Central Board of Secondary Education

Question Paper Name :	B Tech 3 Apr 2016 Shift 1
Subject Name :	B. Tech
Duration :	180
Total Marks :	360
Display Marks:	Yes

B. Tech

Group Number :	1
Group Maximum Duration :	0
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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 Option Orientation : Vertical

For

$$x \in R,\ f(x) = |\log 2 - \sin x|$$

and

$$g(x) = f\big(f(x)\big),$$

then :

Options :

A. g is not differentiable at $x = 0$

B. $g'(0) = \cos\big(\log 2\big)$

C. $g'(0) = -\cos\big(\log 2\big)$

D. g is differentiable at $x = 0$ and

$$g'(0) = -\sin(\log 2)$$

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

Let

$$p = \lim_{x \to 0^+} \left(1 + \tan^2\sqrt{x}\ \right)^{\frac{1}{2x}}$$

then $log\ p$ is equal to :

Options :

A. $\frac{1}{2}$

B. $\frac{1}{4}$

C. 2

D. 1

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

If the standard deviation of the numbers 2, 3, a and 11 is 3.5, then which of the following is true?

Options :

A. $3a^2 - 26a + 55 = 0$

B. $3a^2 - 32a + 84 = 0$

C. $3a^2 - 34a + 91 = 0$

D. $3a^2 - 23a + 44 = 0$

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

A value of θ for which

$$\frac{2 + 3i\sin\theta}{1 - 2i\ \sin\ \theta}$$

is purely imaginary, is :

Options :

A. $\sin^{-1}\left(\frac{\sqrt{3}}{4}\right)$

B. $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

C. $\frac{\pi}{3}$

D. $\frac{\pi}{6}$

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

Let two fair six-faced dice A and B be thrown simultaneously. If E_1 is the event that die A shows up four, E_2 is the event that die B shows up two and E_3 is the event that the sum of numbers on both dice is odd, then which of the following statements is *NOT* true?

Options :

A. E_1 and E_2 are independent.

B. E_2 and E_3 are independent.

C. E_1 and E_3 are independent.

D. E_1, E_2 and E_3 are independent.

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

The area (in sq. units) of the region

$$\left\{(x,y) : y^2 \geq 2x \ \ and \ \ x^2 + y^2 \leq 4x, x \geq 0, y \geq 0\right\}$$

is :

Options :

A. $\pi - \frac{4\sqrt{2}}{3}$

B. $\frac{\pi}{2} - \frac{2\sqrt{2}}{3}$

C. $\pi - \frac{4}{3}$

D. $\pi - \frac{8}{3}$

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

If a curve

$$y = f(x)$$

passes through the point $(1, -1)$ and satisfies the differential equation,

$$y(1 + xy)dx = x$$

dy, then

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

is equal to :

Options :

A. $\frac{2}{5}$

B. $\frac{4}{5}$

C. $-\frac{2}{5}$

D. $-\frac{4}{5}$

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

The integral

$$\int \frac{2x^{12} + 5x^9}{(x^5 + x^3 + 1)^3} dx$$

is equal to :

Options :

A. $\frac{x^5}{2(x^5 + x^3 + 1)^2} + C$

B. $\frac{-x^{10}}{2(x^5 + x^3 + 1)^2} + C$

C. $\frac{-x^5}{(x^5 + x^3 + 1)^2} + C$

D. $$\frac{x^{10}}{2(x^5+x^3+1)^2}+C$$

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

A wire of length 2 units is cut into two parts which are bent respectively to form a square of side $= x$ units and a circle of radius $= r$ units. If the sum of the areas of the square and the circle so formed is minimum, then:

Options :

A. $$x = 2r$$

B. $$2x = r$$

C. $$2x = (\pi + 4)r$$

D. $$(4-\pi)x = \pi\, r$$

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

The system of linear equations

$$x + \lambda y - z = 0$$
$$\lambda x - y - z = 0$$
$$x + y - \lambda z = 0$$

has a non-trivial solution for :

Options :

A. infinitely many values of λ.

B. exactly one value of λ.

C. exactly two values of λ.

D. exactly three values of λ.

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

If

$$A = \begin{bmatrix} 5a & -b \\ 3 & 2 \end{bmatrix}$$

and A adj $A = A\,A^T$, then $5a + b$ is equal to :

Options :

A.

B. 13

C. -1

D. 5

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

The eccentricity of the hyperbola whose length of the latus rectum is equal to 8 and the length of its conjugate axis is equal to half of the distance between its foci, is :

Options :

A. $\frac{2}{\sqrt{3}}$

B. $\sqrt{3}$

C. $\frac{4}{3}$

D. $\frac{4}{\sqrt{3}}$

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

If one of the diameters of the circle, given by the equation,

$$x^2 + y^2 - 4x + 6y - 12 = 0,$$

is a chord of a circle S, whose centre is at $(-3, 2)$, then the radius of S is :

Options :

A. 5

B. 10

C. $5\sqrt{2}$

D. $5\sqrt{3}$

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

Two sides of a rhombus are along the lines, $x - y + 1 = 0$ and $7x - y - 5 = 0$. If its diagonals intersect at $(-1, -2)$, then which one of the following is a vertex of this rhombus?

