Central Board of Secondary Education

Question Paper Name :	JEE Main 2017 Paper 1 (B.E./B.Tech) Apr 9 Single slot
Subject Name :	Paper 1 (B.E./B.Tech)
Duration :	180
Total Marks :	360

Paper 1 (B.E./B.Tech)

Mathematics

Section Number :	1
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120

Question Number : 1 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The function $f : \mathbf{N} \to \mathbf{N}$ defined by $f(x) = x - 5\left[\frac{x}{5}\right]$, where $\mathbf{N}$ is the set of natural numbers and $[x]$ denotes the greatest integer less than or equal to x, is :

(1) one-one and onto.

(2) one-one but not onto.

(3) onto but not one-one.

(4) neither one-one nor onto.

Question Number : 2 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The sum of all the real values of x satisfying the equation $2^{(x-1)(x^2+5x-50)} = 1$ is :

(1) 16

(2) 14

(3) -4

(4) -5

Question Number : 3 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The equation

$$\mathrm{Im}\left(\frac{iz-2}{z-i}\right)+1=0,\ z\in\mathbf{C},\ z\neq i$$

represents a part of a circle having radius equal to :

(1) 2

(2) 1

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

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

Question Number : 4 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

For two 3×3 matrices A and B, let $A+B=2B'$ and $3A+2B=I_3$, where B' is the transpose of B and I_3 is 3×3 identity matrix. Then :

(1) $5A+10B=2I_3$

(2) $10A+5B=3I_3$

(3) $B+2A=I_3$

(4) $3A+6B=2I_3$

Question Number : 5 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If $x=a,\ y=b,\ z=c$ is a solution of the system of linear equations

$$x+8y+7z=0$$

$$9x+2y+3z=0$$

$$x+y+z=0$$

such that the point (a, b, c) lies on the plane $x+2y+z=6$, then $2a+b+c$ equals :

(1) -1

(2) 0

(3) 1

(4) 2

Question Number : 6 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The number of ways in which 5 boys and 3 girls can be seated on a round table if a particular boy B_1 and a particular girl G_1 never sit adjacent to each other, is :

(1) $5 \times 6!$

(2) $6 \times 6!$

(3) $7!$

(4) $5 \times 7!$

Question Number : 7 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The coefficient of x^{-5} in the binomial expansion of $\left(\frac{x+1}{x^{\frac{2}{3}} - x^{\frac{1}{3}} + 1} - \frac{x-1}{x - x^{\frac{1}{2}}}\right)^{10}$, where $x \neq 0, 1$, is :

(1) 1

(2) 4

(3) -4

(4) -1

Question Number : 8 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If three positive numbers a, b and c are in A.P. such that $abc = 8$, then the minimum possible value of b is :

(1) 2

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

(3) $4^{\frac{2}{3}}$

(4) 4

Question Number : 9 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Let

$$S_n = \frac{1}{1^3} + \frac{1+2}{1^3+2^3} + \frac{1+2+3}{1^3+2^3+3^3} +$$

$$..... + \frac{1+2+.....+n}{1^3+2^3+.....+n^3}. \text{ If } 100\,S_n = n,$$

then n is equal to :

(1) 199

(2) 99

(3) 200

(4) 19

Question Number : 10 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The value of k for which the function

$$f(x) = \begin{cases} \left(\frac{4}{5}\right)^{\frac{\tan 4x}{\tan 5x}}, & 0 < x < \frac{\pi}{2} \\ k + \frac{2}{5}, & x = \frac{\pi}{2} \end{cases}$$

is continuous at $x = \frac{\pi}{2}$, is :

(1) $\frac{17}{20}$

(2) $\frac{2}{5}$

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

(4) $-\frac{2}{5}$

Question Number : 11 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If $2x = y^{\frac{1}{5}} + y^{-\frac{1}{5}}$ and

$(x^2 - 1)\frac{d^2y}{dx^2} + \lambda x\frac{dy}{dx} + ky = 0$, then $\lambda + k$

is equal to :

(1) -23

(2) -24

(3) 26

(4) -26

Question Number : 12 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The function f defined by

$f(x) = x^3 - 3x^2 + 5x + 7$, is :

(1) increasing in **R**.

(2) decreasing in **R**.

(3) decreasing in $(0, \infty)$ and increasing in $(-\infty, 0)$.

(4) increasing in $(0, \infty)$ and decreasing in $(-\infty, 0)$.

Question Number : 13 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Let f be a polynomial function such that $f(3x) = f'(x) \cdot f''(x)$, for all $x \in \mathbf{R}$. Then :

(1) $f(2) + f'(2) = 28$

(2) $f''(2) - f'(2) = 0$

(3) $f''(2) - f(2) = 4$

(4) $f(2) - f'(2) + f''(2) = 10$

Question Number : 14 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If $f\left(\frac{3x-4}{3x+4}\right) = x + 2, x \neq -\frac{4}{3}$, and

$\int f(x)\,dx = A\log|1-x| + Bx + C$, then

the ordered pair (A, B) is equal to :

(where C is a constant of integration)

(1) $\left(\frac{8}{3}, \frac{2}{3}\right)$

(2) $\left(-\frac{8}{3}, \frac{2}{3}\right)$

(3) $\left(-\frac{8}{3}, -\frac{2}{3}\right)$

(4) $\left(\frac{8}{3}, -\frac{2}{3}\right)$

Question Number : 15 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If $\int_1^2 \frac{dx}{(x^2-2x+4)^{\frac{3}{2}}} = \frac{k}{k+5}$, then k is

equal to :

(1) 1

(2) 2

(3) 3

(4) 4

Question Number : 16 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If

$$\lim_{n\to\infty}\frac{1^a+2^a+.....+n^a}{(n+1)^{a-1}[(na+1)+(na+2)+.....+(na+n)]}=\frac{1}{60}$$

for some positive real number a, then a is equal to :

(1) 7

(2) 8

(3) $\frac{15}{2}$

(4) $\frac{17}{2}$

Question Number : 17 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A tangent to the curve, $y=f(x)$ at $P(x, y)$ meets x-axis at A and y-axis at B. If $AP : BP = 1 : 3$ and $f(1)=1$, then the curve also passes through the point :

