

JEE Main 2020 Paper 1 (B.E./B.Tech) 9 January 2020 Shift 2 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) 2020 - Session 1**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 9 January 2020, Shift 2. 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, enter the numerical answer in the format requested in the question. Use only the constants given in the question while calculating.
- (v) **Marking scheme**: MCQs carry **+4** for a correct answer and **-1** for an incorrect answer. Numerical questions carry **+4** for a correct answer and **0** for an incorrect answer. Unanswered questions carry **0**.
- (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 - Section A · Multiple Choice Questions

1. Let $a, b \in \mathbb{R}$, $a \neq 0$ be such that the equation, $ax^2 - 2bx + 5 = 0$ has a repeated root α , which is also a root of the equation, $x^2 - 2bx - 10 = 0$. If β is the other root of this equation, then $\alpha^2 + \beta^2$ is equal to :

- (A) 28 (B) 24
(C) 26 (D) 25

2. Let a function $f : [0, 5] \rightarrow \mathbb{R}$ be continuous, $f(1) = 3$ and F be defined as :

$$F(x) = \int_1^x t^2 g(t) dt$$

, where

$$g(t) = \int_1^t f(u) du$$

Then for the function F , the point $x = 1$ is :

- (A) a point of inflection. (B) a point of local maxima.
(C) a point of local minima. (D) not a critical point.

3. In the expansion of

$$\left(\frac{x}{\cos \theta} + \frac{1}{x \sin \theta} \right)^{16}$$

, if ℓ_1 is the least value of the term independent of x when

$$\frac{\pi}{8} \leq \theta \leq \frac{\pi}{4}$$

and ℓ_2 is the least value of the term independent of x when

$$\frac{\pi}{16} \leq \theta \leq \frac{\pi}{8}$$

, then the ratio $\ell_2 :$

$$\ell_1$$

is equal to :

- (A) 8 : 1 (B) 16 : 1
(C) 1 : 8 (D) 1 : 16

4. Let $a - 2b + c = 1$.

If

$$f(x) = \begin{vmatrix} x+a & x+2 & x+1 \\ x+b & x+3 & x+2 \\ x+c & x+4 & x+3 \end{vmatrix}$$

, then:

- (A) $f(50) = 1$ (B) $f(-50) = -1$
(C) $f(50) = -501$ (D) $f(-50) = 501$

5. The following system of linear equations

$$7x + 6y - 2z = 0$$

$$3x + 4y + 2z = 0$$

$$x - 2y - 6z = 0, \text{ has}$$

- (A) no solution (B) infinitely many solutions, (x, y, z) satisfying $y = 2z$
(C) infinitely many solutions, (x, y, z) satisfying $x = 2z$ (D) only the trivial solution

6. Let f and g be differentiable functions on $\mathbb{R}$ such that fg is the identity function. If for some $a, b \in \mathbb{R}$, $g'(a) = 5$ and $g(a) = b$, then $f'(b)$ is equal to :

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

7. A random variable X has the following probability distribution :

X:	1	2	3	4	5
P(X):	K^2	$2K$	K	$2K$	$5K^2$

Then $P(X > 2)$ is equal to :

- (A) $\frac{1}{6}$
(B) $\frac{7}{12}$
(C) $\frac{1}{36}$
(D) $\frac{23}{36}$

8. If

$$x = \sum_{n=0}^{\infty} (-1)^n \tan^{2n} \theta$$

and

$$y = \sum_{n=0}^{\infty} \cos^{2n} \theta$$

for $0 < \theta < \frac{\pi}{4}$, then :

- (A) $x(1+y) = 1$ (B) $y(1-x) = 1$
 (C) $y(1+x) = 1$ (D) $x(1-y) = 1$

9. Let $[t]$ denote the greatest integer $\leq t$ and

$$\lim_{x \rightarrow 0} x \left[\frac{4}{x} \right] = A$$

Then the function, $f(x) = [x^2] \sin(\pi x)$ is discontinuous, when x is equal to :

- (A) $\sqrt{A+1}$
 (B) $\sqrt{A+5}$
 (C) $\sqrt{A+21}$
 (D) $\sqrt{A}$

10. If

$$\int \frac{d\theta}{\cos^2 \theta (\tan 2\theta + \sec 2\theta)} = \lambda \tan \theta + 2 \log_e |f(\theta)| + C$$

where C is a constant of integration, then the ordered pair $(\lambda, f(\theta))$ is equal to :

- (A) $(-1, 1 - \tan \theta)$ (B) $(1, 1 + \tan \theta)$
 (C) $(-1, 1 + \tan \theta)$ (D) $(1, 1 - \tan \theta)$

11. Let a_n be the n^{th} term of a G.P. of positive terms.

$$\sum_{n=1}^{100} a_{2n+1} = 200$$

and

$$\sum_{n=1}^{100} a_{2n} = 100$$

, then

$$\sum_{n=1}^{200} a_n$$

is equal to :

- (A) 150 (B) 175
 (C) 225 (D) 300

12. If

$$x = 2 \sin \theta - \sin 2\theta$$

and

$$y = 2 \cos \theta - \cos 2\theta$$

, $\theta \in [0, 2\pi]$, then $\frac{d^2 y}{dx^2}$ at $\theta = \pi$ is :

