Central Board of Secondary Education

Question Paper Name :	JEE Main 2014 Paper 1 (B.E./B.Tech) Apr 19 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

Let $f : \mathbf{R} \to \mathbf{R}$ be defined by $f(x) = \dfrac{|x| - 1}{|x| + 1}$

then f is :

(1) both 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

For all complex numbers z of the form $1 + i\alpha$, $\alpha \in \mathbf{R}$, if $z^2 = x + iy$, then :

(1) $y^2 - 4x + 2 = 0$

(2) $y^2 + 4x - 4 = 0$

(3) $y^2 - 4x + 4 = 0$

(4) $y^2 + 4x + 2 = 0$

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

The equation $\sqrt{3x^2 + x + 5} = x - 3$, where x is real, has :

(1) no solution

(2) exactly one solution

(3) exactly two solutions

(4) exactly four solutions.

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

Let A and B be any two 3×3 matrices. If

A is symmetric and B is skewsymmetric,

then the matrix $AB-BA$ is :

(1) skewsymmetric

(2) symmetric

(3) neither symmetric nor skewsymmetric

(4) I or $-I$, where I is an identity matrix.

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

If

$$\Delta_r = \begin{vmatrix} r & 2r-1 & 3r-2 \\ \frac{n}{2} & n-1 & a \\ \frac{1}{2}n(n-1) & (n-1)^2 & \frac{1}{2}(n-1)(3n+4) \end{vmatrix},$$

then the value of $\sum_{r=1}^{n-1}\Delta_r$:

(1) depends only on a

(2) depends only on n

(3) depends both on a and n

(4) is independent of both a and n.

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

Two women and some men participated in a chess tournament in which every participant played two games with each of the other participants. If the number of games that the men played between themselves exceeds the number of games that the men played with the women by 66, then the number of men who participated in the tournament lies in the interval :

(1) [8, 9]

(2) [10, 12)

(3) (11, 13]

(4) (14, 17)

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

The coefficient of x^{1012} in the expansion of $(1+x^{n}+x^{253})^{10}$, (where $n \leq 22$ is any positive integer), is :

(1) 1

(2) ${}^{10}C_4$

(3) 4n

(4) ${}^{253}C_4$

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

The number of terms in an A.P. is even; the sum of the odd terms in it is 24 and that the even terms is 30. If the last term exceeds the first term by $10\frac{1}{2}$, then the number of terms in the A.P. is :

(1) 4

(2) 8

(3) 12

(4) 16

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

Let $f(n) = \left[\frac{1}{3} + \frac{3n}{100}\right]n$, where $[n]$ denotes the greatest integer less than or equal to n.

Then $\sum_{n=1}^{56} f(n)$ is equal to :

(1) 56

(2) 689

(3) 1287

(4) 1399

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

If the function

$$f(x) = \begin{cases} \frac{\sqrt{2 + \cos x} - 1}{(\pi - x)^2}, & x \neq \pi \\ k, & x = \pi \end{cases}$$

is continuous at $x = \pi$, then k equals :

(1) 0

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

(3) 2

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

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

Let $f: \mathbf{R} \to \mathbf{R}$ be a function such that $|f(x)| \leq x^2$, for all $x \in \mathbf{R}$. Then, at $x = 0$, f is :

(1) continuous but not differentiable

(2) continuous as well as differentiable

(3) neither continuous nor differentiable

(4) differentiable but not continuous.

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

If non-zero real numbers b and c are such that $min\ f(x) > max\ g(x)$, where

$f(x) = x^2 + 2bx + 2c^2$ and

$g(x) = -x^2 - 2cx + b^2$ $(x \in \mathbf{R})$;

then $\left|\frac{c}{b}\right|$ lies in the interval :

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

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

(3) $\left[\frac{1}{\sqrt{2}}, \sqrt{2}\right]$

(4) $\left(\sqrt{2}, \infty\right)$

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

If the volume of a spherical ball is increasing at the rate of 4π cc/sec, then the rate of increase of its radius (in cm/sec), when the volume is 288π cc, is :

(1) $\frac{1}{6}$

(2) $\frac{1}{9}$

(3) $\frac{1}{36}$

(4) $\frac{1}{24}$

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

If m is a non - zero number and

$$\int \frac{x^{5m-1}+2x^{4m-1}}{\left(x^{2m}+x^{m}+1\right)^{3}}\,dx = f(x)+c\ ,$$

then $f(x)$ is :

(1) $\dfrac{x^{5m}}{2m\left(x^{2m}+x^{m}+1\right)^{2}}$

(2) $\dfrac{x^{4m}}{2m\left(x^{2m}+x^{m}+1\right)^{2}}$

(3) $\dfrac{2m\left(x^{5m}+x^{4m}\right)}{\left(x^{2m}+x^{m}+1\right)^{2}}$

(4) $\dfrac{\left(x^{5m}-x^{4m}\right)}{2m\left(x^{2m}+x^{m}+1\right)^{2}}$

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

Let function F be defined as

$F(x) = \int_{1}^{x} \frac{e^{t}}{t}\,dt\ , x>0$ then the value of

the integral $\int_{1}^{x} \frac{e^{t}}{t+a}\,dt$, where

$a > 0$, is :

