JEE Main 2014 Paper 1 (B.E./B.Tech) Apr 12 Single slot 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) 2014 - Annual**, conducted by the Central Board of Secondary Education (CBSE) in Computer Based Test (CBT) mode on 12 April 2014, Single slot (Online CBT). 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. The sum of the roots of the equation, $x^2 + |2x - 3| - 4 = 0$, is:

(1) 2 (2) -2

(3) $\sqrt{2}$ (4) $-\sqrt{2}$

2. Let $z \neq -i$ be any complex number such that $\frac{z-i}{z+i}$ is a purely imaginary number. Then $z + \frac{1}{z}$ is:

(1) 0 (2) any non-zero real number other than 1 .

(3) any non-zero real number. (4) a purely imaginary number.

3. 8-digit numbers are formed using the digits 1, 1, 2, 2, 2, 3, 4, 4. The number of such numbers in which the odd digits do no occupy odd places, is:

(1) 160 (2) 120

(3) 60 (4) 48

4. Let G be the geometric mean of two positive numbers a and b, and M be the arithmetic mean of $\frac{1}{a}$ and $\frac{1}{b}$. If $\frac{1}{M} : G$ is $4 : 5$, then a : b can be:

(1) $1 : 4$ (2) $1 : 2$

(3) $2 : 3$ (4) $3 : 4$

5. The least positive integer n such that $1 - \frac{2}{3} - \frac{2}{3^2} - \ldots . - \frac{2}{3^{n-1}} < \frac{1}{100}$, is:

(1) 4 (2) 5

(3) 6 (4) 7

6. If $1 + x^4 + x^5 = \sum_{i=0}^{5} a_i \left(1 + x^i\right)$, for all x in R, then a_2 is:

(1) -4 (2) 6

(3) -8 (4) 10

7. If $\left(2 + \frac{x}{3}\right)^{55}$ is expanded in the ascending powers of x and the coefficients of powers of x in two consecutive terms of the expansion are equal, then these terms are:

(1) 7^{th} and 8^{th} (2) 8^{th} and 9^{th}

(3) 28^{th} and 29^{th} (4) 27^{th} and 28^{th}

8. If a line intercepted between the coordinate axes is trisected at a point $A(4, 3)$, which is nearer to x-axis, then its equation is:

(1) $4x - 3y = 7$ (2) $3x + 2y = 18$

(3) $3x + 8y = 36$ (4) $x + 3y = 13$

9. If the three distinct lines $x + 2ay + a = 0, x + 3by + b = 0$ and $x + 4ay + a = 0$ are concurrent, then the point (a, b) lies on a :

(1) circle (2) hyperbola

(3) straight line (4) parabola

10. For the two circles $x^2 + y^2 = 16$ and $x^2 + y^2 - 2y = 0$, there is/are

(1) one pair of common tangents (2) two pair of common tangents

(3) three pair of common tangents (4) no common tangent

11. Two tangents are drawn from a point $(-2,-1)$ to the curve, $y^2 = 4x$. If α is the angle between them, then $|\tan\alpha|$ is equal to:

(1) $\frac{1}{3}$ (2) $\frac{1}{\sqrt{3}}$

(3) $\sqrt{3}$ (4) 3

12. The minimum area of a triangle formed by any tangent to the ellipse $\frac{x^2}{16} + \frac{y^2}{81} = 1$ and the co-ordinate axes is:

(1) 12 (2) 18

(3) 26 (4) 36

13. Let p, q, r denote arbitrary statements. Then the logically equivalent of the statement $p \Rightarrow (q \vee r)$ is:

(1) $(p \vee q) \Rightarrow r$ (2) $(p \Rightarrow q) \vee (p \Rightarrow r)$

(3) $(p \Rightarrow \sim q) \wedge (p \Rightarrow r)$ (4) $(p \Rightarrow q) \wedge (p \Rightarrow \sim r)$

14. Let $\bar{X}$ and M.D. be the mean and the mean deviation about $\bar{X}$ of n observations $x_i, i = 1, 2, n$. If each of the observations is increased by 5 , then the new mean and the mean deviation about the new mean, respectively, are :

(1) $\bar{X}$, M.D. (2) $\overline{X} + 5$, M.D.

(3) $\bar{X}$, M.D. $+5$ (4) $\overline{X} + 5$, M.D. $+5$

15. A relation on the set $A = \{x : |x| < 3, x \in Z\}$, where Z is the set of integers is defined by $R = \{(x, y) : y = |x|, x \neq -1\}$. Then the number of elements in the power set of R is:

(1) 32 (2) 16

(3) 8 (4) 64

16. If $A = \begin{bmatrix} 1 & 2 & x \\ 3 & -1 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} y \\ x \\ 1 \end{bmatrix}$ be such that $AB = \begin{bmatrix} 6 \\ 8 \end{bmatrix}$, then:

