V and resistance R are connected in series in the primary circuit of a potentiometer of length 1 m and resistance 5Ω . The value of R , to give a potential difference of 5 mV across 10 cm of potentiometer wire, is :

- (A) 480 Ω (B) 495 Ω
(C) 490 Ω (D) 395 Ω

Chemistry - Multiple Choice Questions

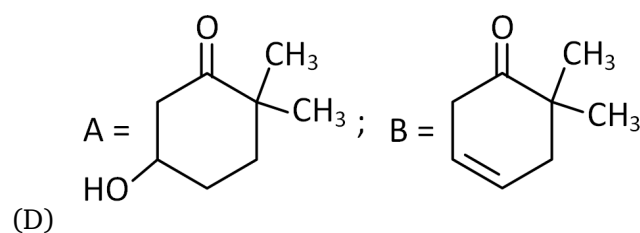
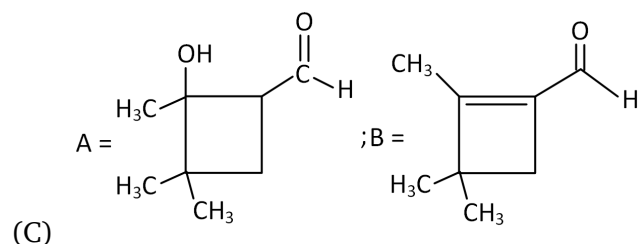
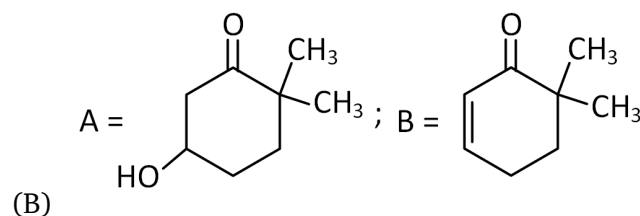
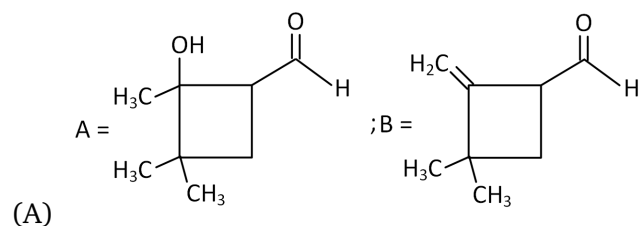
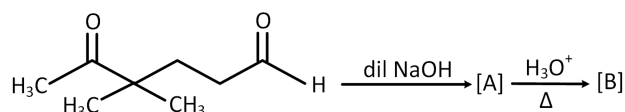
61. Two solids dissociate as follows –



The total pressure when both the solids dissociated simultaneously is –

- (A) $(x + y) \text{ atm}$ (B) $(\sqrt{x + y}) \text{ atm}$
 (C) $2(\sqrt{x + y}) \text{ atm}$ (D) $x^2 + y^2 \text{ atm}$

62. In the following reaction, products A and B are –



63. Decomposition of X exhibits a rate constant of $0.05 \mu\text{g}/\text{year}$. How many year are required for the decomposition of $5 \mu\text{g}$ of X into $2.5 \mu\text{g}$?

- (A) 50 (B) 20
 (C) 25 (D) 40

64. Freezing point of a 4% aqueous solution of X is equal to freezing point of 12% aqueous solution of Y. If molecular weight of X is A, then molecular weight of Y is –

- (A) 4A (B) 2A
 (C) 3A (D) A

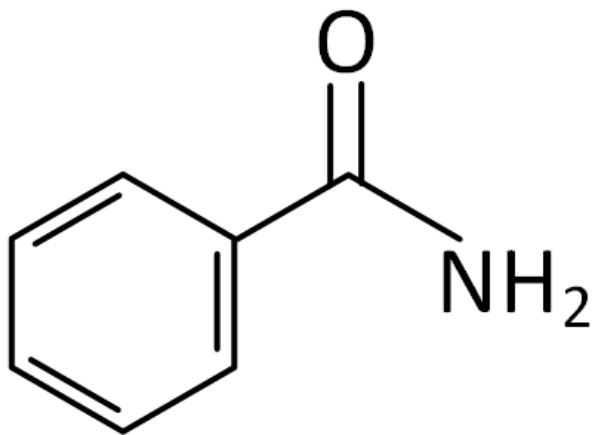
65. $\text{Mn}_2(\text{CO})_{10}$ is an organometallic compound due to the presence of -

