Question Number : 1 Question Id : 184242301 Question Type : MCQ Option Shuffling : Yes Negative Marks Display Text : 2/3 Option Orientation : Vertical
Correct Marks : 2 Wrong Marks : 0.66

The process of nuclear fusion requires high temperature:

Options:

1. ✗ because all nuclear reactions absorb heat

2. ✔ because the particles cannot come closer unless they are moving rapidly

3. ✗ because mass deficit must be supplied
4. ✗ to supply binding energy

Question Number: 2  Question Id: 184242302  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3  Option Orientation: Vertical  
Correct Marks: 2  Wrong Marks: 0.66  
The nuclear forces is a/an:
Options:
1. ✓ short range attractive force
2. ✗ short range repulsive force
3. ✗ long range attractive force
4. ✗ long range repulsive force

Question Number: 3  Question Id: 184242303  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3  Option Orientation: Vertical  
Correct Marks: 2  Wrong Marks: 0.66  
Which particle from below has the zero Baryon number?
Options:
1. ✗ Neutrino
2. ✓ Pion
3. ✗ Proton
4. ✗ Delta Baryon

Question Number: 4  Question Id: 184242304  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3  Option Orientation: Vertical  
Correct Marks: 2  Wrong Marks: 0.66  
The coulomb energy in the semi-empirical mass formula of a nucleus is dependent on mass number (A) in which form?
Options:
1. ✗ It is directly proportional to $A^{2/3}$

2. ✔ It is inversely proportional to $A^{1/3}$

3. ✗ It is inversely proportional to $A^{2/3}$

4. ✗ It is inversely proportional to $A^{5/2}$

Question Number : 5  Question Id : 184242305  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66

Which one of the following particles is a Lepton?

Options :
1. ✗ Photon

2. ✔ $\mu$ – Meson

3. ✗ $\pi$ – Meson

4. ✗ Proton

Question Number : 6  Question Id : 184242306  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66

The number of hyperfine components observed in the electronic transition $^2P_{3/2} \rightarrow ^2S_{1/2}$ of an atom with nuclear spin 1/2 is:

Options :
1. ✗ 3

2. ✔ 4
3. ✗ 6

4. ✗ 5

Question Number : 7  Question Id : 184242307  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
The decay chain of the nucleus $^{238}_{92}U$ involves eight $\alpha$-decays and six $\beta^-$-decays. The final nucleus at the end process will have:
Options :
1. ✓ Z=82, A=206
2. ✗ Z=84, A=224
3. ✗ Z=88, A=206
4. ✗ Z=76, A=200

Question Number : 8  Question Id : 184242308  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
Which of the following pairs of nuclei are mirror nuclei?
Options :
1. ✗ $^{13}_6 C$, $^{12}_6 C$
2. ✓ $^{13}_6 C$, $^{13}_7 N$
3. ✗ $^{16}_8 O$, $^{20}_{10} Ne$
4. ✗ $^2_1 H$, $^3_1 H$
The quark structure of Delta Baryon is:

Options:
1. uuu
2. udu
3. sss
4. ddd

The Baryon number and Lepton number of electrons, respectively, are:

Options:
1. 1, 0
2. 0, 0
3. 1, 1
4. 0, 1

The quarks are supposed to exist in how many flavours?

Options:
1. Two
Question Number : 12  Question Id : 184242312  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
How does the nuclear density change when the nuclear mass (A) is doubled?
Options :
1. ✗ Nuclear density gets tripled
2. ✗ Nuclear density is halved
3. ✗ Nuclear density is doubled
4. ✓ Nuclear density remains the same

Question Number : 13  Question Id : 184242313  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
The nucleus of $^9\text{Be}_4$ consists of:
Options :
1. ✗ 13 up quarks and 13 down quarks
2. ✓ 13 up quarks and 14 down quarks
3. ✗ 14 up quarks and 13 down quarks
4. 14 up quarks and 14 down quarks

Question Number : 14  Question Id : 184242314  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66
Which of the following statements regarding Neutrino is incorrect?
Options:
1. A neutrino has spin of 1/2
2. A neutrino has zero rest mass
3. A neutrino does not interact with matter
4. A neutrino has charge equal to 1.5 x 10^-19 C

Question Number : 15  Question Id : 184242315  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66
The nuclear spins of \( ^{14}C \) and \( ^{25}Mg \) nuclei, respectively, are:
Options:
1. zero and half integer
2. half-integer and zero
3. an integer and a half integer
4. both half integers

Question Number : 16  Question Id : 184242316  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66
According to the Fermi theory of \( \beta \)-decay, the number of final states of electrons corresponding to momenta between \( p \) and \( p + dp \) is:
Options:
1. independent of $p$

2. proportional to $p dp$

3. proportional to $p^2 dp$

4. proportional to $p^3 dp$

---

Question Number : 17  Question Id : 184242317  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
From the Meson field theory, the potential energy of interaction between two nucleons is proportional to:
Options :
\[ e^{-\mu r^2} \]

1. \[ \frac{e^{-\mu r^2}}{r^2} \]

2. \[ \frac{e^{-\mu r^2}}{r} \]

3. \[ \frac{e^{-\mu r^2}}{r^2} \]

4. \[ \frac{e^{-\mu r^2}}{r} \]

---

Question Number : 18  Question Id : 184242318  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
The coordination number of a body-centred cubic structure (BCC) is:
Options :

1. 4
Question Number : 19  Question Id : 184242319  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  
Correct Marks : 2  Wrong Marks : 0.66  
Arrange the following structures in their decreasing order of packing fraction.  
Options :  
1. Body-centred Cubic lattice(BCC), Simple Cubic (SC), Hexagonal Close Packed Lattice (HCP)  
2. Hexagonal Close packed lattice(HCP), Simple cubic (SC), Body-centred Cubic lattice (BCC)  
3. Simple cubic (SC), Body-centred cubic lattice(BCC), Hexagonal Close packed Lattice(HCP)  
4. Hexagonal Close packed Lattice (HCP), Body-centred Cubic lattice (BCC), Simple cubic (SC) lattice