(1) $e^{a}[F(x)-F(1+a)]$

(2) $e^{-a}[F(x+a)-F(a)]$

(3) $e^{a}[F(x+a)-F(1+a)]$

(4) $e^{-a}[F(x+a)-F(1+a)]$

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

The area of the region above the x-axis bounded by the curve $y = \tan x, 0 \le x \le \frac{\pi}{2}$ and the tangent to the curve at $x = \frac{\pi}{4}$ is :

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

(2) $\frac{1}{2}\left(\log 2 + \frac{1}{2}\right)$

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

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

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

If $\frac{dy}{dx} + y \tan x = \sin 2x$ and $y(0) = 1$, then $y(\pi)$ is equal to :

(1) 1

(2) -1

(3) -5

(4) 5

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

The circumcentre of a triangle lies at the origin and its centroid is the mid point of the line segment joining the points (a^2+1, a^2+1) and $(2a, -2a)$, $a \neq 0$. Then for any a, the orthocentre of this triangle lies on the line :

(1) $y - 2ax = 0$

(2) $y - (a^2+1)x = 0$

(3) $y + x = 0$

(4) $(a-1)^2x - (a+1)^2y = 0$

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

If a line L is perpendicular to the line $5x-y=1$, and the area of the triangle formed by the line L and the coordinate axes is 5, then the distance of line L from the line $x+5y=0$ is :

(1) $\frac{7}{\sqrt{5}}$

(2) $\frac{5}{\sqrt{13}}$

(3) $\frac{7}{\sqrt{13}}$

(4) $\frac{5}{\sqrt{7}}$

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

The equation of the circle described on the chord $3x+y+5=0$ of the circle $x^2+y^2=16$ as diameter is :

(1) $x^2+y^2+3x+y-11=0$

(2) $x^2+y^2+3x+y+1=0$

(3) $x^2+y^2+3x+y-2=0$

(4) $x^2+y^2+3x+y-22=0$

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

A chord is drawn through the focus of the parabola $y^2 = 6x$ such that its distance from the vertex of this parabola is $\frac{\sqrt{5}}{2}$, then its slope can be :

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

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

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

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

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

The tangent at an extremity (in the first quadrant) of latus rectum of the hyperbola $\frac{x^2}{4} - \frac{y^2}{5} = 1$, meets x - axis and y - axis at A and B respectively. Then $(OA)^2 - (OB)^2$, where O is the origin, equals :

(1) $-\frac{20}{9}$

(2) $\frac{16}{9}$

(3) 4

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

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

Equation of the line of the shortest distance between the lines $\frac{x}{1} = \frac{y}{-1} = \frac{z}{1}$ and $\frac{x-1}{0} = \frac{y+1}{-2} = \frac{z}{1}$ is :

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

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

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

(4) $\frac{x}{-2} = \frac{y}{1} = \frac{z}{2}$

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

If the angle between the line $2(x+1) = y = z+4$ and the plane $2x - y + \sqrt{\lambda}\, z + 4 = 0$ is $\frac{\pi}{6}$, then the value of λ is :

(1) $\frac{135}{7}$

(2) $\frac{45}{11}$

(3) $\frac{45}{7}$

(4) $\frac{135}{11}$

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

If $\vec{x} = 3\hat{i} - 6\hat{j} - \hat{k}$, $\vec{y} = \hat{i} + 4\hat{j} - 3\hat{k}$ and $\vec{z} = 3\hat{i} - 4\hat{j} - 12\hat{k}$, then the magnitude of the projection of $\vec{x} \times \vec{y}$ on $\vec{z}$ is :

(1) 12

(2) 15

(3) 14

(4) 13

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

Let A and E be any two events with positive probabilities :

Statement - 1 : $P(E/A) \geq P(A/E)P(E)$

Statement - 2 : $P(A/E) \geq P(A \cap E)$.

(1) Both the statements are true

(2) Both the statements are false

(3) Statement - 1 is true, Statement - 2 is false

(4) Statement - 1 is false, Statement - 2 is true.

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

Let $\bar{x}$, M and σ^2 be respectively the mean, mode and variance of n observations $x_1, x_2, ..., x_n$ and $d_i = -x_i - a$, $i = 1, 2, ..., n$, where a is any number.

Statement I : Variance of $d_1, d_2, ..., d_n$ is σ^2.