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

13. If 10 different balls are to be placed in 4 distinct boxes at random, then the probability that two of these boxes contain exactly 2 and 3 balls is :

- (A) $\frac{965}{2^{11}}$
 (B) $\frac{965}{2^{10}}$
 (C) $\frac{945}{2^{11}}$
 (D) $\frac{945}{2^{10}}$

14. Given :

$$f(x) = \begin{cases} x, & 0 \leq x < \frac{1}{2} \\ \frac{1}{2}, & x = \frac{1}{2} \\ 1-x, & \frac{1}{2} < x \leq 1 \end{cases}$$

and

$$g(x) = \left(x - \frac{1}{2}\right)^2, x \in R$$

Then the area (in sq. units) of the region bounded by the curves, $y = f(x)$ and $y = g(x)$ between the lines, $2x = 1$ and $2x = \sqrt{3}$, is :

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

15. If z be a complex number satisfying $|\operatorname{Re}(z)| + |\operatorname{Im}(z)| = 4$, then $|z|$ cannot be :

- (A) $\sqrt{10}$
 (B) $\sqrt{7}$
 (C) $\sqrt{\frac{17}{2}}$
 (D) $\sqrt{8}$

16. If

$$\frac{dy}{dx} = \frac{xy}{x^2 + y^2}$$

; $y(1) = 1$; then a value of x satisfying $y(x) = e$ is :

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

17. If $A = \{x \in R : |x| < 2\}$ and $B = \{x \in R : |x - 2| \geq 3\}$; then :

- (A) $A - B = [-1, 2)$ (B) $A \cup B = R - (2, 5)$
 (C) $A \cap B = (-2, -1)$ (D) $B - A = R - (-2, 5)$

18. The length of the minor axis (along y-axis) of an ellipse in the standard form is

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

. If this ellipse touches the line, $x + 6y = 8$; then its eccentricity is :

- (A) $\frac{1}{3}\sqrt{\frac{11}{3}}$
 (B) $\frac{1}{2}\sqrt{\frac{5}{3}}$
 (C) $\sqrt{\frac{5}{6}}$
 (D) $\frac{1}{2}\sqrt{\frac{11}{3}}$

19. If one end of a focal chord AB of the parabola $y^2 = 8x$ is at

$$A\left(\frac{1}{2}, -2\right)$$

, then the equation of the tangent to it at B is :

- (A) $2x - y - 24 = 0$ (B) $x - 2y + 8 = 0$
 (C) $x + 2y + 8 = 0$ (D) $2x + y - 24 = 0$

20. If $p \rightarrow (p \wedge \sim q)$ is false, then the truth values of p and q are respectively :

- (A) T, T (B) T, F
 (C) F, T (D) F, F

21. The number of terms common to the two A.P's 3, 7, 11, ..., 407 and 2, 9, 16, ..., 709 is _____.

22. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three vectors such that $|\vec{a}| = \sqrt{3}$

$$|\vec{b}| = 5, \vec{b} \cdot \vec{c} = 10$$

and the angle between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{3}$. If $\vec{a}$ is perpendicular to the vector $\vec{b} \times \vec{c}$, then

$$|\vec{a} \times (\vec{b} \times \vec{c})|$$

is equal to _____.

23. If the curves, $x^2 - 6x + y^2 + 8 = 0$ and $x^2 - 8y + y^2 + 16 - k = 0$, ($k > 0$) touch each other at a point, then the largest value of k is _____.

24. If the distance between the plane, $23x - 10y - 2z + 48 = 0$ and the plane containing the lines

$$\frac{x+1}{2} = \frac{y-3}{4} = \frac{z+1}{3}$$

and

$$\frac{x+3}{2} = \frac{y+2}{6} = \frac{z-1}{\lambda} (\lambda \in R)$$

is equal to

$$\frac{k}{\sqrt{633}}$$

, then k is equal to _____.

25. If $C_r \equiv {}^{25}C_r$ and

$C_0 + 5.C_1 + 9.C_2 + \dots + (101).C_{25} = 2^{25}.k$, then k is equal to _____.

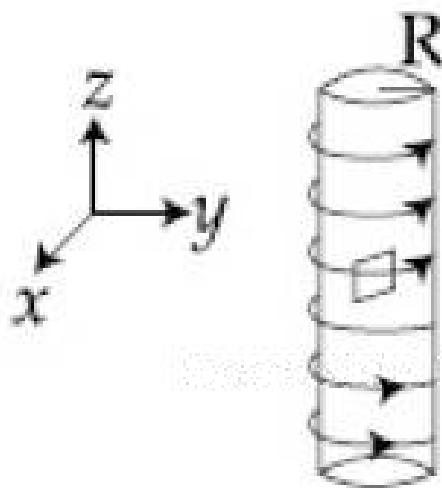
26. An electron of mass m and magnitude of charge $|e|$ initially at rest gets accelerated by a constant electric field E . The rate of change of de-Broglie wavelength of this electron at time t ignoring relativistic effects is :

- (A) $\frac{-h}{|e|Et}$
 (B) $\frac{-h}{|e|E\sqrt{t}}$
 (C) $\frac{-h}{|e|Et^2}$
 (D) $\frac{|e|Et}{h}$

