Central Board of Secondary Education

Question Paper Name :	B Tech 9 Apr 2014 Single slot
Subject Name :	B. Tech
Duration :	180
Total Marks :	360
Display Marks:	Yes

B. Tech

Group Number :	1
Group Maximum Duration :	0
Group Minimum Duration :	180
Show Attended Group? :	No
Edit Attended Group? :	No
Break time :	0
Group Marks :	360

Mathematics Section A

Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 1 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $\frac{1}{\sqrt{\alpha}}, \frac{1}{\sqrt{\beta}}$ are the roots of the equation $ax^2 + bx + 1 = 0,\ (a \neq 0,\ a, b \in R)$, then the equation $x\left(x + b^3\right) + \left(a^3 - 3abx\right) = 0$ has roots:

(1) $\sqrt{\alpha\beta}$ and $\alpha\beta$

(2) $\alpha^{-\frac{3}{2}}$ and $\beta^{-\frac{3}{2}}$

(3) $\alpha\beta^{\frac{1}{2}}$ and $\alpha^{\frac{1}{2}}\beta$

(4) $\alpha^{\frac{3}{2}}$ and $\beta^{\frac{3}{2}}$

Question Number : 2 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If equations $ax^2 + bx + c = 0,\ (a,\ b,\ c \in R,\ a \neq 0)$ and $2x^2 + 3x + 4 = 0$ have a common root, then $a : b : c$ equals :

(1) $2 : 3 : 4$

(2) $4 : 3 : 2$

(3) $1 : 2 : 3$

(4) $3 : 2 : 1$

Question Number : 3 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let $w(Im\ w \neq 0)$ be a complex number. Then, the set of all complex numbers z satisfying the equation $w - \overline{w}z = k(1 - z)$, for some real number k, is

(1) $\{z :\ z \neq 1\}$

(2) $\{z :\ |z| = 1,\ z \neq 1\}$

(3) $\{z :\ z = \overline{z}\}$

(4) $\{z :\ |z| = 1\}$

Question Number : 4 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The sum of the digits in the unit's place of all the 4 - digit numbers formed by using the numbers $3,\ 4,\ 5$ and 6, without repetition is :

(1) 18 (2) 36

(3) 108 (4) 432

Question Number : 5 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Given an A.P. whose terms are all positive integers. The sum of its first nine terms is greater than 200 and less than 220. If the second term in it is 12, then its 4^{th} term is :

(1) 8 (2) 24

(3) 20 (4) 16

Question Number : 6 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the sum $\frac{3}{1^2}+\frac{5}{1^2+2^2}+\frac{7}{1^2+2^2+3^2}+$ .... .+ up to 20 terms is equal to $\frac{k}{21}$, then k is equal to

(1) 240 (2) 120

(3) 60 (4) 180

Question Number : 7 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The number of terms in the expansion of $(1+x)^{101}\left(1-x+x^2\right)^{100}$ in powers of x is

(1) 301 (2) 302

(3) 101 (4) 202

Question Number : 8 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $\operatorname{cosec}\theta=\frac{\mathrm{p}+\mathrm{q}}{\mathrm{p}-\mathrm{q}}(\mathrm{p}\neq\mathrm{q},\mathrm{p}\neq 0)$, then $\left|\cot\left(\frac{\pi}{4}+\frac{\theta}{2}\right)\right|$ is equals to:

(1) pq (2) $\sqrt{\frac{\mathrm{p}}{\mathrm{q}}}$

(3) $\sqrt{\frac{\mathrm{q}}{\mathrm{p}}}$ (4) $\sqrt{\mathrm{pq}}$

Question Number : 9 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The number of values of α in $[0,\ 2\pi]$ for which $2\sin^3\alpha-7\sin^2\alpha+7\sin\alpha=2$, is :

(1) 3 (2) 1

(3) 6 (4) 4

Question Number : 10 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Given three points P, Q, R with $P(5,3)$ and R lies on the $x-$axis. If the equation of RQ is $x-2y=2$ and PQ is parallel to the $x-$axis, then the centroid of ΔPQR lies on the line

(1) $x-2y+1=0$ (2) $2x+y-9=0$

(3) $2x-5y=0$ (4) $5x-2y=0$

Question Number : 11 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let a and b be any two numbers satisfying $\frac{1}{a^2}+\frac{1}{b^2}=\frac{1}{4}$. Then, the foot of perpendicular from the origin on the variable line $\frac{x}{a}+\frac{y}{b}=1$ lies on :

(1) A circle of radius $=2$ (2) A hyperbola with each semi-axis $=\sqrt{2}$.