Question Number : 20  Question Id : 184242320  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  
Correct Marks : 2  Wrong Marks : 0.66  
The atomic radius of a face-centred cubic lattice with lattice parameter (a) is:  
Options :  
1. a/3  
2. $\frac{a}{2\sqrt{2}}$  
3. a/4
4. $\frac{a}{2}$

The c/a ratio of a hexagonal close packed structure is:

Options:
1. $\frac{1}{\sqrt{3}}$
2. $\frac{2}{\sqrt{3}}$
3. $\frac{4}{\sqrt{3}}$
4. $\frac{8}{\sqrt{3}}$

The susceptibility of a superconductor is:

Options:
1. positive
2. negative
3. zero
4. 100
The Bragg's law can be represented as:

1. \(2K \cdot G + G^2 = 0\)

2. \(2K \cdot G + G^3 = 0\)

3. \(2K \cdot G + G = 0\)

4. \(2K \cdot G = 0\)

Name the lattice of the system having the parameters \(a=11.20\, \text{A.U.}, b=8.63\, \text{A.U.}, c=6.19\, \text{A.U.}, \alpha=47\, \text{deg}, \beta=81\, \text{deg}, \gamma=95\, \text{deg}\).

Options:

1. Monoclinic
2. Triclinic
3. Hexagonal
4. Tetragonal

The reciprocal lattice of a face-centred cubic lattice (fcc) is a:

Options:

1. Body Centred Cubic (BCC) lattice
2. Hexagonal Close Packed (HCP) lattice

3. Simple Cubic (SC) lattice

4. Face Centred Cubic (FCC) lattice

According to the Debye's theory of specific heats of solids, the value of specific heats of solids falls at a rate of \( \frac{1}{T^3} \) at low temperatures.

Options:

1. \( \frac{1}{T^3} \)

2. \( \frac{1}{T^2} \)

3. \( \frac{1}{T} \)

4. \( \frac{1}{T^4} \)

A magnetised spin wave is called:

Options:

1. phonon

2. photon
3. magnons

4. excitons

The penetration depth $\lambda$-$T$ graph is given by:

Options:

1. 

2. 

3. 

Correct Marks: 2  Wrong Marks: 0.66
Question Number : 29  Question Id : 184242329  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  
Option Orientation : Vertical  
Correct Marks : 2  Wrong Marks : 0.66

The Laue method of x-ray diffraction by a crystal is suitable for the determination of crystal orientation and symmetry and also for the study of:

Options :

1. ✓ crystal imperfections

2. ✗ surface structure

3. ✗ magnetic moment

4. ✗ scattering from neighbouring elements in a periodic table

---

Question Number : 30  Question Id : 184242330  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  
Option Orientation : Vertical  
Correct Marks : 2  Wrong Marks : 0.66

The metallic iron changes from the body-centred cubic structure (bcc) to the face-centred cubic structure (fcc) at 910°C with an increase in the atomic radii. The density of iron in this structural change:

Options :

1. ✗ remains constant

2. ✓ increases

3. ✗ decreases
4. becomes zero

Question Number : 31  Question Id : 184242331  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
The glancing angle on the cube face (100) of a rock salt crystal (a = 2.8 AU) corresponding to the second-order reflection for x-rays of λ=0.7 AU is given by:
Options :
1. 14°28’
2. 28°56’
3. 21°42’
4. 7°14’

Question Number : 32  Question Id : 184242332  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
In the powder method pattern for lead with radiation of λ = 1.54 AU, the (220) Bragg reflection angle is θ = 32°. The radius of the atom will be:
Options :
1. 1.54 AU
2. 1.45 AU
3. 5.41 AU
4. 4.51 AU

Question Number : 33  Question Id : 184242333  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
Which of the following is a true statement?

Options:

1. ✓ Diamagnetism is the inherent property of each substance

2. ✗ The magnetic susceptibility of a diamagnetic substance is always positive

3. ✗ The magnetic susceptibility of a ferromagnetic substance does not depend on the temperature and magnetic field

4. ✗ The magnetic susceptibility of a paramagnetic substance increases with an increase in the temperature

The equilibrium concentration of a Schottky defect in crystal is given by:

Options:

\[ n_s \approx \exp \left( \frac{-E_g}{T} \right) \]

1. ✗

\[ n_s \approx \exp \left( \frac{-E_g}{K} \right) \]

2. ✗

\[ n_s \approx \exp \left( \frac{E_g}{K T} \right) \]

3. ✗

\[ n_s \approx \exp \left( \frac{E_g}{K T} \right) \]

4. ✓

The absolute value of velocity of electrons corresponding to the point of inflexion and E-k diagram is:
The doublets observed in the alkali spectra are due to the:

Options:

1. screening of K electrons

2. spin-orbit interaction of the electrons

3. pressure of isotopes

4. energy of the electrons

The multiplicity of the state $^2D_{3/2}$ is given by:

Options:

1. 1

2. 2
The magnetic moment associated with the first orbit in hydrogen atom is given by:

Options:
1. \( \frac{h}{4\pi me} \)
2. \( \frac{4\pi m}{he} \)
3. \( \frac{eh}{4\pi m} \)
4. \( \frac{ehm}{4\pi} \)

For an atom in the state of \( ^2D_{\frac{5}{2}} \), the Lande g-factor should be:

Options:
1. 1.44
2. 1.65
3. 1.20
The ground state of sodium (Z=11) is represented as:

Options:
1. \(^3P_{1/2}\)
2. \(^2P_{1/2}\)
3. \(^1P_{1/2}\)
4. \(^2S_{1/2}\)

Which of the following has the order of increasing energy?

