

# JEE Main 2020 Paper 1 (B.E./B.Tech) 8 January 2020 Shift 1 Question Paper



Conducted by the National Testing Agency (NTA)

Time Allowed: 3 Hours

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

Maximum Marks: 300

## General Instructions

- (i) This paper is **Paper 1 (B.E./B.Tech.)** of **JEE (Main) 2020 - Session 1**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 8 January 2020, Shift 1. The total duration is **3 hours**.
- (ii) The paper has **75 questions** and a maximum of **300 marks**: Mathematics, Physics and Chemistry carry 25 questions (100 marks) each, in that order.
- (iii) Each subject has **two sections**. **Section A** has **20 multiple choice questions** (MCQs) with four options each. Select the most appropriate answer. **Section B** has **5 numerical value questions**.
- (iv) **All questions are compulsory**. For Section B, 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 inverse function of  $f(x) =$

$$\frac{8^{2x} - 8^{-2x}}{8^{2x} + 8^{-2x}}$$

,  $x \in (-1, 1)$ , is :

- (A)  $\frac{1}{4} \log_e \left( \frac{1-x}{1+x} \right)$   
 (B)  $\frac{1}{4} (\log_8 e) \log_e \left( \frac{1-x}{1+x} \right)$   
 (C)  $\frac{1}{4} (\log_8 e) \log_e \left( \frac{1+x}{1-x} \right)$   
 (D)  $\frac{1}{4} \log_e \left( \frac{1+x}{1-x} \right)$

2. For which of the following ordered pairs  $(\mu, \delta)$ , the system of linear equations

$$x + 2y + 3z = 1$$

$$3x + 4y + 5z = \mu$$

$$4x + 4y + 4z = \delta$$

is inconsistent ?

- (A) (1, 0) (B) (4, 3)  
 (C) (4, 6) (D) (3, 4)

3. If

$$\int \frac{\cos x dx}{\sin^3 x (1 + \sin^6 x)^{2/3}} = f(x) (1 + \sin^6 x)^{1/\lambda} + c$$

where  $c$  is a constant of integration, then

$$\lambda f\left(\frac{\pi}{3}\right)$$

is equal to

- (A)  $\frac{9}{8}$   
 (B) 2  
 (C) -2  
 (D)  $-\frac{9}{8}$

4. Let A and B be two independent events such that

$$P(A) = \frac{1}{3} \text{ and } P(B) = \frac{1}{6}.$$

Then, which of the following is TRUE?

- (A)  $P\left(\frac{A}{A \cup B}\right) = \frac{1}{4}$   
 (B)  $P\left(\frac{A}{B}\right) = \frac{2}{3}$   
 (C)  $P\left(\frac{A'}{B'}\right) = \frac{1}{3}$   
 (D)  $P\left(\frac{A}{B'}\right) = \frac{1}{3}$

5. The locus of a point which divides the line segment joining the point (0, -1) and a point on the parabola,  $x^2 = 4y$ , internally in the ratio 1 : 2, is :

- (A)  $9x^2 - 3y = 2$  (B)  $4x^2 - 3y = 2$   
 (C)  $x^2 - 3y = 2$  (D)  $9x^2 - 12y = 8$

6. Let  $f(x) = x \cos^{-1}(-\sin|x|)$ ,  
 $x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

, then which of the following is true?

- (A)  $f'$  is decreasing in  $\left(-\frac{\pi}{2}, 0\right)$   
 and increasing in  $\left(0, \frac{\pi}{2}\right)$   
 (B)  $f'(0) = -\frac{\pi}{2}$   
 (C)  $f$  is not differentiable at  $x = 0$   
 (D)  $f'$  is increasing in  $\left(-\frac{\pi}{2}, 0\right)$   
 and decreasing in  $\left(0, \frac{\pi}{2}\right)$

7.

$$\lim_{x \rightarrow 0} \left( \frac{3x^2 + 2}{7x^2 + 2} \right)^{\frac{1}{x^2}}$$

is equal to

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

8. Let two points be A(1, -1) and B(0, 2). If a point P(x', y') be such that the area of  $\Delta PAB = 5$  sq. units and it lies on the line,  $3x + y - 4\lambda = 0$ , then a value of  $\lambda$  is :

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

9. Let  $f : \mathbf{R} \rightarrow \mathbf{R}$  be such that for all  $x \in \mathbf{R}$  ( $2^{1+x} + 2^{1-x}$ ),  $f(x)$  and  $(3^x + 3^{-x})$  are in A.P., then the minimum value of  $f(x)$  is

- (A) 2  
(B) 0  
(C) 3  
(D) 4

10. The mean and the standard deviation (s.d.) of 10 observations are 20 and 2 respectively. Each of these 10 observations is multiplied by p and then reduced by q, where  $p \neq 0$  and  $q \neq 0$ . If the new mean and new s.d. become half of their original values, then q is equal to

- (A) 10  
(B) -20  
(C) -10  
(D) -5

11. For  $a > 0$ , let the curves  $C_1 : y^2 = ax$  and  $C_2 : x^2 = ay$  intersect at origin O and a point P. Let the line  $x = b$  ( $0 < b < a$ ) intersect the chord OP and the x-axis at points Q and R, respectively. If the line  $x = b$  bisects the area bounded by the curves,  $C_1$  and  $C_2$ , and the area of  $\Delta OQR = \frac{1}{2}$ , then 'a' satisfies the equation :

- (A)  $x^6 - 12x^3 + 4 = 0$   
(B)  $x^6 - 12x^3 - 4 = 0$   
(C)  $x^6 + 6x^3 - 4 = 0$   
(D)  $x^6 - 6x^3 + 4 = 0$

