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 SA
Creation Date: 2016-11-09 16:30:18
Duration: 180
Total Marks: 100
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 : 4356472001  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1

Suppose the quadratic polynomial $P(x) = ax^2 + bx + c$ has positive coefficients $a, b, c$ in arithmetic progression in that order. If $P(x) = 0$ has integer roots $\alpha$ and $\beta$, then $\alpha + \beta + \alpha\beta$ equals

A. 3  B. 5  C. 7  D. 14

Options:
1. ✗ A
2. ✗ B
3. ✔ C
4. ✗ D

Question Number : 2  Question Id : 4356472002  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1
The number of digits in the decimal expansion of $16^{55}16$ is

A. 16     B. 17     C. 18     D. 19

Options :
1. ✗ A
2. ✗ B
3. ✔ C
4. ✗ D

Question Number : 3 Question Id : 4356472003 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical
Correct : 1

Let $t$ be real number such that $t^2 = at + b$ for some positive integers $a$ and $b$. Then for any choice of positive integers $a$ and $b$, $t^3$ is never equal to

A. $4t + 3$     B. $8t + 5$     C. $10t + 3$     D. $6t + 5$

Options :
1. ✗ A
2. ✔ B
3. ✗ C
4. ✗ D

Question Number : 4 Question Id : 4356472004 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical
Correct : 1

Consider the equation $(1 + a + b)^2 = 3(1 + a^2 + b^2)$, where $a, b$ are real numbers. Then

A. there is no solution pair $(a, b)$
B. there are infinitely many solution pairs $(a, b)$
C. there are exactly two solution pairs $(a, b)$
D. there is exactly one solution pair $(a, b)$

Options :
1. ✗ A
2. ✗ B
3. ✗ C
4. ✔ D

Question Number : 5 Question Id : 4356472005 Question Type : MCQ Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical
Correct : 1
Let \( a_1, a_2, \ldots, a_{100} \) be non-zero real numbers such that
\[
a_1 + a_2 + \cdots + a_{100} = 0.
\]
Then

A. \( \sum_{i=1}^{100} a_i 2^{ai} > 0 \) and \( \sum_{i=1}^{100} a_i 2^{-ai} < 0 \)

B. \( \sum_{i=1}^{100} a_i 2^{ai} \geq 0 \) and \( \sum_{i=1}^{100} a_i 2^{-ai} \geq 0 \)

C. \( \sum_{i=1}^{100} a_i 2^{ai} \leq 0 \) and \( \sum_{i=1}^{100} a_i 2^{-ai} \leq 0 \)

D. the sign of \( \sum_{i=1}^{100} a_i 2^{ai} \) or \( \sum_{i=1}^{100} a_i 2^{-ai} \) depends on the choice of \( a_i \)’s

Options:
1. ✔️ A
2. ✗ B
3. ✗ C
4. ✗ D

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Question Number: 6  Question Id: 4356472006  Question Type: MCQ  Display Question Number: Yes  Single Line Question Option: No  Option Orientation: Vertical  Correct: 1

Let \( ABCD \) be a trapezium, in which \( AB \) is parallel to \( CD \), \( AB = 11 \), \( BC = 4 \), \( CD = 6 \) and \( DA = 3 \). The distance between \( AB \) and \( CD \) is

A. 2  
B. 2.4  
C. 2.8  
D. not determinable with the data

Options:
1. ✗ A
2. ✔️ B
3. ✗ C
4. ✗ D

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Question Number: 7  Question Id: 4356472007  Question Type: MCQ  Display Question Number: Yes  Single Line Question Option: No  Option Orientation: Vertical  Correct: 1

The points \( A, B, C, D, E \) are marked on the circumference of a circle in clockwise direction such that \( \angle ABC = 130^\circ \) and \( \angle CDE = 110^\circ \). The measure of \( \angle ACE \) in degrees is

A. 50°  
B. 60°  
C. 70°  
D. 80°

Options:
1. ✗ A
2. ✔️ B
3. ✗ C
4. ✗ D
Question Number : 8  Question Id : 4356472008  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1

Three circles of radii 1, 2 and 3 units respectively touch each other externally in the plane. The circumradius of the triangle formed by joining the centers of the circles is

A. 1.5  B. 2  C. 2.5  D. 3

Options :
1.  A
2.  B
3.  ✓ C
4.  D

Question Number : 9  Question Id : 4356472009  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1

Let \( P \) be a point inside a triangle \( ABC \) with \( \angle ABC = 90^\circ \). Let \( P_1 \) and \( P_2 \) be the images of \( P \) under reflection in \( AB \) and \( BC \) respectively. The distance between the circumcenters of triangles \( ABC \) and \( P_1P_2 \) is

