A p-type semiconductor has acceptor levels 60 meV above the valence band. What will be the maximum wavelength of an electromagnetic wave which can create a hole? (Plank’s constant $= 4.14 \times 10^{-15}$ eV·s, Speed of light in vacuum $= 3 \times 10^8$ m/s)

Options:
1. 20.7 μm
2. 30.8 μm
3. 40.9 μm
4. 50.0 μm
For an electron orbiting around the nucleus in a hydrogen like atom with atomic number \( Z \); \( T \), \( U \) and \( E \) denote the kinetic, potential and total energy respectively of the electron. Which of the following statements are valid in this context?

(A) \( T + U \) is same for all orbits

(B) \( 2T + U \) is same for all orbits

(C) \( E + U \) is same for all orbits

(D) \( E + T \) is same for all orbits

Choose the most appropriate answer from the options given below:

**Options**:

6760335945. (B) only

6760335946. (C) only

6760335947. (A) and (D) only

6760335948. (C) and (E) only
Two wavelengths $\lambda_1=496\text{nm}$ and $\lambda_2=620\text{nm}$ fall on a metal surface. Calculate the work function if the ratio of max speed of photoelectron is $v_1:v_2=\sqrt{2}:1$ for corresponding $\lambda_1$ and $\lambda_2$ respectively.

(Take $hc=1240\text{eV-nm}$)

Options:

6760335949. 0.5 eV

6760335950. 1.5 eV

6760335951. 1.8 eV

6760335952. 2.5 eV
The reported graph shows the variation of ‘v’ with ‘u’, where ‘u’ represents the distance of the object from the lens and v represent the distance of image from lens. This lens forms a real image of the object. The power of the lens is -

Options:
6760335953. -10 D
6760335954. 10 D
6760335955. -5 D
6760335956. 5 D

A choke coil is needed to operate an arc lamp at 160 V (rms) and 50 Hz. The arc lamp has an effective resistance of 5Ω when running at 10A (rms). The inductance of the choke coil is -
Options:
6760335957. $4.84 \times 10^{-2}$ H
6760335958. $2.71 \times 10^{-2}$ H
6760335959. $5.67 \times 10^{-2}$ H
6760335960. $1.67 \times 10^{-2}$ H

Question Number: 6 Question Id: 6760331986 Question Type: MCQ Option Shuffling: Yes Is Question Mandatory: No
Correct Marks: 4 Wrong Marks: 1
A given mass 1g of copper is drawn into a wire and made into a circular loop. The circular loop is placed perpendicularly in a magnetic field which is varying at a rate of $0.17 \frac{T}{s}$. The induced current in the loop approximately is _____.
(Resistivity and density of copper are $1.7 \times 10^{-8} \Omega \cdot m$ and 9000 kg/m$^3$)
Options:
6760335961. 0.88 A
6760335962. 0.088 A
6760335963. 8.8 A
6760335964. 0.088 mA

Question Number: 7 Question Id: 6760331987 Question Type: MCQ Option Shuffling: Yes Is Question Mandatory: No
Correct Marks: 4 Wrong Marks: 1
The same current is passed through two identical conducting wires of the same length L. One of them, \( w_1 \), is bent in the form of a circular loop of \( N_1 \) turns while the other wire, \( w_2 \), is bent in the form of a circular loop of \( N_2 \) turns. The ratio of the magnetic fields at the centre of the coils \( w_1 \) and \( w_2 \) will be -

Options:

\[
\frac{N_1}{N_2}
\]

6760335965.

\[
\frac{N_2}{N_1}
\]

6760335966.

\[
\left( \frac{N_1}{N_2} \right)^2
\]

6760335967.

\[
\left( \frac{N_2}{N_1} \right)^2
\]

6760335968.

---

**Question Number : 8 Question Id : 6760331988 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1**

Which of the following curve represents properties similar to \( \text{CuCl}_2 \) (Paramagnetic)?

Options:
Question Number : 9 Question Id : 6760331989 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The electric potential at any point $P(x, y, z)$ is $V = x^3z - x^2y - 3$ volts.

The electric field $\vec{E}_Q$ at point $Q(2, 3, 1)$ will be (in V/m) -

Options:

6760335973. $8\hat{i} - 12\hat{j} - 3\hat{k}$

6760335974. $4(2\hat{i} - 3\hat{j})$

6760335975. $4(\hat{j} - 2\hat{k})$

6760335976. $2(2\hat{k} - 3\hat{i})$
A body of mass ‘M’ is moving with a velocity ‘v’. It makes a one dimensional head on elastic collision with a stationary body of same mass. They are in contact for a very small time ‘Δt’. The contact force between them varies as shown in the figure. Find the magnitude of $F_{\text{max}}$.