(1) $\left(\frac{1}{3}, 24\right)$

(2) $\left(\frac{1}{2}, 4\right)$

(3) $\left(2, \frac{1}{8}\right)$

(4) $\left(3, \frac{1}{28}\right)$

Question Number : 18 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A square, of each side 2, lies above the x-axis and has one vertex at the origin. If one of the sides passing through the origin makes an angle $30°$ with the positive direction of the x-axis, then the sum of the x-coordinates of the vertices of the square is :

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

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

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

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

Question Number : 19 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A line drawn through the point P(4, 7) cuts the circle $x^2+y^2=9$ at the points A and B. Then PA·PB is equal to :

(1) 53

(2) 56

(3) 74

(4) 65

Question Number : 20 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The eccentricity of an ellipse having centre at the origin, axes along the co-ordinate axes and passing through the points $(4, -1)$ and $(-2, 2)$ is :

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

(2) $\frac{2}{\sqrt{5}}$

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

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

Question Number : 21 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If $y = mx + c$ is the normal at a point on the parabola $y^2 = 8x$ whose focal distance is 8 units, then $|c|$ is equal to :

(1) $2\sqrt{3}$

(2) $8\sqrt{3}$

(3) $10\sqrt{3}$

(4) $16\sqrt{3}$

Question Number : 22 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If a variable plane, at a distance of 3 units from the origin, intersects the coordinate axes at A, B and C, then the locus of the centroid of ΔABC is :

(1) $\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = 1$

(2) $\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = 3$

(3) $\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = \frac{1}{9}$

(4) $\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = 9$

Question Number : 23 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If the line, $\frac{x-3}{1} = \frac{y+2}{-1} = \frac{z+\lambda}{-2}$ lies in the plane, $2x - 4y + 3z = 2$, then the shortest distance between this line and the line, $\frac{x-1}{12} = \frac{y}{9} = \frac{z}{4}$ is :

(1) 2

(2) 1

(3) 0

(4) 3

Question Number : 24 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If the vector $\vec{b} = 3\hat{j} + 4\hat{k}$ is written as the sum of a vector $\vec{b_1}$, parallel to $\vec{a} = \hat{i} + \hat{j}$ and a vector $\vec{b_2}$, perpendicular to $\vec{a}$, then $\vec{b_1} \times \vec{b_2}$ is equal to :

(1) $-3\hat{i} + 3\hat{j} - 9\hat{k}$

(2) $6\hat{i} - 6\hat{j} + \frac{9}{2}\hat{k}$

(3) $-6\hat{i} + 6\hat{j} - \frac{9}{2}\hat{k}$

(4) $3\hat{i} - 3\hat{j} + 9\hat{k}$

Question Number : 25 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

From a group of 10 men and 5 women, four member committees are to be formed each of which must contain at least one woman. Then the probability for these committees to have more women than men, is :

(1) $\frac{21}{220}$

(2) $\frac{3}{11}$

(3) $\frac{1}{11}$

(4) $\frac{2}{23}$

Question Number : 26 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Let E and F be two independent events. The probability that both E and F happen is $\frac{1}{12}$ and the probability that neither E nor F happens is $\frac{1}{2}$, then a value of $\frac{P(E)}{P(F)}$ is :

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

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

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

(4) $\frac{5}{12}$

Question Number : 27 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The sum of 100 observations and the sum of their squares are 400 and 2475, respectively. Later on, three observations, 3, 4 and 5, were found to be incorrect. If the incorrect observations are omitted, then the variance of the remaining observations is :

(1) 8.25

(2) 8.50

(3) 8.00

(4) 9.00

Question Number : 28 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A value of x satisfying the equation $\sin[\cot^{-1}(1+x)] = \cos[\tan^{-1}x]$, is :

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

(2) -1

(3) 0

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

Question Number : 29 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The two adjacent sides of a cyclic quadrilateral are 2 and 5 and the angle between them is 60°. If the area of the quadrilateral is $4\sqrt{3}$, then the perimeter of the quadrilateral is :

(1) 12.5

(2) 13.2

(3) 12

(4) 13

Question Number : 30 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Contrapositive of the statement

'If two numbers are not equal, then their squares are not equal', is :

(1) If the squares of two numbers are equal, then the numbers are equal.

(2) If the squares of two numbers are equal, then the numbers are not equal.

(3) If the squares of two numbers are not equal, then the numbers are not equal.

(4) If the squares of two numbers are not equal, then the numbers are equal.

Physics

Section Number : 2
Number of Questions : 30
Number of Questions to be attempted : 30
Section Marks : 120

Question Number : 31 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A physical quantity P is described by the relation

$$P = a^{1/2} b^2 c^3 d^{-4}$$

If the relative errors in the measurement of a, b, c and d respectively, are 2%, 1%, 3% and 5%, then the relative error in P will be :

(1) 8%

(2) 12%

(3) 32%

(4) 25%

Question Number : 32 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A car is standing 200 m behind a bus, which is also at rest. The two start moving at the same instant but with different forward accelerations. The bus has acceleration 2 m/s^2 and the car has acceleration 4 m/s^2. The car will catch up with the bus after a time of :

(1) $\sqrt{110}$ s

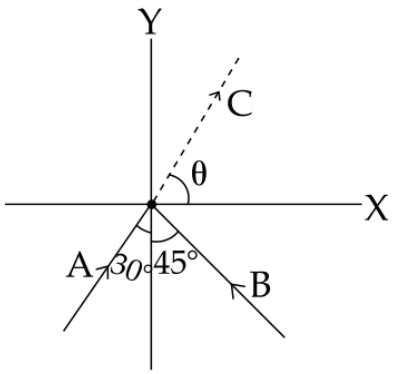
(2) $\sqrt{120}$ s

(3) $10\sqrt{2}$ s

(4) 15 s

Question Number : 33 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Two particles A and B of equal mass M are moving with the same speed v as shown in the figure. They collide completely inelastically and move as a single particle C. The angle θ that the path of C makes with the X-axis is given by :



