ENTRI

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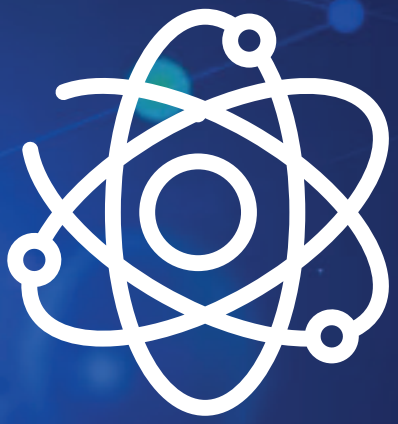


SET PHYSICS 100 FREE QUESTIONS

1. **How does the intensity affect the photoelectric current?**

A) As intensity increases, the photoelectric effect increases
B) As the intensity increases, the photoelectric effect decreases
C) As the intensity decreases, the photoelectric effect becomes twice
D) No effect

Answer: A) As intensity increases, the photoelectric effect increases

Solution:

- Each incident photon ejects one photoelectron from a metal surface.
- Therefore, the number of photoelectrons emitted depends on the number of photons falling on the metal surface, which in turn depends on the intensity on the incident light.
- Hence, as the intensity increases, the number of photoelectrons ejected increases and hence photoelectric current increases.

2. **An iron rod is heated. The colours at different temperatures are noted. Which of the following colours shows that the iron rod is at the lowest temperature?**

A) Red
B) Blue
C) White
D) Yellow

Answer: A) Red

Solution:

- As the body gets hotter, the frequency of the emitted radiation keeps on increasing.
- Blue colour has the highest frequency out of red, yellow and white.
- Thus, as the iron rod gets heated first it would become red, then yellow, then white.

3. **The Cartesian system in two dimensions is also called as.....**

A) Circular coordinate system
B) Rectangular coordinate system
C) Spherical coordinate system
D) Space coordinate system

Answer: B) Rectangular coordinate system

Solution:

- A Cartesian coordinate system in two dimensions also called a rectangular coordinate system or an orthogonal coordinate system.
- It is defined by an ordered pair of perpendicular lines (axes), a single unit of length for both axes, and an orientation for each axis.
- The rectangular coordinate system consists of two real number lines that intersect at a right angle.
- The horizontal number line is called the x-axis, and the vertical number line is called the y-axis.

4. **A charge is placed in a square container. The position of the charge with respect to the origin can be found by:**

A) Circular system
B) Cartesian system
C) Spherical system
D) Space coordinate system

Answer: B) Cartesian system

Solution:

- Since the container possesses dimensions of a square (length, breadth and height), it can be found by Cartesian system.
- A Cartesian coordinate system in two dimensions (also called a rectangular coordinate system or an orthogonal coordinate system) is defined by an ordered pair of perpendicular lines (axes), a single unit of length for both axes, and an orientation for each axis.

5. **Which of the following is a stable nucleus?**

A) The nucleus with even protons and odd electron

B) The nucleus with even number of protons and neutrons

C) The nucleus with even neutrons and odd protons

D) The nucleus with odd protons and neutrons

Answer: B) The nucleus with even number of protons and neutrons

Solution:

- The nuclei of atoms having even numbers of both protons and neutrons are the most stable ones.
- This also means that they are less radioactive than nuclides containing even numbers of protons and odd numbers of neutrons.
- These have a binding energy of the order of 8 MeV per nucleon.

6. An example of the spherical system in the following is .....

A) Charge in box

B) Charge in space

C) Uncharged system

D) Charge in dielectric

Answer: B) Charge in space

Solution:

- Space charge is an interpretation of a collection of electric charges.
- Here excess electric charge is treated as a continuum of charge distributed over a region of space rather than distinct point-like charges.
- From a point charge +Q, the electric field spreads in all 360 degrees. The calculation of the electric field, in this case, will be a spherical system.

7. The cylindrical coordinate system is also referred to as?

A) Circular system

B) Cartesian system

C) Space system

D) Spherical system

Answer: A) Circular system

Solution:

- The cylindrical coordinates (r, φ, z) is also called as circular system and is used for systems with circular dimensions.
- A three-dimensional coordinate system that is used to specify a point's location by using the radial distance, the azimuthal, and the height of the point from a particular plane is known as a cylindrical coordinate system.
- This coordinate system is useful in dealing with systems that take the shape of a cylinder.

