Central Board of Secondary Education

Question Paper Name :	B Tech 12 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

The sum of the roots of the equation, $x^2 + |2x - 3| - 4 = 0$, is:

(1) 2 (2) -2

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

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

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

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

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

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

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

(1) 160 (2) 120

(3) 60 (4) 48

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

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

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

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

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

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

(1) 4 (2) 5

(3) 6 (4) 7

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

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

(1) -4 (2) 6

(3) -8 (4) 10

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

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

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

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

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

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

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

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

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

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

(1) circle (2) hyperbola

(3) straight line (4) parabola

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

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

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

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

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

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

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

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

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

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

(1) 12 (2) 18

(3) 26 (4) 36

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

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

(1) $(\mathrm{p} \vee \mathrm{q}) \Rightarrow \mathrm{r}$ (2) $(\mathrm{p} \Rightarrow \mathrm{q}) \vee (\mathrm{p} \Rightarrow \mathrm{r})$

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

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

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

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

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

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

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

(1) 32 (2) 16

(3) 8 (4) 64

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

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

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

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

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

If

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

then k is equal to:

(1) $4\lambda\mathrm{abc}$ (2) $-4\lambda\mathrm{abc}$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(1) π (2) $\frac{\pi}{2}$

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

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

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

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

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

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

If $\hat{x}, \hat{y}$ and $\hat{z}$ are three unit vectors in threedimensional space, then the minimum value of

$|\hat{x}+\hat{y}|^2+|\hat{y}+\hat{z}|^2+|\hat{z}+\hat{x}|^2$

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

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

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

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

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

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

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

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

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

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

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

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

(1) 0.71 (2) 0.70

(3) 0.51 (4) 0.20

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

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

(1) $\frac{ch}{2\pi\varepsilon_o^2}$

(2) $\frac{e^2}{2\pi\varepsilon_o G m_e^2}$

(3) $\frac{\mu_o\varepsilon_o}{c^2}\frac{G}{he^2}$

(4) $\frac{2\pi\sqrt{\mu_o\varepsilon_o}}{ce^2}\frac{h}{G}$

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

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

(1) 37 s

(2) 27 s

(3) 24 s

(4) 45 s

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

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

(1) 0.19 m

(2) 0.379 m

(3) 0.569 m

(4) 0.758 m

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

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

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

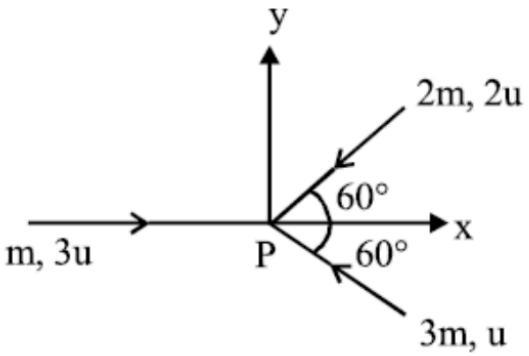
(2) mv^2

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

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

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

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



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

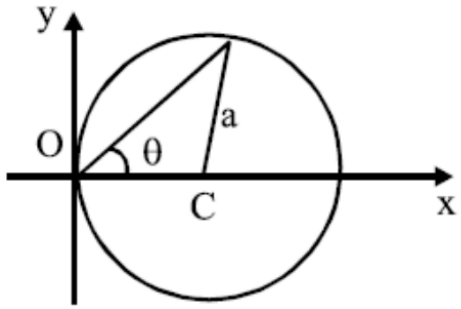
(2) $\frac{u}{12}(\hat{i}-\sqrt{3}\hat{j})$

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

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

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

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



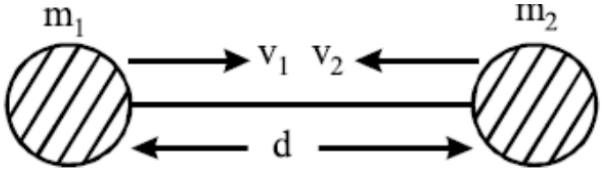
(1) va $(1+\cos 2\theta)$

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

(3) va $\cos 2\theta$

(4) va

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



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

(1) $v_1 = v_2$

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

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

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

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

(4) $\mathrm{v_1 = m_2\sqrt{\frac{2G}{m_1}}}$

$\mathrm{v_2 = m_2\sqrt{\frac{2G}{m_2}}}$

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

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

(1) 1.4×10^4 N

(2) 2.7×10^4 N

(3) 3.3×10^4 N

(4) 1.1×10^4 N

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

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

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

(2) $\frac{\sqrt{2}\,\mathrm{A}}{\pi \mathrm{a}^2}\sqrt{\frac{\mathrm{h}}{\mathrm{g}}}$