A. \( \frac{AB}{2} \)  B. \( \frac{AP + BP + CP}{3} \)

C. \( \frac{AC}{2} \)  D. \( \frac{AB + BC + AC}{2} \)

Options :
1.  A
2.  B
3.  ✓ C
4.  D

Question Number : 10  Question Id : 4356472010  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1

Let \( a \) and \( b \) be two positive real numbers such that \( a + 2b \leq 1 \). Let \( A_1 \) and \( A_2 \) be, respectively, the areas of circles with radii \( ab^3 \) and \( b^2 \). Then the maximum possible value of \( \frac{A_1}{A_2} \) is

A. \( \frac{1}{16} \)  B. \( \frac{1}{64} \)  C. \( \frac{1}{16\sqrt{2}} \)  D. \( \frac{1}{32} \)

Options :
1.  A
2.  ✓ B
3.  C
4.  D
There are two candles of same length and same size. Both of them burn at uniform rate. The first one burns in 5 hours and the second one burns in 3 hours. Both the candles are lit together. After how many minutes the length of the first candle is 3 times that of the other?

A. 90  
B. 120  
C. 135  
D. 150

Options:
1. ✗ A
2. ✗ B
3. ✗ C
4. ✓ D

Consider a cuboid all of whose edges are integers and whose base is a square. Suppose the sum of all its edges is numerically equal to the sum of the areas of all its six faces. Then the sum of all its edges is

A. 12  
B. 18  
C. 24  
D. 36

Options:
1. ✗ A
2. ✗ B
3. ✓ C
4. ✗ D

Let $A_1, A_2, \ldots, A_m$ be non-empty subsets of \{1,2,3,...,100\} satisfying the following conditions:
1. the numbers $|A_1|, |A_2|, \ldots, |A_m|$ are distinct;
2. $A_1, A_2, \ldots, A_m$ are pairwise disjoint.
(Here $|A|$ denotes the number of elements in the set $A$.)

Then the maximum possible value of $m$ is

A. 13  
B. 14  
C. 15  
D. 16

Options:
1. ✓ A
2. ✗ B
3. ✗ C
4. ✗ D

Question Number : 14  Question Id : 4356472014  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
The number of all 2-digit numbers \( n \) such that \( n \) is equal to the sum of the square of digit in its tens place and the cube of the digit in units place is

A. 0  
B. 1  
C. 2  
D. 4

Let \( f \) be a function defined on the set of all positive integers such that \( f(xy) = f(x) + f(y) \) for all positive integers \( x, y \). If \( f(12) = 24 \) and \( f(8) = 15 \), the value of \( f(48) \) is

A. 31  
B. 32  
C. 33  
D. 34

A person walks 25.0° north of east for 3.18 km. How far would she have to walk due north and then due east to arrive at the same location?

A. towards north 2.88 km and towards east 1.34 km.
B. towards north 2.11 km and towards east 2.11 km
C. towards north 1.25 km and towards east 1.93 km
D. towards north 1.34 km and towards east 2.88 km.
Question Number : 17  Question Id : 4356472017  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1

The length and width of a rectangular room are measured to be 3.95±0.05 m and 3.05±0.05 m, respectively. The area of the floor is

A. 12.05±0.01 m².
B. 12.05±0.005 m².
C. 12.05±0.34 m².
D. 12.05±0.40 m².

Options :
1. ✗ A
2. ✗ B
3. ✔ C
4. ✗ D

Question Number : 18  Question Id : 4356472018  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1

A car goes around uniform circular track of radius \( R \) at a uniform speed \( v \) once in every \( T \) seconds. The magnitude of the centripetal acceleration is \( a_c \). If the car now goes uniformly around a larger circular track of radius \( 2R \) and experiences a centripetal acceleration of magnitude \( 8a_c \), then its time period is

A. \( 2T \)
B. \( 3T \)
C. \( T/2 \)
D. \( 3/2 \ T \)

Options :
1. ✗ A
2. ✗ B
3. ✔ C
4. ✗ D

Question Number : 19  Question Id : 4356472019  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1
The primary and the secondary coils of a transformer contain 10 and 100 turns, respectively. The primary coil is connected to a battery that supplies a constant voltage of 1.5 volts. The voltage across the secondary coil is

A. 1.5 V  
B. 0.15 V  
C. 0.0 V  
D. 15 V

Options:
1. ✗ A  
2. ✗ B  
3. ✔ C  
4. ✗ D

Question Number : 20  Question Id : 4356472020  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1

Water falls down a 500.0 m shaft to reach a turbine which generates electricity. How much water must fall per second in order to generate $1.00 \times 10^9$ Watts of power? (Assume 50% efficiency of conversion and $g = 10 \text{ m/s}^2$)