27. There is a small source of light at some depth below the surface of water (refractive index $= \frac{4}{3}$) in a tank of large cross sectional surface area. Neglecting any reflection from the bottom and absorption by water, percentage of light that emerges out of surface is (nearly) :
 [Use the fact that surface area of a spherical cap of height h and radius of curvature r is $2\pi rh$]:

- (A) 17% (B) 34%
 (C) 50% (D) 21%

28. An electron gun is placed inside a long solenoid of radius R on its axis. The solenoid has n turns/length and carries a current I . The electron gun shoots an electron along the radius of the solenoid with speed v . If the electron does not hit the surface of the solenoid, maximum possible value of v is (all symbols have their standard meaning) :

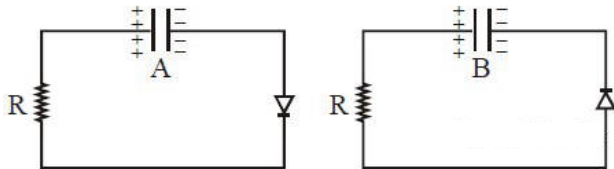


- (A) $\frac{e\mu_0 nIR}{4m}$
 (B) $\frac{e\mu_0 nIR}{m}$
 (C) $\frac{e\mu_0 nIR}{2m}$
 (D) $\frac{2e\mu_0 nIR}{m}$

29. Two steel wires having same length are suspended from a ceiling under the same load. If the ratio of their energy stored per unit volume is 1 : 4, the ratio of their diameters is:

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

30. Two identical capacitors A and B, charged to the same potential 5V are connected in two different circuits as shown below at time $t = 0$. If the charge on capacitors A and B at time $t = CR$ is Q_A and Q_B respectively, then (Here e is the base of natural logarithm)



- (A) $Q_A = \frac{CV}{e}$, $Q_B = \frac{VC}{2}$
- (B) $Q_A = \frac{CV}{2}$, $Q_B = \frac{VC}{e}$
- (C) $Q_A = VC$, $Q_B = \frac{VC}{e}$
- (D) $Q_A = VC$, $Q_B = CV$

31. A plane electromagnetic wave is propagating along the direction

$$\frac{\hat{i} + \hat{j}}{\sqrt{2}}$$

, with its polarization along the direction $\hat{k}$. The correct form of the magnetic field of the wave would be (here B_0 is an appropriate constant) :

- (A) $B_0 \frac{\hat{i} - \hat{j}}{\sqrt{2}} \cos\left(\omega t - k \frac{\hat{i} + \hat{j}}{\sqrt{2}}\right)$
- (B) $B_0 \frac{\hat{i} + \hat{j}}{\sqrt{2}} \cos\left(\omega t - k \frac{\hat{i} + \hat{j}}{\sqrt{2}}\right)$
- (C) $B_0 \frac{\hat{j} - \hat{i}}{\sqrt{2}} \cos\left(\omega t + k \frac{\hat{i} + \hat{j}}{\sqrt{2}}\right)$
- (D) $B_0 \hat{k} \cos\left(\omega t - k \frac{\hat{i} + \hat{j}}{\sqrt{2}}\right)$

32. Two gases-argon (atomic radius 0.07 nm, atomic weight 40) and xenon (atomic radius 0.1 nm, atomic weight 140) have the same number density and are at the same temperature. The ratio of their respective mean free times is closest to :

- (A) 2.3 (B) 1.83
(C) 4.67 (D) 3.67

33. A wire of length L and mass per unit length $6.0 \times 10^{-3} \text{ kgm}^{-1}$ is put under tension of 540 N. Two consecutive frequencies that it resonates at are : 420 Hz and 490 Hz. Then L in meters is :

- (A) 5.1 m (B) 2.1 m
(C) 1.1 m (D) 8.1 m

34. Planet A has mass M and radius R . Planet B has half the mass and half the radius of Planet A. If the escape velocities from the Planets A and B are v_A and v_B , respectively, then

$$\frac{v_A}{v_B} = \frac{n}{4}$$

. The value of n is :

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

35. A small spherical droplet of density d is floating exactly half immersed in a liquid of density ρ and surface tension T . The radius of the droplet is (take note that the surface tension applies an upward force on the droplet) :

- (A) $r = \sqrt{\frac{T}{(d - \rho)g}}$
- (B) $r = \sqrt{\frac{2T}{3(d + \rho)g}}$
- (C) $r = \sqrt{\frac{T}{(d + \rho)g}}$
- (D) $r = \sqrt{\frac{3T}{(2d - \rho)g}}$