Options:
1. \(^1D_2, ^3D_2, ^3F_2\)
2. \(^3F_2, ^3D_2, ^1D_2\)
3. \(^3D_2, ^3F_2, ^1D_2\)
4. \(^1D_2, ^3F_2, ^3D_2\)

The hyperfine splitting of the spectral lines of an atom is due to:
1. ✗  the coupling between the spins of two or more electrons

2. ✗  the coupling between the spins and the orbital angular momenta of the electrons

3. ✔  the coupling between the electron spins and the nuclear spin

4. ✗  the effect of external electromagnetic fields

Question Number: 43  Question Id: 184242343  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3
Correct Marks: 2  Wrong Marks: 0.66
Options:
1. ✗  4

2. ✗  6

3. ✔  8

4. ✔  10

Question Number: 44  Question Id: 184242344  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3
Correct Marks: 2  Wrong Marks: 0.66
Options:
1. ✗  \( \left( \frac{27}{5} \right) \lambda \)
2. $\left(\frac{5}{27}\right)^{\lambda}$

3. $\left(\frac{32}{27}\right)^{\lambda}$

4. $\left(\frac{27}{32}\right)^{\lambda}$

Question Number : 45  Question Id : 184242345  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical
Correct Marks : 2 Wrong Marks : 0.66
Which one of the following molecules does NOT exhibit a rotational spectrum?
Options:
1. $\checkmark$ H$_2$

2. ✗ CO

3. ✗ HCl

4. ✗ HBr

Question Number : 46  Question Id : 184242346  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical
Correct Marks : 2 Wrong Marks : 0.66
At ordinary temperature, the molecules:
Options:
1. $\checkmark$ remain in their lowest vibrational level

2. ✗ remain in their highest vibrational level

3. ✗ can remain in any vibrational level
4. do not show any type of vibration

Question Number : 47  Question Id : 184242347  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66  Raman effect is due to collision of: Options :
1. photon with electron  
2. photon with molecule  
3. electron with atom  
4. electron with photon

Question Number : 48  Question Id : 184242348  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66  The L, S and J quantum numbers corresponding to the ground state electronic configuration of Boron (Z=5) are: Options :
1. L=1, S=1/2, J=3/2  
2. ✓ L=1, S=1/2, J=1/2  
3. L=1, S=3/2, J=1/2  
4. L=0, S=3/2, J=3/2

Question Number : 49  Question Id : 184242349  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66  The total number of Zeeman components observed in an electronic transition \( { }^2D_{3/2} \rightarrow { }^2P_{3/2} \) of an atom in a weak field is: Options :
1. 4

2. 6

3. 10

4. ✔️ 12

Question Number : 50  Question Id : 184242350  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66

The degeneracy of the spectral term $^3F$ is:

Options :
1. ✔️ 7

2. 9

3. 15

4. ✔️ 21

Question Number : 51  Question Id : 184242351  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66

The total number of Zeeman components observed in an electronic transition $^2D_{3/2} \rightarrow ^2P_{3/2}$ of an atom in a weak field is:

Options :
1. ✔️ 4

2. 6
3.  ✓ 12

4.  × 10

Question Number: 52  Question Id: 184242352  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3  Option Orientation: Vertical  Correct Marks: 2  Wrong Marks: 0.66
A JFET is a/an:
Options:
1.  ✓ unipolar device
2.  × bipolar device
3.  × current-controlled device
4.  × positive resistor

Question Number: 53  Question Id: 184242353  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3  Option Orientation: Vertical  Correct Marks: 2  Wrong Marks: 0.66
A diode that has negative resistance characteristic is the:
Options:
1.  × Schottky diode
2.  ✓ Tunnel diode
3.  × Laser diode
4.  × Photo device

Question Number: 54  Question Id: 184242354  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3  Option Orientation: Vertical  Correct Marks: 2  Wrong Marks: 0.66
The optical storage devices employ:

1. ultraviolet light
2. electromagnetic fields
3. optical couplers
4. lasers

Which of the following is a non-linear thermometer?

1. Mercury
2. Thermocouple
3. Platinum
4. Thermistor

Which of the following is a correct statement?

1. A byte is a collection of 4 bits
2. A nibble is a collection of 8 bits
3. ✓ A word is a collection of 15 bits

4. ✗ A byte is a collection of 2 bits

In a differentiator, the feedback element is a:

Options:
1. ✓ resistor
2. ✗ capacitor
3. ✗ Zener diode
4. ✗ voltage divider

The NAND gate is known as a universal gate because:

Options:
1. ✓ it can be used for AND, OR and NOT operations
2. ✗ it can be used as an inverter
3. ✗ it can be used for AND operations
4. ✗ it can be used for OR operations
Each R-C network in the phase shift oscillator introduces a phase change of:

Options:

1. 180°

2. 360°

3. 90°

4. 60°

Which of the following characteristics does NOT necessarily apply to an op-amp?

Options:

1. High gain

2. Low power

3. High input impedance

4. Low output impedance

The minimum number of resistors required in a 4 bit D/A network of weighed resistor type is:

Options:

1. 4 Kilo Ohm

2. 8 Kilo Ohm
3. ✗ 15 Kilo Ohm

4. ✔ 16 Kilo Ohm

Question Number : 62  Question Id : 184242362  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Correct Marks : 2  Wrong Marks : 0.66
The phase shifts through an op-amp are caused by:
Options :
1. ✔ the internal RC circuit
2. ✗ the external RC circuit
3. ✗ the gain roll-off
4. ✗ negative feedback

Question Number : 63  Question Id : 184242363  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Correct Marks : 2  Wrong Marks : 0.66
The minimum number of flip-flops required for a divide-by-12 circuit is:
Options :
1. ✔ 4
2. ✗ 8
3. ✗ 12
4. ✗ 16

Question Number : 64  Question Id : 184242364  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Correct Marks : 2  Wrong Marks : 0.66
A certain op-amp has bias currents of 50 μA and 49.3 μA. The input offset current is:

Options:

1. ✓ 700 nA

2. ✗ 700 μA

3. ✗ 350 μA

4. ✗ 350 nA

The Boolean expression \( \overline{ABC} + \overline{ABCD} + \overline{ABC}D + \overline{ABCD} \) reduces to:

Options:

1. ✗ \( \overline{AB} \)

2. ✗ D

3. ✗ A

4. ✓ \( \overline{AD} \)

A feature that distinguishes the J-K flip-flop from the S-R flip-flop is the:

Options:

1. ✓ toggle condition
2. preset input
3. type of clock
4. clear input

The gate(s) used to check whether the number of 1s in a digital word is even or odd is/are:

Options:
1. ✓ EX-OR
2. NAND
3. NOR
4. AND, OR and NOT

The change in the internal energy of a gas is directly proportional to the:

Options:
1. ✓ change in temperature
2. change in pressure
3. change in volume
4. **change in atoms**

Which of the following is true in case of cyclic process?