Options :

A. $\left(\frac{1}{3}, -\frac{8}{3}\right)$

B. $\left(-\frac{10}{3}, -\frac{7}{3}\right)$

C. $(-3, -9)$

D. $(-3, -8)$

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

If the $2^{nd}, 5^{th}$ *and* 9^{th} terms of a non-constant A.P. are in G.P., then the common ratio of this G.P. is :

Options :

A. 1

B. $\frac{7}{4}$

C. $\frac{8}{5}$

D. $\frac{4}{3}$

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

The sum of all real values of x satisfying the equation

$$\left(x^2 - 5x + 5\right)^{x^2 + 4x - 60} = 1$$

is :

Options :

A. 6

B. 5

C. 3

D. -4

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

If all the words (with or without meaning) having five letters,formed using the letters of the word SMALL and arranged as in a dictionary, then the position of the word SMALL is :

Options :

A. 46^{th}

B. 59^{th}

C. 52^{nd}

D. 58^{th}

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

If $f(x)+2f\left(\frac{1}{x}\right)=3x, x\neq 0$, and $S=\{x\in \mathbf{R}: f(x)=f(-x)\}$; then S :

Options :

A. is an empty set.

B. contains exactly one element.

C. contains exactly two elements.

D. contains more than two elements.

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

If

$$0\leq x<2\pi$$

, then the number of real values of x, which satisfy the equation

$$\cos x+\cos 2x+\cos 3x+\cos 4x=0$$

is:

Options :

A. 7

B. 9

C. 3

D. 5

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

Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three unit vectors such that

$$\vec{a} \times \left(\vec{b} \times \vec{c}\right) = \frac{\sqrt{3}}{2}\left(\vec{b} + \vec{c}\right).$$

If $\vec{b}$ is not parallel to $\vec{c}$, then the angle between $\vec{a}$ and $\vec{b}$ is:

Options :

A. $\frac{2\pi}{3}$

B. $\frac{5\pi}{6}$

C. $\frac{3\pi}{4}$

D. $\frac{\pi}{2}$

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

If the sum of the first ten terms of the series

$$\left(1\frac{3}{5}\right)^2 + \left(2\frac{2}{5}\right)^2 + \left(3\frac{1}{5}\right)^2 + 4^2 + \left(4\frac{4}{5}\right)^2 + ...is\,\frac{16}{5}m,$$

then m is equal to :

Options :

A. 100

B. 99

C. 102

D. 101

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

If the number of terms in the expansion of

$$\left(1 - \frac{2}{x} + \frac{4}{x^2}\right)^n,\ x \neq 0,$$

is 28, then the sum of the coefficients of all the terms in this expansion, is :

Options :

A. 243

B. 729

C. 64

D. 2187

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

$$\lim_{n \to \infty} \left(\frac{(n+1)(n+2)...3n}{n^{2n}} \right)^{\frac{1}{n}}$$

is equal to:

Options :

A. $\frac{9}{e^2}$

B. $3 \log 3 - 2$

C. $\frac{18}{e^4}$

D. $\frac{27}{e^2}$

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

The Boolean expression

$(p \wedge \sim q) \vee q \vee (\sim p \wedge q)$ is equivalent to :

Options :

A. $\sim p \wedge q$

B. $p \wedge q$

C. $p \vee q$

D. $p \vee \sim q$

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

If the line,

$$\frac{x-3}{2}=\frac{y+2}{-1}=\frac{z+4}{3}$$

lies in the planes,

$$lx+my-z=9,$$

then l^2+m^2 is equal to :

Options :

A. 5

B. 2

C. 26

D. 18

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

A man is walking towards a vertical pillar in a straight path, at a uniform speed. At a certain point A on the path, he observes that the angle of elevation of the top of the pillar is 30°. After walking for 10 minutes from A in the same direction, at a point B, he observes that the angle of elevation of the top of the pillar is 60°. Then the time taken (in minutes) by him, from B to reach the pillar, is :

Options :

A. 6

B. 10

C. 20

D. 5

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

The centres of those circles which touch the circle,

$$x^2+y^2-8x-8y-4=0$$

, externally and also touch the x-axis, lie on :

Options :

A. a circle

B. an ellipse which is not a circle

C. a hyperbola

D. a parabola

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

Let P be the point on the parabola, $y^2 = 8x$ which is at a minimum distance from the centre C of the circle,

$$x^2 + \left(y + 6\right)^2 = 1$$

. Then the equation of the circle, passing through C and having its centre at P is:

Options :

A. $x^2 + y^2 - \frac{x}{4} + 2y - 24 = 0$

B. $x^2 + y^2 - 4x + 9y + 18 = 0$

C. $x^2 + y^2 - 4x + 8y + 12 = 0$

D. $x^2 + y^2 - x + 4y - 12 = 0$

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

The distance of the point $(1, -5, 9)$ from the plane $x - y + z = 5$ measured along the line $x = y = z$ is :

Options :

A. $\frac{10}{\sqrt{3}}$

B. $\frac{20}{3}$

C. $3\sqrt{10}$

D. $10\sqrt{3}$

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

Consider :

f

$$(x) = \tan^{-1}\left(\sqrt{\frac{1+\sin x}{1-\sin x}}\right), x \in \left(0, \frac{\pi}{2}\right).$$

A normal to $y =$ f(x) at

$$x = \frac{\pi}{6}$$

also passes through the point:

Options :

A. $\left(\frac{\pi}{6}, 0\right)$

B. $\left(\frac{\pi}{4}, 0\right)$

C. $(0,0)$

D. $\left(0, \frac{2\pi}{3}\right)$

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 Option Orientation : Vertical

