Question Paper Preview

Notations :

1. Options shown in green color and with ✔ icon are correct.
2. Options shown in red color and with ✖ icon are incorrect.

Subject Name:	Stream SB
Creation Date:	2016-11-09 16:31:08
Duration:	180
Total Marks:	160
Display Marks:	Yes
Calculator:	Scientific
Magnifying Glass Required?:	No
Ruler Required?:	No
Eraser Required?:	No
Scratch Pad Required?:	No
Rough Sketch/Notepad Required?:	No
Protractor Required?:	No

Part I Mathematics

Display Number Panel:	Yes
Group All Questions:	No

Question Number : 1 Question Id : 4356472081 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The number of triples (x, y, z) of real numbers satisfying the equation

$$x^4 + y^4 + z^4 + 1 = 4xyz$$

is

A. 0 B. 4 C. 8 D. more than 8

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 2 Question Id : 4356472082 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Let $P(x)$ be a polynomial with real coefficients such that $P(\sin^2 x) = P(\cos^2 x)$, for all $x \in [0, \pi/2]$. Consider the following statements:

I. $P(x)$ is an even function.

II. $P(x)$ can be expressed as a polynomial in $(2x-1)^2$.

III. $P(x)$ is a polynomial of even degree.

Then

A. all are false

B. only I and II are true

C. only II and III are true

D. all are true

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 3 Question Id : 4356472083 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

For any real number r, let $A_r = \{e^{i\pi rn} : n \text{ is a natural number}\}$ be a set of complex numbers. Then,

A. A_1, $A_{\frac{1}{\pi}}$, $A_{0.3}$ are all infinite sets

B. A_1 is a finite set and $A_{\frac{1}{\pi}}$, $A_{0.3}$ are infinite sets

C. A_1, $A_{\frac{1}{\pi}}$, $A_{0.3}$ are all finite sets

D. A_1, $A_{0.3}$ are finite sets and $A_{\frac{1}{\pi}}$ is an infinite set

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 4 Question Id : 4356472084 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The number of integers k for which the equation $x^3 - 27x + k = 0$ has at least two distinct integer roots is

A. 1 B. 2 C. 3 D. 4

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 5 Question Id : 4356472085 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Suppose the tangent to the parabola $y = x^2 + px + q$ at $(0, 3)$ has slope -1. Then $p + q$ equals

A. 0 B. 1 C. 2 D. 3

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 6 Question Id : 4356472086 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Let $O = (0, 0)$; let A and B be points respectively on x-axis and y-axis such that $\angle OBA = 60°$. Let D be a point in the first quadrant such that OAD is an equilateral triangle. Then the slope of DB is

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

C. $\frac{1}{\sqrt{2}}$ D. $\frac{1}{\sqrt{3}}$

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 7 Question Id : 4356472087 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Suppose the parabola $(y-k)^2 = 4(x-h)$, with vertex A, passes through $O = (0,0)$ and $L = (0,2)$. Let D be an end point of the latus rectum. Let the y-axis intersect the axis of the parabola at P. Then $\angle PDA$ is equal to

A. $\tan^{-1}\frac{1}{19}$

B. $\tan^{-1}\frac{2}{19}$

C. $\tan^{-1}\frac{4}{19}$

D. $\tan^{-1}\frac{8}{19}$

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 8 Question Id : 4356472088 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

In a circle with centre O, suppose A, P, B are three points on its circumference such that P is the mid-point of minor arc AB. Suppose when $\angle AOB = \theta$,

$$\frac{\text{area}(\triangle AOB)}{\text{area}(\triangle APB)} = \sqrt{5} + 2,$$

If $\angle AOB$ is doubled to 2θ, then the ratio $\frac{\text{area}(\triangle AOB)}{\text{area}(\triangle APB)}$ is

A. $\frac{1}{\sqrt{5}}$

B. $\sqrt{5} - 2$

C. $2\sqrt{3} + 3$

D. $\frac{\sqrt{5}-1}{2}$

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 9 Question Id : 4356472089 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Let $X = \{x \in \mathbb{R}: \cos(\sin x) = \sin(\cos x)\}$. The number of elements in X is

A. 0 B. 2 C. 4 D. not finite

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

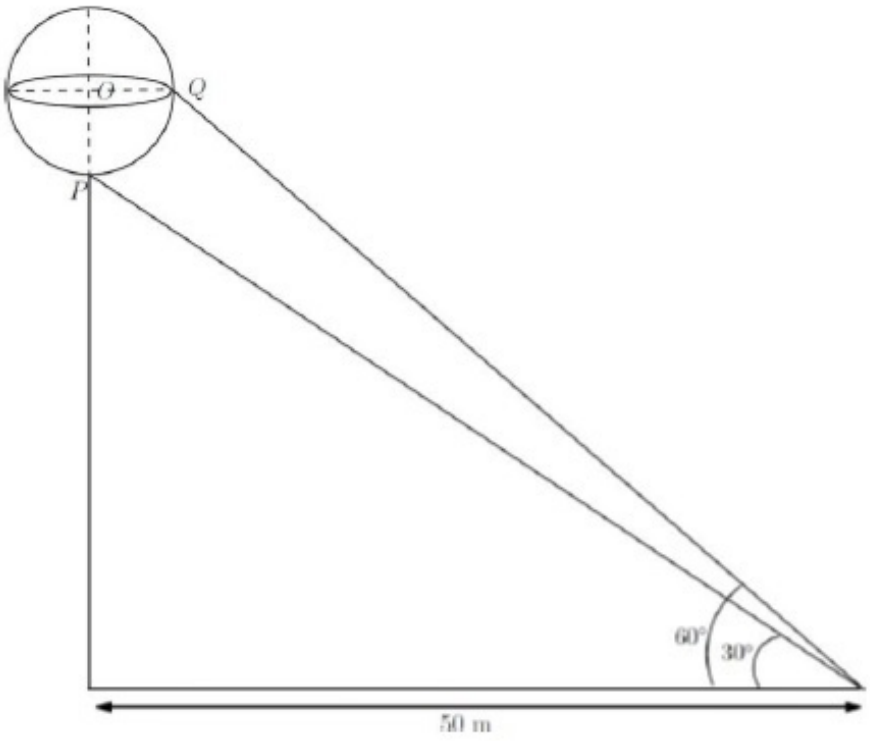
Question Number : 10 Question Id : 4356472090 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A sphere with centre O sits atop a pole as shown in the figure. An observer on the ground is at a distance $50m$ from the foot of the pole. She notes that the angles of elevation from the observer to points P and Q on the sphere are $30°$ and $60°$, respectively. Then, the radius of the sphere in meters is

A. $100\left(1-\frac{1}{\sqrt{3}}\right)$ B. $\frac{50\sqrt{6}}{3}$

C. $50\left(1-\frac{1}{\sqrt{3}}\right)$ D. $\frac{100\sqrt{6}}{3}$



Options :

1. ✖ A
2. ✖ B

3. ✔ C

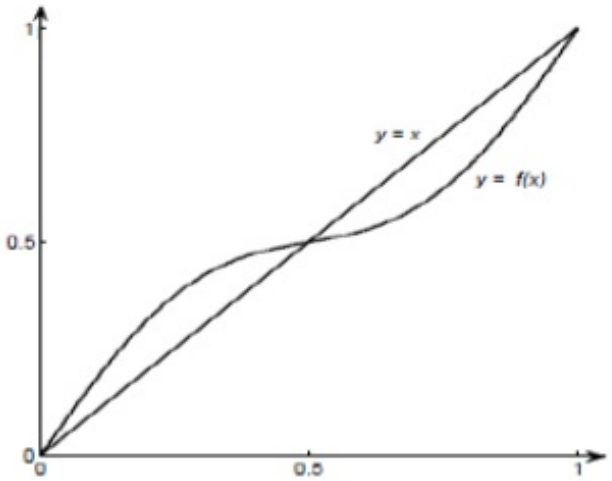
4. ✖ D

Question Number : 11 Question Id : 4356472091 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The graph of the function $f(x) = x + \frac{1}{8}\sin(2\pi x),\ 0 \le x \le 1$ is shown below. Define

$$f_1(x) = f(x), \quad f_{n+1}(x) = f(f_n(x)), \text{ for } n \ge 1.$$



Which of the following statements are true?