8. Given the matrices

; $A=\begin{bmatrix} 1 & -2 & 3 \\ 2 & 4 & -1 \end{bmatrix}$,$B=\begin{bmatrix} 5 \\ 2 \\ -3 \end{bmatrix}$. **Indicate whether the product AB is defined or not, if defined what is the order of the matrix product?**

A) Defined,2×1

B) Defined,1×2

C) Defined,3×3

D)Not defined

Answer: A) Defined,2×1

Solution:

- A matrix is a rectangular array or table of numbers, symbols, or expressions, arranged in rows and columns, which is used to represent a mathematical object or a property of such an object.

; $A=\begin{bmatrix} 1 & -2 & 3 \\ 2 & 4 & -1 \end{bmatrix}$,$B=\begin{bmatrix} 5 \\ 2 \\ -3 \end{bmatrix}$

- Since A is of order 2×3
- and B is of the order 3×1
- The product AB is defined and is of order 2×1

9. Which of the following criteria is used to choose a coordinate system?

A) Geometry

B) Distance

C) Magnitude

D) Intensity

Answer: A) Geometry

Solution:

- A coordinate system is a system that uses one or more numbers, or coordinates, to uniquely determine the position of the points or other geometric elements on a manifold such as **Euclidean space.**
- The selection of the coordinate system is based on the **geometry** of the coordinate system.
- When we consider a positive point charge, the electric field spreads from it in all directions.
- Hence here we consider a spherical system.

10. A particle of mass m moving with a velocity 1m/s collides perfectly elastically with another particle of mass 2m (at rest). If the incident particle is reflected by $90\ degrees$, the heavy mass will make an angle with the initial direction of m, equal to?

A) 30 degrees

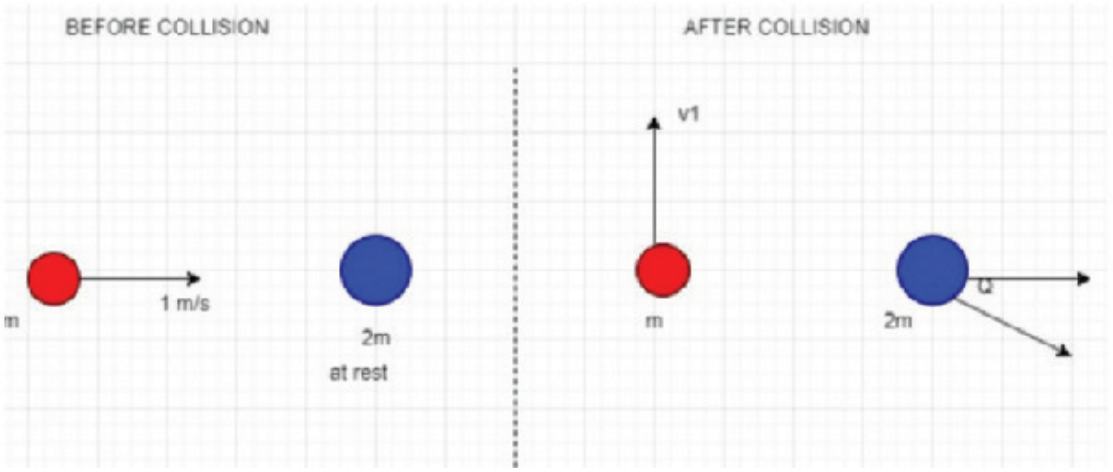
B) 90 degrees

C) 60 degrees

D) 45 degrees

Answer: A) 30 degrees

Solution:



- Since the particles are colliding elastically, both the momentum and the energy must be conserved.
- When we consider the momentum along the x-axis, then

$$m(1) + 0 = mv_2 cos\Theta$$

$$m(1) = mv_2 cos\Theta$$

$$(1) = v_2 cos\Theta$$

$$v_2 = \frac{1}{2Cos\Theta}$$

$$v_2 = \frac{Sec\Theta}{2}$$

- This is the velocity of the heavier mass.
- When we consider the momentum along the y direction, then

$$0 - mv_1 + m(-v_2 Sin\Theta)$$

$$v_1 - 2v_2 Sin\Theta$$

$$v_1 = 2\frac{Sec\Theta}{2} Sin\Theta$$

$$v_1 - Sec\Theta Sin\Theta$$

$$v_1 - tan\Theta$$

- Since the collisions are elastic, the total kinetic energy is conserved, hence the change in kinetic energy will be zero.