36. For the four sets of three measured physical quantities as given below. Which of the following options is correct ?

(i) $A_1 = 24.36, B_1 = 0.0724, C_1 = 256.2$

(ii) $A_2 = 24.44, B_2 = 16.082, C_2 = 240.2$

(iii) $A_3 = 25.2, B_3 = 19.2812, C_3 = 236.183$

(iv) $A_4 = 25, B_4 = 236.191, C_4 = 19.5$

(A) $A_1 + B_1 + C_1 = A_2 + B_2 + C_2 = A_3 + B_3 + C_3 = A_4 + B_4 + C_4$

(B) $A_4 + B_4 + C_4 < A_1 + B_1 + C_1$

$A_3 + B_3 + C_3 < A_2 + B_2 + C_2$

$A_2 + B_2 + C_2 < A_4 + B_4 + C_4$

(C) $A_4 + B_4 + C_4 < A_1 + B_1 + C_1 = A_2 + B_2 + C_2 = A_3 + B_3 + C_3$

(D) $A_4 + B_4 + C_4 > A_3 + B_3 + C_3 = A_2 + B_2 + C_2 > A_1 + B_1 + C_1$

(A) $A_1 + B_1 + C_1 = A_2 + B_2 + C_2 = A_3 + B_3 + C_3 = A_4 + B_4 + C_4$

(B) $A_4 + B_4 + C_4 < A_1 + B_1 + C_1$

$A_3 + B_3 + C_3 < A_2 + B_2 + C_2$

37. A small circular loop of conducting wire has radius a and carries current I . It is placed in a uniform magnetic field B perpendicular to its plane such that when rotated slightly about its diameter and released, it starts performing simple harmonic motion of time period T . If the mass of the loop is m then :

(A) $T = \sqrt{\frac{2m}{IB}}$

(B) $T = \sqrt{\frac{\pi m}{IB}}$

(C) $T = \sqrt{\frac{\pi m}{2IB}}$

(D) $T = \sqrt{\frac{2\pi m}{IB}}$

38. A particle of mass m is projected with a speed u from the ground at an angle

$$\theta = \frac{\pi}{3}$$

w.r.t. horizontal (x -axis). When it has reached its maximum height, it collides completely inelastically with another particle of the same mass and velocity $u\hat{i}$. The horizontal distance covered by the combined mass before reaching the ground is:

(A) $2\sqrt{2} \frac{u^2}{g}$

(B) $\frac{3\sqrt{3}}{8} \frac{u^2}{g}$

(C) $\frac{3\sqrt{2}}{4} \frac{u^2}{g}$

(D) $\frac{5}{8} \frac{u^2}{g}$

39. In LC circuit the inductance $L = 40$ mH and capacitance $C = 100$ μ F. If a voltage $V(t) = 10\sin(314t)$ is applied to the circuit, the current in the circuit is given as :

(A) $0.52 \cos 314 t$

(B) $5.2 \cos 314 t$

(C) $0.52 \sin 314 t$

(D) $10 \cos 314 t$

40. A rod of length L has non-uniform linear mass density given by $\rho(x) =$

$$a + b\left(\frac{x}{L}\right)^2$$

, where a

and b are constants and $0 \leq x \leq L$. The value of x for the centre of mass of the rod is at :

(A) $\frac{3}{2} \left(\frac{a+b}{2a+b} \right) L$

(B) $\frac{4}{3} \left(\frac{a+b}{2a+3b} \right) L$

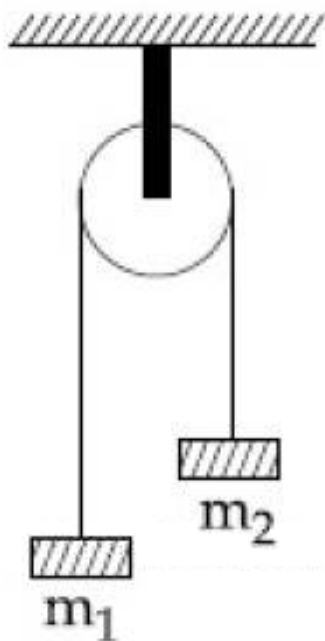
(C) $\frac{3}{4} \left(\frac{2a+b}{3a+b} \right) L$

(D) $\frac{3}{2} \left(\frac{2a+b}{3a+b} \right) L$

41. A particle starts from the origin at $t = 0$ with an initial velocity of $3.0 \hat{i}$ m/s and moves in the x-y plane with a constant acceleration $(6\hat{i} + 4\hat{j})$ m/s². The x-coordinate of the particle at the instant when its y-coordinate is 32 m is D meters. The value of D is :-

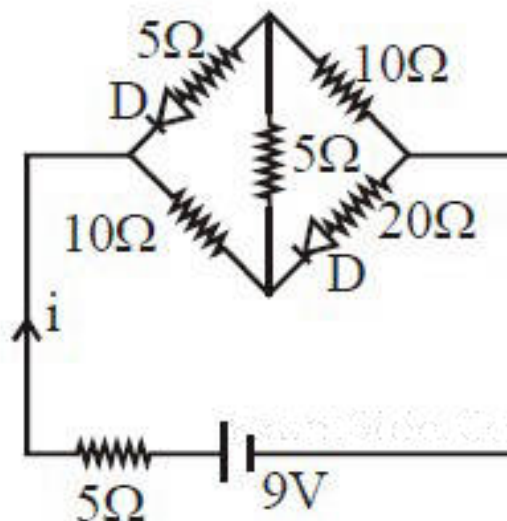
- (A) 40 (B) 32
(C) 50 (D) 60

42. A uniformly thick wheel with moment of inertia I and radius R is free to rotate about its centre of mass (see fig). A massless string is wrapped over its rim and two blocks of masses m_1 and m_2 ($m_1 > m_2$) are attached to the ends of the string. The system is released from rest. The angular speed of the wheel when m_1 descends by a distance h is :



