Physics Section A

Section Id : 864351151
Section Number : 1
Section type : Online
Mandatory or Optional : Mandatory
Number of Questions : 20
Number of Questions to be attempted : 20
Section Marks : 80
Mark As Answered Required? : Yes
Sub-Section Number : 1
Sub-Section Id : 864351151
Question Shuffling Allowed : Yes

Question Number : 1
Question Id : 8643512251
Question Type : MCQ
Option Shuffling : Yes
Is Question Mandatory : No
Correct Marks : 4
Wrong Marks : 1
Two identical antennas mounted on identical towers are separated from each other by a distance of 45 km. What should nearly be the minimum height of receiving antenna to receive the signals in line of sight?
(Assume radius of earth is 6400 km)

Options:
8643516751. 79.1 m
8643516752. 39.55 m
8643516753. 158.2 m
8643516754. 19.77 m

Question Number : 2 Question Id : 8643512252 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The de-Broglie wavelength associated with an electron and a proton were calculated by accelerating them through same potential of 100 V. What should nearly be the ratio of their wavelengths? \((m_p = 1.00727u \ m_e = 0.00055u)\)

Options:
8643516755. 43 : 1
8643516756. 1860 : 1
8643516757. 41.4 : 1
8643516758. \((1860)^2 : 1\)

Question Number : 3 Question Id : 8643512253 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The refractive index of a converging lens is 1.4. What will be the focal length of this lens if it is placed in a medium of same refractive index? Assume the radii of curvature of the faces of lens are \(R_1\) and \(R_2\) respectively.

Options:
8643516759. Zero
8643516760. 1
8643516761. Infinite
8643516762. \( \frac{R_1 R_2}{R_1 - R_2} \)

Question Number : 4 Question Id : 8643512254 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
Red light differs from blue light as they have :
Options :
8643516763. Same frequencies and same wavelengths
8643516764. Different frequencies and different wavelengths
8643516765. Same frequencies and different wavelengths
8643516766. Different frequencies and same wavelengths

Question Number : 5 Question Id : 8643512255 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
The magnetic field in a region is given by \( \vec{B} = B_0 \left( \frac{x}{a} \right) \hat{k} \). A square loop of side \( d \) is placed with its edges along the \( x \) and \( y \) axes. The loop is moved with a constant velocity \( \vec{v} = v_0 \hat{i} \).

The emf induced in the loop is:

\[
\frac{B_0 v_0 d}{2a}
\]

Options:

8643516767.

8643516768.

8643516769.

8643516770.

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Question Number : 6 Question Id : 8643512256 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1

Amplitude of a mass-spring system, which is executing simple harmonic motion decreases with time. If mass = 500g, Decay constant = 20 g/s then how much time is required for the amplitude of the system to drop to half of its initial value?

\( \ln 2 = 0.693 \)

Options:

8643516771. 34.65 s

8643516772. 15.01 s
Question Number : 7 Question Id : 8643512257 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

Calculate the value of mean free path ($\lambda$) for oxygen molecules at temperature 27°C and pressure $1.01 \times 10^5$ Pa. Assume the molecular diameter 0.3 nm and the gas is ideal. ($k = 1.38 \times 10^{-23}$ JK$^{-1}$)

Options :
8643516775. 32 nm
8643516776. 58 nm
8643516777. 86 nm
8643516778. 102 nm

Question Number : 8 Question Id : 8643512258 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

What will be the nature of flow of water from a circular tap, when its flow rate increased from 0.18 L/min to 0.48 L/min? The radius of the tap and viscosity of water are 0.5 cm and $10^{-3}$ Pa s, respectively. (Density of water : $10^3$ kg/m$^3$)

Options :
8643516779. Steady flow to unsteady flow
8643516780. Unsteady to steady flow
8643516781. Remains steady flow
8643516782. Remains turbulent flow
Question Number : 9  Question Id : 8643512259  Question Type : MCQ  Option Shuffling : Yes  Is Question Mandatory : No  Correct Marks : 4  Wrong Marks : 1

A charge Q is moving \( \mathbf{dl} \) distance in the magnetic field \( \mathbf{B} \). Find the value of work done by \( \mathbf{B} \).

Options:

8643516783. 1

8643516784. Zero

8643516785. Infinite

8643516786. \(-1\)

Question Number : 10  Question Id : 8643512260  Question Type : MCQ  Option Shuffling : Yes  Is Question Mandatory : No  Correct Marks : 4  Wrong Marks : 1

Calculate the time interval between 33% decay and 67% decay if half-life of a substance is 20 minutes.

Options:

8643516787. 20 minutes

8643516788. 40 minutes

8643516789. 60 minutes

8643516790. 13 minutes

Question Number : 11  Question Id : 8643512261  Question Type : MCQ  Option Shuffling : Yes  Is Question Mandatory : No  Correct Marks : 4  Wrong Marks : 1
For the given circuit, comment on the type of transformer used.