$$\Delta K.\ E = 0$$

- Kinetic energy before collision = Kinetic energy after collision

$$\frac{1}{2}m(1)^1 = \frac{1}{2}mv_1^1 + \frac{1}{2}2mv_2^1$$

$$\frac{1}{2}(1)^1 = \frac{1}{2}tan^2\Theta + \frac{1}{2}2Sec^2\Theta/4$$

$$(1)^1 = tan^2\Theta + 2mSec^2\Theta/4$$

$$(1)^1 = tan^2\Theta + (1 + tan^2\Theta)/2$$

$$\frac{1}{2} = \frac{3}{2}tan^2\Theta$$

$$\Theta = tan^{-}\frac{1}{\sqrt{3}}$$

$$\Theta = 30^0$$

11. **The minimum energy required to remove an electron from the metal surface is?**

A) Stopping potential
B) Work function
C) Kinetic energy
D) None of the above

Answer: B) Work function

Solution:

- The value of retarding potential at which the photo electric current is zero are called stopping potential.
- The minimum energy required to remove an electron from the metal surface is the work function.
- The maximum energy of the ejected electrons from the metal surface after ejection is called maximum kinetic energy.

12. **Although there are indications of a non-zero rest mass for the neutrinos, often they are assumed to be massless. What will be the relative velocity of a neutrino approaching a photon head on? approaching a photon head on?**

A) c
B) 2c
C) 0
D) √2c

Answer: A) c

Solution:

- Neutrinos are generally assumed to be massless quantities, but in reality they have mass.

- If photons had rest mass, they would move slower than the constant c that governs transformations between moving coordinate systems.
- c is customarily called the "speed of light" but, if photons had rest mass, they would move at less than c; we would have to give c another name (probably "Einstein's constant").

13. **A periodic and repeating disturbance exists on the surface of a lake which generates waves travelling outward from the point of disturbance in the form of circular waves. The frequency of the disturbance is 10 Hz. The velocity of the waves on the surface is 5 m/s. What is the minimum distance between particles of the medium which remain stationary?**

A) 5 m
B) 0.25 m
C) 2.5 m
D) 0.5 m

Answer: B) 0.25 m

Solution:

- The frequency of disturbance = 10 Hz
- The velocity of the waves on the surface= 5 m/s.
- The minimum distance between particles of the medium which remain stationary

= 25/100

=0.25 m

14. If A is a square matrix, then what can we tell about the trace of the matrix?

A) Is equal to the sum of the Eigen values.
B) Is equal to the product of the eigen values.
C) Is equal to the difference of the Eigen values.
D) None of these

Answer: A) Is equal to the sum of the Eigen values.

Solution:

- For a Matrix, the trace of the matrix is the sum of the diagonal elements.
- And it is equal to the sum of the eigen values of the matrix.
- The trace of a square matrix A, denoted tr, is defined to be the sum of elements on the main diagonal of A. The trace is only defined for a square matrix. It can be proved that the trace of a matrix is the sum of its eigenvalues.

15. The quantum numbers s = ½ and s = -½ are the allowed values for the spin components of an electron. What do these represent?

A) Clockwise and anti-clockwise rotation of an electron about its axis respectively.
B) Anti-clockwise and clockwise rotation of an electron about its axis respectively.
C) Magnetic moments of the electron pointing up and down respectively.
D) Two quantum mechanical spin states which do not have classical analog.

Answer: D) Two quantum mechanical spin states which do not have classical analog.

Solution:

- Electron Spin or Spin Quantum Number is the fourth quantum number for electrons in atoms and molecules.
- Denoted as ms, the electron spin is constituted by either upward (ms=+1/2) or downward (ms = −1/2) arrows
- The spin states represent the two quantum mechanical spin states which do not have classical analog.
- The Spin Quantum Number (ms) describes the angular momentum of an electron. An electron spins around an axis and has both angular momentum and orbital angular momentum.

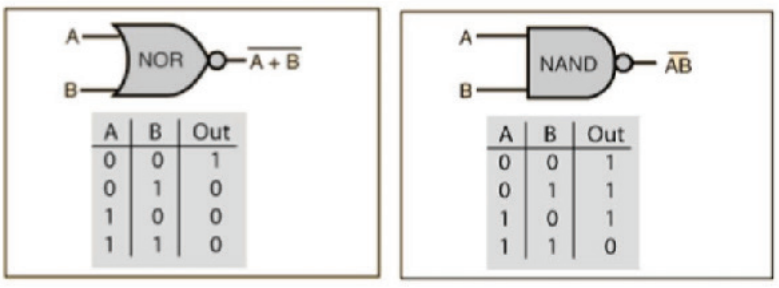
16.Any type of sophisticated logic gates can be constructed using?