Options:

- \( \frac{mv}{4} \)
- \( \frac{7mv}{7\Delta t} \)
- \( \frac{8mv}{8\Delta t} \)
- \( \frac{7mv}{7\Delta t} \)
- \( \frac{mv}{8\Delta t} \)
- \( \frac{mv}{8\Delta t} \)

Question Number: 11  Question Id: 6760331991  Question Type: MCQ  Option Shuffling: Yes  Is Question Mandatory: No  Correct Marks: 4  Wrong Marks: 1
The tension in a string is increased by 44%. If its frequency of vibration is to remain unchanged, its length must be increased by

Options :
- 6760335981. 12%
- 6760335982. 20%
- 6760335983. 24%
- 6760335984. 56%

Consider two thermally insulated vessels filled with air, having volumes \((V_1)\), \((V_2)\), Pressure \(P_1\), \(P_2\) and temperature \(T_1\), \(T_2\) for vessels 1 and 2 respectively. What is the temperature inside the vessel at equilibrium if joining valve of vessels 1 and 2 is opened?

Options :
- \(\frac{T_1 T_2 (P_1 V_1 + P_2 V_2)}{P_1 V_1 T_2 + P_2 V_2 T_1}\)
- \(\frac{T_1 T_2 (P_1 V_1 - P_2 V_2)}{P_1 V_1 T_2 - P_2 V_2 T_1}\)
\[
\frac{T_1 T_2 (P_1 V_1 + P_2 V_2)}{P_1 V_1 T_1 + P_2 V_2 T_2}
\]
6760335987. \( P_1 V_1 + P_2 V_2 \)
6760335988.

**Question Number : 13 Question Id : 6760331993 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1**

Given below are two statements:

**Statement I :** Second law of thermodynamics is derived from the fact that it is impossible to run an irreversible engine without aid of external agency.

**Statement II :** Second law of thermodynamics provides the concept of entropy.

In the light of above statements choose the most appropriate answer from the options given below -

**Options :**
6760335989. Both statement I and II are correct.
6760335990. Both statements I and II are incorrect.
6760335991. Statement I is correct but statement II is incorrect.
6760335992. Statement I is incorrect but statement II is correct.
A copper rod of length 1m is stretched by 30 mm within elastic limit. The energy stored in the stretched rod is converted into heat, then the rise in temperature of the rod is ________. 

[Given Young’s Modulus $\gamma=1.05 \times 10^{11} \text{N/m}^2$ Specific gravity of copper = 9  
specific heat capacity $S = 100 \text{ Cal/kg/°C}$]

Options:
6760335993. 1.25°C
6760335994. 12.5°C
6760335995. 15.0°C
6760335996. 15.5°C

Which is the correct graph to explain the Newton’s law of cooling. $T$ and $T_0$ are the temperatures of hot body and surrounding respectively. 

Options:
Question Number : 16 Question Id : 6760331996 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
The distance of an equatorial satellite from the centre of Earth which is always above a certain place on the Earth’s surface is -

Options:

\[ \left( \frac{GM}{\omega^2} \right)^{\frac{1}{3}} \]

6760336001.

\[ \left( \frac{GM}{\omega^2} \right)^{\frac{1}{2}} \]

6760336002.

\[ \left( \frac{GM}{\omega^2} \right)^{\frac{2}{3}} \]

6760336003.

\[ \left( \frac{GM}{\omega^2} \right)^{\frac{1}{3}} \]

6760336004.

A neutron of mass \( m_n \) collides against a moderator nucleus of mass 10 \( m_n \) at rest. Considering the collision to be one dimensional, the fractional kinetic energy lost by the neutron (\( f_1 \)) is [Given: The collision is elastic]

Options:

6760336005. 0.67

6760336006. 0.33

6760336007. 0.72
Question Number : 18 Question Id : 6760331998 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The position time relation of a body of mass 0.02 kg is given by (one-dimensional motion)
\[ x = 9 \text{ cm} \text{ (for } t = 3, 9, 15, 21\text{ s } \ldots \ldots \ldots) \]
\[ x = 0 \text{ cm} \text{ (for } t = 0, 6, 12, 18, 24\text{ s } \ldots \ldots \ldots) \]
If the time between two consecutive impulse is ‘3s’, find the magnitude of each impulse.
Options :
6760336009. \(1.2 \times 10^{-3}\) kg m/s
6760336010. 1.2 kg m/s
6760336011. \(1.2 \times 10^{-1}\) kg m/s
6760336012. 1200 g cm\(^{-1}\)

Question Number : 19 Question Id : 6760331999 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The potential energy function for a particle executing SHM is given by

\[ V(x) = \frac{1}{2}kx^2 \],

where \( k \) is the force constant of the oscillator. Which of the following diagram correctly shows the position - momentum curve for the motion.

Options:

6760336013.

6760336014.
A student measured volume of a 3 dimensional body of height, length and breadth h, l and b respectively using three vernier callipers A, B and C. He found the volumes to be $V_A$, $V_B$, $V_C$ respectively and forgot to apply the zero error correction.

The actual value of volume is $V_0$. If $V_A > V_0$, $V_B - V_C$ is a positive value and $V_C < V_0$, then what is not true about A, B and C.