Options:
8643516791. Step-up transformer
8643516792. Step-down transformer
8643516793. Auto transformer
8643516794. Auxilliary transformer

Question Number : 12 Question Id : 8643512262 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
The half-life of Au\(^{198}\) is 2.7 days. The activity of 1.50 mg of Au\(^{198}\) if its atomic weight is 198 g mol\(^{-1}\) is, (\(N_A = 6 \times 10^{23}/\text{mol}\)).
Options:
8643516795. 240 Ci
8643516796. 357 Ci
8643516797. 252 Ci
8643516798. 535 Ci

Question Number : 13 Question Id : 8643512263 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
A bimetallic strip consists of metals A and B. It is mounted rigidly as shown. The metal A has higher coefficient of expansion compared to that of metal B. When the bimetallic strip is placed in a cold bath, it will:

Options:

8643516799. Bend towards the right
8643516800. Bend towards the left
8643516801. Not bend but shrink
8643516802. Neither bend nor shrink

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A large block of wood of mass \( M = 5.99 \text{ kg} \) is hanging from two long massless cords. A bullet of mass \( m = 10 \text{ g} \) is fired into the block and gets embedded in it. The (block + bullet) then swing upwards, their centre of mass rising a vertical distance \( h = 9.8 \text{ cm} \) before the (block + bullet) pendulum comes momentarily to rest at the end of its arc. The speed of the bullet just before collision is:

(take \( g = 9.8 \text{ ms}^{-2} \))

Options:

8643516803. \( 811.4 \text{ m/s} \)
Question Number : 15 Question Id : 8643512265 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
Statement I : A cyclist is moving on an unbanked road with a speed of 7 kmh\(^{-1}\) and takes a sharp circular turn along a path of radius of 2m without reducing the speed. The static friction coefficient is 0.2. The cyclist will not slip and pass the curve. \((g = 9.8 \text{ m/s}^2)\)
Statement II : If the road is banked at an angle of 45°, cyclist can cross the curve of 2m radius with the speed of 18.5 kmh\(^{-1}\) without slipping.
In the light of the above statements, choose the correct answer from the options given below.
Options :
8643516807. Both statement I and statement II are true
8643516808. Both statement I and statement II are false
8643516809. Statement I is correct and statement II is incorrect
8643516810. Statement I is incorrect and statement II is correct

Question Number : 16 Question Id : 8643512266 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
A mosquito is moving with a velocity \(\vec{v} = 0.5 t^2 \hat{i} + 3t \hat{j} + 9 \hat{k} \text{ m/s}\) and accelerating in uniform conditions. What will be the direction of mosquito after 2 s ?
Options :
\[\tan^{-1}\left(\frac{5}{2}\right)\text{ from } x\text{-axis}\]
8643516811.
\[ \tan^{-1}\left(\frac{5}{2}\right) \text{ from y-axis} \]
8643516812.

\[ \tan^{-1}\left(\frac{2}{3}\right) \text{ from x-axis} \]
8643516813.

\[ \tan^{-1}\left(\frac{2}{3}\right) \text{ from y-axis} \]
8643516814.

**Question Number : 17 Question Id : 8643512267 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

In order to determine the Young’s Modulus of a wire of radius 0.2 cm (measured using a scale of least count = 0.001 cm) and length 1 m (measured using a scale of least count = 1 mm), a weight of mass 1 kg (measured using a scale of least count = 1 g) was hanged to get the elongation of 0.5 cm (measured using a scale of least count 0.001 cm). What will be the fractional error in the value of Young’s Modulus determined by this experiment?

**Options :**

8643516815. 1.4 \%

8643516816. 0.9 \%

8643516817. 0.14 \%

8643516818. 9 \%

**Question Number : 18 Question Id : 8643512268 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**

**Correct Marks : 4 Wrong Marks : 1**

A resistor develops 500 J of thermal energy in 20 s when a current of 1.5 A is passed through it. If the current is increased from 1.5 A to 3 A, what will be the energy developed in 20 s.

**Options :**

8643516819. 500 J

8643516820. 1000 J
Question Number : 19 Question Id : 8643512269 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

Find out the surface charge density at the intersection of point $x=3$ m plane and $x$-axis, in the region of uniform line charge of 8 nC/m lying along the $z$-axis in free space.

Options :

8643516823. 47.88 C/m

8643516824. 0.07 nC m$^{-2}$

8643516825. 0.424 nC m$^{-2}$

8643516826. 4.0 nC m$^{-2}$

Question Number : 20 Question Id : 8643512270 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

The following logic gate is equivalent to :

![Logic Gate Diagram]

Options :

8643516827. AND Gate

8643516828. NAND Gate
OR Gate

NOR Gate

8643516829.

Physics Section B

Section Id : 864351152
Section Number : 2
Section type : Online
Mandatory or Optional : Mandatory
Number of Questions : 10
Number of Questions to be attempted : 5
Section Marks : 20
Mark As Answered Required? : Yes
Sub-Section Number : 1
Sub-Section Id : 864351152
Question Shuffling Allowed : Yes

Question Number : 21 Question Id : 8643512271 Question Type : SA
Correct Marks : 4 Wrong Marks : 0
If one wants to remove all the mass of the earth to infinity in order to break it up completely.