A) AND and OR gates only.
B) AND and NOT gates only
C) NAND or NOR gates only.
D) OR and NOT gates only

Answer: C) NAND or NOR gates only.

Solution:

- Any sophisticated logic gate can be constructed using NAND or NOR gates only.
- A logic gate is an idealized or physical device implementing a Boolean function, a logical operation performed on one or more binary inputs that produces a single binary output.
- Logic gates are primarily implemented using diodes or transistors acting as electronic switches, but can also be constructed using vacuum tubes, electromagnetic relays (relay logic) etc.
- Logic circuits include such devices as multiplexers, registers, arithmetic logic units (ALUs), and computer memory, all the way up through complete microprocessors, which may contain more than 100 million logic gates.



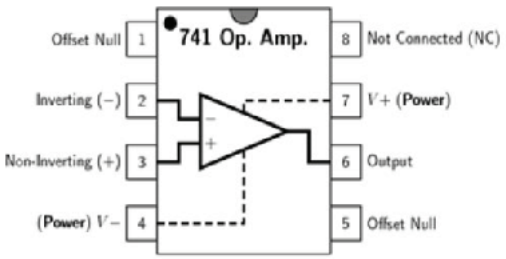
17.An integrating circuit is constructed using an µA741 OP AMP. What are the important components in the circuit apart from the OP AMP?

A) A resistor in series with the input and an inductor as the feedback element.
B) A resistor in series with the input and a capacitor as the feedback element.
C) A capacitor in series with the input and a resistor as the feedback element.
D) A capacitor in series with the input and an inductor as the feedback element.

Answer: B) A resistor in series with the input and a capacitor as the feedback element.

Solution:

A) The 741 Op Amp IC is a monolithic integrated circuit, comprising of a general purpose Operational Amplifier.
B) An Operational Amplifier, or op-amp for short, is fundamentally a voltage amplifying device designed to be used with external feedback components such as resistors and capacitors between its output and input terminals.
C) It consists of a resistor in series with the input and a capacitor as the feedback element.



18.What do the reciprocal lattice of a crystal represent?

A) Fourier transform
B) Laplace transform
C) Fourier series
D) Laplace series

Answer: A) Fourier transform

Solution:

- The original lattice is a periodic spatial function in real space.
- Whereas the reciprocal lattice exists in reciprocal space.
- The reciprocal lattice is the Fourier transform of the original lattice.

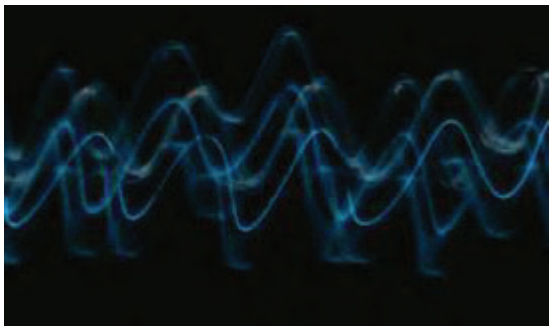
19.Which of the pairs is incorrect?

A) Water waves- Height of the waves
B) Sound waves- Temperature
C) Light- Electric and magnetic field
D) All of these

Answer: B) Sound waves- Temperature

Solution:

- The quantity whose variations are responsible for the formation of matter waves is called the wave function.
- This wavefunction is denoted by symbol \(\Psi\).
- In the case of sound waves, it is the pressure that varies.
- Sound waves are created by object vibrations and produce pressure waves.



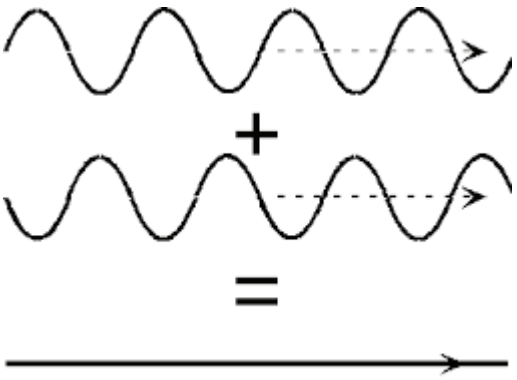
20. **What kind of interference undergoes at the point where there is minimum probability of finding the particle?**

A) Destructive interference
B) Constructive interference
C) No interference at all
D) None of these

Answer: A) Destructive interference

Solution:

- At the point where the probability of finding the particle is minimum, the amplitude of the resultant wave will be minimum.
- This is because the waves will undergo destructive interference at that point.
- Hence the probability of finding the particle at that point is zero. The amplitude at that point is also zero.



