

JEE Main 2016 Paper 1 (B.E./B.Tech) 3 April 2016 Shift 1 (morning) Question Paper



Conducted by the Central Board of Secondary Education (CBSE)

Time Allowed: 3 Hours

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

Maximum Marks: 360

General Instructions

- (i) This paper is **Paper 1 (B.E./B.Tech.)** of **JEE (Main) 2016 - Annual**, conducted by the Central Board of Secondary Education (CBSE) in Pen & paper mode on 3 April 2016, Shift 1. The total duration is **3 hours**.
- (ii) The paper has **90 questions** and a maximum of **360 marks**: Mathematics, Physics and Chemistry carry 30 questions (120 marks) each, in that order.
- (iii) Each subject has **30 multiple choice questions** (MCQs), with four options each. Select the most appropriate answer.
- (iv) **All questions are compulsory**. Use only the constants given in the question while calculating.
- (v) **Marking scheme**: **+4** for a correct answer, **-1** for an incorrect answer, and **0** for an unanswered or marked-for-review question.
- (vi) All calculations and rough work are to be done on the rough sheets only. Calculators, log tables, slide rules and electronic gadgets are not allowed.

Mathematics - Multiple Choice Questions

1. For

$$x \in R, f(x) = |\log 2 - \sin x|$$

and

$$g(x) = f(f(x)),$$

then :

- (A) g is not differentiable at $x = 0$
 (B) $g'(0) = \cos(\log 2)$
 (C) $g'(0) = -\cos(\log 2)$
 (D) g is differentiable at $x = 0$ and $g'(0) = -\sin(\log 2)$

2. Let

$$p = \lim_{x \rightarrow 0^+} \left(1 + \tan^2 \sqrt{x}\right)^{\frac{1}{2x}}$$

then $\log p$ is equal to :

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

3. If the standard deviation of the numbers 2, 3, a and 11 is 3.5, then which of the following is true?

- (A) $3a^2 - 26a + 55 = 0$ (B) $3a^2 - 32a + 84 = 0$
 (C) $3a^2 - 34a + 91 = 0$ (D) $3a^2 - 23a + 44 = 0$

4. A value of θ for which

$$\frac{2 + 3i \sin \theta}{1 - 2i \sin \theta}$$

is purely imaginary, is :

- (A) $\sin^{-1}\left(\frac{\sqrt{3}}{4}\right)$
 (B) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$
 (C) $\frac{\pi}{3}$
 (D) $\frac{\pi}{6}$

5. Let two fair six-faced dice A and B be thrown simultaneously. If E_1 is the event that die A shows up four, E_2 is the event that die B shows up two and E_3 is the event that the sum of numbers on both dice is odd, then which of the following statements is *NOT* true?

- (A) E_1 and E_2 are independent. (B) E_2 and E_3 are independent.
 (C) E_1 and E_3 are independent. (D) E_1, E_2 and E_3 are independent.

6. The area (in sq. units) of the region

$$\{(x, y) : y^2 \geq 2x \text{ and } x^2 + y^2 \leq 4x, x \geq 0, y \geq 0\}$$

is :

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

7. If a curve

$$y = f(x)$$

passes through the point $(1, -1)$ and satisfies the differential equation,

$$y(1 + xy)dx = x$$

dy , then

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

is equal to :

- (A) $\frac{2}{5}$
 (B) $\frac{4}{5}$
 (C) $-\frac{2}{5}$
 (D) $-\frac{4}{5}$

8. The integral

$$\int \frac{2x^{12} + 5x^9}{(x^5 + x^3 + 1)^3} dx$$

is equal to :

- (A) $\frac{x^5}{2(x^5 + x^3 + 1)^2} + C$
 (B) $\frac{-x^{10}}{2(x^5 + x^3 + 1)^2} + C$
 (C) $\frac{-x^5}{(x^5 + x^3 + 1)^2} + C$
 (D) $\frac{x^{10}}{2(x^5 + x^3 + 1)^2} + C$

9. A wire of length 2 units is cut into two parts which are bent respectively to form a square of side = x units and a circle of radius = r units. If the sum of the areas of the square and the circle so formed is minimum, then:

- (A) $x = 2r$
 (B) $2x = r$
 (C) $2x = (\pi + 4)r$
 (D) $(4 - \pi)x = \pi r$

10. The system of linear equations

$$x + \lambda y - z = 0$$

$$\lambda x - y - z = 0$$

$$x + y - \lambda z = 0$$

has a non-trivial solution for :

- (A) infinitely many values of λ .
 (B) exactly one value of λ .
 (C) exactly two values of λ .
 (D) exactly three values of λ .

11. If

$$A = \begin{bmatrix} 5a & -b \\ 3 & 2 \end{bmatrix}$$

and $A \text{ adj } A = A A^T$, then $5a + b$ is equal to :

- (A) 4
 (B) 13
 (C) -1
 (D) 5

12. The eccentricity of the hyperbola whose length of the latus rectum is equal to 8 and the length of its conjugate axis is equal to half of the distance between its foci, is :

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

13. If one of the diameters of the circle, given by the equation,

$$x^2 + y^2 - 4x + 6y - 12 = 0,$$

is a chord of a circle S , whose centre is at $(-3, 2)$, then the radius of S is :

- (A) 5
 (B) 10
 (C) $5\sqrt{2}$
 (D) $5\sqrt{3}$

14. Two sides of a rhombus are along the lines, $x - y + 1 = 0$ and $7x - y - 5 = 0$. If its diagonals intersect at $(-1, -2)$, then which one of the following is a vertex of this rhombus?

