

JEE Main 2020 Paper 1 (B.E./B.Tech) 3 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 3 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. Let x_i ($1 \leq i \leq 10$) be ten observations of a random variable X . If

$$\sum_{i=1}^{10} (x_i - p) = 3$$

and

$$\sum_{i=1}^{10} (x_i - p)^2 = 9$$

where $0 \neq p \in \mathbb{R}$, then the standard deviation of these observations is :

- (A) $\frac{7}{10}$
 (B) $\frac{9}{10}$
 (C) $\frac{4}{5}$
 (D) $\sqrt{\frac{3}{5}}$

2. If the surface area of a cube is increasing at a rate of $3.6 \text{ cm}^2/\text{sec}$, retaining its shape; then the rate of change of its volume (in cm^3/sec), when the length of a side of the cube is 10 cm, is :

- (A) 9 (B) 10
 (C) 18 (D) 20

3. Let the latus rectum of the parabola $y^2 = 4x$ be the common chord to the circles C_1 and C_2 each of them having radius $2\sqrt{5}$. Then, the distance between the centres of the circles C_1 and C_2 is :

- (A) 8
 (B) 12
 (C) $8\sqrt{5}$
 (D) $4\sqrt{5}$

4. Let R_1 and R_2 be two relation defined as follows :

$$R_1 = \{(a, b) \in \mathbb{R}^2 : a^2 + b^2 \in \mathbb{Q}\} \text{ and}$$

$$R_2 = \{(a, b) \in \mathbb{R}^2 : a^2 + b^2 \notin \mathbb{Q}\},$$

where $\mathbb{Q}$ is the set of all rational numbers. Then :

- (A) Neither R_1 nor R_2 is transitive. (B) R_2 is transitive but R_1 is not transitive.
 (C) R_1 and R_2 are both transitive. (D) R_1 is transitive but R_2 is not transitive.

5. Let $a, b, c \in \mathbb{R}$ be such that $a^2 + b^2 + c^2 = 1$. If

$$a \cos \theta = b \cos \left(\theta + \frac{2\pi}{3} \right) = c \cos \left(\theta + \frac{4\pi}{3} \right)$$

, where

$$\theta = \frac{\pi}{9}$$

, then the angle between the vectors $a\hat{i} + b\hat{j} + c\hat{k}$ and $b\hat{i} + c\hat{j} + a\hat{k}$ is :

- (A) 0
 (B) $\frac{\pi}{9}$
 (C) $\frac{2\pi}{3}$
 (D) $\frac{\pi}{2}$

6.

$\lim_{x \rightarrow a} \frac{(a+2x)^{\frac{1}{3}} - (3x)^{\frac{1}{3}}}{(3a+x)^{\frac{1}{3}} - (4x)^{\frac{1}{3}}}$
($a \neq 0$) is equal to :

- (A) $\left(\frac{2}{9}\right)\left(\frac{2}{3}\right)^{\frac{1}{3}}$
 (B) $\left(\frac{2}{3}\right)\left(\frac{2}{9}\right)^{\frac{1}{3}}$
 (C) $\left(\frac{2}{3}\right)^{\frac{4}{3}}$
 (D) $\left(\frac{2}{9}\right)^{\frac{4}{3}}$

7. The set of all real values of λ for which the quadratic equations,

$(\lambda^2 + 1)x^2 - 4\lambda x + 2 = 0$ always have exactly one root in the interval $(0, 1)$ is :

- (A) $(-3, -1)$ (B) $(2, 4]$
 (C) $(0, 2)$ (D) $(1, 3]$

8. Suppose $f(x)$ is a polynomial of degree four, having critical points at $-1, 0, 1$. If

$T = \{x \in \mathbb{R} \mid f(x) = f(0)\}$, then the sum of squares of all the elements of T is :

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

9. If a ΔABC has vertices $A(-1, 7)$, $B(-7, 1)$ and $C(5, -5)$, then its orthocentre has coordinates :

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

10. If the term independent of x in the expansion of

$$\left(\frac{3}{2}x^2 - \frac{1}{3x}\right)^9$$

is k , then $18k$ is equal to :

- (A) 5 (B) 9
 (C) 7 (D) 11

11. If the value of the integral

$$\int_0^{\frac{1}{2}} \frac{x^2}{(1-x^2)^{\frac{3}{2}}} dx$$

is $\frac{k}{6}$, then k is equal to :

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

12. The probability that a randomly chosen 5-digit number is made from exactly two digits is :

- (A) $\frac{150}{10^4}$
 (B) $\frac{134}{10^4}$
 (C) $\frac{121}{10^4}$
 (D) $\frac{135}{10^4}$

13. If $x^3 dy + xy dx = x^2 dy + 2y dx$; $y(2) = e$ and $x > 1$, then $y(4)$ is equal to :

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

14. If z_1, z_2 are complex numbers such that $\operatorname{Re}(z_1) = |z_1 - 1|$, $\operatorname{Re}(z_2) = |z_2 - 1|$, and $\arg(z_1 - z_2) = \frac{\pi}{6}$, then $\operatorname{Im}(z_1 + z_2)$ is equal to :