(1) $y = 2x$ (2) $y = -2x$

(3) $y = x$ (4) $y = -x$

17. If

$$\begin{pmatrix} a^2 & b^2 & c^2 \\ |(a+\lambda)^2 & (b+\lambda)^2 & (c+\lambda^2) \\ (a-\lambda)^2 & (b-\lambda^2) & (-\lambda^2 \end{pmatrix} = k\lambda \begin{vmatrix} a^2 & b^2 & c^2 \\ a & b & c \\ 1 & 1 & 1 \end{vmatrix}, \lambda \neq 0$$

then k is equal to:

(1) $4\lambda abc$ (2) $-4\lambda abc$

(3) $4\lambda^2$ (4) $-4\lambda^2$

18. If $f(\theta)=\begin{vmatrix}1 & \cos\theta & 1\\ -\sin\theta & 1 & -\cos\theta\\ -1 & \sin\theta & 1\end{vmatrix}$ and A and B are respectively the maximum and the minimum values of $f(\theta)$, then (A, B) is equal to:

(1) $(3,-1)$ (2) $(4, 2-\sqrt{2})$

(3) $(2+\sqrt{2}, 2-\sqrt{2})$ (4) $(2+\sqrt{2}, -1)$

19. Statement I: The equation $\left(\sin^{-1}x\right)^3+\left(\cos^{-1}x\right)^3-a\pi^3=0$ has a solution for all $a\geq\frac{1}{32}$. Statement II: For any $x\in R$, $\sin^{-1}x+\cos^{-1}x=\frac{\pi}{2}$ and $0\leq\left(\sin^{-1}x-\frac{\pi}{4}\right)^2\leq\frac{9\pi^2}{16}$

(1) Both statements I and II are true. (2) Both statements I and II are false.

(3) Statement I is true and statement II is false. (4) Statement I is false and statement II is true.

20. If $f(x)=x^2-x+5, x>\frac{1}{2}$, and g(x) is its inverse function, then $g'(7)$ equals:

(1) $-\frac{1}{3}$ (2) $\frac{1}{13}$

(3) $\frac{1}{3}$ (4) $-\frac{1}{13}$

21. Let $f, g: R\to R$ be two functions defined by $f(x)=\begin{cases}x\sin\left(\frac{1}{x}\right) & ,x\neq 0\\ 0, & ,x=0\end{cases}$ and $g(x)=xf(x)$ Statement I: f is a continuous function at $x=0$. Statement II: g is a differentiable function at $x=0$.

(1) Both statement I and II are false. (2) Both statement I and II are true.

(3) Statement I is true, statement II is false. (4) Statement I is false, statement II is true.

22. Let f and g be two differentiable functions on R such that $f'(x)>0$ and $g'(x)<0$ for all $x\in R$. Then for all x :

(1) $f(g(x))>f(g(x-1))$ (2) $f(g(x))>f(g(x+1))$

(3) $g(f(x))>g(f(x-1))$ (4) $g(f(x))<g(f(x+1))$

23. The integral $\int\frac{\sin^2x\cos^2x}{\left(\sin^3x+\cos^3x\right)^2}dx$ is equal to:

(1) $\frac{1}{(1+\cot^3x}+c$ (2) $-\frac{1}{3(1+\tan^3x}+c\Big)$

(3) $\frac{\sin^3x}{(1+\cos^3x}+c$ (4) $-\frac{\cos^3x}{3(1+\sin^3x}+c$

24. If [ ] denotes the greatest integer function, then the integral $\int_0^{\pi}[\cos xdx$ is equal to:

(1) $\frac{\pi}{2}$ (2) 0

(3) -1 (4) $-\frac{\pi}{2}$

25. If for a continuous function f(x), $\int_{-\pi}^{t}(f(x)+xdx)=\pi^2-t^2$, for all $t\geq-\pi$, then f $\left(-\frac{\pi}{3}\right)$ is equal to:

(1) π (2) $\frac{\pi}{2}$

(3) $\frac{\pi}{3}$ (4) $\frac{\pi}{6}$

26. The general solution of the differential equation, $\sin 2x\left(\frac{dy}{dx}-\sqrt{\tan x}\right)-y=0$, is :

(1) $y\sqrt{\tan x}=x+c$ (2) $y\sqrt{\cot x}=\tan x+c$

(3) $y\sqrt{\tan x}=\cot x+c$ (4) $y\sqrt{\cot x}=x+c$

27. If $\hat{x}, \hat{y}$ and $\hat{z}$ are three unit vectors in threedimensional space, then the minimum value of $|\hat{x}+\hat{y}|^2+|\hat{y}+\hat{z}|^2+|\hat{z}+\hat{x}|^2$

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

(3) $3\sqrt{3}$ (4) 6

28. A symmetrical form of the line of intersection of the planes $x = ay + b$ and $z = cy + d$ is

(1) $\frac{x-b}{a} = \frac{y-1}{1} = \frac{z-d}{c}$ (2) $\frac{x-b-a}{a} = \frac{y-1}{1} = \frac{z-d-c}{c}$