- (A) $\left(\frac{1}{3}, -\frac{8}{3}\right)$
 (B) $\left(-\frac{10}{3}, -\frac{7}{3}\right)$
 (C) $(-3, -9)$
 (D) $(-3, -8)$

15. If the 2^{nd} , 5^{th} and 9^{th} terms of a non-constant A.P. are in G.P., then the common ratio of this G.P. is :

- (A) 1
 (B) $\frac{7}{4}$
 (C) $\frac{8}{5}$
 (D) $\frac{4}{3}$

16. The sum of all real values of x satisfying the equation

$$(x^2 - 5x + 5)^{x^2 + 4x - 60} = 1$$

is :

- (A) 6
(B) 5
(C) 3
(D) -4

17. If all the words (with or without meaning) having five letters, formed using the letters of the word SMALL and arranged as in a dictionary, then the position of the word SMALL is :

- (A) 46^{th}
(B) 59^{th}
(C) 52^{nd}
(D) 58^{th}

18. If $f(x) + 2f\left(\frac{1}{x}\right) = 3x, x \neq 0$, and $S = \{x \in \mathbf{R} : f(x) = f(-x)\}$; then S :

- (A) is an empty set. (B) contains exactly one element.
(C) contains exactly two elements. (D) contains more than two elements.

19. If

$$0 \leq x < 2\pi$$

, then the number of real values of x , which satisfy the equation

$$\cos x + \cos 2x + \cos 3x + \cos 4x = 0$$

is:

- (A) 7 (B) 9
(C) 3 (D) 5

20. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three unit vectors such that

$$\vec{a} \times (\vec{b} \times \vec{c}) = \frac{\sqrt{3}}{2} (\vec{b} + \vec{c}).$$

If $\vec{b}$ is not parallel to $\vec{c}$, then the angle between $\vec{a}$ and $\vec{b}$ is:

- (A) $\frac{2\pi}{3}$
(B) $\frac{5\pi}{6}$
(C) $\frac{3\pi}{4}$
(D) $\frac{\pi}{2}$

21. If the sum of the first ten terms of the series

$$\left(1\frac{3}{5}\right)^2 + \left(2\frac{2}{5}\right)^2 + \left(3\frac{1}{5}\right)^2 + 4^2 + \left(4\frac{4}{5}\right)^2 + \dots \text{is } \frac{16}{5}m,$$

then m is equal to :

- (A) 100 (B) 99
(C) 102 (D) 101

22. If the number of terms in the expansion of

$$\left(1 - \frac{2}{x} + \frac{4}{x^2}\right)^n, x \neq 0,$$

is 28, then the sum of the coefficients of all the terms in this expansion, is :

- (A) 243 (B) 729
(C) 64 (D) 2187

23.

$$\lim_{n \rightarrow \infty} \left(\frac{(n+1)(n+2)\dots 3n}{n^{2n}} \right)^{\frac{1}{n}}$$

is equal to:

- (A) $\frac{9}{e^2}$
(B) $3 \log 3 - 2$
(C) $\frac{18}{e^4}$
(D) $\frac{27}{e^2}$

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

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

25. If the line,

$$\frac{x-3}{2} = \frac{y+2}{-1} = \frac{z+4}{3}$$
 lies in the planes,
 $lx + my - z = 9,$
 then $l^2 + m^2$ is equal to :

- (A) 5
 (B) 2
 (C) 26
 (D) 18

26. A man is walking towards a vertical pillar in a straight path, at a uniform speed. At a certain point A on the path, he observes that the angle of elevation of the top of the pillar is 30° . After walking for 10 minutes from A in the same direction, at a point B, he observes that the angle of elevation of the top of the pillar is 60° . Then the time taken (in minutes) by him, from B to reach the pillar, is :

- (A) 6
 (B) 10
 (C) 20
 (D) 5

27. The centres of those circles which touch the circle,

$$x^2 + y^2 - 8x - 8y - 4 = 0$$

, externally and also touch the x -axis, lie on :

- (A) a circle
 (B) an ellipse which is not a circle
 (C) a hyperbola
 (D) a parabola

28. Let P be the point on the parabola, $y^2 = 8x$ which is at a minimum distance from the centre C of the circle,

$$x^2 + (y+6)^2 = 1$$

. Then the equation of the circle, passing through C and having its centre at P is:

- (A) $x^2 + y^2 - \frac{x}{4} + 2y - 24 = 0$
 (B) $x^2 + y^2 - 4x + 9y + 18 = 0$
 (C) $x^2 + y^2 - 4x + 8y + 12 = 0$
 (D) $x^2 + y^2 - x + 4y - 12 = 0$

29. The distance of the point $(1, -5, 9)$ from the plane $x - y + z = 5$ measured along the line $x = y = z$ is :

- (A) $\frac{10}{\sqrt{3}}$
 (B) $\frac{20}{3}$
 (C) $3\sqrt{10}$
 (D) $10\sqrt{3}$

30. Consider :
 f

$$(x) = \tan^{-1} \left(\sqrt{\frac{1 + \sin x}{1 - \sin x}} \right), x \in \left(0, \frac{\pi}{2} \right).$$

A normal to $y = f(x)$ at

$$x = \frac{\pi}{6}$$

also passes through the point:

- (A) $\left(\frac{\pi}{6}, 0 \right)$
 (B) $\left(\frac{\pi}{4}, 0 \right)$
 (C) $(0, 0)$
 (D) $\left(0, \frac{2\pi}{3} \right)$

Physics - Multiple Choice Questions

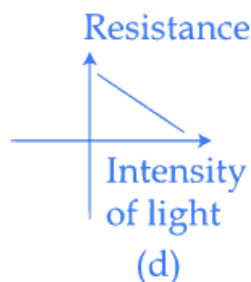
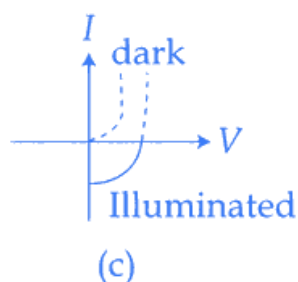
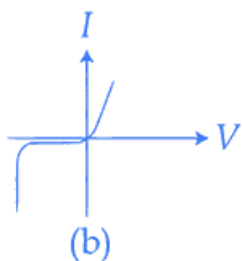
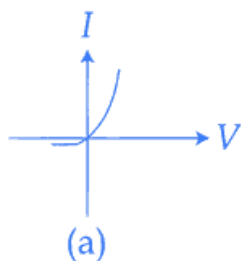
31. Radiation of wavelength λ , is incident on a photocell. The fastest emitted electron has speed v . If the wavelength is changed to

$$\frac{3\lambda}{4},$$

the speed of the fastest emitted electron will be:

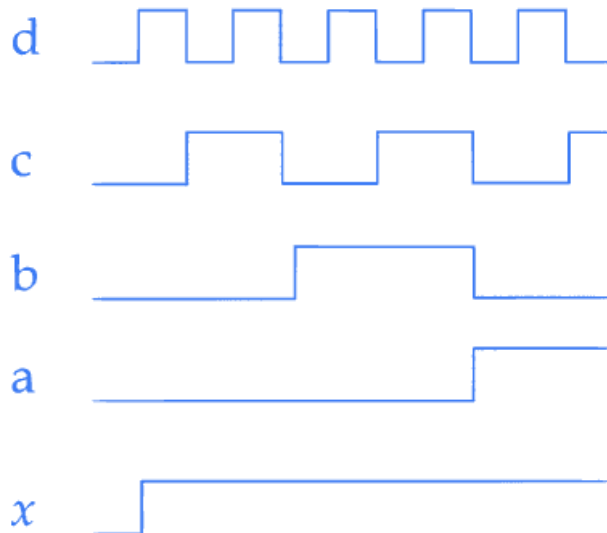
- (A) $= v\left(\frac{4}{3}\right)^{\frac{1}{2}}$
 (B) $= v\left(\frac{3}{4}\right)^{\frac{1}{2}}$
 (C) $> v\left(\frac{4}{3}\right)^{\frac{1}{2}}$
 (D) $< v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

32. Identify the semiconductor devices whose characteristics are given below, in the order (a), (b), (c), (d) :



- (A) Simple diode, Zener diode, Solar cell, Light dependent resistance
 (B) Zener diode, Simple diode, Light dependent resistance, Solar cell
 (C) Solar cell, Light dependent resistance, Zener diode, simple diode
 (D) Zener diode, Solar cell, simple diode, Light dependent resistance

33. If a, b, c, d are inputs to a gate and x is its output, then, as per the following time graph, the gate is :

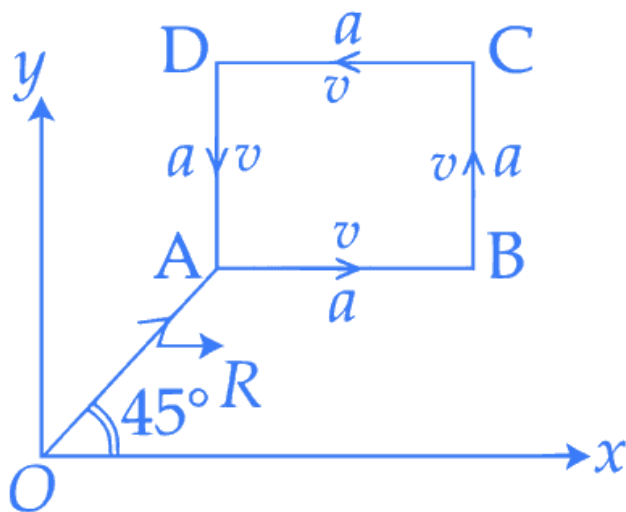


- (A) OR
 (B) NAND
 (C) NOT
 (D) AND

34. In an experiment for determination of refractive index of glass of a prism by $i - \delta$, plot it was found that a ray incident at angle 35° , suffers a deviation of 40° and that it emerges at angle 79° . In that case which of the following is closest to the maximum possible value of the refractive index?

- (A) 1.7
 (B) 1.8
 (C) 1.5
 (D) 1.6

35. A particle of mass m is moving along the side of a square of side 'a', with a uniform speed v in the x-y plane as shown in the figure :



Which of the following statements is **false** for the angular momentum $\vec{L}$ about the origin ?

(A) $\vec{L} = mv \left[\frac{R}{\sqrt{2}} + a \right] \hat{k}$

when the particle is moving from B to C.

(B) $\vec{L} = \frac{mv}{\sqrt{2}} R \hat{k}$

when the particle is moving from D to A.

(C) $\vec{L} = -\frac{mv}{\sqrt{2}} R \hat{k}$

when the particle is moving from A to B

(D) $\vec{L} = mv \left[\frac{R}{\sqrt{2}} - a \right] \hat{k}$

when the particle is moving from C to D.

36. Arrange the following electromagnetic radiations per quantum in the order of increasing energy :

A : Blue light

B : Yellow light

C : X-ray

D : Radiowave.

(A) C, A, B, D

(B) B, A, D, C

(C) D, B, A, C

(D) A, B, D, C

37. An arc lamp requires a direct current of 10 A at 80 V to function. If it is connected to a 220 V (rms), 50 Hz AC supply, the series inductor needed for it to work is close to :

(A) 0.044 H

(B) 0.065 H

(C) 80 H

(D) 0.08 H

38. The box of a pin hole camera, of length L , has a hole of radius a . It is assumed that when the hole is illuminated by a parallel beam of light of wavelength λ the spread of the spot (obtained on the opposite wall of the camera) is the sum of its geometrical spread and the spread due to diffraction. The spot would then have its minimum size (say $b_{\min}$) when :

(A) $a = \sqrt{\lambda L}$

and

$b_{\min} = \sqrt{4\lambda L}$

(B) $a = \frac{\lambda^2}{L}$

and

$b_{\min} = \sqrt{4\lambda L}$

(C) $a = \frac{\lambda^2}{L}$

and

$b_{\min} = \left(\frac{2\lambda^2}{L} \right)$

(D) $a = \sqrt{\lambda L}$

and

$b_{\min} = \left(\frac{2\lambda^2}{L} \right)$

39. A student measures the time period of 100 oscillations of a simple pendulum four times. The data set is 90 s, 91 s, 95 s and 92 s. If the minimum division in the measuring clock is 1 s, then the reported mean time should be :