- (A) C–O bond (B) Mn – Mn bond
(C) Mn – O bond (D) Mn – C bond

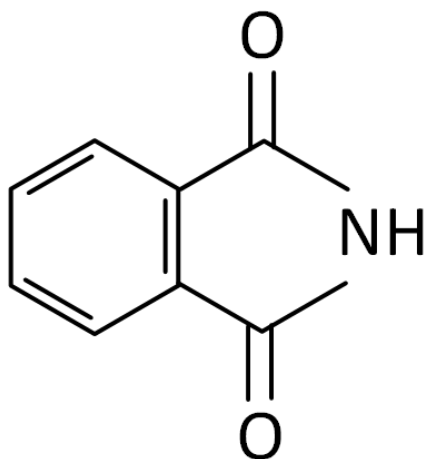
66. The hardness of a water sample (in terms of equivalents of CaCO_3) containing 10^{-3} M CaSO_4 is (Molar mass of $\text{CaSO}_4 = 136 \text{ g mol}^{-1}$)

- (A) 90 ppm (B) 100 ppm
(C) 50 ppm (D) 10 ppm

67. The increasing order of reactivity of the following compounds towards reaction with alkyl halides directly is

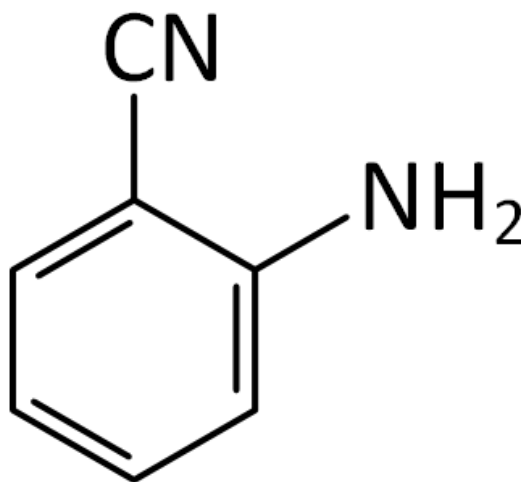


(A)

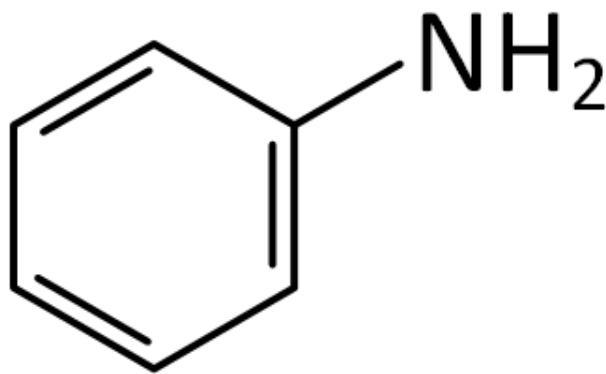


(B)

67. (continued)



(C)



(D)

- (A) $A < B < C < D$ (B) $B < A < C < D$
(C) $B < A < D < C$ (D) $A < C < D < B$

68. In the following reaction :
Aldehyde + Alcohol



Acetal

Aldehyde			Alcohol
HCHO			tBuOH
CH ₃ CHO			MeOH

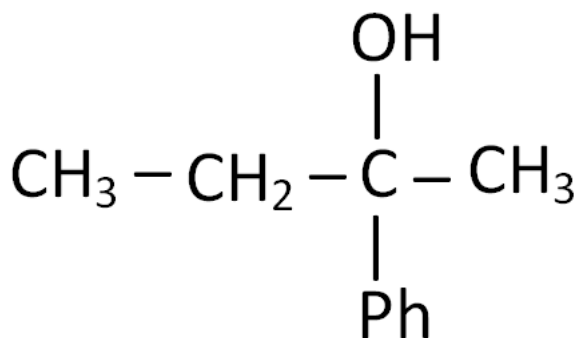
The best combination is

- (A) CH₃CHO and MeOH (B) HCHO and MeOH
(C) CH₃CHO and tBuOH (D) HCHO and tBuOH

69. Among the following compounds most basic amino acid is -

- (A) Lysine (B) Asparagine
(C) Histidine (D) Serine

70.



