

JEE Main 2020 Paper 1 (B.E./B.Tech) 6 September 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 2**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 6 September 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.

1. The integral

$$\int_1^2 e^x \cdot x^x (2 + \log_e x) dx$$

equals :

- (A) $e(4e + 1)$ (B) $e(2e - 1)$
(C) $e(4e - 1)$ (D) $4e^2 - 1$

2. The area (in sq. units) of the region enclosed by the curves $y = x^2 - 1$ and $y = 1 - x^2$ is equal to :

- (A) $\frac{8}{3}$
(B) $\frac{4}{3}$
(C) $\frac{7}{2}$
(D) $\frac{16}{3}$

3. The set of all real values of λ for which the function

$$f(x) = (1 - \cos^2 x)(\lambda + \sin x), x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$$

has exactly one maxima and exactly one minima, is :

- (A) $\left(-\frac{3}{2}, \frac{3}{2}\right) - \{0\}$
(B) $\left(-\frac{3}{2}, \frac{3}{2}\right)$
(C) $\left(-\frac{1}{2}, \frac{1}{2}\right) - \{0\}$
(D) $\left(-\frac{1}{2}, \frac{1}{2}\right)$

4. Let L denote the line in the xy-plane with x and y intercepts as 3 and 1 respectively. Then the image of the point $(-1, -4)$ in this line is :

- (A) $\left(\frac{11}{5}, \frac{28}{5}\right)$
(B) $\left(\frac{29}{5}, \frac{11}{5}\right)$
(C) $\left(\frac{29}{5}, \frac{8}{5}\right)$
(D) $\left(\frac{8}{5}, \frac{29}{5}\right)$

5. For a suitably chosen real constant a, let a function, $f : R - \{-a\} \rightarrow R$ be defined by

$$f(x) = \frac{a - x}{a + x}$$

. Further suppose that for any real number $x \neq -a$ and $f(x) \neq -a$, $(f \circ f)(x) = x$. Then

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

is equal to :

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

6. For all twice differentiable functions $f : R \rightarrow R$, with $f(0) = f(1) = f'(0) = 0$

- (A) $f'(x) \neq 0$, at every point $x \in (0, 1)$ (B) $f'(x) = 0$, for some $x \in (0, 1)$
(C) $f'(0) = 0$ (D) $f'(x) = 0$, at every point $x \in (0, 1)$

7. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a function defined by $f(x) = \max \{x, x^2\}$. Let S denote the set of all points in $\mathbb{R}$, where f is not differentiable. Then :

- (A) $\{0, 1\}$ (B) $\{0\}$
(C) ϕ (an empty set) (D) $\{1\}$

8. Let

$$\theta = \frac{\pi}{5}$$

and

$$A = \begin{bmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{bmatrix}$$

.

If $B = A + A^4$, then $\det(B)$:

- (A) lies in $(1, 2)$ (B) lies in $(2, 3)$.
(C) is zero. (D) is one.

9. The common difference of the A.P. $b_1, b_2, \dots, b_m$ is 2 more than the common difference of A.P. $a_1, a_2, \dots, a_n$. If $a_{40} = -159$, $a_{100} = -399$ and $b_{100} = a_{70}$, then b_1 is equal to :

- (A) 127 (B) 81
(C) -127 (D) -81

10. If the constant term in the binomial expansion of

$$\left(\sqrt{x} - \frac{k}{x^2} \right)^{10}$$

is 405, then $|k|$ equals :

- (A) 3 (B) 9
(C) 1 (D) 2

11. Let $z = x + iy$ be a non-zero complex number such that

$$z^2 = i|z|^2$$

, where $i = \sqrt{-1}$, then z lies on the :

- (A) line, $y = -x$ (B) real axis
(C) line, $y = x$ (D) imaginary axis

12. If α and β are the roots of the equation $2x(2x + 1) = 1$, then β is equal to :

- (A) $-2\alpha(\alpha + 1)$
(B) $2\alpha(\alpha + 1)$
(C) $2\alpha^2$
(D) $2\alpha(\alpha - 1)$

13. The probabilities of three events A , B and C are given by

$P(A) = 0.6$, $P(B) = 0.4$ and $P(C) = 0.5$.