Options:
6760336017. $V_A$ and $V_B$ may have values more than $V_0$ and $V_C$.
6760336018. A has positive zero error, C has negative zero error.
6760336019. B may have positive, negative or no zero error.
6760336020. A has a negative zero error and C has a positive zero error.
Physics Section B

Section Id : 676033134
Section Number : 2
Section type : Online
Mandatory or Optional : Mandatory
Number of Questions : 10
Number of Questions to be attempted : 5
Section Marks : 20
Enable Mark as Answered Mark for Review and Clear Response : Yes
Sub-Section Number : 1
Sub-Section Id : 676033134
Question Shuffling Allowed : Yes

Question Number : 21 Question Id : 6760332001 Question Type : SA
Correct Marks : 4 Wrong Marks : 0
An Amplitude Modulated (AM) wave is expressed as
\[ C = 5(1+0.3\cos 200\pi t)\cos\left(1\times10^8 \pi t\right) \text{ volts.} \]
Its percentage modulation is \( \text{________} \) %.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers : 100

Question Number : 22 Question Id : 6760332002 Question Type : SA
Two heaters X and Y are connected in parallel across the supply of V volts. Heater X generates 500 kCal of heat in 20 minutes while Y generates 1000 kCal in 10 minutes. The resistance of heater X is 10Ω. If these heaters are connected in series across the same voltage, then the heat produced in 5 minutes will be ______ kCal.

Response Type: Numeric
Evaluation Required For SA: Yes
Show Word Count: Yes
Answers Type: Equal
Text Areas: PlainText
Possible Answers: 100

The magnitude of resultant of two forces acting at a point is 12N and the sum of their magnitude is 18N. If the resultant is at right angles with the smaller one, then the differences in the magnitude of the two forces will be ______ N.

Response Type: Numeric
Evaluation Required For SA: Yes
Show Word Count: Yes
Answers Type: Equal
Text Areas: PlainText
Possible Answers: 100
A particle of mass 1 kg is projected at $t = 0$ from a point ‘O’ on the ground with a speed ‘$u$’ at an angle 45° to the horizontal. The magnitude of angular momentum of the particle about ‘O’ at time $\frac{u}{g}$ is given by $\frac{7u^3}{ag}$. Then the value of $a$ is _________. (Take $\frac{1}{\sqrt{2}} = 0.7$ and $g = 10 \text{ m/s}^2$)
A small solid spherical marble of mass M and radius 5 cm rolls along loop track without slipping. The height above the base, from where it has to start rolling down incline such that the sphere just completes the vertical circular loop of radius 25 cm is _________ cm. (g = 10 m/s²)

![Diagram](image)

Response Type: Numeric
Evaluation Required For SA: Yes
Show Word Count: Yes
Answers Type: Equal
Text Areas: PlainText
Possible Answers:
100

Question Number: 26 Question Id: 6760332006 Question Type: SA
Correct Marks: 4 Wrong Marks: 0

Employing a resistance of 8Ω, a capacitor is charged through a battery of 12V. In 2μs time, the potential difference across the capacitor is found to be 6V.

The storage capacity of the capacitor is \( \frac{x}{100} \mu F \). Then the value of x is _____.

(ln2=0.69)

Response Type: Numeric
Evaluation Required For SA: Yes
Show Word Count: Yes
As per the reported figure, the value of voltage across the terminals A B (i.e. $V_{AB}$) is ________ V during the proper flow of current.
The voltage between the plates of a capacitor of capacitance $5\mu F$ is changing at a rate of $8\times10^2 \frac{V}{s}$. The displacement current is _________ mA.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers :
100

Question Number : 29 Question Id : 6760332009 Question Type : SA
Correct Marks : 4 Wrong Marks : 0
A light source of 25.1 mW emits $2 \times 10^{16}$ photons per second. An unknown metal is brought in front of this light source from which electrons of speed upto $10^6$ m/s are emitted upon the incidence of the photons from the light source. The work function of the unknown metal is _______ eV.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers :
100

Question Number : 30 Question Id : 6760332010 Question Type : SA
Correct Marks : 4 Wrong Marks : 0
In the Bohr’s atomic model, second energy state potential energy of hydrogen is (–E). the kinetic energy of electron in the first energy state will be _____E.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers :
100
Matching List-I with List-II:

<table>
<thead>
<tr>
<th>List-I: Examples of Colloids</th>
<th>List-II: Type of Colloid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Paints</td>
<td>I. Emulsion</td>
</tr>
<tr>
<td>B. Hair cream</td>
<td>II. Gel</td>
</tr>
<tr>
<td>C. Whipped cream</td>
<td>III. Sol</td>
</tr>
<tr>
<td>D. Cheese</td>
<td>IV. Foam</td>
</tr>
</tbody>
</table>

Choose the most appropriate answer from the options given below:

Options:

6760336031. A-III, B-I, C-IV, D-II
6760336032. A-II, B-I, C-IV, D-III
6760336033. A-IV, B-III, C-II, D-I
6760336034. A-I, B-IV, C-III, D-II

Question Number: 32 Question Id: 6760332012 Question Type: MCQ Option Shuffling: Yes Is Question Mandatory: No Correct Marks: 4 Wrong Marks: 1

Identify the element with positive value of electron gain enthalpy

Options:

6760336035. At
6760336036. F
During the isolation of copper from copper matte, SiO₂ is added to

Options:
6760336039. remove FeS / FeO as FeSiO₃.
6760336040. reduce the melting point of the matte.
6760336041. reduce Cu₂S to metallic Cu.
6760336042. remove any C present.