can not be prepared by -

- (A) CH₃CH₂COCH₃ + PhMgX
(B) PhCOCH₃ + CH₃CH₂MgX
(C) PhCOCH₂CH₃ + CH₃MgX
(D) HCHO + PhCH(CH₃)CH₂MgX

71. The pair of metal ions that can give a spin only magnetic moment of 3.9 BM for the complex [M(H₂O)₆]Cl₂, is -

- (A) V²⁺ and Fe²⁺ (B) V²⁺ and Co²⁺
(C) Co²⁺ and Fe²⁺ (D) Cr²⁺ and Mn²⁺

72. The element with Z = 120 (not yet discovered) will be an/a -

- (A) Alkaline earth metal (B) Alkali metal
(C) Transition metal (D) Inner transition metal

73. What is the work function of the metal if the light of wavelength 4000

Å

generates photoelectrons of velocity $6 \times 10^5 \text{ ms}^{-1}$ from it ?

(Mass of electron = $9 \times 10^{-31} \text{ kg}$;

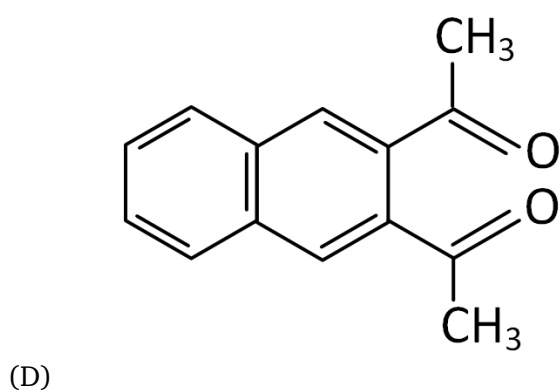
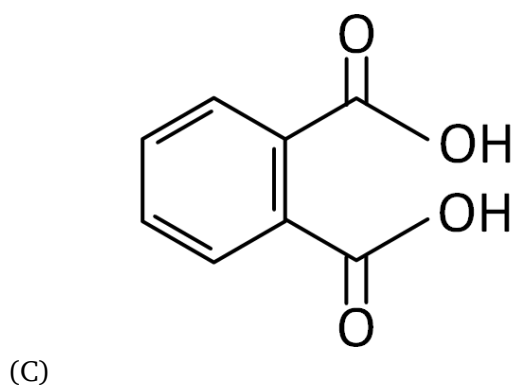
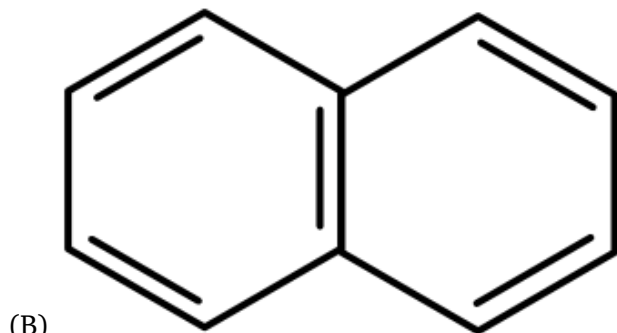
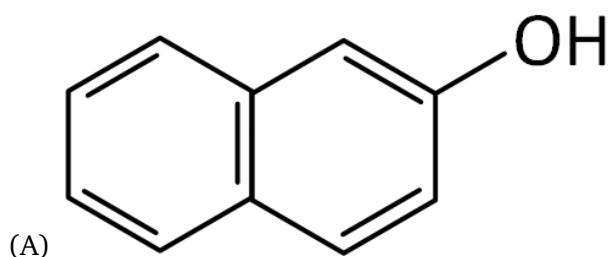
Velocity of light = $3 \times 10^8 \text{ ms}^{-1}$