(A) 92 ± 1.8 s

(B) 92 ± 3 s

(C) 92 ± 2 s

(D) 92 ± 5.0 s

40. An observer looks at a distant tree of height 10 m with a telescope of magnifying power of 20. To the observer the tree appears:

- (A) 20 times taller (B) 20 times nearer
(C) 10 times taller (D) 10 times nearer

41. Two identical wires A and B , each of length ' l ', carry the same current I . Wire A is bent into a circle of radius R and wire B is bent to form a square of side ' a '. If B_A and B_B are the values of magnetic fields at the centres of the circle and square respectively, then the ratio $\frac{B_A}{B_B}$ is:

- (A) $\frac{\pi^2}{16}$
(B) $\frac{\pi^2}{8\sqrt{2}}$
(C) $\frac{\pi^2}{8}$
(D) $\frac{\pi^2}{16\sqrt{2}}$

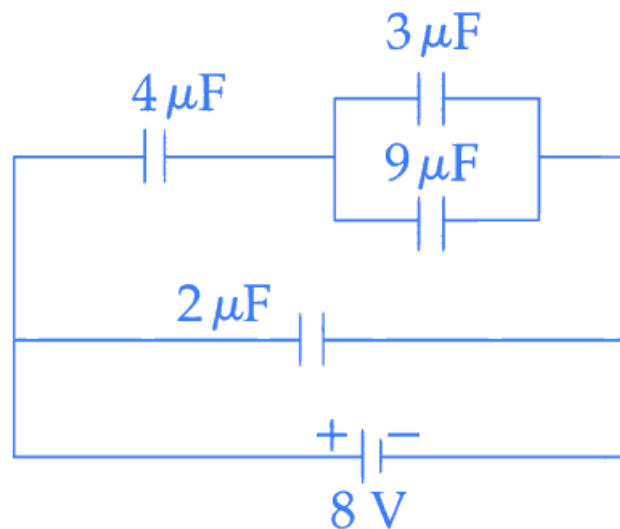
42. A galvanometer having a coil resistance of $100\ \Omega$ gives a full scale deflection, when a current of 1 mA is passed through it. The value of the resistance, which can convert this galvanometer into ammeter giving a full scale deflection for a current of 10 A , is :

- (A) $0.1\ \Omega$
(B) $3\ \Omega$
(C) $0.01\ \Omega$
(D) $2\ \Omega$

43. The temperature dependence of resistance of Cu and undoped Si in the temperature range $300 - 400\text{ K}$, is best described by :

- | | |
|--|--|
| (A) Linear increases for Cu , exponential decrease of Si . | (B) Linear decrease for Cu , linear decrease for Si |
| (C) Linear increase for Cu , linear increase for Si . | (D) Linear increase for Cu , exponential increase for Si |

44. A combination of capacitors is set up as shown in the figure. The magnitude of the electric field, due to a point charge Q (having a charge equal to the sum of the charges on the $4\ \mu F$ and $9\ \mu F$ capacitors), at a point distance 30 m from it, would equal :



- (A) 420 N/C
(B) 480 N/C
(C) 240 N/C
(D) 360 N/C

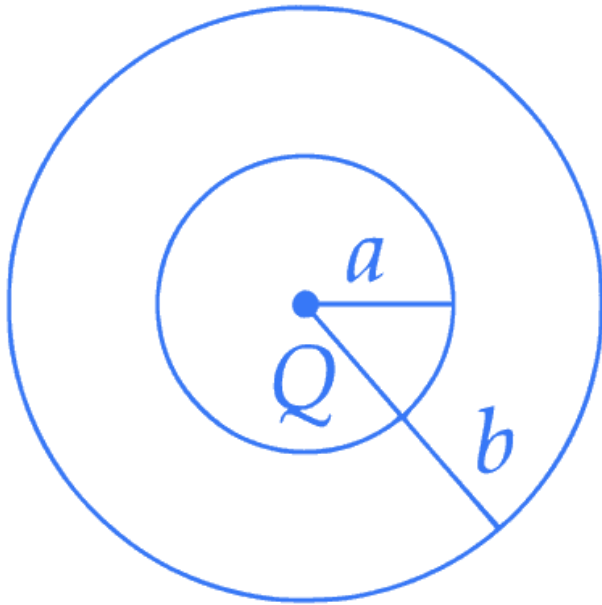
45. A particle performs simple harmonic motion with amplitude A . Its speed is trebled at the instant that it is at a distance $\frac{2A}{3}$ from equilibrium position. The new amplitude of the motion is:

- (A) $A\sqrt{3}$
(B) $\frac{7A}{3}$
(C) $\frac{A}{3}\sqrt{41}$
(D) $3A$

46. The region between two concentric spheres of radii ' a ' and ' b ', respectively (see figure), have volume charge density

$$\rho = \frac{A}{r},$$

where A is a constant and r is the distance from the center. A such that the electric field in the region between the spheres will be constant, is :



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

47. A uniform string of length 20 m is suspended from a rigid support. A short wave pulse is introduced at its lowest end. It starts moving up the string. The time taken to reach the supports is : (take

$$g = 10\text{ ms}^{-2}$$

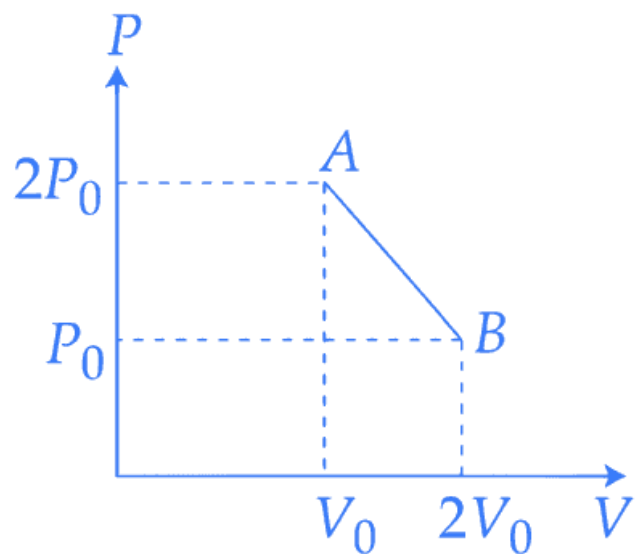
)