A. 250 m$^3$  
B. 400 m$^3$  
C. 500 m$^3$  
D. 200 m$^3$

Options:
1. ✗ A  
2. ✔ B  
3. ✗ C  
4. ✗ D

Question Number : 21  Question Id : 4356472021  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1
The diagram below shows two circular loops of wire (A and B) centred on and perpendicular to the x-axis, and oriented with their planes parallel to each other. The y-axis passes vertically through loop A (dashed line). There is a current $I_B$ in loop B as shown. Possible actions which we might perform on loop A are:

(i) Move A to the right along x axis closer to B
(ii) Move A to the left along x axis away from B
(iii) As viewed from above, rotate A clockwise about y axis
(iv) As viewed from above, rotate A anticlockwise about y axis

Which of these actions will induce a current in A only in the direction shown.

A. Only (i)
B. Only (ii)
C. Only(i) and (iv)
D. Only (ii) and (iii)

Options :
1. ✔️ A
2. ✗ B
3. ✗ C
4. ✗ D
A rigid ball rolls without slipping on a surface shown below.

Which one of the following is the most likely representation of the distance travelled by the ball vs time graph?

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

In an experiment, setup A consists of two parallel wires which carry currents in opposite directions as shown in the figure. A second setup B is identical to setup A, except that there is a metal plate between the wires.

Let $F_A$ and $F_B$ be the magnitude of the force between the two wires in setup A and setup B, respectively.

A. $F_A > F_B \neq 0$
B. $F_A < F_B$
C. $F_A = F_B \neq 0$
D. $F_A > F_B = 0$

Options:
In the circuit, wire 1 is of negligible resistance. Then

\[ R_1 \quad \text{wire 1} \quad R_2 \]

\[ \varepsilon_1 \quad - \quad + \quad \varepsilon_2 \]

A. Current will flow through wire 1 if \(\varepsilon_1 \neq \varepsilon_2\)
B. Current will flow through wire 1 if \(\varepsilon_1/R_1 \neq \varepsilon_2/R_2\)
C. Current will flow through wire 1 if \((\varepsilon_1 + \varepsilon_2)/(R_1 + R_2) \neq (\varepsilon_1 - \varepsilon_2)/(R_1 - R_2)\)
D. No current will flow through wire 1.

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

The radius of a nucleus is given by \(r_0 A^{1/3}\) where \(r_0 = 1.3 \times 10^{-15}\) m and \(A\) is the mass number of the nucleus. The Lead nucleus has \(A = 206\). The electrostatic force between two protons in this nucleus is approximately

A. \(10^2\) N
B. \(10^7\) N
C. \(10^{12}\) N
D. \(10^{17}\) N

Options:
1. A
2. B
3. C
4. **D**

Question Number : 26  Question Id : 4356472026  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1

A hollow lens is made of thin glass and in the shape of a double concave lens. It can be filled with air, water of refractive index 1.33 or CS₂ of refractive index 1.6. It will act as a diverging lens if it is

A. filled with air and immersed in water.
B. filled with water and immersed in CS₂.
C. filled with air and immersed in CS₂.
D. filled with CS₂ and immersed in water.

Options :
1. **A**
2. **B**
3. **C**
4. ✔ D

Question Number : 27  Question Id : 4356472027  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1

A stone thrown down with a speed *u* takes a time *t₁* to reach the ground, while another stone, thrown upwards from the same point with the same speed, takes time *t₂*. The maximum height the second stone reaches from the ground is

A. \( \frac{1}{2} gt₁t₂ \)
B. \( g'8 (t₁ + t₂)^2 \)
C. \( g'8 (t₁ - t₂)^2 \)
D. \( \frac{1}{2} gt₂^2 \)

Options :
1. **A**
2. **B**
3. ✔ C
4. ✗ D

Question Number : 28  Question Id : 4356472028  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1
An electric field due to a positively charged long straight wire at a distance \( r \) from it is proportional to \( r^{-1} \) in magnitude. Two electrons are orbiting such a long straight wire in circular orbits of radii 1 Å and 2 Å. The ratio of their respective time periods is

A. \( 1:1 \)  
B. \( 1:2 \)  
C. \( 2:1 \)  
D. \( 4:1 \)

Options:
1. ✗ A
2. ✔ B
3. ✗ C
4. ✗ D

Question Number : 29  Question Id : 4356472029  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  
Correct : 1

Two particles of identical mass are moving in circular orbits under a potential given by \( V(r) = Kr^{-n} \), where \( K \) is a constant. If the radii of their orbits are \( r_1, r_2 \) and their speeds are \( v_1, v_2 \), respectively, then

\[
\begin{align*}
A. & \quad v_1^2 r_1^n = v_2^2 r_2^n \\
B. & \quad v_1^2 r_1^{-n} = v_2^2 r_2^{-n} \\
C. & \quad v_1^2 r_1 = v_2^2 r_2 \\
D. & \quad v_1^2 r_1^{2-n} = v_2^2 r_2^{2-n}
\end{align*}
\]

Options:
1. ✔ A
2. ✗ B
3. ✗ C
4. ✗ D

Question Number : 30  Question Id : 4356472030  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  
Correct : 1

Mercury is often used in clinical thermometers. Which one of the following properties of mercury is not a reason for this?