(3) A hyperbola with each semi-axis $=2$ (4) A circle of radius $=\sqrt{2}$

Question Number : 12 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the point $(1,\ 4)$ lies inside the circle $x^2+y^2-6x+10y+p=0$ and the circle does not touch or intersect the coordinate axes, then the set of all possible values of p is the interval

(1) $(25,\ 39)$ (2) $(25,\ 29)$

(3) $(0,\ 25)$ (4) $(9,\ 25)$

Question Number : 13 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If OB is the semi-minor axis of an ellipse, F_1 and F_2 are its focii and the angle between F_1B and F_2B is a right angle, then the square of the eccentricity of the ellipse is

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

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

Question Number : 14 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $f(x)$ is continuous and $f\left(\frac{9}{2}\right)=\frac{2}{9}$, then $\lim\limits_{x\to 0} f\left(\frac{1-\cos 3x}{x^2}\right)$ equals to

(1) $\frac{8}{9}$ (2) 0

(3) $\frac{2}{9}$ (4) $\frac{9}{2}$

Question Number : 15 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The contrapositive of the statement "I go to school if it does not rain" is

(1) If it rains, I go to school. (2) If it rains, I do not go to school.

(3) If I go to school, it rains. (4) If I do not go to school, it rains.

Question Number : 16 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In a set of $2n$ distinct observations, each of the observation below the median of all the observations is increased by 5 and each of the remaining observations is decreased by 3. Then, the mean of the new set of observations :

(1) Increases by 2 . (2) Increases by 1 .

(3) Decreases by 2 . (4) Decreases by 1 .

Question Number : 17 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let P be the relation defined on the set of all real numbers such that $P=\left\{(a,b):\sec^2 a-\tan^2 b=1\right\}$. Then, P is

(1) reflexive and symmetric but not transitive (2) symmetric and transitive but not reflexive

(3) reflexive and transitive but not symmetric (4) an equivalence relation

Question Number : 18 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If B is a 3×3 matrix such that $B^2=0$, then $det.\ \left[(I+B)^{50}-50B\right]$ is equal to :

(1) 1 (2) 2

(3) 3 (4) 50

Question Number : 19 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $a,\ b,\ c$ are non - zero real numbers and if the system of equations

$(a-1)x = y+z$

$(b-1)y = x+z$

$(c-1)z = x+y$

has a non - trivial solution, then $ab+bc+ca$ equals :

(1) -1 (2) $a+b+c$

(3) abc (4) 1

Question Number : 20 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $y = e^{nx}$, then $\frac{d^2y}{dx^2}.\frac{d^2x}{dy^2}$ is equal to :

(1) ne^{-nx} (2) $-ne^{-nx}$

(3) ne^{nx} (4) 1

Question Number : 21 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $f(x) = \left(\frac{3}{5}\right)^x + \left(\frac{4}{5}\right)^x - 1,\ x \in R$, then the equation $f(x) = 0$ has :

(1) No solution (2) More than two solutions

(3) One solution (4) Two solutions

Question Number : 22 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the Rolle's theorem holds for the function $f(x) = 2x^3 + ax^2 + bx$ in the interval $[-1, 1]$ for the point $c = \frac{1}{2}$, then the value of $2a + b$ is:

(1) -1 (2) 2

(3) 1 (4) -2

Question Number : 23 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

$\int \frac{\sin^8 x - \cos^8 x}{(1-2\sin^2 x\cos^2 x)}dx$ is equal to

(1) $-\frac{1}{2}\sin 2x + c$ (2) $-\sin^2 x + c$

(3) $-\frac{1}{2}\sin x + c$ (4) $\frac{1}{2}\sin 2x + c$

Question Number : 24 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The integral $\int_0^{\frac{1}{2}} \frac{\ln(1+2x)}{1+4x^2}dx$ equals

(1) $\frac{\pi}{4}\ln 2$ (2) $\frac{\pi}{16}\ln 2$

(3) $\frac{\pi}{8}\ln 2$ (4) $\frac{\pi}{32}\ln 2$

Question Number : 25 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let $A = \{(x, y) : y^2 \le 4x,\ y - 2x \ge -4\}$. The area of the region A in square units is

(1) 10 (2) 8

(3) 9 (4) 11

Question Number : 26 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the differential equation representing the family of all circles touching x-axis at the origin is $\left(x^2-y^2\right)\frac{dy}{dx}=g(x)y$, then $g(x)$ equals

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

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

Question Number : 27 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $\left|\overrightarrow{a}\right|=2$, $\left|\overrightarrow{b}\right|=3$ and $\left|2\overrightarrow{a}-\overrightarrow{b}\right|=5$, then $\left|2\overrightarrow{a}+\overrightarrow{b}\right|$ equals :

(1) 5 (2) 7

(3) 17 (4) 1

Question Number : 28 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Equation of the plane which passes through the point of intersection of lines $\frac{x-1}{3}=\frac{y-2}{1}=\frac{z-3}{2}$ and $\frac{x-3}{1}=\frac{y-1}{2}=\frac{z-2}{3}$ and has the largest distance from the origin is:

(1) $4x+3y+5z=50$ (2) $3x+4y+5z=49$

(3) $5x+4y+3z=57$ (4) $7x+2y+4z=54$

Question Number : 29 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A line in the 3-dimensional space makes an angle $\theta\left(0<\theta\leq\frac{\pi}{2}\right)$ with both the X and $Y-$axes. Then, the set of all values of θ is in the interval :

(1) $\left(\frac{\pi}{3},\frac{\pi}{2}\right]$ (2) $\left(0,\frac{\pi}{4}\right]$

(3) $\left[\frac{\pi}{4},\frac{\pi}{2}\right]$ (4) $\left[\frac{\pi}{6},\frac{\pi}{3}\right]$

Question Number : 30 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $A$and B are two events such that $P(A\cup B)=P(A\cap B)$, then the incorrect statement amongst the following statements is :

(1) $P(A)+P(B)=1$ (2) $P(A\cap B')=0$

(3) A & B are equally likely (4) $P(A'\cap B)=0$

Physics Section A

Section Number :	2
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 31 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

An experiment is performed to obtain the value of acceleration due to gravity g by using a simple pendulum of length L. In this experiment time for 100 oscillations is measured by using a watch of 1 second least count and the value is 90.0 seconds. The length L is measured by using a meter scale of least count 1 mm and the value is 20.0 cm. The error in the determination of g would be :

(1) 4.4%
(2) 2.27%
(3) 1.7%
(4) 2.7%

Question Number : 32 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The position of a projectile launched from the origin at t = 0 is given by $\vec{r} = \left(40\,\hat{i} + 50\,\hat{j}\right)$m at t = 2s. If the projectile was launched at an angle θ from the horizontal, then θ is (take g = 10 ms^{-2}).

(1) $\tan^{-1}\frac{3}{2}$
(2) $\tan^{-1}\frac{2}{3}$
(3) $\tan^{-1}\frac{7}{4}$
(4) $\tan^{-1}\frac{4}{5}$

Question Number : 33 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Water is flowing at a speed of 1.5 m s^{-1} through a horizontal tube of cross-sectional area 10^{-2} m^2 and you are trying to stop the flow by your palm. Assuming that the water stops immediately after hitting the palm, the minimum force that you must exert should be (density of water = 10^3 kg m^{-3})

(1) 33.7 N
(2) 45 N
(3) 15 N
(4) 22.5 N

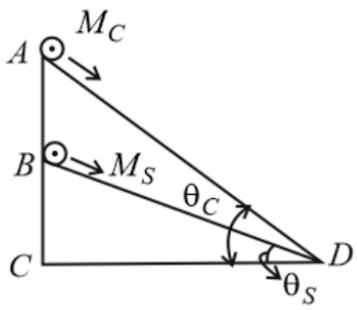
Question Number : 34 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A block A of mass 4 kg is placed on another block B of mass 5 kg, and the block B rests on a smooth horizontal table. If the minimum force that can be applied on A so that both the blocks move together is 12 N, the maximum force that can be applied on B for the blocks to move together will be :

(1) 0 N
(2) 25 N
(3) 48 N
(4) 27 N

Question Number : 35 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

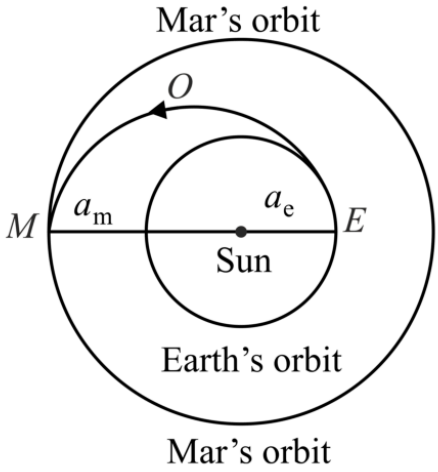
A cylinder of mass M_c and sphere of mass M_s are placed at points A and B of two inclines, respectively. (See figure). If they roll on the incline without slipping such that their accelerations are the same, then the ratio $\frac{\sin\theta_c}{\sin\theta_s}$ is :



(1) $\frac{8}{7}$
(2) $\sqrt{\frac{8}{7}}$
(3) $\sqrt{\frac{15}{14}}$
(4) $\frac{15}{14}$

Question Number : 36 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

India's Mangalyan was sent to the Mars by launching it into a transfer orbit EOM around the sun. It leaves the earth at E and meets Mars at M. If the semi-major axis of Earth's orbit is $a_e = 1.5 \times 10^{11} m$, that of Mar's orbit $a_m = 2.28 \times 10^{11} m$, taking Kepler's laws, give the estimate of time for Mangalyan to reach Mars from Earth.



(1) 220 days.
(2) 500 days.
(3) 260 days.
(4) 320 days.