- (A) $2\sqrt{2}\text{ s}$
 (B) $2\pi\sqrt{2}\text{ s}$
 (C) $2\pi\sqrt{2}\text{ s}$
 (D) $\frac{2}{3}$

48. A pipe open at both ends has a fundamental frequency f in air. The pipe is dipped vertically in water so that half of it is in water. The fundamental frequency of the air column is now :

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

49. ' n ' moles of an ideal gas undergoes a process $A \rightarrow B$ as shown in the figure. The maximum temperature of the gas during the process will be :



- (A) $\frac{9P_0V_0}{2nR}$
 (B) $\frac{9P_0V_0}{nR}$
 (C) $\frac{9P_0V_0}{4nR}$
 (D) $\frac{3P_0V_0}{2nR}$

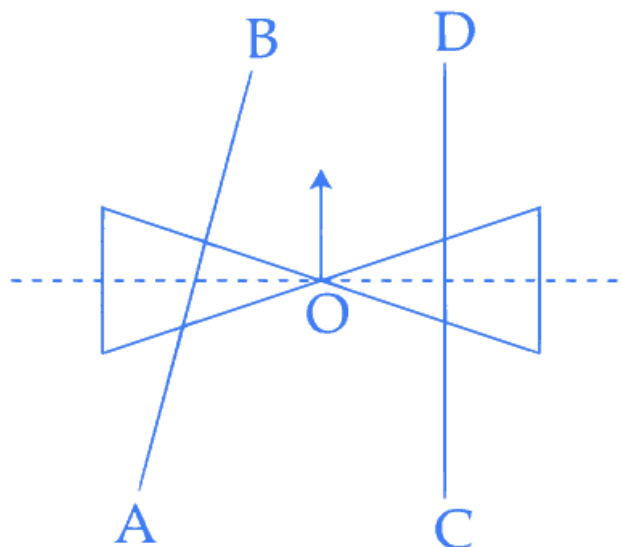
50. An ideal gas undergoes a quasi static, reversible process in which its molar heat capacity C remains constant. If during this process the relation of pressure P and volume V is given by $PV^n = \text{constant}$, then n is given by (Here C_p and C_v are molar specific heat at constant pressure and constant volume, respectively):

- (A) $n = \frac{C_p - C}{C - C_v}$
 (B) $n = \frac{C - C_v}{C - C_p}$
 (C) $n = \frac{C_p}{C_v}$
 (D) $n = \frac{C - C_p}{C - C_v}$

51. A pendulum clock loses 12 s a day if the temperature is 40°C and gains 4 s a day if the temperature is 20°C . The temperature at which the clock will show correct time, and the co-efficient of linear expansion (α) of the metal of the pendulum shaft are respectively :

- (A) 30°C ; $\alpha = 1.85 \times 10^{-3}/^\circ\text{C}$
 (B) 55°C ; $\alpha = 1.85 \times 10^{-2}/^\circ\text{C}$
 (C) 25°C ; $\alpha = 1.85 \times 10^{-5}/^\circ\text{C}$
 (D) 60°C ; $\alpha = 1.85 \times 10^{-4}/^\circ\text{C}$

52. A roller is made by joining together two cones at their vertices O . It is kept on two rails AB and CD , which are placed asymmetrically (see figure), with its axis perpendicular to CD and its center O at the center of line joining AB and CD (see figure). It is given a light push so that it starts rolling with its center O moving parallel to CD in the direction shown. As it moves, the roller will tend to :



- (A) go straight
 (B) turn left and right alternately
 (C) turn left
 (D) turn right

53. A person trying to lose weight by burning fat lifts a mass of 10 kg upto a height of 1 m 1000 times. Assume that the potential energy lost each time he lowers the mass is dissipated. How much fat will he use up considering the work done only when the weight is lifted up? Fat supplies $3.8 \times 10^7 \text{ J}$ of energy per kg which is converted to mechanical energy with a 20% efficiency rate. Take

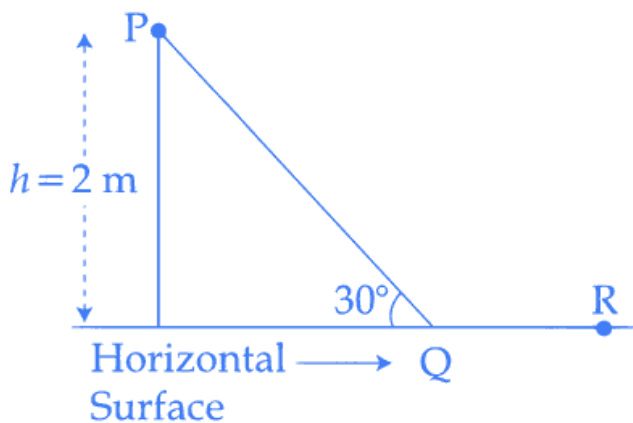
$$g = 9.8 \text{ ms}^{-2}$$

:

- (A) $9.89 \times 10^{-3} \text{ kg}$
 (B) $12.89 \times 10^{-3} \text{ kg}$
 (C) $2.45 \times 10^{-3} \text{ kg}$
 (D) $6.45 \times 10^{-3} \text{ kg}$

54. A point particle of mass m , moves along the uniformly rough track PQR as shown in the figure. The coefficient of friction, between the particle and the rough track equals μ . The particle is released, from rest from the point P and it comes to rest at point R . The energies, lost by the ball, over the parts, PQ and QR , of the track, are equal to each other, and no energy is lost when particle changes direction from PQ to QR . The value of the coefficient of friction μ and the distance x

($= QR$),
are, respectively close to:



- (A) 0.29 and 3.5 m (B) 0.29 and 6.5 m
(C) 0.2 and 6.5 m (D) 0.2 and 3.5 m

55. A satellite is revolving in a circular orbit at a height ' h ' from the earth's surface (radius of earth R ; $h \ll R$). The minimum increase in its orbital velocity required, so that the satellite could escape from the earth's gravitational field, is close to : (Neglect the effect of atmosphere.)