(3) $\frac{\mathrm{x-a}}{\mathrm{b}} = \frac{\mathrm{y-0}}{1} = \frac{\mathrm{z-c}}{\mathrm{d}}$ (4) $\frac{\mathrm{x-b-a}}{\mathrm{b}} = \frac{\mathrm{y-1}}{0} = \frac{\mathrm{z-d-c}}{\mathrm{d}}$

29. If the distance between planes, $4x - 2y - 4z + 1 = 0$ and $4x - 2y - 4z + d = 0$ is 7 , then d is:

(1) 41 or -42 (2) 42 or -43

(3) -41 or 43 (4) -42 or 44

30. A number x is chosen at random from the set $\{1, 2, 3, 4, \ldots, 100\}$. Define the event: A = the chosen number x satisfies $\frac{(x-10)(x-50)}{(x-30)} \geq 0$ Then P(A) is:

(1) 0.71 (2) 0.70

(3) 0.51 (4) 0.20

31. From the following combinations of physical constants (expressed through their usual symbols) the only combination, that would have the same value in different systems of units, is:

(1) $\frac{ch}{2\pi\varepsilon_0^2}$ (2) $\frac{e^2}{2\pi\varepsilon_0 Gm_e^2}$

(3) $\frac{\mu_0\varepsilon_0}{c^2}\frac{G}{he^2}$ (4) $\frac{2\pi\sqrt{\mu_0\varepsilon_0}}{ce^2}\frac{h}{G}$

32. A person climbs up a stalled escalator in 60 s. If standing on the same but escalator running with constant velocity he takes 40 s. How much time is taken by the person to walk up the moving escalator?

(1) 37 s (2) 27 s

(3) 24 s (4) 45 s

33. A bullet of mass 4 g is fired horizontally with a speed of 300 m/s into 0.8 kg block of wood at rest on a table. If the coefficient of friction between the block and the table is 0.3, how far will the block slide approximately?

(1) 0.19 m (2) 0.379 m

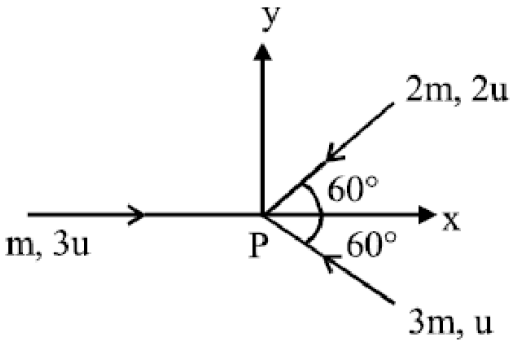
(3) 0.569 m (4) 0.758 m

34. A spring of unstretched length 1 has a mass m with one end fixed to a rigid support. Assuming spring to be made of a uniform wire, the kinetic energy possessed by it if its free end is pulled with uniform velocity v is:

(1) $\frac{1}{2}mv^2$ (2) mv^2

(3) $\frac{1}{3}mv^2$ (4) $\frac{1}{6}mv^2$

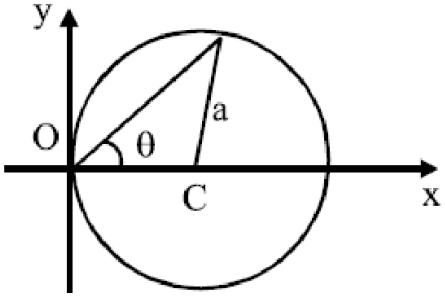
35. Three masses m, 2 m and 3 m are moving in x – y plane with speed 3u, 2u and u respectively as shown in figure. The three masses collide at the same point at P and stick together. The velocity of resulting mass will be:



(1) $\frac{u}{12}(\hat{i}+\sqrt{3}\hat{j})$ (2) $\frac{u}{12}(\hat{i}-\sqrt{3}\hat{j})$

(3) $\frac{u}{12}(-\hat{i}+\sqrt{3}\hat{j})$ (4) $\frac{u}{12}(-\hat{i}-\sqrt{3}\hat{j})$

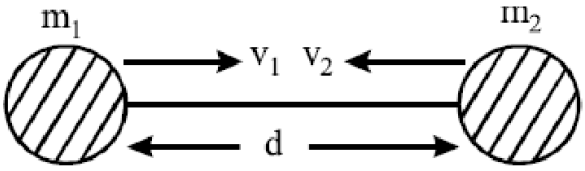
36. A particle is moving in a circular path of radius a, with a constant velocity v as shown in the figure. The centre of circle is marked by ' C '. The angular momentum from the origin O can be written as:



(1) va $(1+\cos 2\theta)$ (2) va $(1+\cos\theta)$

(3) va $\cos 2\theta$ (4) va

37.