Radiation of wavelength λ, is incident on a photocell. The fastest emitted electron has speed v. If the wavelength is changed to

$$\frac{3\lambda}{4},$$

the speed of the fastest emitted electron will be:

Options :

A. $= v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

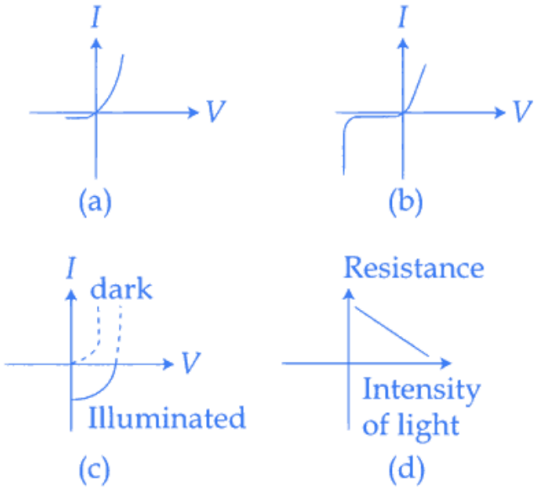
B. $= v\left(\frac{3}{4}\right)^{\frac{1}{2}}$

C. $> v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

D. $< v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

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

Identify the semiconductor devices whose characteristics are given below, in the order $(a), (b), (c), (d)$:



Options :

A. Simple diode, Zener diode, Solar cell, Light dependent resistance

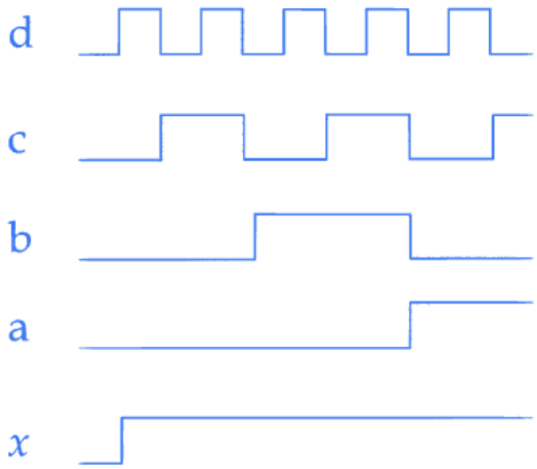
B. Zener diode, Simple diode, Light dependent resistance, Solar cell

C. Solar cell, Light dependent resistance, Zener diode, simple diode

D. Zener diode, Solar cell, simple diode, Light dependent resistance

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

If a, b, c, d are inputs to a gate and x is its output, then, as per the following time graph, the gate is :



Options :

A. *OR*

B. *NAND*

C. *NOT*

D. *AND*

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

In an experiment for determination of refractive index of glass of a prism by $i - \delta$, plot it was found thata ray incident at angle 35°, suffers a deviation of 40° and that it emerges at angle 79°. In that case which of the following is closest to the maximum possible value of the refractive index?

Options :

A. 1.7

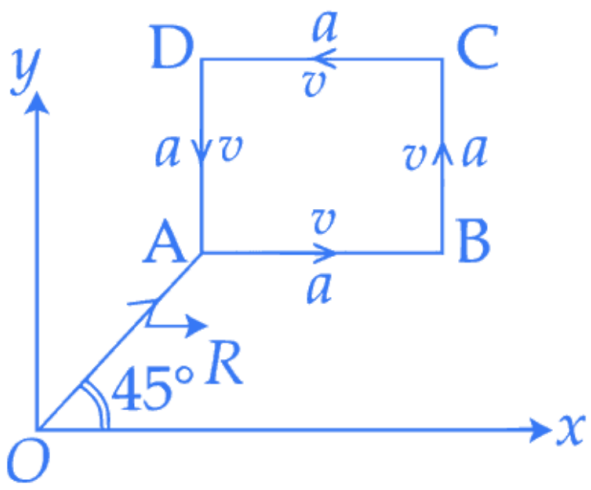
B. 1.8

C. 1.5

D. 1.6

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

A particle of mass m is moving along the side of a square of side 'a', with a uniform speed v in the x-y plane as shown in the figure :



Which of the following statements is **false** for the angular momentum $\vec{L}$ about the origin ?

Options :

$$\vec{L} = mv\left[\frac{R}{\sqrt{2}} + a\right]\hat{k}$$

A. when the particle is moving from B to C.

$$\vec{L} = \frac{mv}{\sqrt{2}}R\hat{k}$$

B. when the particle is moving from D to A.

$$\vec{L} = -\frac{mv}{\sqrt{2}}R\hat{k}$$

C. when the particle is moving from A to B

$$\vec{L} = mv\left[\frac{R}{\sqrt{2}} - a\right]\hat{k}$$

D. when the particle is moving from C to D.

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

Arrange the following electromagnetic radiations per quantum in the order of increasing energy :

A : Blue light B : Yellow light

C : X-ray D : Radiowave.