Statement II : Mean and mode of $d_1, d_2, ..., d_n$ are $-\bar{x} - a$ and $-M - a$, respectively

(1) Statement I and Statement II are both false

(2) Statement I and Statement II are both true

(3) Statement I is true and Statement II is false

(4) Statement I is false and Statement II is true

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

The function $f(x) = |\sin 4x| + |\cos 2x|$, is a periodic function with period :

(1) 2π

(2) π

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

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

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

The principal value of $\tan^{-1}\left(\cot\frac{43\pi}{4}\right)$ is :

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

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

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

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

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

The contrapositive of the statement "if I am not feeling well, then I will go to the doctor" is :

(1) If I am feeling well, then I will not go to the doctor

(2) If I will go to the doctor, then I am feeling well

(3) If I will not go to the doctor, then I am feeling well

(4) If I will go to the doctor, then I am not feeling well.

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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

Match **List - I** (Event) with **List - II** (Order of the time interval for happening of the event) and select the correct option from the options given below the lists.

List - I		**List - II**	
(a)	Rotation period of earth	(i)	10^5 s
(b)	Revolution period of earth	(ii)	10^7 s
(c)	Period of a light wave	(iii)	10^{-15} s
(d)	Period of a sound wave	(iv)	10^{-3} s

(1) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

(2) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

(3) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

(4) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

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

A bullet looses $\left(\frac{1}{n}\right)^{th}$ of its velocity passing through one plank. The number of such planks that are required to stop the bullet can be :

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

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

(3) Infinite

(4) n

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

A heavy box is to be dragged along a rough horizontal floor. To do so, person A pushes it at an angle 30° from the horizontal and requires a minimum force F_A, while person B pulls the box at an angle 60° from the horizontal and needs minimum force F_B.

If the coefficient of friction between the box and the floor is $\frac{\sqrt{3}}{5}$, the ratio $\frac{F_A}{F_B}$ is :

(1) $\sqrt{3}$

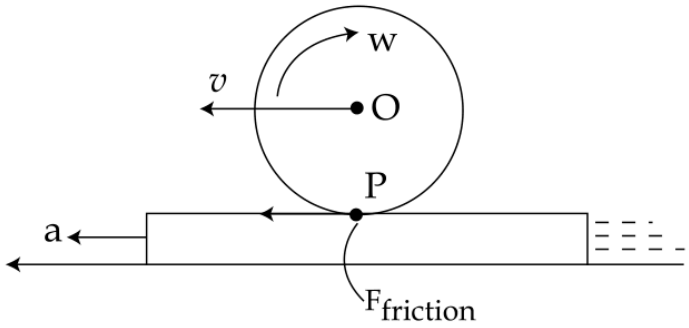
(2) $\frac{5}{\sqrt{3}}$

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

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

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

Consider a cylinder of mass M resting on a rough horizontal rug that is pulled out from under it with acceleration 'a' perpendicular to the axis of the cylinder. What is $F_{friction}$ at point P ? It is assumed that the cylinder does not slip.



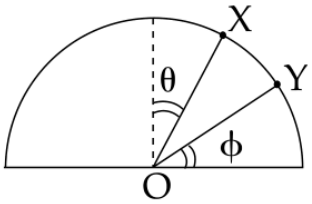
(1) Mg

(2) Ma

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

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

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



A particle is released on a vertical smooth semicircular track from point X so that OX makes angle θ from the vertical (see figure). The normal reaction of the track on the particle vanishes at point Y where OY makes angle ϕ with the horizontal. Then :

(1) $\sin\phi = \cos\ \theta$

(2) $\sin\phi = \frac{1}{2}\cos\theta$

(3) $\sin\phi = \frac{2}{3}\cos\theta$

(4) $\sin\phi = \frac{3}{4}\cos\theta$

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

A ball of mass 160 g is thrown up at an angle of 60° to the horizontal at a speed of 10 ms^{-1}. The angular momentum of the ball at the highest point of the trajectory with respect to the point from which the ball is thrown is nearly ($g = 10\ ms^{-2}$)

(1) 1.73 kg m^2/s

(2) 3.0 kg m^2/s

(3) 3.46 kg m^2/s

(4) 6.0 kg m^2/s

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

The gravitational field in a region is given by $\vec{g} = 5\text{N/kg}\,\hat{i} + 12\,\text{N/kg}\,\hat{j}$. The change in the gravitational potential energy of a particle of mass 2 kg when it is taken from the origin to a point (7 m, −3 m) is :

(1) 71 J

(2) $13\sqrt{58}$ J

(3) −71 J

(4) 1 J

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

The velocity of water in a river is 18 km/hr near the surface. If the river is 5 m deep , find the shearing stress between the horizontal layers of water. The co-efficient of viscosity of water $= 10^{-2}$ poise.