Options:

1. Internal energy of the system increases

2. The work done by the system is equal to the quantity of the heat given to the system

3. The work done does not depend on the quantity of the heat given to the system

4. The work done is zero

In a gas, the relative magnitude of the most probable speed \( v_p \), the average speed \( \bar{v} \) and the root mean square speed \( v_{rms} \) of the molecule is represented as:

Options:

1. \( v_{rms} > \bar{v} > v_p \)

2. \( \bar{v} > v_{rms} > v_p \)

3. \( v_p > \bar{v} > v_{rms} \)

4. \( v_p > v_{rms} > \bar{v} \)
At any temperature, the energy of the molecules of an ideal gas possess:

Options:
1. ✔ only kinetic energy

2. ☒ only potential energy

3. ☒ both kinetic and potential energy

4. ☒ neither kinetic nor potential energy

---

The efficiency of a heat engine working between heat reservoirs at temperatures 327°C and 27°C is:

Options:
1. ☒ 25%

2. ☒ 50%

3. ☒ 75%

4. ☒ 100%

---

In case of the Bose-Einstein condensation the:

Options:
1. ✔ number of particles increases at low energy levels observed at low temperatures and high pressures
2. ✗ number of particles decreases at low energy levels observed at low temperatures and high pressures

3. ✗ number of particles increases at low energy levels observed at high temperature and low pressures

4. ✗ number of particles decreases at lower energy levels observed at high temperatures and low pressures

Question Number : 74  Question Id : 184242374  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3 Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
The temperature of the surface of the sun is approximated as 8000 K. If we take a big lens and focus the sun rays and produce a temperature of 10000 K, this will violate:
Options :
1. ✗ Zeroth law of thermodynamics
2. ✗ First law of thermodynamics
3. ✔ Second law of thermodynamics
4. ✗ Third law of thermodynamics

Question Number : 75  Question Id : 184242375  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3 Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
For any process, the second law of thermodynamics requires that the change of entropy of the universe is:
Options :
1. ✗ positive only
2. ✔ positive or zero
3. zero only

4. negative or zero

Question Number : 76  Question Id : 184242376  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
A second-order phase transition is characterised by:
Options :
1. latent heat of the system

2. discontinuous change in specific heat system

3. change in volume of the system

4. irreversible behaviour of the system during warming and cooling

Question Number : 77  Question Id : 184242377  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
The entropy of a photon gas is proportional to:
Options :
1. T

2. T^2

3. ✓ T^3

4. ✗ T^{2 2}
In the grand canonical ensemble, the comprising system is capable of exchanging:

1. only energy
2. only constituent particles
3. both energy and constituent particles
4. neither energy nor constituent particles

If $Z$ is the partition function of a system and $\beta = \frac{1}{KT}$, where $K$ is Boltzmann constant, then the average pressure $P$ is given by:

Options:

1. $P = \frac{\partial Z}{\partial \beta}$
2. $P = \frac{1}{\beta} \left( \frac{\partial \ln Z}{\partial \beta} \right)$
3. $P = -\frac{1}{\beta} \left( \frac{\partial \ln Z}{\partial \beta} \right)$
4. $P = \frac{1}{\beta^2} \left( \frac{\partial \ln Z}{\partial \beta} \right)$

The Fermi energy of a free electron gas depends on the electron density ($\rho$) as:

Options:

1. $\rho^{\frac{1}{3}}$
2. $\rho^{2/3}$

3. $\rho^{-1/3}$

4. $\rho^{-2/3}$

Question Number: 81  Question Id: 184242381  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3  Option Orientation: Vertical  Correct Marks: 2  Wrong Marks: 0.66

In the Joule-Thompson experiment, for a real gas, the:

Options:
1. enthalpy remains constant

2. energy remains constant

3. entropy decreases

4. enthalpy decreases

---

Question Number: 82  Question Id: 184242382  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3  Option Orientation: Vertical  Correct Marks: 2  Wrong Marks: 0.66

Four phase points are distributed in two cells (i and j) in phase space. Then the thermodynamic probability for the macrostate $n_i = 3, n_j = 1$ is:

Options:
1. 2

2. 4

3. 6
4. 24

In B-E statistics, the number of particles condensing into the ground state is given by:

Options:

1. Zero

2. \( \eta \left[ 1 - \left( \frac{T}{T_0} \right)^{5/2} \right] \)

3. \( \eta \left[ 1 - \left( \frac{T}{T_0} \right)^{3/2} \right] \)

4. \( \eta \left[ 1 - \left( \frac{T}{T_0} \right)^{1/2} \right] \)

Which of the following quantities varies in matter waves?

Options:

1. Height

2. Pressure

3. Wave function

4. Fields
The dimension of Planck's constant is the same as the dimension of:

1. linear momentum
2. force
3. torque
4. angular momentum

The norm of normalised wave functions is:

1. zero
2. infinity
3. two
4. one

The energy operator $\hat{E}$ in momentum space is represented as:

1. $i \hbar \frac{\partial}{\partial t}$
2. $- \frac{\hbar}{i} \frac{\partial}{\partial p}$
3. $\frac{\hbar}{i} \frac{\partial}{\partial x}$

4. $\frac{\hbar}{i} \frac{\partial}{\partial t}$

Question Number: 88  Question Id: 184242388  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3  
Correct Marks: 2  Wrong Marks: 0.66

The zero-point energy of a linear harmonic oscillator is:

Options:
1. $h \nu$

2. $\left( \frac{\nu}{2} \right) \hbar \omega$

3. zero

4. $\hbar \omega$

Question Number: 89  Question Id: 184242389  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3  
Correct Marks: 2  Wrong Marks: 0.66

The energy (E) for the bound state of an electron in a hydrogen atom is:

Options:
1. $E = 0$

2. $E = \infty$

3. $E < 0$

4. $E > 0$
Which two of the following are NOT canonically conjugate variables?