Two hypothetical planets of masses m_1 and m_2 are at rest when they are infinite distance apart. Because of the gravitational force they move towards each other along the line joining their centres. What is their speed when their separation is ' d '? (Speed of m_1 is v_1 and that of m_2 is v_2)

(1) $v_1 = v_2$

(2) $v_1 = m_2\sqrt{\dfrac{2G}{d\,(m_1+m_2)}}$, $v_2 = m_1\sqrt{\dfrac{2G}{d\,(m_1+m_2)}}$

(3) $v_1 = m_1\sqrt{\dfrac{2G}{d\,(m_1+m_2)}}$, $v_2 = m_2\sqrt{\dfrac{2G}{d\,(m_1+m_2)}}$

(4) $v_1 = m_2\sqrt{\dfrac{2G}{m_1}}$, $v_2 = m_2\sqrt{\dfrac{2G}{m_2}}$

38. Steel ruptures when a shear of $3.5 \times 10^8\ N\ m^{-2}$ is applied. The force needed to punch a 1 cm diameter hole in a steel sheet 0.3 cm thick is nearly:

(1) 1.4×10^4 N
(2) 2.7×10^4 N
(3) 3.3×10^4 N
(4) 1.1×10^4 N

39. A cylindrical vessel of cross-section A contains water to a height h. There is a hole in the bottom of radius ' a '. The time in which it will be emptied is:

(1) $\frac{2A}{\pi a^2}\sqrt{\frac{h}{g}}$
(2) $\frac{\sqrt{2}A}{\pi a^2}\sqrt{\frac{h}{g}}$
(3) $\frac{2\sqrt{2}A}{\pi a^2}\sqrt{\frac{h}{g}}$
(4) $\frac{A}{\sqrt{2}\pi a^2}\sqrt{\frac{h}{g}}$

40. Two soap bubbles coalesce to form a single bubble. If V is the subsequent change in volume of contained air and S change in total surface area, T is the surface tension and P atmospheric pressure, then which of the following relation is correct?

(1) $4PV + 3ST = 0$
(2) $3PV + 4ST = 0$
(3) $2PV + 3ST = 0$
(4) $3PV + 2ST = 0$

41. Hot water cools from 60°C to 50°C in the first 10 minutes and to 42°C in the next 10 minutes. The temperature of the surroundings is:

(1) 25°C
(2) 10°C
(3) 15°C
(4) 20°C

42. A Carnot engine absorbs 1000 J of heat energy from a reservoir at 127°C and rejects 600 J of heat energy during each cycle. The efficiency of engine and temperature of sink will be:

(1) 20% and −43°C
(2) 40% and −33°C
(3) 50% and −20°C
(4) 70% and −10°C

43. At room temperature a diatomic gas is found to have an r.m.s. speed of 1930 ms^{-1}. The gas is:

(1) H_2 (2) Cl_2

(3) O_2 (4) F_2

44. Which of the following expressions corresponds to simple harmonic motion along a straight line, where x is the displacement and a, b, c are positive constants?

(1) $a + bx - cx^2$ (2) bx^2

(3) $a - bx + cx^2$ (4) $-bx$

45. A source of sound A emitting waves of frequency 1800 Hz is falling towards ground with a terminal speed v. The observer B on the ground directly beneath the source receives waves of frequency 2150 Hz. The source A receives waves, reflected from ground of frequency nearly: (Speed of sound = 343 m/s)

(1) 2150 Hz (2) 2500 Hz

(3) 1800 Hz (4) 2400 Hz

46. A spherically symmetric charge distribution is characterised by a charge density having the following variations: $\rho(r) = \rho_o\left(1 - \frac{r}{R}\right)$ for $r < R$ $\rho(r) = 0$ for $r \geq R$ Where r is the distance from the centre of the charge distribution ρ_0 is a constant. The electric field at an internal point $(r < R)$ is:

(1) $\frac{\rho_o}{4\varepsilon_o}\left(\frac{r}{3} - \frac{r^2}{4R}\right)$ (2) $\frac{\rho_0}{\varepsilon_0}\left(\frac{r}{3} - \frac{r^2}{4R}\right)$

(3) $\frac{\rho_o}{3\varepsilon_o}\left(\frac{r}{3} - \frac{r^2}{4R}\right)$ (4) $\frac{\rho_o}{12\varepsilon_o}\left(\frac{r}{3} - \frac{r^2}{4R}\right)$

47. The space between the plates of a parallel plate capacitor is filled with a 'dielectric' whose 'dielectric constant' varies with distance as per the relation:

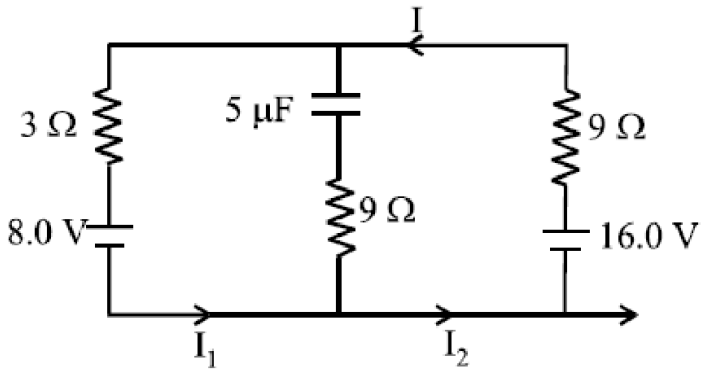
$$K(x) = K_o + \lambda x(\lambda = \text{a constant})$$