(1) $\tan\theta = \dfrac{\sqrt{3}+\sqrt{2}}{1-\sqrt{2}}$

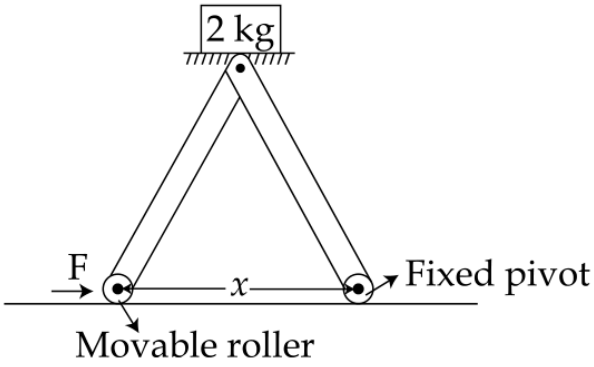
(2) $\tan\theta = \dfrac{\sqrt{3}-\sqrt{2}}{1-\sqrt{2}}$

(3) $\tan\theta = \dfrac{1-\sqrt{2}}{\sqrt{2}\left(1+\sqrt{3}\right)}$

(4) $\tan\theta = \dfrac{1-\sqrt{3}}{1+\sqrt{2}}$

Question Number : 34 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The machine as shown has 2 rods of length 1 m connected by a pivot at the top. The end of one rod is connected to the floor by a stationary pivot and the end of the other rod has a roller that rolls along the floor in a slot. As the roller goes back and forth, a 2 kg weight moves up and down. If the roller is moving towards right at a constant speed, the weight moves up with a :



(1) constant speed

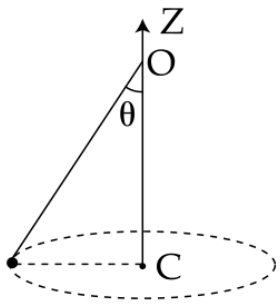
(2) decreasing speed

(3) increasing speed

(4) speed which is $\frac{3}{4}$th of that of the roller when the weight is 0.4 m above the ground

Question Number : 35 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A conical pendulum of length 1 m makes an angle $\theta = 45°$ w.r.t. Z-axis and moves in a circle in the XY plane. The radius of the circle is 0.4 m and its center is vertically below O. The speed of the pendulum, in its circular path, will be : (Take $g = 10\ ms^{-2}$)



(1) 0.4 m/s

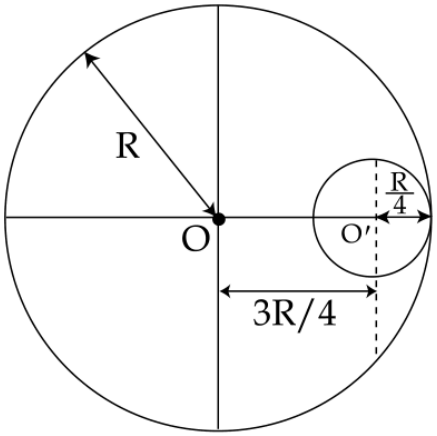
(2) 4 m/s

(3) 0.2 m/s

(4) 2 m/s

Question Number : 36 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A circular hole of radius $\frac{R}{4}$ is made in a thin uniform disc having mass M and radius R, as shown in figure. The moment of inertia of the remaining portion of the disc about an axis passing through the point O and perpendicular to the plane of the disc is :



(1) $\frac{219\,MR^2}{256}$

(2) $\frac{237\,MR^2}{512}$

(3) $\frac{19\,MR^2}{512}$

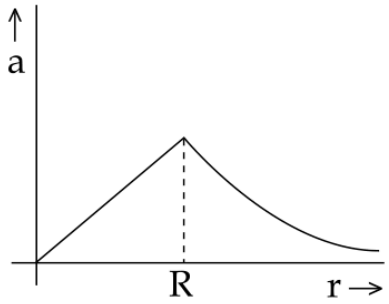
(4) $\frac{197\,MR^2}{256}$

Question Number : 37 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

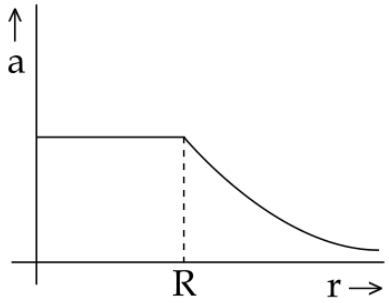
The mass density of a spherical body is given by $\rho(r) = \frac{k}{r}$ for $r \le R$ and $\rho(r) = 0$ for $r > R$,
where r is the distance from the centre.

The correct graph that describes qualitatively the acceleration, a, of a test particle as a function of r is :

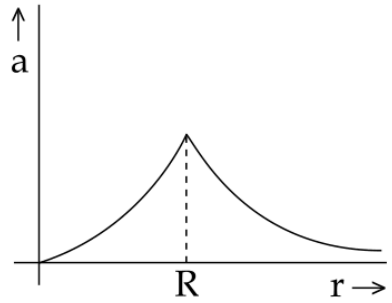
(1)



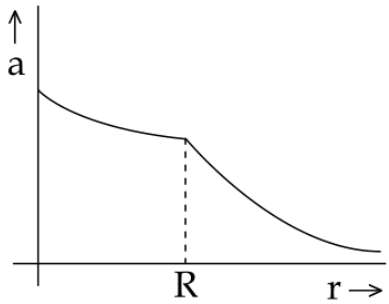
(2)



(3)



(4)



Question Number : 38 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A steel rail of length 5 m and area of cross section $40\,cm^2$ is prevented from expanding along its length while the temperature rises by 10°C. If coefficient of linear expansion and Young's modulus of steel are $1.2\times10^{-5}\ K^{-1}$ and $2\times10^{11}\ Nm^{-2}$ respectively, the force developed in the rail is approximately :

(1) 2×10^{7} N

(2) 1×10^{5} N

(3) 2×10^{9} N

(4) 3×10^{-5} N

Question Number : 39 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Two tubes of radii r_1 and r_2, and lengths l_1 and l_2, respectively, are connected in series and a liquid flows through each of them in stream line conditions. P_1 and P_2 are pressure differences across the two tubes.