Question Number : 37 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In materials like aluminium and copper, the correct order of magnitude of various elastic modulii is :

(1) Young's modulii $<$ shear modulii $<$ bulk modulii (2) Bulk modulii $<$ shear modulii $<$ Young's modulii

(3) Shear modulii $<$ Young's modulii $<$ bulk modulii (4) Bulk modulii $<$ Young's modulii $<$ shear modulii

Question Number : 38 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A capillary tube is immersed vertically in water and the height of the water column is x. When this arrangement is taken into a mine of depth d, the height of the water column is y. If R is the radius of earth, the ratio $\frac{x}{y}$ is :

(1) $\left(\frac{R-d}{R+d}\right)$
(2) $\left(\frac{R+d}{R-d}\right)$
(3) $\left(1-\frac{2d}{R}\right)$
(4) $\left(1-\frac{d}{R}\right)$

Question Number : 39 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Water of volume 2 L in a closed container is heated with a coil of 1 kW. While water is heated, the container loses energy at a rate of 160 J/s. In how much time will the temperature of water rise from 27°C to 77°C ? (Specific heat of water is 4.2 kJ/kg and that of the container is negligible).

(1) 8 min 20 s
(2) 7 min
(3) 14 min
(4) 6 min 2 s

Question Number : 40 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The equation of state for a gas is given by $PV = nRT + \alpha V$, where n is the number of moles and α is a positive constant. The initial temperature and pressure of one mole of the gas contained in a cylinder are T_0 and P_0 respectively. The work done by the gas when its temperature doubles isobarically will be :

(1) $P_0\, T_0 \ln 2$
(2) $\frac{P_0 T_0 R}{P_0+\alpha}$
(3) $\frac{P_0 T_0 R}{P_0-\alpha}$
(4) $P_0\, T_0 R$

Question Number : 41 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

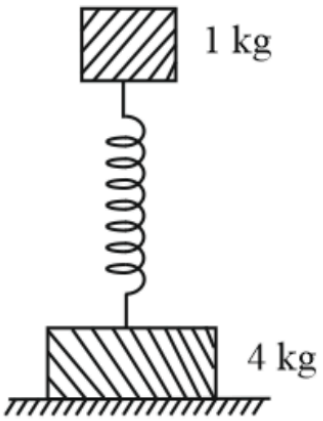
Modern vacuum pumps can evacuate a vessel down to a pressure of 4.0×10^{-15} atm. at room temperature (300 K). Taking R = 8.3 JK^{-1} $mole^{-1}$, 1 atm = 10^5 Pa and $N_{Avogadro} = 6 \times 10^{23}$ $mole^{-1}$, the mean distance between molecules of gas in an evacuated vessel will be of the order of :

(1) $0.2\ \mu m$ (2) $0.2\ mm$

(3) $0.2\ cm$ (4) $0.2\ nm$

Question Number : 42 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Two bodies of masses 1 kg and 4 kg are connected to a vertical spring, as shown in the figure. The smaller mass executes simple harmonic motion of angular frequency 25 rad s^{-1}, and amplitude 1.6 cm while the bigger mass remains stationary on the ground. The maximum force exerted by the system on the floor is (take $g = 10\ m\ s^{-2}$).



(1) 20 N (2) 60 N

(3) 40 N (4) 10 N

Question Number : 43 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The amplitude of a simple pendulum, oscillating in air with a small spherical bob, decreases from 10 cm to 8 cm in 40 seconds. Assuming that Stokes law is valid, and ratio of the coefficient of viscosity of air to that of carbon dioxide is 1.3, the time in which amplitude of this pendulum will reduce from 10 cm to 5 cm in carbondioxide will be close to (ln 5 = 1.601, ln 2 = 0.693).

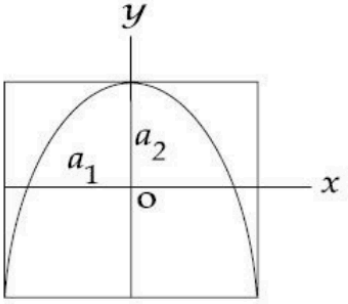
(1) 231 s (2) 142 s

(3) 208 s (4) 161 s

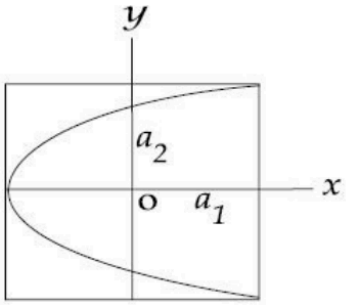
Question Number : 44 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A particle which is simultaneously subjected to two perpendicular simple harmonic motions represented by; $x = a_1 \cos \omega t$ and $y = a_2 \cos 2\omega t$ traces a curve given by :

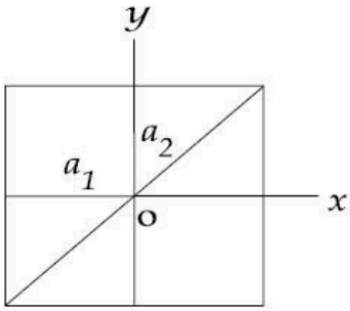
(1)