The amount of energy that needs to be supplied will be \( \frac{x}{5} \frac{GM^2}{R} \) where \( x \) is _________

(Round off to the Nearest Integer)
(M is the mass of earth, \( R \) is the radius of earth, \( G \) is the gravitational constant)

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 : 8643512272 Question Type : SA
Correct Marks : 4 Wrong Marks : 0
A swimmer can swim with velocity of 12 km/h in still water. Water flowing in a river has velocity 6 km/h. The direction with respect to the direction of flow of river water he should swim in order to reach the point on the other bank just opposite to his starting point is _________°. (Round off to the Nearest Integer)

(Find the angle in degrees)

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

Question Number: 23 Question Id: 8643512273 Question Type: SA  
Correct Marks: 4 Wrong Marks: 0

A body of mass 2 kg moves under a force of \(2\hat{i} + 3\hat{j} + 5\hat{k}\) N. It starts from rest and was at the origin initially. After 4 s, its new coordinates are (8, b, 20). The value of b is _________. (Round off to the Nearest Integer)

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

Question Number: 24 Question Id: 8643512274 Question Type: SA  
Correct Marks: 4 Wrong Marks: 0

A force \(\mathbf{F} = 4\hat{i} + 3\hat{j} + 4\hat{k}\) is applied on an intersection point of \(x = 2\) plane and \(x\)-axis. The magnitude of torque of this force about a point (2, 3, 4) is _________. (Round off to the Nearest Integer)

Response Type: Numeric  
Evaluation Required For SA: Yes  
Show Word Count: Yes  
Answers Type: Equal  
Text Areas: PlainText
Question Number : 25 Question Id : 8643512275 Question Type : SA
Correct Marks : 4 Wrong Marks : 0
A solid disc of radius ‘a’ and mass ‘m’ rolls down without slipping on an inclined plane making an angle θ with the horizontal. The acceleration of the disc will be \( \frac{2}{b} g \sin \theta \) where b is \( \underline{\text{__________}} \). (Round off to the Nearest Integer)
\( g = \text{acceleration due to gravity} \)
\( \theta = \text{angle as shown in figure} \)

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 : 8643512276 Question Type : SA
Correct Marks : 4 Wrong Marks : 0
For an ideal heat engine, the temperature of the source is 127°C. In order to have 60% efficiency the temperature of the sink should be \( \underline{\text{__________}} \)°C. (Round off to the Nearest Integer)

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers :
100
Question Number : 27 Question Id : 8643512277 Question Type : SA
Correct Marks : 4 Wrong Marks : 0
In a parallel plate capacitor set up, the plate area of capacitor is 2 m² and the plates are separated by 1 m. If the space between the plates are filled with a dielectric material of thickness 0.5 m and area 2 m² (see fig) the capacitance of the set-up will be \( \text{ } \varepsilon_0 \). (Dielectric constant of the material = 3.2) (Round off to the Nearest Integer)

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

Question Number : 28 Question Id : 8643512278 Question Type : SA
Correct Marks : 4 Wrong Marks : 0
The energy dissipated by a resistor is 10 mJ in 1 s when an electric current of 2 mA flows through it. The resistance is \( \text{ } \Omega \). (Round off to the Nearest Integer)

**Response Type** : Numeric
**Evaluation Required For SA** : Yes
**Show Word Count** : Yes
**Answers Type** : Equal
**Text Areas** : PlainText
**Possible Answers** :
100
A deviation of 2° is produced in the yellow ray when prism of crown and flint glass are achromatically combined. Taking dispersive powers of crown and flint glass as 0.02 and 0.03 respectively and refractive index for yellow light for these glasses are 1.5 and 1.6 respectively. The refracting angles for crown glass prism will be _________° (in degree). (Round off to the Nearest Integer)

Chemistry Section A

A closed organ pipe of length L and an open organ pipe contain gases of densities \( \rho_1 \) and \( \rho_2 \) respectively. The compressibility of gases are equal in both the pipes. Both the pipes are vibrating in their first overtone with same frequency. The length of the open pipe is \( \frac{x}{3} L \sqrt{\frac{\rho_1}{\rho_2}} \)

where \( x \) is _________. (Round off to the Nearest Integer)
Question Number : 31 Question Id : 8643512281 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The INCORRECT statement regarding the structure of $C_{60}$ is:

Options:
8643516841. It contains 12 six-membered rings and 24 five-membered rings.
8643516842. The six-membered rings are fused to both six and five-membered rings.
8643516843. The five-membered rings are fused only to six-membered rings.
8643516844. Each carbon atom forms three sigma bonds.

Question Number : 32 Question Id : 8643512282 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The INCORRECT statements below regarding colloidal solutions is:

Options:
8643516845. A colloidal solution shows colligative properties.
8643516846. A colloidal solution shows Brownian motion of colloidal particles.
8643516847. The flocculating power of $Al^{3+}$ is more than that of $Na^+$.
8643516848. An ordinary filter paper can stop the flow of colloidal particles.

