Agniveer Vayu Science (Group X) - 4 Nov 2020 - Memory Based Paper

Physics

Question 1

The electrostatic force between two charges of 6 C and 2 C separated by some distance is 12 N. If -4 C charge is added to each of them then find the new magnitude of force between them (distance between the charges remains same).

Options:

A. 12 N

B. 6 N

C. 4 N

D. 2 N

Answer: C

Solution:

CONCEPT:

- **Coulomb's law**: When two charged particles of charges $q_1$and $q_2$are separated by a distance r from each other then the**electrostatic force**between them**is directly proportional to the multiplication of charges of two particles and inversely proportional to the square of the distance between them**.

Force (F) ∝ $q_1 \times q_2$

$F \propto \frac{1}{r^2}$

$F = K\frac{q_1 \times q_2}{r^2}$

Where K is a constant = $9 \times 10^9 Nm^2/C^2$

CALCULATION:

Given that:

q_1= 6 C and q_2= 2 C

Force (F) = 12 N

$F = K\frac{q_1 \times q_2}{r^2}$

$12 = K\frac{6 \times 2}{r^2}$

$\frac{K}{r^2} = 1$

Now - 4C charge is added to each of them:

New charges,q_1= 6 C + (- 4 C) = 2 C

And q_2= 2 C + (-4 C) = - 2 C

The **new force (F')** will be:

$F' = K\frac{2 \times (-2)}{r^2} = -\frac{4K}{r^2} = -4 \times 1 = -4N$ (**Since K/r^2**= 1)

Thus **magnitude of new electrostatic force (F') = 4 N**

Hence option 3 is correct.

Question 2

The relation between frequency ‘f’ wavelength ‘λ’ and velocity of propagation ‘v’ of the wave is

Options:

A. λ = f × ν

B. f = λ ÷ ν

C. ν = f × λ

D. λ = f ÷ ν

Answer: C

Solution:

CONCEPT:

- **Wavelength (λ)** is equal to the distance traveled by the wave during the time in which any one particle of the medium completes one vibration about its mean position. It is the length of one wave.
- **Frequency (f)** of vibration of a particle is defined as the number of vibrations completed by the particle in one second. It is the number of complete wavelengths traversed by the wave in one second.
- The relation between **velocity, frequency, and wavelength** is given by **-** $v = f\times \lambda$

📌 Important Points

- The frequency is the property of the source. It does not change by changing the medium.
- The wavelength and velocity of waves can change by changing the medium.

Question 3

Which logic gate will produce the following output?

Input		Output
A	**B**	**Y**
0	0	0
0	1	0
1	0	0
1	1	1

Options:

A. OR

B. AND

C. NAND

D. NOR

Answer: B

Solution:

CONCEPT

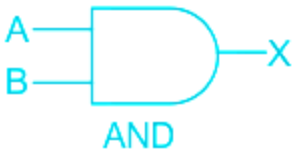
Logic gates:

- It is an**electric circuit**, which works on**simple Boolean algebra**to perform a**logical operation**for**one or more binary inputs**that produce a**single binary output**.

Typesof Logic gates:

AND Gate: If both the inputs are high, it produces a high output.

- The Boolean algebra for AND gate is**X = A. B**



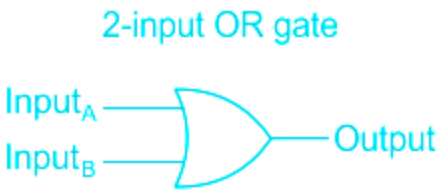
AND gate

Input A	Input B	Output
0	0	0
1	0	0
0	1	0
1	1	1

And NAND gate is opposite of AND gate which means output is one when any of input is 1 whereas if both inputs is 1 output is 0

OR gate: If any of the input is high, it produces a high output.

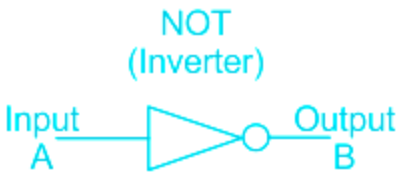
- The Boolean algebra for OR gate is**X = A + B**



A	B	Output
0	0	0
0	1	1
1	0	1
1	1	1

NOT gate: It inverts the input. Whatever the input is given, it changes its value at the output.

- The Boolean algebra for NOT gate is $X = \overline{X}$



A	B
0	1
1	0

Explanation:

From the above explanation, we can see that in our case the output for a given truth table is only possible for **ANDgate.**

Question 4

Which of the following is not a force?

Options:

A. Thrust

B. Impulse

C. Weight

D. Tension

Answer: B

Solution:

The correct option is**Impulse**.