I. There are infinitely many $x \in [0,1]$ for which $\lim_{n\to\infty} f_n(x) = 0$.

II. There are infinitely many $x \in [0,1]$ for which $\lim_{n\to\infty} f_n(x) = \frac{1}{2}$.

III. There are infinitely many $x \in [0,1]$ for which $\lim_{n\to\infty} f_n(x) = 1$.

IV. There are infinitely many $x \in [0,1]$ for which $\lim_{n\to\infty} f_n(x)$ does not exist.

A. I and III only

B. II only

C. I, II, III only

D. I, II, III and IV

Options :

1. ✖ A

2. ✔ B

3. ✖ C

4. ✖ D

Question Number : 12 Question Id : 4356472092 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The limit $\lim_{x\to\infty} x^2 \int_0^x e^{t^2-x^3}\,dt$ equals

A. $\frac{1}{3}$

B. 2

C. ∞

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

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 13 Question Id : 4356472093 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The polynomial equation $x^3 - 3ax^2 + (27a^2 + 9)x + 2016 = 0$ has

A. exactly one real root for any real a

B. three real roots for any real a

C. three real roots for any $a \geq 0$, and exactly one real root for any $a < 0$

D. three real roots for any $a \leq 0$, and exactly one real root for any $a > 0$

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 14 Question Id : 4356472094 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The area of the region bounded by the curve $y = |x^3 - 4x^2 + 3x|$ and the x-axis, $0 \leq x \leq 3$, is

A. $\frac{37}{6}$

B. $\frac{9}{4}$

C. $\frac{37}{12}$

D. 0

Options :

1. ✖ A
2. ✖ B

3. ✔ C

4. ✖ D

Question Number : 15 Question Id : 4356472095 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The number of continuous functions $f:[0,1] \to [0,1]$ such that $f(x) < x^2$ for all x and $\int_0^1 f(x)\,dx = \frac{1}{3}$ is

A. 0 B. 1 C. 2 D. infinite

Options :

1. ✔ A

2. ✖ B

3. ✖ C

4. ✖ D

Question Number : 16 Question Id : 4356472096 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

On the real line $\mathbb{R}$, we define two functions f and g as follows:

$$f(x) = \min\{x - [x], 1 - x + [x]\},$$

$$g(x) = \max\{x - [x], 1 - x + [x]\},$$

where $[x]$ denotes the largest integer not exceeding x. The positive integer n for which

$$\int_0^n (g(x) - f(x))dx = 100$$

is

A. 100 B. 198 C. 200 D. 202

Options :

1. ✖ A

2. ✖ B

3. ✔ C

4. ✖ D

Question Number : 17 Question Id : 4356472097 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Let $\vec{v}$ be a vector in the plane such that $|\vec{v} - \vec{i}| = |\vec{v} - 2\vec{i}| = |\vec{v} - \vec{j}|$. Then $|\vec{v}|$ lies in the interval

A. $(0, 1]$ B. $(1, 2]$ C. $(2, 3]$ D. $(3, 4]$

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 18 Question Id : 4356472098 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A box contains b blue balls and r red balls. A ball is drawn randomly from the box and is returned to the box with another ball of the same colour. The probability that the second ball drawn from the box is blue is

A. $\frac{b}{r+b}$

B. $\frac{b^2}{(r+b)^2}$

C. $\frac{b+1}{r+b+1}$

D. $\frac{b(b+1)}{(r+b)(r+b+1)}$

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 19 Question Id : 4356472099 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The number of noncongruent integer-sided triangles whose sides belong to the set $\{10, 11, 12, \ldots, 22\}$ is

A. 283 B. 446 C. 448 D. 449

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 20 Question Id : 4356472100 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Suppose we have to cover the xy-plane with identical tiles such that no two tiles overlap and no gap is left between the tiles. Suppose that we can choose tiles of the following shapes: equilateral triangle, square, regular pentagon, regular hexagon. Then the tiling can be done with tiles of

A. all four shapes

B. exactly three of the four shapes

C. exactly two of the four shapes

D. exactly one of the four shapes

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Part IPhysics

Display Number Panel:	Yes
Group All Questions:	No

Question Number : 21 Question Id : 4356472101 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Physical processes are sometimes described visually by lines. Only the following can cross:

A. Streamlines in fluid flow.

B. Lines of forces in electrostatics.

C. Rays in geometrical optics.

D. Lines of force in magnetism.

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 22 Question Id : 4356472102 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A uniform ring of radius R is moving on a horizontal surface with speed v and then climbs up a ramp of inclination 30° to a height h. There is no slipping in the entire motion. Then h is

A. $v^2/2g$

B. v^2/g

C. $3v^2/2g$

D. $2v^2/g$

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 23 Question Id : 4356472103 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A gas at initial temperature T undergoes sudden expansion from volume V to $2V$. Then

A. the process is adiabatic.

B. the process is isothermal.

C. the work done in this process is $nRT \ln_e(2)$ where n is the number of moles of the gas.

D. the entropy in the process does not change.

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 24 Question Id : 4356472104 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Photons of wavelength λ are incident on a metal. The most energetic electrons ejected from the metal are bent into a circular arc of radius R by a perpendicular magnetic field having a magnitude B. The work function of the metal is (where symbols have their usual meanings)

A. $\frac{hc}{\lambda} - m_e + \frac{e^2B^2R^2}{2m_e}$

B. $\frac{hc}{\lambda} + 2m_e\left(\frac{eBR}{2m_e}\right)^2$

C. $\frac{hc}{\lambda} - m_ec^2 - \frac{e^2B^2R^2}{2m_e}$

D. $\frac{hc}{\lambda} - 2m_e\left(\frac{eBR}{2m_e}\right)^2$

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 25 Question Id : 4356472105 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A container is divided into two equal parts I and II by a partition with a small hole of diameter d. The two partitions are filled with same ideal gas, but held at temperatures T_I = 150 K and T_{II} = 300 K by connecting to heat reservoirs. Let λ_I and λ_{II} be the mean free paths of the gas particles in the two parts such that $d >> \lambda_I$ and $d >> \lambda_{II}$. Then λ_I/λ_{II} is close to

A. 0.25

B. 0.5

C. 0.7

D. 1.0

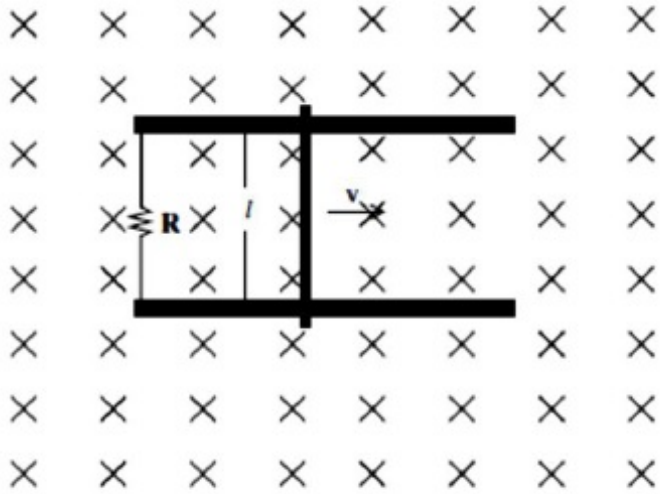
Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 26 Question Id : 4356472106 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A conducting bar of mass m and length l moves on two frictionless parallel rails in the presence of a constant uniform magnetic field of magnitude B directed into the page as shown in the figure. The bar is given an initial velocity v_0 towards the right at $t = 0$. Then the



A. induced current in the circuit is in the clockwise direction.

B. velocity of the bar decreases linearly with time.

C. distance the bar travels before it comes to a complete stop is proportional to R.

D. power generated across the resistance is proportional to l.

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 27 Question Id : 4356472107 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A particle with total mechanical energy, which is small and negative, is under the influence of a one dimensional potential $U(x) = x^4/4 - x^2/2$ J where x is in meters. At time t = 0 s, it is at $x = -0.5$ m. Then at a later time it can be found

A. anywhere on the x axis.

B. between $x = -1.0$ m to $x = 1.0$ m.

C. between $x = -1.0$ m to $x = 0.0$ m.

D. between $x = 0.0$ m to $x = 1.0$ m.

Options :

1. ✖ A
2. ✖ B

3. ✔ C

4. ✖ D

Question Number : 28 Question Id : 4356472108 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A nurse measures the blood pressure of a seated patient to be 190 mm of Hg.

A. the blood pressure at the patient's feet is less than 190 mm of Hg.

B. the actual pressure is about 0.25 times the atmospheric pressure.

C. the blood pressure at the patient's neck is more than 190 mm of Hg.

D. the actual pressure is about 1.25 times the atmospheric pressure.

Options :

1. ✖ A

2. ✖ B

3. ✖ C

4. ✔ D

Question Number : 29 Question Id : 4356472109 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A particle at a distance of 1 m from the origin starts moving such that $dr/d\theta = r$, where (r, θ) are polar coordinates. Then the angle between resultant velocity and tangential velocity component is

A. 30 degrees.

B. 45 degrees.

C. 60 degrees.

D. dependent on where the particle is.

Options :

1. ✖ A

2. ✔ B

3. ✖ C

4. ✖ D

Question Number : 30 Question Id : 4356472110 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Electrons accelerated from rest by an electrostatic potential are collimated and sent through a Young's double slit setup. The fringe width is w. If the accelerating potential is doubled then the width is now close to

A. 0.5 w

B. 0.7 w

C. 1.0 w

D. 2.0 w

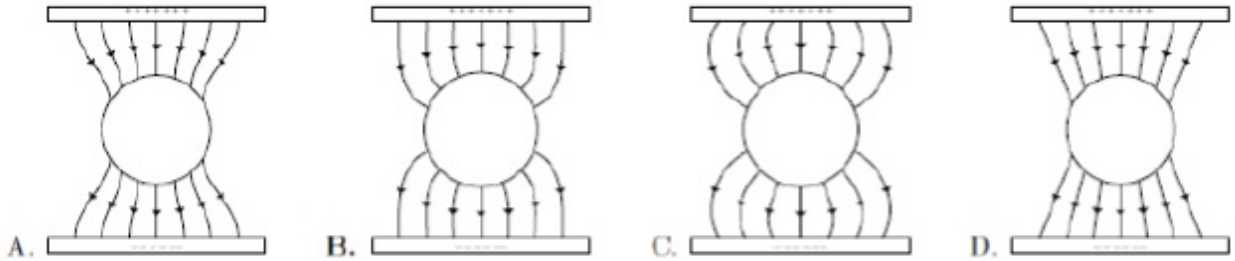
Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 31 Question Id : 4356472111 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A metallic sphere is kept in between two oppositely charged plates. The most appropriate representation of the field lines is



Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 32 Question Id : 4356472112 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

An electron with kinetic energy E collides with a hydrogen atom in the ground state. The collision will be elastic