Question Number : 33 Question Id : 8643512283 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
The characteristics of elements X, Y and Z with atomic numbers, respectively, 33, 53 and 83 are:
Question Number : 34 Question Id : 8643512284 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
Which of the following reduction reaction CANNOT be carried out with coke?
Options:

8643516853. \( \text{Fe}_2\text{O}_3 \rightarrow \text{Fe} \)

8643516854. \( \text{ZnO} \rightarrow \text{Zn} \)

8643516855. \( \text{Cu}_2\text{O} \rightarrow \text{Cu} \)

8643516856. \( \text{Al}_2\text{O}_3 \rightarrow \text{Al} \)

Question Number : 35 Question Id : 8643512285 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
The correct statements about \( \text{H}_2\text{O}_2 \) are:
(A) used in the treatment of effluents.
(B) used as both oxidising and reducing agents.
(C) the two hydroxyl groups lie in the same plane.
(D) miscible with water.
Choose the correct answer from the options given below:
Options:

8643516857. (A), (B) and (D) only
(B), (C) and (D) only

(A), (C) and (D) only

(A), (B), (C) and (D)

Question Number : 36 Question Id : 8643512286 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
Identify the elements X and Y using the ionisation energy values given below :

<table>
<thead>
<tr>
<th>Ionization energy (kJ/mol)</th>
<th>1st</th>
<th>2nd</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>495</td>
<td>4563</td>
</tr>
<tr>
<td>Y</td>
<td>731</td>
<td>1450</td>
</tr>
</tbody>
</table>

Options :

8643516861. $X = \text{Na} ; Y = \text{Mg}$

8643516862. $X = \text{Mg} ; Y = \text{Na}$

8643516863. $X = \text{F} ; Y = \text{Mg}$

8643516864. $X = \text{Mg} ; Y = \text{F}$

Question Number : 37 Question Id : 8643512287 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
The exact volumes of 1 M NaOH solution required to neutralise 50 mL of 1 M $\text{H}_3\text{PO}_3$ solution and 100 mL of 2 M $\text{H}_3\text{PO}_2$ solution, respectively, are :

Options :

8643516865. 50 mL and 50 mL

8643516866. 100 mL and 50 mL

8643516867. 100 mL and 200 mL
100 mL and 100 mL

Question Number : 38
Question Id : 8643512288
Question Type : MCQ
Option Shuffling : Yes
Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1

Arrange the following metal complex/compounds in the increasing order of spin only magnetic moment. Presume all the three, high spin system.

(Atomic numbers Ce = 58, Gd = 64 and Eu = 63.)

(a) \((\text{NH}_4)_2[\text{Ce}(\text{NO}_3)_6]\)  (b) \(\text{Gd(NO}_3)_3\) and  (c) \(\text{Eu(NO}_3)_3\)

Answer is:

Options:

8643516869. (a) < (b) < (c)

8643516870. (a) < (c) < (b)

8643516871. (b) < (a) < (c)

8643516872. (c) < (a) < (b)

Question Number : 39
Question Id : 8643512289
Question Type : MCQ
Option Shuffling : Yes
Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1

\(\text{Fel}_2\) and \(\text{Fel}_3\) are known when \(x\) and \(y\) are:

Options:

8643516873. \(x=\text{F, Cl, Br, I}\) and \(y=\text{F, Cl, Br, I}\)

8643516874. \(x=\text{F, Cl, Br, I}\) and \(y=\text{F, Cl, Br}\)

8643516875. \(x=\text{F, Cl, Br}\) and \(y=\text{F, Cl, Br, I}\)

8643516876. \(x=\text{Cl, Br, I}\) and \(y=\text{F, Cl, Br, I}\)

Question Number : 40
Question Id : 8643512290
Question Type : MCQ
Option Shuffling : Yes
The green house gas/es is (are) :

(A) Carbon dioxide
(B) Oxygen
(C) Water vapour
(D) Methane

Choose the most appropriate answer from the options given below:

Options:

(A) only
8643516877.

8643516878. (A) and (C) only

8643516879. (A), (C) and (D) only

8643516880. (A) and (B) only

Match List-I with List-II:

<table>
<thead>
<tr>
<th>List-I</th>
<th>List-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test/Reagents/Observation(s)</td>
<td>Species detected</td>
</tr>
<tr>
<td>(a) Lassaigne’s Test</td>
<td>(i) Carbon</td>
</tr>
<tr>
<td>(b) Cu(II) oxide</td>
<td>(ii) Sulphur</td>
</tr>
<tr>
<td>(c) Silver nitrate</td>
<td>(iii) N, S, P, and halogen</td>
</tr>
<tr>
<td>(d) The sodium fusion extract gives black precipitate with acetic acid and lead acetate</td>
<td>(iv) Halogen Specifically</td>
</tr>
</tbody>
</table>

The correct match is:

Options:

8643516881. (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

8643516882. (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)
Question Number : 42 Question Id : 8643512292 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

Statement I : Sodium hydride can be used as an oxidising agent.
Statement II : The lone pair of electrons on nitrogen in pyridine makes it basic.

Choose the CORRECT answer from the options given below:

Options:

8643516885. Both statement I and statement II are true

8643516886. Both statement I and statement II are false

8643516887. Statement I is true but statement II is false

8643516888. Statement I is false but statement II is true

Question Number : 43 Question Id : 8643512293 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

An unsaturated hydrocarbon X on ozonolysis gives A. Compound A when warmed with ammonical silver nitrate forms a bright silver mirror along the sides of the test tube. The unsaturated hydrocarbon X is:

Options:

8643516889. \[ \text{CH}_3 - \text{C} = \text{C} - \text{CH}_3 \]

8643516890. \[ \text{CH}_3 - \begin{array}{c} \text{C} \\ \text{CH}_3 \end{array} \]

8643516891. \[ \text{HC} = \text{C} - \text{CH}_2 - \text{CH}_3 \]
Question Number : 44 Question Id : 8643512294 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

Identify the reagent(s) ‘A’ and condition(s) for the reaction

Options :