If $P(A \cup B) = 0.8$, $P(A \cap C) = 0.3$, $P(A \cap B \cap C) = 0.2$, $P(B \cap C) = \beta$

and $P(A \cup B \cup C) = \alpha$, where $0.85 \leq \alpha \leq 0.95$, then β lies in the interval :

- (A) $[0.35, 0.36]$ (B) $[0.20, 0.25]$
(C) $[0.25, 0.35]$ (D) $[0.36, 0.40]$

14. If

$$y = \left(\frac{2}{\pi}x - 1 \right) \operatorname{cosec} x$$

is the solution of the differential equation,

$$\frac{dy}{dx} + p(x)y = \frac{2}{\pi} \operatorname{cosec} x$$

,

$$0 < x < \frac{\pi}{2}$$

, then the function $p(x)$ is equal to :

- (A) $\cot x$ (B) $\sec x$
(C) $\tan x$ (D) $\operatorname{cosec} x$

15. The centre of the circle passing through the point (0, 1) and touching the parabola $y = x^2$ at the point (2, 4) is :

- (A) $\left(\frac{6}{5}, \frac{53}{10}\right)$
 (B) $\left(\frac{3}{10}, \frac{16}{5}\right)$
 (C) $\left(\frac{-53}{10}, \frac{16}{5}\right)$
 (D) $\left(\frac{-16}{5}, \frac{53}{10}\right)$

16. If the tangent to the curve, $y = f(x) = x \log_e x$, ($x > 0$) at a point (c, f(c)) is parallel to the line-segment joining the points (1, 0) and (e, e), then c is equal to :

- (A) $\frac{e-1}{e}$
 (B) $e^{\left(\frac{1}{1-e}\right)}$
 (C) $e^{\left(\frac{1}{e-1}\right)}$
 (D) $\frac{1}{e-1}$

17. If the normal at an end of a latus rectum of an ellipse passes through an extremity of the minor axis, then the eccentricity e of the ellipse satisfies :

- (A) $e^4 + 2e^2 - 1 = 0$ (B) $e^4 + e^2 - 1 = 0$
 (C) $e^2 + 2e - 1 = 0$ (D) $e^2 + e - 1 = 0$

18. Consider the statement :

“For an integer n, if $n^3 - 1$ is even, then n is odd.”
 The contrapositive statement of this statement is :

- (A) For an integer n, if n is even, then $n^3 - 1$ is even.
 (B) For an integer n, if $n^3 - 1$ is not even, then n is not odd.
 (C) For an integer n, if n is odd, then $n^3 - 1$ is even.
 (D) For an integer n, if n is even, then $n^3 - 1$ is odd.

19. The angle of elevation of the summit of a mountain from a point on the ground is 45° . After climbing up one km towards the summit at an inclination of 30° from the ground, the angle of elevation of the summit is found to be 60° . Then the height (in km) of the summit from the ground is :

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

20. A plane P meets the coordinate axes at A, B and C respectively. The centroid of $\triangle ABC$ is given to be (1, 1, 2). Then the equation of the line through this centroid and perpendicular to the plane P is :

- (A) $\frac{x-1}{1} = \frac{y-1}{1} = \frac{z-2}{2}$
 (B) $\frac{x-1}{2} = \frac{y-1}{1} = \frac{z-2}{1}$
 (C) $\frac{x-1}{2} = \frac{y-1}{2} = \frac{z-2}{1}$
 (D) $\frac{x-1}{1} = \frac{y-1}{2} = \frac{z-2}{2}$

21. Consider the data on x taking the values $0, 2, 4, 8, \dots, 2^n$ with frequencies ${}^nC_0, {}^nC_1, {}^nC_2, \dots, {}^nC_n$ respectively. If the mean of this data is $\frac{728}{2^n}$, then n is equal to _____.

22. If $\vec{x}$ and $\vec{y}$ be two non-zero vectors such that

$$|\vec{x} + \vec{y}| = |\vec{x}|$$

and $2\vec{x} + \lambda\vec{y}$ is perpendicular to $\vec{y}$, then the value of λ is _____.

23. The sum of distinct values of λ for which the system of equations

$$(\lambda - 1)x + (3\lambda + 1)y + 2\lambda z = 0$$

$$(\lambda - 1)x + (4\lambda - 2)y + (\lambda + 3)z = 0$$

$$2x + (3\lambda + 1)y + 3(\lambda - 1)z = 0$$

has non-zero solutions, is _____.