If P_2 is $4P_1$ and l_2 is $\frac{l_1}{4}$, then the radius r_2 will be equal to :

(1) r_1

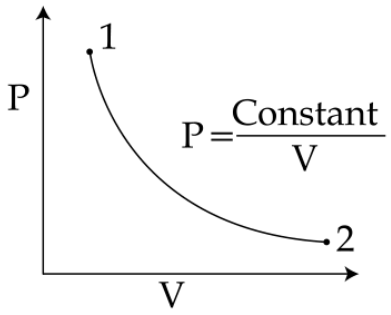
(2) $2r_1$

(3) $4r_1$

(4) $\frac{r_1}{2}$

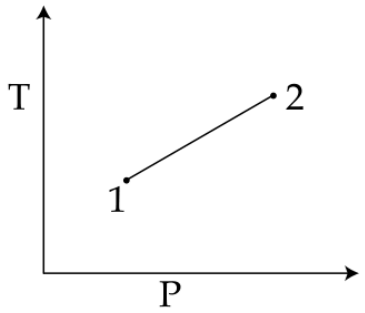
Question Number : 40 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

For the P-V diagram given for an ideal gas,

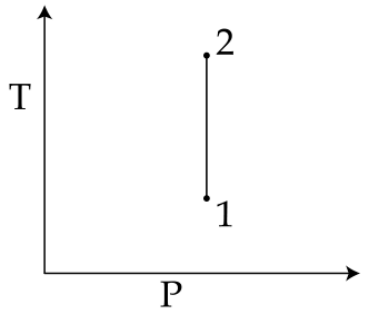


out of the following which one correctly represents the T-P diagram ?

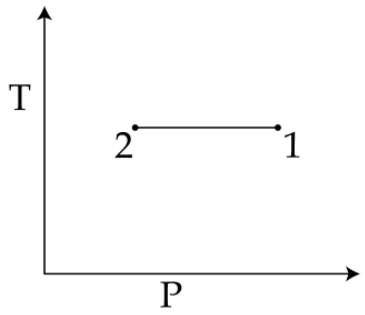
(1)



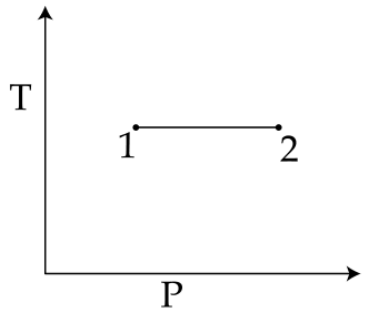
(2)



(3)



(4)



Question Number : 41 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

N moles of a diatomic gas in a cylinder are at a temperature T. Heat is supplied to the cylinder such that the temperature remains constant but n moles of the diatomic gas get converted into monoatomic gas. What is the change in the total kinetic energy of the gas ?

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

(2) 0

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

(4) $\frac{5}{2}$ nRT

Question Number : 42 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A block of mass 0.1 kg is connected to an elastic spring of spring constant 640 Nm^{-1} and oscillates in a damping medium of damping constant 10^{-2} kg s^{-1}. The system dissipates its energy gradually. The time taken for its mechanical energy of vibration to drop to half of its initial value, is closest to :

(1) 2 s

(2) 3.5 s

(3) 5 s

(4) 7 s

Question Number : 43 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A standing wave is formed by the superposition of two waves travelling in opposite directions. The transverse displacement is given by

$$y(x, t) = 0.5 \sin\left(\frac{5\pi}{4} x\right) \cos(200\pi t).$$

What is the speed of the travelling wave moving in the positive x direction ?

(x and t are in meter and second, respectively.)

(1) 160 m/s

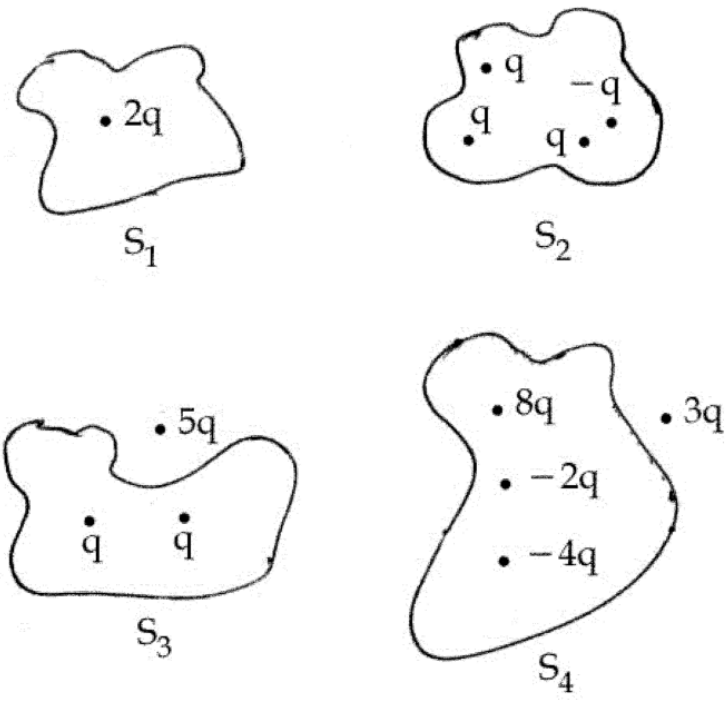
(2) 90 m/s

(3) 180 m/s

(4) 120 m/s

Question Number : 44 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Four closed surfaces and corresponding charge distributions are shown below.



Let the respective electric fluxes through the surfaces be Φ_1, Φ_2, Φ_3 and Φ_4. Then :

(1) $\Phi_1 < \Phi_2 = \Phi_3 > \Phi_4$

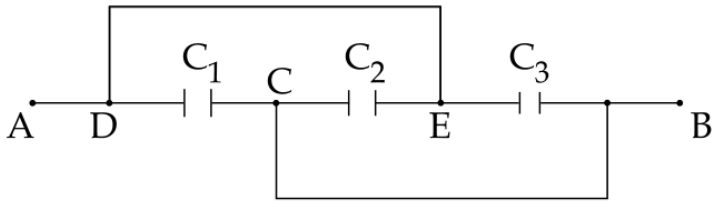
(2) $\Phi_1 > \Phi_2 > \Phi_3 > \Phi_4$

(3) $\Phi_1 = \Phi_2 = \Phi_3 = \Phi_4$

(4) $\Phi_1 > \Phi_3$; $\Phi_2 < \Phi_4$

Question Number : 45 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A combination of parallel plate capacitors is maintained at a certain potential difference.