- (A) $\left[\frac{2(m_1 + m_2)gh}{(m_1 + m_2)R^2 + I} \right]^{\frac{1}{2}}$
 (B) $\left[\frac{m_1 + m_2}{(m_1 + m_2)R^2 + I} \right]^{\frac{1}{2}} gh$
 (C) $\left[\frac{(m_1 - m_2)}{(m_1 + m_2)R^2 + I} \right]^{\frac{1}{2}} gh$
 (D) $\left[\frac{2(m_1 - m_2)gh}{(m_1 + m_2)R^2 + I} \right]^{\frac{1}{2}}$

43. The current i in the network is :



- (A) 0.6 A (B) 0.3 A
(C) 0 A (D) 0.2 A

44. A spring mass system (mass m , spring constant k and natural length l) rest in equilibrium on a horizontal disc. The free end of the spring is fixed at the centre of the disc. If the disc together with spring mass system, rotates about its axis with an angular velocity ω , ($k \gg m\omega^2$) the relative change in the length of the spring is best given by the option :

- (A) $\frac{m\omega^2}{3k}$
 (B) $\frac{m\omega^2}{k}$
 (C) $\frac{2m\omega^2}{k}$
 (D) $\sqrt{\frac{2}{3}} \left(\frac{m\omega^2}{k} \right)$

45. The energy required to ionise a hydrogen like ion in its ground state is 9 Rydbergs. What is the wavelength of the radiation emitted when the electron in this ion jumps from the second excited state to the ground state ?

- (A) 35.8 nm (B) 11.4 nm
(C) 8.6 nm (D) 24.2 nm

46. In a Young's double slit experiment 15 fringes are observed on a small portion of the screen when light of wavelength 500 nm is used. Ten fringes are observed on the same section of the screen when another light source of wavelength λ is used. Then the value of λ is (in nm) _____.

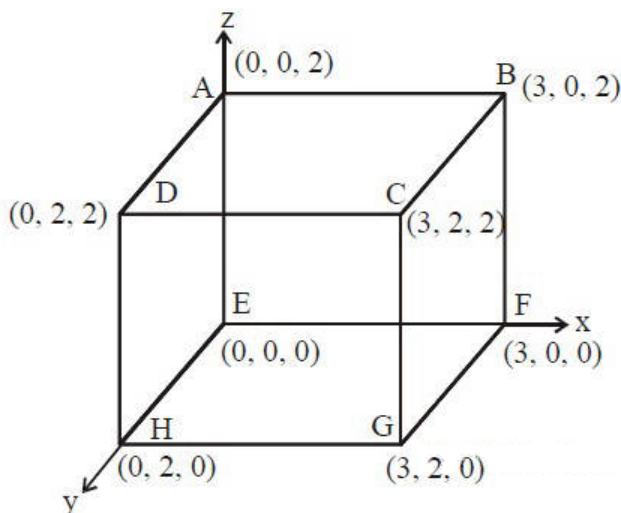
47. Starting at temperature 300 K, one mole of an ideal diatomic gas ($\gamma = 1.4$) is first compressed adiabatically from volume V_1 to $V_2 = \frac{V_1}{16}$. It is then allowed to expand isobarically to volume $2V_2$. If all the processes are the quasi-static then the final temperature of the gas (in $^\circ\text{K}$) is (to the nearest integer) _____.

48. An electric field

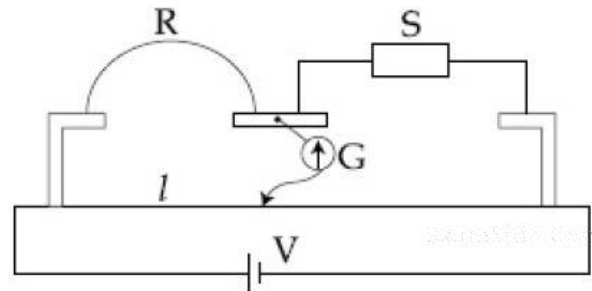
$$\vec{E} = 4x\hat{i} - (y^2 + 1)\hat{j}$$

N/C

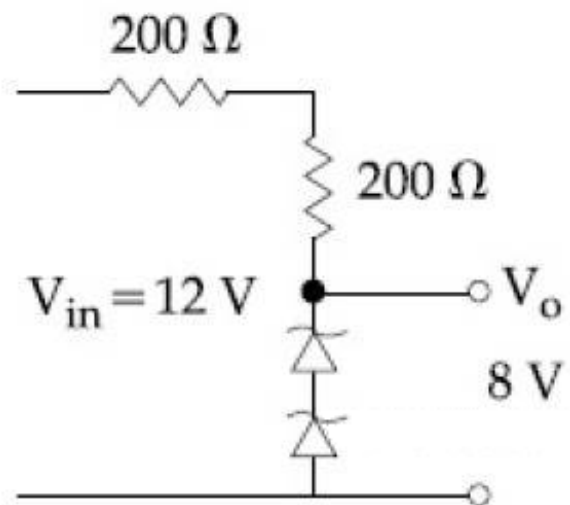
passes through the box shown in figure. The flux of the electric field through surfaces ABCD and BCGF are marked as ϕ_I and ϕ_{II} respectively. The difference between $(\phi_I - \phi_{II})$ is (in Nm^2/C) _____.