The capacitance C, of the capacitor, would be related to its vacuum capacitance C_o for the relation :

(1) $C = \frac{\lambda d}{\ln(1+K_o\lambda d}C_o\Big)$ (2) $C = \frac{\lambda}{d\cdot\ln(1+K_o\lambda d}C_o\Big)$

(3) $C = \frac{\lambda d}{\ln(1+\lambda d/K_o}C_o\Big)$ (4) $C = \frac{\lambda}{d.\ln(1+K_o/\lambda d}C_o\Big)$

48. The circuit shown here has two batteries of 8.0 V and 16.0 V and three resistors 3Ω, 9Ω and 9Ω and a capacitor of 5.0μF.



How much is the current I in the circuit in steady state?

(1) 1.6 A (2) 0.67 A

(3) 2.5 A (4) 0.25 A

49. In the experiment of calibration of voltmeter, a standard cell of e.m.f. 1.1 volt is balanced against 440 cm of potential wire. The potential difference across the ends of resistance is found to balance against 220 cm of the wire. The corresponding reading of voltmeter is 0.5 volt. The error in the reading of volmeter will be:

(1) -0.15 volt
(2) 0.15 volt
(3) 0.5 volt
(4) -0.05 volt

50. A positive charge ' q ' of mass ' m ' is moving along the $+x$ axis. We wish to apply a uniform magnetic field B for time Δt so that the charge reverses its direction crossing the y axis at a distance d. Then:

(1) $\mathrm{B}=\frac{\mathrm{mv}}{\mathrm{qd}}$ and $\Delta \mathrm{t}=\frac{\pi \mathrm{d}}{\mathrm{v}}$
(2) $\mathrm{B}=\frac{\mathrm{mv}}{2\mathrm{qd}}$ and $\Delta \mathrm{t}=\frac{\pi \mathrm{d}}{2\mathrm{v}}$
(3) $\mathrm{B}=\frac{2\mathrm{mv}}{\mathrm{qd}}$ and $\Delta \mathrm{t}=\frac{\pi \mathrm{d}}{2\mathrm{v}}$
(4) $B=\frac{2\mathrm{mv}}{\mathrm{qd}}$ and $\Delta \mathrm{t}=\frac{\pi \mathrm{d}}{\mathrm{v}}$

51. Consider two thin identical conducting wires covered with very thin insulating material. One of the wires is bent into a loop and produces magnetic field B_1, at its centre when a current I passes through it. The ratio $\mathrm{B}_1 : \mathrm{B}_2$ is:

(1) 1:1
(2) 1 : 3
(3) 1 : 9
(4) 9 : 1

52. A sinusoidal voltage $\mathrm{V(t)}=100\sin(500\mathrm{t})$ is applied across a pure inductance of $L=0.02\mathrm{H}$. The current through the coil is:

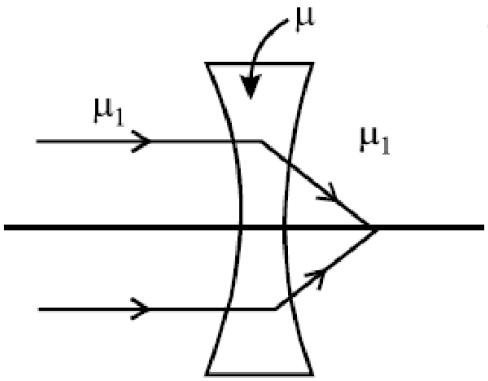
(1) $10\cos(500\mathrm{t})$
(2) $-10\cos(500\mathrm{t})$
(3) $10\sin(500t)$
(4) $-10\sin(500t)$

53. A lamp emits monochromatic green light uniformly in all directions. The lamp is 3% efficient in converting electrical power to electromagnetic waves and consumes 100 W of power. The amplitude of the electric field associated with the electromagnetic radiation at a distance of 5 m from the lamp will be nearly:

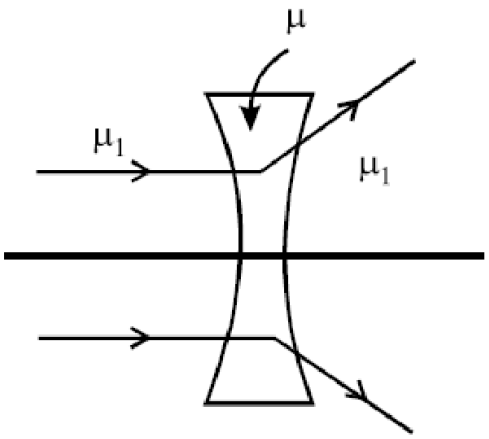
(1) 1.34 V/m
(2) 2.68 V/m
(3) 4.02 V/m
(4) 5.36 V/m