When a 3 mm thick slab is introduced between all the plates, in order to maintain the same potential difference, the distance between the plates is increased by 2.4 mm. Find the dielectric constant of the slab.

(1) 3

(2) 4

(3) 5

(4) 6

Question Number : 46 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A uniform wire of length l and radius r has a resistance of 100 Ω. It is recast into a wire of radius $\frac{r}{2}$. The resistance of new wire will be :

(1) 1600 Ω

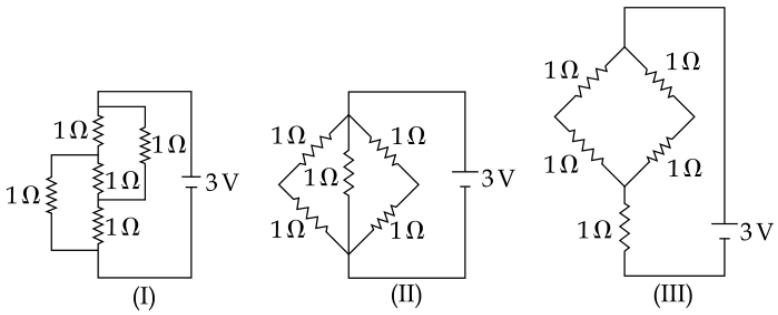
(2) 400 Ω

(3) 200 Ω

(4) 100 Ω

Question Number : 47 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The figure shows three circuits I, II and III which are connected to a 3V battery. If the powers dissipated by the configurations I, II and III are P_1, P_2 and P_3 respectively, then :



(1) $P_1 > P_2 > P_3$

(2) $P_1 > P_3 > P_2$

(3) $P_2 > P_1 > P_3$

(4) $P_3 > P_2 > P_1$

Question Number : 48 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A negative test charge is moving near a long straight wire carrying a current. The force acting on the test charge is parallel to the direction of the current. The motion of the charge is :

(1) away from the wire

(2) towards the wire

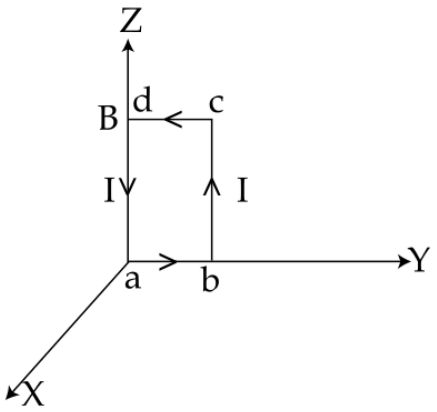
(3) parallel to the wire along the current

(4) parallel to the wire opposite to the current

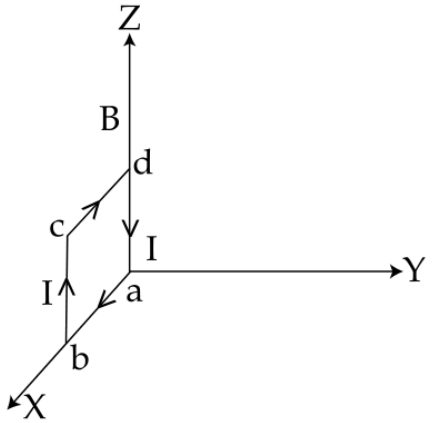
Question Number : 49 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A uniform magnetic field B of 0.3 T is along the positive Z-direction. A rectangular loop (abcd) of sides 10 cm × 5 cm carries a current I of 12 A. Out of the following different orientations which one corresponds to stable equilibrium ?

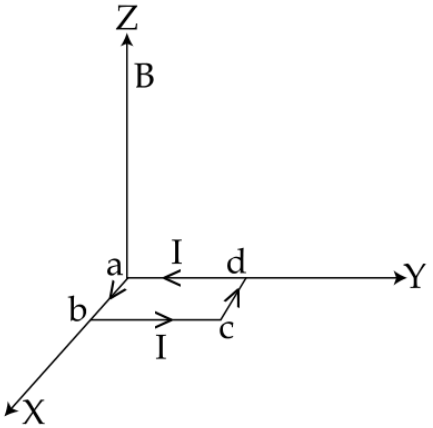
(1)



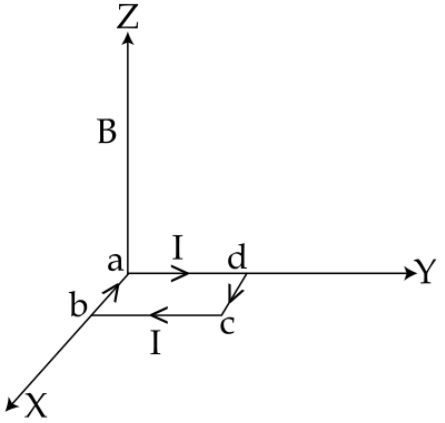
(2)



(3)



(4)



Question Number : 50 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A sinusoidal voltage of peak value 283 V and angular frequency 320/s is applied to a series LCR circuit. Given that $R = 5\ \Omega$, $L = 25$ mH and $C = 1000\ \mu F$. The total impedance, and phase difference between the voltage across the source and the current will respectively be :

(1) $10\ \Omega$ and $\tan^{-1}\left(\frac{5}{3}\right)$

(2) $7\ \Omega$ and $45°$

(3) $10\ \Omega$ and $\tan^{-1}\left(\frac{8}{3}\right)$

(4) $7\ \Omega$ and $\tan^{-1}\left(\frac{5}{3}\right)$

Question Number : 51 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The electric field component of a monochromatic radiation is given by

$$\vec{E} = 2E_0\ \hat{i}\ \cos kz \cos \omega t$$

Its magnetic field $\vec{B}$ is then given by :

(1) $\frac{2E_0}{c}\ \hat{j}\ \sin kz \cos \omega t$

(2) $-\frac{2E_0}{c}\ \hat{j}\ \sin kz \sin \omega t$

(3) $\frac{2E_0}{c}\ \hat{j}\ \sin kz \sin \omega t$

(4) $\frac{2E_0}{c}\ \hat{j}\ \cos kz \cos \omega t$

Question Number : 52 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

In an experiment a convex lens of focal length 15 cm is placed coaxially on an optical bench in front of a convex mirror at a distance of 5 cm from it. It is found that an object and its image coincide, if the object is placed at a distance of 20 cm from the lens. The focal length of the convex mirror is :