21.What all ideas one can get from the 1st law of thermodynamics?

A) The existence of internal energy function.
B) The principle of conservation of energy.
C) The definition of heat as energy in transit due to temperature difference.
D) All of these

Answer: D) All of these

Solution:

- As, per the first law of thermodynamics, the heat added to a system is equal to the increase in the internal energy of the system plus the work done by the system.

  dQ= dU+ dW

- It tells us about the conservation of energy.
- Also depicts the exitance of internal energy.
- Apart from that, the definition of heat as energy in transit due to temperature difference.

22.Chemical potential governs the flow of ……between two systems?

A) Heat
B) Particles
C) Internal energy
D) None of these

Answer: B) Particles

Solution:

- Chemical potential governs the flow of particles between two systems.
- It is found in the system that can exchange both energy as well as particles.
- Which means that the system must be in diffusive contact.

23. When we can represent the thermodynamic variable of a system, as the sum of the subsystems in it, then it is said to be ..... variable.

A) Extensive
B) Intensive
C) Open
D) Closed

Answer: A) Extensive

Solution:

- A thermodynamical system can be open, closed or isolated.
- Each thermodynamical system has been defined by several thermodynamical variables.
- These variables can be either intensive or extensive.
- When the thermodynamic variable of the system can be expressed as the sum of variables of the subsystem, then it is said to be Extensive variable. Example- Entropy, momentum.
- But when the thermodynamic variable of the entire system is the that of the individual system, then it is said to be intensive variable. Example - Temperature, pressure.

24. Which of the below given do not have the same dimensions?

A) Angular momentum and action
B) Lagrangian and Hamiltonian
C) Momentum and Impulse
D) Density and specific gravity

Answer: D) Density and specific gravity

Solution:

- Density is defined as mass per unit volume of a substance.
- The dimension of Density= Mass/ Density
- Specific gravity is defined as the ratio of density of a substance relative to the density of another reference material.
- It is a dimensionless quantity.

25. Which among the following statements is wrong if n is the number of events?

E) Binomial distribution is a limiting case of normal distribution when n is large
F) Normal distribution is a limiting case of Binomial distribution when n is large
G) Poisson distribution is a limiting case of binomial distribution when n is large
H) For normal distribution the mean, the mode and the median coincide.

Answer: A) Binomial distribution is a limiting case of normal distribution when n is large.

Solution:

- When n is the number of events, then Binomial distribution is a limiting case of normal distribution when n is large.
- The binomial distribution with parameters n and p is the discrete probability distribution of the number of successes in a sequence of n independent experiments.
- Each asking a yes–no question, and each with its own Boolean-valued outcome: success or failure.

26. Number of degrees of freedom for a particle constrained to be stationary at the point x= 1, y = -1 in the XY plane is ---------.

A) 3
B) 2
C) 1
D) None of these

Answer: D) None of these

Solution:

- Degrees of freedom refers to the maximum number of logically independent values, which are values that have the freedom to vary, in the data sample.
- Degrees of freedom is calculated by subtracting one from the number of items within the data sample.
- Since, the particle is stationary at x= 1 and y= −1.

27. The number of normal modes for a two coupled one dimensional oscillator is ------.

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

Answer: B) 2

Solution:

- Coupled Oscillations occur when two or more oscillating systems are connected in such a manner as to allow motion energy to be exchanged between them.
- Coupled oscillators occur in nature (e.g., the moon and earth orbiting each other) or can be found in man-made devices (such as with the pacemaker).
- A normal mode of an oscillating system is a pattern of motion in which all parts of the system move sinusoidally with the same frequency and with a fixed phase relation.
- For two coupled 1-D oscilator, the no. of normal modes is 2.

28. Photoelectrons stopping potential depends on?

A) Frequency of incident light and nature of the cathode material
B) The intensity of the incident light
C) The frequency of the incident light
D) Nature of cathode material

Answer: A) Frequency of incident light and nature of the cathode material

Solution:

- Stopping potential for photoelectrons depends on both the frequency of the incident light and nature of the cathode material.
- The stopping potential does not depend on the intensity nor the number of incident photons but the stopping potential depends on the frequency of the incident light.
- the higher the frequency of the incident light higher the stopping potential or cut potential.