Options:
1. The x-component of position and linear momentum vectors
2. The azimuthal angle and z-component of orbital angular momentum
3. Time and energy
4. The y-component of position and z-component of linear momentum vectors

The probability of an electron tunnelling through a potential barrier varies with the thickness of the barrier as it decreases:

Options:
1. exponentially with thickness
2. linearly with thickness
3. inversely with thickness
4. sinusoidally with thickness

The x-component of angular momentum operator is given by:

Options:
1. $-i \hbar \left( y \frac{\partial}{\partial z} - z \frac{\partial}{\partial y} \right)$
2. \( -\hbar \left( z \frac{\partial}{\partial x} - x \frac{\partial}{\partial z} \right) \)

3. \( -\hbar \left( x \frac{\partial}{\partial y} - y \frac{\partial}{\partial x} \right) \)

4. \( \hbar \left( \frac{y \partial}{\partial z} - z \frac{\partial}{\partial y} \right) \)

Question Number : 93  Question Id : 184242393  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66

The sufficient condition for the validity of the Born approximation in the theory of scattering is given by:

Options :

1. \( |v(0)|^2 \ll 1 \)

2. \( |v(0)|^2 \gg 1 \)

3. \( |v(0)|^2 > 1 \)

4. \( |v(0)|^2 = 1 \)

Question Number : 94  Question Id : 184242394  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66

A symmetric wave function for two particle functions can be described by:

Options :

1. \( \psi_{(1,2)} \)

2. \( \psi_{(1,2)} + \psi_{(2,1)} \)

3. \( \psi_{(1,2)} - \psi_{(2,1)} \)
4. \( \psi (2,1) \)

**Question Number** : 95  **Question Id** : 184242395  **Question Type** : MCQ  **Option Shuffling** : Yes  **Negative Marks Display Text** : 2/3  **Option Orientation** : Vertical
Correct Marks : 2  Wrong Marks : 0.66
The equation \( \left( \nabla^2 - \frac{1}{c^2} \frac{\partial^2}{\partial t^2} \right) \psi = \frac{m_e^2 c^2}{\hbar^2} \psi \) is known as:

Options :
1. **Schroedinger equation**

2. ✔ **Klein Gorden equation**

3. ✗ **Dirac equation**

4. ✗ **Einstein equation**

**Question Number** : 96  **Question Id** : 184242396  **Question Type** : MCQ  **Option Shuffling** : Yes  **Negative Marks Display Text** : 2/3  **Option Orientation** : Vertical
Correct Marks : 2  Wrong Marks : 0.66
Which of the following statements is INCORRECT with respect to operators in quantum mechanics?
Options :
1. ✗ The commutator bracket of two linear operators is zero.

2. ✗ In quantum mechanics the physical quantities are represented by linear operators.

3. ✔ The squaring operator is a linear operator.

4. ✗ The application of a linear operator to a function gives zero, then the operator is called Null operator.
The value of the commutation relation \( \left[ \frac{\partial}{\partial x}, \frac{\partial^2}{\partial x^2} \right] \) is:

Options:
1. ✓ 0
2. ✗ 1
3. ✗ 2
4. ✗ \( \infty \)

Question Number : 98 Question Id : 184242398 Question Type : MCQ Option Shuffling : Yes Negative Marks Display Text : 2/3 Option Orientation : Vertical Correct Marks : 2 Wrong Marks : 0.66

The total angular momentum (J) values, which may arise from addition of following two angular momenta \( j_1 = 1 \) and \( j_2 = 1 \) are

Options:
1. ✗ 3, 1, 2
2. ✓ 2, 1, 0
3. ✗ 2, 1, -1
4. ✗ 4, 3, 2

Question Number : 99 Question Id : 184242399 Question Type : MCQ Option Shuffling : Yes Negative Marks Display Text : 2/3 Option Orientation : Vertical Correct Marks : 2 Wrong Marks : 0.66

The eigenvalues of the matrix \( \begin{pmatrix} 3 & 2 \\ 2 & 0 \end{pmatrix} \) are:

Options:
1. ✓ 4 or -1
2. ✗ 4 or 0
3. 1 or 2

4. 3 or 2

Question Number: 100  Question Id: 184242400  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3  Option Orientation: Vertical  
Correct Marks: 2  Wrong Marks: 0.66  
The Dirac hole in Dirac’s theory has been identified with a/an _______ particle.  
Options:
1. electron  
2. positron  
3. neutrino  
4. proton

Question Number: 101  Question Id: 184242401  Question Type: MCQ  Option Shuffling: Yes  Negative Marks Display Text: 2/3  Option Orientation: Vertical  
Correct Marks: 2  Wrong Marks: 0.66  
Which of the following statements is INCORRECT with respect to hydrogen atoms?  
Options:
1. The ground state energy of hydrogen atoms is -13.6 eV  
2. The energy levels are equal spaced  
3. The lowest energy level is non degenerate  
4. The potential function is central and rotationally invariant
The value of $[\hat{x}, \hat{p}_x]$ is:

Options:
1. $i\hbar$
2. $-\hbar$
3. $\hbar$
4. $0$

An electron in the $n = 2$ state of hydrogen remains there on the average of about $10^{-7}$ sec, before making a transition to $n = 1$ state. The uncertainty in the energy of the $n = 2$ state is

Options:
1. $0.527 \times 10^{-27}$ J
2. $0.527 \times 10^{-27}$ erg
3. $0.527 \times 10^{-25}$ J
4. $5.27 \times 10^{-27}$ J

The value of the commutator $[\hat{x}, \hat{p}_x^2]$ is:

Options:
1. $\hbar^2 \frac{d}{dx}$
The Hermitian matrix will be unitary when:

1. $H^2 = 0$

2. $H^2 = 1$

3. $H = 1$

4. $H = 0$

The normalisation constant $N$ for the given wave function $\psi (x) = Ne^{-a^2x^2} (a$ is constant) is:

1. $\alpha^\frac{1}{2} \left( \frac{2}{\pi} \right)^\frac{1}{4}$

2. $\sqrt{a} \left( \frac{\pi}{2} \right)^\frac{1}{4}$
3. $\sqrt{2a}$

4. $\frac{1}{2} \sqrt{a\pi}$

**Question Number : 107  Question Id : 184242407  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical**

Correct Marks : 2 Wrong Marks : 0.66

The expectation value of the position coordinate x in the n$^\text{th}$ state of a particle confined in a one dimensional box of L wide is:

Options :

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

2. $\frac{2}{L}$

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

4. $\frac{\sqrt{2}}{L}$

**Question Number : 108  Question Id : 184242408  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical**

Correct Marks : 2 Wrong Marks : 0.66

The electric field intensity at a point between two parallel sheets of charge in terms of surface charge density ($\sigma$), is:

Options :

1. $\frac{\sigma}{\varepsilon_0}$

2. $\frac{\sigma}{2\varepsilon_0}$

3. $\frac{\sigma}{3\varepsilon_0}$
Question Number : 109 Question Id : 184242409 Question Type : MCQ Option Shuffling : Yes Negative Marks Display Text : 2/3 Option Orientation : Vertical
Correct Marks : 2 Wrong Marks : 0.66
The relation between three electric vectors- electric intensity (\(\vec{E}\)), electric polarisation (\(\vec{P}\)), and electric displacement (\(\vec{D}\)), is:
Options :
1. \(\vec{D} = \vec{P} + \vec{E}\)
2. \(\vec{D} = \frac{\vec{P}}{\epsilon} \)
3. \(\vec{D} = \epsilon_0 \vec{E} + \vec{P}\)
4. \(\vec{D} = \epsilon_0 (\vec{E} + \vec{P})\)

Question Number : 110 Question Id : 184242410 Question Type : MCQ Option Shuffling : Yes Negative Marks Display Text : 2/3 Option Orientation : Vertical
Correct Marks : 2 Wrong Marks : 0.66
The differential form of Ampere’s circuital law is given by:
Options :
1. \(\nabla \times \vec{B} = \mu_0 \vec{J}\)
2. \(\nabla + \vec{B} = \mu_0 \vec{J}\)
3. \(\nabla^2 \vec{B} = \mu_0 \vec{J}\)
4. \(\nabla \times \vec{E} = 0\)
Faraday’s law of electromagnetic induction gives a relation between the magnitude of:

1. current density and the volume change density
2. induced current and the electric flux
3. induced current and the magnetic flux
4. induced emf and the electric flux

Question Number : 112  Question Id : 184242412  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
A circular conductor of very large radius is subjected to a current of 12 A. The magnetic field at the centre of the conductor is:

Options :
1. 1
2. 0
3. ∞
4. 2

Question Number : 113  Question Id : 184242413  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
Which of the following statements is FALSE with respect to the electrostatic properties of an ideal conductor?

Options :
1. The electric field inside a conductor is zero
2. The charge density in the interior of a conductor is zero
3. ✗ A conductor is an equipotential

4. ✓ An electric field is parallel to the surface just outside a conductor.

The direction of an electromagnetic wave travelling in free space, whose electric field intensity given by \( \vec{E} = 20 \cos (\omega t + 3z) \hat{i} \) volt/metre, is:

Options:
1. ★ \( \hat{i} \)
2. ★ \( -\hat{j} \)
3. ✓ \( -\hat{k} \)
4. ★ \( \hat{j} \)

Poisson’s equation in a free space is given by:

Options:
1. ★ \( \nabla^2 \varphi = \varepsilon_0 / \rho \)
2. ✓ \( \nabla^2 \varphi = 0 \)
3. ★ \( \nabla^2 \varphi = \rho / \varepsilon_0 \)
4. ★ \( \nabla^2 \varphi = \infty \)
If the electric field remains along a straight line as a function of time at some point in the medium, then the wave is said to be:
Options:
1. ✔ linearly polarised
2. ✗ circularly polarised
3. ✗ elliptically polarised
4. ✗ unpolarised

A parallel polarised wave is incident from air into paraffin. If the permittivity for paraffin is one, then the Brewster angle is:
Options:
1. ✔ 45°
2. ✗ 30°
3. ✗ 60°
4. ✗ 15°

If the ratio of conduction current density and displacement current density is greater than one, then the medium is a/an:
Options:
1. ✗ good dielectric

2. ✔ good conductor

3. ✗ insulator

4. ✗ bad conductor

Question Number : 119  Question Id : 184242419  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
If \( A \) and \( \phi \) are vector and scalar potential, respectively, then the Lorentz condition is given by:
Options :
1. ✗ \( \nabla \cdot \mathbf{A} = 0 \)

2. ✔ \( \frac{1}{c} \frac{\partial \phi}{\partial t} = 0 \)

3. ✗ \( \nabla \cdot \mathbf{A} + \frac{1}{c} \frac{\partial \phi}{\partial t} = 0 \)

4. ✗ \( \nabla + \mathbf{A} + \frac{1}{c} \frac{\partial \phi}{\partial t} = 0 \)

Question Number : 120  Question Id : 184242420  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
A material has zero permittivity. The maximum potential it can possess is:
Options :
1. ✔ zero

2. ✗ unity
3. infinity

4. two

Question Number : 121  Question Id : 184242421  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66

Which of the given boundary conditions on the fields at the interfaces between two media is NOT accurate?

Options :

1. \( E_{\text{tan}1} = E_{\text{tan}2} \)

2. \( D_{\text{n}1} = D_{\text{n}2} \)

3. \( B_{\text{n}1} = B_{\text{n}2} \)

4. \( E_{\text{cot}1} = E_{\text{cot}2} \)

Question Number : 122  Question Id : 184242422  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66

Which of the following statements is true for the generation of electromagnetic waves?

Options :

1. Charges at rest

2. Steady current

3. Accelerating charges

4. Electric monopole.

Question Number : 123  Question Id : 184242423  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66
Which of the following statements is NOT accurate for dielectric materials?