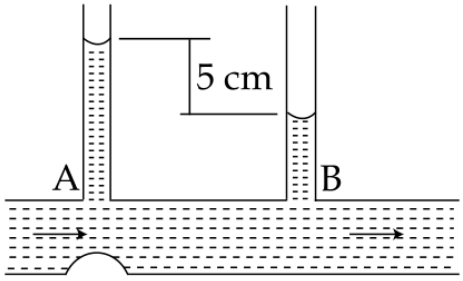
(1) $10^{-1}\ \text{N/m}^2$

(2) $10^{-2}\ \text{N/m}^2$

(3) $10^{-3}\ \text{N/m}^2$

(4) $10^{-4}\ \text{N/m}^2$

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



In the diagram shown, the difference in the two tubes of the manometer is 5 cm, the cross section of the tube at A and B is 6 mm^2 and 10 mm^2 respectively. The rate at which water flows through the tube is ($g = 10\ ms^{-2}$)

(1) 7.5 cc/s

(2) 8.0 cc/s

(3) 10.0 cc/s

(4) 12.5 cc/s

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

A large number of liquid drops each of radius r coalesce to from a single drop of radius R. The energy released in the process is converted into kinetic energy of the big drop so formed. The speed of the big drop is (given surface tension of liquid T, density ρ)

(1) $\sqrt{\frac{T}{\rho}\left(\frac{1}{r}-\frac{1}{R}\right)}$

(2) $\sqrt{\frac{2T}{\rho}\left(\frac{1}{r}-\frac{1}{R}\right)}$

(3) $\sqrt{\frac{4T}{\rho}\left(\frac{1}{r}-\frac{1}{R}\right)}$

(4) $\sqrt{\frac{6T}{\rho}\left(\frac{1}{r}-\frac{1}{R}\right)}$

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

A black coloured solid sphere of radius R and mass M is inside a cavity with vacuum inside. The walls of the cavity are maintained at temperature T_0. The initial temperature of the sphere is $3T_0$. If the specific heat of the material of the sphere varies as αT^3 per unit mass with the temperature T of the sphere, where α is a constant, then the time taken for the sphere to cool down to temperature $2T_0$ will be (σ is Stefan Boltzmann constant)

(1) $\frac{M\alpha}{4\pi R^2\sigma} ln\left(\frac{3}{2}\right)$

(2) $\frac{M\alpha}{4\pi R^2\sigma} ln\left(\frac{16}{3}\right)$

(3) $\frac{M\alpha}{16\pi R^2\sigma} ln\left(\frac{16}{3}\right)$

(4) $\frac{M\alpha}{16\pi R^2\sigma} ln\left(\frac{3}{2}\right)$

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

A gas is compressed from a volume of 2 m^3 to a volume of 1 m^3 at a constant pressure of 100 N/m^2. Then it is heated at constant volume by supplying 150 J of energy. As a result, the internal energy of the gas :

(1) Increases by 250 J

(2) Decreases by 250 J

(3) Increases by 50 J

(4) Decreases by 50 J

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

A gas molecule of mass M at the surface of the Earth has kinetic energy equivalent to 0°C. If it were to go up straight without colliding with any other molecules, how high it would rise ? Assume that the height attained is much less than radius of the earth. (k_B is Boltzmann constant)

(1) 0

(2) $\frac{273\ k_B}{2\ Mg}$

(3) $\frac{546\ k_B}{3\ Mg}$

(4) $\frac{819\ k_B}{2\ Mg}$

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

A body is in simple harmonic motion with time period half second ($T = 0.5$ s) and amplitude one cm ($A = 1$ cm). Find the average velocity in the interval in which it moves from equilibrium position to half of its amplitude.

(1) 4 cm/s

(2) 6 cm/s

(3) 12 cm/s

(4) 16 cm/s

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

The total length of a sonometer wire between fixed ends is 110 cm. Two bridges are placed to divide the length of wire in ratio 6 : 3 : 2. The tension in the wire is 400 N and the mass per unit length is 0.01 kg/m. What is the minimum common frequency with which three parts can vibrate ?

(1) 1100 Hz

(2) 1000 Hz

(3) 166 Hz

(4) 100 Hz

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

The electric field in a region of space is given by, $\vec{E} = E_o \hat{i} + 2E_o \hat{j}$ where $E_0 = 100\ N/C$. The flux of this field through a circular surface of radius 0.02 m parallel to the Y-Z plane is nearly :

(1) 0.125 Nm^2/C

(2) 0.02 Nm^2/C

(3) 0.005 Nm^2/C

(4) 3.14 Nm^2/C

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

The gap between the plates of a parallel plate capacitor of area A and distance between plates d, is filled with a dielectric whose permittivity varies linearly from ϵ_1 at one plate to ϵ_2 at the other. The capacitance of capacitor is :