Options :

A. C, A, B, D

B. B, A, D, C

C. D, B, A, C

D. A, B, D, C

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

An arc lamp requires a direct current of 10 A at 80 V to function. If it is connected to a 220 V (rms), 50 Hz AC supply, the series inductor needed for it to work is close to :

Options :

A. 0.044 H

B. 0.065 H

C. 80 H

D. 0.08 H

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

The box of a pin hole camera, of length L, has a hole of radius a. It is assumed that when the hole is illuminated by a parallel beam of light of wavelength λ the spread of the spot (obtained on the opposite wall of the camera) is the sum of its geometrical spread and the spread due to diffraction. The spot would then have its minimum size (say $b_{\min}$) when :

Options :

$$a = \sqrt{\lambda L}$$

and

A. $$b_{\min} = \sqrt{4\lambda L}$$

$$a = \frac{\lambda^2}{L}$$

and

B. $$b_{\min} = \sqrt{4\lambda L}$$

$$a = \frac{\lambda^2}{L}$$

and

C. $$b_{\min} = \left(\frac{2\lambda^2}{L}\right)$$

$$a = \sqrt{\lambda L}$$

and

D. $$b_{\min} = \left(\frac{2\lambda^2}{L}\right)$$

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

A student measures the time period of 100 oscillations of a simple pendulum four times. The data set is 90 s, 91 s, 95 s and 92 s. If the minimum division in the measuring clock is 1 s, then the reported mean time should be :

Options :

A. 92 ± 1.8 s

B. 92 ± 3 s

C. 92 ± 2 s

D. 92 ± 5.0 s

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

An observer looks at a distant tree of height 10 m with a telescope of magnifying power of 20. To the observer the tree appears:

Options :

A. 20 times taller

B. 20 times nearer

C. 10 times taller

D. 10 times nearer

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

Two identical wires A and B, each of length $'l'$, carry the same current I. Wire A is bent into a circle of radius R and wire B is bent to form a square of side $'a'$. If B_A and B_B are the values of magnetic fields at the centres of the circle and square respectively, then the ratio $\frac{B_A}{B_B}$ is:

Options :

A. $\frac{\pi^2}{16}$

B. $\frac{\pi^2}{8\sqrt{2}}$

C. $\frac{\pi^2}{8}$

D. $\frac{\pi^2}{16\sqrt{2}}$

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

A galvanometer having a coil resistance of 100 Ω gives a full scale deflection, when a currect of 1 mA is passed through it. The value of the resistance, which can convert this galvanometer into ammeter giving a full scale deflection for a current of 10 A, is :

Options :

A. 0.1 Ω

B. 3 Ω

C. 0.01 Ω

D. 2 Ω

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

The temperature dependence of resistance of Cu and undoped Si in the temperature range $300 - 400\ K$, is best described by :

Options :

A. Linear increases for Cu, exponential decrease of Si.

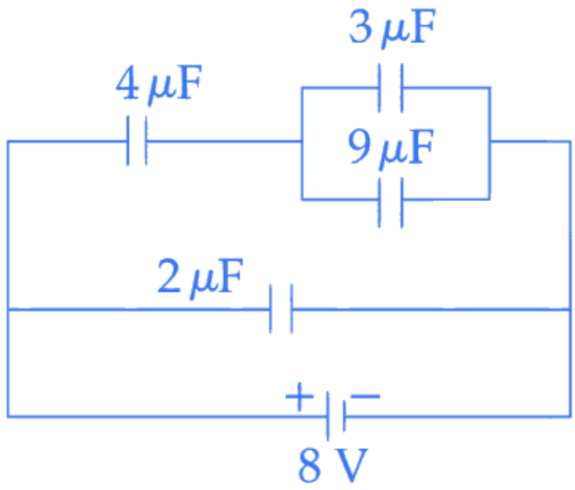
B. Linear decrease for Cu, linear decrease for Si

C. Linear increase for Cu, linear increase for Si.

D. Linear increase for Cu, exponential increase for Si

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

A combination of capacitors is set up as shown in the figure. The magnitude of the electric field, due to a point charge Q (having a charge equal to the sum of the charges on the 4 μF and 9 μF capacitors), at a point distance 30 m from it, would equal :



Options :

A. $420N/C$

B. $480N/C$

C. $240N/C$

D. $360N/C$

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

A particle performs simple harmonic motion with amplitude A. Its speed is trebled at the instant that it is at a distance $\frac{2A}{3}$ from equilibrium position. The new amplitude of the motion is:

Options :

A. $A\sqrt{3}$

B. $\frac{7A}{3}$

C. $\frac{A}{3}\sqrt{41}$

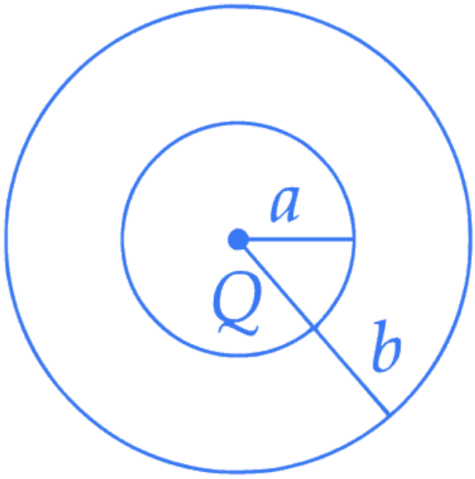
D. $3A$

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

The region between two concentric spheres of radii $'a'$ and $'b'$, respectively (see figure), have volume charge density

$$\rho = \frac{A}{r},$$

where A is a constant and r is the distance from the center. A such that the electric field in the region between the spheres will be constant, is :



Options :

A. $\frac{2Q}{\pi\left(a^2 - b^2\right)}$

B. $\frac{2Q}{\pi\, a^2}$

C. $\frac{Q}{2\pi\, a^2}$

D. $\frac{Q}{2\pi\left(b^2 - a^2\right)}$

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

A uniform string of length 20 m is suspended from a rigid support. A short wave pulse is introduced at its lowest end. It starts moving up the string. The time taken to reach the supports is :
(take

$$g = 10ms^{-2}$$

)