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

56. A screw gauge with a pitch of 0.5 mm and a circular scale with 50 divisions is used to measure the thickness of a thin sheet of Aluminium. Before starting the measurement, it is found that when the two jaws of the screw gauge are brought in contact, the 45th division coincides with the main scale line and that the zero of the main scale is barely visible. What is the thickness of the sheet if the main scale reading is 0.5 mm and the 25th division coincides with the main scale line?

- (A) 0.70 mm (B) 0.50 mm
(C) 0.75 mm (D) 0.80 mm

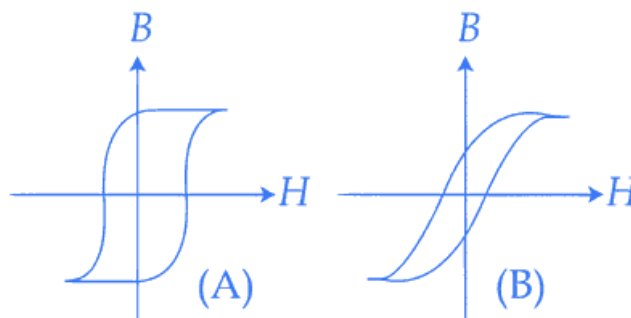
57. Choose the correct statement :

- | | |
|--|--|
| (A) In amplitude modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal. | (B) In amplitude modulation the frequency of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal. |
| (C) In frequency modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal. | (D) In frequency modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the frequency of the audio signal. |

58. For a common emitter configuration, if α and β have their usual meanings, the incorrect relationship between α and β is :

- | | |
|-----|--|
| (A) | $\alpha = \frac{\beta}{1 + \beta}$ |
| (B) | $\alpha = \frac{\beta^2}{1 + \beta^2}$ |
| (C) | $\frac{1}{\alpha} = \frac{1}{\beta} + 1$ |
| (D) | $\alpha = \frac{\beta}{1 - \beta^2}$ |

59. Hysteresis loops for two magnetic materials A and B are given below :



These materials are used to make magnets for electric generators, transformer core and electro-magnet core. Then it is proper to use :

- | | |
|---|---|
| (A) A for transformers and B for electric generators. | (B) B for electromagnets and transformers. |
| (C) A for electric generators and transformers. | (D) A for electromagnets and B for electric generators. |

60. Half-lives of two radioactive elements A and B are 20 minutes and 40 minutes, respectively. Initially, the samples have equal number of nuclei. After 80 minutes, the ratio of decayed number of A and B nuclei will be:

- | | |
|-----|--------|
| (A) | 1 : 4 |
| (B) | 5 : 4 |
| (C) | 1 : 16 |
| (D) | 4 : 1 |

Chemistry - Multiple Choice Questions

61. The reaction of zinc with dilute and concentrated nitric acid, respectively, produces :

- (A) NO_2 and NO (B) NO and N_2O
(C) NO_2 and N_2O (D) N_2O and NO_2

62. Which of the following compounds is metallic and ferromagnetic ?

- (A) CrO_2 (B) VO_2
(C) MnO_2 (D) TiO_2

63. Decomposition of H_2O_2 follows a first order reaction. In fifty minutes the concentration of H_2O_2 decreases from 0.5 to 0.125 M in one such decomposition. When the concentration of H_2O_2 reaches 0.05 M, the rate of formation of O_2 will be :

- (A) $6.93 \times 10^{-4} \text{ mol min}^{-1}$ (B) $6.96 \times 10^{-2} \text{ mol min}^{-1}$
(C) $1.34 \times 10^{-2} \text{ mol min}^{-1}$ (D) 2.66 L min^{-1} at STP

64. Galvanization is applying a coating of :

- (A) Cr (B) Cu
(C) Zn (D) Pb

65. 18 g glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) is added to 178.2 g water. The vapor pressure of water (in torr) for this aqueous solution is :

- (A) 76.0 (B) 752.4
(C) 759.0 (D) 7.6

66. The reaction of propene with HOCl ($\text{Cl}_2 + \text{H}_2\text{O}$) proceeds through the intermediate:

- (A) $\text{CH}_3 - \text{CH}^+ - \text{CH}_2 - \text{OH}$
(B) $\text{CH}_3 - \text{CHCl} - \text{CH}_2^+$
(C) $\text{CH}_3 - \text{CH}^+ - \text{CH}_2 - \text{OH}$
(D) $\text{CH}_3 - \text{CH}^+ - \text{CH}_2 - \text{Cl}$

67. At 300 K and 1 atm, 15 mL of a gaseous hydrocarbon requires 375 mL air containing 20% O_2 by volume for complete combustion. After combustion the gases occupy 345 mL. Assuming that the water formed is in liquid form and the volumes were measured at the same temperature and pressure, the formula of the hydrocarbon is:

- (A) C_3H_8 (B) C_4H_8
(C) C_4H_{10} (D) C_3H_6

68. The distillation technique most suited for separating glycerol from spent-lye in the soap industry is :

- (A) Simple distillation (B) Fractional distillation
(C) Steam distillation (D) Distillation under reduced pressure