Options:
1. ✗ It contains bound charges
2. ✓ It contains free charges
3. ✗ It gets polarised when placed in an external electric field
4. ✗ The electric flux density inside the dielectric is increased due to polarisation

Question Number : 124 Question Id : 184242424 Question Type : MCQ Option Shuffling : Yes Negative Marks Display Text : 2/3 Option Orientation : Vertical
Correct Marks : 2 Wrong Marks : 0.66
In a central force field, the trajectory of a particle mass (m) and angular momentum (L) in plane polar co-ordinates is given by \( \frac{1}{r} = \frac{m}{L^2} (1 + \varepsilon \cos \theta) \), where \( \varepsilon \) is the eccentricity of the particle’s motion. Which of the following choices for \( \varepsilon \) gives rise to a hyperbolic trajectory?

Options:
1. ✗ 0 < \( \varepsilon \) < 1
2. ✗ \( \varepsilon \) = 1
3. ✓ \( \varepsilon \) > 1
4. ✗ \( \varepsilon \) = 0

Question Number : 125 Question Id : 184242425 Question Type : MCQ Option Shuffling : Yes Negative Marks Display Text : 2/3 Option Orientation : Vertical
Correct Marks : 2 Wrong Marks : 0.66
Lagrangian (L) is given by:

(Note: \( T \rightarrow \) Kinetic energy & \( V \rightarrow \) Potential energy)

Options:
1. ✗ \( L = T + V \)
2. \( L = T^2 + V^2 \)

3. \( L = T - V \)

4. \( L = T^2 - V^2 \)

**Question Number : 126**  Question Id : 184242426  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  
Correct Marks : 2  Wrong Marks : 0.66  
A rigid body moving freely in space has _____ degrees of freedom.  
Options :  
1. \( \times \) 3  
2. \( \checkmark \) 6  
3. \( \times \) 5  
4. \( \times \) 4

**Question Number : 127**  Question Id : 184242427  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  
Correct Marks : 2  Wrong Marks : 0.66  
Frame \( \hat{S} \) is moving with speed \( v \) along the X-axis relative to frame \( S \). A rod of length \( l_0 \) is stationary in frame \( S \) along the X-axis. The length of the rod observed in frame \( \hat{S} \) is:  
Options :  
1. \( \frac{l_0}{\sqrt{1-\frac{v^2}{c^2}}} \)  
2. \( l_0 \)
3. $l_0 \sqrt{1 - \frac{v^2}{c^2}}$

4. $\frac{l_0}{v}$

Question Number : 128  Question Id : 184242428  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
In which of the following frames does Pseudo force appear?
Options:
1. Inertial frame
2. Non-inertial frame
3. Both inertial and non-inertial frame
4. Pseudo inertial frame

Question Number : 129  Question Id : 184242429  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Option Orientation : Vertical
Correct Marks : 2  Wrong Marks : 0.66
In terms of the Poisson bracket, Hamilton’s canonical equations are:
Options:
\[ \dot{q}_k = [p_k, H] \]
1. $\dot{p}_k = [q_k, H]$
\[ \dot{q}_k = [q_k, H] \]
2. $\dot{p}_k = [p_k, H]$
\[ \dot{q}_k = [-p_k, H] \]
3. $\dot{p}_k = [-q_k, H]$
\[ \dot{q}_k = [-q_k, \mathbf{H}] \]
4. \[ \dot{p}_k = [-p_k, \mathbf{H}] \]

The value of the Poisson bracket \( \{ \mathbf{a}, \mathbf{b} \} \) where \( \mathbf{a} \) and \( \mathbf{b} \) are constant vectors, is:

Options:
1. \( \mathbf{a} \cdot \mathbf{b} \)
2. \( \mathbf{a} + \mathbf{b} \)
3. \( ab \)
4. \( \mathbf{a} - \mathbf{b} \)

Hamilton’s canonical equations are:

Options:
1. \( \dot{q}_k = \frac{\partial H}{\partial p_k} \) \& \( \dot{p}_k = -\frac{\partial H}{\partial q_k} \)
2. \( \dot{q}_k = -\frac{\partial H}{\partial p_k} \) \& \( \dot{p}_k = \frac{\partial H}{\partial q_k} \)
3. \( \dot{q}_k = \frac{\partial H}{\partial p_k} \) \& \( \dot{p}_k = \frac{\partial H}{\partial p_k} \)
4. \( \dot{q}_k = -\frac{\partial H}{\partial p_k} \) \& \( \dot{p}_k = -\frac{\partial H}{\partial q_k} \)
Question Number : 132  Question Id : 184242432  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Correct Marks : 2  Wrong Marks : 0.66
Which of the following relations among three functions A, B and C, represents Jacobi’s identity?

Options :

1.  \[ [A,[B,C]] + [B,[A,C]] + [C,[A,B]] = 0 \]

2.  \[ [A,[B,C]] + [B,[C,A]] + [C,[A,B]] = 0 \]

3.  \[ [A,[B,C]] - [B,[C,A]] + [C,[A,B]] = 0 \]

4.  \[ [A,[B,C]] + [B,[C,A]] - [C,[A,B]] = 0 \]

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Question Number : 133  Question Id : 184242433  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Correct Marks : 2  Wrong Marks : 0.66
The rest energy of electron and rest energy of proton, respectively, are:

Options :

1.  \[ 0.511 \text{Mev and 914 Mev} \]

2.  \[ 5.11 \text{Mev and 914 Mev} \]

3.  \[ 511 \text{Mev and 914 Mev} \]

4.  \[ 0.511 \text{Mev and 419 Mev} \]

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Question Number : 134  Question Id : 184242434  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3
Correct Marks : 2  Wrong Marks : 0.66
A light source is switched on and switched off at a constant frequency (f). An observer moving with a velocity (v) with respect to the light source will observe the frequency of the switching to be:

Options :

1.  \[ f \left(1 - \frac{v^2}{c^2}\right)^{-1} \]
2. \[ f \left(1 - \frac{v^2}{c^2}\right) \]

3. \[ f \left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}} \]

4. \[ f \left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} \]

Question Number : 135  Question Id : 184242435  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66

A particle of mass \(m\) is moving in the potential \(V(x) = \frac{1}{2} ax^2 + \frac{1}{4} bx^4\), where \(a, b\) are positive constants. The frequency of small oscillations about a point of stable equilibrium is:

Options :

1. \(\frac{2a}{m}\)

2. \(\frac{\sqrt{a}}{2m}\)

3. \(\frac{\sqrt{3a}}{m}\)

4. \(\frac{\sqrt{6a}}{m}\)

Question Number : 136  Question Id : 184242436  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66

Which of the following is NOT an example of Axial vector?