A. The coefficient of the thermal expansion is large.  
B. It is shiny.  
C. It is a liquid at room temperature.  
D. It has high density.

Options:
Part I Chemistry

Display Number Panel: Yes
Group All Questions: No

Question Number : 31  Question Id : 4356472031  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1
One mole of one of the sodium salts listed below, having carbon content close to 14.3%, produces 1 mole of carbon dioxide upon heating (atomic mass Na = 23, H = 1, C = 12, O = 16). The salt is

A. \( \text{C}_3\text{H}_5\text{COONa} \)
B. \( \text{NaHCO}_3 \)
C. \( \text{HCOONa} \)
D. \( \text{CH}_3\text{COONa} \)

Options :
1. ✗ A
2. ✔️ B
3. ✗ C
4. ✗ D

Question Number : 32  Question Id : 4356472032  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1
Among formic acid, acetic acid, propanoic acid and phenol, the strongest acid in water is

A. formic acid
B. acetic acid
C. propanoic acid
D. phenol

Options :
Question Number : 33  Question Id : 4356472033  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1

According to Graham’s Law, the rate of diffusion of CO, O₂, N₂ and CO₂ follows the order:

A. CO = N₂ > O₂ > CO₂
B. CO = N₂ > CO₂ > O₂
C. O₂ > CO = N₂ > CO₂
D. CO₂ > O₂ > CO = N₂

Options :
1. ✔ A
2. ✗ B
3. ✗ C
4. ✗ D

Question Number : 34  Question Id : 4356472034  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1

The major product formed when 2-butene is reacted with O₃ followed by treatment with Zn/H₂O is

A. CH₃COOH
B. CH₃CHO
C. CH₃CH₂OH
D. CH₂=CH₂

Options :
1. ✗ A
2. ✔ B
3. ✗ C
4. ✗ D

Question Number : 35  Question Id : 4356472035  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1
The IUPAC name for the following compound is

\[
\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-C-CH}_2\text{-CH}_2\text{-CH}_3
\]

A. 2-propylhex-1-ene  
B. 2-butylpent-1-ene  
C. 2-propyl-2-butylethene  
D. propyl-1-butylethene

Options:
1. ✔ A  
2. ✗ B  
3. ✗ C  
4. ✗ D

The major products obtained in the reaction of oxalic acid with conc. H₂SO₄ upon heating are

A. CO, CO₂, H₂O  
B. CO, SO₂, H₂O  
C. H₂S, CO, H₂O  
D. HCOOH, H₂S, CO

Options:
1. ✔ A  
2. ✗ B  
3. ✗ C  
4. ✗ D
LiOH reacts with CO₂ to form Li₂CO₃ (atomic mass of Li = 7). The amount of CO₂ (in g) consumed by 1 g of LiOH is closest to

A. 0.916  
B. 1.832  
C. 0.544  
D. 1.088

Options :
1. ✔️ A
2. ✗ B
3. ✗ C
4. ✗ D

The oxidation number of sulphur is +4 in

A. H₂S  
B. CS₂  
C. Na₂SO₄  
D. Na₂SO₃

Options :
1. ✗ A
2. ✔️ B
3. ✗ C
4. ✔️ D

Al₂O₃ reacts with

A. only water  
B. only acids  
C. only alkalis  
D. both acids and alkalis

Options :
1. **A**
2. **B**
3. **C**
4. ✔️ **D**

The major product formed in the oxidation of acetylene by alkaline KMnO₄ is

A. ethanol
B. acetic acid
C. formic acid
D. oxalic acid

Options:
1. **A**
2. **B**
3. **C**
4. ✔️ **D**

Question Number : 41  Question Id : 4356472041  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1

In a closed vessel, an ideal gas at 1 atm is heated from 27 °C to 327 °C. The final pressure of the gas will approximately be

A. 3 atm
B. 0.5 atm
C. 2 atm
D. 12 atm

Options:
1. **A**
2. **B**
3. ✔️ **C**
4. **D**

Question Number : 42  Question Id : 4356472042  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1
Among the elements Li, N, C and Be, one with the largest atomic radius is