29. Density of a nucleus depends on the?

A) Mass number
B) Atomic number
C) Number of neutrons
D) None of these

Answer: D) None of these

Solution:

- The density of the nucleus of an atom is, on average, about 2.3×1017 kg/m3. This is called nuclear density. It is the same for all the nuclei.
- Density of the nucleus is independent of atomic mass, mass number, and the number of neutrons.
- The density of a nucleus is constant for all the elements.

30. As the wavelength increases, the energy emitted from the black body radiation will .....first and then.....

A) Increase, become constant
B) Increase, decreases.
C) Decrease, increases
D) None of these

Answer: B) Increase, decreases.

Solution:

- Black body: Those type of body that neither reflect nor transmits but absorbs the whole of the heat radiation called the black body.
- Energy distribution of black body radiation state that when wavelength increases, the energy emitted from the black body radiation will also be increasing.
- As the wavelength increases, the energy emitted increases and reaches the maximum height. After this point, it started decreasing gradually.

31. Which of the statement is true for a perfect black body?

A) Absorbs all the incident radiation
B) Allow all the incident radiation to pass through it
C) Reflects all the incident radiation
D) Has its surface coated with lamp black or graphite

Answer: A) Absorbs all the incident radiation

Solution:

- A black body or blackbody is an idealized physical body that absorbs all incident electromagnetic radiation, regardless of frequency or angle of incidence.
- The name "black body" is given because it absorbs all colours of light.
- A black body is a perfect emitter and absorber.

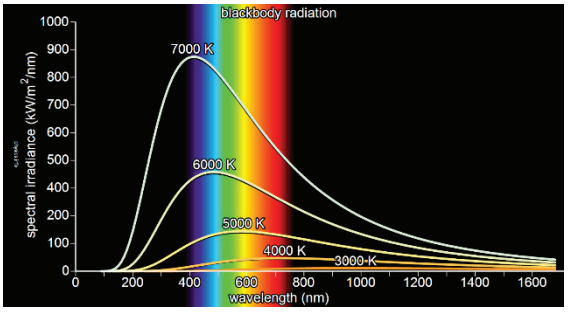
32. **A black body can absorb radiations of _.**

A) Higher wavelength only
B) Lower wavelength only
C) Intermediate wavelength only
D) All wavelengths

Answer: D) All wavelengths

Solution:

- A black body or blackbody is an idealized physical body that absorbs all incident electromagnetic radiation, regardless of frequency or angle of incidence.
- A black body is an object that absorbs all the radiant energy reaching its surface.
- It absorbs the incident radiation of all wavelength falling on it.
- It emits the maximum amount of thermal radiation at all wavelength at any specified temperature.



33. Which of the following is associated with an electron microscope?

A) Matter waves
B) Electrical waves
C) Magnetic waves
D) Electromagnetic waves

Answer: A) Matter waves

Solution:

- The waves associated with microscopic particles when they are in motion are called matter waves.
- Electron microscope makes use of the matter waves associated with fast moving electrons.
- Matter waves are **a central part of the theory of quantum mechanics, being half of** wave–particle duality. All matter exhibits wave-like behaviour.
- A wave is associated with each moving particle which is called a matter-wave. A wave transports information or energy in the manner of signals from one point towards another, although no tangible thing travels with it.

34.Which of the following is not a property of photon?

A) Charge
B) Velocity
C) Energy
D) Momentum

Answer: A) Charge

Solution:

- A photon is a subatomic particle that carries the electromagnetic force.
- It has zero charge.
- The energy of a photon is given by, $E= h\upsilon$
- The momentum of a photon is given by, $P= h/\upsilon$

35. The Einstein's photoelectric equation is $h\upsilon=\Phi+K$. Which of the following is represented by K?

A) Minimum kinetic energy of electrons
B) Maximum kinetic energy of electrons
C) Mean kinetic energy of electrons
D) None of these

Answer: Maximum kinetic energy of electrons

Solution:

- When the photons fall on a metal surface then some electrons get ejected from the metal surface. This phenomenon is called the photoelectric effect.
- The minimum energy needed to remove electrons from the metal surface is called work function of the metal.
- The maximum energy of ejected electrons from the metal surface after ejection is called maximum kinetic energy.
- Einstein's equation of photoelectric effect is $h\upsilon=\Phi+K$.