(1) 27.5 cm

(2) 20.0 cm

(3) 25.0 cm

(4) 30.5 cm

Question Number : 53 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A single slit of width 0.1 mm is illuminated by a parallel beam of light of wavelength 6000 Å and diffraction bands are observed on a screen 0.5 m from the slit. The distance of the third dark band from the central bright band is :

(1) 3 mm

(2) 9 mm

(3) 4.5 mm

(4) 1.5 mm

Question Number : 54 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A Laser light of wavelength 660 nm is used to weld Retina detachment. If a Laser pulse of width 60 ms and power 0.5 kW is used the approximate number of photons in the pulse are :
[Take Planck's constant $h = 6.62 \times 10^{-34}$ Js]

(1) 10^{20}

(2) 10^{18}

(3) 10^{22}

(4) 10^{19}

Question Number : 55 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The acceleration of an electron in the first orbit of the hydrogen atom (n = 1) is :

(1) $\frac{h^2}{\pi^2 m^2 r^3}$

(2) $\frac{h^2}{8\pi^2 m^2 r^3}$

(3) $\frac{h^2}{4\pi^2 m^2 r^3}$

(4) $\frac{h^2}{4\pi m^2 r^3}$

Question Number : 56 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Imagine that a reactor converts all given mass into energy and that it operates at a power level of 10^9 watt. The mass of the fuel consumed per hour in the reactor will be : (velocity of light, c is 3×10^8 m/s)

(1) 0.96 gm

(2) 0.8 gm

(3) 4×10^{-2} gm

(4) 6.6×10^{-5} gm

Question Number : 57 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The current gain of a common emitter amplifier is 69. If the emitter current is 7.0 mA, collector current is :

(1) 9.6 mA

(2) 6.9 mA

(3) 0.69 mA

(4) 69 mA

Question Number : 58 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A signal is to be transmitted through a wave of wavelength λ, using a linear antenna. The length l of the antenna and effective power radiated P_{eff} will be given respectively as :
(K is a constant of proportionality)

(1) $\lambda, P_{eff} = K\left(\frac{l}{\lambda}\right)^2$

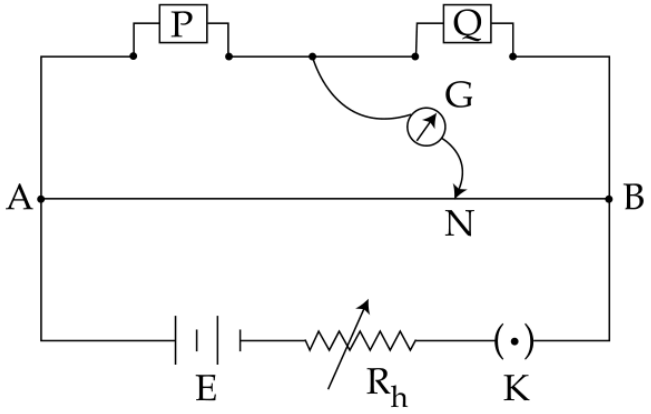
(2) $\frac{\lambda}{8}, P_{eff} = K\left(\frac{l}{\lambda}\right)$

(3) $\frac{\lambda}{16}, P_{eff} = K\left(\frac{l}{\lambda}\right)^3$

(4) $\frac{\lambda}{5}, P_{eff} = K\left(\frac{l}{\lambda}\right)^{\frac{1}{2}}$

Question Number : 59 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

In a meter bridge experiment resistances are connected as shown in the figure. Initially resistance P = 4 Ω and the neutral point N is at 60 cm from A. Now an unknown resistance R is connected in series to P and the new position of the neutral point is at 80 cm from A. The value of unknown resistance R is :



(1) $\frac{33}{5}\ \Omega$

(2) $6\ \Omega$

(3) $7\ \Omega$

(4) $\frac{20}{3}\ \Omega$

Question Number : 60 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

In an experiment to determine the period of a simple pendulum of length 1 m, it is attached to different spherical bobs of radii r_1 and r_2. The two spherical bobs have uniform mass distribution. If the relative difference in the periods, is found to be 5×10^{-4} s, the difference in radii, $|r_1 - r_2|$ is best given by :

(1) 1 cm

(2) 0.1 cm

(3) 0.5 cm

(4) 0.01 cm

- o 0 o -

Chemistry

Section Number :	3
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120

Question Number : 61 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

An ideal gas undergoes isothermal expansion at constant pressure. During the process :

(1) enthalpy increases but entropy decreases.

(2) enthalpy remains constant but entropy increases.

(3) enthalpy decreases but entropy increases.

(4) Both enthalpy and entropy remain constant.

Question Number : 62 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

50 mL of 0.2 M ammonia solution is treated with 25 mL of 0.2 M HCl. If pK_b of ammonia solution is 4.75, the pH of the mixture will be :

(1) 3.75

(2) 4.75

(3) 8.25

(4) 9.25

Question Number : 63 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The electron in the hydrogen atom undergoes transition from higher orbitals to orbital of radius 211.6 pm. This transition is associated with :

(1) Lyman series

(2) Balmer series

(3) Paschen series

(4) Brackett series

Question Number : 64 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

At 300 K, the density of a certain gaseous molecule at 2 bar is double to that of dinitrogen (N_2) at 4 bar. The molar mass of gaseous molecule is :

(1) 28 g mol^{-1}

(2) 56 g mol^{-1}

(3) 112 g mol^{-1}

(4) 224 g mol^{-1}

Question Number : 65 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

What quantity (in mL) of a 45% acid solution of a mono-protic strong acid must be mixed with a 20% solution of the same acid to produce 800 mL of a 29.875% acid solution ?