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

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

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

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

(1) $4\mathrm{PV}+3\mathrm{ST}=0$ (2) $3\mathrm{PV}+4\mathrm{ST}=0$

(3) $2\mathrm{PV}+3\mathrm{ST}=0$ (4) $3\mathrm{PV}+2\mathrm{ST}=0$

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

Hot water cools from $60^{\circ}\mathrm{C}$ to $50^{\circ}\mathrm{C}$ in the first 10 minutes and to $42^{\circ}\mathrm{C}$ in the next 10 minutes. The temperature of the surroundings is:

(1) $25^{\circ}\mathrm{C}$ (2) $10^{\circ}\mathrm{C}$

(3) $15^{\circ}\mathrm{C}$ (4) $20^{\circ}\mathrm{C}$

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

A Carnot engine absorbs 1000 J of heat energy from a reservoir at $127^{\circ}\mathrm{C}$ and rejects 600 J of heat energy during each cycle. The efficiency of engine and temperature of sink will be:

(1) 20% and $-43^{\circ}\mathrm{C}$ (2) 40% and $-33^{\circ}\mathrm{C}$

(3) 50% and $-20^{\circ}\mathrm{C}$ (4) 70% and $-10^{\circ}\mathrm{C}$

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

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

(1) H_2 (2) Cl_2

(3) O_2 (4) F_2

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

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

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

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

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

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

(1) 2150 Hz (2) 2500 Hz

(3) 1800 Hz (4) 2400 Hz

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

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

(1) $\frac{\rho_{\mathrm{o}}}{4\varepsilon_{\mathrm{o}}}\left(\frac{\mathrm{r}}{3}-\frac{\mathrm{r}^2}{4\mathrm{R}}\right)$ (2) $\frac{\rho_0}{\varepsilon_0}\left(\frac{r}{3}-\frac{r^2}{4R}\right)$

(3) $\frac{\rho_{\mathrm{o}}}{3\varepsilon_{\mathrm{o}}}\left(\frac{\mathrm{r}}{3}-\frac{\mathrm{r}^2}{4\mathrm{R}}\right)$ (4) $\frac{\rho_{\mathrm{o}}}{12\varepsilon_{\mathrm{o}}}\left(\frac{\mathrm{r}}{3}-\frac{\mathrm{r}^2}{4\mathrm{R}}\right)$

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

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

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

The capacitance C, of the capacitor, would be related to its vacuum capacitance $\mathrm{C_o}$ for the relation :

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

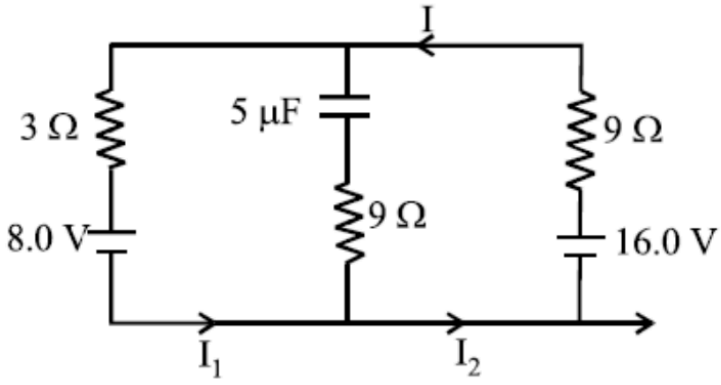
(2) $\mathrm{C = \frac{\lambda}{d \cdot \ln(1+K_o \lambda d} C_o)}$

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

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

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

The circuit shown here has two batteries of 8.0 V and 16.0 V and three resistors $3\Omega, 9\Omega$ and 9Ω and a



capacitor of $5.0\mu\mathrm{F}$.

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

(1) 1.6 A

(2) 0.67 A

(3) 2.5 A

(4) 0.25 A

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

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

(1) -0.15 volt

(2) 0.15 volt

(3) 0.5 volt

(4) -0.05 volt

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

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

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

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

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

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

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

Consider two thin identical conducting wires covered with very thin insulating material. One of the wires is bent into a loop and produces magnetic field $\mathrm{B_1}$, at its centre when a current I passes through it. The ratio $\mathrm{B_1 : B_2}$ is:

(1) 1:1

(2) 1 : 3

(3) 1 : 9

(4) 9 : 1

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

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

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

(3) $10\sin(500t)$ (4) $-10\sin(500t)$

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

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

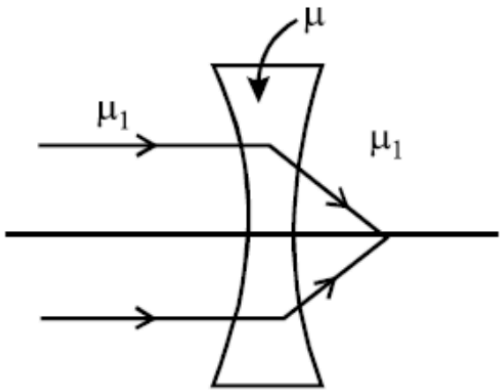
(1) $1.34\ \mathrm{V/m}$ (2) $2.68\ \mathrm{V/m}$