Options :

A. $2\sqrt{2}\ s$

B. $2\pi\sqrt{2}\ s$

C. $2\pi\sqrt{2}\ s$

D. $\frac{2}{s}$

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

A pipe open at both ends has a fundamental frequency f in air. The pipe is dipped vertically in water so that half of it is in water. The fundamental frequency of the air column is now :

Options :

A. $2f$

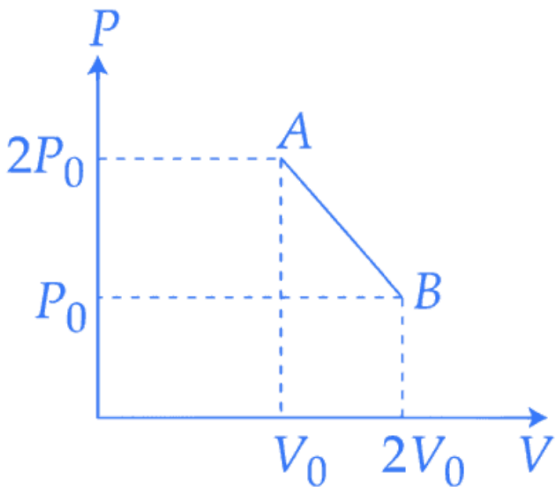
B. f

C. $\frac{f}{2}$

D. $\frac{3f}{4}$

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

$'n'$ moles of an ideal gas undergoes a process $A \rightarrow B$ as shown in the figure. The maximum temperature of the gas during the process will be :



Options :

A. $\frac{9P_0V_0}{2nR}$

B. $\frac{9P_0V_0}{nR}$

C. $\frac{9P_0V_0}{4nR}$

D. $\frac{3P_0V_0}{2nR}$

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

An ideal gas undergoes a quasi static, reversible process in which its molar heat capacity C remains constant. If during this process the relation of pressure P and volume V is given by $PV^n =$ constant, then n is given by (Here C_p and C_v are molar specific heat at constant pressure and constant volume, respectively:

Options :

A. $n = \frac{C_p - C}{C - C_v}$

B. $n = \frac{C - C_v}{C - C_p}$

C. $n = \frac{C_p}{C_v}$

D. $$n = \frac{C - C_p}{C - C_v}$$

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

A pendulum clock loses 12 s a day if the temperature is $40°C$ and gains 4 s a day if the temperature is $20°C$. The temperature at which the clock will show correct time, and the co-efficient of linear expansion (α) of the metal of the pendulum shaft are respectively :

Options :

A. $30°C;\ \alpha = 1.85 \times 10^{-3}/°C$

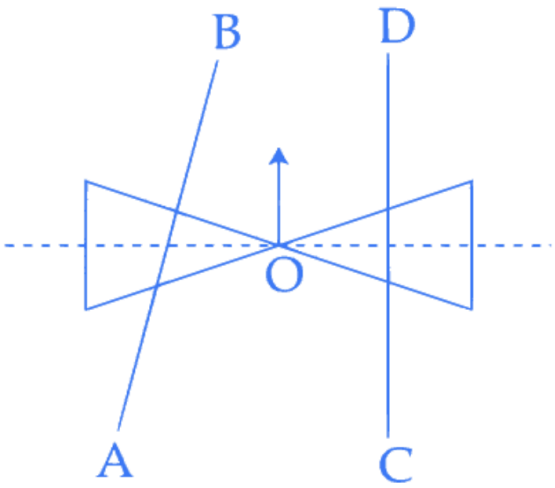
B. $55°C;\ \alpha = 1.85 \times 10^{-2}/°C$

C. $25°C;\ \alpha = 1.85 \times 10^{-5}/°C$

D. $60°C;\ \alpha = 1.85 \times 10^{-4}/°C$

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

A roller is made by joining together two cones at their vertices 0. It is kept on two rails AB and CD, which are placed asymmetrically (see figure), with its axis perpendicular to CD and its center O at the center of line joining AB and CD (see figure). It is given a light push so that it starts rolling with its center O moving parallel to CD in the direction shown. As it moves, the roller will tend to :



Options :

A. go straight

B. turn left and right alternately

C. turn left

D. turn right

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

A person trying to lose weight by burning fat lifts a mass of 10 kg upto a height of 1 m 1000 times. Assume that the potential energy lost each time he lowers the mass is dissipated. How much fat will he use up considering the work done only when the weight is lifted up? Fat supplies $3.8 \times 10^7 J$ of energy per kg which is converted to mechanical energy with a 20% efficiency rate. Take

$$g = 9.8\, ms^{-2}$$

:

Options :