36. During Einstein's Photoelectric Experiment, what changes are observed when the frequency of the incident radiation is increased?

A) The value of saturation current increases
B) The value of stopping potential decreases
C) The value of stopping potential increases
D) No effect

Answer: The value of stopping potential increases

Solution:

- As the frequency of the incident radiation increases, the kinetic energies of the emitted electron increase as well and therefore requires more repulsive force to be applied to stop them.
- Thus, the stopping potential increases.
- The value of saturation current increases, as the intensity of the incident radiation, increases.
- The value of stopping potential decreases, as the frequency decreases.

37. Light of wavelength 3500 Å is incident on two metals A and B. Which metal will yield more photoelectrons if their work functions are 5 eV and 2 eV respectively?

A) A
B) B
C) A & B
D) Can't determine

Answer: B) B

Solution:

- The photoelectric effect occurs when electrons are released after light is shone onto a metal.

- Electrons released in this way are called photoelectrons, which leads to the name photoelectric effect.
- According to classical physics, this happens because energy is transferred to the electrons from the light

- Since the work function of metal A is higher, it will not yield any photoelectrons. Hence, only metal B will yield photoelectrons.

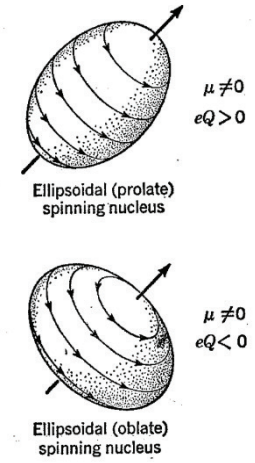
38) Which nuclei has zero spin?

A) Even mass nuclei composed of odd numbers of protons and neutrons
B) Even mass nuclei composed of even numbers of protons and neutrons
C) Even mass nuclei composed of even number of protons and odd number of neutrons
D) Even mass nuclei composed of odd number of protons and even number of neutrons

Answer: B) Even mass nuclei composed of even numbers of protons and neutrons

Solution:

- For a nucleus of which the numbers of protons and of neutrons are both even in its ground state (i.e. lowest energy state), the nuclear spin and magnetic moment are both always zero.
- Even mass nuclei composed of even numbers of protons and neutrons have zero spin (I = 0). Examples are Carbon-12 and Oxygen-16.
- For a nucleus of which the numbers of protons and of neutrons are both even in its ground state (i.e. lowest energy state), the nuclear spin and magnetic moment are both always zero.



39. Concerning nuclear spin (I), which of the following is true?

A) Spin is due to rotation of the nucleus about its axis.
B) Protons have spin, but neutrons do not.
C) Spin can only have integer or half-integer values.
D) Another name for spin is "precession".

Answer: Spin can only have integer or half-integer values.

Solution:

- Spin is a fundamental quantum property of subatomic particles and does not result from their physical rotation. Many subatomic particles besides the proton have spin, including the neutrons and electrons.
- Spin is quantized and can take on a limited number of discrete values, so (c) is true.
- When placed in an external magnetic field, nuclear spin results in precession, but spin and precession are not the same.

40. Which of the following spins (I) could a nucleus not possess?

A) 0
B) ½
C) ¾
D) 5

Answer: C) ¾

Solution:

- Quantum mechanics restricts nuclear spin to only integer or half-integer (1/2, 3/2, 5/2, etc) values, so I = 3/4 is not permitted.
- It is common practice to represent the total angular momentum of a nucleus by the symbol I and to call it "nuclear spin".
- Spin was a natural consequence of the 1928 relativistic quantum mechanical equation of Paul Dirac.

41. **Concerning nuclear spin (I), which of the following statements is false?**

A) Protons and neutrons each have spin = ½.

B)To determine net nuclear spin (I), you simply add up the number of protons and neutrons and divide by 2.

C)Different isotopes of the same element commonly have different nuclear spins.

D) Every element has at least one isotope with non-zero spin.

Answer: B) To determine net nuclear spin (I), you simply add up the number of protons and neutrons and divide by 2.

Solution:

- Ccsq dq0058SDEEESAZDXsimple formula for I exists as interactions between more elementary components (quarks and gluons) must be considered. The other statements — a), c) and d) — are all true.