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

15. Let e_1 and e_2 be the eccentricities of the ellipse,

$$\frac{x^2}{25} + \frac{y^2}{b^2} = 1$$

($b < 5$) and the hyperbola,

$$\frac{x^2}{16} - \frac{y^2}{b^2} = 1$$

respectively satisfying $e_1 e_2 = 1$. If α and β are the distances between the foci of the ellipse and the foci of the hyperbola respectively, then the ordered pair (α, β) is equal to :

- (A) (8, 10)
 (B) (8, 12)
 (C) $\left(\frac{24}{5}, 10\right)$
 (D) $\left(\frac{20}{3}, 12\right)$

16. If

$$\int \sin^{-1}\left(\sqrt{\frac{x}{1+x}}\right) dx$$

$$= A(x)\tan^{-1}(\sqrt{x}) + B(x) + C,$$

where C is a constant of integration, then the ordered pair $(A(x), B(x))$ can be :

- (A) $(x + 1, -\sqrt{x})$ (B) $(x + 1, \sqrt{x})$
 (C) $(x - 1, -\sqrt{x})$ (D) $(x - 1, \sqrt{x})$

17. Let A be a 3×3 matrix such that $\operatorname{adj} A =$

$$\begin{bmatrix} 2 & -1 & 1 \\ -1 & 0 & 2 \\ 1 & -2 & -1 \end{bmatrix}$$

and $B = \operatorname{adj}(\operatorname{adj} A)$.

If $|A| = \lambda$ and $|(B^{-1})^T| = \mu$, then the ordered pair,

$(|\lambda|, \mu)$ is equal to :

- (A) (3, 81)
 (B) $\left(9, \frac{1}{9}\right)$
 (C) $\left(3, \frac{1}{81}\right)$
 (D) $\left(9, \frac{1}{81}\right)$

18. The plane which bisects the line joining, the points $(4, -2, 3)$ and $(2, 4, -1)$ at right angles also passes through the point :

- (A) (4, 0, 1) (B) (0, -1, 1)
 (C) (0, 1, -1) (D) (4, 0, -1)

19. If the sum of the series

$$20 + 19\frac{3}{5} + 19\frac{1}{5} + 18\frac{4}{5} + \dots$$

upto n th term is 488 and the n th term is negative, then :

- (A) $n = 41$ (B) $n = 60$
 (C) n th term is -4 (D) n th term is $-4\frac{2}{5}$

20. Let p, q, r be three statements such that the truth value of

$(p \wedge q) \rightarrow (\sim q \vee r)$ is F. Then the truth values of p, q, r are respectively :

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

21. Let S be the set of all integer solutions, (x, y, z), of the system of equations

$$x - 2y + 5z = 0$$

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

$$-7x + 14y + 9z = 0$$

such that $15 \leq x^2 + y^2 + z^2 \leq 150$. Then, the number of elements in the set S is equal to _____.

22. If m arithmetic means (A.Ms) and three geometric means (G.Ms) are inserted between 3 and 243 such that 4th A.M. is equal to 2nd G.M., then m is equal to _____.

23. The total number of 3-digit numbers, whose sum of digits is 10, is _____.

24. Let a plane P contain two lines

$$\vec{r} = \hat{i} + \lambda(\hat{i} + \hat{j})$$

, $\lambda \in R$ and

$$\vec{r} = -\hat{j} + \mu(\hat{j} - \hat{k})$$

,

$$\mu \in R$$

If $Q(\alpha, \beta, \gamma)$ is the foot of the perpendicular drawn from the point $M(1, 0, 1)$ to P, then $3(\alpha + \beta + \gamma)$ equals _____.

25. If the tangent to the curve, $y = e^x$ at a point (c, e^c) and the normal to the parabola, $y^2 = 4x$ at the point $(1, 2)$ intersect at the same point on the x-axis, then the value of c is _____.

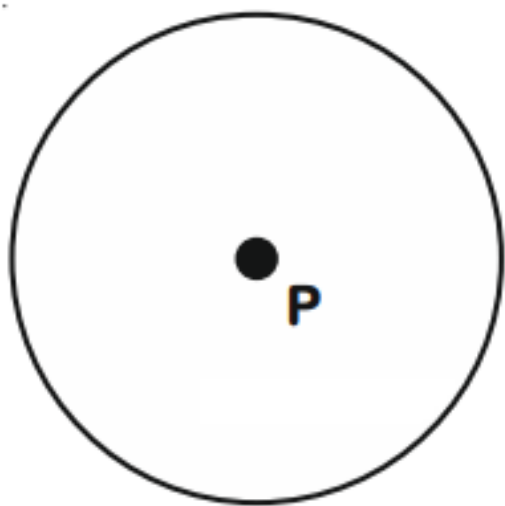
26. Hydrogen ion and singly ionized helium atom are accelerated, from rest, through the same potential difference. The ratio of final speeds of hydrogen and helium ions is close to :

- (A) 2 : 1 (B) 1 : 2
(C) 5 : 7 (D) 10 : 7

27. To raise the temperature of a certain mass of gas by 50°C at a constant pressure, 160 calories of heat is required. When the same mass of gas is cooled by 100°C at constant volume, 240 calories of heat is released. How many degrees of freedom does each molecule of this gas have (assume gas to be ideal)?