A. for all values of E.

B. for $E < 10.2$ eV.

C. for $10.2 \text{ eV} < E < 13.6$ eV only.

D. for $0 < E < 3.4$ eV only.

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 33 Question Id : 4356472113 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The continuous part of X-ray spectrum is a result of the

A. photoelectric effect.

B. Raman effect.

C. Compton effect.

D. inverse photoelectric effect.

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 34 Question Id : 4356472114 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Thermal expansion of a solid is due to the

A. symmetric characteristic of the inter atomic potential energy curve of the solid.

B. asymmetric characteristic of the inter atomic potential energy curve of the solid.

C. double well nature of the inter-atomic potential energy curve of the solid.

D. rotational motion of the atoms of the solid.

Options :

1. ✖ A
2. ✔ B

3. ✖ C

4. ✖ D

Question Number : 35 Question Id : 4356472115 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

An electron and a photon have same wavelength of 10^{-9} m. If E is the energy of the photon and p is the momentum of the electron, the magnitude of E/p in SI units is

A. 1.00×10^{-9}

B. 1.50×10^{8}

C. 3.00×10^{8}

D. 1.20×10^{7}

Options :

1. ✖ A

2. ✖ B

3. ✔ C

4. ✖ D

Question Number : 36 Question Id : 4356472116 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

If one takes into account finite mass of the proton, the correction to the binding energy of the hydrogen atom is approximately (mass of proton $= 1.60 \times 10^{-27}$ kg, mass of electron $= 9.10 \times 10^{-31}$kg)

A. 0.06%

B. 0.0006%

C. 0.02%

D. 0.00%

Options :

1. ✔ A

2. ✖ B

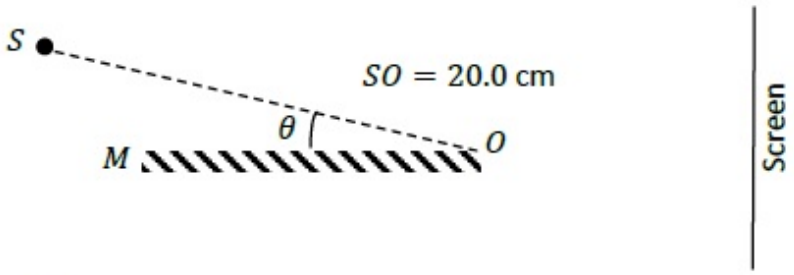
3. ✖ C

4. ✖ D

Question Number : 37 Question Id : 4356472117 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A monochromatic light source S of wavelength 440 nm is placed slightly above a plane mirror M as shown. Image of S in M can be used as a virtual source to produce interference fringes on the screen. The distance of source S from O is 20.0 cm, and the distance of screen from O is 100.0 cm (figure is not to scale). If the angle $\theta = 0.50 \times 10^{-3}$ radians, the width of the interference fringes observed on the screen is



A. 2.20 mm

B. 2.64 mm

C. 1.10 mm

D. 0.55 mm

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 38 Question Id : 4356472118 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A nuclear fuel rod generates energy at a rate of 5×10^8 Watt/m^3. It is in the shape of a cylinder of radius 4.0 mm and length 0.20 m. A coolant of specific heat 4×10^3 J/(kg-K) flows past it at a rate of 0.2 kg/s. The temperature rise in this coolant is approximately

A. 2° C

B. 6° C

C. 12° C

D. 30° C

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 39 Question Id : 4356472119 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A hearing test is conducted on an aged person. It is found that her threshhold of hearing is 20 decibels at 1 kHz and it rises linearly with frequency to 60 decibels at 9 kHz. The minimum intensity of sound that the person can hear at 5 kHz is

A. 10 times than that at 1 kHz

B. 100 times than that at 1 kHz

C. 0.5 times than that at 9 kHz

D. 0.05 times than that at 9 kHz

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 40 Question Id : 4356472120 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Two infinitely long parallel wires carry currents of magnitude I_1 and I_2 and are at a distance 4 cm apart. The magnitude of the net magnetic field is found to reach a non-zero minimum value between the two wires and 1 cm away from the first wire. The ratio of the two currents and their mutual direction is

A. $\frac{I_2}{I_1} = 9$, antiparallel

B. $\frac{I_2}{I_1} = 9$, parallel

C. $\frac{I_2}{I_1} = 3$, antiparallel

D. $\frac{I_2}{I_1} = 3$, parallel

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Display Number Panel: Yes
Group All Questions: No

Question Number : 41 Question Id : 4356472121 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical
Correct : 1

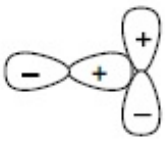
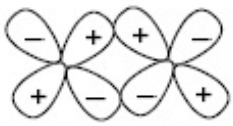
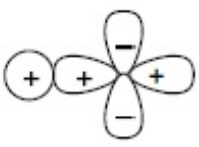
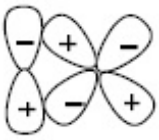
The shape of SCl_4 is best described as a

A. square
B. tetrahedron
C. square pyramid
D. see-saw

Options :
1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 42 Question Id : 4356472122 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical
Correct : 1

Among the following atomic orbital overlaps, the non-bonding overlap is

A. 
B. 
C. 
D. 

Options :
1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 43 Question Id : 4356472123 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical
Correct : 1

Among the following complexes, the one that can exhibit optical activity is

A. $[CoCl_6]^{3-}$

B. $[Co(en)Cl_4]^-$

C. *cis*-$[Co(en)_2Cl_2]^+$

D. *trans*-$[Co(en)_2Cl_2]^+$

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 44 Question Id : 4356472124 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The pK_a of oxoacids of chlorine in water follows the order

A. $HClO < HClO_3 < HClO_2 < HClO_4$

B. $HClO_4 < HClO_3 < HClO_2 < HClO$

C. $HClO_4 < HClO_2 < HClO_3 < HClO$

D. $HClO_2 < HClO < HClO_3 < HClO_4$

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 45 Question Id : 4356472125 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The packing efficiency of the face centered cubic (fcc), body centered cubic (bcc) and simple/primitive cubic (pc) lattices follows the order

A. fcc > bcc > pc

B. bcc > fcc > pc

C. pc > bcc > fcc

D. bcc > pc > fcc

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 46 Question Id : 4356472126 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The ratio of root mean square velocity of hydrogen at 50 K to that of nitrogen at 500 K is closest to

A. 1.18

B. 0.85

C. 0.59

D. 1.40

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 47 Question Id : 4356472127 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The molecule with the highest dipole moment among the following is

A. NH_3

B. NF_3

C. CO

D. HF

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 48 Question Id : 4356472128 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The most stable Lewis acid-base adduct among the following is

A. $H_2O \rightarrow BCl_3$

B. $H_2S \rightarrow BCl_3$

C. $H_3N \rightarrow BCl_3$

D. $H_3P \rightarrow BCl_3$

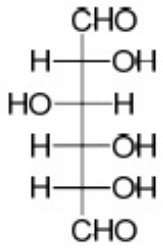
Options :

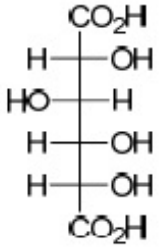
1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

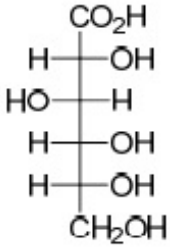
Question Number : 49 Question Id : 4356472129 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

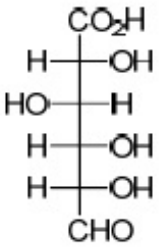
Correct : 1

The reaction of D-glucose with ammoniacal $AgNO_3$ produces

A. 

B. 

C. 

D. 

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 50 Question Id : 4356472130 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The reagent(s) used for the conversion of benzene diazonium hydrogensulfate to benzene is/are

A. H_2O

B. $H_3PO_2 + H_2O$

C. $H_2SO_4 + H_2O$

D. CuCl/HCl

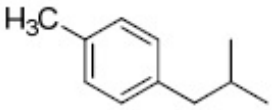
Options :

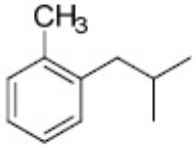
1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

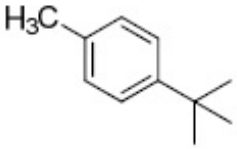
Question Number : 51 Question Id : 4356472131 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

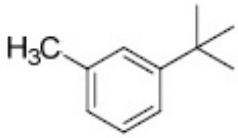
Correct : 1

The major product obtained in the reaction of toluene with 1-bromo-2-methyl propane in the presence of anhydrous $AlCl_3$ is

A. 

B. 

C. 

D. 

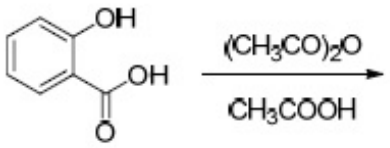
Options :

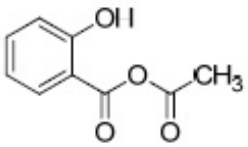
1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

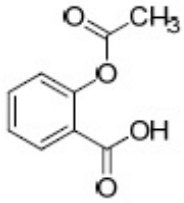
Question Number : 52 Question Id : 4356472132 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

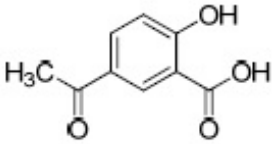
Correct : 1

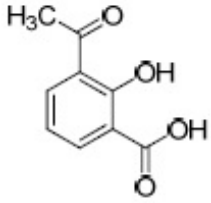
The major product in the following reaction is



A. 

B. 

C. 

D. 