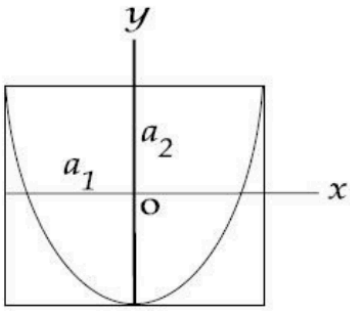
(2)



(3)



(4)



Question Number : 45 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A transverse wave is represented by : $y = \frac{10}{\pi} \sin\left(\frac{2\pi}{T}t - \frac{2\pi}{\lambda}x\right)$ For what value of the wavelength the wave velocity is twice the maximum particle velocity?

(1) 40 cm

(2) 60 cm

(3) 10 cm

(4) 20 cm

Question Number : 46 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The magnitude of the average electric field normally present in the atmosphere just above the surface of the Earth is about 150 N/C, directed inward towards the center of the Earth. This gives the total net surface charge carried by the Earth to be : [Given : $\in_O = 8.85 \times 10^{-12}\ C^2/N\text{-}m^2,\ R_E = 6.37 \times 10^6 m$]

(1) -680 kC

(2) $+ 670\ kC$

(3) $+ 680$ kC

(4) $- 670$ kC

Question Number : 47 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Three capacitances, each of 3 μF, are provided. These cannot be combined to provide the resultant capacitance of :

(1) 2 μF

(2) 6 μF

(3) 1.5 μF

(4) 1 μF

Question Number : 48 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A d.c. main supply of e.m.f. 220 V is connected across a storage battery of e.m.f. 200 V through a resistance of 1 Ω. The battery terminals are connected to external resistance R. The minimum value of R, so that a current passes through the battery to charge it is:

(1) 9 Ω

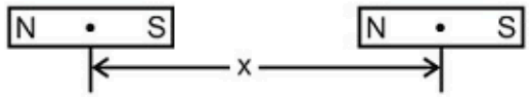
(2) 7 Ω

(3) 11 Ω

(4) 0

Question Number : 49 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The mid points of two small magnetic dipoles of length d in end-on positions, are separated by a distance x $(x \gg d)$. The magnitude of force between them is proportional to x^{-n} where n is :



(1) 3 (2) 4

(3) 2 (4) 1

Question Number : 50 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The magnetic field of earth at the equator is approximately 4×10^{-5}T. The radius of earth is 6.4×10^{6}m. Then the dipole moment of the earth will be nearly of the order of :

(1) 10^{20} A m^2 (2) 10^{16} A m^2

(3) 10^{10} A m^2 (4) 10^{23} A m^2

Question Number : 51 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

When the rms voltages V_L, V_C and V_R are measured respectively across the inductor L, the capacitor C and the resistor R in a series LCR circuit connected to an AC source, it is found that the ratio $V_L : V_C : V_R = 1 : 2 : 3$. If the rms voltage of the AC source is 100 V, then V_R is close to :

(1) 50 V (2) 70 V

(3) 100 V (4) 90 V

Question Number : 52 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Match List I (Wavelength range of electromagnetic spectrum) with **List II** (Method of production of these waves) and select the **correct** option from the options given below the lists.

	List I		**List II**
(a)	700 nm to 1 mm	**(i)**	Vibration of atoms and molecules.
(b)	1 nm to 400 nm	**(ii)**	Inner shell electrons in atoms moving from one energy level to a lower level.
(c)	$< 10^{-3}$ nm	**(iii)**	Radioactive decay of the nucleus.
(d)	1 mm to 0.1 m	**(iv)**	Magnetron valve.

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

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

Question Number : 53 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A diver looking up through the water sees the outside world contained in a circular horizon. The refractive index of water is $\frac{4}{3}$, and the diver's eyes are 15 cm below the surface of the water. Then the radius of the circle is :

(1) $\frac{15\times\sqrt{7}}{3}$ cm (2) $\frac{15\times3}{\sqrt{7}}$ cm

(3) $15 \times 3\sqrt{7}$ cm (4) $15 \times 3 \times \sqrt{5}$ cm

Question Number : 54 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The focal lengths of objective lens and eye lens of a Galilean Telescope are respectively 30 cm and 3.0 cm. Telescope produces virtual, erect image of an object situated far away from it at least distance of distinct vision from the eye lens. In this condition the Magnifying Power of the Galilean Telescope should be :