- (A) 6 (B) 7
(C) 5 (D) 3

28. A perfectly diamagnetic sphere has a small spherical cavity at its centre, which is filled with a paramagnetic substance. The whole system is placed in a uniform magnetic field $\vec{B}$. Then the field inside the paramagnetic substance is :



- (A) $\vec{B}$
(B) zero
(C) much large than $|\vec{B}|$ and parallel to $\vec{B}$
(D) much large than $|\vec{B}|$ but opposite to $\vec{B}$

29. Concentric metallic hollow spheres of radii R and $4R$ hold charges Q_1 and Q_2 respectively. Given that surface charge densities of the concentric spheres are equal, the potential difference $V(R) - V(4R)$ is :

- (A) $\frac{3Q_2}{4\pi\epsilon_0 R}$
(B) $\frac{3Q_1}{4\pi\epsilon_0 R}$
(C) $\frac{3Q_1}{16\pi\epsilon_0 R}$
(D) $\frac{Q_2}{4\pi\epsilon_0 R}$

30. A block of mass 1.9 kg is at rest at the edge of a table, of height 1 m. A bullet of mass 0.1 kg collides with the block and sticks to it. If the velocity of the bullet is 20 m/s in the horizontal direction just before the collision then the kinetic energy just before the combined system strikes the floor, is [Take $g = 10 \text{ m/s}^2$. Assume there is no rotational motion and loss of energy after the collision is negligible.]

- (A) 23 J (B) 21 J
(C) 20 J (D) 19 J

31. A calorimeter of water equivalent 20 g contains 180 g of water at 25°C . 'm' grams of steam at 100°C is mixed in it till the temperature of the mixture is 31°C . The value of 'm' is close to :

(Latent heat of water = 540 cal g^{-1} , specific heat of water = $1 \text{ cal g}^{-1} ^{\circ}\text{C}^{-1}$)

- (A) 2.6 (B) 2
(C) 4 (D) 3.2

32. Two light waves having the same wavelength λ in vacuum are in phase initially. Then the first wave travels a path L_1 through a medium of refractive index n_1 while the second wave travels a path of length L_2 through a medium of refractive index n_2 . After this the phase difference between the two waves is :

- (A) $\frac{2\pi}{\lambda}(n_1L_1 - n_2L_2)$
 (B) $\frac{2\pi}{\lambda}(n_2L_1 - n_1L_2)$
 (C) $\frac{2\pi}{\lambda}\left(\frac{L_1}{n_1} - \frac{L_2}{n_2}\right)$
 (D) $\frac{2\pi}{\lambda}\left(\frac{L_2}{n_1} - \frac{L_1}{n_2}\right)$

33. The electric field of a plane electromagnetic wave propagating along the x direction in vacuum is

$$\vec{E} = E_0 \hat{j} \cos(\omega t - kx)$$

The magnetic field $\vec{B}$, at the moment $t = 0$ is :

- (A) $\vec{B} = \frac{E_0}{\sqrt{\mu_0 \epsilon_0}} \cos(kx) \hat{j}$
 (B) $\vec{B} = \frac{E_0}{\sqrt{\mu_0 \epsilon_0}} \cos(kx) \hat{k}$
 (C) $\vec{B} = E_0 \sqrt{\mu_0 \epsilon_0} \cos(kx) \hat{k}$
 (D) $\vec{B} = E_0 \sqrt{\mu_0 \epsilon_0} \cos(kx) \hat{j}$

34. A uniform magnetic field B exists in a direction perpendicular to the plane of a square loop made of a metal wire. The wire has a diameter of 4 mm and a total length of 30 cm. The magnetic field changes with time at a steady rate $\frac{dB}{dt} = 0.032 \text{ Ts}^{-1}$. The induced current in the loop is close to (Resistivity of the metal wire is $1.23 \times 10^{-8} \Omega\text{m}$)

- (A) 0.53 A (B) 0.43 A
 (C) 0.34 A (D) 0.61 A

35. If a semiconductor photodiode can detect a photon with a maximum wavelength of 400 nm, then its band gap energy is :

Planck's constant $h = 6.63 \times 10^{-34} \text{ J.s}$. Speed of light $c = 3 \times 10^8 \text{ m/s}$

- (A) 1.5 eV (B) 2.0 eV
 (C) 3.1 eV (D) 1.1 eV

36. The mass density of a planet of radius R varies with the distance r from its centre as $\rho(r) =$

$$\rho_0 \left(1 - \frac{r^2}{R^2}\right)$$

Then the gravitational field is maximum at :

- (A) $r = \frac{1}{\sqrt{3}}R$
 (B) $r = R$
 (C) $r = \sqrt{\frac{3}{4}}R$
 (D) $r = \sqrt{\frac{5}{9}}R$

37. Amount of solar energy received on the earth's surface per unit area per unit time is defined as solar constant. Dimension of solar constant is :

- (A) MLT^{-2} (B) ML^0T^{-3}
 (C) $\text{M}^2\text{L}^0\text{T}^{-1}$ (D) ML^2T^{-2}

38. Two sources of light emit X-rays of wavelength 1 nm and visible light of wavelength 500 nm, respectively. Both the sources emit light of the same power 200 W. The ratio of the number density of photons of X-rays to the number density of photons of the visible light of the given wavelengths is :

- (A) $\frac{1}{500}$
 (B) 500
 (C) 250
 (D) $\frac{1}{250}$

39. Which of the following will NOT be observed when a multimeter (operating in resistance measuring mode) probes connected across a component, are just reversed?