Plank's constant = $6.626 \times 10^{-34} \text{ Js}$;

Charge of electron = $1.6 \times 10^{-19} \text{ JeV}^{-1}$)

- (A) 4.0 eV (B) 0.9 eV
(C) 2.1 eV (D) 3.1 eV

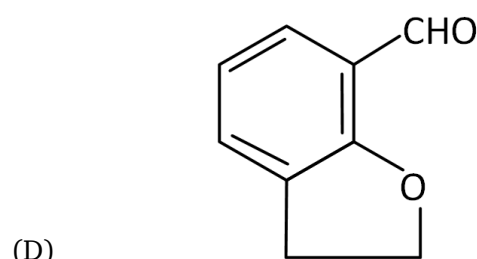
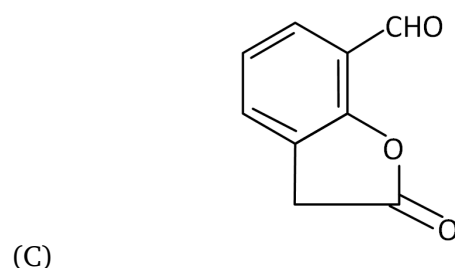
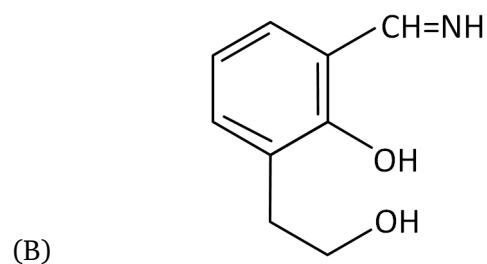
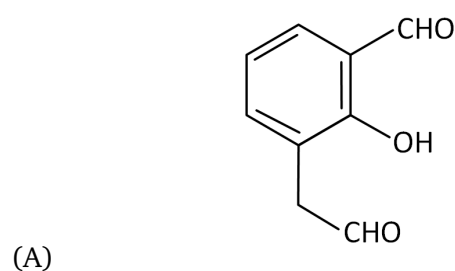
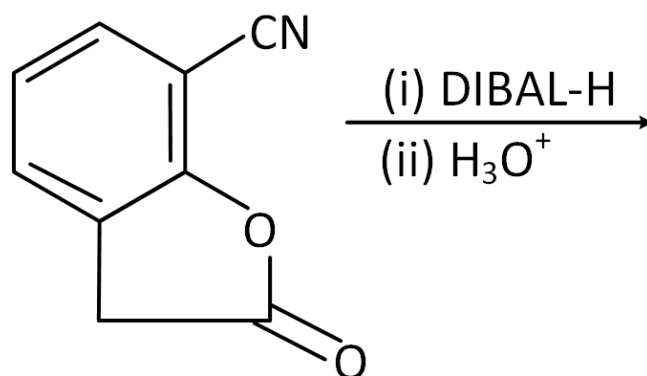
74. Among the following four aromatic compounds, which one will have the lowest melting point ?



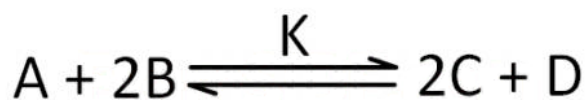
75. 50 mL of 0.5 M oxalic acid is needed to neutralize 25 mL of sodium hydroxide solution. The amount of NaOH in 50 mL of the given sodium hydroxide solution is -