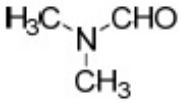
Options :

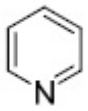
1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 53 Question Id : 4356472133 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The compounds containing sp hybridized carbon atom are

(i) 

(ii) 

(iii) H_3C-CN

(iv) $H_2C=C=CHCH_3$

A. (i) and (ii)

B. (iii) and (iv)

C. (ii) and (iii)

D. (i) and (iv)

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 54 Question Id : 4356472134 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Upon heating with acidic $KMnO_4$, an organic compound produces hexan-1,6-dioic acid as the major product. The starting compound is

A. benzene

B. cyclohexene

C. 1-methylcyclohexene

D. 2-methylcyclohexene

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 55 Question Id : 4356472135 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

It takes 1 h for a first order reaction to go to 50% completion. The total time required for the same reaction to reach 87.5% completion will be

A. 1.75 h

B. 6.00 h

C. 3.50 h

D. 3.00 h

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 56 Question Id : 4356472136 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

A unit cell of calcium fluoride has four calcium ions. The number of fluoride ions in the unit cell is

A. 2

B. 4

C. 6

D. 8

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 57 Question Id : 4356472137 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The equilibrium constant of a 2 electron redox reaction at 298 K is 3.8×10^{-3}. The cell potential E^0 (in V) and the free energy change ΔG^0 (in kJ mol^{-1}) for this equilibrium, respectively, are

A. −0.071, −13.8

B. −0.071, 13.8

C. 0.71, −13.8

D. 0.071, −13.8

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 58 Question Id : 4356472138 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The number of stereoisomers possible for the following compound is

CH_3-CH=CH-CH(Br)-CH_2-CH_3

A. 2

B. 3

C. 4

D. 8

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 59 Question Id : 4356472139 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

In the radioactive disintegration series $^{232}_{90}Th \rightarrow {}^{208}_{82}Pb$, involving α and β decay, the total number of α and β particles emitted are

A. 6 α and 6 β

B. 6 α and 4 β

C. 6 α and 5 β

D. 5 α and 6 β

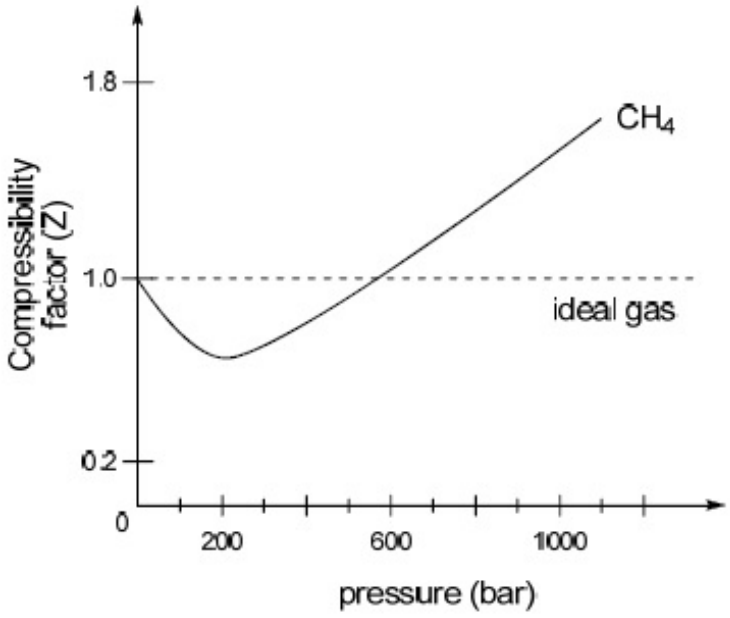
Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 60 Question Id : 4356472140 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

In the following compressibility factor (Z) vs. pressure graph at 300 K, the compressibility of CH_4 at pressures <200 bar deviates from ideal behaviour because



A. the molar volume of CH_4 is less than its molar volume in the ideal state

B. the molar volume of CH_4 is same as that in its ideal state

C. intermolecular interactions between CH_4 molecules decreases

D. the molar volume of CH_4 is more than its molar volume in the ideal state

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Part I Biology

Display Number Panel: Yes
Group All Questions: No

Question Number : 61 Question Id : 4356472141 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Which of the following molecules is a primary acceptor of CO_2 in photosynthesis?

A. Pyruvate

B. 3-phosphoglycerate

C. Phosphoenol pyruvate

D. Oxaloacetate

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 62 Question Id : 4356472142 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Which one of the following pairs of molecules **NEVER** forms a hydrogen bond between them?

A. Water and water

B. Water and glucose

C. Water and ethanol

D. Water and octane

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 63 Question Id : 4356472143 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Lactase hydrolyses lactose into

A. glucose + glucose

B. glucose + galactose

C. galactose + galactose

D. galactose + fructose

Options :

1. ✖ A

2. ✔ B

3. ✖ C

4. ✖ D

Question Number : 64 Question Id : 4356472144 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Which of the following statements is **INCORRECT** regarding biological membrane?

A. It is composed of lipids and proteins

B. Peripheral proteins are loosely associated with the membrane

C. Integral proteins span the lipid bilayer

D. Lipids and membrane proteins do not provide structural and functional asymmetry

Options :

1. ✖ A

2. ✖ B

3. ✖ C

4. ✔ D

Question Number : 65 Question Id : 4356472145 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The percentage of sunlight captured by plants is

A. 2-10%

B. 10-20%

C. 60-80%

D. 100%

Options :

1. ✔ A

2. ✖ B

3. ✖ C

4. ✖ D

Question Number : 66 Question Id : 4356472146 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The hard outer layer of pollens, named exine, is made of

A. cellulose

B. tapetum

C. sporopollenin

D. pectin

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 67 Question Id : 4356472147 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Insectivorous plants such as Venus fly trap catch and digest insects in order to supplement the deficiency of

A. sulphur

B. nitrogen

C. potassium

D. phosphorus

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 68 Question Id : 4356472148 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Which of the following statements about nucleosome is TRUE?

A. It consists of only DNA.

B. It is a nucleus-like structure found in prokaryotes.

C. It consists of DNA and proteins.

D. It consists of only histone proteins.

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 69 Question Id : 4356472149 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Epithelial cells in animals are held by specialized junctions, one of them being "Gap junction". Function of a "Gap junction" is to

A. facilitate cell-cell communication by rapid transfer of small molecules

B. cement the neighbouring cells

C. stop substances from leaking

D. provide gaps in the tissue to facilitate uptake of small molecules across tissues

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 70 Question Id : 4356472150 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Which of the following statements is TRUE about glandular epithelium in salivary gland?

A. It consists of isolated single cells.

B. It consists of multicellular cluster of cells.

C. Its secretions are endocrine.

D. It consists of squamous epithelial cells.

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 71 Question Id : 4356472151 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Which one of the following ion pairs is involved in nerve impulses?

A. Na^+, K^+

B. Na^+, Cl^-

C. K^+, Cl^-

D. K^+, Ca^{2+}

Options :

1. ✔ A

2. ✖ B

3. ✖ C

4. ✖ D

Question Number : 72 Question Id : 4356472152 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Which of the following hormones that controls blood pressure is secreted by human heart?

A. Erythropoetin

B. Atrial natriuretic factor

C. ACTH

D. Glucocorticoid

Options :

1. ✖ A

2. ✔ B

3. ✖ C

4. ✖ D

Question Number : 73 Question Id : 4356472153 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Oxytocin and vasopressin are synthesized in

A. hypothalamus

B. adrenal gland

C. pituitary gland

D. ovary

Options :

1. ✖ A

2. ✖ B

3. ✔ C

4. ✖ D

Question Number : 74 Question Id : 4356472154 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

If you exhale multiple times into a conical flask containing lime water through a single inlet fixed through a stop cork, lime water will

A. become cooler

B. turn milky

C. remain unchanged

D. turn yellow

Options :

1. ✖ A

2. ✔ B

3. ✖ C

4. ✖ D

Question Number : 75 Question Id : 4356472155 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

The path of passage of stimulus when you accidentally touch a hotplate is

A. receptor→brain→muscles

B. muscles→spinal cord→receptor

C. muscles→brain→receptor

D. receptor→spinal cord→muscles

Options :

1. ✖ A

2. ✖ B

3. ✖ C

4. ✔ D

Question Number : 76 Question Id : 4356472156 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

In the presence of glucose and lactose, *Escherichia coli* utilizes glucose. However, lactose also enters the cells because

A. low level of permease is always present in the cell

B. it uses the same transporter as glucose

C. it diffuses through the bacterial cell membrane

D. it is transported through porins

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 77 Question Id : 4356472157 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Passive immunization is achieved by administering

A. heat killed vaccines

B. toxoids

C. live attenuated vaccines

D. antibodies

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 78 Question Id : 4356472158 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Which of the following anions neutralize the acidic pH of the chyme that enters into the duodenum from the stomach?

A. $H_2PO_4^-$

B. HSO_4^-

C. HCO_3^-

D. CH_3COO^-

Options :

1. ✖ A

2. ✖ B

3. ✔ C

4. ✖ D

Question Number : 79 Question Id : 4356472159 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

If $^{14}CO_2$ is added to a suspension of photosynthesizing chloroplasts, which of the following will be the first compound to be radioactive?

A. ATP

B. NADPH

C. NADH

D. 3-phospho glycerate

Options :

1. ✖ A

2. ✖ B

3. ✖ C

4. ✔ D

Question Number : 80 Question Id : 4356472160 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 1

Which of the following species makes the largest true flower in the world?