42. An electric dipole is placed inside a cube. What will be the nature of electric flux from the cube surface?

A) Coming out of the surface

B) Coming in towards the surface
C) No flux at all
D)Coming out from one half and coming inwards in another half

Answer: C) No flux at all

Solution:

- An electric dipole consists of two point charges.The amount of charges is the same but their polarities are different.
- Therefore the sum of total charges in a dipole is always 0.
- But flux from a closed surface is related to the total charge inside a surface.
- As the total charge inside the cube is zero, so there will be no flux coming out or going in towards the surface.

43. Quadrupole moment for prolate spheroid charge distribution is _.

A) 0
B) > 0
C) < 0
D) Not defined

Answer: B) > 0

Solution:

- Prolate spheroid particle model is made from rotating an ellipse with the longest dimension (the major axis) 2a and shortest dimension (the minor axis) 2b around the major axis.
- For a nucleus in the form of a prolate ellipsoid elongated along the spin, the quadrupole moment has a positive value.
- That is Q >> 0

44. A spin-1/2 particle A undergoes the delay A → B + C + D, where it is known that B and C are also spin-1/2 particles. The complete set of allowed values of the spin of the particle D is-

A) 1/2 , 1, 3/2, 2, 5/2, 3....
B) 0, 1
C) 1/ 2 Only
D) 1/2, 3/2, 5/ 2, 7/2

Answer: C) 1/ 2 Only

Solution:

- Spin of the left side and combined spin of the products must be same to conserve the spin angular momentum conservation law.
- Atomic nucleus is a particle of subatomic scale. Thus, it can be described by a set of "quantum properties".
- One of them is called "nuclear spin", which fundamentally is related to the sensitivity of the nucleus to the effects of external magnetic fields.

45. In the large hadron collider (LHC), two equal energy proton beams traverse in opposite directions along a circular path of length 27 km. If the total centre of mass energy of a proton-proton pair is14 TeV, which of the following is the best approximation for the proper time taken by a proton to traverse the entire path?

A) 12 ns
B) 1.2 micro sec
C) 1.2 ns
D) 0.12 micro sec

Answer: A) 12 ns

Solution:

- The proton travel at nearly speed of light in LHC, therefore

$$t \approx \frac{d}{c} = \frac{27\times10^{3}}{3\times10^{8}} \approx 9\times10^{-5} \text{ sec}$$

Since, proton is relativistic, $t_0 = t\sqrt{1-\frac{v^2}{c^2}} = \frac{t}{\gamma}$

$$\because E = \gamma m_0 c^2 \Rightarrow \frac{1}{\gamma} = \frac{m_0 c^2}{E} = \frac{938\ MeV}{7\ TeV} = \frac{938\times10^{6}\ eV}{7\times10^{12}\ eV} = 1.34\times10^{-4}$$

Thus, $t_0 = \frac{t}{\gamma} = 9\times10^{-5}\times1.34\times10^{-4} = 12\times10^{-9}$ sec $= 12\ ns$

46.

Consider the three vectors $\vec{v}_1 = 2\hat{i} + 3\hat{k}, \vec{v}_2 = \hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{v}_3 = 5\hat{i} + \hat{j} + a\hat{k}$ where $\hat{i}, \hat{j}$ and $\hat{k}$ are the standard unit vectors in a three-dimensional Euclidean space. These vectors will be linearly dependent if the value of a is

(a) $\frac{31}{4}$ (b) $\frac{23}{4}$ (c) $\frac{27}{4}$ (d) 0

Answer: (a)

Given vector will be linearly dependent if the determinant of the matrix formed by taking these vectors as column is zero.

$$\begin{vmatrix} 2 & 1 & 5 \\ 0 & 2 & 1 \\ 3 & 2 & a \end{vmatrix} = 0 \Rightarrow 2(2a-2)-(-3)+5(-6)=0$$

$$\Rightarrow 4a-4+3-30=0 \Rightarrow 4a-31=0 \Rightarrow a=\frac{31}{4}$$

47. **Which of the following statements concerning the coefficient of volume expansion α and the isothermal compressibility κ of a solid is true?**

A) α and κ are both intensive variables
B) α is an intensive and κ is an extensive variable
C) α is an extensive and κ is an intensive variable
D) α and κ are both extensive variables

Answer: α and κ are both intensive variables

Solution:

$$\alpha = \frac{1}{V}\left(\frac{dV}{dT}\right), \kappa = -\frac{1}{V}\left(\frac{\partial P}{\partial V}\right)_T$$ both are intensive property

- Physical properties of materials and systems can often be categorized into two.
- They are intensive and extensive property.
- An intensive property is **a physical property of a system that does not depend on the system size or the amount of material in the system**.

THANK YOU

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