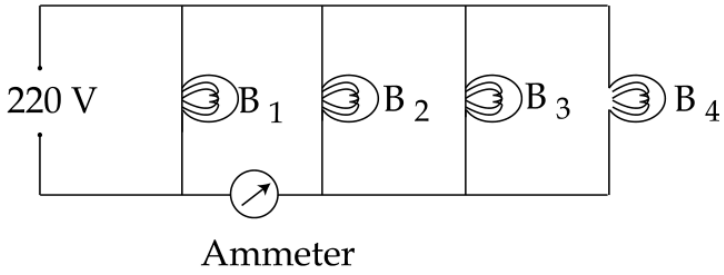
(1) $\epsilon_0(\epsilon_1 + \epsilon_2)A/d$

(2) $\epsilon_0(\epsilon_2 + \epsilon_1)A/2d$

(3) $\epsilon_0 A/[d\ ln(\epsilon_2/\epsilon_1)]$

(4) $\epsilon_0(\epsilon_2 - \epsilon_1)A/[d\ ln(\epsilon_2/\epsilon_1)]$

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



Four bulbs B_1, B_2, B_3 and B_4 of 100 W each are connected to 220 V main as shown in the figure. The reading in an ideal ammeter will be :

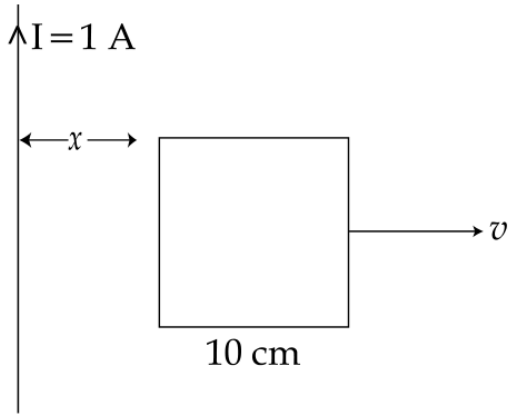
(1) 0.45 A

(2) 0.90 A

(3) 1.35 A

(4) 1.80 A

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



A square frame of side 10 cm and a long straight wire carrying current 1 A are in the plane of the paper. Starting from close to the wire, the frame moves towards the right with a constant speed of $10\ ms^{-1}$ (see figure). The e.m.f induced at the time the left arm of the frame is at $x = 10$ cm from the wire is :

(1) 2 μV

(2) 1 μV

(3) 0.75 μV

(4) 0.5 μV

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

An example of a perfect diamagnet is a superconductor. This implies that when a superconductor is put in a magnetic field of intensity B, the magnetic field B_s inside the superconductor will be such that :

(1) $B_s = -B$

(2) $B_s = 0$

(3) $B_s = B$

(4) $B_s < B$ but $B_s \neq 0$

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

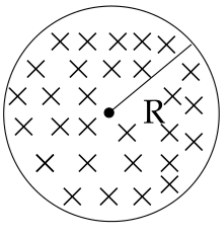
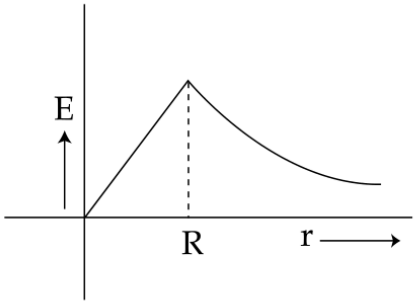
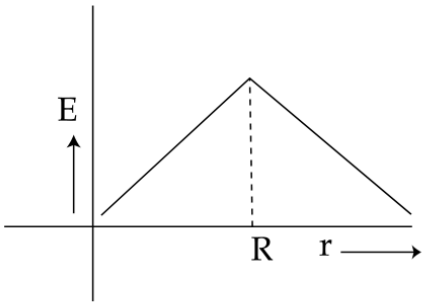


Figure shows a circular area of radius R where a uniform magnetic field $\vec{B}$ is going into the plane of paper and increasing in magnitude at a constant rate. In that case, which of the following graphs, drawn schematically, correctly shows the variation of the induced electric field E(r) ?

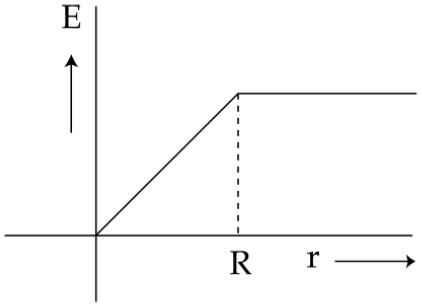
(1)



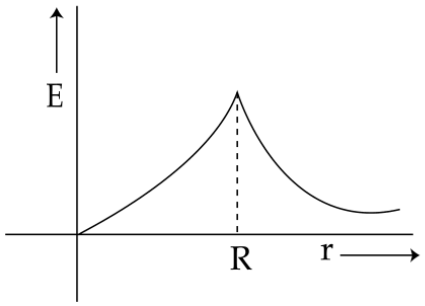
(2)



(3)



(4)



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

If denote microwaves, X rays, infrared, gamma rays, ultra-violet, radio waves and visible parts of the electromagnetic spectrum by M, X, I, G, U, R and V, the following is the arrangement in ascending order of wavelength :