24. Suppose that a function $f : \mathbb{R} \rightarrow \mathbb{R}$ satisfies $f(x + y) = f(x)f(y)$ for all $x, y \in \mathbb{R}$ and $f(1) = 3$. If

$$\sum_{i=1}^n f(i) = 363$$

then n is equal to _____.

25. The number of words (with or without meaning) that can be formed from all the letters of the word "LETTER" in which vowels never come together is _____.

26. Two planets have masses M and $16M$ and their radii are a and $2a$, respectively. The separation between the centres of the planets is $10a$. A body of mass m is fired from the surface of the larger planet towards the smaller planet along the line joining their centres. For the body to be able to reach at the surface of smaller planet, the minimum firing speed needed is :

- (A) $2\sqrt{\frac{GM}{a}}$
 (B) $\sqrt{\frac{GM^2}{ma}}$
 (C) $\frac{3}{2}\sqrt{\frac{5GM}{a}}$
 (D) $4\sqrt{\frac{GM}{a}}$

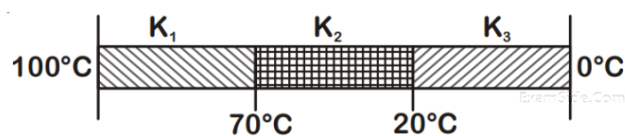
27. Given the masses of various atomic particles $m_p = 1.0072 \text{ u}$, $m_n = 1.0087 \text{ u}$, $m_e = 0.000548 \text{ u}$, $m_{\bar{\nu}} = 0$, $m_d = 2.0141 \text{ u}$, where $p \equiv$ proton, $n \equiv$ neutron, $e \equiv$ electron, $\bar{\nu} \equiv$ antineutrino and $d \equiv$ deuteron. Which of the following process is allowed by momentum and energy conservation?

- (A) $n + n \rightarrow \text{deuterium atom (electron bound to the nucleus)}$ (B) $n + p \rightarrow d + \gamma$
 (C) $p \rightarrow n + e^+ + \bar{\nu}$ (D) $e^+ + e^- \rightarrow \gamma$

28. A square loop of side $2a$ and carrying current I is kept in xz plane with its centre at origin. A long wire carrying the same current I is placed parallel to z -axis and passing through point $(0, b, 0)$, ($b \gg a$). The magnitude of torque on the loop about z -axis will be :

- (A) $\frac{2\mu_0 I^2 a^2}{\pi b}$
 (B) $\frac{2\mu_0 I^2 a^2 b}{\pi(a^2 + b^2)}$
 (C) $\frac{\mu_0 I^2 a^2 b}{2\pi(a^2 + b^2)}$
 (D) $\frac{\mu_0 I^2 a^2}{2\pi b}$

29. Three rods of identical cross-section and lengths are made of three different materials of thermal conductivity K_1 , K_2 and K_3 , respectively. They are joined together at their ends to make a long rod (see figure). One end of the long rod is maintained at 100°C and the other at 0°C (see figure). If the joints of the rod are at 70°C and 20°C in steady state and there is no loss of energy from the surface of the rod, the correct relationship between K_1 , K_2 and K_3 is :



- (A) $K_1 : K_3 = 2 : 3$, $K_2 : K_3 = 2 : 5$ (B) $K_1 < K_2 < K_3$
 (C) $K_1 : K_2 = 5 : 2$, $K_1 : K_3 = 3 : 5$ (D) $K_1 > K_2 > K_3$

30. A double convex lens has power P and same radii of curvature R of both the surfaces. The radius of curvature of a surface of a plano-convex lens made of the same material with power $1.5 P$ is :

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

31. When a particle of mass m is attached to a vertical spring of spring constant k and released, its motion is described by

$y(t) = y_0 \sin^2 \omega t$, where ' y ' is measured from the lower end of unstretched spring. Then ω is:

- (A) $\sqrt{\frac{g}{y_0}}$
 (B) $\frac{1}{2}\sqrt{\frac{g}{y_0}}$
 (C) $\sqrt{\frac{2g}{y_0}}$
 (D) $\sqrt{\frac{g}{2y_0}}$

32. A circuit to verify Ohm's law uses ammeter and voltmeter in series or parallel connected correctly to the resistor. In the circuit :