A = Cl₂ ; dark, Anhydrous AlCl₃

A = HCl, ZnCl₂

A = Cl₂ ; UV light

A = HCl ; Anhydrous AlCl₃

Question Number : 45 Question Id : 8643512295 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

In the above reaction, the reagent “A” is :

Options :

LiAlH₄
Alkaline KMnO₄, H⁺

HCl, Zn – Hg

NaBH₄ H₃O⁺

Question Number : 46 Question Id : 8643512296 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

The structure of X is:

Options :

1. [Image of the first option]
2. [Image of the second option]
3. [Image of the third option]
Question Number : 47 Question Id : 8643512297 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
Which of the following is least basic?
Options :
8643516905. \((\text{CH}_3\text{CO})_2\mathbf{N}\)
8643516906. \((\text{C}_2\text{H}_5)_2\mathbf{N}\)
8643516907. \((\text{CH}_3\text{CO})\mathbf{NH}_2\text{C}_2\text{H}_5\)
8643516908. \((\text{C}_2\text{H}_5)_3\mathbf{N}\)

Question Number : 48 Question Id : 8643512298 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1
Ammonolysis of Alkyl halides followed by the treatment with NaOH solution can be used to prepare primary, secondary and tertiary amines. The purpose of NaOH in the reaction is:
Options :
8643516909. to remove basic impurities
8643516910. to activate \(\text{NH}_3\) used in the reaction
8643516911. to increase the reactivity of alkyl halide
8643516912. to remove acidic impurities
Which of the following polymer is used in the manufacture of wood laminates?

Options:

8643516913. Melamine formaldehyde resin
8643516914. Urea formaldehyde resin
8643516915. cis-poly isoprene
8643516916. Phenol and formaldehyde resin

The secondary structure of protein is stabilised by:

Options:

8643516917. van der Waals forces
8643516918. Peptide bond
8643516919. Hydrogen bonding
8643516920. glycosidic bond
When 35 mL of 0.15 M lead nitrate solution is mixed with 20 mL of 0.12 M chromic sulphate solution, \( \_\_\_\_\_\_ \times 10^{-5} \) moles of lead sulphate precipitate out. (Round off to the Nearest Integer).

**Possible Answers:**
100

Ga (atomic mass 70 u) crystallizes in a hexagonal close packed structure. The total number of voids in 0.581 g of Ga is \( \_\_\_\_\_\_ \times 10^{21} \). (Round off to the Nearest Integer).

[Given: \( N_A = 6.023 \times 10^{23} \)]

**Possible Answers:**
100

The number of orbitals with \( n = 5 \), \( m_l = +2 \) is \_\_\_\_\_. (Round off to the Nearest Integer).

**Possible Answers:**
100
At 25°C, 50 g of iron reacts with HCl to form FeCl₂. The evolved hydrogen gas expands against a constant pressure of 1 bar. The work done by the gas during this expansion is _________ J.
(Round off to the Nearest Integer).

[Given : R=8.314 J mol⁻¹ K⁻¹. Assume, hydrogen is an ideal gas]
[Atomic mass of Fe is 55.85 u]

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

100

At 363 K, the vapour pressure of A is 21 kPa and that of B is 18 kPa. One mole of A and 2 moles of B are mixed. Assuming that this solution is ideal, the vapour pressure of the mixture is _________ kPa. (Round off to the Nearest Integer).

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

100

Sulphurous acid (H₂SO₃) has $K_a_1 = 1.7 \times 10^{-2}$ and $K_a_2 = 6.4 \times 10^{-8}$. The pH of 0.588 M H₂SO₃ is _________ (Round off to the Nearest Integer).

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers :
A 5.0 m mol dm\(^{-3}\) aqueous solution of KCl has a conductance of 0.55 mS when measured in a cell of cell constant 1.3 cm\(^{-1}\). The molar conductivity of this solution is _________ mSm\(^2\) mol\(^{-1}\). (Round off to the Nearest Integer).

A and B decompose via first order kinetics with half-lives 54.0 min and 18.0 min respectively. Starting from an equimolar non reactive mixture of A and B, the time taken for the concentration of A to become 16 times that of B is _________ min. (Round off to the Nearest Integer).

\([\text{Ti(H}_2\text{O)}_6]^{3+}\) absorbs light of wavelength 498 nm during a d – d transition. The octahedral splitting energy for the above complex is _________ \times 10^{-19} \text{ J}. (Round off to the Nearest Integer). \(\text{h} = 6.626 \times 10^{-34} \text{ Js}; \ c = 3 \times 10^8 \text{ ms}^{-1}\)
In Duma’s method of estimation of nitrogen, 0.1840 g of an organic compound gave 30 mL of nitrogen collected at 287 K and 758 mm of Hg pressure. The percentage composition of nitrogen in the compound is _________. (Round off to the Nearest Integer).