A. Li  
B. N  
C. C  
D. Be

Options:
1. ✓ A
2. ✗ B
3. ✗ C
4. ✗ D

A redox reaction among the following is

(i) \( \text{CdCl}_2 + 2 \text{KOH} \rightarrow \text{Cd(OH)}_2 + 2 \text{KCl} \)
(ii) \( \text{BaCl}_2 + \text{K}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2 \text{KCl} \)
(iii) \( \text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2 \)
(iv) \( 2 \text{Ca} + \text{O}_2 \rightarrow 2 \text{CaO} \)

A. (i)  
B. (ii)  
C. (iii)  
D. (iv)

Options:
1. ✗ A
2. ✗ B
3. ✗ C
4. ✓ D

Question Number : 43  Question Id : 4356472043  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1

Question Number : 44  Question Id : 4356472044  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1
The electronic configuration which obeys Hund’s rule for the ground state of carbon atom is

A.  
\[
\begin{array}{c}
\text{Energy} \\
\downarrow \\
\downarrow \\
\text{1s} \\
\text{2s} \\
\text{2p}
\end{array}
\begin{array}{c}
\uparrow \\
\uparrow \\
\end{array}
\]

B.  
\[
\begin{array}{c}
\text{Energy} \\
\downarrow \\
\downarrow \\
\text{1s} \\
\text{2s} \\
\text{2p}
\end{array}
\begin{array}{c}
\uparrow \\
\uparrow \\
\end{array}
\]

C.  
\[
\begin{array}{c}
\text{Energy} \\
\downarrow \\
\downarrow \\
\text{1s} \\
\text{2s} \\
\text{2p}
\end{array}
\begin{array}{c}
\uparrow \\
\uparrow \\
\end{array}
\]

D.  
\[
\begin{array}{c}
\text{Energy} \\
\downarrow \\
\downarrow \\
\text{1s} \\
\text{2s} \\
\text{2p}
\end{array}
\begin{array}{c}
\uparrow \\
\uparrow \\
\end{array}
\]

Options:
1. ✔ A
2. ✗ B
3. ✗ C
4. ✗ D

Question Number : 45  Question Id : 4356472045  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 1
The graph that depicts Einstein's photoelectric effect for a monochromatic source of frequency above the threshold frequency is

Options:

1. ✗ A
2. ✗ B
3. ✓ C
4. ✗ D

What is the length of human DNA containing $6.6 \times 10^9$ bp?

A. 22 nm  
B. 0.22 mm  
C. 2.2 m  
D. 22 m

Options:
The *Diptheria, Pertussis, Tetanus* (DPT) vaccine consists of

A. live attenuated strains of *Diptheria, Pertussis, Tetanus*
B. toxoid of *Diptheria, Tetanus*, and heat killed whole cells of *Pertussis*
C. whole cell lysate of *Diptheria, Pertussis, Tetanus*
D. heat killed strains of *Diptheria, Pertussis, Tetanus*

**Options**:
1. ✔ A
2. ✔ B
3. ✔ C
4. ✔ D

Which of the following is NOT an enzyme?

A. Lipase
B. Amylase
C. Trypsin
D. Bilirubin

**Options**:
1. ✔ A
2. ✔ B
3. ✔ C
4. ✔ D
The pH of the avian blood is maintained by

A. \( \text{HCO}_3^- \)
B. \( \text{H}_2\text{PO}_4^- \)
C. \( \text{CH}_3\text{COO}^- \)
D. \( \text{Cl}^- \)

Options:
1. ✓ A
2. ✗ B
3. ✗ C
4. ✗ D

Podocyte layer that provides outer lining to the surface of glomerular capillaries are found in

A. bowman’s capsule
B. loop of Henle
C. renal artery
D. ureter

Options:
1. ✓ A
2. ✗ B
3. ✗ C
4. ✗ D

If a dsDNA has 20% adenine, what would be its cytosine content?

A. 20%
B. 30%
C. 40%
D. 80%

Options:
1. ✗ A
2. ✔ B
3. ✗ C
4. ✗ D

Question Number : 52  Question Id : 4356472052  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1
Which one of the following is incapable of curing Pellagra?

A. Niacine
B. Nicotine
C. Nicotinamide
D. Tryptophan

Options :
1. ✗ A
2. ✔ B
3. ✗ C
4. ✗ D

Question Number : 53  Question Id : 4356472053  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1
In *Escherichia coli*, how many codons code for the standard amino-acids?