A. $9.89 \times 10^{-3}\ kg$

B. $12.89 \times 10^{-3}\ kg$

C. $2.45 \times 10^{-3}\ kg$

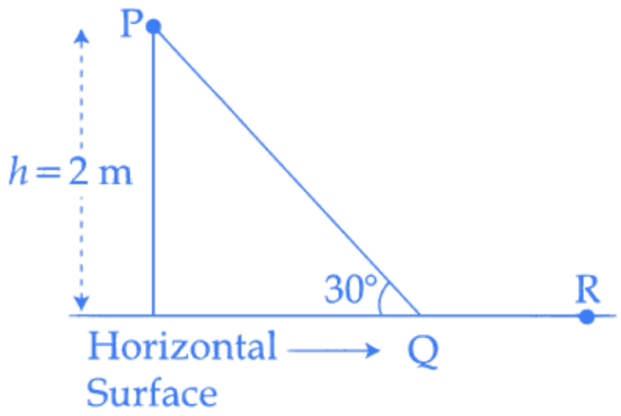
D. $6.45 \times 10^{-3}\ kg$

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

A point particle of mass m, moves long the uniformly rough track PQR as shown in the figure. The coefficient of friction, between the particle and the rough track equals μ. The particle is released, from rest from the point P and it comes to rest at point R. The energies, lost by the ball, over the parts, PQ and QR, of the track, are equal to each other , and no energy is lost when particle changes direction from PQ to QR. The value of the coefficient of friction μ and the distance x

$$(= QR),$$

are, respectively close to:



Options :

A. 0.29 and 3.5 m

B. 0.29 and 6.5 m

C. 0.2 and 6.5 m

D. 0.2 and 3.5 m

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

A satellite is revolving in a circular orbit at a height $'h'$ from the earth's surface (radius of earth $R; h << R$). The minimum increase in its orbital velocity required, so that the satellite could escape from the earth's gravitational field, is close to : (Neglect the effect of atmosphere.)

Options :

A. $\sqrt{2gR}$

B. $\sqrt{gR}$

C. $\sqrt{gR/2}$

D. $\sqrt{gR}\ (\sqrt{2}\ -1)$

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

A screw gauge with a pitch of 0.5 mm and a circular scale with 50 divisions is used to measure the thickness of a thin sheet of Aluminium. Before starting the measurement, it is found that when the two jaws of the screw gauge are brought in contact, the 45^{th} division coincides with the main scale line and that the zero of the main scale is barely visible. What is the thickness of the sheet if the main scale reading is 0.5 mm and the 25^{th} division coincides with the main scale line?

Options :

A. 0.70 mm

B. 0.50 mm

C. 0.75 mm

D. 0.80 mm

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

Choose the correct statement :

Options :

A. In amplitude modulation the amplitude of the high frequency carrier wave is make to vary in proportion to the amplitude of the audio signal.

B. In amplitude modulation the frequency of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal.

C. In frequency modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal.

D. In frequency modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the frequency of the audio signal.

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

For a common emitter configuration, if α and β have their usual meanings, the incorrect relationship between α and β is :

Options :

A. $$\alpha = \frac{\beta}{1+\beta}$$

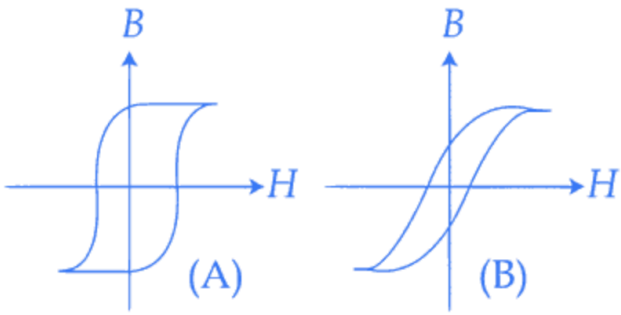
B. $$\alpha = \frac{\beta^2}{1+\beta^2}$$

C. $$\frac{1}{\alpha} = \frac{1}{\beta} + 1$$

D. $$\alpha = \frac{\beta}{1-\beta^2}$$

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

Hysteresis loops for two magnetic materials A and B are given below :



These materials are used to make magnets for electric generators, transformer core and electromagnet core. Then it is proper to use :

Options :

A. A for transformers and B for electric generators.

B. B for electromagnets and transformers.

C. A for electric generators and transformers.

D. A for electromagnets and B for electric generators.

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

Half-lives of two radioactive elements A and B are 20 minutes and 40 minutes, respectively. Initially, the samples have equal number of nuclei. After 80 minutes, the ratio of decayed number of A and B nuclei will be:

Options :

A. 1 : 4

B. 5 : 4

C. 1 : 16

D. 4 : 1

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 Option Orientation : Vertical

The reaction of zinc with dilute and concentrated nitric acid, respectively, produces :

Options :

A. NO_2 and NO

B. NO and N_2O

C. NO_2 and N_2O

D. N_2O and NO_2

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

Which of the following compounds is metallic and ferromagnetic ?

Options :

A. CrO_2

B. VO_2

C. MnO_2

D. TiO_2

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

Decomposition of H_2O_2 follows a first order reaction. In fifty minutes the concentration of H_2O_2 decreases from 0.5 to 0.125 M in one such decomposition. When the concentration of H_2O_2 reaches 0.05 M, the rate of formation of O_2 will be :

Options :

A. 6.93×10^{-4} mol min^{-1}

B. 6.96×10^{-2} mol min^{-1}

C. 1.34×10^{-2} mol min^{-1}

D. 2.66 L min^{-1} at STP

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

Galvanization is applying a coating of :

Options :

A. Cr

B. Cu

C. Zn

D. Pb

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

18 g glucose ($C_6H_{12}O_6$) is added to 178.2 g water. The vapor pressure of water (in torr) for this aqueous solution is :

Options :

A. 76.0

B. 752.4

C. 759.0

D. 7.6

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

The reaction of propene with HOCl ($Cl_2 + H_2O$) proceeds through the intermediate:

Options :