Options :

1. Angular momentum

2. Torque
3. ✗ Magnetic field

4. ✓ Electric field

Question Number : 137  Question Id : 184242437  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66
The value of div $\vec{r}$ (where $\vec{r}$ is position vector) is:
Options :
1. ✗ 1

2. ✗ 0

3. ✓ 3

4. ✗ 2

Question Number : 138  Question Id : 184242438  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  Correct Marks : 2  Wrong Marks : 0.66
The ‘Gauss Divergence’ theorem is represented as:
Options :
1. ✓ $\iiint A \cdot d\vec{s} = \iiint (\text{div } A) \, dv$

2. ✗ $\iint (\text{Curl } A) \cdot d\vec{s} = \oint A \cdot d\vec{l}$

3. ✗ $\iint (\text{div } A) \, d\vec{s} = \oint A \cdot d\vec{l}$

4. ✗ $\iint A \cdot d\vec{s} = \iiint (\text{grad } A) \, dv$
The argument of quotient of two complex numbers is the:

Options:

1. $\text{quotient of their arguments}$

2. $\text{sum of their arguments}$

3. $\text{product of their arguments}$

4. $\text{difference of their arguments}$

If $V$ is a scalar field and $\vec{A}$ a vector field, then the value of $\text{div}(V\vec{A})$ is:

Options:

1. $\text{grad } V \cdot \vec{A} + V \text{ div } \vec{A}$

2. $\text{grad } V \cdot \vec{A} + V \text{ curl } \vec{A}$

3. $V \text{ div } \vec{A}$

4. $\text{grad } V \cdot \vec{A}$

The expression of $x$ in terms of Hermite polynomials is:

Options:

1. $x = \frac{1}{2} H_1(x)$
2. \( x = H_1(x) \)

3. \( x = H_0(x) \)

4. \( x = \frac{1}{2} H_0(x) \)

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**Question Number : 142  Question Id : 184242442  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3**

**Option Orientation : Vertical**

Correct Marks : 2 Wrong Marks : 0.66

The Cauchy - Riemann conditions for a complex function \( f(z) = u(x,y) + iv(x,y) \) is:

Options :

1. \( \frac{\partial v}{\partial x} = \frac{\partial u}{\partial y} \)

2. \( \frac{\partial u}{\partial y} = \frac{\partial v}{\partial y} \)

3. \( \frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}, \frac{\partial v}{\partial x} = -\frac{\partial u}{\partial y} \)

4. \( \frac{\partial u}{\partial x} = -\frac{\partial v}{\partial y}, \frac{\partial v}{\partial x} = \frac{\partial u}{\partial y} \)

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**Question Number : 143  Question Id : 184242443  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3**

**Option Orientation : Vertical**

Correct Marks : 2 Wrong Marks : 0.66

The value of \( \frac{1+i}{1-i} \) is:

Options :

1. \( 1 \)

2. \( 0 \)
3. $\checkmark$ i

4. $\times$ -i

Question Number : 144  Question Id : 184242444  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  
Correct Marks : 2  Wrong Marks : 0.66  
If A and B are two events then according to theorem of total probability, the probability of event $(A+B)$ is expressed as:  
Options :

1. $\times$ $P(A+B) = P(A) - P(B) + P(AB)$

2. $\checkmark$ $P(A+B) = P(A) + P(B) - P(AB)$

3. $\times$ $P(A+B) = P(A) + P(B) - P(A/B)$

4. $\times$ $P(A+B) = P(A) - P(B) + P(B/A)$

Question Number : 145  Question Id : 184242445  Question Type : MCQ  Option Shuffling : Yes  Negative Marks Display Text : 2/3  Option Orientation : Vertical  
Correct Marks : 2  Wrong Marks : 0.66  
An object falls freely under gravity, starting from rest and falls for 10 sec. If the time measurement has uncertainty of 0.05 sec and acceleration due to gravity $(g)$ is $10 \, \text{m/sec}^2$, then uncertainty in the distance fallen is:

Options :

1. $\times$ 10 m

2. $\checkmark$ 5 m

3. $\times$ 3 m

4. $\times$ 2 m
The general solution of the given equation $\frac{dy}{dt} = Ay$ is:

Options:

1. $y = Ce^{At}$
2. $y = Ce^{-At}$
3. $y = Ce^{At^2}$
4. $y = Ce^t$

If $V(x, y, z) = 3x^2y - yz^2$, then the grad $V$ at the point $(1, 2, -1)$ is:

Options:

1. $10\hat{i} + \hat{j} + 4\hat{k}$
2. $12\hat{i} + 2\hat{j} + 4\hat{k}$
3. $2\hat{i} + 12\hat{j} + 4\hat{k}$
4. $4\hat{i} + 2\hat{j} + 12\hat{k}$

For any square matrix $A$, which of the following is NOT Hermitian?

Options:

1. $(A + A^*)$
2. \((AA^+)\)

3. \((A^+A)\)

4. \((A - A^+)\)

The product of the eigenvalues of the matrix 

\[
\begin{pmatrix}
\alpha & 1 & 0 \\
0 & \beta & 1 \\
0 & 0 & \delta
\end{pmatrix}
\]

is:

Options:

1. \(\propto \beta^2 \delta\)

2. \(\propto \delta^2 \beta\)

3. \(\beta \delta^2 \propto\)

4. \(\propto \beta \delta\)

The Fourier transform of the Dirac delta function \(\delta(x)\) is:

Options:

1. \(\frac{1}{2\pi}\)

2. \(\frac{1}{\sqrt{\pi}}\)
3. \( \frac{1}{\sqrt{2\pi}} \)

4. \( \frac{\pi}{2} \)