H₂O₂ reacts with MnO₄⁻ in basic medium to produce

Options:
6760336043. Mn₂O₃
6760336044. MnO₂
6760336045. MnO²⁻
6760336046. Mn₂O₇
Question Number : 35 Question Id : 6760332015 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

Given below are two statements:

Statement-I : The chlorides of both beryllium and aluminium have structures in which chlorobridges are present in vapour phase.

Statement-II : Chlorides of both beryllium and aluminium are insoluble in organic solvents and are strong Lewis acids.

Choose the most appropriate answer:

Options:
6760336047. Both Statement-I and Statement-II are true.
6760336048. Both Statement-I and Statement-II are false.
6760336049. Statement-I is true but Statement-II is false.
6760336050. Statement-I is false but Statement-II is true.

Question Number : 36 Question Id : 6760332016 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

The number of $\sigma$ (sigma) bond present in chloric acid, chlorous acid and perchloric acid are, respectively,

Options:
6760336051. 3, 4 and 5
6760336052. 4, 3 and 5
Ruby and emerald are coloured due to the presence of

Options:
6760336055. Chromium(III) in both.
6760336056. Chromium(III) and Chromium(II) respectively.
6760336057. Chromium(III) and Copper(II) respectively.
6760336058. Chromium(II) and Copper(II) respectively.

The oxidation states of Mn in \( \text{Mn}_2(\text{CO})_{10}, \ [\text{Mn(}\text{CO})_5\text{Br}] \) and \( \text{K[Mn(CN)}_6\text{]} \) are, respectively.

Options:
6760336059. 0, +6, +5
6760336060. +5, +6, +6
Question Number : 39 Question Id : 6760332019 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The set in which both ligands generally behave in a bidentate chelating mode is
Options :
6760336063. CO, SCN
6760336064. ethylenediamine, oxalate
6760336065. \(\text{CH}_3\text{NH}_2\), oxalate
6760336066. NCS, ethylenediamine

Question Number : 40 Question Id : 6760332020 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The INCORRECT statement among those given below regarding smog is
Options :
6760336067. Photochemical smog occurs primarily in warm, dry and sunny climate.
6760336068. Classical smog is also called oxidizing smog.
6760336069. Peroxyacetyl nitrate is a component of photochemical smog.
Photochemical smog leads to cracking of rubber.

In the reaction given below,

\[
\text{conc.} \ H_2\text{SO}_4 \xrightarrow{\Delta} \ A + B
\]

the products A and B formed are

- Geometrical isomers
- Position isomers
- Chain isomers
- Metamers
Reaction of \( \text{CH}_3 - \text{CH} = \text{CH}_2 \) with different reagents (List-I) yield different products (List-II).

Match List-I with List-II:

<table>
<thead>
<tr>
<th>List-I : Reagents</th>
<th>List-II : Products on reaction with ( \text{CH}_3 - \text{CH} = \text{CH}_2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. ( \text{O}_3/\text{Zn, H}_2\text{O} )</td>
<td>I. Ethanoic acid</td>
</tr>
<tr>
<td>B. ( \text{KMnO}_4/\text{H}_2\text{SO}_4 )</td>
<td>II. Propan-2-ol</td>
</tr>
<tr>
<td>C. ( \text{KMnO}_4/\text{NaOH} )</td>
<td>III. Ethanal</td>
</tr>
<tr>
<td>D. ( \text{H}_3\text{O}^+ )</td>
<td>IV. Propane-1, 2-diol</td>
</tr>
</tbody>
</table>

The correct match is:

Options:
6760336075. A-III, B-I, C-IV, D-II
6760336076. A-III, B-IV, C-I, D-II
6760336077. A-II, B-I, C-IV, D-III
6760336078. A-IV, B-I, C-II, D-III

Neopentyl bromide on reaction with ethyl alcohol gives, as the major product,
Question Number : 44 Question Id : 6760332024 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
The major products $A$ and $B$ in the following reaction sequence are

\[
\begin{align*}
&\text{Ketone} \\
&\text{(i) } C_6H_5MgBr \\
&\text{dry ether} \\
&\text{(ii) } H_3O^+ \\
&\longrightarrow A \\
&\text{H}_2\text{SO}_4, \text{H}_2\text{O} \\
&\longrightarrow B
\end{align*}
\]

\((\text{Ph} = -C_6H_5)\)

Options:

\(A = \) \[\text{Structure Image}\] , \(B = \) \[\text{Structure Image}\]

6760336083.
Q: Cannizzaro reaction cannot be given by

O: $\text{CCl}_3\text{CHO}$
For the compounds below given

![Chemical structures]

the correct order of basicity is

Options:
1. III < I < II < IV
2. I < II < IV < III
3. I < II < III < IV
4. III < IV < I < II

Question Number : 47 Question Id : 6760332027 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
The major products A and B in the following reaction sequence are

\[ \text{Ph} = -C_6H_5 \]

\[ \text{C}_{\text{Ph}} \text{CN} + \text{H}_3\text{C}_6\text{MgBr} \xrightarrow{\text{dry ether}\ H_3\text{O}^+} A \xrightarrow{\text{LiAlH}_4\ H_3\text{O}^+} B \]

Options:

A = \[ \text{C}_{\text{Ph}}\text{CNPh} \]

B = \[ \text{C}_{\text{Ph}}\text{NH}_2\text{Ph} \]

A = \[ \text{C}_{\text{Ph}}\text{COPh} \]

B = \[ \text{C}_{\text{Ph}}\text{OHPh} \]
Question Number : 48 Question Id : 6760332028 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The drug that is used as an antacid is

Options :
6760336099. Cimetidine
6760336100. Veronal
6760336101. Codeine
6760336102. Iproniazid

Question Number : 49 Question Id : 6760332029 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The evidence about the cyclic structure of glucose appears from the fact that
Options:
6760336103. Penta-acetate of glucose does not react with hydroxyl amine.
6760336104. Glucose reacts with \( \text{NH}_2\text{OH} \) to form oxime.
6760336105. Glucose does not form hexa-acetate.
6760336106. Glucose produces gluconic acid with hydroxyl amine.

Question Number: 50
Question Id: 6760332030
Question Type: MCQ
Option Shuffling: Yes
Is Question Mandatory: No
Correct Marks: 4
Wrong Marks: 1

The reagent that gives purple coloured complex with \( S^{2-} \) ion is

Options:
6760336107. \( \text{Na}_4 [\text{Fe(CN)}_5 \text{NOS}] \)
6760336108. \( \text{Na}_2 [\text{Fe(CN)}_5 \text{NO}] \)
6760336109. \( \text{Na}_2 [\text{Fe(CN)}_5 \text{ONO}] \)
6760336110. \( \text{Na}_4 [\text{Fe(CN)}_5 \text{ONO}] \)

Chemistry Section B

Section Id: 676033136
Section Number: 4
Section type: Online
The amount of potassium chlorate (KClO₃) that needs to be completely decomposed in order to liberate 40 dm³ of oxygen gas at STP is _______ g.

(Nearest integer)

[Atomic Masses: K = 39.0 u; Cl = 35.5 u; O = 16.0 u, R = 0.0831 L bar mol⁻¹ K⁻¹]

Assume oxygen is an ideal gas at STP; at STP molar volume of an ideal gas is 22.7 L mol⁻¹]
A gaseous mixture of helium and oxygen contains 20% helium by weight. If the partial pressure of oxygen in the mixture is 5 atm, the partial pressure of helium is _______ atm. 

(Nearest integer)

[Atomic Masses : He : 4.0 u; O : 16.0 u]

Response Type : Numeric 
Evaluation Required For SA : Yes 
Show Word Count : Yes 
Answers Type : Equal 
Text Areas : PlainText 
Possible Answers : 

100

The number of photons emitted by a 800 nm lamp having an average power of 5 mW in 10 s is _______ × 10^{17}. 

(Nearest integer)

[Given : h = 6.626 × 10^{-34} Js; C = 3.0 × 10^8 ms^{-1}]

Response Type : Numeric 
Evaluation Required For SA : Yes 
Show Word Count : Yes 
Answers Type : Equal 
Text Areas : PlainText 
Possible Answers : 

100
The bond order in NO+ is ________.

( integer answer)

Response Type: Numeric
Evaluation Required For SA: Yes
Show Word Count: Yes
Answers Type: Equal
Text Areas: PlainText
Possible Answers:
100

The standard reaction enthalpy for hydrogenation of propene is −124 kJ mol⁻¹. Additionally, standard heat of combustion $\Delta_c H^\circ$ (propane) = −2220 kJ mol⁻¹.

and standard heat of formation $\Delta_f H^\circ$ (water) = −286 kJ mol⁻¹.

If $\Delta_c H^\circ$ (propene) = −x kJ mol⁻¹, the value of x is ________.