12. Let  $f(x) = (\sin(\tan^{-1}x) + \sin(\cot^{-1}x))^2 - 1$ ,  $|x| > 1$ .  
If

$$\frac{dy}{dx} = \frac{1}{2} \frac{d}{dx} (\sin^{-1}(f(x)))$$

and

$$y(\sqrt{3}) = \frac{\pi}{6}$$

, then  $y(-\sqrt{3})$  is equal to :

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

13. The shortest distance between the lines

$$\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$$

and

$$\frac{x+3}{-3} = \frac{y+7}{2} = \frac{z-6}{4}$$

is :

- (A) 3  
(B)  $\frac{7}{2}\sqrt{30}$   
(C)  $3\sqrt{30}$   
(D)  $2\sqrt{30}$

14. If a, b and c are the greatest value of  ${}^{19}C_p$ ,  ${}^{20}C_q$  and  ${}^{21}C_r$  respectively, then :

- (A)  $\frac{a}{11} = \frac{b}{22} = \frac{c}{21}$   
(B)  $\frac{a}{10} = \frac{b}{22} = \frac{c}{21}$   
(C)  $\frac{a}{10} = \frac{b}{11} = \frac{c}{42}$   
(D)  $\frac{a}{11} = \frac{b}{22} = \frac{c}{42}$

15. Let  $y = y(x)$  be a solution of the differential equation,

$$\sqrt{1-x^2} \frac{dy}{dx} + \sqrt{1-y^2} = 0$$

,  $|x| < 1$ .

If

$$y\left(\frac{1}{2}\right) = \frac{\sqrt{3}}{2}$$

, then

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

is equal to :

(A)  $-\frac{\sqrt{3}}{2}$

(B) None of those

(C)  $\frac{1}{\sqrt{2}}$

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

16. If the equation,  $x^2 + bx + 45 = 0$  ( $b \in \mathbb{R}$ ) has conjugate complex roots and they satisfy  $|z + 1| = 2\sqrt{10}$ , then :

(A)  $b^2 - b = 42$  (B)  $b^2 + b = 12$

(C)  $b^2 + b = 72$  (D)  $b^2 - b = 30$

17. If  $c$  is a point at which Rolle's theorem holds for the function,

$f(x) =$

$$\log_e \left( \frac{x^2 + \alpha}{7x} \right)$$

in the interval  $[3, 4]$ , where  $a \in \mathbb{R}$ , then  $f''(c)$  is equal to

(A)  $\frac{1}{12}$

(B)  $\frac{\sqrt{3}}{7}$

(C)  $-\frac{1}{12}$

(D)  $-\frac{1}{24}$

18. Let the line  $y = mx$  and the ellipse  $2x^2 + y^2 = 1$  intersect at a point  $P$  in the first quadrant. If the normal to this ellipse at  $P$  meets the co-ordinate axes at

$$\left( -\frac{1}{3\sqrt{2}}, 0 \right)$$

and  $(0, \beta)$ , then  $\beta$  is equal to :

(A)  $\frac{\sqrt{2}}{3}$

(B)  $\frac{2}{3}$

(C)  $\frac{2\sqrt{2}}{3}$

(D)  $\frac{2}{\sqrt{3}}$

19. Which one of the following is a tautology?

(A)  $P \wedge (P \vee Q)$

(B)  $P \vee (P \wedge Q)$

(C)  $Q \rightarrow (P \wedge (P \rightarrow Q))$

(D)  $(P \wedge (P \rightarrow Q)) \rightarrow Q$

20. Let the volume of a parallelepiped whose coterminal edges are given by

$$\vec{u} = \hat{i} + \hat{j} + \lambda \hat{k}$$

,

$$\vec{v} = \hat{i} + \hat{j} + 3\hat{k}$$

and

$$\vec{w} = 2\hat{i} + \hat{j} + \hat{k}$$

be 1 cu. unit. If  $\theta$  be the angle between the edges  $\vec{u}$  and  $\vec{w}$ , then  $\cos \theta$  can be :

(A)  $\frac{7}{6\sqrt{3}}$

(B)  $\frac{7}{6\sqrt{6}}$

(C)  $\frac{5}{7}$

(D)  $\frac{5}{3\sqrt{3}}$

21. The least positive value of 'a' for which the equation

$$2x^2 + (a - 10)x + \frac{33}{2} = 2a \text{ has real roots is}$$

22. The number of all  $3 \times 3$  matrices A, with entries from the set  $\{-1, 0, 1\}$  such that the sum of the diagonal elements of  $AA^T$  is 3, is

23. An urn contains 5 red marbles, 4 black marbles and 3 white marbles. Then the number of ways in which 4 marbles can be drawn so that at the most three of them are red is \_\_\_\_\_.