- | | |
|--|---|
| (A) Multimeter shows NO deflection in both cases i.e. before and after reversing the probes if the chosen component is metal wire. | (B) Multimeter shows a deflection, accompanied by a splash of light out of connected component in one direction and NO deflection on reversing the probes if the chosen component is LED. |
| (C) Multimeter shows an equal deflection in both cases i.e. before and after reversing the probes if the chosen component is resistor. | (D) Multimeter shows NO deflection in both cases i.e. before and after reversing the probes if the chosen component is capacitor. |

40. The radius R of a nucleus of mass number A can be estimated by the formula

$$R = (1.3 \times 10^{-15})A^{1/3} \text{ m.}$$

It follows that the mass density of a nucleus is of the order of :

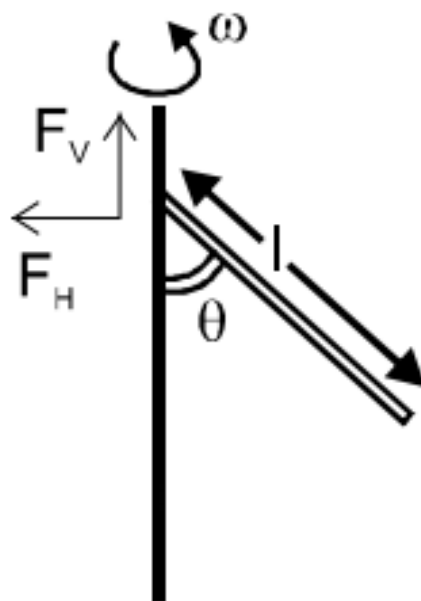
$$(M_{\text{prot.}} \cong M_{\text{neut}} \simeq 1.67 \times 10^{-27} \text{ kg})$$

- | | |
|---------------------------------|---------------------------------|
| (A) $10^{24} \text{ kg m}^{-3}$ | (B) $10^{10} \text{ kg m}^{-3}$ |
| (C) $10^{17} \text{ kg m}^{-3}$ | (D) 10^3 kg m^{-3} |

41. A uniform rod of length ' l ' is pivoted at one of its ends on a vertical shaft of negligible radius. When the shaft rotates at angular speed ω the rod makes an angle θ with it (see figure). To find θ equate the rate of change of angular momentum (direction going into the paper)

$$\frac{ml^2}{12}\omega^2 \sin \theta \cos \theta$$

about the centre of mass (CM) to the torque provided by the horizontal and vertical forces F_H and F_V about the CM. The value of θ is then such that :



- | | |
|-----|---------------------------------------|
| (A) | $\cos \theta = \frac{2g}{3l\omega^2}$ |
| (B) | $\cos \theta = \frac{3g}{2l\omega^2}$ |
| (C) | $\cos \theta = \frac{g}{2l\omega^2}$ |
| (D) | $\cos \theta = \frac{g}{l\omega^2}$ |

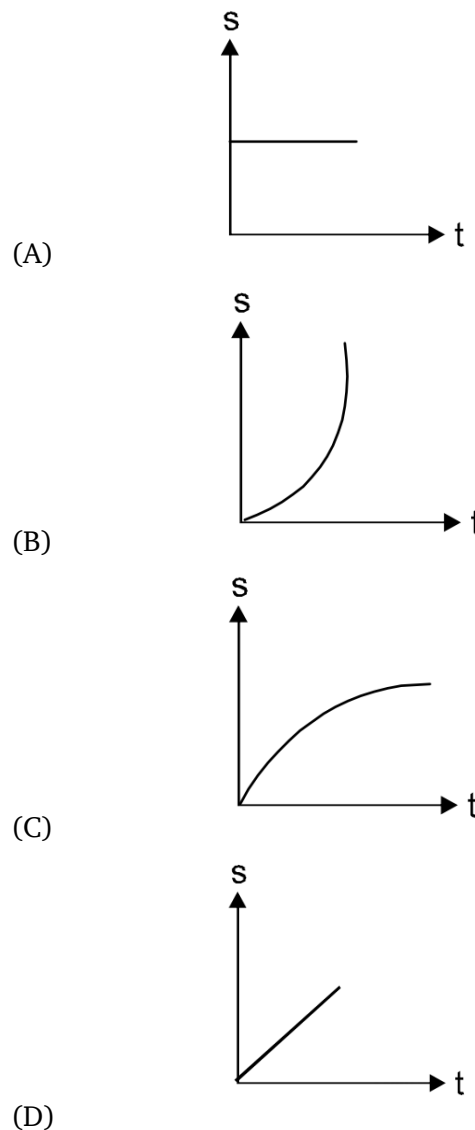
42. A block of mass m attached to a massless spring is performing oscillatory motion of amplitude 'A' on a frictionless horizontal plane. If half of the mass of the block breaks off when it is passing through its equilibrium point, the amplitude of oscillation for the remaining system become fA . The value of f is :