- | | |
|---|--|
| (A) Ammeter is always connected in series and voltmeter in parallel | (B) Both ammeter and voltmeter must be connected in series |
| (C) Both ammeter and voltmeter must be connected in parallel | (D) Ammeter is always used in parallel and voltmeter is series |

33. Two identical electric point dipoles have dipole moments

$$\vec{p}_1 = p\hat{i}$$

and

$$\vec{p}_2 = -p\hat{i}$$

and are held on the x axis at distance ' a ' from each other. When released, they move along the x -axis with the direction of their dipole moments remaining unchanged. If the mass of each dipole is ' m ', their speed when they are infinitely far apart is :

- (A) $\frac{p}{a}\sqrt{\frac{3}{2\pi\epsilon_0 ma}}$
 (B) $\frac{p}{a}\sqrt{\frac{1}{\pi\epsilon_0 ma}}$
 (C) $\frac{p}{a}\sqrt{\frac{1}{2\pi\epsilon_0 ma}}$
 (D) $\frac{p}{a}\sqrt{\frac{2}{\pi\epsilon_0 ma}}$

34. Particle A of mass m_1 moving with velocity $(\sqrt{3}\hat{i} + \hat{j}) ms^{-1}$ collides with another particle B of mass m_2 which is at rest initially. Let $\vec{V}_1$ and $\vec{V}_2$ be the velocities of particles A and B after collision respectively. If $m_1 = 2m_2$ and after collision

$$\vec{V}_1 =$$

$(\hat{i} + \sqrt{3}\hat{j})$, the angle between $\vec{V}_1$ and $\vec{V}_2$ is :

- (A) 105° (B) 15°
 (C) -45° (D) 60°

35. The linear mass density of a thin rod AB of length L varies from A to B as

$$\lambda(x) = \lambda_0 \left(1 + \frac{x}{L}\right)$$

, where x is the distance from A. If M is the mass of the rod then its moment of inertia about an axis passing through A and perpendicular to the rod is :

- (A) $\frac{2}{5}ML^2$
 (B) $\frac{5}{12}ML^2$
 (C) $\frac{7}{18}ML^2$
 (D) $\frac{3}{7}ML^2$

36. In a dilute gas at pressure P and temperature T , the mean time between successive collisions of a molecule varies with T as :

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

37. When a car is at rest, its driver sees rain drops falling on it vertically. When driving the car with speed v , he sees that rain drops are coming at an angle 60° from the horizontal. On further increasing the speed of the car to $(1 + \beta)v$, this angle changes to 45° . The value of β is close to :

- (A) 0.50 (B) 0.73
 (C) 0.37 (D) 0.41

38. Consider the force F on a charge ' q ' due to a uniformly charged spherical shell of radius R carrying charge Q distributed uniformly over it. Which one of the following statements is true for F , if ' q ' is placed at distance r from the centre of the shell?

- (A) $\frac{1}{4\pi\epsilon_0} \frac{qQ}{R^2} > F > 0$
 for $r < R$
 (B) $F = \frac{1}{4\pi\epsilon_0} \frac{qQ}{r^2}$
 for $r > R$
 (C) $F = \frac{1}{4\pi\epsilon_0} \frac{qQ}{r^2}$
 for all r
 (D) $F = \frac{1}{4\pi\epsilon_0} \frac{qQ}{R^2}$
 for $r < R$

39. Assuming the nitrogen molecule is moving with r.m.s. velocity at 400 K, the de-Broglie wavelength of nitrogen molecule is close to :

(Given : nitrogen molecule weight : 4.64×10^{-26} kg,

Boltzman constant: 1.38×10^{-23} J/K,

Planck constant : 6.63×10^{-34} J.s)

- (A) 0.44 $\text{\AA}$
 (B) 0.34 $\text{\AA}$
 (C) 0.20 $\text{\AA}$
 (D) 0.24 $\text{\AA}$

40. A charged particle going around in a circle can be considered to be a current loop. A particle of mass m carrying charge q is moving in a plane with speed v under the influence of magnetic field $\vec{B}$. The magnetic moment of this moving particle:

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

41. A particle moving in the xy plane experiences a velocity dependent force

$$\vec{F} = k(v_y \hat{i} + v_x \hat{j})$$

, where v_x and v_y are the

x and y components of its velocity $\vec{v}$. If $\vec{a}$ is the acceleration of the particle, then

which of the following statements is true for the particle?