54. The refractive index of the material of a concave lens is μ. It is immersed in a medium of refractive index μ_1. A parallel beam of light is incident on the lens. The path of the emergent rays when $\mu_1 > \mu$ is:

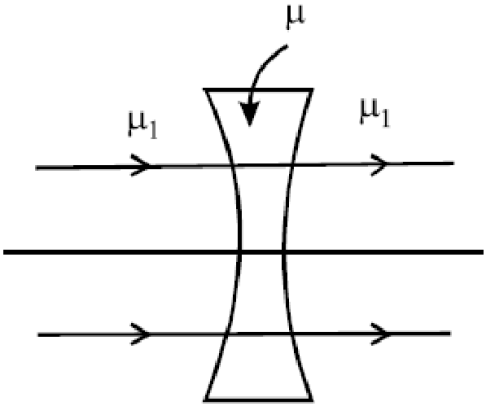
(1)



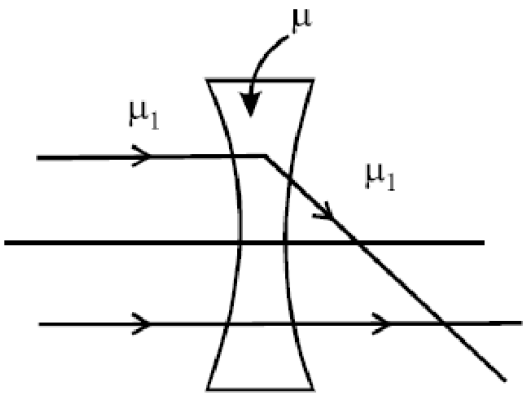
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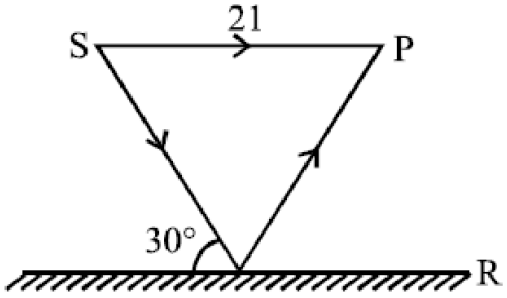
(3)



(4)



55. Interference pattern is observed at ' P ' due to superimposition of two rays coming out from a source ' S ' as shown in the figure. The value of ' l ' for which maxima is obtained at ' P ' is: (R is perfect reflecting surface)



(1) $1 = \frac{2n\lambda}{\sqrt{3}-1}$

(2) $1 = \frac{(2n-1)\lambda}{2(\sqrt{3}-1}\Big)$

(3) $1 = \frac{(2n-1\lambda)\sqrt{3}}{4(2-\sqrt{3}}\Big)$

(4) $1 = \frac{(2n-1)\lambda}{\sqrt{3}-1}$

56. In an experiment of single slit diffraction pattern, first minimum for red light coincides with first maximum of some other wavelength. If wavelength of red light is $6600\mathring{A}$, then wavelength of first maximum will be:

(1) $3300\mathring{A}$

(2) $4400\mathring{A}$

(3) $5500\mathring{A}$

(4) $6600\mathring{A}$

57. A beam of light has two wavelengths of $4972\mathring{A}$ and $6216\mathring{A}$ with a total intensity of 3.6×10^{-3} Wm^{-2} equally distributed among the two wavelengths. The beam falls normally on an area of 1 cm^2 of a clean metallic surface of work function $2.3\mathrm{eV}$. Assume that there is no loss of light by reflection and that each capable photon ejects one electron. The number of photoelectrons liberated in 2 s is approximately:

(1) 6×10^{11} (2) 9×10^{11}

(3) 11×10^{11} (4) 15×10^{11}

58. For LED's to emit light in visible region of electromagnetic light, it should have energy band gap in the range of:

(1) 0.1eV to 0.4eV (2) 0.5eV to 0.8eV

(3) 0.9eV to 1.6eV (4) 1.7eV to 3.0eV

59. A piece of bone of an animal from a ruin is found to have $^{14}\mathrm{C}$ activity of 12 disintegrations per minute per gm of its carbon content. The $^{14}\mathrm{C}$ activity of a living animal is 16 disintegrations per minute per gm. How long ago nearly did the animal die? (Given half life of $^{14}\mathrm{C}$ is $\mathrm{t}_{1/2} = 5760$ years)

(1) 1672 years (2) 2391 years

(3) 3291 years (4) 4453 years

60. For sky wave propagation, the radio waves must have a frequency range in between:

(1) 1MHz to 2MHz (2) 5MHz to 25MHz

(3) 35MHz to 40MHz (4) 45MHz to 50MHz

61. The amount of $BaSO_4$ formed upon mixing 100 mL of 20.8%$BaCl_2$ solution with 50 mL of 9.8% H_2SO_4 solution will be: (Ba = 137, Cl = 35.5, S = 32, H = 1 and O = 16)