24. Let the normal at a point P on the curve  $y^2 - 3x^2 + y + 10 = 0$  intersect the y-axis at

$$\left(0, \frac{3}{2}\right)$$

If m is the slope of the tangent at P to the curve, then  $|m|$  is equal to

25. The sum

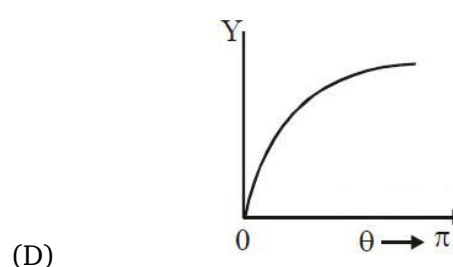
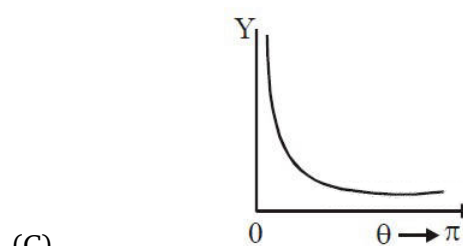
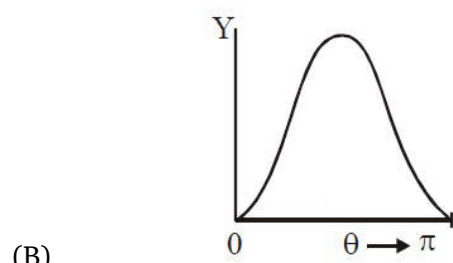
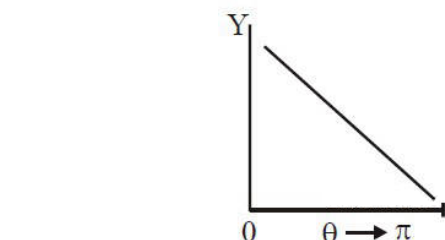
$$\sum_{k=1}^{20} (1 + 2 + 3 + \dots + k)$$

is :

26. The graph which depicts the results of Rutherford gold foil experiment with  $\alpha$ -particles is :

$\theta$  : Scattering angle

Y : Number of scattered  $\alpha$ -particles detected  
(Plots are schematic and not to scale)



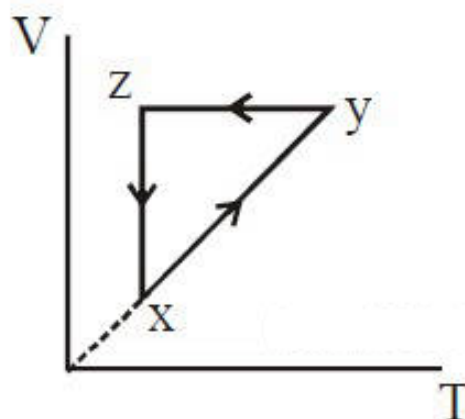
27. The critical angle of a medium for a specific wavelength, if the medium has relative permittivity 3 and relative permeability  $\frac{4}{3}$  for this wavelength, will be :

- (A)  $45^\circ$  (B)  $15^\circ$   
(C)  $30^\circ$  (D)  $60^\circ$

28. Effective capacitance of parallel combination of two capacitors  $C_1$  and  $C_2$  is  $10 \mu\text{F}$ . When these capacitors are individually connected to a voltage source of 1V, the energy stored in the capacitor  $C_2$  is 4 times that of  $C_1$ . If these capacitors are connected in series, their effective capacitance will be :

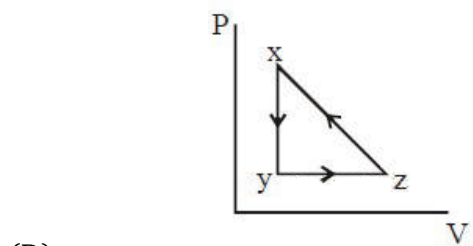
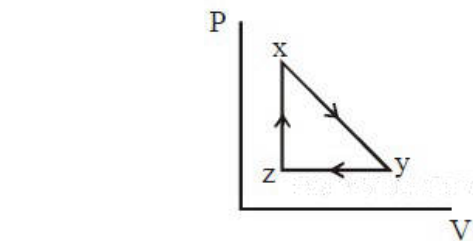
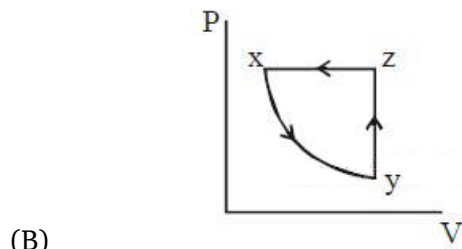
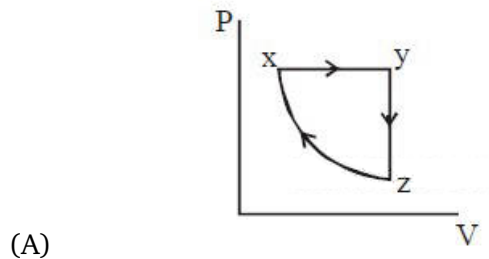
- (A)  $4.2 \mu\text{F}$  (B)  $8.4 \mu\text{F}$   
(C)  $1.6 \mu\text{F}$  (D)  $3.2 \mu\text{F}$

29. A thermodynamic cycle  $xyzx$  is shown on a V-T diagram.



The P-V diagram that best describes this cycle is :  
(Diagrams are schematic and not to scale)

29. (continued)



30. In finding the electric field using Gauss Law the formula

$$|\vec{E}| = \frac{q_{enc}}{\epsilon_0 |A|}$$

is applicable. In the formula  $\epsilon_0$  is permittivity of free space,  $A$  is the area of Gaussian surface and  $q_{enc}$  is charge enclosed by the Gaussian surface. The equation can be used in which of the following situation?

- (A) Only when  $|\vec{E}| =$  constant on the surface.
- (B) For any choice of Gaussian surface.
- (C) Only when the Gaussian surface is an equipotential surface.
- (D) Only when the Gaussian surface is an equipotential surface and  $|\vec{E}|$  is constant on the surface.