- (A) kinetic energy of particle is constant in time
 (B) quantity $\vec{v} \times \vec{a}$ is constant in time
 (C) quantity $\vec{v} \cdot \vec{a}$ is constant in time
 (D) $\vec{F}$ arises due to a magnetic field

42. A fluid is flowing through a horizontal pipe of varying cross-section, with speed $v \text{ ms}^{-1}$ at a point where the pressure is P pascal. At another point where pressure is $\frac{P}{2}$ Pascal its speed is $V \text{ ms}^{-1}$. If the density of the fluid is $\rho \text{ kg m}^{-3}$ and the flow is streamline, then V is equal to :

- (A) $\sqrt{\frac{P}{2\rho} + v^2}$
 (B) $\sqrt{\frac{P}{\rho} + v^2}$
 (C) $\sqrt{\frac{2P}{\rho} + v^2}$
 (D) $\sqrt{\frac{P}{\rho} + v}$

43. For a plane electromagnetic wave, the magnetic field at a point x and time t is

$$\vec{B}(x, t) = \left[1.2 \times 10^{-7} \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t) \right] \hat{k}$$

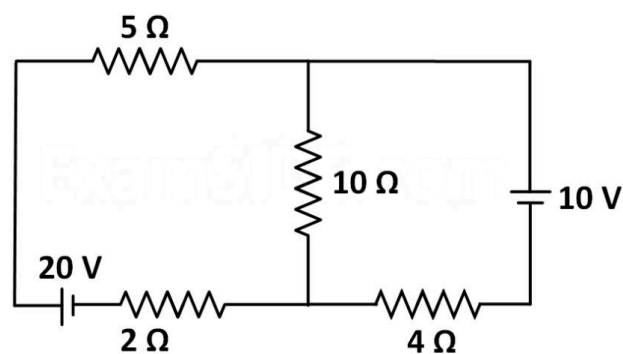
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The instantaneous electric field $\vec{E}$ corresponding to $\vec{B}$ is :

(speed of light $c = 3 \times 10^8 \text{ ms}^{-1}$)

- (A) $\vec{E}(x, t) = \left[36 \sin(1 \times 10^3 x + 1.5 \times 10^{11} t) \right] \hat{i} \frac{V}{m}$
 (B) $\vec{E}(x, t) = \left[36 \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t) \right] \hat{k} \frac{V}{m}$
 (C) $\vec{E}(x, t) = \left[36 \sin(1 \times 10^3 x + 0.5 \times 10^{11} t) \right] \hat{j} \frac{V}{m}$
 (D) $\vec{E}(x, t) = \left[-36 \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t) \right] \hat{j} \frac{V}{m}$

44. In the figure shown, the current in the 10 V battery is close to :



- (A) 0.36 A from negative to positive terminal
 (B) 0.42 A from positive to negative terminal
 (C) 0.71 A from positive to negative terminal
 (D) 0.21 A from positive to negative terminal

45. A student measuring the diameter of a pencil of circular cross-section with the help of a vernier scale records the following four readings 5.50 mm, 5.55 mm, 5.45 mm, 5.65 mm. The average of these four readings is 5.5375 mm and the standard deviation of the data is 0.07395 mm. The average diameter of the pencil should therefore be recorded as :

- (A) $(5.54 \pm 0.07) \text{ mm}$
 (B) $(5.5375 \pm 0.0740) \text{ mm}$
 (C) $(5.5375 \pm 0.0739) \text{ mm}$
 (D) $(5.538 \pm 0.074) \text{ mm}$

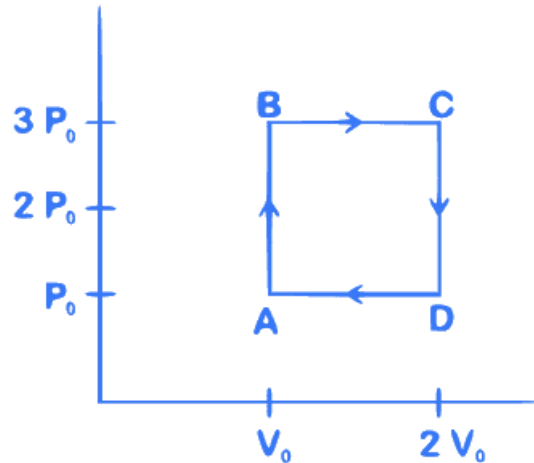
46. A Young's double-slit experiment is performed using monochromatic light of wavelength λ . The intensity of light at a point on the screen, where the path difference is λ , is K units. The intensity of light at a point where the path difference is $\frac{\lambda}{6}$ is given by $\frac{nK}{12}$, where n is an integer. The value of n is _____.