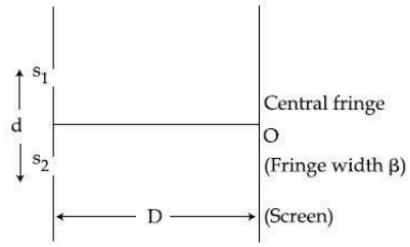
(1) $+8.8$ (2) -11.2

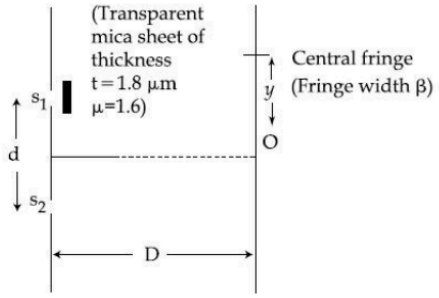
(3) $+11.2$ (4) -8.8

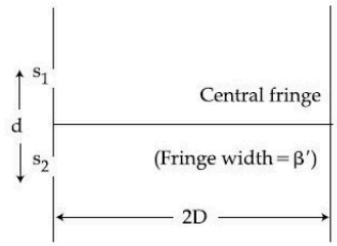
Question Number : 55 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Using monochromatic light of wavelength λ, an experimentalist sets up the Young's double slit experiment in three ways as shown.

If she observes that $y = \beta'$, the wavelength of light used is :







(1) 520 nm (2) 580 nm

(3) 540 nm (4) 560 nm

Question Number : 56 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

For which of the following particles will it be most difficult to experimentally verify the de-Broglie relationship?

(1) An electron (2) An α-particle

(3) A dust particle (4) A proton

Question Number : 57 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the binding energy of the electron in a hydrogen atom is 13.6 eV, the energy required to remove the electron from the first excited state of Li^{++} is :

(1) 13.6 eV (2) 3.4 eV

(3) 122.4 eV (4) 30.6 eV

Question Number : 58 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

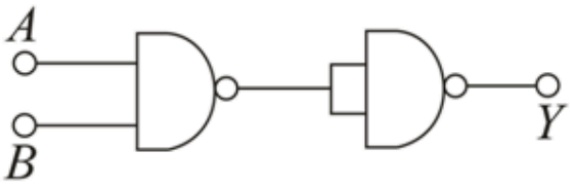
An n-p-n transistor has three leads A, B and C. Connecting B and C by moist fingers, A to the positive lead of an ammeter, and C to the negative lead of the ammeter, one finds large deflection. Then, A, B and C refer respectively to :

(1) Base, emitter and collector (2) Base, collector and emitter

(3) Emitter, base and collector (4) Collector, emitter and base

Question Number : 59 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Identify the gate and match A, B, Y in the bracket to check.



(1) $OR\ (A = 1,\ B = 1,\ Y = 0)$

(2) $XOR\ (A = 0,\ B = 0,\ Y = 0)$

(3) $NOT\ (A = 1,\ B = 1,\ Y = 1)$

(4) $AND\ (A = 1,\ B = 1,\ Y = 1)$

Question Number : 60 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A transmitting antenna at the top of a tower has a height 32 m and the height of the receiving antenna is 50 m. What is the maximum distance between them for satisfactory communication in line of sight (LOS) mode?

(1) $45.5\ \text{km}$

(2) $54.5\ \text{km}$

(3) $55.4\ \text{km}$

(4) $455\ \text{km}$

Chemistry Section A

Section Number :	3
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 61 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Dissolving 120 g of a compound of (mol. wt. 60) in 1000 g of water gave a solution of density 1.12 g/mL. The molarity of the solution is :

(1) 2.50 M

(2) 1.00 M

(3) 2.00 M

(4) 4.00 M

Question Number : 62 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The amount of oxygen in 3.6 moles of water is:

(1) $57.6\ \text{g}$

(2) $115.2\ \text{g}$

(3) $18.4\ \text{g}$

(4) $28.8\ \text{g}$

Question Number : 63 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The energy of an electron in first Bohr's orbit of H atom is $-13.6\,\text{eV}$. The energy value of electron in the first excited state of Li^{2+} is :

(1) $27.2\,\text{eV}$

(2) $-30.6\,\text{eV}$

(3) $30.6\,\text{eV}$

(4) $-27.2\,\text{eV}$

Question Number : 64 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In the following sets of reactants which two sets best exhibit the amphoteric character of Al_2O_3 . xH_2O ?

Set I $Al_2O_3 \cdot xH_2O_{(s)} + OH^-_{(aq)}$

Set II $Al_2O_3x \cdot H_2O_{(s)} + H_2O_{(l)}$

Set III $Al_2O_3x \cdot H_2O_{(s)} + H^+_{(aq)}$

Set IV $Al_2O_3 \cdot xH_2O_{(s)} + NH_{3(aq)}$

(1) 2 and 4

(2) 1 and 2

(3) 1 and 3

(4) 3 and 4

Question Number : 65 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The number and type of bonds in C_2^{2-} ion in CaC_2 are:

(1) Two σ-bonds and two π-bonds

(2) One σ-bond and two π-bonds

(3) One σ-bond and one π-bond

(4) Two σ-bonds and one π-bond

Question Number : 66 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which of the following has unpaired electron(s)?