31. Consider a solid sphere of radius  $R$  and mass density

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

,

$$0 < r \leq R$$

The minimum density of a liquid in which it will float is :

- (A)  $\frac{2\rho_0}{3}$
- (B)  $\frac{2\rho_0}{5}$
- (C)  $\frac{\rho_0}{5}$
- (D)  $\frac{\rho_0}{3}$

**32.** The dimension of stopping potential  $V_0$  in photoelectric effect in units of Planck's constant 'h', speed of light 'c' and Gravitational constant 'G' and ampere A is :

- (A)  $h^{1/3} G^{2/3} c^{1/3} A^{-1}$  (B)  $h^0 c^5 G^{-1} A^{-1}$   
 (C)  $h^{2/3} c^{5/3} G^{1/3} A^{-1}$  (D)  $h^2 G^{3/2} c^{1/3} A^{-1}$

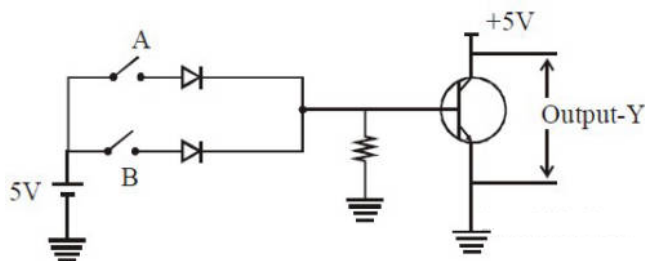
**33.** Consider a uniform rod of mass  $M = 4m$  and length  $\ell$  pivoted about its centre. A mass  $m$  moving with velocity  $v$  making angle

$$\theta = \frac{\pi}{4}$$

to the rod's long axis collides with one end of the rod and sticks to it. The angular speed of the rod-mass system just after the collision is :

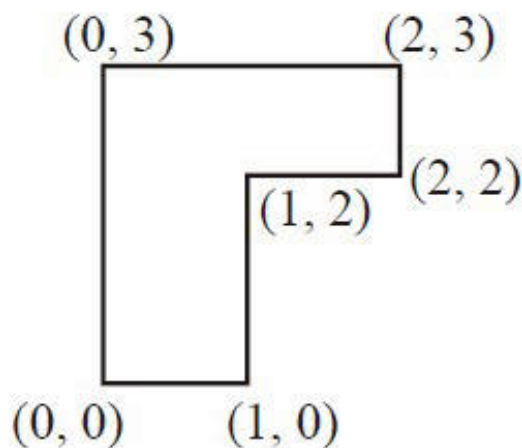
- (A)  $\frac{3\sqrt{2} v}{7 \ell}$   
 (B)  $\frac{3 v}{7 \ell}$   
 (C)  $\frac{3 v}{7\sqrt{2} \ell}$   
 (D)  $\frac{4 v}{7 \ell}$

**34.** Boolean relation at the output stage-Y for the following circuit is :



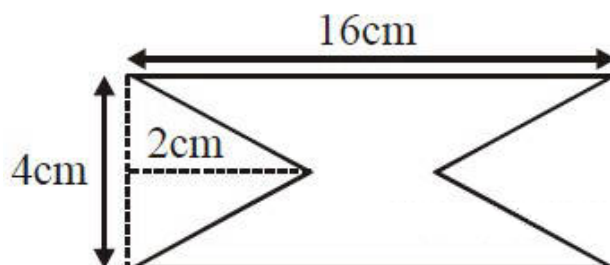
- (A) A.B  
 (B)  $A + B$   
 (C)  $A.B$   
 (D)  $A + B$

**35.** The coordinates of centre of mass of a uniform flag shaped lamina (thin flat plate) of mass 4kg. (The coordinates of the same are shown in figure) are :



- (A) (0.75m, 1.75m) (B) (1m, 1.75m)  
 (C) (0.75m, 0.75m) (D) (1.25m, 1.50m)

**36.** At time  $t = 0$  magnetic field of 1000 Gauss is passing perpendicularly through the area defined by the closed loop shown in the figure. If the magnetic field reduces linearly to 500 Gauss, in the next 5s, then induced EMF in the loop is :

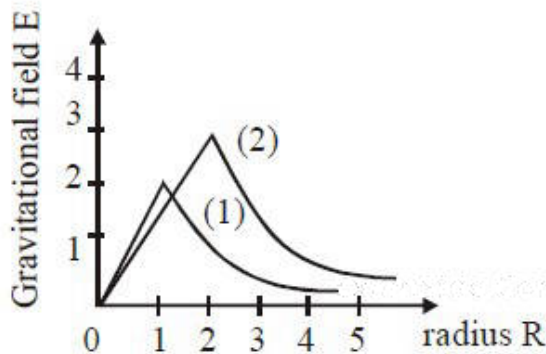


- (A) 48  $\mu V$  (B) 28  $\mu V$   
 (C) 56  $\mu V$  (D) 36  $\mu V$

37. The magnifying power of a telescope with tube 60 cm is 5. What is the focal length of its eye piece ?

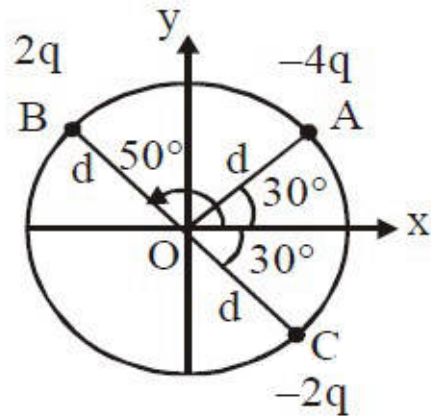
- (A) 40 cm (B) 10 cm  
(C) 30 cm (D) 20 cm

38. Consider two solid spheres of radii  $R_1 = 1\text{m}$ ,  $R_2 = 2\text{m}$  and masses  $M_1$  and  $M_2$ , respectively. The gravitational field due to sphere (1) and (2) are shown. The value of  $\frac{M_1}{M_2}$  is :