(1) R, M, I, V, U, X and G

(2) M, R, V, X, U, G and I

(3) G, X, U, V, I, M and R

(4) I, M, R, U, V, X and G

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

A ray of light is incident from a denser to a rarer medium. The critical angle for total internal reflection is θ_{iC} and the Brewster's angle of incidence is θ_{iB}, such that $\sin\theta_{iC}/\sin\theta_{iB} = \eta = 1.28$. The relative refractive index of the two media is :

(1) 0.2

(2) 0.4

(3) 0.8

(4) 0.9

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

The diameter of the objective lens of microscope makes an angle β at the focus of the microscope. Further, the medium between the object and the lens is an oil of refractive index n. Then the resolving power of the microscope.

(1) Increases with decreasing value of n

(2) Increases with decreasing value of β

(3) Increases with increasing value of $n \sin 2\beta$

(4) Increases with increasing value of $\frac{1}{n \sin 2\beta}$

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

In a Young's double slit experiment, the distance between the two identical slits is 6.1 times larger than the slit width. Then the number of intensity maxima observed within the central maximum of the single slit diffraction pattern is :

(1) 3

(2) 6

(3) 12

(4) 24

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

Match **List - I** (Experiment performed) with **List - II** (Phenomena discovered/ associated) and select the correct option from the options given below the lists :

List - I		**List - II**	
(a)	Davisson and Germer Experiment	(i)	Wave nature of electrons
(b)	Millikan's oil drop experiment	(ii)	Charge of an electron
(c)	Rutherford experiment	(iii)	Quantisation of energy levels
(d)	Franck - Hertz experiment	(iv)	Existence of nucleus

(1) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

(2) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

(3) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(4) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

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

A piece of wood from a recently cut tree shows 20 decays per minute. A wooden piece of same size placed in a museum (obtained from a tree cut many years back) shows 2 decays per minute. If half life of C^{14} is 5730 years, then age of the wooden piece placed in the museum is approximately :

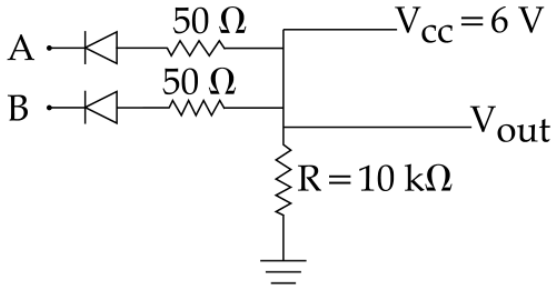
(1) 10439 years

(2) 13094 years

(3) 19039 years

(4) 39049 years

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



Given : A and B are input terminals.

Logic 1 = > 5 V

Logic 0 = < 1 V

Which logic gate operation, the following circuit does ?

(1) AND Gate

(2) OR Gate

(3) XOR Gate

(4) NOR Gate

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

Long range radio transmission is possible when the radiowaves are reflected from the ionosphere. For this to happen the frequency of the radiowaves must be in the range :

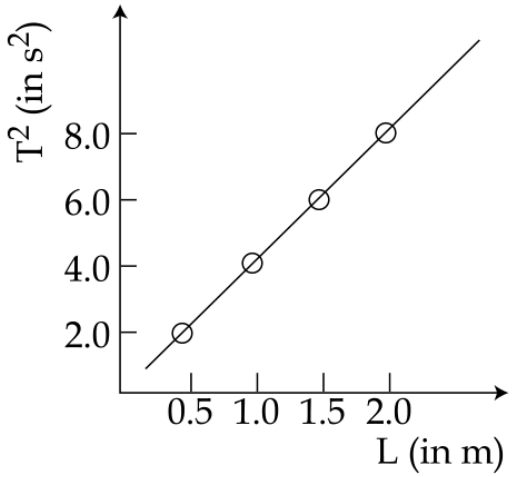
(1) 80 - 150 MHz

(2) 8 - 25 MHz

(3) 1 - 3 MHz

(4) 150 - 500 kHz

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



In an experiment for determining the gravitational acceleration g of a place with the help of a simple pendulum, the measured time period square is plotted against the string length of the pendulum in the figure.

What is the value of g at the place ?

(1) 9.81 m/s^2

(2) 9.87 m/s^2

(3) 9.91 m/s^2

(4) 10.0 m/s^2

Chemistry

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

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

Ionization energy of gaseous Na atoms is $495.5\ kJmol^{-1}$. The lowest possible frequency of light that ionizes a sodium atom is ($h = 6.626 \times 10^{-34}$ Js, $N_A = 6.022 \times 10^{23}\ mol^{-1}$)

(1) $7.50 \times 10^{4}\ s^{-1}$

(2) $4.76 \times 10^{14}\ s^{-1}$

(3) $3.15 \times 10^{15}\ s^{-1}$

(4) $1.24 \times 10^{15}\ s^{-1}$

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

Choose the correct statement with respect to the vapour pressure of a liquid among the following :

(1) Increases linearly with increasing temperature

(2) Increases non-linearly with increasing temperature

(3) Decreases linearly with increasing temperature

(4) Decreases non-linearly with increasing temperature

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

Which one of the following molecules is paramagnetic ?