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

43. Two resistors 400Ω and 800Ω are connected in series across a 6 V battery. The potential difference measured by a voltmeter of $10\text{ k}\Omega$ across 400Ω resistor is close to :

- (A) 2.05 V (B) 1.95 V
 (C) 2 V (D) 1.8 V

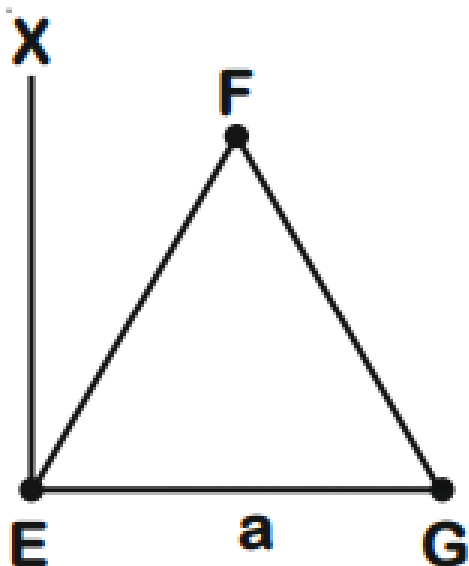
44. A particle is moving unidirectionally on a horizontal plane under the action of a constant power supplying energy source. The displacement (s) - time (t) graph that describes the motion of the particle is (graphs are drawn schematically and are not to scale) :



45. A metallic sphere cools from 50°C to 40° in 300 s. If atmospheric temperature around is 20°C , then the sphere's temperature after the next 5 minutes will be close to :

- (A) 35°C (B) 31°C
 (C) 33°C (D) 28°C

46. An massless equilateral triangle EFG of side 'a' (As shown in figure) has three particles of mass m situated at its vertices. The moment of inertia of the system about the line EX perpendicular to EG in the plane of EFG is $\frac{N}{20} ma^2$ where N is an integer. The value of N is _____.



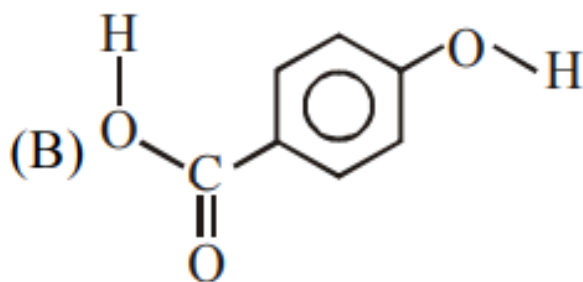
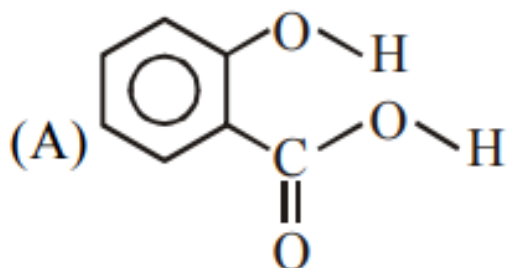
47. When an object is kept at a distance of 30 cm from a concave mirror, the image is formed at a distance of 10 cm from the mirror. If the object is moved with a speed of 9 cms^{-1} , the speed (in cms^{-1}) with which image moves at that instant is _____.

48. A galvanometer coil has 500 turns and each turn has an average area of $3 \times 10^{-4} \text{ m}^2$. If a torque of 1.5 Nm is required to keep this coil parallel to a magnetic field when a current of 0.5 A is flowing through it, the strength of the field (in T) is _____.

49. A block starts moving up an inclined plane of inclination 30° with an initial velocity of v_0 . It comes back to its initial position with velocity $\frac{v_0}{2}$. The value of the coefficient of kinetic friction between the block and the inclined plane is close to $\frac{I}{1000}$. The nearest integer to I is _____.

50. If minimum possible work is done by a refrigerator in converting 100 grams of water at 0°C to ice, how much heat (in calories) is released to the surroundings at temperature 27°C (Latent heat of ice = 80 Cal/gram) to the nearest integer ?

51. Consider the following molecules and statements related to them :



- (a) (B) is more likely to be crystalline than (A)
 (b) (B) has higher boiling point than (A)
 (c) (B) dissolves more readily than (A) in water
 Identify the correct option from below :

- (A) only (a) is true (B) (a), (b) and (c) are true
 (C) (b) and (c) are true (D) (a) and (b) are true

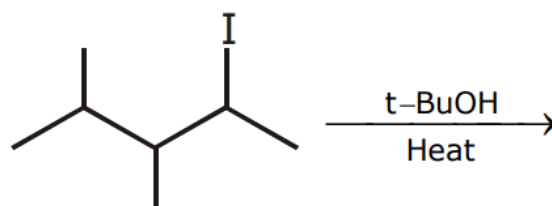
52. The five successive ionization enthalpies of an element are 800, 2427, 3658, 25024 and 32824 kJ mol⁻¹. The number of valence electrons in the element is :