A. *Amorphophallus titanium*

B. *Rafflesia arnoldii*

C. *Nelumbo nucifera*

D. *Helianthus annuus*

Options :

1. ✖ A

2. ✔ B

3. ✖ C

4. ✖ D

Part II Mathematics

Display Number Panel:	Yes
Group All Questions:	No

Question Number : 81 Question Id : 4356472161 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

The remainder when the polynomial $1 + x^2 + x^4 + x^6 + \cdots + x^{22}$ is divided by $1 + x + x^2 + x^3 + \cdots + x^{11}$ is

A. 0

B. 2

C. $1+ x^2 + x^4 + \cdots + x^{10}$

D. $2(1+ x^2 + x^4 + \cdots + x^{10})$

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 82 Question Id : 4356472162 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

The range of the polynomial $p(x) = 4x^3 - 3x$ as x varies over the interval $(-\frac{1}{2}, \frac{1}{2})$ is

A. $[-1, 1]$

B. $(-1, 1]$

C. $(-1, 1)$

D. $\left(-\frac{1}{2}, \frac{1}{2}\right)$

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 83 Question Id : 4356472163 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Ten ants are on the real line. At time $t = 0$, the k-th ant starts at the point k^2 and travelling at uniform speed, reaches the point $(11 - k)^2$ at time $t = 1$. The number of distinct times at which at least two ants are at the same location is

A. 45

B. 11

C. 17

D. 9

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 84 Question Id : 4356472164 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

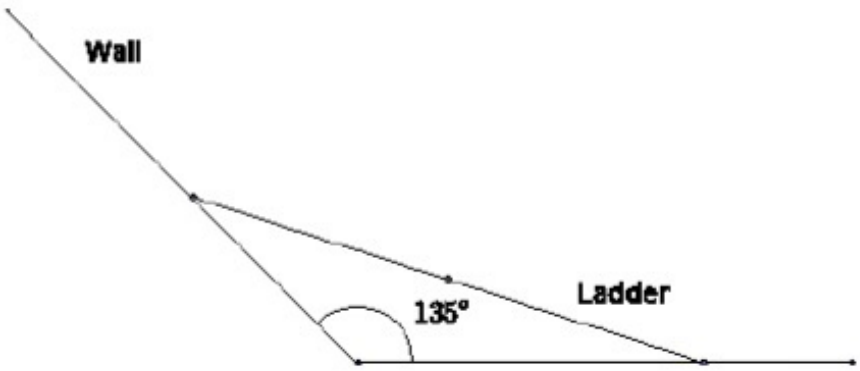
A wall is inclined to the floor at an angle of $135°$. A ladder of length ℓ is resting on the wall. As the ladder slides down, its mid-point traces an arc of an ellipse. Then the area of the ellipse is

A. $\frac{\pi\ell^2}{4}$

B. $\pi\ell^2$

C. $4\pi\ell^2$

D. $2\pi\ell^2$



Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 85 Question Id : 4356472165 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Let AB be a sector of a circle with centre O and radius d, $\angle AOB = \theta \left(< \frac{\pi}{2}\right)$, and D be a point on OA such that BD is perpendicular OA. Let E be the midpoint of BD and F be a point on the arc AB such that EF is parallel to OA. Then the ratio of length of the arc AF to the length of the arc AB is

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

B. $\frac{\theta}{2}$

C. $\frac{1}{2}\sin\theta$

D. $\frac{\sin^{-1}\left(\frac{1}{2}\sin\theta\right)}{\theta}$

Options :

1. ✖ A
2. ✖ B

3. ✖ C

4. ✔ D

Question Number : 86 Question Id : 4356472166 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Let $f(x)$ be a non-negative differentiable function on $[0,\infty)$ such that $f(0) = 0$ and $f'(x) \leq 2f(x)$ for all $x > 0$. Then, on $[0,\infty)$,

A. $f(x)$ is always a constant function

B. $f(x)$ is strictly increasing

C. $f(x)$ is strictly decreasing

D. $f'(x)$ changes sign

Options :

1. ✔ A

2. ✖ B

3. ✖ C

4. ✖ D

Question Number : 87 Question Id : 4356472167 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

For each positive real number λ, let A_λ be the set of all natural numbers n such that $|\sin(\sqrt{n+1}) - \sin(\sqrt{n})| < \lambda$. Let A_λ^c be the complement of A_λ in the set of all natural numbers. Then

A. $A_{\frac{1}{2}}$, $A_{\frac{1}{3}}$, $A_{\frac{2}{5}}$ are all finite sets

B. $A_{\frac{1}{3}}$ is a finite set but $A_{\frac{1}{2}}$, $A_{\frac{2}{5}}$ are infinite sets

C. $A^c_{\frac{1}{2}}$, $A^c_{\frac{1}{3}}$, $A^c_{\frac{2}{5}}$ are all finite sets

D. $A_{\frac{1}{3}}$, $A_{\frac{2}{5}}$ are finite sets and $A_{\frac{1}{2}}$ is an infinite set

Options :

1. ✖ A

2. ✖ B

3. ✔ C

4. ✖ D

Question Number : 88 Question Id : 4356472168 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Let f be a continuous function defined on $[0,1]$ such that $\int_0^1 f^2(x)\,dx = \left(\int_0^1 f(x)\,dx\right)^2$. Then the range of f

A. has exactly two points

B. has more than two points

C. is the interval $[0,1]$

D. is a singleton

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 89 Question Id : 4356472169 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Three schools send 2, 4 and 6 students, respectively, to a summer camp. The 12 students must be accommodated in 6 rooms numbered 1, 2, 3, 4, 5, 6 in such a way that each room has exactly 2 students and both from the same school. The number of ways, the students can be accommodated in the rooms is

A. 60 B. 45 C. 32400 D. 2700

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 90 Question Id : 4356472170 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Let a be a fixed nonzero complex number with $|a| < 1$ and

$$w = \left(\frac{z-a}{1-\bar{a}z}\right).$$

where z is a complex number. Then

A. there exists a complex number z with $|z| < 1$ such that $|w| > 1$

B. $|w| > 1$ for all z such that $|z| < 1$

C. $|w| < 1$ for all z such that $|z| < 1$

D. there exists z such that $|z| < 1$ and $|w| = 1$

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Part II Physics

Display Number Panel:	Yes
Group All Questions:	No

Question Number : 91 Question Id : 4356472171 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

A light balloon filled with helium of density ρ_{He} is tied to a long light string of length l and the string is attached to the ground. If the balloon is displaced slightly in the horizontal direction from the equilibrium and released then:

A. The ballon undergoes simple harmonic motion with period $2\pi\sqrt{\left(\frac{\rho_{air}}{\rho_{air}-\rho_{He}}\right)\frac{l}{g}}$.

B. The ballon undergoes simple harmonic motion with period $2\pi\sqrt{\left(\frac{\rho_{air}-\rho_{He}}{\rho_{air}}\right)\frac{l}{g}}$.

C. The ballon undergoes simple harmonic motion with period $2\pi\sqrt{\left(\frac{\rho_{He}}{\rho_{air}-\rho_{He}}\right)\frac{l}{g}}$.

D. The ballon undergoes conical oscillations with period $2\pi\sqrt{\left(\frac{\rho_{air}+\rho_{He}}{\rho_{air}-\rho_{He}}\right)\frac{l}{g}}$.

Options :

1. ✖ A
2. ✖ B

3. ✔ C

4. ✖ D

Question Number : 92 Question Id : 4356472172 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Consider a cube of uniform charge density ρ. The ratio of electrostatic potential at the centre of the cube to that at one of the corners of the cube is

A. 2

B. $\sqrt{3}/2$

C. $\sqrt{2}$

D. 1

Options :

1. ✔ A

2. ✖ B

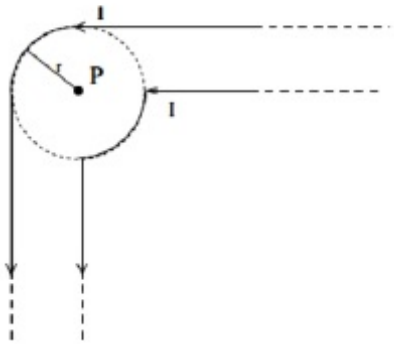
3. ✖ C

4. ✖ D

Question Number : 93 Question Id : 4356472173 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Two infinitely long wires each carrying current I along the same direction are made into the geometry as shown in the figure. The magnetic field at the point P is



A. $\frac{\mu_o I}{\pi r}$

B. $\frac{\mu_o I}{r}\left(\frac{1}{\pi}+\frac{1}{4}\right)$

C. Zero

D. $\frac{\mu_o I}{2\pi r}$

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 94 Question Id : 4356472174 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

A photon of wavelength λ is absorbed by an electron confined to a box of length $\sqrt{(35h\lambda/8mc)}$. As a result, the electron makes a transition from state $k = 1$ to the state n. Subsequently the electron transits from the state n to the state m by emitting a photon of wavelength $\lambda' = 1.75\lambda$. Then

A. n = 4; m = 2

B. n = 5; m = 3

C. n = 6; m = 4

D. n = 3; m = 1

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 95 Question Id : 4356472175 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Consider two masses with $m_1 > m_2$ connected by a light inextensible string that passes over a pulley of radius R and moment of inertia I about its axis of rotation. The string does not slip on the pulley and the pulley turns without friction. The two masses are released from rest separated by a vertical distance $2h$. When the two masses pass each other, the speed of the masses is proportional to