A. $CH_3 - CH^+ - CH_2 - OH$

B. $CH_3 - CHCl - CH_2^+$

C. CH_3 - CH^+ - CH_2 - OH

D. $CH_3 - CH^+ - CH_2 - Cl$

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

At 300 K and 1 atm, 15 mL of a gaseous hydrocarbon requires 375 mL air containing 20% O_2 by volume for complete combustion. After combustion the gases occupy 345 mL. Assuming that the water formed is in liquid form and the volumes were measured at the same temperature and pressure, the formula of the hydrocarbon is:

Options :

A. C_3H_8

B. C_4H_8

C. C_4H_{10}

D. C_3H_6

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

The distillation technique most suited for separating glycerol from spent-lye in the soap industry is :

Options :

A. Simple distillation

B. Fractional distillation

C. Steam distillation

D. Distillation under reduced pressure

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

The equilibrium constant at 298 K for a reaction $A + B \rightleftharpoons C + D$ is 100. If the initial concentration of all the four species were 1M each, then equilibrium concentration of D (in mol L^{-1}) will be:

Options :

A. 0.818

B. 1.818

C. 1.182

D. 0.182

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

The heats of combustion of carbon and carbon monoxide are –393.5 and –283.5 kJ mol^{-1}, respectively. The heat of formation (in kJ) of carbon monoxide per mole is :

Options :

A. 676.5

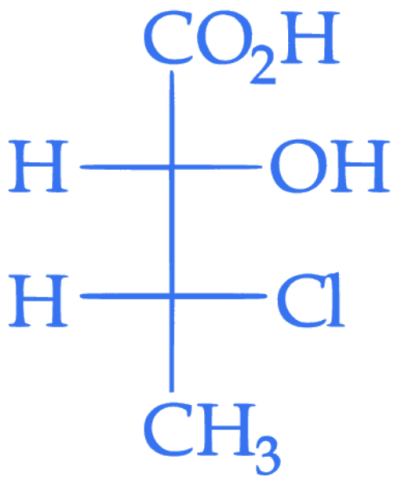
B. -676.5

C. –110

D. 110.5

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

The absolute configuration of



is :

Options :

A. $(2S, 3S)$

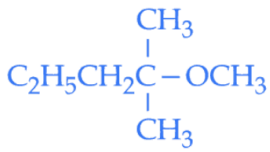
B. $(2R, 3R)$

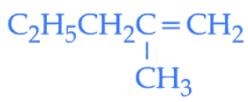
C. $(2R, 3S)$

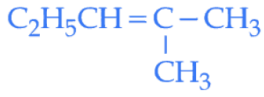
D. $(2S, 3R)$

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

2-chloro-2-methylpentane on reaction with sodium methoxide in methanol yields:

(a) 

(b) 

(c) 

Options :

A. All of these

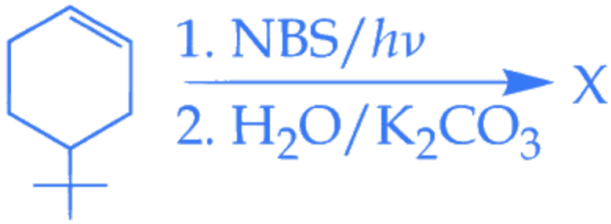
B. (a) and (c)

C. (c) only

D. (a) and (b)

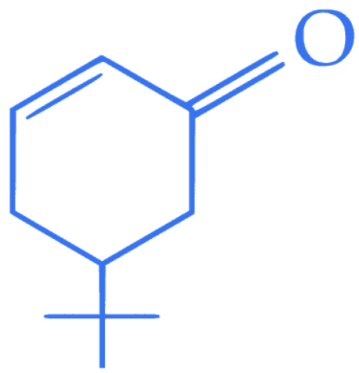
Question Number : 73 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The product of the reaction given below is :

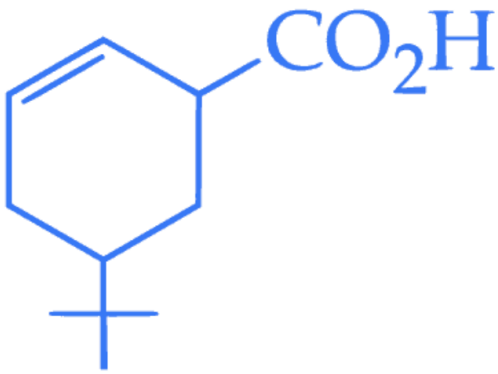


Options :

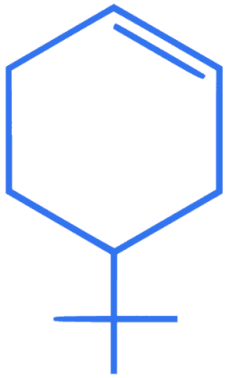
A.



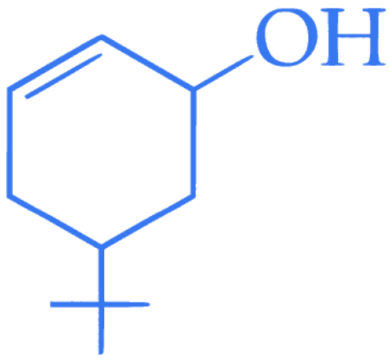
B.



C.



D.