- (A) 2 (B) 3
 (C) 4 (D) 5

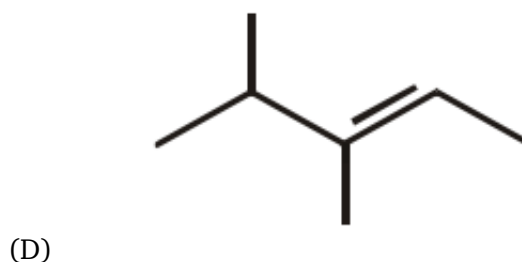
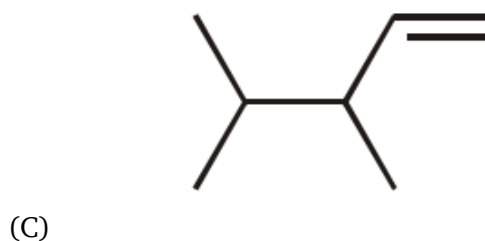
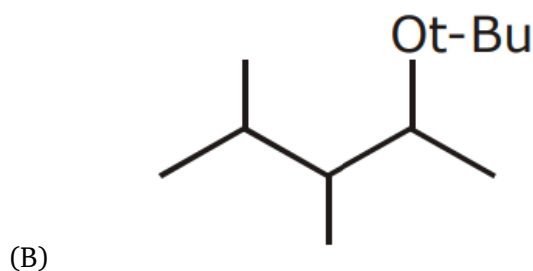
53. The strengths of 5.6 volume hydrogen peroxide (of density 1 g/mL) in terms of mass percentage and molarity (M), respectively, are: (Take molar mass of hydrogen peroxide as 34 g/mol)

- (A) 0.85 and 0.5 (B) 0.85 and 0.25
 (C) 1.7 and 0.25 (D) 1.7 and 0.5

54. The major product in the following reaction is :



(A)



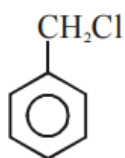
55. Among the statements (I – IV), the correct ones are:

- (I) Be has smaller atomic radius compared to Mg.
 (II) Be has higher ionization enthalpy than Al.
 (III) Charge/radius ratio of Be is greater than that of Al.

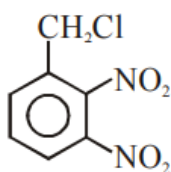
(IV) Both Be and Al form mainly covalent compounds.

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

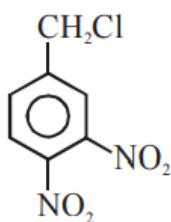
56. The decreasing order of reactivity of the following compounds towards nucleophilic substitution (S_N2) is :



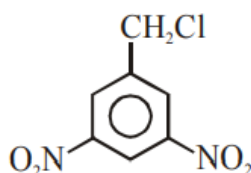
(I)



(II)



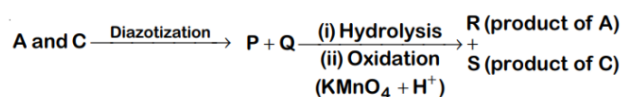
(III)



(IV)

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

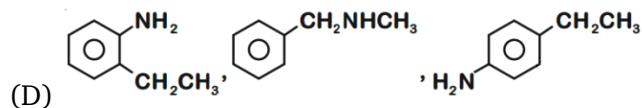
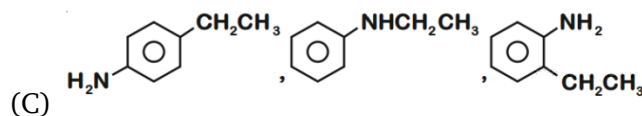
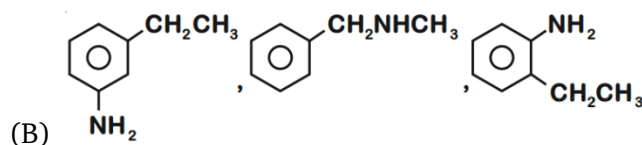
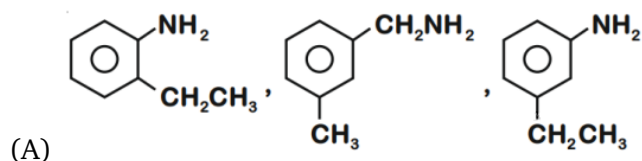
57. Three isomers A, B and C (mol. formula $C_8H_{11}N$) give the following results :



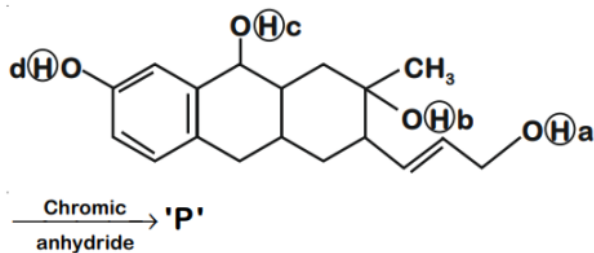
R has lower boiling point than S



A, B and C, respectively are :



58. Consider the following reaction :



The product 'P' gives positive ceric ammonium nitrate test. This is because of the presence of which of these -OH group(s)?