(1) O_2^-

(2) N_2^{2+}

(3) O_2^{2-}

(4) N_2

Question Number : 67 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The temperature at which oxygen molecules have the same root mean square speed as helium atoms have at 300 K is : (Atomic masses : He = 4 u, O = 16 u)

(1) 600 K

(2) 2400 K

(3) 1200 K

(4) 300 K

Question Number : 68 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Van der Waal's equation for a gas is stated as,

$P = \frac{nRT}{V-nb} - a\left(\frac{n}{V}\right)^2$.

This equation reduces to the perfect gas equation, $P = \frac{nRT}{V}$ When,

(1) temperature is sufficiently high and pressure is low.

(2) both temperature and pressure are very low.

(3) both temperature and pressure are very high.

(4) temperature is sufficiently low and pressure is high.

Question Number : 69 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The standard enthalpy of formation of NH_3 is -46.0 kJ / mol. If bond enthalpy of H_2 is -436 kJ / mol and that of N_2 is -712 kJ / mol , the average bond enthalpy of N − H bond in NH_3 is :

(1) -964 kJ / mol

(2) -1102 kJ / mol

(3) $+1056$ kJ / mol

(4) $+352$ kJ / mol

Question Number : 70 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

At a certain temperature, only 50% HI is dissociated into H_2 and I_2 at equilibrium. The equilibrium constant is :

(1) 0.5

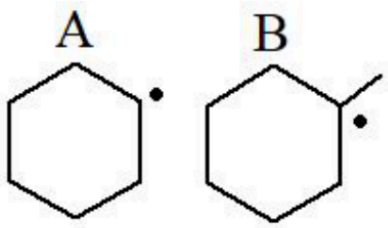
(2) 4.0

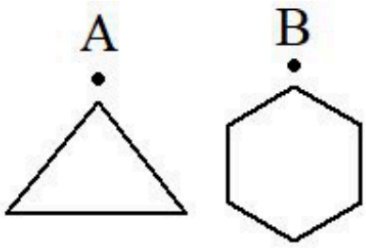
(3) 1.0

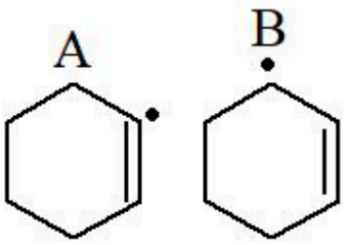
(4) 0.25

Question Number : 71 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In which of the following pairs A is more stable than B?

(1) 

(2) 

(3) 

(4) A B

$Ph_3C^{\bullet}$, $(CH_3)_3C^{\bullet}$

Question Number : 72 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In a face centered cubic lattice atoms A are at the corner points and atoms B at the face centered points. If atom B is missing from one of the face centered points, the formula of the ionic compound is :

(1) A_2B_3

(2) AB_2

(3) A_5B_2

(4) A_2B_5

Question Number : 73 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A current of 10.0 A flows for 2.00 h through an electrolytic cell containing a molten salt of metal X. This results in the decomposition of 0.250 mol of metal X at the cathode. The oxidation state of X in the molten salt is:

$(F = 96,500\ C)$

(1) $1+$

(2) $4+$

(3) $3+$

(4) $2+$

Question Number : 74 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The standard electrode potentials $\left(E^{\circ}_{M^+/M}\right)$ of four metals A, B, C and D are -1.2 V,0.6 V, 0.85 V and -0.76 V, respectively. The sequence of deposition of metals on applying potential is

(1) $B > D > C > A$

(2) $A > C > B > D$

(3) $C > B > D > A$

(4) $D > A > B > C$

Question Number : 75 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The half-life period of a first-order reaction is 15 minutes. The amount of substance left after one hour will be

(1) $\frac{1}{16}$ of the original amount

(2) $\frac{1}{8}$ of the original amount.

(3) $\frac{1}{32}$ of the original amount.

(4) $\frac{1}{4}$ of the original amount.

Question Number : 76 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The form of iron obtained from blast furnace is :

(1) Cast Iron

(2) Wrought Iron

(3) Steel

(4) Pig Iron

Question Number : 77 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The gas evolved on heating CaF_2 and SiO_2 with concentrated H_2SO_4, on hydrolysis gives a white gelatinous precipitate. The precipitate is:

(1) Silicic acid

(2) Calcium fluorosilicate

(3) Hydrofluorosilicic acid

(4) Silica gel

Question Number : 78 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which of the following is not formed when H_2S reacts with acidic $K_2Cr_2O_7$ solution ?

(1) K_2SO_4

(2) $Cr_{2(}SO_4)_3$

(3) S

(4) $CrSO_4$

Question Number : 79 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The correct statement about the magnetic properties of $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ is : (Z = 26).

(1) Both are paramagnetic.

(2) Both are diamagnetic.

(3) $[Fe(CN)_6]^{3-}$ is paramagnetic, $[FeF_6]^{3-}$ is diamagnetic.