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

39. Three charged particle A, B and C with charges  $-4q$ ,  $2q$  and  $-2q$  are present on the circumference of a circle of radius  $d$ . the charged particles A, C and centre O of the circle formed an equilateral triangle as shown in figure. Electric field at O along x-direction is :



- (A)  $\frac{3\sqrt{3} q}{4\pi\epsilon_0 d^2}$   
(B)  $\frac{\sqrt{3} q}{4\pi\epsilon_0 d^2}$   
(C)  $\frac{\sqrt{3} q}{\pi\epsilon_0 d^2}$   
(D)  $\frac{2\sqrt{3} q}{\pi\epsilon_0 d^2}$

40. A leak proof cylinder of length 1m, made of a metal which has very low coefficient of expansion is floating vertically in water at  $0^\circ\text{C}$  such that its height above the water surface is 20 cm. When the temperature of water is increased to  $4^\circ\text{C}$ , the height of the cylinder above the water surface becomes 21 cm. The density of water at  $T = 4^\circ\text{C}$ , relative to the density at  $T = 0^\circ\text{C}$  is close to :

- (A) 1.04 (B) 1.26  
(C) 1.01 (D) 1.03

41. A particle of mass  $m$  is fixed to one end of a light spring having force constant  $k$  and unstretched length  $\ell$ . The other end is fixed. The system is given an angular speed  $\omega$  about the fixed end of the spring such that it rotates in a circle in gravity free space. Then the stretch in the spring is :

- (A)  $\frac{m\ell\omega^2}{k - m\omega^2}$   
 (B)  $\frac{m\ell\omega^2}{k - m\omega}$   
 (C)  $\frac{m\ell\omega^2}{k + m\omega^2}$   
 (D)  $\frac{m\ell\omega^2}{k + m\omega}$

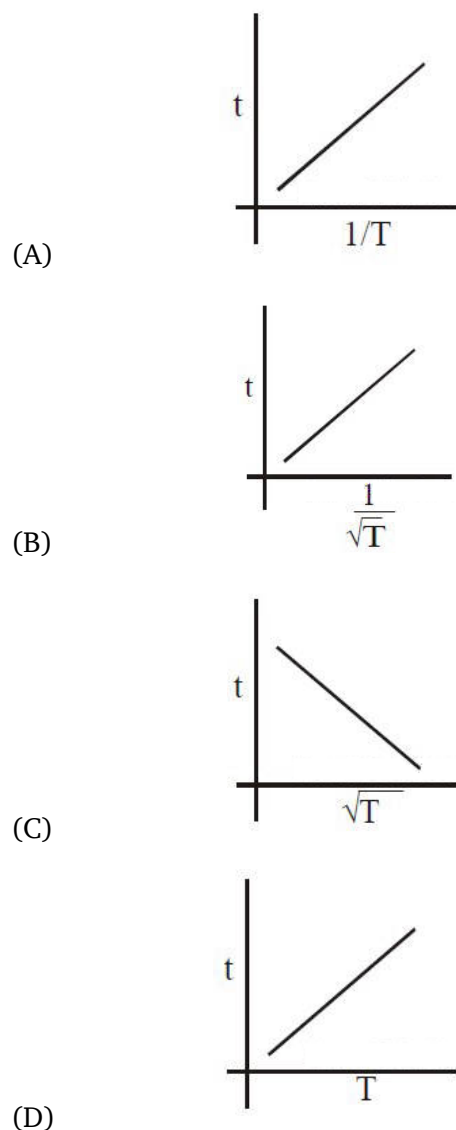
42. When photon of energy 4.0 eV strikes the surface of a metal A, the ejected photoelectrons have maximum kinetic energy  $T_A$  eV and de-Broglie wavelength  $\lambda_A$ . The maximum kinetic energy of photoelectrons liberated from another metal B by photon of energy 4.50 eV is  $T_B = (T_A - 1.5)$  eV. If the de-Broglie wavelength of these photoelectrons  $\lambda_B = 2\lambda_A$ , then the work function of metal B is :

- (A) 1.5eV (B) 4eV  
 (C) 2eV (D) 3eV

43. Photon with kinetic energy of 1MeV moves from south to north. It gets an acceleration of  $10^{12} \text{ m/s}^2$  by an applied magnetic field (west to east). The value of magnetic field : (Rest mass of proton is  $1.6 \times 10^{-27} \text{ kg}$ ) :

- (A) 0.71mT (B) 7.1mT  
 (C) 0.071mT (D) 71mT

44. The plot that depicts the behavior of the mean free time  $t$  (time between two successive collisions) for the molecules of an ideal gas, as a function of temperature ( $T$ ), qualitatively, is: (Graphs are schematic and not drawn to scale)



45. The length of a potentiometer wire is 1200 cm and it carries a current of 60 mA. For a cell of emf 5V and internal resistance of  $20\Omega$ , the null point on it is found to be a 1000 cm. The resistance of whole wire is :

- (A)  $80\Omega$  (B)  $60\Omega$   
 (C)  $120\Omega$  (D)  $100\Omega$

46. A particle is moving along the x-axis with its coordinate with the time 't' given by

$x(t) = 10 + 8t - 3t^2$ . Another particle is moving the y-axis with its coordinate as a function of time given by  $y(t) = 5 - 8t^3$ .

At  $t = 1$  s, the speed of the second particle as measured in the frame of the first particle is given as  $\sqrt{v}$ . Then  $v$  (in m/s) is \_\_\_\_\_.