A. 64
B. 60
C. 61
D. 20

Options :
1. ✗ A
2. ✗ B
3. ✔ C
4. ✗ D

Question Number : 54  Question Id : 4356472054  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1
Bombyx mori (silk worm) belongs to the order

A. Lepidoptera
B. Diptera
C. Hymenoptera
D. Coleoptera

Options:
1. ✔ A
2. ✗ B
3. ✗ C
4. ✗ D

The source of mammalian hormone “Relaxin” is

A. ovary
B. stomach
C. intestine
D. pancreas

Options:
1. ✔ A
2. ✗ B
3. ✗ C
4. ✗ D

Which one of the following animals is a connecting link between reptiles and mammals?

A. Platypus
B. Bat
C. Armadillo
D. Frog

Options:
1. ✔ A
2. ✗ B
3. ** C
4. ** D

**Question Number : 57**  Question Id : 4356472057  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1

What is the number of chromosomes in an individual with Turner’s syndrome?

A. 44  
B. 45  
C. 46  
D. 47

**Options :**
1. ** A  
2. ✔ B  
3. ** C  
4. ** D

**Question Number : 58**  Question Id : 4356472058  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1

Chipko movement in the year 1974 in Garhwal Himalayas involved

A. protecting tigers  
B. preventing soil erosion by planting trees  
C. preventing pollution by closing down industries  
D. hugging trees to prevent the contractors from felling them

**Options :**
1. ** A  
2. ** B  
3. ** C  
4. ✔ D

**Question Number : 59**  Question Id : 4356472059  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 1
Which of the following amino acids is NOT involved in gluconeogenesis?

A. Alanine  
B. Lysine  
C. Glutamate  
D. Arginine

Options:
1. ✗ A  
2. ✔ B  
3. ✗ C  
4. ✗ D

Which of the following entities causes syphilis?

A. Treponema pallidum  
B. Neisseria gonorrhoea  
C. HIV  
D. Hepatitis B

Options:
1. ✔ A  
2. ✗ B  
3. ✗ C  
4. ✗ D

Part II Mathematics

Display Number Panel: Yes  
Group All Questions: No

Which of the following entities causes syphilis?

A. Treponema pallidum  
B. Neisseria gonorrhoea  
C. HIV  
D. Hepatitis B

Options:
1. ✔ A  
2. ✗ B  
3. ✗ C  
4. ✗ D

Correct: 2
Suppose $a$ is a positive real number such that $a^5 - a^3 + a = 2$. Then

A. $a^6 < 2$  
B. $2 < a^6$ < 3
C. $3 < a^6$ < 4  
D. $4 \leq a^6$

Options:
1. ✗ A  
2. ✗ B  
3. ✓ C  
4. ✗ D

Question Number: 62 Question Id: 4356472062 Question Type: MCQ Display Question Number: Yes Single Line Question Option: No Option Orientation: Vertical
Correct: 2

Consider the quadratic equation $nx^2 + 7\sqrt{n}x + n = 0$, where $n$ is a positive integer. Which of the following statements are necessarily correct?
I. For any $n$, the roots are distinct.
II. There are infinitely many values of $n$ for which both roots are real.
III. The product of the roots is necessarily an integer.

A. III only  
B. I and III only
C. II and III only  
D. I, II and III

Options:
1. ✗ A  
2. ✓ B  
3. ✗ C  
4. ✗ D

Question Number: 63 Question Id: 4356472063 Question Type: MCQ Display Question Number: Yes Single Line Question Option: No Option Orientation: Vertical
Correct: 2

Consider a semicircle of radius 1 unit constructed on the diameter $AB$, and let $O$ be its centre. Let $C$ be a point on $AO$ such that $AC:CO = 2:1$. Draw $CD$ perpendicular to $AO$ with $D$ on the semicircle. Draw $OE$ perpendicular to $AD$ with $E$ on $AD$. Let $OE$ and $CD$ intersect at $H$. Then $DH$ equals

A. $\frac{1}{\sqrt{5}}$  
B. $\frac{1}{\sqrt{3}}$
C. $\frac{1}{\sqrt{2}}$  
D. $\frac{\sqrt{5}-1}{2}$

Options:
1. ✗ A  
2. ✗ B  
3. ✓ C  
4. ✗ D
Let $S_1$ be the sum of areas of the squares whose sides are parallel to coordinate axes. Let $S_2$ be the sum of areas of the slanted squares as shown in the figure. Then $S_1/S_2$ is:

A. $2$  
B. $\sqrt{2}$  
C. $1$  
D. $\frac{1}{\sqrt{2}}$

If a 3-digit number is randomly chosen, what is the probability that either the number itself or some permutation of the number (which is a 3-digit number) is divisible by 4 and 5?