A. $\sqrt{\frac{m_1-m_2}{m_1+m_2+\frac{I}{R^2}}}$

B. $\sqrt{\frac{(m_1+m_2)(m_1-m_2)}{m_1+m_2+\frac{I}{R^2}}}$

C. $\sqrt{\frac{m_1+m_2+\frac{I}{R^2}}{m_1-m_2}}$

D. $\sqrt{\frac{\frac{I}{R^2}}{m_1+m_2}}$

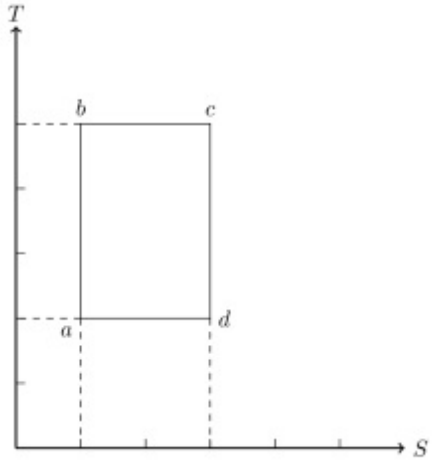
Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

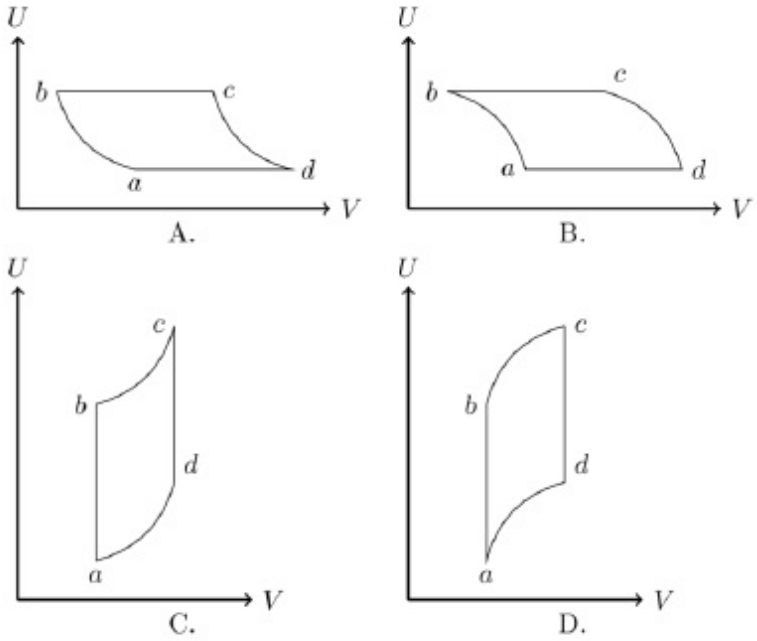
Question Number : 96 Question Id : 4356472176 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

An ideal gas is taken reversibly around the cycle a-b-c-d-a as shown on the T (temperature) - S (entropy) diagram.



The most appropriate representation of above cycle on a U (internal energy)$-V$ (volume) diagram is



Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 97 Question Id : 4356472177 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

The heat capacity of one mole an ideal is found to be $C_V = 3R(1 + aRT)/2$ where a is a constant. The equation obeyed by this gas during a reversible adiabatic expansion is

A. $TV^{3/2}e^{aRT}$ = constant

B. $TV^{3/2}e^{3aRT/2}$ = constant

C. $TV^{3/2}$ = constant

D. $TV^{3/2}e^{2aRT/3}$ = constant

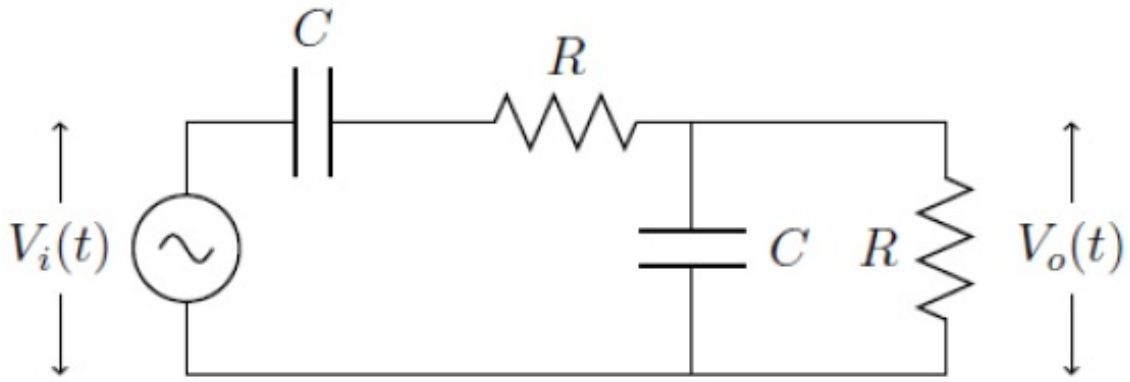
Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

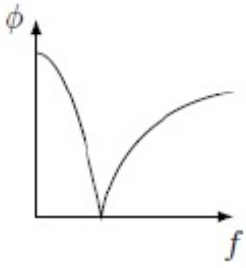
Question Number : 98 Question Id : 4356472178 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

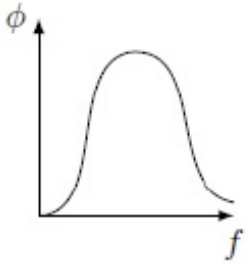
Correct : 2

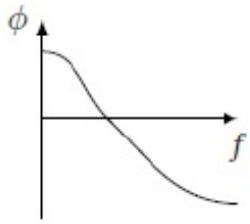
If the input voltage V_i to the circuit below is given by $V_i(t) = A\cos(2\pi ft)$, the output voltage is given by $V_o(t) = B\cos(2\pi ft + \phi)$.

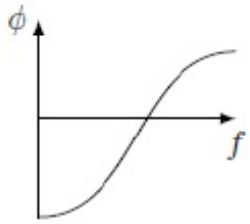


Which one of the following four graphs best depict the variation of ϕ vs f?

A. 

B. 

C. 

D. 

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 99 Question Id : 4356472179 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

A glass prism has a right-triangular cross section ABC, with $\angle A = 90°$. A ray of light parallel to the hypotenuse BC and incident on the side AB emerges grazing the side AC. Another ray, again parallel to the hypotenuse BC, incident on the side AC suffers total internal reflection at the side AB. Which one of the following must be true about the refractive index μ of the material of the prism?

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

B. $\mu > \sqrt{3}$

C. $\mu < \sqrt{\frac{3}{2}}$

D. $\sqrt{2} < \mu < \sqrt{3}$

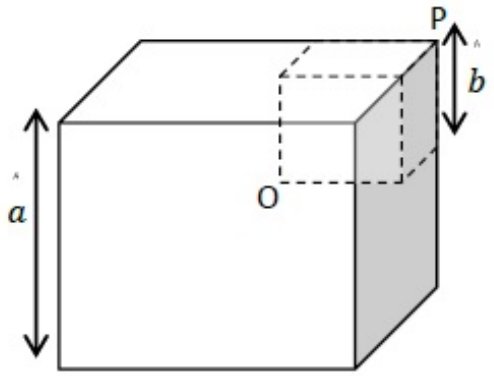
Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 100 Question Id : 4356472180 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

A smaller cube with side b (depicted by dashed lines) is excised from a bigger uniform cube with side a as shown below such that both cubes have a common vertex P. Let $X = a/b$. If the centre of mass of the remaining solid is at the vertex O of smaller cube then X satisfies



A. $X^3 - X^2 - X - 1 = 0$

B. $X^2 - X - 1 = 0$

C. $X^3 + X^2 - X - 1 = 0$

D. $X^3 - X^2 - X + 1 = 0$

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

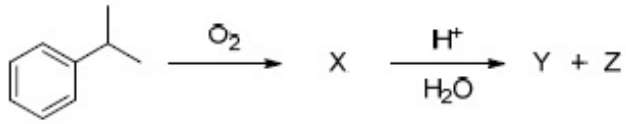
Part II Chemistry

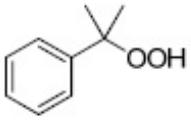
Display Number Panel:	Yes
Group All Questions:	No

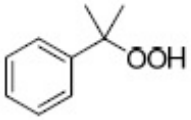
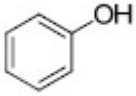
Question Number : 101 Question Id : 4356472181 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

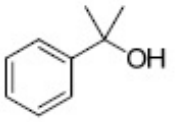
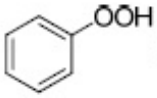
Correct : 2

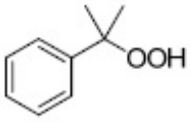
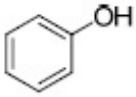
X, Y and Z in the following reaction sequence are



A. X =  Y =  Z = 

B. X =  Y =  Z = 

C. X =  Y =  Z = 

D. X =  Y =  Z = 

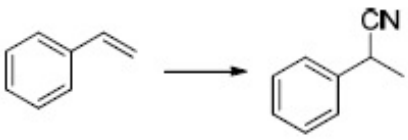
Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 102 Question Id : 4356472182 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

The reagents required for the following two-step transformation are



A. (i) HBr, benzoyl peroxide; (ii) CH_3CN

B. (i) HBr; (ii) NaCN

C. (i) Br_2; (ii) NaCN

D. (i) NaBr; (ii) NaCN

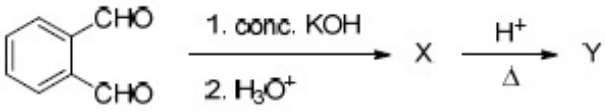
Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

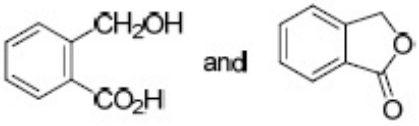
Question Number : 103 Question Id : 4356472183 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

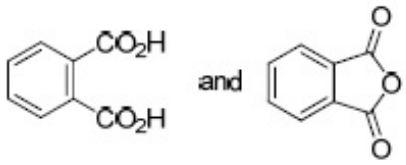
Correct : 2

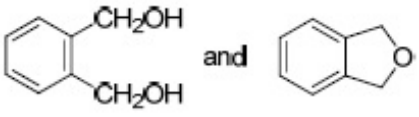
In the reaction sequence

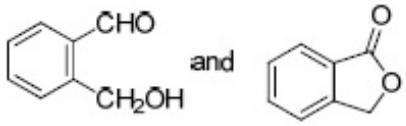


the major products X and Y, respectively, are

A. 