[Given : Aqueous tension at 287 K = 14 mm of Hg]

Mathematics Section A

If the foot of the perpendicular from point (4, 3, 8) on the line \( L_1 : \frac{x-a}{l} = \frac{y-2}{3} = \frac{z-b}{4} \),

\( l \neq 0 \) is (3, 5, 7), then the shortest distance between the line \( L_1 \) and line

\( L_2 : \frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5} \) is equal to:

Options :
\[ \frac{1}{\sqrt{6}} \]

\[ \frac{1}{2} \]

\[ \frac{1}{\sqrt{3}} \]

\[ \frac{\sqrt{2}}{\sqrt{3}} \]

Question Number : 62 Question Id : 8643512312 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

Let the lengths of intercepts on x-axis and y-axis made by the circle \( x^2 + y^2 + ax + 2ay + c=0 \), \((a < 0)\) be \(2\sqrt{2}\) and \(2\sqrt{5}\), respectively. Then the shortest distance from origin to a tangent to this circle which is perpendicular to the line \(x + 2y = 0\), is equal to :

Options :

\[ \sqrt{10} \]

\[ \sqrt{11} \]

\[ \sqrt{7} \]

\[ \sqrt{6} \]

Question Number : 63 Question Id : 8643512313 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

Let \( \vec{a} = \hat{i} + 2\hat{j} - 3\hat{k} \) and \( \vec{b} = 2\hat{i} - 3\hat{j} + 5\hat{k} \). If \( \vec{r} \times \vec{a} = \vec{b} \times \vec{r} \), \( \vec{r} \cdot (\alpha \hat{i} + 2\hat{j} + \hat{k}) = 3 \) and \( \vec{r} \cdot (2\hat{i} + 5\hat{j} - \alpha\hat{k}) = -1 \), \( \alpha \in R \), then the value of \( \alpha + |\vec{r}|^2 \) is equal to :

Options :
Let \( f \) be a real valued function, defined on \( \mathbb{R} - \{-1, 1\} \) and given by
\[
f(x) = 3 \log_e \frac{|x - 1|}{|x + 1|} - \frac{2}{x - 1}.
\]

Then in which of the following intervals, function \( f(x) \) is increasing?

**Options:**
1. \((-\infty, \infty) - \{-1, 1\}\)
2. \((-\infty, -1) \cup \left(\left[\frac{1}{2}, \infty\right) - \{1\}\right)\)
3. \((-\infty, \frac{1}{2}] - \{-1\}\)
4. \((-1, \frac{1}{2}]\)

If the points of intersections of the ellipse \( \frac{x^2}{16} + \frac{y^2}{b^2} = 1 \) and the circle \( x^2 + y^2 = 4b \), \( b > 4 \) lie on the curve \( y^2 = 3x^2 \), then \( b \) is equal to:

**Options:**
Question Number : 66 Question Id : 8643512316 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
Let C be the locus of the mirror image of a point on the parabola \( y^2 = 4x \) with respect to the line \( y = x \). Then the equation of tangent to C at P(2, 1) is:
Options :
8643516951. \( x + 3y = 5 \)
8643516952. \( 2x + y = 5 \)
8643516953. \( x - y = 1 \)
8643516954. \( x + 2y = 4 \)

Question Number : 67 Question Id : 8643512317 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1
Let A denote the event that a 6-digit integer formed by 0, 1, 2, 3, 4, 5, 6 without repetitions, be divisible by 3. Then probability of event A is equal to:
Options :
8643516955. \( \frac{4}{9} \)
8643516956. \( \frac{3}{7} \)
8643516957. \( \frac{11}{27} \)
If \( y = y(x) \) is the solution of the differential equation \( \frac{dy}{dx} + (\tan x) \ y = \sin x, \ 0 \leq x \leq \frac{\pi}{3} \), with \( y(0) = 0 \), then \( y\left(\frac{\pi}{4}\right) \) equal to:

Options:

\[
\left(\frac{1}{2\sqrt{2}}\right) \log_e 2
\]

\[
\frac{1}{2} \log_e 2
\]

\[
\log_e 2
\]

\[
\frac{1}{4} \log_e 2
\]

Let \( \alpha \in \mathbb{R} \) be such that the function \( f(x) = \begin{cases} \cos^{-1}\left(\frac{1 - \{x\}^2}{\{x\} - \{x\}^3}\right), & x \neq 0 \\ \alpha, & x = 0 \end{cases} \) is continuous at \( x = 0 \), where \( \{x\} = x - [x] \), \([x]\) is the greatest integer less than or equal to \( x \). Then:

Options:

\[
\alpha = 0
\]

\[
\text{no such } \alpha \text{ exists}
\]
\[ \alpha = \frac{\pi}{\sqrt{2}} \]

\[ \alpha = \frac{\pi}{4} \]

**Question Number : 70  Question Id : 8643512320  Question Type : MCQ  Option Shuffling : Yes  Is Question Mandatory : No  Correct Marks : 4  Wrong Marks : 1**

If \((x, y, z)\) be an arbitrary point lying on a plane \(P\) which passes through the points \((42, 0, 0),\ (0, 42, 0)\) and \((0, 0, 42)\), then the value of the expression

\[ 3 + \frac{x-11}{(y-19)^2 (z-12)^2} + \frac{y-19}{(x-11)^2 (z-12)^2} + \frac{z-12}{(x-11)^2 (y-19)^2} - \frac{x+y+z}{14(x-11) (y-19) (z-12)} \]

is equal to:

**Options :**

8643516967. \(-45\)

8643516968. \(39\)

8643516969. \(0\)

8643516970. \(3\)

**Question Number : 71  Question Id : 8643512321  Question Type : MCQ  Option Shuffling : Yes  Is Question Mandatory : No  Correct Marks : 4  Wrong Marks : 1**

Let \(A = \{2, 3, 4, 5, ..., 30\}\) and \(\sim\) be an equivalence relation on \(A \times A\), defined by \((a, b) \sim (c, d)\), if and only if \(ad = bc\). Then the number of ordered pairs which satisfy this equivalence relation with ordered pair \((4, 3)\) is equal to:

**Options :**

8643516971. \(5\)
Let \( P(x) = x^2 + bx + c \) be a quadratic polynomial with real coefficients such that \( \int_0^1 P(x) \, dx = 1 \) and \( P(x) \) leaves remainder 5 when it is divided by \( (x-2) \). Then the value of \( 9(b+c) \) is equal to:

Options:

8643516975.