(Nearest integer)
Response Type: Numeric
Evaluation Required For SA: Yes
Show Word Count: Yes
Answers Type: Equal
Text Areas: PlainText
Possible Answers:
Question Number : 56 Question Id : 6760332036 Question Type : SA
Correct Marks : 4 Wrong Marks : 0

0.7 cm³ of compound A (molar mass = 70 g mol⁻¹, density = 1.024 g cm⁻³) is dissolved in 1 dm³ of water. If the depression in freezing point of water is 0.02 °C, the van’t Hoff factor for the compound A is ________ × 10⁻².
(Nearest integer)

[Given : Kᵣ for H₂O = 1.86 K kg mol⁻¹, Density of H₂O = 1.0 g cm⁻³]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers :

100

Question Number : 57 Question Id : 6760332037 Question Type : SA
Correct Marks : 4 Wrong Marks : 0

x × 10⁻⁵ g of Ca(OH)₂ are required to produce 200 cm³ of an aqueous solution of pH 10.0.

The value of x is ________ .
(Nearest integer)

[Given : Atomic masses : Ca : 40.0 u; H : 1.0 u; O : 16.0 u]

Response Type : Numeric
Evaluation Required For SA : Yes
The standard electrode potentials of the reactions are given below.

\[
\begin{align*}
\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- & \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O} \quad E^\circ = 1.51 \text{ V} \\
2\text{CO}_2 + 2\text{H}^+ + 2\text{e}^- & \rightleftharpoons \text{H}_2\text{C}_2\text{O}_4 \quad E^\circ = -0.49 \text{ V}
\end{align*}
\]

The equilibrium constant for the reaction

\[
2\text{MnO}_4^- + 6\text{H}^+ + 5\text{H}_2\text{C}_2\text{O}_4 \rightleftharpoons 2\text{Mn}^{2+} + 8\text{H}_2\text{O} + 10\text{CO}_2
\]

is \(10^x\). The value of \(x\) is ________.

(Nearest integer)

\[
\frac{2.303 \cdot \text{RT}}{\text{F}} = 0.059 \text{ V}
\]

Response Type: Numeric
Evaluation Required For SA: Yes
Show Word Count: Yes
Answers Type: Equal
Text Areas: PlainText
Possible Answers: 100
N$_2$O$_5$ decomposes following first order kinetics according to the reaction

\[ 2\text{N}_2\text{O}_5(g) \rightarrow 4\text{NO}_2(g) + \text{O}_2(g) \]

N$_2$O$_5$ is introduced in a closed vessel. After 46 minutes, the pressure in the vessel is 549.43 mm of Hg. After a very long time, the pressure saturated at 584.5 mm of Hg. The rate constant of the reaction in hr$^{-1}$ is \________ .

(Nearest integer)

[Assume : ln 10 = 2.3,

Assume all gases behave as ideal gases]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers : 100
In the reactions above, yield of the first step is 90% and that of the second step is 80%. The overall yield of the reaction is _______ %.

Response Type: Numeric
Evaluation Required For SA: Yes
Show Word Count: Yes
Answers Type: Equal
Text Areas: PlainText
Possible Answers: 100
Question Number : 61 Question Id : 6760332041 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

The domain of the function \( f(x) = \frac{\log_2(x+3)}{(x+1)(x+2)} \) is

Options :
1. \( \mathbb{R} - \{-1, -2\} \)
2. \( (-2, \infty) \)
3. \( \mathbb{R} - \{-1, -2, -3\} \)
4. \( (-3, \infty) - \{-1, -2\} \)

Question Number : 62 Question Id : 6760332042 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

If \( A \) is a \( 3 \times 3 \) matrix and \( |A| = \frac{1}{36} \), then the value of \( 2 \cdot \text{adj} \left( 3 \cdot \text{adj} \left( 6A \right) \right) \) is

Options :
1. \( 2^7 \times 3^8 \)
The system of equations

\[
\begin{align*}
x + 2y + pz &= 4 \\
x + qy + z &= 5 \\
2x + 4y + z &= 8
\end{align*}
\]

has

Options:

6760336129. a unique solution for \( p = 1 \) and \( q = 2 \)
6760336130. a unique solution for \( p = 2 \) and \( q = 2 \)
6760336131. infinitely many solutions for \( p = \frac{1}{2} \) and \( q = 2 \)
6760336132. no solution for \( p = 2 \) and \( q = 1 \)
If \( C_r \) \((r = 0, 1, 2, \ldots, 11)\) are the Binomial coefficients in the expansion of \((1 + x)^{11}\), then the value of

\[ C_0 + (C_0 + C_1) + (C_0 + C_1 + C_2) + \ldots + (C_0 + C_1 + \ldots + C_{11}) \]

is

**Options:**

6760336133. \(13.2^{10}\)

6760336134. \(13.2^{11}\)

6760336135. \(23.2^{10}\)

6760336136. \(23.2^{11}\)

A fair coin is tossed \(n\) times. If the probability of getting 6 heads is equal to that of getting 8 tails, then the probability of getting 2 heads, is

**Options:**

\[ \frac{91}{2^{14}} \]

6760336137.

\[ \frac{13}{2^{14}} \]

6760336138.
\[ \lim_{{x \to 2}} \left( 2 - \cos\left( 2x^2 - 5x + 2 \right) \right)^{\frac{1}{(x^2 - 4x + 4)}} \] is equal to

Options:

1. \[ \frac{1}{7} \]
2. \[ \frac{51}{2^{14}} \]
3. \[ \frac{9}{e^4} \]
4. \[ \frac{9}{e^2} \]
5. \[ \frac{3}{e^4} \]
6. \[ \frac{3}{e^2} \]
Let $f : \mathbb{R} \to \mathbb{R}$ be twice differentiable and satisfy $f(x + y) = f(x) + f(y)$. If $f''(0) = 1$, then which of the following is true?