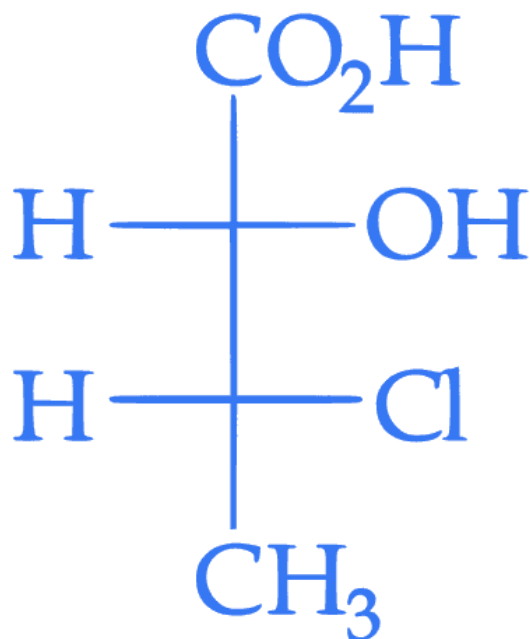
69. The equilibrium constant at 298 K for a reaction $\text{A} + \text{B} \rightleftharpoons \text{C} + \text{D}$ is 100. If the initial concentration of all the four species were 1M each, then equilibrium concentration of D (in mol L^{-1}) will be:

- (A) 0.818 (B) 1.818
(C) 1.182 (D) 0.182

70. The heats of combustion of carbon and carbon monoxide are -393.5 and $-283.5 \text{ kJ mol}^{-1}$, respectively. The heat of formation (in kJ) of carbon monoxide per mole is :

- (A) 676.5 (B) -676.5
(C) -110 (D) 110.5

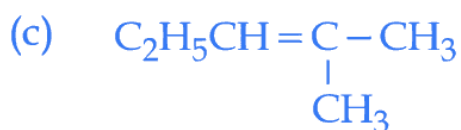
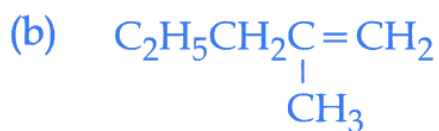
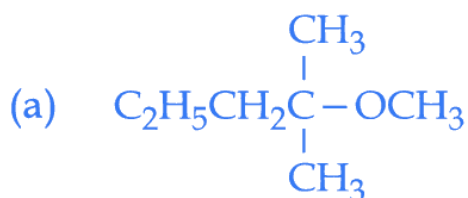
71. The absolute configuration of



is :

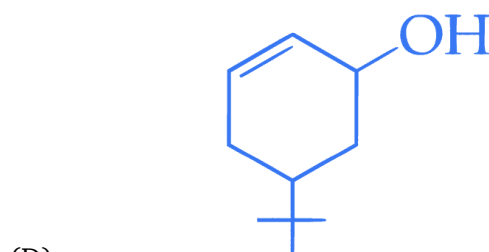
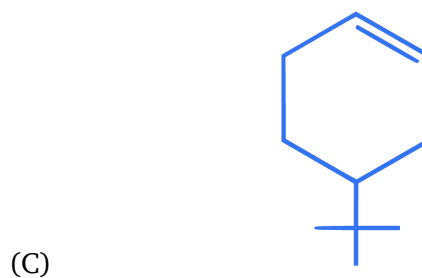
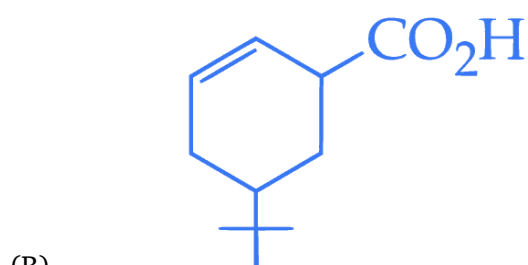
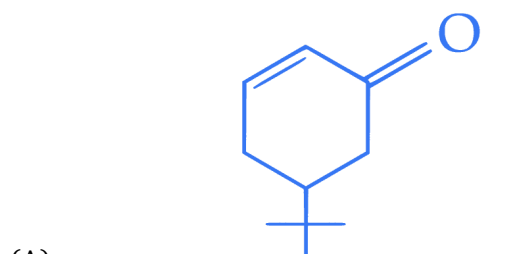
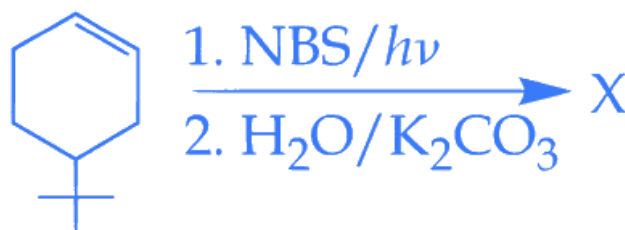
- (A) (2*S*, 3*S*)
 (B) (2*R*, 3*R*)
 (C) (2*R*, 3*S*)
 (D) (2*S*, 3*R*)

72. 2-chloro-2-methylpentane on reaction with sodium methoxide in methanol yields:



- (A) All of these
 (B) (a) and (c)
 (C) (c) only
 (D) (a) and (b)

73. The product of the reaction given below is :



74. In the Hofmann bromamide degradation reaction, the number of moles of NaOH and Br₂ used per mole of amine produced are:

- | | |
|---|--|
| (A) Four moles of NaOH and two moles of Br ₂ . | (B) Two moles of NaOH and two moles of Br ₂ |
| (C) Four moles of NaOH and one mole of Br ₂ | (D) One mole of NaOH and one mole of Br ₂ |

75. Which one of the following complexes shows optical isomerism?

(en = ethylenediamine)

- | | |
|--|--|
| (A) cis[Co(en) ₂ Cl ₂]Cl | (B) trans[Co(en) ₂ Cl ₂]Cl |
| (C) [Co(NH ₃) ₄ Cl ₂]Cl | (D) [Co(NH ₃) ₃ Cl ₃] |

76. Thiol group is present in :

- | | |
|--------------|----------------|
| (A) Cytosine | (B) Cystine |
| (C) Cysteine | (D) Methionine |