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

In the Hofmann bromamide degradation reaction, the number of moles of NaOH and Br_2 used per mole of amine produced are:

Options :

A. Four moles of NaOH and two moles of Br_2.

B. Two moles of NaOH and two moles of Br_2

C. Four moles of NaOH and one mole of Br_2

D. One mole of NaOH and one mole of Br_2

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

Which one of the following complexes shows optical isomerism?
(en = ethylenediamine)

Options :

A. $cis[Co(en)_2Cl_2]Cl$

B. $trans[Co(en)_2Cl_2]Cl$

C. $[Co(NH_3)_4Cl_2]Cl$

D. $[Co(NH_3)_3Cl_3]$

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

Thiol group is present in :

Options :

A. Cytosine

B. Cystine

C. Cysteine

D. Methionine

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

The pair having the same magnetic moment is :
[At. No.: Cr = 24, Mn = 25, Fe = 26, Co = 27]

Options :

A. $[Cr(H_2O)_6]^{2+}$ and $[Fe(H_2O)_6]^{2+}$

B. $[Mn(H_2O)_6]^{2+}$ and $[Cr(H_2O)_6]^{2+}$

C. $[CoCl_4]^{2-}$ and $[Fe(H_2O)_6]^{2+}$

D. $[Cr(H_2O)_6]^{2+}$ and $[CoCl_4]^{2-}$

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

A stream of electrons from a heated filament was passed between two charged plates kept at a potential difference V esu. If e and m are charge and mass of an electron, respectively, then the value of h / λ (where λ is wavelength associated with electron wave) is given by :

Options :

A. 2meV

B. $\sqrt{meV}$

C. $\sqrt{2meV}$

D. meV

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

The species in which the N atom is in a state of sp hybridization is :

Options :

A. NO_2^+

B. NO_2^-

C. NO_3^-

D. NO_3^-

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

Which of the following atoms has the highest first ionization energy?

Options :

A. Na

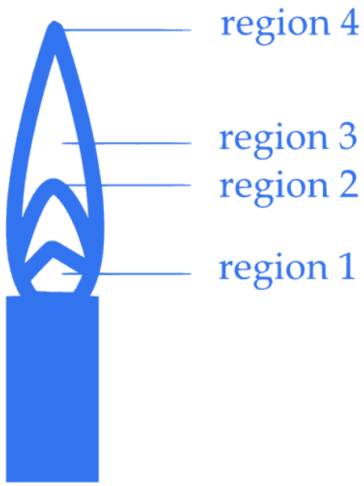
B. K

C. Sc

D. Rb

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

The hottest region of Bunsen flame shown in the figure below is :



Options :

A. region 1

B. region 2

C. region 3

D. region 4

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

The pair in which phosphorous atoms have a formal oxidation state of +3 is :

Options :

A. Orthophosphorous and pyrophosphorous acids

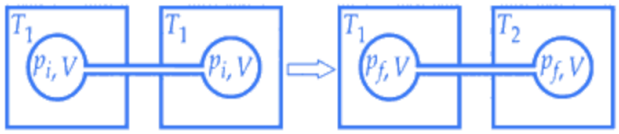
B. Pyrophosphorous and hypophosphoric acids

C. Orthophosphorus and hypophosphoric acids

D. Pyrophosphorous and pyrophosphoric acids

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

Two closed bulbs of equal volume (V) containing an ideal gas initially at pressure p_i and temperature T_1 are connected through a narrow tube of negligible volume as shown in the figure below. The temperature of one of the bulbs is then raised to T_2. The final pressure p_f is :



Options :

A. $2p_i\left(\frac{T_2}{T_1+T_2}\right)$

B. $2p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$

C. $p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$

D. $2p_i\left(\frac{T_1}{T_1+T_2}\right)$

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

Which of the following is an anionic detergent ?

Options :

A. Sodium stearate

B. Sodium lauryl sulphate

C. Cetyltrimethyl ammonium bromide

D. Glyceryl oleate

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

Which one of the following ores is best concentrated by froth floatation method?

Options :

A. Siderite

B. Galena

C. Malachite

D. Magnetite

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

The concentration of fluoride, lead, nitrate and iron in a water sample from an underground lake was found to be 1000 ppb, 40 ppb, 100 ppm and 0.2 ppm, respectively. This water is unsuitable for drinking due to high concentration of :

Options :

A. Lead

B. Nitrate

C. Iron

D. Fluoride

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

Which of the following statements about low density polythene is **FALSE** ?

Options :

A. Its synthesis requires high pressure.

B. It is a poor conductor of electricity.

C. Its synthesis requires dioxygen or a peroxide initiator as a catalyst.

D. It is used in the manufacture of buckets, dust-bins etc.

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

The main oxides formed on combustion of Li, Na and K in excess of air are, respectively :

Options :

A. LiO_2, Na_2O_2 and K_2O

B. Li_2O_2, Na_2O_2 and KO_2

C. Li_2O, Na_2O_2 and KO_2

D. Li_2O, Na_2O and KO_2

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

For a linear plot of log (x/m) versus log p in a Freundlich adsorption isotherm, which of the following statements is correct ? (k and n are constants)

Options :

A. Both k and 1/n appear in the slope term.

B. 1/n appears as the intercept.

C. Only 1/n appears as the slope

D. log (1/n) appears as the intercept.

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

Which one of the following statements about water is FALSE?

Options :

A. Water is oxidized to oxygen during photosynthesis

B. Water can act both as an acid and as a base.

C. There is extensive intramolecular hydrogen bonding in the condensed phase.

D. Ice formed by heavy water sinks in normal water