8643516976.

8643516977.

8643516978.

Consider a rectangle ABCD having 5, 7, 6, 9 points in the interior of the line segments AB, CD, BC, DA respectively. Let \( \alpha \) be the number of triangles having these points from different sides as vertices and \( \beta \) be the number of quadrilaterals having these points from different sides as vertices. Then \( (\beta - \alpha) \) is equal to:

Options:

8643516979. 1173

8643516980. 1890

8643516981. 717
Consider the integral
\[ I = \int_{0}^{10} \frac{[x]e^{[x]}}{e^{x-1}} \, dx, \]
where \([x]\) denotes the greatest integer less than or equal to \(x\). Then the value of \(I\) is equal to:

Options:

8643516983. \(45 (e + 1)\)

8643516984. \(9 (e + 1)\)

8643516985. \(45 (e - 1)\)

8643516986. \(9 (e - 1)\)

Let \(A(-1, 1), B(3, 4)\) and \(C(2, 0)\) be given three points. A line \(y = mx, \) \(m > 0,\) intersects lines \(AC\) and \(BC\) at point \(P\) and \(Q\) respectively. Let \(A_1\) and \(A_2\) be the areas of \(\Delta ABC\) and \(\Delta PQC\) respectively, such that \(A_1 = 3A_2,\) then the value of \(m\) is equal to:

Options:

8643516987. \(1\)

8643516988. \(\frac{4}{15}\)

8643516989. \(2\)
The least value of $|z|$ where $z$ is a complex number which satisfies the inequality
\[
\exp \left( \frac{(|z| + 3)(|z| - 1)}{|z| + 1} \log_2 2 \right) \geq \log_\sqrt{2} |5\sqrt{7} + 9i|, \quad i = \sqrt{-1},
\]
is equal to:

Options:

8643516991. \text{ 2}

8643516992. $\sqrt{5}$

8643516993. \text{ 3}

8643516994. 8

The maximum value of $f(x) = \begin{vmatrix} \sin^2 x & 1 + \cos^2 x & \cos 2x \\ 1 + \sin^2 x & \cos^2 x & \cos 2x \\ \sin^2 x & \cos^2 x & \sin 2x \end{vmatrix}$, $x \in \mathbb{R}$ is:

Options:

8643516995. $\sqrt{5}$

8643516996. 5

8643516997. $\sqrt{7}$

8643516998. $\frac{3}{4}$
Given that the inverse trigonometric functions take principal values only. Then, the number of real values of $x$ which satisfy $\sin^{-1}\left(\frac{3x}{5}\right) + \sin^{-1}\left(\frac{4x}{5}\right) = \sin^{-1}x$ is equal to:

Options:

8643516999. 0
8643517000. 1
8643517001. 2
8643517002. 3

Let $f : S \to S$ where $S = (0, \infty)$ be a twice differentiable function such that $f(x + 1) = xf(x)$. If $g : S \to \mathbb{R}$ be defined as $g(x) = \log_e f(x)$, then the value of $|g''(5) - g''(1)|$ is equal to:

Options:

\[
\begin{align*}
8643517003. & \quad 205 \\
8643517004. & \quad 197 \\
8643517005. & \quad 187 \\
8643517006. & \quad 1
\end{align*}
\]
Let $C_1$ be the curve obtained by the solution of differential equation $2xy \frac{dy}{dx} = y^2 - x^2, \ x>0$.

Let the curve $C_2$ be the solution of $\frac{2xy}{x^2-y^2} = \frac{dy}{dx}$. If both the curves pass through $(1, 1)$, then the area enclosed by the curves $C_1$ and $C_2$ is equal to:

Options :

8643517007. $\frac{\pi}{4} + 1$

8643517008. $\pi - 1$

8643517009. $\frac{\pi}{2} - 1$

8643517010. $\pi + 1$

Mathematics Section B

Section Id : 864351156
Section Number : 6
Section type : Online
Mandatory or Optional : Mandatory
Number of Questions : 10
Number of Questions to be attempted : 5
Section Marks : 20
Mark As Answered Required? : Yes
Sub-Section Number : 1
Sub-Section Id : 864351156
Question Shuffling Allowed : Yes

Question Number : 81 Question Id : 8643512331 Question Type : SA
Correct Marks : 4 Wrong Marks : 0
For real numbers \( \alpha, \beta, \gamma \) and \( \delta \), if

\[
\int \frac{(x^2 - 1) + \tan^{-1} \left( \frac{x^2 + 1}{x} \right)}{(x^4 + 3x^2 + 1) \tan^{-1} \left( \frac{x^2 + 1}{x} \right)} \, dx
\]

\[
= \alpha \log_e \left( \tan^{-1} \left( \frac{x^2 + 1}{x} \right) \right) + \beta \tan^{-1} \left( \frac{\gamma(x^2 - 1)}{x} \right) + \delta \tan^{-1} \left( \frac{x^2 + 1}{x} \right) + C
\]

where \( C \) is an arbitrary constant, then the value of \( 10(\alpha + \beta \gamma + \delta) \) is equal to \( \ldots \).