49. In a meter bridge experiment S is a standard resistance. R is a resistance wire. It is found that balancing length is $l = 25$ cm. If R is replaced by a wire of half length and half diameter that of R of same material, then the balancing distance l' (in cm) will now be _____.



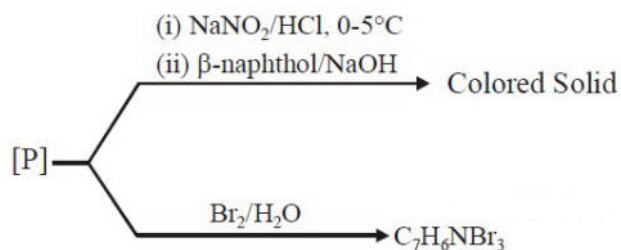
50. The circuit shown below is working as a 8 V dc regulated voltage source. When 12 V is used as input, the power dissipated (in mW) in each diode is; (considering both zener diodes are identical) _____.



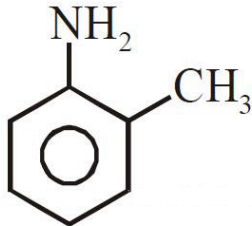
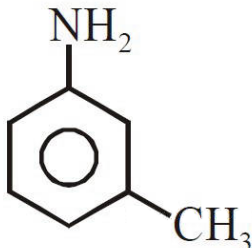
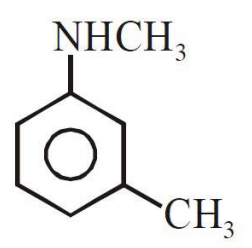
51. The first and second ionisation enthalpies of a metal are 496 and 4560 kJ mol⁻¹, respectively. How many moles of HCl and H₂SO₄, respectively, will be needed to react completely with 1 mole of the metal hydroxide ?

- (A) 1 and 2 (B) 1 and 0.5
(C) 1 and 1 (D) 2 and 0.5

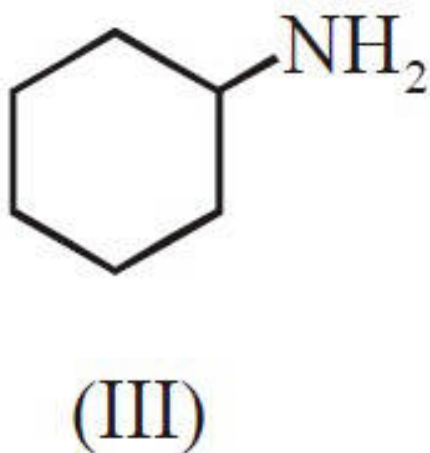
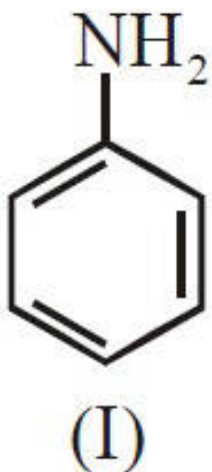
52. Consider the following reactions,



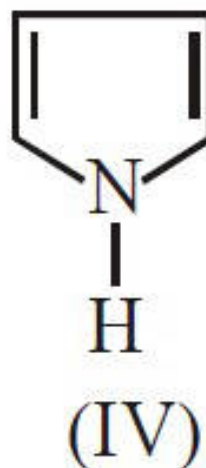
The compound [P] is :

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

53. The decreasing order of basicity of the following amines is :



53. (continued)



- (A) (III) > (II) > (I) > (IV) (B) (I) > (III) > (IV) > (II)
 (C) (III) > (I) > (II) > (IV) (D) (II) > (III) > (IV) > (I)

54. The reaction of $\text{H}_3\text{N}_3\text{B}_3\text{Cl}_3$ (A) with LiBH_4 in tetrahydrofuran gives inorganic benzene (B). Further, the reaction of (A) with (C) leads to $\text{H}_3\text{N}_3\text{B}_3(\text{Me})_3$. Compounds (B) and (C) respectively, are :

- (A) Borazine and MeBr (B) Diborane and MeMgBr
 (C) Boron nitride and MeBr (D) Borazine and MeMgBr

55. A, B and C are three biomolecules. The results of the tests performed on them are given below:

	Molisch's Test	Barfoed Test	Biuret Test
A	Positive	Negative	Negative
B	Positive	Positive	Negative
C	Negative	Negative	Positive

A, B and C are respectively :

- (A) A = Lactose, B = Glucose, C = Albumin (B) A = Lactose, B = Fructose, C = Alanine
 (C) A = Lactose, B = Glucose, C = Alanine (D) A = Glucose, B = Fructose, C = Albumin