(3) $4.02\ \mathrm{V/m}$ (4) $5.36\ \mathrm{V/m}$

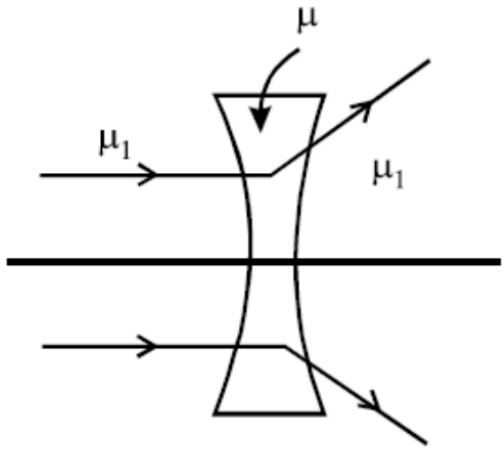
Question Number : 54 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

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

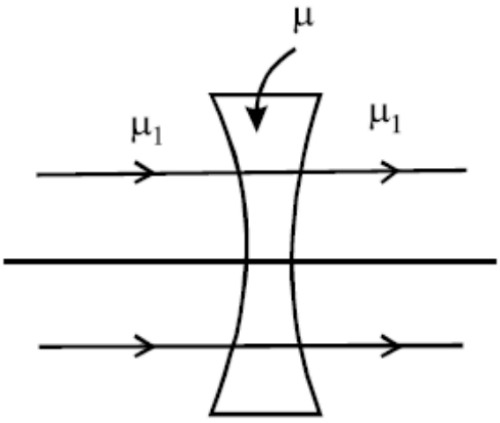
(1)



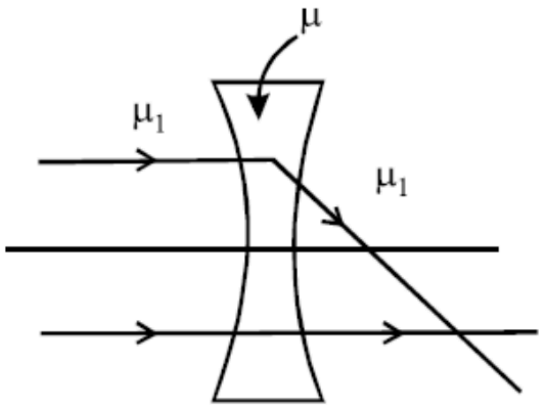
(2)



(3)

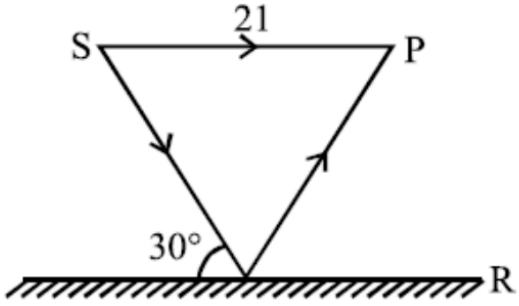


(4)



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

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



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

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

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

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

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

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

(1) $3300\mathring{A}$

(2) $4400\mathring{A}$

(3) $5500\mathring{A}$

(4) $6600\mathring{A}$

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

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

(1) 6×10^{11}

(2) 9×10^{11}

(3) 11×10^{11}

(4) 15×10^{11}

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

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

(1) 0.1eV to 0.4eV

(2) 0.5eV to 0.8eV

(3) 0.9eV to 1.6eV

(4) 1.7eV to 3.0eV

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

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

(1) 1672 years

(2) 2391 years

(3) 3291 years

(4) 4453 years

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

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

(1) 1MHz to 2MHz

(2) 5MHz to 25MHz

(3) 35MHz to 40MHz

(4) 45MHz to 50MHz

Chemistry Section A

Section Number :

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

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

(1) 23.3 g

(2) 11.65 g

(3) 30.6 g

(4) 33.2 g

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

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

(1) $\frac{1}{2}\frac{e^2}{r}$

(2) $-\frac{e^2}{r}$

(3) $\frac{me^2}{r}$

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

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

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

(1) 10^{-33} m

(2) 10^{-35} m

(3) 10^{-31} m

(4) 10^{-25} m

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

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

(1) 8.041×10^{-40} J

(2) 2.680×10^{-19} J

(3) 1.640×10^{-18} J

(4) 6.111×10^{-17} J

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

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

(1) atomic numbers

(2) atomic masses

(3) number of principal energy levels

(4) number of valence electrons

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

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

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

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

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

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

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

(1) C_2H_4

(2) N_2F_2

(3) $C_2H_2Cl_2$

(4) HCN

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

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

(1) -312.5 J K^{-1} mol^{-1}

(2) $-242.8JK^{-1}$ mol^{-1}

(3) $-108.1JK^{-1}$ mol^{-1}

(4) -37.6 J K^{-1} mol^{-1}

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

(1) The dissociation energy of the hydrogen molecule, H_2.