(1) N_2

(2) NO

(3) CO

(4) O_3

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

Zirconium phosphate $[Zr_3(PO_4)_4]$ dissociates into three zirconium cations of charge $+4$ and four phosphate anions of charge -3. If molar solubility of zirconium phosphate is denoted by S and its solubility product by K_{sp} then which of the following relationship between S and K_{sp} is correct ?

(1) $S = \{K_{sp}/(6912)^{1/7}\}$

(2) $S = \{K_{sp}/144\}^{1/7}$

(3) $S = (K_{sp}/6912)^{1/7}$

(4) $S = \{K_{sp}/6912\}^{7}$

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

For the decomposition of the compound, represented as

$NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$

the $K_p = 2.9 \times 10^{-5}$ atm^3.

If the reaction is started with 1 mol of the compound, the total pressure at equilibrium would be :

(1) 1.94×10^{-2} atm

(2) 5.82×10^{-2} atm

(3) 7.66×10^{-2} atm

(4) 38.8×10^{-2} atm

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

For the reaction,

$3A + 2B \rightarrow C + D$,

the differential rate law can be written as :

(1) $\frac{1}{3}\frac{d[A]}{dt} = \frac{d[C]}{dt} = k[A]^n[B]^m$

(2) $-\frac{d[A]}{dt} = \frac{d[C]}{dt} = k[A]^n[B]^m$

(3) $+\frac{1}{3}\frac{d[A]}{dt} = -\frac{d[C]}{dt} = k[A]^n[B]^m$

(4) $-\frac{1}{3}\frac{d[A]}{dt} = \frac{d[C]}{dt} = k[A]^n[B]^m$

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

Sulphur dioxide and oxygen were allowed to diffuse through a porous partition. 20 dm^3 of SO_2 diffuses through the porous partition in 60 seconds. The volume of O_2 in dm^3 which diffuses under the similar condition in 30 seconds will be (atomic mass of sulphur = 32 u) :

(1) 7.09

(2) 14.1

(3) 10.0

(4) 28.2

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

The observed osmotic pressure for a 0.10 M solution of $Fe(NH_4)_2(SO_4)_2$ at 25°C is 10.8 atm. The expected and experimental (observed) values of Van't Hoff factor (i) will be respectively :

$(R = 0.082 \text{ L atm } k^{-} mol^{-1})$

(1) 5 and 4.42

(2) 4 and 4.00

(3) 5 and 3.42

(4) 3 and 5.42

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

The total number of octahedral void(s) per atom present in a cubic close packed structure is :

(1) 2

(2) 4

(3) 1

(4) 3

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

For an ideal solution of two components A and B, which of the following is true ?

(1) $\Delta H_{mixing} < 0$ (zero)

(2) $\Delta H_{mixing} > 0$ (zero)

(3) $A - B$ interaction is stronger than $A - A$ and $B - B$ interactions

(4) $A - A$, $B - B$ and $A - B$ interactions are identical

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

Consider the reaction :

$$H_2SO_{3(aq)} + Sn^{4+}_{(aq)} + H_2O_{(l)} \rightarrow Sn^{2+}_{(aq)} + HSO^{-}_{4(aq)} + 3H^{+}_{(aq)}$$

Which of the following statements is correct ?

(1) Sn^{4+} is the oxidizing agent because it undergoes oxidation

(2) Sn^{4+} is the reducing agent because it undergoes oxidation

(3) H_2SO_3 is the reducing agent because it undergoes oxidation

(4) H_2SO_3 is the reducing agent because it undergoes reduction

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

Which one of the following has largest ionic radius ?

(1) Li^+

(2) O_2^{2-}

(3) B^{3+}

(4) F^-

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

An octahedral complex with molecular composition $M.5NH_3.Cl.SO_4$ has two isomers, A and B. The solution of A gives a white precipitate with $AgNO_3$ solution and the solution of B gives white precipitate with $BaCl_2$ solution. The type of isomerism exhibited by the complex is :

(1) Linkage isomerism

(2) Ionisation isomerism

(3) Coordinate isomerism

(4) Geometrical isomerism

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

How many electrons are involved in the following redox reaction ?

$$Cr_2O_7^{2-} + Fe^{2+} + C_2O_4^{2-} \rightarrow Cr^{3+} + Fe^{3+} + CO_2 \text{ (Unbalanced)}$$

(1) 3

(2) 4

(3) 6

(4) 5

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

Amongst LiCl, RbCl, $BeCl_2$ and $MgCl_2$ the compounds with the greatest and the least ionic character, respectively are :

(1) LiCl and RbCl

(2) RbCl and $BeCl_2$

(3) $MgCl_2$ and $BeCl_2$

(4) RbCl and $MgCl_2$

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

Nickel($Z = 28$) combines with a uninegative monodentate ligand to form a diamagnetic complex $[NiL_4]^{2-}$. The hybridisation involved and the number of unpaired electrons present in the complex are respectively :

(1) sp^3, two

(2) dsp^2, zero

(3) dsp^2, one

(4) sp^3, zero

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

Which of these statements is **not** true ?