(4) $[Fe(CN)_6]^{3-}$ is diamagnetic, $[FeF_6]^{3-}$ is paramagnetic.

Question Number : 80 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A compound of vanadium chloride has spin only magnetic moment of 1.73 BM. Its formula is

(1) VCl_2

(2) VCl_5

(3) VCl_4

(4) VCl_3

Question Number : 81 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

An octahedral complex of Co^{3+} is diamagnetic. The hybridisation involved in the formation of the complex is :

(1) dsp^2

(2) d^2sp^3

(3) dsp^3d

(4) sp^3d^2

Question Number : 82 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Allyl phenyl ether can be prepared by heating :

(1) $CH_2 = CH - Br + C_6H_5 - CH_2 - ONa$

(2) $C_6H_5 - CH = CH - Br + CH_3 - ONa$

(3) $CH_2 = CH - CH_2 - Br + C_6H_5ONa$

(4) $C_6H_5Br + CH_2 = CH - CH_2 - ONa$

Question Number : 83 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

For the compounds CH_3Cl, CH_3Br, CH_3I and CH_3F, the correct order of increasing C-halogen bond length is :

(1) $CH_3F < CH_3Br < CH_3Cl < CH_3I$

(2) $CH_3F < CH_3I < CH_3Br < CH_3Cl$

(3) $CH_3F < CH_3Cl < CH_3Br < CH_3I$

(4) $CH_3Cl < CH_3Br < CH_3F < CH_3I$

Question Number : 84 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In a nucleophilic substitution reaction : $R - Br + Cl^- \xrightarrow{DMF} R - Cl + Br^-$, which one of the following undergoes complete inversion of configuration ?

(1) $C_6H_5CHC_6H_5Br$

(2) $C_6H_5CCH_3C_6H_5Br$

(3) $C_6H_5CH_2Br$

(4) $C_6H_5CH_2CH_2Br$

Question Number : 85 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In the hydroboration - oxidation reaction of propene with diborane, H_2O_2 and NaOH, the organic compound formed is:

(1) $CH_3\,CH_2\,CH_2\,OH$ (2) $CH_3\,CH_2\,OH$

(3) $CH_3\,CHOHCH_3$ (4) $(CH_3)_3\,COH$

Question Number : 86 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which is the major product formed when acetone is heated with iodine and potassium hydroxide?

(1) Acetophenone (2) Iodoform

(3) Iodoacetone (4) Acetic acid

Question Number : 87 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

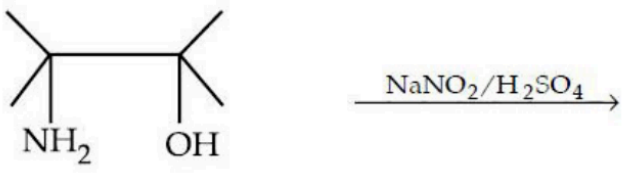
Which one of the following reactions will not result in the formation of carbon-carbon bond ?

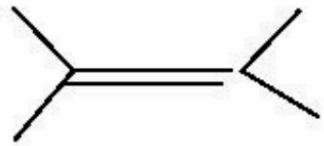
(1) Friedel Craft's acylation (2) Reimer-Tieman reaction

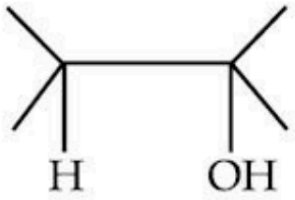
(3) Cannizaro reaction (4) Wurtz reaction

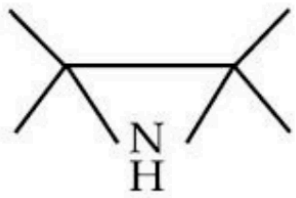
Question Number : 88 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

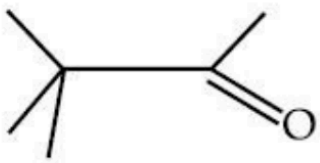
The major product of the reaction is



(1) 

(2) 

(3) 

(4) 

Question Number : 89 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Structure of some important polymers are given. Which one represents Buna-S ?

(1) $(-CH_2-CH=CH-CH_2-\underset{\displaystyle CN}{\underset{|}{CH}}-CH_2-)_n$ (2) $(-CH_2-CH=CH-CH_2-\underset{\displaystyle C_6H_5}{\underset{|}{CH}}-CH_2-)_n$

(3) $(-CH_2-\overset{\displaystyle CH_3}{\overset{|}{C}}=CH-CH_2-)_n$ (4) $(-CH_2-\overset{\displaystyle Cl}{\overset{|}{C}}=CH-CH_2-)_n$

Question Number : 90 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which one of the following class of compounds is obtained by polymerization of acetylene ?

(1) Poly-ene (2) Poly-amide

(3) Poly-yne (4) Poly-ester