47. A point object in air is in front of the curved surface of a plano-convex lens. The radius of curvature of the curved surface is 30 cm and the refractive index of the lens material is 1.5, then the focal length of the lens (in cm) is \_\_\_\_\_.

48. A one metre long (both ends open) organ pipe is kept in a gas that has double the density of air at STP. Assuming the speed of sound in air at STP is 300 m/s, the frequency difference between the fundamental and second harmonic of this pipe is \_\_\_\_\_ Hz.

49. A body A, of mass  $m = 0.1$  kg has an initial velocity of  $3\hat{i}$  ms<sup>-1</sup>. It collides elastically with another body, B of the same mass which has an initial velocity of  $5\hat{j}$  ms<sup>-1</sup>. After collision, A moves with a velocity

$$\vec{v} = 4(\hat{i} + \hat{j})$$

. The energy of B after collision is written as  $\frac{x}{10}$ . The value of  $x$  is \_\_\_\_\_.

50. Four resistances of  $15\Omega$ ,  $12\Omega$ ,  $4\Omega$  and  $10\Omega$  respectively in cyclic order to form Wheatstone's network. The resistance that is to be connected in parallel with the resistance of  $10\Omega$  to balance the network is \_\_\_\_\_  $\Omega$ .

51. Arrange the following compounds in increasing order of C–OH bond length :  
methanol, phenol, p-ethoxyphenol

- (A) phenol < methanol < p-ethoxyphenol  
(B) methanol < p-ethoxyphenol < phenol  
(C) methanol < phenol < p-ethoxyphenol  
(D) phenol < p-ethoxyphenol < methanol

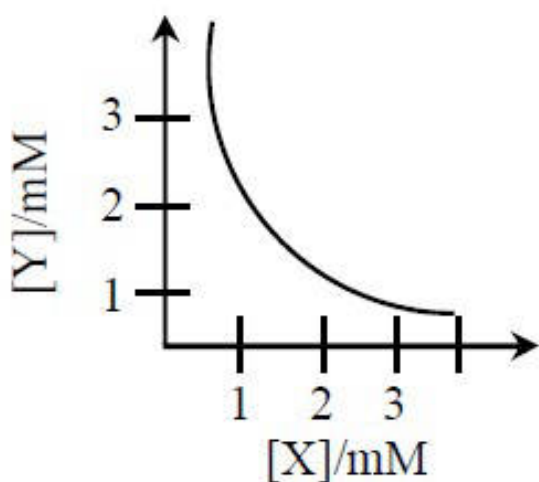
52. The complex that can show fac- and mer-isomers is :

- (A)  $[\text{CoCl}_2(\text{en})_2]$  (B)  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$   
(C)  $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$  (D)  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$

53. The rate of a certain biochemical reaction at physiological temperature (T) occurs  $10^6$  times faster with enzyme than without. The change in the activation energy upon adding enzyme is :

- (A)  $+6RT$  (B)  $-6(2.303)RT$   
(C)  $-6RT$  (D)  $+6(2.303)RT$

54. The stoichiometry and solubility product of a salt with the solubility curve given below is, respectively :

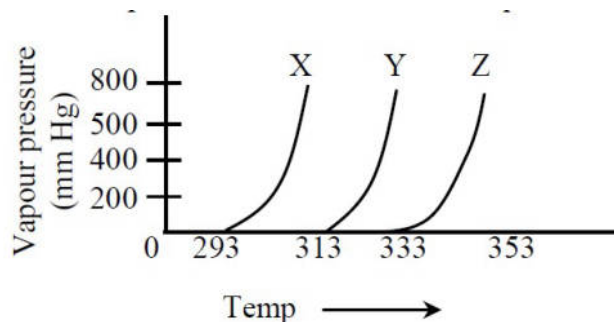


- (A)  $\text{XY}, 2 \times 10^{-6} \text{ M}^3$  (B)  $\text{XY}_2, 1 \times 10^{-9} \text{ M}^3$   
(C)  $\text{XY}_2, 4 \times 10^{-9} \text{ M}^3$  (D)  $\text{X}_2\text{Y}, 2 \times 10^{-9} \text{ M}^3$

55. The third ionization enthalpy is minimum for :

- (A) Ni (B) Co  
(C) Mn (D) Fe

56. A graph of vapour pressure and temperature for three different liquids X, Y, and Z is shown below :



The following inferences are made :

- (A) X has higher intermolecular interactions compared to Y.  
(B) X has lower intermolecular interactions compared to Y.  
(C) Z has lower intermolecular interactions compared to Y.

The correct inference (s) is / are :

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

57. Which of the following statement is not true for glucose?

- (A) Glucose gives Schiff's test for aldehyde (B) Glucose reacts with hydroxylamine to form oxime  
(C) The pentaacetate of glucose does not react with hydroxylamine to give oxime (D) Glucose exists in two crystalline forms  $\alpha$  and  $\beta$

58. The predominant intermolecular forces present in ethyl acetate, a liquid, are:

- |                                                           |                                            |
|-----------------------------------------------------------|--------------------------------------------|
| (A) Dipole-dipole and hydrogen bonding                    | (B) hydrogen bonding and London dispersion |
| (C) London dispersion, dipole-dipole and hydrogen bonding | (D) London dispersion and dipole-dipole    |

59. A flask contains a mixture of isohexane and 3-methylpentane. One of the liquids boils at 63°C while the other boils at 60°C. What is the best way to separate the two liquids and which one will be distilled out first?