(1) NO^+ is not isoelectronic with O_2

(2) B is always covalent in its compounds

(3) In aqueous solution, the Tl^+ ion is much more stable than Tl (III)

(4) $LiAlH_4$ is a versatile reducing agent in organic synthesis.

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

Example of a three-dimensional silicate is :

(1) Zeolites

(2) Ultramarines

(3) Feldspars

(4) Beryls

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

Amongst the following, identify the species with an atom in +6 oxidation state :

(1) $[MnO_4]^-$

(2) $[Cr(CN)_6]^{3-}$

(3) Cr_2O_3

(4) CrO_2Cl_2

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

Which one of the following ores is known as Malachite :

(1) Cu_2O

(2) Cu_2S

(3) $CuFeS_2$

(4) $Cu(OH)_2.CuCO_3$

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

The major product formed when 1, 1, 1 – trichloro - propane is treated with aqueous potassium hydroxide is :

(1) Propyne

(2) 1 - Propanol

(3) 2 - Propanol

(4) Propionic acid

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

Which one of the following is an example of thermosetting polymers ?

(1) Neoprene

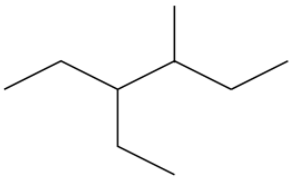
(2) Buna -N

(3) Nylon 6, 6

(4) Bakelite

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

The correct IUPAC name of the following compound



is :

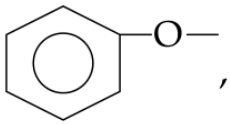
(1) 4 - methyl - 3 - ethylhexane

(2) 3 - ethyl - 4 - methylhexane

(3) 3, 4 - ethylmethylhexane

(4) 4 - ethyl - 3 - methylhexane

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

Which one of the following substituents at *para*-position is most effective in stabilizing the phenoxide , ion ?

(1) $-CH_3$

(2) $-OCH_3$

(3) $-COCH_3$

(4) $-CH_2OH$

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

The final product formed when Methyl amine is treated with $NaNO_2$ and HCl is :

(1) Diazomethane

(2) Methylalcohol

(3) Methylcyanide

(4) Nitromethane

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

Which one of the following compounds will not be soluble in sodium bicarbonate ?

(1) 2, 4, 6 - Trinitrophenol

(2) Benzoic acid

(3) *o* - Nitrophenol

(4) Benzene sulphonic acid

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

Williamson synthesis of ether is an example of :

(1) Nucleophilic addition

(2) Electrophilic addition

(3) Electrophilic substitution

(4) Nucleophilic substitution

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

The reason for double helical structure of DNA is the operation of :

(1) Electrostatic attractions

(2) van der Waals forces

(3) Dipole - Dipole interactions

(4) Hydrogen bonding

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

Among the following organic acids, the acid present in rancid butter is :

(1) Pyruvic acid

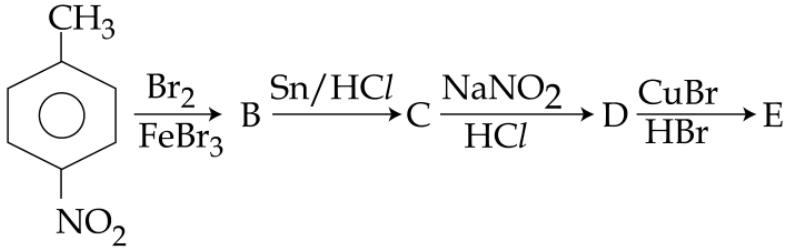
(2) Lactic acid

(3) Butyric acid

(4) Acetic acid

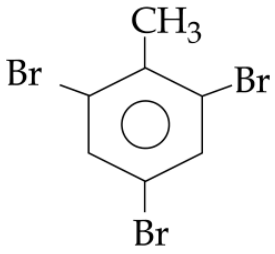
Question Number : 90 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

In a set of reactions *p* - nitrotoluene yielded a product E

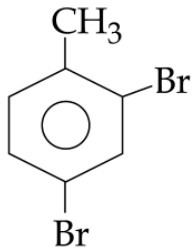


The product E would be :

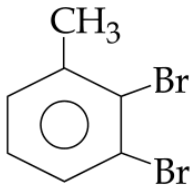
(1)



(2)



(3)



(4)