47. The centre of mass of solid hemisphere of radius 8 cm is x from the centre of the flat surface. Then value of x is _____.

48. In a series LR circuit, power of 400W is dissipated from a source of 250 V, 50 Hz. The power factor of the circuit is 0.8. In order to bring the power factor to unity, a capacitor of value C is added in series to the L and R . Taking the value of C as

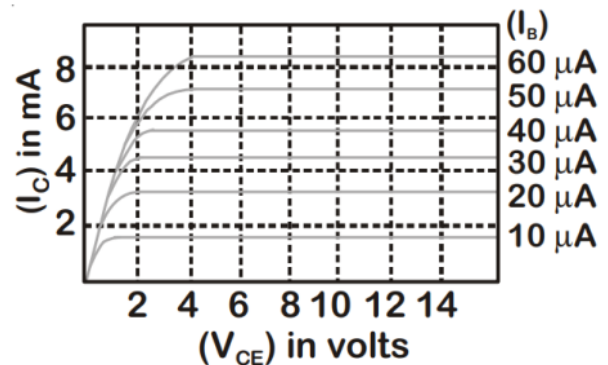
$\left(\frac{n}{3\pi}\right) \mu\text{F}$, then value of n is _____.

49. An engine operates by taking a monoatomic ideal gas through the cycle shown in the figure. The percentage efficiency of the engine is close to _____.

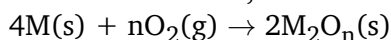


50. The output characteristics of a transistor is shown in the figure.

When V_{CE} is 10V and $I_C = 4.0$ mA, then value of β_{ac} is _____.



51. For a reaction,



the free energy change is plotted as a function of temperature. The temperature below which the oxide is stable could be inferred from the plot as the point at which :

- (A) the free energy change shows a change from negative to positive value
 (B) the slope changes from positive to negative
 (C) the slope changes from negative to positive
 (D) the slope changes from positive to zero

52. For the given cell :



change in Gibbs energy (ΔG) is negative, if :

- (A) $C_2 = \sqrt{2}C_1$
 (B) $C_2 = \frac{C_1}{\sqrt{2}}$
 (C) $C_1 = 2C_2$
 (D) $C_1 = C_2$

53. Which one of the following statements is not true?

- (A) Lactose contains α -glycosidic linkage between C_1 of galactose and C_4 of glucose
 (B) Lactose is a reducing sugar and it gives Fehling's test
 (C) On acid hydrolysis, lactose gives one molecule of D(+)-glucose and one molecule of D(+)-galactose
 (D) Lactose ($C_{11}H_{22}O_{11}$) is a disaccharide and it contains 8 hydroxyl groups

54. The correct match between Item-I (starting material) and Item-II (reagent) for the preparation of benzaldehyde is :

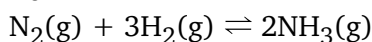
Item-I	Item-II
(I) Benzene	(P) HCl and $SnCl_2$, H_3O^+
(II) Benzonitrile	(Q) H_2 , Pd-BaSO ₄ , S and quinoline
(III) Benzoyl Chloride	(R) CO, HCl and $AlCl_3$

- (A) (I) - (R), (II) - (P) and (III) - (Q)
 (B) (I) - (P), (II) - (Q) and (III) - (R)
 (C) (I) - (Q), (II) - (R) and (III) - (P)
 (D) (I) - (R), (II) - (Q) and (III) - (P)

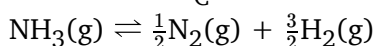
55. For a d^4 metal ion in an octahedral field, the correct electronic configuration is :

- (A) $t_{2g}^4 e_g^0$ when $\Delta_0 < P$
 (B) $t_{2g}^3 e_g^1$ when $\Delta_0 > P$
 (C) $e_g^2 t_{2g}^2$ when $\Delta_0 < P$
 (D) $t_{2g}^3 e_g^1$ when $\Delta_0 < P$