(1) 320

(2) 325

(3) 316

(4) 330

Question Number : 66 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

To find the standard potential of M^{3+}/M electrode, the following cell is constituted : $Pt/M/M^{3+}(0.001\ mol\ L^{-1})/Ag^{+}(0.01\ mol\ L^{-1})/Ag$

The emf of the cell is found to be 0.421 volt at 298 K. The standard potential of half reaction $M^{3+} + 3e^{-} \rightarrow M$ at 298 K will be :

(Given $E^{\ominus}_{Ag^{+}/Ag}$ at 298 K = 0.80 Volt)

(1) 0.38 Volt

(2) 0.32 Volt

(3) 1.28 Volt

(4) 0.66 Volt

Question Number : 67 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A gas undergoes change from state A to state B. In this process, the heat absorbed and work done by the gas is 5 J and 8 J, respectively. Now gas is brought back to A by another process during which 3 J of heat is evolved. In this reverse process of B to A :

(1) 10 J of the work will be done by the gas.

(2) 6 J of the work will be done by the gas.

(3) 10 J of the work will be done by the surrounding on gas.

(4) 6 J of the work will be done by the surrounding on gas.

Question Number : 68 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Adsorption of a gas on a surface follows Freundlich adsorption isotherm. Plot of $\log\frac{x}{m}$ versus log p gives a straight line with slope equal to 0.5, then :

($\frac{x}{m}$ is the mass of the gas adsorbed per gram of adsorbent)

(1) Adsorption is independent of pressure.

(2) Adsorption is proportional to the pressure.

(3) Adsorption is proportional to the square root of pressure.

(4) Adsorption is proportional to the square of pressure.

Question Number : 69 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The rate of a reaction quadruples when the temperature changes from 300 to 310 K. The activation energy of this reaction is :

(Assume activation energy and pre-exponential factor are independent of temperature; ln $2 = 0.693$; $R = 8.314$ J mol^{-1} K^{-1})

(1) 107.2 kJ mol^{-1}

(2) 53.6 kJ mol^{-1}

(3) 26.8 kJ mol^{-1}

(4) 214.4 kJ mol^{-1}

Question Number : 70 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A solution is prepared by mixing 8.5 g of CH_2Cl_2 and 11.95 g of $CHCl_3$. If vapour pressure of CH_2Cl_2 and $CHCl_3$ at 298 K are 415 and 200 mmHg respectively, the mole fraction of $CHCl_3$ in vapour form is : (Molar mass of $Cl = 35.5\ g\ mol^{-1}$)

(1) 0.162

(2) 0.675

(3) 0.325

(4) 0.486

Question Number : 71 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The electronic configuration with the highest ionization enthalpy is :

(1) $[Ne]\ 3s^2\ 3p^1$

(2) $[Ne]\ 3s^2\ 3p^2$

(3) $[Ne]\ 3s^2\ 3p^3$

(4) $[Ar]\ 3d^{10}\ 4s^2\ 4p^3$

Question Number : 72 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The following reaction occurs in the Blast Furnace where iron ore is reduced to iron metal :

$$Fe_2O_3(s) + 3\ CO(g) \rightleftharpoons 2\ Fe(l) + 3\ CO_2(g)$$

Using the Le Chatelier's principle, predict which one of the following will **not** disturb the equilibrium ?

(1) Removal of CO

(2) Removal of CO_2

(3) Addition of CO_2

(4) Addition of Fe_2O_3

Question Number : 73 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Which one of the following is an oxide ?

(1) KO_2

(2) BaO_2

(3) SiO_2

(4) CsO_2

Question Number : 74 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Which of the following is a set of green house gases ?

(1) CH_4, O_3, N_2, SO_2

(2) O_3, N_2, CO_2, NO_2

(3) O_3, NO_2, SO_2, Cl_2

(4) CO_2, CH_4, N_2O, O_3

Question Number : 75 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The group having triangular planar structures is :

(1) BF_3, NF_3, CO_3^{2-}

(2) CO_3^{2-} , NO_3^- , SO_3

(3) NH_3, SO_3, CO_3^{2-}

(4) NCl_3, BCl_3, SO_3

Question Number : 76 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

XeF_6 on partial hydrolysis with water produces a compound 'X'. The same compound 'X' is formed when XeF_6 reacts with silica. The compound 'X' is :

(1) XeF_2

(2) XeF_4

(3) $XeOF_4$

(4) XeO_3

Question Number : 77 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The number of $P-OH$ bonds and the oxidation state of phosphorus atom in pyrophosphoric acid ($H_4P_2O_7$) respectively are :

(1) four and four

(2) five and four

(3) five and five

(4) four and five

Question Number : 78 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Which of the following ions does **not** liberate hydrogen gas on reaction with dilute acids ?

(1) Ti^{2+}

(2) V^{2+}

(3) Cr^{2+}

(4) Mn^{2+}

Question Number : 79 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The correct sequence of decreasing number of π-bonds in the structures of H_2SO_3, H_2SO_4 and $H_2S_2O_7$ is :

(1) $H_2SO_3 > H_2SO_4 > H_2S_2O_7$

(2) $H_2SO_4 > H_2S_2O_7 > H_2SO_3$

(3) $H_2S_2O_7 > H_2SO_4 > H_2SO_3$

(4) $H_2S_2O_7 > H_2SO_3 > H_2SO_4$

Question Number : 80 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

$[Co_2(CO)_8]$ displays :

(1) one Co – Co bond, six terminal CO and two bridging CO

(2) one Co – Co bond, four terminal CO and four bridging CO

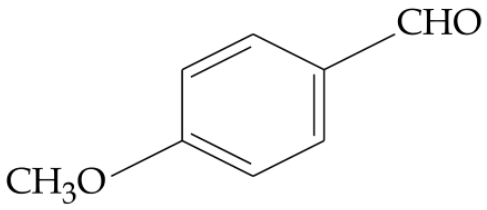
(3) no Co – Co bond, six terminal CO and two bridging CO

(4) no Co – Co bond, four terminal CO and four bridging CO

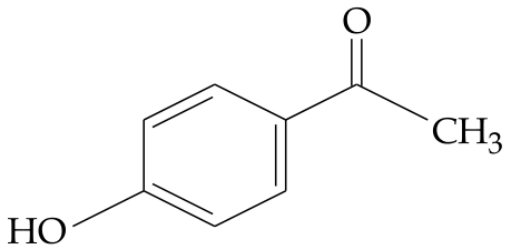
Question Number : 81 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A compound of molecular formula $C_8H_8O_2$ reacts with acetophenone to form a single cross-aldol product in the presence of base. The same compound on reaction with conc. NaOH forms benzyl alcohol as one of the products. The structure of the compound is :