**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**: 8643512332  **Question Type**: SA
**Correct Marks**: 4  **Wrong Marks**: 0

In \( \triangle ABC \), the lengths of sides \( AC \) and \( AB \) are 12 cm and 5 cm, respectively. If the area of \( \triangle ABC \) is 30 cm\(^2\) and \( R \) and \( r \) are respectively the radii of circumcircle and incircle of \( \triangle ABC \), then the value of \( 2R + r \) (in cm) is equal to \( \ldots \).

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

**Question Number**: 83  **Question Id**: 8643512333  **Question Type**: SA
**Correct Marks**: 4  **Wrong Marks**: 0

If the distance of the point \((1, -2, 3)\) from the plane \( x + 2y - 3z + 10 = 0 \) measured parallel to the line, \( \frac{x - 1}{3} = \frac{2 - y}{m} = \frac{z + 3}{1} \) is \( \sqrt{7} \), then the value of \(|m|\) is equal to \( \ldots \).

**Response Type**: Numeric
Let \( \mathbf{c} \) be a vector perpendicular to the vectors \( \mathbf{a} = \hat{i} + \hat{j} - \hat{k} \) and \( \mathbf{b} = \hat{i} + 2\hat{j} + \hat{k} \). If \( \mathbf{c} \cdot (\hat{i} + \hat{j} + 3\hat{k}) = 8 \) then the value of \( \mathbf{c} \cdot (\mathbf{a} \times \mathbf{b}) \) is equal to \( \underline{_______} \).

Let \( f: \mathbb{R} \to \mathbb{R} \) and \( g: \mathbb{R} \to \mathbb{R} \) be defined as

\[
  f(x) = \begin{cases} 
    x + a, & x < 0 \\
    |x - 1|, & x \geq 0 
  \end{cases} \quad \text{and} \quad g(x) = \begin{cases} 
    x + 1, & x < 0 \\
    (x - 1)^2 + b, & x \geq 0 
  \end{cases}
\]

where \( a, b \) are non-negative real numbers. If \((gof)(x)\) is continuous for all \( x \in \mathbb{R} \), then \( a + b \) is equal to \( \underline{_______} \).
Consider the statistics of two sets of observations as follows:

<table>
<thead>
<tr>
<th>Observation</th>
<th>Size</th>
<th>Mean</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation I</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Observation II</td>
<td>n</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

If the variance of the combined set of these two observations is $\frac{17}{9}$, then the value of $n$ is equal to ________.

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

100

Question Number: 87  Question Id: 8643512337  Question Type: SA  
Correct Marks: 4  Wrong Marks: 0

Let $n$ be a positive integer. Let $A = \sum_{k=0}^{n} (-1)^k \binom{n}{k} \left[ \left( \frac{1}{2} \right)^k + \left( \frac{3}{4} \right)^k + \left( \frac{7}{8} \right)^k + \left( \frac{15}{16} \right)^k + \left( \frac{31}{32} \right)^k \right]$

If $63A = 1 - \frac{1}{2^{30}}$, then $n$ is equal to ________.

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

100

Question Number: 88  Question Id: 8643512338  Question Type: SA  
Correct Marks: 4  Wrong Marks: 0
Let \( A = \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} \) and \( B = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} \) be two \( 2 \times 1 \) matrices with real entries such that \( A = XB \), where

\[
X = \frac{1}{\sqrt{3}} \begin{bmatrix} 1 \\ 1 \\ k \end{bmatrix}, \quad \text{and} \quad k \in \mathbb{R}.
\]

If \( a_1^2 + a_2^2 = \frac{2}{3} (b_1^2 + b_2^2) \) and \( (k^2 + 1) b_2^2 \neq -2 b_1 b_2 \), then the value of \( k \) is ________.

Question Number : 89  Question Id : 8643512339  Question Type : SA
Correct Marks : 4  Wrong Marks : 0

Let \( \frac{1}{16} \), \( a \) and \( b \) be in G.P. and \( \frac{1}{a} \), \( \frac{1}{b} \), \( 6 \) be in A.P., where \( a, b > 0 \). Then \( 72(a + b) \) is equal to

\[
\text{_______}.
\]

Question Number : 90  Question Id : 8643512340  Question Type : SA
Correct Marks : 4  Wrong Marks : 0

Let

\[
S_n(x) = \log_{a^{1/2}} x + \log_{a^{1/3}} x + \log_{a^{1/6}} x + \log_{a^{1/11}} x + \log_{a^{1/18}} x + \log_{a^{1/27}} x + \ldots \text{ up to n-terms,}
\]

where \( a > 1 \). If \( S_{24}(x) = 1093 \) and \( S_{12}(2x) = 265 \), then value of \( a \) is equal to ________.