**Options:**

- $f(0) = 1$
- $f'(2) = 1$
- $f''(0) = 1$
- $f'(1) = 2$

---

**Equation of a tangent to the curve** $y = 2 \int_0^x |t| \, dt$ **which is parallel to the line**, $2x - y = 13$ **is**

**Options:**

- $y = 2x + 13$
- $y = 2x + 1$
- $y = 2x - 7$
\[ y = 2x \]

Question Number : 69 Question Id : 6760332049 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

If \( \int \sin^{-1}\left( \frac{2x + 2}{\sqrt{4x^2 + 8x + 13}} \right) \, dx = A \tan^{-1}\left( \frac{2x + 2}{3} \right) + B \log_e \left( 4x^2 + 8x + 13 \right) + C \) (C is a constant of integration), then the ordered pair \((A, 4B)\) is equal to

Options :

\[
\begin{align*}
6760336153. & \quad \left( \frac{3}{2}, (x+1), -3 \right) \\
6760336154. & \quad \left( \frac{3}{2}, (x+1), 3 \right) \\
6760336155. & \quad (x + 1, -3) \\
6760336156. & \quad (x + 1, -6)
\end{align*}
\]

Question Number : 70 Question Id : 6760332050 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

The value of the integral \( \int_{\log_e x}^{6} \frac{\log_e x \, dx}{\log_e x^2 + \log_e (x^2 - 14x + 49)} \) is

Options :
If \( u + v + w = 91 \), and \( 2u = 3v = 4w \), then the value of \( \int_{u-v+w}^{2u+v+4w} e^{(x-[x])} \, dx \), where \([x]\) denotes the greatest integer \( \leq x\), is equal to

Options:

\[ 160 \left( 1 - \frac{1}{e} \right) \]
If two distinct chords, drawn from the point \((\alpha, \beta)\) on the circle \(x^2 + y^2 = \alpha x + \beta y\) (where \(\alpha \beta \neq 0\)) are bisected by the \(y\)-axis, then

Options:

\[ \alpha^2 = 8\beta^2 \]

\[ 8\alpha^2 = \beta^2 \]

\[ 8\alpha^2 < \beta^2 \]

\[ 8\alpha^2 > \beta^2 \]

If the area of the triangle formed by the tangent at a point in the first quadrant on the ellipse, \(4x^2 + 3y^2 = 12\) and its axes is 4 sq. units, then one such point is

Options:

\( \left( 1, \frac{\sqrt{8}}{3} \right) \)
Let the normal at any point of hyperbola \( \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1 \) intersect the coordinate axes at points P and Q. Then the locus of the mid-point of PQ is:

Options:

1. \[ 2\left(b^2x^2 + a^2y^2\right) = a^2 + b^2 \]
2. \[ 2\left(b^2x^2 - a^2y^2\right) = a^2 + b^2 \]
3. \[ 4\left(a^2x^2 + b^2y^2\right) = \left(a^2 + b^2\right)^2 \]
\[ 4\left(a^2x^2 - b^2y^2\right) = (a^2 + b^2) \]

Question Number : 75 Question Id : 6760332055 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The equation of a line passing through the point \((2, -1, 1)\) and the point of intersection of the lines \(2x - y - 4 = 0 = y + 2z\) and \(x + 3z = 0 = 2x + 5z - 1\), is

Options :
\[
\begin{align*}
\frac{x - 2}{1} &= \frac{y + 1}{-3} = \frac{z - 1}{2} \\
\frac{x - 2}{1} &= \frac{y + 1}{3} = \frac{z - 1}{-2} \\
\frac{x - 2}{1} &= \frac{y + 1}{3} = \frac{z - 1}{2} \\
\frac{x - 2}{-1} &= \frac{y + 1}{3} = \frac{z - 1}{2}
\end{align*}
\]

Question Number : 76 Question Id : 6760332056 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The distance of the point \((5, 6, 9)\) from the plane, which passes through the line of intersection of the planes \(x + y - z = 1\) and \(2x + 3y + 4z = 5\), and is perpendicular to the plane \(x - y + z = 0\) is
Question Number: 77  Question Id: 6760332057  Question Type: MCQ  Option Shuffling: Yes  Is Question Mandatory: No  Correct Marks: 4  Wrong Marks: 1

The mean and the variance of seven observations are 8 and 16 respectively. If five of the observations are 2, 4, 10, 12 and 14, then the absolute difference of the remaining two observations is

Options:

6760336185. 2

6760336186. 3

6760336187. 4

6760336188. 6
Question Number : 78 Question Id : 6760332058 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

A bag contains four bulbs. Some of these bulbs are defective. Two bulbs are drawn at random and it is found that both the bulbs are defective. What is the probability that the bag contains exactly 3 defective bulbs?