- (A) 20 g (B) 4 g
(C) 80 g (D) 10 g

76. The major product of the following reaction is -



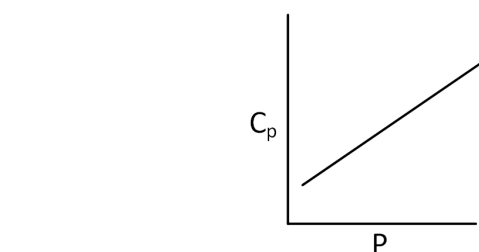
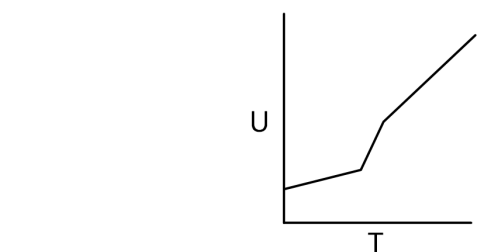
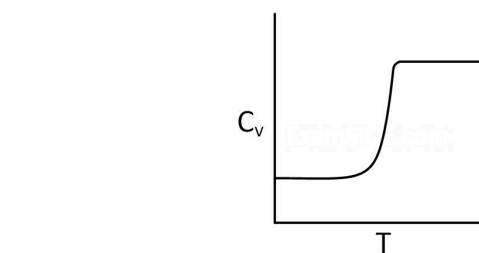
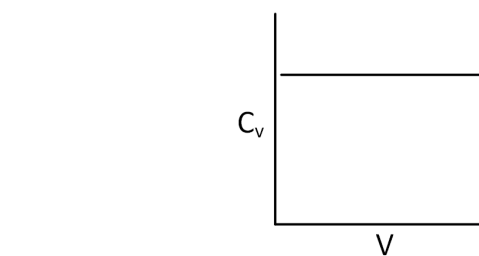
77. In a chemical reaction,



the initial concentration of B was 1.5 times of the concentration of A, but the equilibrium concentrations of A and B were found to be equal. The equilibrium constant (K) for the aforesaid chemical reaction is -

- (A) 16 (B) 1
(C) 1/4 (D) 4

78. For diatomic ideal gas in a closed system, which of the following plots does not correctly describe the relation between various thermodynamic quantities?

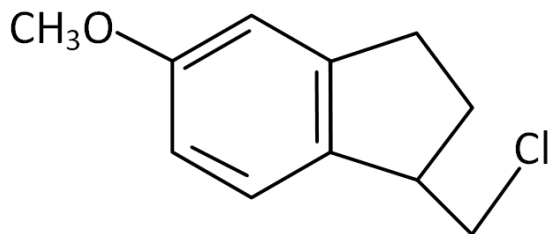
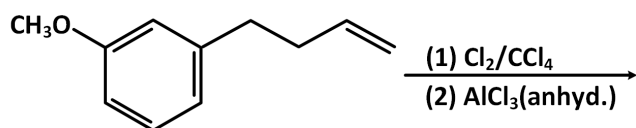


79. The correct order for acid strength of compounds :

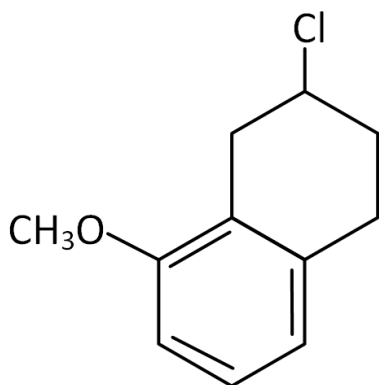
$\text{CH} \equiv \text{CH}$, $\text{CH}_3\text{-C} \equiv \text{CH}$ and $\text{CH}_2 = \text{CH}_2$ is as follows

- (A) $\text{CH} \equiv \text{CH} > \text{CH}_2 = \text{CH}_2 > \text{CH}_3\text{-C} \equiv \text{CH}$
(B) $\text{CH}_3\text{-C} \equiv \text{CH} > \text{CH}_2 = \text{CH}_2 > \text{CH} \equiv \text{CH}$
(C) $\text{HC} \equiv \text{CH} > \text{CH}_3\text{-C} \equiv \text{CH} > \text{CH}_2 = \text{CH}_2$
(D) $\text{CH}_3\text{-CH} \equiv \text{CH} > \text{CH} \equiv \text{CH} > \text{CH}_2 = \text{CH}_2$