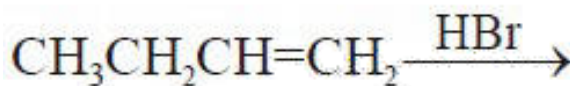
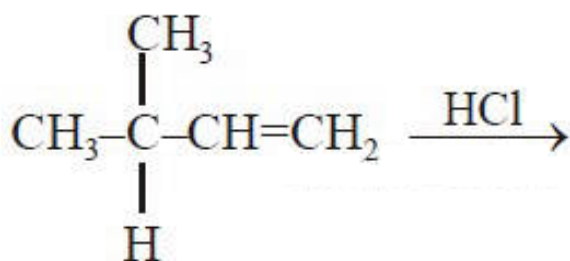
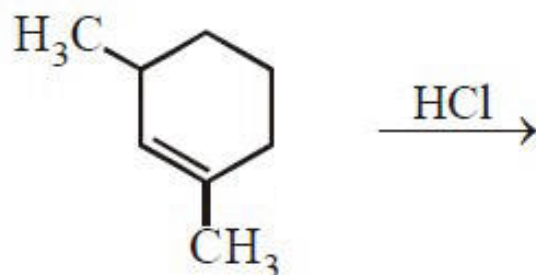
56. 5 g of zinc is treated separately with an excess of

- (a) dilute hydrochloric acid and
(b) aqueous sodium hydroxide.

The ratio of the volumes of H_2 evolved in these two reactions is :

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

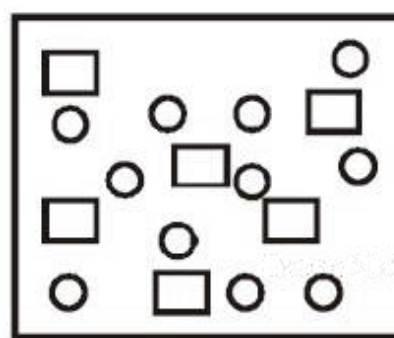
57. Which of the following reactions will not produce a racemic product?



58. The true statement amongst the following is :

- (A) S is a function of temperature but ΔS is not a function of temperature. (B) Both S and ΔS are not functions of temperature.
(C) Both ΔS and S are functions of temperature. (D) S is not a function of temperature but ΔS is a function of temperature.

59. In the figure shown below reactant A (represented by square) is in equilibrium with product B (represented by circle). The equilibrium constant is :



- (A) 1 (B) 2
(C) 8 (D) 4

60. The isomer(s) of $[Co(NH_3)_4Cl_2]$ that has/have a Cl-Co-Cl angle of 90° , is/are :

- (A) cis only (B) cis and trans
(C) meridional and trans (D) trans only

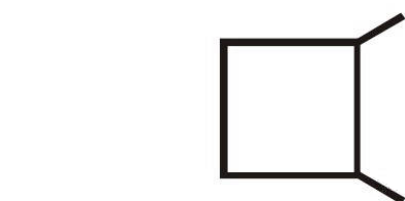
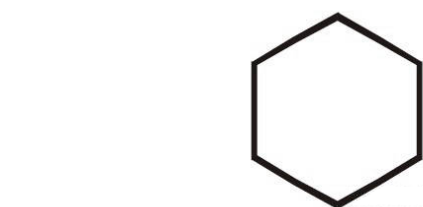
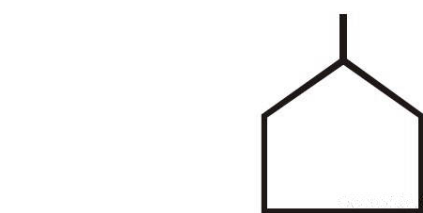
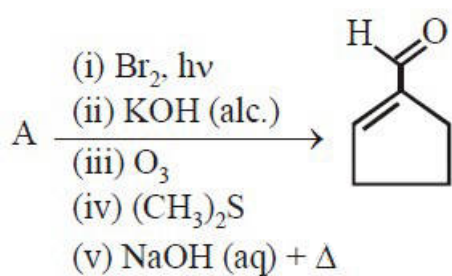
61. The solubility product of $Cr(OH)_3$ at 298 K is 6.0×10^{-31} . The concentration of hydroxide ions in a saturated solution of $Cr(OH)_3$ will be :

- (A) $(2.22 \times 10^{-31})^{1/4}$ (B) $(4.86 \times 10^{-29})^{1/4}$
(C) $(18 \times 10^{-31})^{1/4}$ (D) $(18 \times 10^{-31})^{1/2}$

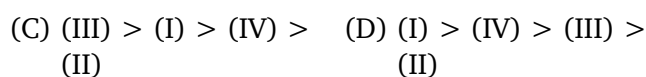
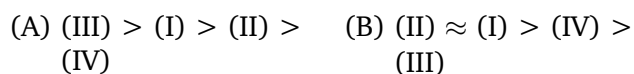
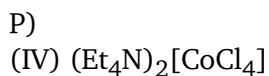
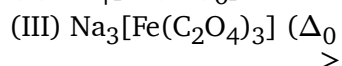
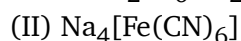
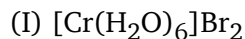
62. Which of the following has the shortest C-Cl bond?