77. The pair having the same magnetic moment is :

[At. No.: Cr = 24, Mn = 25, Fe = 26, Co = 27]

- | | |
|---|---|
| (A) [Cr(H ₂ O) ₆] ²⁺ and [Fe(H ₂ O) ₆] ²⁺ | (B) [Mn(H ₂ O) ₆] ²⁺ and [Cr(H ₂ O) ₆] ²⁺ |
| (C) [CoCl ₄] ²⁻ and [Fe(H ₂ O) ₆] ²⁺ | (D) [Cr(H ₂ O) ₆] ²⁺ and [CoCl ₄] ²⁻ |

78. A stream of electrons from a heated filament was passed between two charged plates kept at a potential difference V esu. If e and m are charge and mass of an electron, respectively, then the value of h / λ (where λ is wavelength associated with electron wave) is given by :

- | | |
|----------|---------------|
| (A) 2meV | |
| (B) | $\sqrt{meV}$ |
| (C) | $\sqrt{2meV}$ |
| (D) meV | |

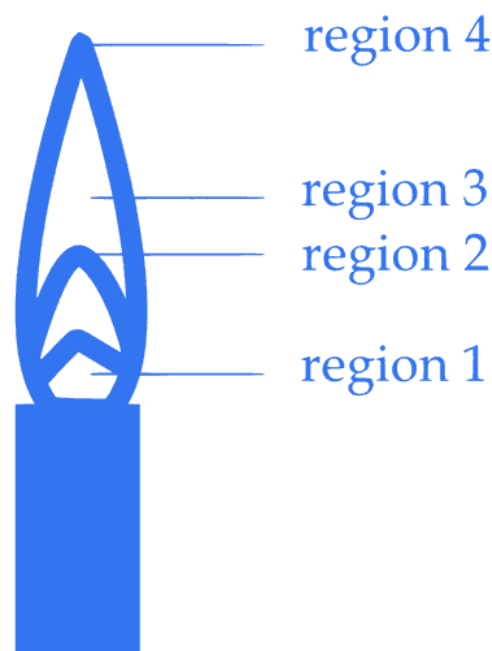
79. The species in which the N atom is in a state of sp hybridization is :

- | | |
|----------------------------------|----------------------------------|
| (A) NO ₂ ⁺ | (B) NO ₂ ⁻ |
| (C) NO ₃ ⁻ | (D) NO ₃ |

80. Which of the following atoms has the highest first ionization energy?

- | | |
|--------|--------|
| (A) Na | (B) K |
| (C) Sc | (D) Rb |

81. The hottest region of Bunsen flame shown in the figure below is :

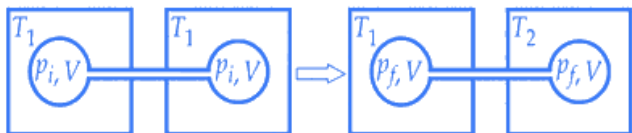


- | | |
|--------------|--------------|
| (A) region 1 | (B) region 2 |
| (C) region 3 | (D) region 4 |

82. The pair in which phosphorous atoms have a formal oxidation state of +3 is :

- | | |
|--|--|
| (A) Orthophosphorous and pyrophosphorous acids | (B) Pyrophosphorous and hypophosphoric acids |
| (C) Orthophosphorus and hypophosphoric acids | (D) Pyrophosphorous and pyrophosphoric acids |

83. Two closed bulbs of equal volume (V) containing an ideal gas initially at pressure p_i and temperature T_1 are connected through a narrow tube of negligible volume as shown in the figure below. The temperature of one of the bulbs is then raised to T_2 . The final pressure p_f is :



- (A) $2p_i \left(\frac{T_2}{T_1 + T_2} \right)$
 (B) $2p_i \left(\frac{T_1 T_2}{T_1 + T_2} \right)$
 (C) $p_i \left(\frac{T_1 T_2}{T_1 + T_2} \right)$
 (D) $2p_i \left(\frac{T_1}{T_1 + T_2} \right)$

84. Which of the following is an anionic detergent ?

- (A) Sodium stearate
 (B) Sodium lauryl sulphate
 (C) Cetyltrimethyl ammonium bromide
 (D) Glyceryl oleate

85. Which one of the following ores is best concentrated by froth floatation method?

- (A) Siderite
 (B) Galena
 (C) Malachite
 (D) Magnetite

86. The concentration of fluoride, lead, nitrate and iron in a water sample from an underground lake was found to be 1000 ppb, 40 ppb, 100 ppm and 0.2 ppm, respectively. This water is unsuitable for drinking due to high concentration of :

- (A) Lead
 (B) Nitrate
 (C) Iron
 (D) Fluoride

87. Which of the following statements about low density polythene is **FALSE** ?

- (A) Its synthesis requires high pressure.
 (B) It is a poor conductor of electricity.
 (C) Its synthesis requires dioxygen or a peroxide initiator as a catalyst.
 (D) It is used in the manufacture of buckets, dust-bins etc.

88. The main oxides formed on combustion of Li, Na and K in excess of air are, respectively :

- (A) LiO_2 , Na_2O_2 and K_2O
 (B) Li_2O , Na_2O_2 and KO_2
 (C) Li_2O , Na_2O_2 and KO_2
 (D) Li_2O , Na_2O and KO_2

89. For a linear plot of $\log (x/m)$ versus $\log p$ in a Freundlich adsorption isotherm, which of the following statements is correct ? (k and n are constants)

- (A) Both k and $1/n$ appear in the slope term.
 (B) $1/n$ appears as the intercept.
 (C) Only $1/n$ appears as the slope
 (D) $\log (1/n)$ appears as the intercept.

90. Which one of the following statements about water is FALSE?

- (A) Water is oxidized to oxygen during photosynthesis
 (B) Water can act both as an acid and as a base.
 (C) There is extensive intramolecular hydrogen bonding in the condensed phase.
 (D) Ice formed by heavy water sinks in normal water

- End of Question Paper -