- |                                              |                                          |
|----------------------------------------------|------------------------------------------|
| (A) fractional distillation, 3-methylpentane | (B) simple distillation, 3-methylpentane |
| (C) fractional distillation, isohexane       | (D) simple distillation, isohexane       |

60. For the Balmer series in the spectrum of H atom,

$$\nu = R_H \left\{ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right\}$$

, the correct statements among (I) to (IV) are :

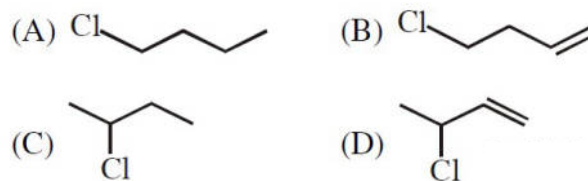
- (I) As wavelength decreases, the lines in the series converge  
 (II) The integer  $n_1$  is equal to 2  
 (III) The lines of longest wavelength corresponds to  $n_2 = 3$   
 (IV) The ionization energy of hydrogen can be calculated from wave number of these lines

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

61. The first ionization energy (in kJ/mol) of Na, Mg, Al and Si respectively, are :

- |                        |                        |
|------------------------|------------------------|
| (A) 496, 577, 786, 737 | (B) 496, 737, 577, 786 |
| (C) 786, 737, 577, 496 | (D) 496, 577, 737, 786 |

62. The decreasing order of reactivity towards dehydrohalogenation ( $E_1$ ) reaction of the following compounds is :

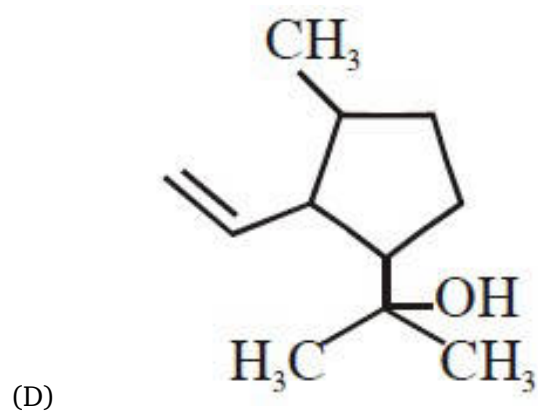
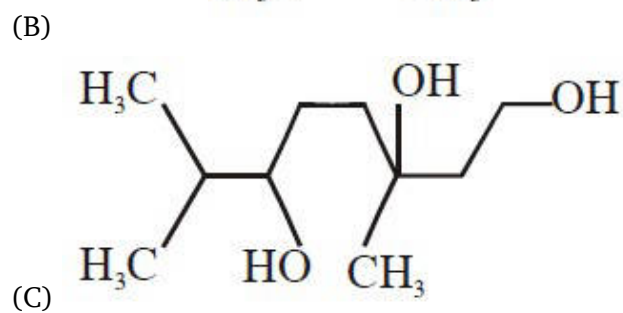
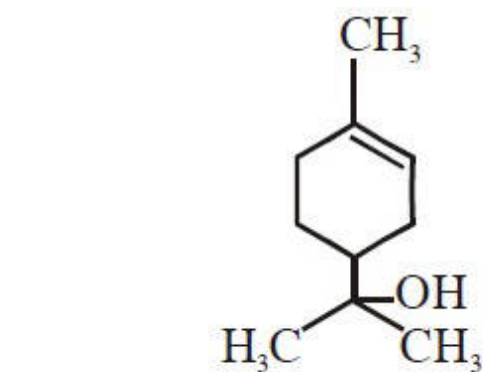
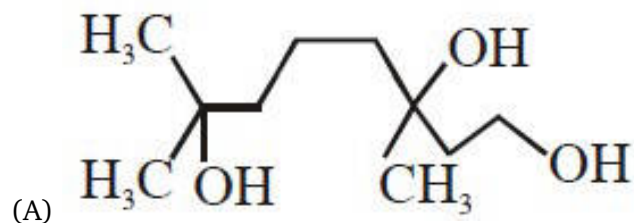
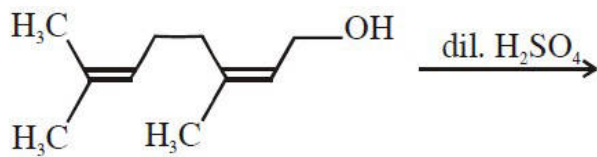


- |       |   |
|-------|---|
| (A) B | > |
| D     | > |
| A     | > |
| C     | > |
| (B) D | > |
| B     | > |
| C     | > |
| A     | > |
| (C) B | > |
| A     | > |
| D     | > |
| C     | > |
| (D) B | > |
| D     | > |
| C     | > |
| A     | > |

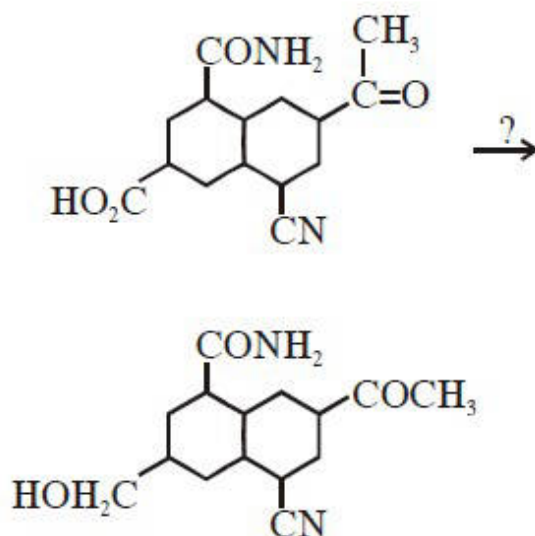
63. The strength of an aqueous NaOH solution is most accurately determined by titrating :  
 (Note : consider that an appropriate indicator is used)