- (A) $Cl-CH=CH-CH_3$ (B) $Cl-CH=CH-NO_2$
(C) $Cl-CH=CH-OCH_3$ (D) $Cl-CH=CH_2$

63. In the following reaction A is :



64. The correct order of the spin-only magnetic moments of the following complexes is :



65. The number of sp^2 hybrid orbitals in a molecule of benzene is :

(A) 24

(B) 12

(C) 6

(D) 18

66. Which polymer has 'chiral' monomer(s) ?

(A) Nylon 6,6

(B) Buna-N

(C) PHBV

(D) Neoprene

67. Amongst the following, the form of water with the lowest ionic conductance at 298 K is :

(A) saline water used for intravenous injection

(B) sea water

(C) distilled water

(D) water from a well

68. Biochemical Oxygen Demand (BOD) is the amount of oxygen required (in ppm) :

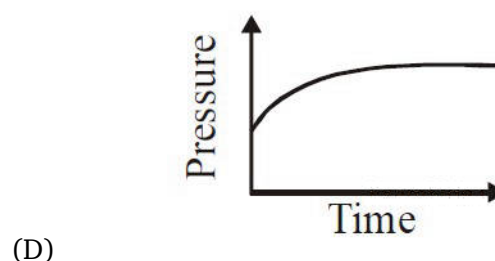
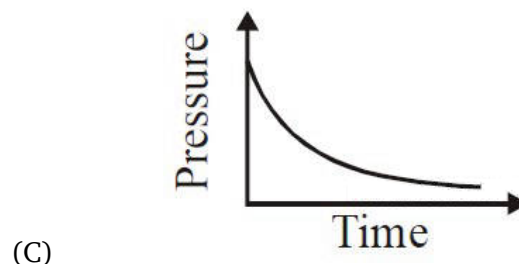
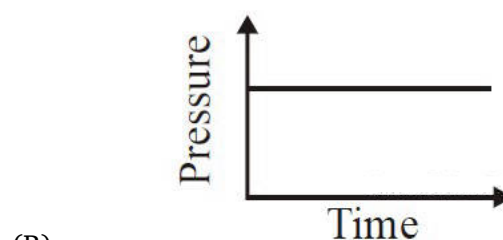
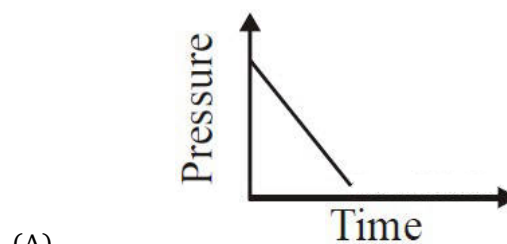
- | | |
|---|--|
| (A) for sustaining life in a water body. | (B) by anaerobic bacteria to breakdown inorganic waste present in a water body. |
| (C) for the photochemical breakdown of waste present in 1 m^3 volume of a water body. | (D) by bacteria to break-down organic waste in a certain volume of a water sample. |

69. Among the statements (a)-(d) the correct ones are :

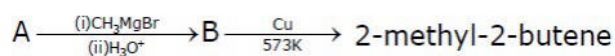
- (a) Lithium has the highest hydration enthalpy among the alkali metals.
 (b) Lithium chloride is insoluble in pyridine.
 (c) Lithium cannot form ethynide upon its reaction with ethyne.
 (d) Both lithium and magnesium react slowly with H_2O .

- | | |
|---------------------------|---------------------------|
| (A) (b) and (c) only | (B) (a) and (d) only |
| (C) (a), (b) and (d) only | (D) (a), (c) and (d) only |

70. A mixture of gases O_2 , H_2 and CO are taken in a closed vessel containing charcoal. The graph that represents the correct behaviour of pressure with time is :



71. Consider the following reactions

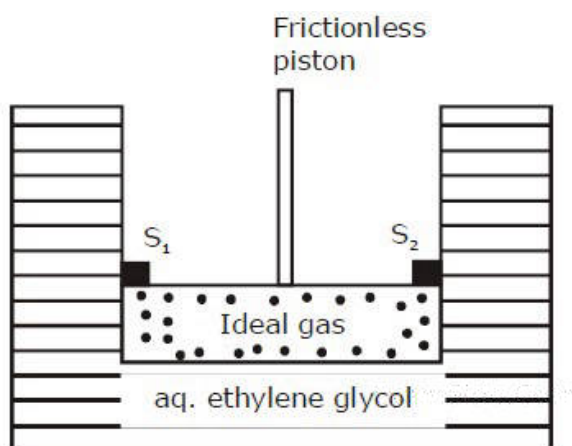


The mass percentage of carbon in A is _____.

72. A cylinder containing an ideal gas (0.1 mol of 1.0 dm^3) is in thermal equilibrium with a large volume of 0.5 molal aqueous solution of ethylene glycol at its freezing point. If the stoppers S_1 and S_2 (as shown in the figure) are suddenly withdrawn, the volume of the gas in litres after equilibrium is achieved will be _____.

(Given, $K_f(\text{water}) = 2.0 \text{ K kg mol}^{-1}$,

$R = 0.08 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$)



73. A sample of milk splits after 60 min. at 300 K and after 40 min. at 400 K when the population of lactobacillus acidophilus in it doubles. The activation energy (in kJ mol^{-1}) for this process is closest to _____.

(Given, $R = 8.3 \text{ J mol}^{-1} \text{ K}^{-1}$,

$$\ln\left(\frac{3}{2}\right) = 0.4$$

, $e^{-3} = 4.0$)

74. 10.30 mg of O_2 is dissolved into a liter of sea water of density 1.03 g/mL . The concentration of O_2 in ppm is _____.

75. The sum of the total number of bonds between chromium and oxygen atoms in chromate and dichromate ions is _____.

- End of Question Paper -