A. $\frac{1}{45}$  
B. $\frac{29}{180}$  
C. $\frac{11}{60}$  
D. $\frac{1}{4}$
Which one of the following four graphs best depict the variation with x of the moment of inertia I of a uniform triangular lamina about an axis parallel to its base at a distance x from it:

Options:
1. ✔️ A
2. ✗ B
3. ✗ C
4. ✗ D

Question Number : 67  Question Id : 4356472067  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical
Correct : 2
A rectangular block is composed of three different glass prisms (with refractive indices $\mu_1$, $\mu_2$ and $\mu_3$) as shown in the figure below. A ray of light incident normal to the left face emerges normal to the right face. Then the refractive indices are related by

\[ \mu_1^2 + \mu_2^2 = 2\mu_3^2 \]

A. $\mu_1^2 + \mu_2^2 = 2\mu_3^2$
B. $\mu_1^2 + \mu_2^2 = \mu_3^2$
C. $\mu_1^2 + \mu_3^2 = 2\mu_2^2$
D. $\mu_2^2 + \mu_3^2 = 2\mu_1^2$

A uniform metal plate shaped like a triangle ABC has a mass of 540 gm. The length of the sides AB, BC, and CA are 3 cm, 5 cm and 4 cm, respectively. The plate is pivoted freely about the point A. What mass must be added to a vertex, so that the plate can hang with the long edge horizontal?

A. 140 gm at C
B. 540 gm at C
C. 140 gm at B
D. 540 gm at B

Options :
1. ✔ A
2. ✗ B
3. ✗ C
4. ✗ D
A 20 gm bullet whose specific heat is 5000 J/(kg-°C) and moving at 2000 m/s plunges into a 1.0 kg block of wax whose specific heat is 3000 J/(kg-°C). Both bullet and wax are at 25 °C and assume that (i) the bullet comes to rest in the wax and (ii) all its kinetic energy goes into heating the wax. Thermal temperature of the wax in °C is close to

A. 28.1
B. 31.5
C. 37.9
D. 42.1

Options:
1. ✗ A
2. ✗ B
3. ✔ C
4. ✗ D

A “V” shaped rigid body has two identical uniform arms. What must be the angle between the two arms so that when the body is hung from one end, the other arm is horizontal?

A. \( \cos^{-1} \left( \frac{1}{3} \right) \)
B. \( \cos^{-1} \left( \frac{1}{2} \right) \)
C. \( \cos^{-1} \left( \frac{1}{4} \right) \)
D. \( \cos^{-1} \left( \frac{1}{6} \right) \)

Options:
1. ✗ A
2. ✗ B
3. ✔ C
4. ✗ D

Part II Chemistry

Display Number Panel: Yes
Group All Questions: No
In the following reactions, X, Y and Z are

\[ \text{C} + X \xrightarrow{Y} \text{CH}_3 \xrightarrow{Z} \text{CH}_3\text{NO}_2 \]

A. \( X = \text{CH}_3\text{Cl}; Y = \text{anhydrous AlCl}_3; Z = \text{HNO}_3 + \text{H}_2\text{SO}_4 \)
B. \( X = \text{CH}_3\text{COCl}; Y = \text{anhydrous AlCl}_3; Z = \text{HNO}_3 + \text{H}_2\text{SO}_4 \)
C. \( X = \text{CH}_3\text{Cl}; Y = \text{conc. H}_2\text{SO}_4; Z = \text{HNO}_3 + \text{H}_2\text{SO}_4 \)
D. \( X = \text{CH}_3\text{Cl}; Y = \text{dil. H}_2\text{SO}_4; Z = \text{HNO}_3 \)

Options:
1. ✓ A
2. ✗ B
3. ✗ C
4. ✗ D

2,3-Dibromobutane can be converted to 2-butyne in a two-step reaction using

A. (i) HCl and (ii) NaH
B. (i) alcoholic KOH and (ii) NaNH\(_2\)
C. (i) Na and (ii) NaOH
D. (i) Br\(_2\) and (ii) NaH

Options:
1. ✗ A
2. ✓ B
3. ✗ C
4. ✗ D

Correct: 2
Given

\[
\begin{align*}
\text{NO (g)} + \text{O}_3 (g) & \rightarrow \text{NO}_2 (g) + \text{O}_2 (g) \quad \Delta H = -198.9 \text{ kJ/mol} \\
\text{O}_3 (g) & \rightarrow 3/2 \text{O}_2 (g) \quad \Delta H = -142.3 \text{ kJ/mol} \\
\text{O}_2 (g) & \rightarrow 2 \text{O} (g) \quad \Delta H = +495.0 \text{ kJ/mol}
\end{align*}
\]

The enthalpy change (\(\Delta H\)) for the following reaction is

\[
\text{NO (g)} + \text{O (g)} \rightarrow \text{NO}_2 (g)
\]