80. The major product of the following reaction is

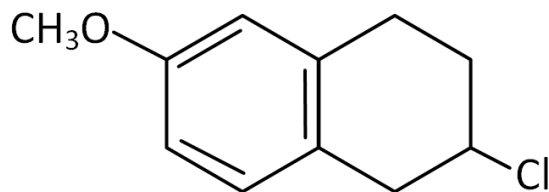
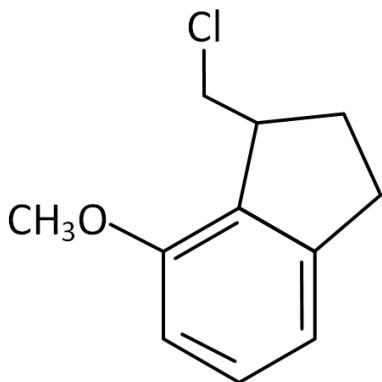


(A)



(B)

(C) photo due



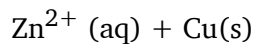
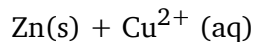
(D)

81. The standard electrode potential E° and its temperature coefficient

$$\left(\frac{dE^\circ}{dT}\right)$$

for a cell are 2V and $-5 \times 10^{-4} \text{ VK}^{-1}$ at 300 K respectively.

The cell reaction is



The standard reaction enthalpy ($\Delta_r H^\circ$) at 300 K in kJ mol^{-1} is, [Use $R = 8 \text{ JK}^{-1} \text{ mol}^{-1}$ and $F = 96,000 \text{ C mol}^{-1}$]

(A) -412.8

(B) -384.0

(C) 192.0

(D) 206.4

82. The metal d-orbitals that are directly facing the ligands in $\text{K}_3[\text{Co}(\text{CN})_6]$ are -

(A) $d_{x^2-y^2}$ and d_{z^2}

(B) d_{xy} , d_{xz} and d_{yz}

(C) d_{xz} , d_{yz} and d_{z^2}

(D) d_{xy} and $d_{x^2-y^2}$

83. The volume of gas A is twice than that of gas B. The compressibility factor of gas A is thrice than that of gas B at same temperature. The pressures of the gases for equal number of moles are -

(A) $2P_A = 3P_B$

(B) $3P_A = 2P_B$

(C) $P_A = 3P_B$

(D) $P_A = 2P_B$

84. Given

Gas	H ₂	CH ₄	CO ₂	SO ₂
Critical Temperature / K	33	190	304	630

On the basis of data given above, predict which of the following gases shows least adsorption on a definite amount of charcoal ?

- (A) SO₂ (B) CH₄
(C) H₂ (D) CO₂

85. In the Hall-Heroult process, aluminium is formed at the cathode. The cathode is made out of -

- (A) Copper (B) Platinum
(C) Carbon (D) Pure aluminium

86. Poly β -hydroxybutyrate-co- β -hydroxyvalerate (PHBV) is a copolymer of

- (A) 2-hydroxybutanoic acid and 3-hydroxypentanoic acid
(B) 3-hydroxybutanoic acid and 2-hydroxypentanoic acid
(C) 3-hydroxybutanoic acid and 3-hydroxypentanoic acid
(D) 3-hydroxybutanoic acid and 4-hydroxypentanoic acid

87. Water samples with BOD values of 4 ppm and 18 ppm, respectively are :

- (A) Clean and Highly polluted (B) Highly polluted and Clean
(C) Highly polluted and Highly polluted (D) Clean and Clean

88. A metal on combustion in excess air forms X. X upon hydrolysis with water yields H₂O₂ and O₂ along with another product. The metal is :

- (A) Rb (B) Mg
(C) Na (D) Li

89. Iodine reacts with concentrated HNO₃ to yield Y along with other products. The oxidation state of iodine in Y, is :

- (A) 3 (B) 1
(C) 7 (D) 5

90. The molecule that has minimum /no role in the formation of photochemical smog, is :

- (A) CH₂ = O (B) O₃
(C) N₂ (D) NO

- End of Question Paper -