(1) 23.3 g
(2) 11.65 g
(3) 30.6 g
(4) 33.2 g

62. If m and e are the mass and charge of the revolving electron in the orbit of radius r for hydrogen atom, the total energy of the revolving electron will be:

(1) $\frac{1}{2}\frac{e^2}{r}$
(2) $-\frac{e^2}{r}$
(3) $\frac{me^2}{r}$
(4) $-\frac{1}{2}\frac{e^2}{r}$

63. The de-Broglie wavelength of a particle of mass 6.63 g moving with a velocity of 100 ms^{-1} is:

(1) 10^{-33} m
(2) 10^{-35} m
(3) 10^{-31} m
(4) 10^{-25} m

64. Excited hydrogen atom emits light in the ultraviolet region at 2.47×10^{15} Hz. With this frequency, the energy of a single photon is: $\left(h = 6.63 \times 10^{-34} Js\right)$

(1) 8.041×10^{-40} J
(2) 2.680×10^{-19} J
(3) 1.640×10^{-18} J
(4) 6.111×10^{-17} J

65. Similarity in chemical properties of the atoms of elements in a group of the Periodic table is most closely related to:

(1) atomic numbers
(2) atomic masses
(3) number of principal energy levels
(4) number of valence electrons

66. Which of the following arrangements represents the increasing order (smallest to largest) of ionic radii of the given species $O^{2-}, S^{2-}, N^{3-}, P^{3-}$?

(1) $O^{2-} < N^{3-} < S^{2-} < P^{3-}$
(2) $O^{2-} < P^{3-} < N^{3-} < S^{2-}$
(3) $N^3 < O^{2-} < P^{3-} < S^{2-}$
(4) $N^{3-} < S^{2-} < O^{2-} < P^{3-}$

67. Which of the following molecules has two sigma (σ) and two pi (π) bonds?

(1) C_2H_4
(2) $N_2 F_2$
(3) $C_2H_2Cl_2$
(4) HCN

68. The (S°) of the following substances are: CH_4 g)186.2JK^{-1} mol^{-1} O_2 (g) 205.2JK^{-1} mol^{-1} CO_2(g)213.6JK^{-1} mol^{-1} H_2O(g) 69.9.JK^{-1} mol^{-1} The entropy change (ΔS°) for the reaction $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O$ (l) is:

(1) -312.5 J K^{-1} mol^{-1}
(2) $-242.8 JK^{-1}$ mol^{-1}
(3) $-108.1 JK^{-1}$ mol^{-1}
(4) -37.6 J K^{-1} mol^{-1}

69. The standard enthalpy of formation ($\Delta_f H^\circ_{298}$) for methane, CH_4 is -74.9 kJ mol^{-1}. In order to calculate the average energy given out in the formation of a C – H bond from this it is necessary to know which one of the following?

(1) The dissociation energy of the hydrogen molecule, H_2.
(2) The first four ionisation energies of carbon.
(3) The dissociation energy of H_2 and enthalpy and sublimation of carbon (graphite).
(4) The first four ionisation energies of carbon and electron affinity of hydrogen.

70. What happens when an inert gas is added to an equilibrium keeping volume unchanged?

(1) More product will form
(2) Less product will form
(3) More reactant will form
(4) Equilibrium will remain unchanged

71. The conjugate base of hydrazoic acid is:

(1) N^{-3}
(2) N_3^-
(3) N_2^-
(4) HN_3^-

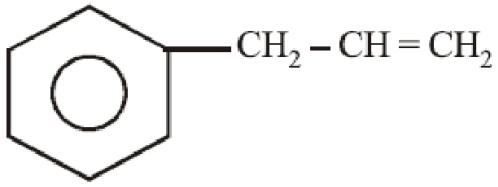
72. Hydrogen peroxide acts both as an oxidising and as a reducing agent depending upon the nature of the reacting species. In which of the following cases H_2O_2 acts as a reducing agent in acid medium?

(1) MnO_4^-
(2) $Cr_2O_7^{2-}$
(3) SO_3^{2-}
(4) KI

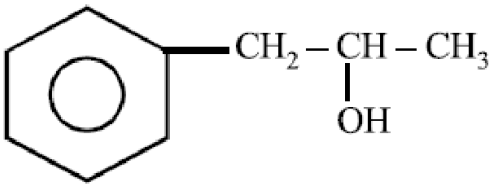
73. Which one of the following acids does not exhibit optical isomerism?

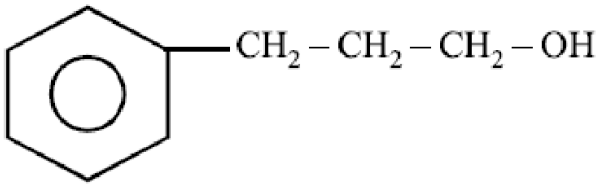
(1) Lactic acid
(2) Tartaric acid
(3) Maleic acid
(4) α-amino acids

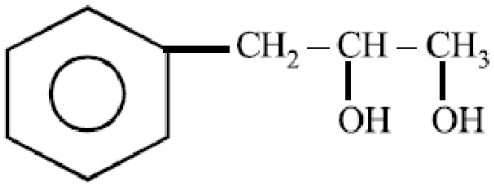
74.