A. -304.1 kJ/mol  
B. +304.1 kJ/mol  
C. -403.1 kJ/mol  
D. +403.1 kJ/mol

Options:

1. ✓ A
2. ✗ B
3. ✗ C
4. ✗ D

---

A 1.85 g sample of an arsenic-containing pesticide was chemically converted to \(\text{AsO}_4^{3-}\) (atomic mass of As = 74.9) and titrated with \(\text{Pb}^{2+}\) to form \(\text{Pb}_2(\text{AsO}_4)_2\). If 20 mL of 0.1 M \(\text{Pb}^{2+}\) is required to reach the equivalence point, the mass percentage of arsenic in the pesticide sample is closest to

A. 8.1  
B. 2.3  
C. 5.4  
D. 3.6

Options:

1. ✗ A
2. ✗ B
3. ✓ C
4. ✗ D

---

Question Number : 74  Question Id : 4356472074  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 2

Question Number : 75  Question Id : 4356472075  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  Correct : 2
When treated with conc. HCl, MnO₂ yields a gas (X) which further reacts with Ca(OH)₂ to generate a white solid (Y). The solid Y reacts with dil. HCl to produce the same gas X. The solid Y is

A. CaO  
B. CaCl₂  
C. Ca(OCl)Cl  
D. CaCO₃

Options :
1. ✗ A
2. ✗ B
3. ✔ C
4. ✗ D

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**Part II: Biology**

Display Number Panel: Yes
Group All Questions: No

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**Question Number: 76**  
**Question Id: 4356472076**  
**Question Type: MCQ**  
**Display Question Number: Yes**  
**Single Line Question Option: No**  
**Option Orientation: Vertical**  
**Correct: 2**

The atmospheric pressure is 760 mm Hg at the sea level. Which of the following ranges is nearest to the partial pressure of CO₂ in mm Hg?

A. 0.30 – 0.31  
B. 0.60 – 0.61  
C. 3.0 – 3.1  
D. 6.0 – 6.1

Options :
1. ✔ A
2. ✗ B
3. ✗ C
4. ✗ D

---

**Question Number: 77**  
**Question Id: 4356472077**  
**Question Type: MCQ**  
**Display Question Number: Yes**  
**Single Line Question Option: No**  
**Option Orientation: Vertical**  
**Correct: 2**
A breeder crossed a pure bred tall plant having white flowers to a pure bred short plant having blue flowers. He obtained 202 F₁ progeny and found that they are all tall having white flowers. Upon selfing these F₁ plants, he obtained a progeny of 2160 plants. Approximately, how many of these are likely to be short and having blue flowers?

A. 1215  
B. 405   
C. 540   
D. 135

Options:
1. ✗ A  
2. ✗ B  
3. ✗ C  
4. ✓ D

---

Question Number : 79  Question Id : 4356472079  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  
Correct : 2

Match the different types of heart given in column A with organisms given in the column B. Choose the correct combination.

**Column A**

P. Neurogenic heart  
Q. Bronchial heart  
R. Pulmonary heart

**Column B**

i. Human  
ii. King crab  
iii. Shark

Options:
1. ✓ A  
2. ✗ B  
3. ✗ C  
4. ✗ D

---

Question Number : 79  Question Id : 4356472079  Question Type : MCQ  Display Question Number : Yes  Single Line Question Option : No  Option Orientation : Vertical  
Correct : 2
Given below are the four schematics that describe the dependence of the rate of an enzymatic reaction on temperature. Which of the following combinations is true for thermophilic and psychrophilic organisms?

A. P and P
B. P and S
C. P and R
D. R and R

Options:
1. **A
2. **B
3. **C
4. ✓ D
Match the enzymes in Group I with the reactions in Group II. Select the correct combination.

<table>
<thead>
<tr>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. Hydrolase</td>
<td>i. Inter- conversion of optical isomers</td>
</tr>
<tr>
<td>Q. Lyase</td>
<td>ii. Oxidation and reduction of two substrates</td>
</tr>
<tr>
<td>R. Isomerase</td>
<td>iii. Joining of two compounds</td>
</tr>
<tr>
<td>S. Ligase</td>
<td>iv. Removal of a chemical group from a substrate</td>
</tr>
<tr>
<td></td>
<td>v. Transfer of a chemical group from one substrate to another</td>
</tr>
</tbody>
</table>

A. P-iv, Q-ii, R-iii, S-i
B. P-v, Q-iv, R-i, S-iii
C. P-iv, Q-i, R-iii, S-v
D. P-i, Q-iv, R-v, S-ii

Options:
1. ✗️ A
2. ✔️ B
3. ✗️ C
4. ✗️ D