(2) The first four ionisation energies of carbon.

(3) The dissociation energy of H_2 and enthalpy and sublimation of carbon (graphite).

(4) The first four ionisation energies of carbon and electron affinity of hydrogen.

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

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

(1) More product will form

(2) Less product will form

(3) More reactant will form

(4) Equilibrium will remain unchanged

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

The conjugate base of hydrazoic acid is:

(1) N^{-3}

(2) N_3^-

(3) N_2^-

(4) HN_3^-

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

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

(1) MnO_4^-

(2) $Cr_2O_7^{2-}$

(3) SO_3^{2-}

(4) KI

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

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

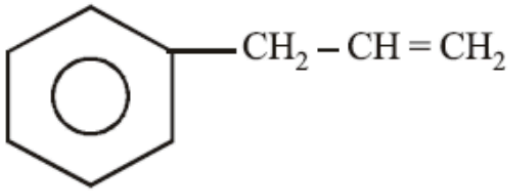
(1) Lactic acid

(2) Tartaric acid

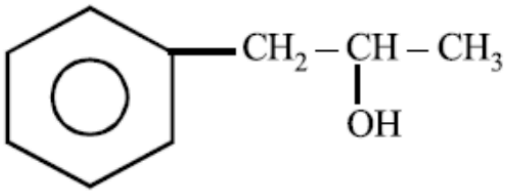
(3) Maleic acid

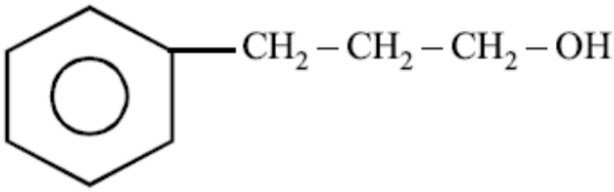
(4) α-amino acids

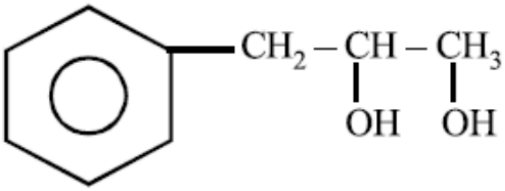
Question Number : 74 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

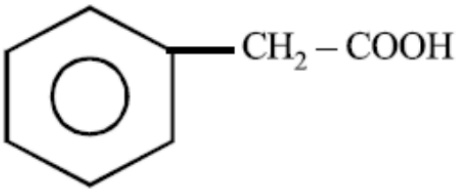


on mercuration-demercuration produces the major product:

(1) 

(2) 

(3) 

(4) 

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

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

(1) One of the steps is endothermic in HCl and HI

(2) Both HCl and HI are strong acids

(3) HCl is oxidizing and the HI is reducing

(4) All the steps are exothermic is HCl and HI

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

Global warming is due to increase of:

(1) methane and nitrous oxide in atmosphere

(2) methane and CO_2 in atmosphere

(3) methane and O_3 in atmosphere

(4) methane and CO in atmosphere

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

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

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

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

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

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

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

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

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

(2) $\frac{N_A}{10}$

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

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

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

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

(1) 16

(2) 60

(3) 99

(4) 132

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

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

(1) XeO_2F_2 (2) $XeOF_4$

(3) XeO_3 (4) XeO_4

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

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

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

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

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

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

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

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

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

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

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

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

(1) CN^- (2) NH_3

(3) F^- (4) CO

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

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

(1) $[Sc(H_2O)_6]^{3+}$ (2) $[Ti(NH_3)_6]^{4+}$

(3) $[V(NH_3)_6]^{3+}$ (4) $[Zn(NH_3)_6]^{2+}$

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

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

(1) Claisen (2) Friedel-craft

(3) Sandmeyer (4) Wurtz

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

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

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

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

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

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

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

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

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

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

(1) Phenolphthalein (2) Alizarin

(3) Coumarin (4) Fluorescein

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

Aminoglycosides are usually used as:

(1) antibiotic

(2) analgesic

(3) hypnotic

(4) antifertility

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

Which of the following will not show mutarotation?

(1) Maltose

(2) Lactose

(3) Glucose

(4) Sucrose