B. 

C. 

D. 

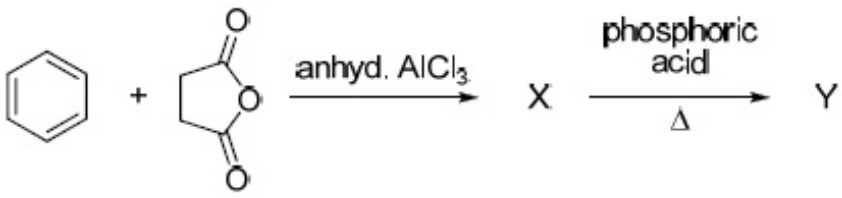
Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

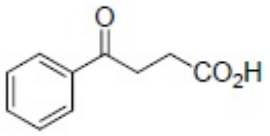
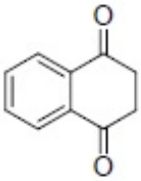
Question Number : 104 Question Id : 4356472184 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

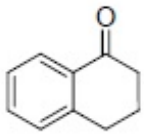
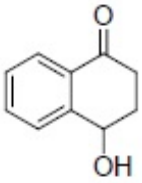
Correct : 2

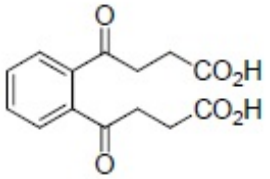
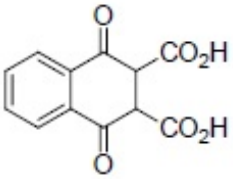
In the following reactions

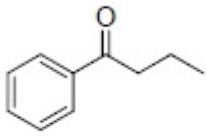
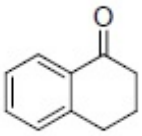


X and Y, respectively, are

A.  and 

B.  and 

C.  and 

D.  and 

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 105 Question Id : 4356472185 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Copper (atomic mass = 63.5) crystallizes in a FCC lattice and has density 8.93 $g.cm^{-3}$.

The radius of copper atom is closest to

A. 361.6 pm B. 511.4 pm

C. 127.8 pm D. 102.8 pm

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 106 Question Id : 4356472186 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Given the standard potentials $E^{\circ}(Cu^{2+}/Cu)$ and $E^{\circ}(Cu^{+}/Cu)$ as 0.340 V and 0.522 V respectively, the value of $E^{\circ}(Cu^{2+}/Cu^{+})$ is

A. 0.364 V

B. 0.158 V

C. −0.182 V

D. −0.316 V

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 107 Question Id : 4356472187 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

For electroplating, 1.5 amp current is passed for 250 s through 250 mL of 0.15 M solution of MSO_4. Only 85% of the current was utilized for electrolysis. The molarity of MSO_4 solution after electrolysis is closest to

[Assume that the volume of the solution remained constant]

A. 0.14

B. 0.014

C. 0.07

D. 0.035

Options :

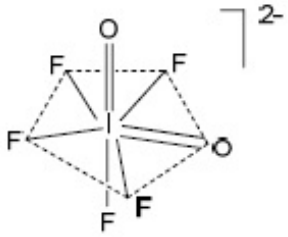
1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 108 Question Id : 4356472188 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

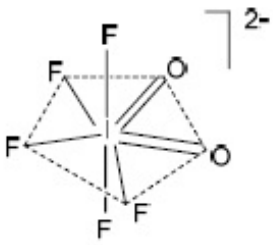
Correct : 2

The hybridization of the central atom and the shape of $[IO_2F_5]^{2-}$ ion, respectively, are

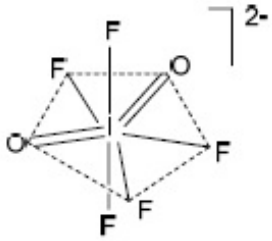
A. sp^3d^3



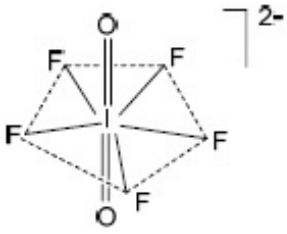
B. sp^2d^4



C. sp^2d^4



D. sp^3d^3



Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 109 Question Id : 4356472189 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

2.33 g of compound X (empirical formula $CoH_{12}N_4Cl_3$) upon treatment with excess $AgNO_3$ solution produces 1.435 g of a white precipitate. The primary and secondary valences of cobalt in compound X, respectively, are

[Given: Atomic mass: Co = 59, Cl = 35.5, Ag = 108]

A. 3, 6

B. 3, 4

C. 2, 4

D. 4, 3

Options :

1. ✔ A
2. ✖ B
3. ✖ C

4. ✖ D

Question Number : 110 Question Id : 4356472190 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

The specific conductance (κ) of 0.02 M aqueous acetic acid solution at 298 K is 1.65 $\times 10^{-4}$ S cm^{-1}. The degree of dissociation of acetic acid is

[Given: equivalent conductance at infinite dilution of H^+ = 349.1 S cm^2 mol^{-1} and CH_3COO^- = 40.9 S cm^2 mol^{-1}]

A. 0.021

B. 0.21

C. 0.012

D. 0.12

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Part II Biology

Display Number Panel:	Yes
Group All Questions:	No

Question Number : 111 Question Id : 4356472191 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Match the following organelles in Group I with the structures in Group II. Choose the correct combination.

Group I	Group II
P. Mitochondrion	i. Cisternae
Q. Golgi	ii. Cristae
R. Chloroplast	iii. Thylakoids
S. Centrosome	iv. Radial spokes

A. P-ii, Q-i, R-iii, S-iv

B. P-iii, Q-i, R-ii, S-iv

C. P-iv, Q-i, R-ii, S-iii

D. P-iv, Q-ii, R-i, S-iii

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 112 Question Id : 4356472192 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

A human population containing 200 individuals has two alleles at the 'T' locus, named *T* & *t*. *T*, which produces tall individuals, is dominant over *t*, which produces short individuals. If the population has 90 *TT*, 40 *Tt* and 70 *tt* genotypes, what will be the frequencies of these two alleles in this population?

A. *T*, 0.50 ; *t*, 0.50

B. *T*, 0.55 ; *t*, 0.45

C. *T*, 0.45 ; *t*, 0.35

D. *T*, 0.90 ; *t*, 0.10

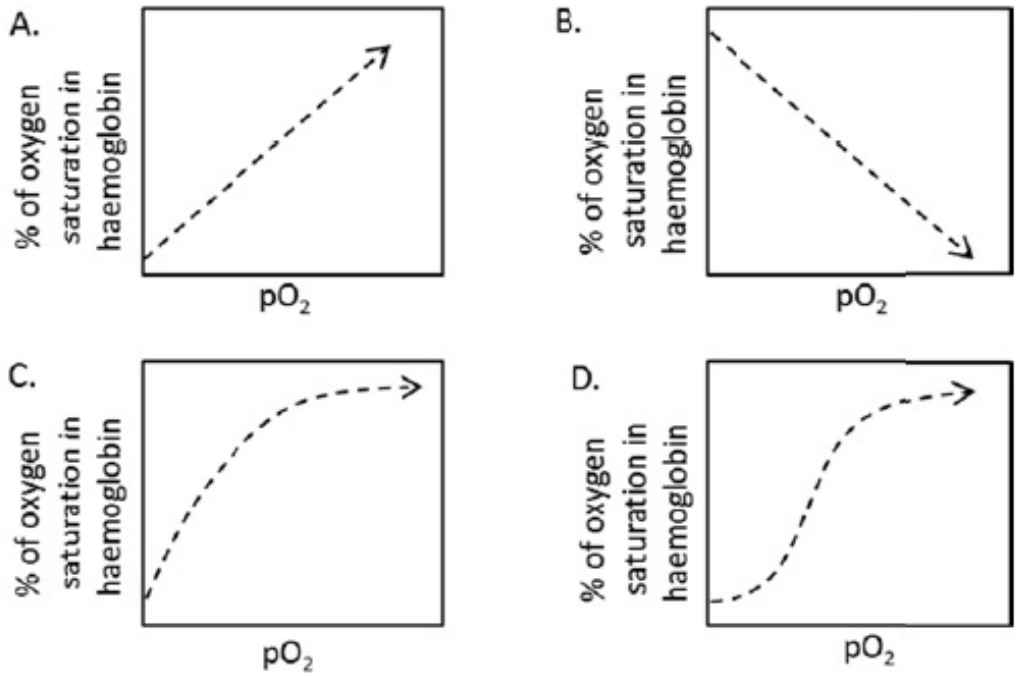
Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 113 Question Id : 4356472193 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Which of the following graphs best describes the oxygen dissociation curve where pO_2 is the partial pressure of oxygen?



Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 114 Question Id : 4356472194 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Which of the following best describes the DNA content and the number of chromosomes at the end of S and M phases of the cell cycle in mitosis, if the DNA content of the cell in the beginning of cell cycle (G1 phase) is considered as C and the number of chromosomes 2N?

A. 2C and 2N for S phase; 2C and 2N for M phase

B. 2C and N for S phase; 2C and N for M phase

C. 2C and 2N for S phase; C and 2N for M phase

D. C and N for S phase; C and 2N for M phase

Options :

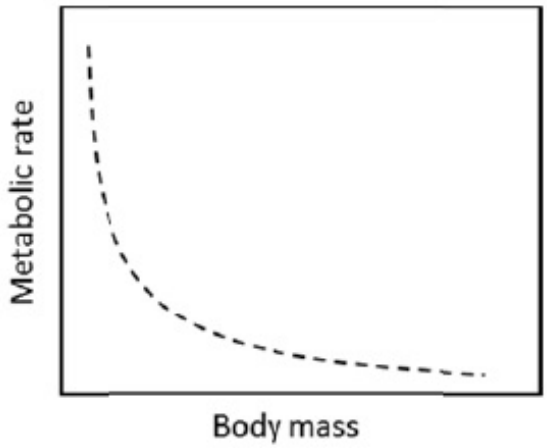
1. ✖ A
2. ✖ B
3. ✔ C

4. ✖ D

Question Number : 115 Question Id : 4356472195 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Study the following graph of metabolic rate of various terrestrial mammals as a function of their body mass and choose the correct option below.



A. Animals are distributed throughout the curve with the smaller animals towards the left and progressively bigger animals towards the right.

B. The smaller animals below a certain critical mass cluster at the left end of the curve and the larger animals above the critical mass cluster on the right end.

C. Animals are distributed throughout the curve with the larger animals towards the left and progressively smaller animals towards the right.

D. The larger animals above a certain critical mass cluster at the left end of the curve and the smaller animals below the critical mass cluster on the right end.

Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 116 Question Id : 4356472196 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

Match the human disorders shown in Group I with the biochemical processes in Group II. Choose the correct combination.

Group I	Group II
P. Phenylketonuria	i. Melanin synthesis
Q. Albinism	ii. Conversion of Phenylalanine to Tyrosine
R. Homocystinuria	iii. Tyrosine degradation
S. Argininemia	iv. Methionine metabolism
	v. Urea Synthesis

A. P-ii, Q-i, R-iv, S-v

B. P-i, Q-iv, R-ii, S-v

C. P-ii, Q-i, R-v, S-iii

D. P-v, Q-iii, R-i, S-ii

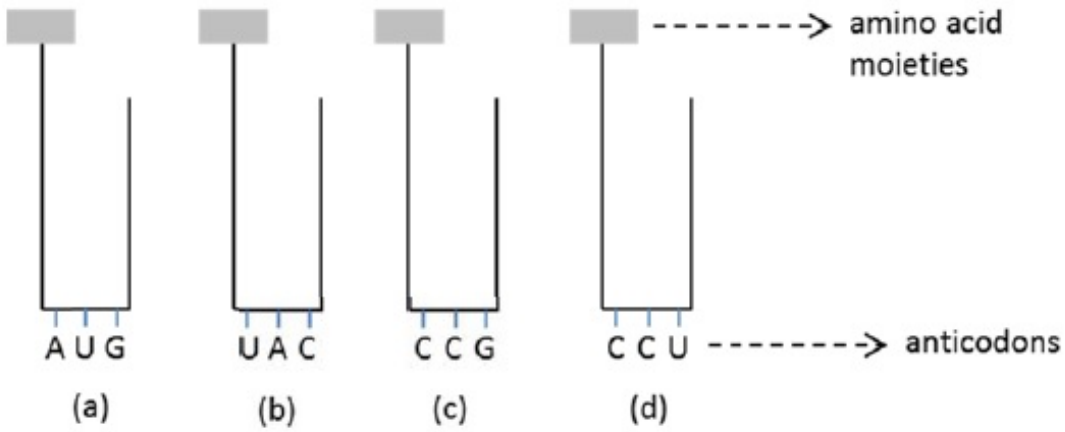
Options :

1. ✔ A
2. ✖ B
3. ✖ C
4. ✖ D

Question Number : 117 Question Id : 4356472197 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

An mRNA is transcribed from a DNA segment having the base sequence 3'-TACATGGGTCCG-5'. What will be the correct order of binding of the four amino acyl-tRNA complexes given below during translation of this mRNA?



A. a, b, c, d

B. b, a, c, d

C. c, d, a, b

D. b, a, d, c

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 118 Question Id : 4356472198 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

If the initial number of template DNA molecules in a PCR reaction is 1000, the number of product DNA molecules at the end of 20 cycles will be closest to

A. 10^3

B. 10^6

C. 10^9

D. 10^{12}

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 119 Question Id : 4356472199 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

The allele for black hair (B) is dominant over brown hair (b) and the allele for brown eye (E) is dominant over blue eye (e). Out of the offsprings obtained upon mating a black-haired and brown-eyed individual (BbEe) with a brown-haired and brown-eyed individual (bbEE), the ratio of brown-haired and brown-eyed individuals to black-haired and brown-eyed individuals is

A. 2:1

B. 3:1

C. 1:1

D. 1:2

Options :

1. ✖ A

2. ✖ B

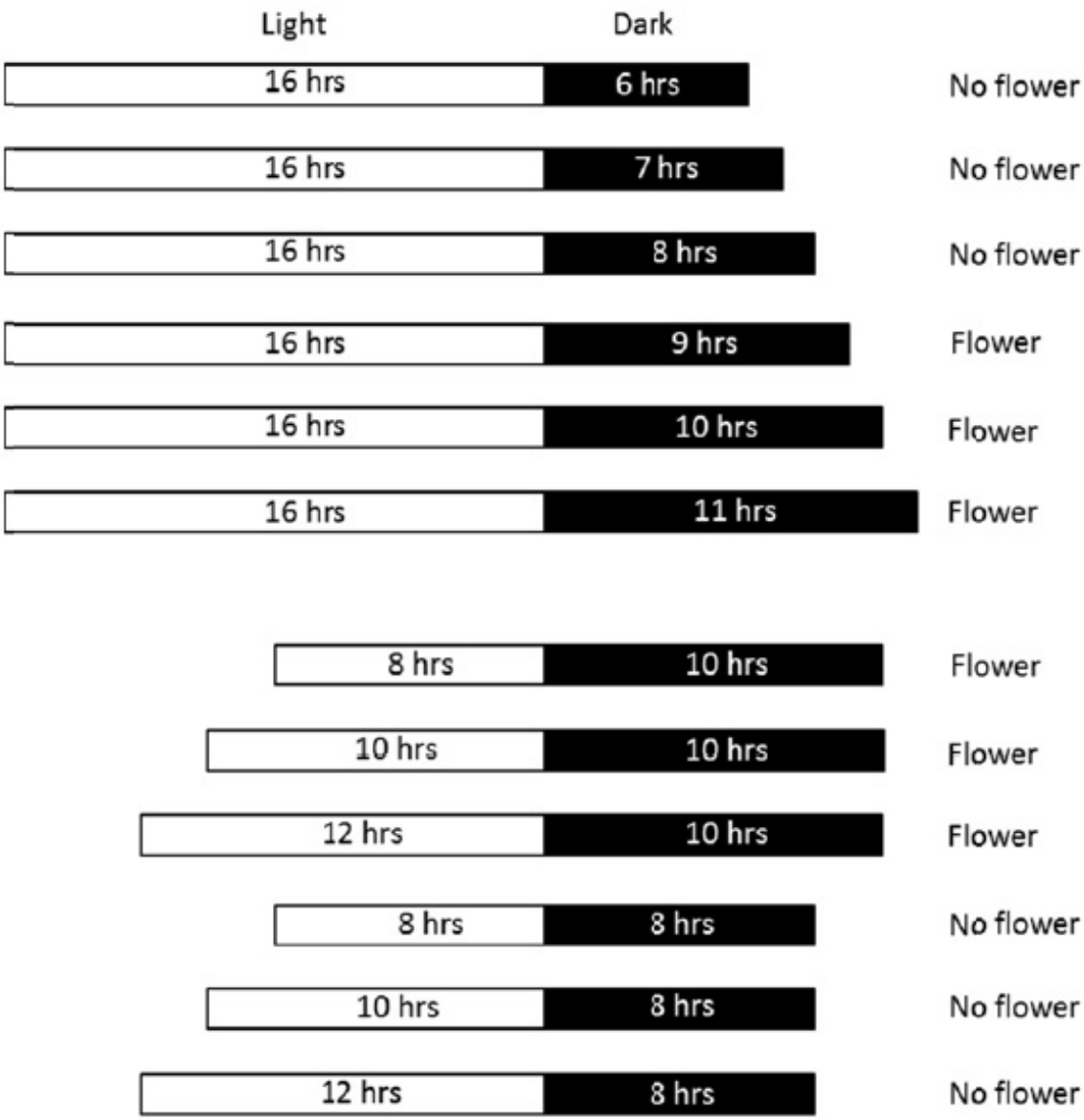
3. ✔ C

4. ✖ D

Question Number : 120 Question Id : 4356472200 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct : 2

In an experiment represented in the schematic below, a plant species was grown in different day and night cycles and its photoperiodic flowering behaviour was noted. This species is a



A. short day plant and actually measures day length to flower.
B. short day plant and actually measures night length to flower.
C. long day plant and actually measures night length to flower.
D. long day plant and actually measures day length to flower.

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D