56. The value of K_C is 64 at 800 K for the reaction



The value of K_C for the following reaction is :



- (A) 8
 (B) $\frac{1}{8}$
 (C) $\frac{1}{4}$
 (D) $\frac{1}{64}$

57. The average molar mass of chlorine is 35.5 g mol^{-1} . The ratio of ^{35}Cl to ^{37}Cl in naturally occurring chlorine is close to :

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

58. A set of solutions is prepared using 180 g of water as a solvent and 10 g of different non-volatile solutes A, B and C. The relative lowering of vapour pressure in the presence of these solutes are in the order :

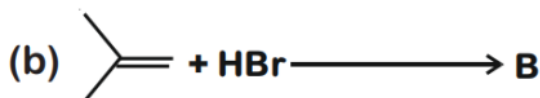
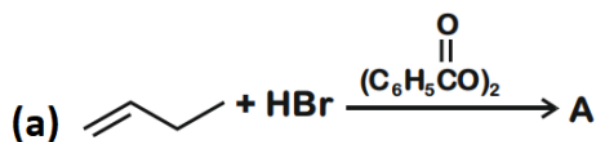
[Given, molar mass of A = 100 g mol^{-1} ; B = 200 g mol^{-1} ; C = $10,000 \text{ g mol}^{-1}$]

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

59. Mischmetal is an alloy consisting mainly of :

- (A) lanthanoid and actinoid metals (B) actinoid and transition metals
(C) lanthanoid metals (D) actinoid metals

60. The increasing order of the boiling points of the major products A, B and C of the following reactions will be :



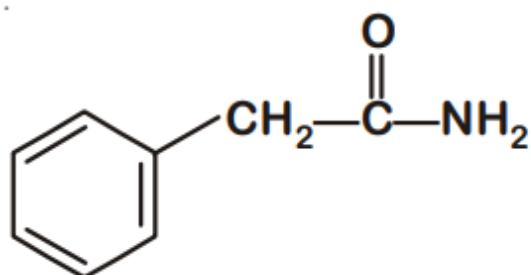
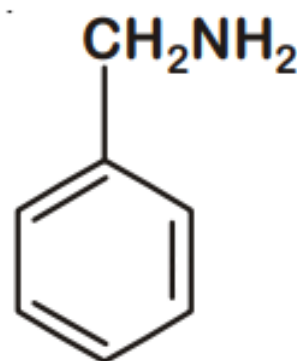
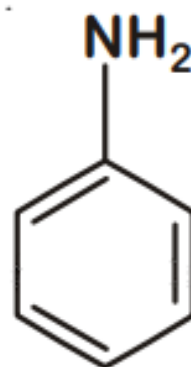
- (A) $A < C < B$ (B) $C < A < B$
(C) $B < C < A$ (D) $A < B < C$

61. Match the following :

Test/Method	Reagent
(i) Lucas Test	(a) $\text{C}_6\text{H}_5\text{SO}_2\text{Cl}$ / aq. KOH
(ii) Dumas method	(b) HNO_3 / AgNO_3
(iii) Kjeldahl's method	(c) CuO/CO_2
(iv) Hinsberg test	(d) Conc. HCl and ZnCl_2
	(e) H_2SO_4

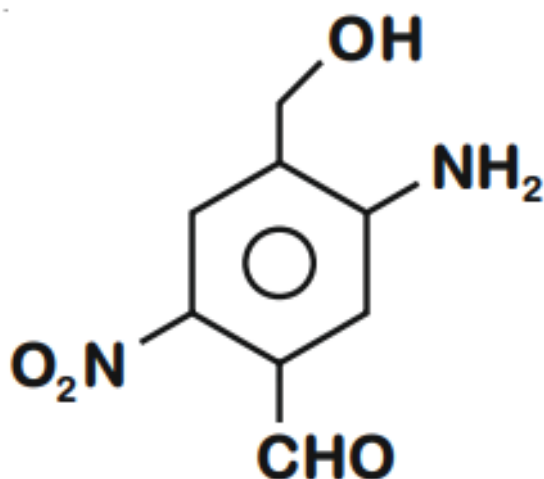
- (A) (i)-(b), (ii)-(d), (iii)-(e), (iv)-(a) (B) (i)-(d), (ii)-(c), (iii)-(e), (iv)-(a)
(C) (i)-(b), (ii)-(a), (iii)-(c), (iv)-(d) (D) (i)-(d), (ii)-(c), (iii)-(b), (iv)-(e)