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

59. For the reaction

$2A + 3B + \frac{3}{2}C \rightarrow 3P$, which statement is correct ?

- (A) $\frac{dn_A}{dt} = \frac{dn_B}{dt} = \frac{dn_C}{dt}$
(B) $\frac{dn_A}{dt} = \frac{2}{3} \frac{dn_B}{dt} = \frac{3}{4} \frac{dn_C}{dt}$
(C) $\frac{dn_A}{dt} = \frac{3}{2} \frac{dn_B}{dt} = \frac{3}{4} \frac{dn_C}{dt}$
(D) $\frac{dn_A}{dt} = \frac{2}{3} \frac{dn_B}{dt} = \frac{4}{3} \frac{dn_C}{dt}$

60. Complex A has a composition of $H_{12}O_6Cl_3Cr$. If the complex on treatment with conc. H_2SO_4 loses 13.5% of its original mass, the correct molecular formula of A is :

[Given: atomic mass of Cr = 52 amu and Cl = 35 amu]

- (A) $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$
(B) $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$
(C) $[Cr(H_2O)_3Cl_3] \cdot 3H_2O$
(D) $[Cr(H_2O)_6]Cl_3$

61. The d-electron configuration of $[Ru(en)_3]Cl_2$ and $[Fe(H_2O)_6]Cl_2$, respectively are :

- (A) $t_{2g}^4 e_g^2$ and $t_{2g}^6 e_g^0$ (B) $t_{2g}^6 e_g^0$ and $t_{2g}^6 e_g^0$
(C) $t_{2g}^6 e_g^0$ and $t_{2g}^4 e_g^2$ (D) $t_{2g}^4 e_g^2$ and $t_{2g}^4 e_g^2$

62. The incorrect statement is :

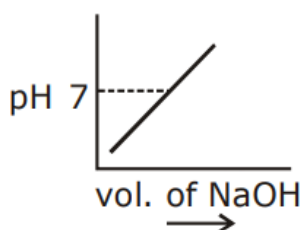
- (A) In manganate and permanganate ions, the p-bonding takes place by overlap of p-orbitals of oxygen and d-orbitals of manganese
(B) Manganate ion is green in colour and permanganate ion in purple in colour
(C) Manganate and permanganate ions are paramagnetic
(D) Manganate and permanganate ions are tetrahedral

63. The increasing order of the reactivity of the following compound in nucleophilic addition reaction is :

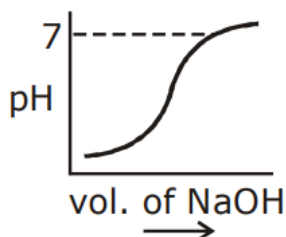
Propanal, Benzaldehyde, Propanone, Butanone

- (A) Butanone < Propanone < Benzaldehyde < Propanal
(B) Benzaldehyde < Butanone < Propanone < Propanal
(C) Propanal < Propanone < Butanone < Benzaldehyde
(D) Benzaldehyde < Propanal < Propanone < Butanone

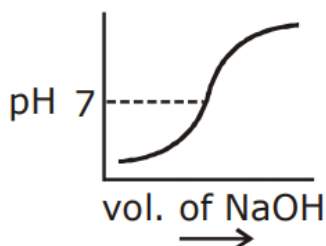
64. 100 mL of 0.1 M HCl is taken in a beaker and to it 100 mL of 0.1 M NaOH is added in steps of 2 mL and the pH is continuously measured. Which of the following graphs correctly depicts the change in pH?



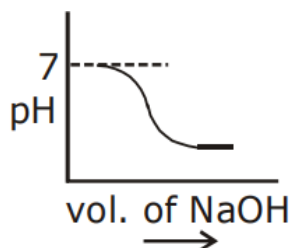
(A)



(B)



(C)

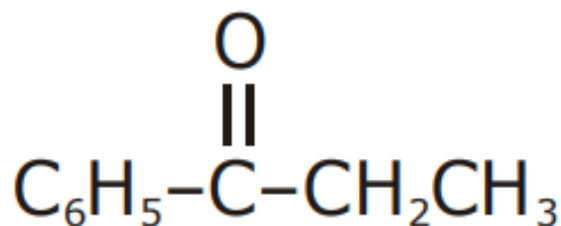
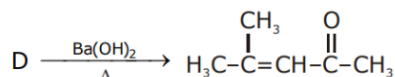
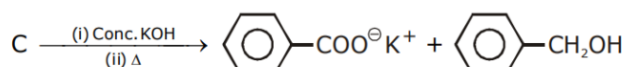
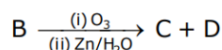
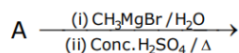


(D)

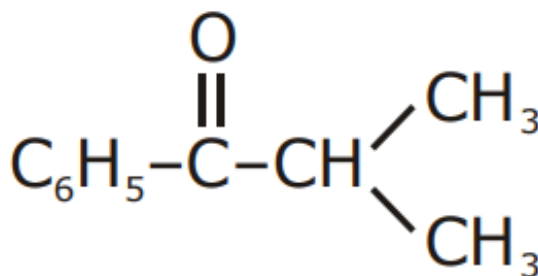
65. Consider the hypothetical situation where the azimuthal quantum number, l , takes values 0, 1, 2, ..., $n + 1$, where n is the principal quantum number. Then, the element with atomic number :