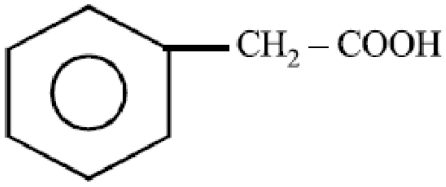


on mercuration-demercuration produces the major product:

(1)


(2)


(3)


(4)


75. In the presence of peroxide, HCl and HI do not give anti-Markownikoff's addition of alkenes because:

(1) One of the steps is endothermic in HCl and HI
(2) Both HCl and HI are strong acids
(3) HCl is oxidizing and the HI is reducing
(4) All the steps are exothermic is HCl and HI

76. Global warming is due to increase of:

(1) methane and nitrous oxide in atmosphere
(2) methane and CO_2 in atmosphere
(3) methane and O_3 in atmosphere
(4) methane and CO in atmosphere

77. In a monoclinic unit cell, the relation of sides and angles are respectively:

(1) $a = b \neq c$ and $\alpha = \beta = \gamma = 90^\circ$
(2) $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^\circ$
(3) $a \neq b \neq c$ and $\beta = \gamma = 90^\circ \neq \alpha$
(4) $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90^\circ$

78. How many electrons would be required to deposit 6.35 g of copper at the cathode during the electrolysis of an aqueous solution of copper sulphate? (Atomic mass of copper $= 63.5\text{u}, \text{N}_\text{A} =$ Avogadro's constant):

(1) $\frac{\text{N}_\text{A}}{20}$ (2) $\frac{\text{N}_\text{A}}{10}$

(3) $\frac{\text{N}_\text{A}}{5}$ (4) $\frac{\text{N}_\text{A}}{2}$

79. The rate coefficient (k) for a particular reactions is $1.3 \times 10^{-4}\text{M}^{-1}\ \text{s}^{-1}$ at 100°C, and $1.3 \times 10^{-3}\ \text{M}^{-1}\ \text{s}^{-1}$ at 150°C. What is the energy of activation (E_A) (in kJ) for this reaction? (R = molar gas constant $= 8.314\text{JK}^{-1}\ \text{mol}^{-1}$)

(1) 16 (2) 60

(3) 99 (4) 132

80. Which of the following xenon-oxo compounds may not be obtained by hydrolysis of xenon fluorides?

(1) $\text{XeO}_2\ \text{F}_2$ (2) XeOF_4

(3) XeO_3 (4) XeO_4

81. Which one of the following exhibits the large number of oxidation states?

(1) Ti(22) (2) V(23)

(3) Cr(24) (4) Mn(25)

82. Copper becomes green when exposed to moist air for a long period. This is due to:

(1) the formation of a layer of cupric oxide on the surface of copper.

(2) the formation of a layer of basic carbonate of copper on the surface of copper.

(3) the formation of a layer of cupric hydroxide on the surface of copper.

(4) the formation of basic copper sulphate layer on the surface of the metal.

83. Among the following species the one which causes the highest CFSE, Δ_0 as a ligand is:

(1) CN^- (2) NH_3

(3) F^- (4) CO

84. Which one of the following complexes will most likely absorb visible light? (At nos. $\text{Sc} = 21, \text{Ti} = 22,\ \text{V} = 23, \text{Zn} = 30$)

(1) $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ (2) $[\text{Ti}(\text{NH}_3)_6]^{4+}$

(3) $[\text{V}(\text{NH}_3)_6]^{3+}$ (4) $[\text{Zn}(\text{NH}_3)_6]^{2+}$

85. Conversion of benzene diazonium chloride to chlorobenzene is an example of which of the following reactions?

(1) Claisen (2) Friedel-craft

(3) Sandmeyer (4) Wurtz

86. The major product obtained in the photo catalysed bromination of 2-methylbutane is:

(1) 1-bromo-2-methylbutane (2) 1-bromo-3-methylbutane

(3) 2-bromo-3-methylbutane (4) 2-bromo-2-methylbutane

87. In the Victor-Meyer's test, the colour given by $1^\circ, 2^\circ$ and 3° alcohols are respectively:

(1) Red, colourless, blue (2) Red, blue, colourless

(3) Colourless, red, blue (4) Red, blue, violet

88. Phthalic acid reacts with resorcinol in the presence of concentrated H_2SO_4 to give:

(1) Phenolphthalein
(2) Alizarin
(3) Coumarin
(4) Fluorescein

89. Aminoglycosides are usually used as:

(1) antibiotic
(2) analgesic
(3) hypnotic
(4) antifertility

90. Which of the following will not show mutarotation?

(1) Maltose
(2) Lactose
(3) Glucose
(4) Sucrose