Options:

6760336189. 0.5
6760336190. 0.3
6760336191. 0.6
6760336192. 0.75

---

Question Number : 79 Question Id : 6760332059 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

The number of solutions of the equation $|\cos x| = \cos x - 2\sin x$, $-2\pi \leq x \leq 2\pi$, is

Options:

6760336193. 7
6760336194. 5
6760336195. 4
6760336196. 3
Consider the following statements:

\[ p : \text{Amit plays cricket} \]
\[ q : \text{Amit is out of Delhi.} \]
\[ r : \text{It is Sunday} \]

Then the statement “Amit plays cricket only if he is in Delhi and it is Sunday” can be expressed as:

Options:

6760336197. \( (q \land r) \Rightarrow p \)

6760336198. \( (\neg q \land r) \Rightarrow p \)

6760336199. \( p \Rightarrow (q \land r) \)

6760336200. \( p \Rightarrow (\neg q \land r) \)

Mathematics Section B
Section Number : 6
Section type : Online
Mandatory or Optional : Mandatory
Number of Questions : 10
Number of Questions to be attempted : 5
Section Marks : 20
Enable Mark as Answered Mark for Review and Clear Response : Yes
Sub-Section Number : 1
Sub-Section Id : 676033138
Question Shuffling Allowed : Yes

Question Number : 81 Question Id : 6760332061 Question Type : SA
Correct Marks : 4 Wrong Marks : 0

If \( z = \frac{\sqrt{3} - i}{2} \) and \((z^{95} + i^{95})^{94} = z^n\), then the minimum positive integral value of ‘\(n\)’ is ________.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers : 100

Question Number : 82 Question Id : 6760332062 Question Type : SA
Correct Marks : 4 Wrong Marks : 0

The integral value of \(a\), for which the equation,

\[(x^2 + x + 2)^2 - (a - 3)(x^2 + x + 2)(x^2 + x + 1) + (a - 4)(x^2 + x + 1)^2 = 0\]

has real roots, is ________.
Question Number : 83 Question Id : 6760332063 Question Type : SA
Correct Marks : 4 Wrong Marks : 0

If \( A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \end{bmatrix} \), the sum of the entries of \( A^{20} \) is ________.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers :

100

Question Number : 84 Question Id : 6760332064 Question Type : SA
Correct Marks : 4 Wrong Marks : 0

The unit digit in the sum of \( 1! + 2! + 3! + \ldots + 2021! \) is ________.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Let \( \vec{a} = -\hat{i} + \hat{j} \) and \( \vec{b} = \hat{i} + \hat{j} - \hat{k} \) be two given vectors. If a vector \( \vec{c} \) satisfies
\[
(\vec{a} \times \vec{c}) + \vec{b} = \vec{0} \quad \text{and} \quad \vec{a} \cdot \vec{c} = 3,
\]
then \( 10 | \vec{c} |^2 \) is equal to \( \underline{\phantom{0000}} \).

If \( 32, 5x \) and \( y \) are in A.P., and \( 2, x \) and \( y \) are in G.P., then the positive common difference of the A.P. is \( \underline{\phantom{0000}} \).
If \( f \) be a twice differentiable function satisfying \( f(x) = x^4 + x^2 f''(1) + f''(2) \), then the modulus of the minimum value of \( f(x) \) is equal to ______.

Response Type: Numeric
Evaluation Required For SA: Yes
Show Word Count: Yes
Answers Type: Equal
Text Areas: PlainText
Possible Answers:
100

If \( \frac{dw(t)}{dt} = t\sqrt{121-t^2} \) and \( w(0) = 0 \), then the value of \( 3w(\sqrt{21}) \) is ______.

Response Type: Numeric
Evaluation Required For SA: Yes
Show Word Count: Yes
Answers Type: Equal
Text Areas: PlainText
Possible Answers:
100

If \( \)
One side of a square lies along the line \( x - 3y + 1 = 0 \) and its one vertex is \((1, 4)\). If \((a, b)\) and \((c, d)\) are its two vertices on the line \( x - 3y + 1 = 0 \), then

\[
|a-2| + |c-2| + |b-1| + |d-1|
\]

is equal to ________.

Response Type: Numeric
Evaluation Required For SA: Yes
Show Word Count: Yes
Answers Type: Equal
Text Areas: PlainText
Possible Answers:

100

The number of real solutions of the equation

\[
\begin{vmatrix}
 x^2 + \sin x \cos x & x(l + \sin x) \\
 x + \cos x & x + 1
\end{vmatrix} = 0
\]

is ________.

Response Type: Numeric
Evaluation Required For SA: Yes
Show Word Count: Yes
Answers Type: Equal
Text Areas: PlainText
Possible Answers:

100