- | | |
|---|---------------------------------|
| (A) 13 has a half-filled valence subshell | (B) 9 is the first alkali metal |
| (C) 8 is the first noble gas | (D) 6 has a 2p-valence subshell |

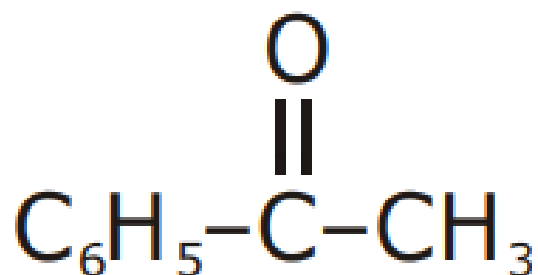
66. The compound A in the following reaction is :



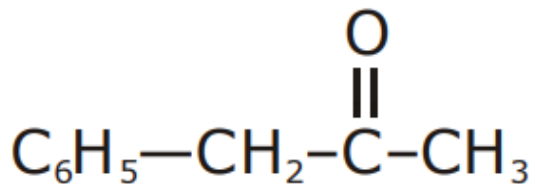
(A)



(B)



(C)



(D)

67. A mixture of one mole each of H_2 , He and O_2 each are enclosed in a cylinder of volume V at temperature T. If the partial pressure of H_2 is 2 atm, the total pressure of the gases in the cylinder is :

- (A) 14 atm (B) 38 atm
(C) 6 atm (D) 22 atm

68. The incorrect statement(s) among (a) – (d) regarding acid rain is (are) :

- (a) It can corrode water pipes.
(b) It can damage structures made up of stone.
(c) It cannot cause respiratory ailments in animals.
(d) It is not harmful for trees

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

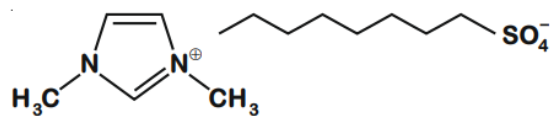
69. Match the following drugs with their therapeutic actions :

(i) Ranitidine	(a) Antidepressant
(ii) Nardil (Phenelzine)	(b) Antibiotic
(iii) Chloramphenicol	(c) Antihistamine
(iv) Dimetane (Brompheniramine)	(d) Antacid
	(e) Analgesic

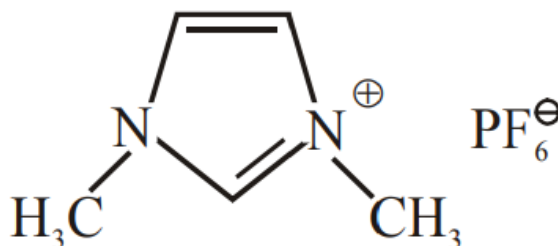
- (A) (i)-(a); (ii)-(c); (iii)-(b); (iv)-(e) (B) (i)-(e); (ii)-(a); (iii)-(c); (iv)-(d)
(C) (i)-(d); (ii)-(a); (iii)-(b); (iv)-(c) (D) (i)-(d); (ii)-(c); (iii)-(a); (iv)-(e)

70. An ionic micelle is formed on the addition of :

- (A) excess water to liquid



- (B) excess water to liquid



- (C) liquid diethyl ether to aqueous NaCl solution

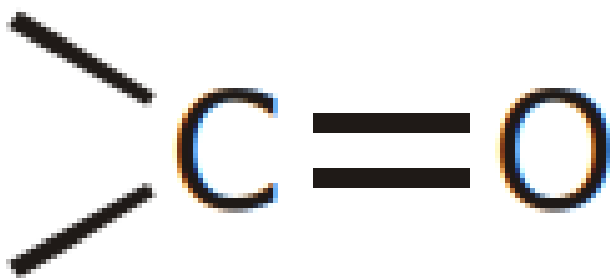
- (D) sodium stearate to pure toluene

Chemistry - Section B · Numerical Value Questions

71. 6.023×10^{22} molecules are present in 10 g of a substance 'x'. The molarity of a solution containing 5 g of substance 'x' in 2 L solution is _____ $\times 10^{-3}$

72. If 250 cm³ of an aqueous solution containing 0.73 g of a protein A is isotonic with one litre of another aqueous solution containing 1.65 g of a protein B, at 298 K, the ratio of the molecular masses of A and B is _____ $\times 10^{-2}$ (to the nearest integer).

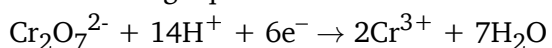
73. The number of



groups present in a tripeptide Asp–Glu–Lys is _____.

74. The volume (in mL) of 0.1 N NaOH required to neutralise 10 mL of 0.1 N phosphinic acid is _____.

75. An acidic solution of dichromate is electrolyzed for 8 minutes using 2A current. As per the following equation



The amount of Cr^{3+} obtained was 0.104 g. The efficiency of the process(in%) is (Take : $F = 96000 \text{ C}$, At. mass of chromium = 52) _____.

- End of Question Paper -