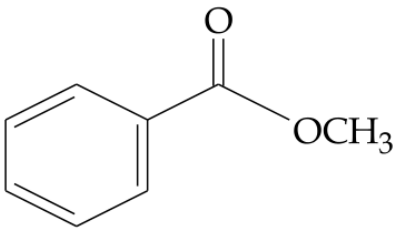
(1)



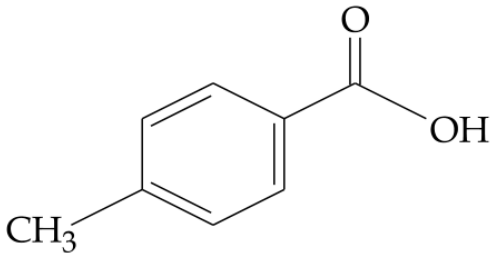
(2)



(3)

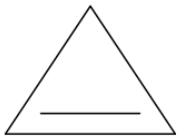


(4)

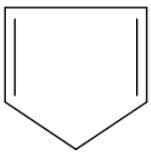


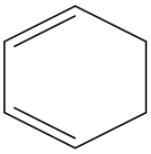
Question Number : 82 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Which of the following compounds is most reactive to an aqueous solution of sodium carbonate ?

(1) 

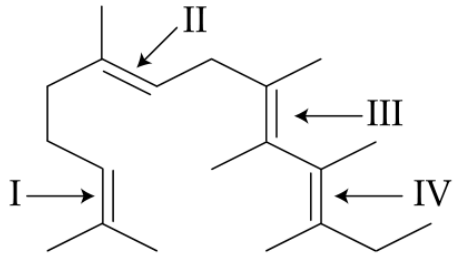
(2) 

(3) 

(4) 

Question Number : 83 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

In the following structure, the double bonds are marked as I, II, III and IV



Geometrical isomerism is **not** possible at site (s) :

(1) III

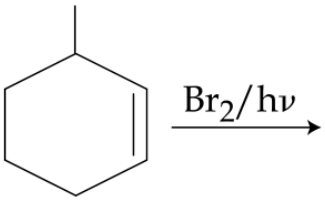
(2) I

(3) I and III

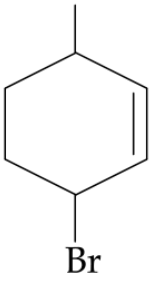
(4) III and IV

Question Number : 84 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

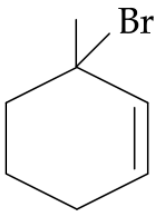
The major product of the following reaction is :



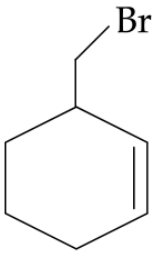
(1)



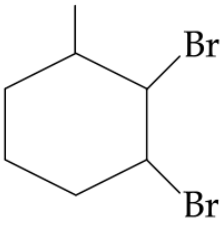
(2)



(3)



(4)



Question Number : 85 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The **incorrect** statement among the following is :

(1) α-D-glucose and β-D-glucose are anomers.

(2) α-D-glucose and β-D-glucose are enantiomers.

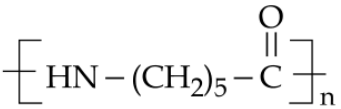
(3) Cellulose is a straight chain polysaccharide made up of only β-D-glucose units.

(4) The penta acetate of glucose does not react with hydroxyl amine.

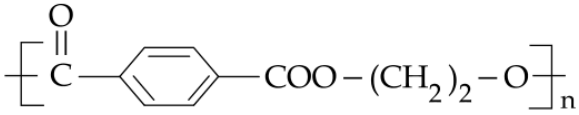
Question Number : 86 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Which of the following is a biodegradable polymer ?

(1) 

(2) 

(3) 

(4) 

Question Number : 87 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The increasing order of the boiling points for the following compounds is :

C_2H_5OH (I) C_2H_5Cl (II) $C_2H_5CH_3$ (III)

$C_2H_5OCH_3$ (IV)

(1) (III) < (IV) < (II) < (I)

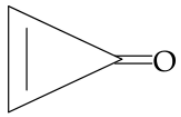
(2) (IV) < (III) < (I) < (II)

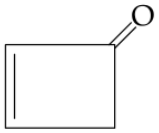
(3) (II) < (III) < (IV) < (I)

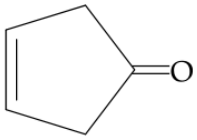
(4) (III) < (II) < (I) < (IV)

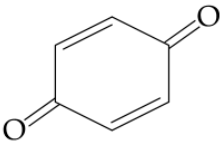
Question Number : 88 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Which of the following compounds will show highest dipole moment ?

(I) 

(II) 

(III) 

(IV) 

(1) (I)

(2) (II)

(3) (III)

(4) (IV)

Question Number : 89 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

In the following reaction sequence :

$$\underset{(C_3H_6Cl_2)}{I} \xrightarrow{KOH(aq)} II \xrightarrow[(ii)\ H_2O/H^+]{(i)\ CH_3MgBr} III$$

$$\xrightarrow{Anhy.\,ZnCl_2 + Con.\,HCl} \text{gives turbidity immediately}$$

The compound I is :

(1) $CH_2(Cl)-CH(Cl)-CH_3$

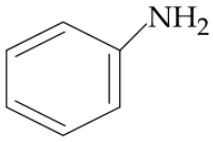
(2) $CH_2(Cl)-CH_2-CH_2(Cl)$

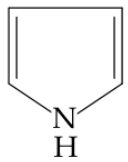
(3) $Cl-CH(Cl)-CH_2-CH_3$

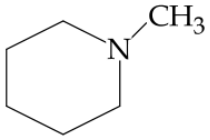
(4) $CH_3-C(Cl)(Cl)-CH_3$

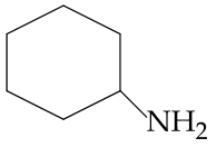
Question Number : 90 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Among the following compounds, the increasing order of their basic strength is :

(I) 

(II) 

(III) 

(IV) 

(1) (I) < (II) < (IV) < (III)

(2) (I) < (II) < (III) < (IV)

(3) (II) < (I) < (IV) < (III)

(4) (II) < (I) < (III) < (IV)