62. Which of the following compounds can be prepared in good yield by Gabriel phthalimide synthesis?



- (D) $\text{CH}_3\text{—CH}_2\text{—NHCH}_3$

63. The IUPAC name of the following compound is :



- (A) 2-nitro-4-hydroxymethyl-5-amino benzaldehyde
(B) 3-amino-4-hydroxymethyl-5-nitro benzaldehyde
(C) 4-amino-2-formyl-5-hydroxymethyl nitrobenzene
(D) 5-amino-4-hydroxymethyl-2-nitro benzaldehyde

64. The correct match between Item - I and Item - II is :

Item - I	Item - II
(a) Natural rubber	(I) 1, 3-butadiene + styrene
(b) Neoprene	(II) 1, 3-butadiene + acrylonitrile
(c) Buna-N	(III) Chloroprene
(d) Buna-S	(IV) Isoprene

- (A) (a) - (IV), (b) - (III), (c) - (II), (d) - (I)
(B) (a) - (III), (b) - (IV), (c) - (I), (d) - (II)
(C) (a) - (III), (b) - (IV), (c) - (II), (d) - (I)
(D) (a) - (IV), (b) - (III), (c) - (I), (d) - (II)

65. The element that can be refined by distillation is :

- (A) gallium
(B) nickel
(C) zinc
(D) tin

66. The reaction of NO with N_2O_4 at 250 K gives :

- (A) N_2O_3
(B) N_2O_5
(C) N_2O
(D) NO_2

67. A crystal is made up of metal ions ' M_1 ' and ' M_2 ' and oxide ions. Oxide ions form a ccp lattice structure. The cation ' M_1 ' occupies 50% of octahedral voids and the cation ' M_2 ' occupies 12.5% of tetrahedral voids of oxide lattice. The oxidation numbers of ' M_1 ' and ' M_2 ' are, respectively :

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

68. Dihydrogen of high purity (> 99.95%) is obtained through :

- (A) the electrolysis of acidified water using Pt electrodes
(B) the electrolysis of warm $Ba(OH)_2$ solution using Ni electrodes
(C) the electrolysis of brine solution
(D) the reaction of Zn with dilute HCl

69. Match the following compounds (Column-I) with their uses (Column-II) :

S.N o.	Column-I	S.N o.	Column-II
(I)	$Ca(OH)_2$	(A)	casts of statues
(II)	NaCl	(B)	white wash
(III)	$CaSO_4, \frac{1}{2}H_2O$	(C)	antacid
(IV)	$CaCO_3$	(D)	washing soda preparation

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

70. Reaction of an inorganic sulphite X with dilute H_2SO_4 generates compound Y. Reaction of Y with NaOH gives X. Further, the reaction of X with Y and water affords compound Z. Y and Z, respectively, are :

- (A) S and Na_2SO_3
(B) SO_2 and $NaHSO_3$
(C) SO_2 and Na_2SO_3
(D) SO_3 and $NaHSO_3$

Chemistry - Section B · Numerical Value Questions

71. A solution of phenol in chloroform when treated with aqueous NaOH gives compound P as a major product. The mass percentage of carbon in P is _____. (to the nearest integer)

(Atomic mass : C = 12; H = 1; O = 16)

72. The atomic number of Unnilunium is _____.

73. The rate of a reaction decreased by 3.555 times when the temperature was changed from 40°C to 30°C. The activation energy (in kJ mol⁻¹) of the reaction is _____.

Take; $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ $\ln 3.555 = 1.268$

74. If the solubility product of AB₂ is $3.20 \times 10^{-11} \text{ M}^3$, then the solubility of AB₂ in pure water is _____ $\times 10^{-4} \text{ mol L}^{-1}$.

[Assuming that neither kind of ion reacts with water]

75. For Freundlich adsorption isotherm, a plot of log (x/m) (y-axis) and log p (x-axis) gives a straight line. The intercept and slope for the line is 0.4771 and 2, respectively. The mass of gas, adsorbed per gram of adsorbent if the initial pressure is 0.04 atm, is _____ $\times 10^{-4} \text{ g}$.
(log 3 = 0.4771)

- End of Question Paper -