- |                                                                                  |                                                                         |
|----------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| (A) Aq. NaOH in a pipette and aqueous oxalic acid in a burette                   | (B) Aq. NaOH in a burette and aqueous oxalic acid in a conical flask    |
| (C) Aq. NaOH in a volumetric flask and concentrated $H_2SO_4$ in a conical flask | (D) Aq. NaOH in a burette and concentrated $H_2SO_4$ in a conical flask |

64. The major product of the following reaction is :



65. The most suitable reagent for the given conversion is :



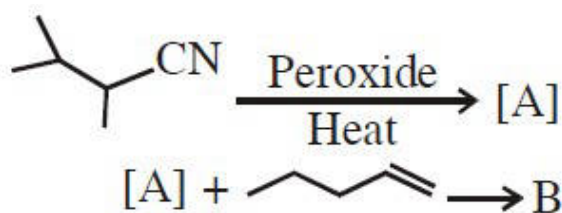
(A)  $\text{LiAlH}_4$

(B)  $\text{B}_2\text{H}_6$

(C)  $\text{NaBH}_4$

(D)  $\text{H}_2/\text{Pd}$

66. The major products A and B in the following reactions are :



- (A)  $\text{A} = \text{Isobutyl-CN}^\bullet$  and  $\text{B} = \text{1-cyano-4-methylhexane}$
- (B)  $\text{A} = \text{Isobutyl-CN}^\bullet$  and  $\text{B} = \text{2-cyano-4-methylhexane}$
- (C)  $\text{A} = \text{Isobutyl-CN}^\bullet$  and  $\text{B} = \text{1-cyano-2,4-dimethylhexane}$
- (D)  $\text{A} = \text{Isobutyl-CN}^\bullet$  and  $\text{B} = \text{2-cyano-2,4-dimethylhexane}$

67. When gypsum is heated to 393 K, it forms :

- (A)  $\text{CaSO}_4 \cdot 0.5\text{H}_2\text{O}$       (B)  $\text{CaSO}_4 \cdot 5\text{H}_2\text{O}$   
 (C) Dead burnt plaster      (D) Anhydrous  $\text{CaSO}_4$

68. The number of bonds between sulphur and oxygen atoms in  $\text{S}_2\text{O}_8^{2-}$  and the number of bonds between sulphur and sulphur atoms in rhombic sulphur, respectively, are :

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

69. As per Hardy-Schulze formulation, the flocculation values of the following for ferric hydroxide sol are in the order :

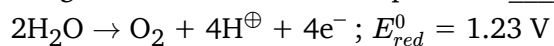
- (A)  $\text{AlCl}_3 > \text{K}_3[\text{Fe}(\text{CN})_6] > \text{K}_2\text{CrO}_4 > \text{KBr} = \text{KNO}_3$       (B)  $\text{K}_3[\text{Fe}(\text{CN})_6] < \text{K}_2\text{CrO}_4 < \text{KBr} = \text{KNO}_3$   
 (C)  $\text{K}_3[\text{Fe}(\text{CN})_6] < \text{K}_2\text{CrO}_4 < \text{AlCl}_3 < \text{KBr} < \text{KNO}_3$       (D)  $\text{K}_3[\text{Fe}(\text{CN})_6] > \text{AlCl}_3 > \text{K}_2\text{CrO}_4 > \text{KBr} > \text{KNO}_3$

70. Among the gases (a) – (e), the gases that cause greenhouse effect are :

- (a)  $\text{CO}_2$   
 (b)  $\text{H}_2\text{O}$   
 (c) CFCs  
 (d)  $\text{O}_2$   
 (e)  $\text{O}_3$   
 (A) (a), (b), (c) and (d)      (B) (a) and (d)  
 (C) (a), (b), (c) and (e)      (D) (a), (c), (d) and (e)

## Chemistry - Section B · Numerical Value Questions

71. What would be the electrode potential for the given half cell reaction at pH = 5? \_\_\_\_\_.

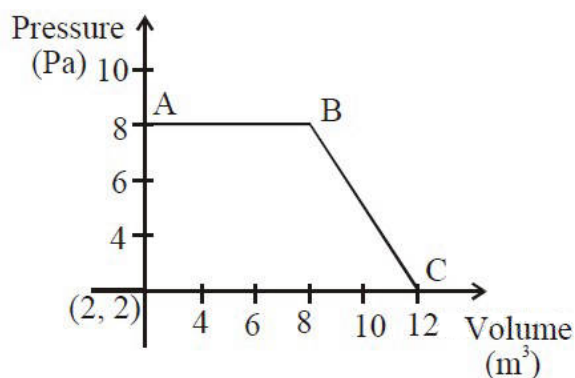


( $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ ; Temp = 298 K; oxygen under std. atm. pressure of 1 bar)

72. Ferrous sulphate heptahydrate is used to fortify foods with iron. The amount (in grams) of the salt required to achieve 10 ppm of iron in 100 kg of wheat is \_\_\_\_\_.

Atomic weight : Fe = 55.85; S = 32.00; O = 16.00

73. The magnitude of work done by a gas that undergoes a reversible expansion along the path ABC shown in the figure is \_\_\_\_\_.



74. The volume (in mL) of 0.125 M  $\text{AgNO}_3$  required to quantitatively precipitate chloride ions in 0.3 g of  $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$  is \_\_\_\_\_.

$M_{[\text{Co}(\text{NH}_3)_6\text{Cl}_3]} = 267.46 \text{ g/mol}$

$M_{\text{AgNO}_3} = 169.87 \text{ g/mol}$

75. The number of chiral centres in penicillin is \_\_\_\_\_.

- End of Question Paper -