CONCEPT:

- **Force**: The interaction which after applying on a body changes or try to change the state of rest or the state of motion is called force.
- **Thrust**: The**force acting perpendicular to the surface**of the object is called thrust.
- **Impulse (J)**: The change in momentum is called impulse.
    - It is not a force. It is simply the difference between the two momentum.
- **Weight**: The gravitational force acting on any object on the earth's surface is called its weight.
- **Tension in a rope:**In the ideal case rope is**massless and intangible**, the force on one side is equal to force on the other side.

EXPLANATION:

- Since the **impulse is the change in momentum and it is not a force**. Hence option 2 is correct.

Question 5

If $v = at + bt^2$

v is velocity and t in seconds, then the dimension of b is:

Options:

A. LT^0

B. LT^{-1}

C. LT^{-2}

D. LT^{-3}

Answer: D

Solution:

CONCEPT:

Principle of homogeneity of dimensions:

- **According to this principle**, a**physical equation will be dimensionally correct**if the**dimensions of all the terms occurring on both sidesof the equation**are the**same**.
- This principle is based on the fact that only the**physical quantities of the same kind can be added**,**subtracted,**or**compared**.
- Thus,**velocity**can be**added to velocitybut not to force**.

EXPLANATION

Given - $v = at + bt^2$

- From the**principle of dimensional homogeneity,**the**left-hand side of the equation dimensionally equal to the right-hand side**of the equation.
- The**dimension formula of velocity**(v) = $[LT^{-1}]$

$\therefore [LT^{-1}] = [a]\,[T]$

$\Rightarrow [a] = \frac{[LT^{-1}]}{[T]} = [LT^{-2}]$

- Therefore the**dimensionof 'a'**is $[LT^{-2}]$.

For the second term,

$\Rightarrow [LT^{-1}] = [b]\,[T^2]$

$\Rightarrow [b] = \frac{[LT^{-1}]}{[T^2]} = [LT^{-3}]$

- Therefore the**dimensionof 'b'**is$[LT^{-3}]$.

Question 6

The total number of images formed by two mirrors inclined at 72° to each other when the object is placed unsymmetrically will be ___?

Options:

A. 2

B. 3

C. 4

D. 5

Answer: D

Solution:

CONCEPT:

- If the **image of an object is viewed in twoplane mirrors**that are inclined to each other, **more than one image is formed**.
- **The number of images formed when the object is placed between two plane mirrors:**

⇒ θ = Angle between the two plane mirrors, and n = number of images formed

- If $\frac{360}{\theta}$ = even number

$\Rightarrow n = \frac{360}{\theta} - 1$

- If $\frac{360}{\theta}$ = odd number andthe object lies symmetrically

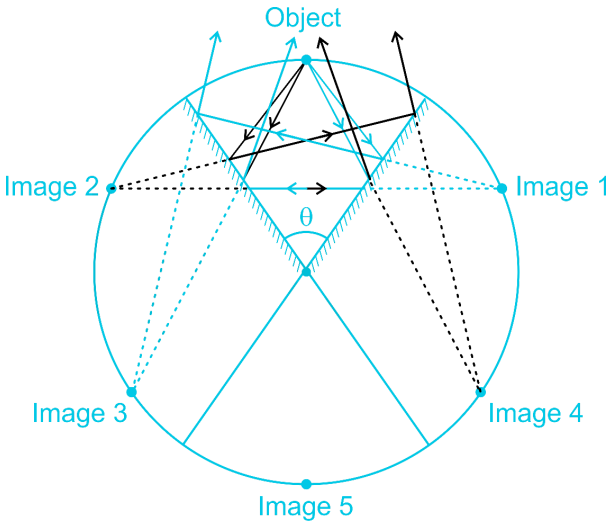
$\Rightarrow n = \frac{360}{\theta} - 1$

- If $\frac{360}{\theta}$ = odd number andthe object lies asymmetrically

$\Rightarrow n = \frac{360}{\theta}$

- If $\frac{360}{\theta}$ = fraction

⇒ n = only integer part of $\frac{360}{\theta}$



CALCULATION:

Given -θ = 72°

The object is placed unsymmetrically

$\Rightarrow$ Number of images $= \frac{360}{\theta} = \frac{360}{72} = 5$

So **option 4**is correct.

Additional Information

- Thefirst mirrorwas made by**German Scientist Justus vonLiebig.**He coated the planesurface of a piece of ordinary glass with silver metal for making this mirror. Such a mirror is called a**silvered glass mirror.**
- **Concave mirror:**If the inner surface of the spherical mirror is the reflecting surface.
- **Convex mirror**:If the outer surface of the spherical mirror is the reflecting surface.

Angle	Number of images formed (n)
30°	11
45°	7
60°	5
120°	2
180°	1
0°	Infinite

Question 7

The mathematical form of the resonant frequency of a LCR circuit is equal to

Options:

A. $\frac{1}{2\pi(LC)}$

B. $\frac{1}{2\pi(LC)^2}$

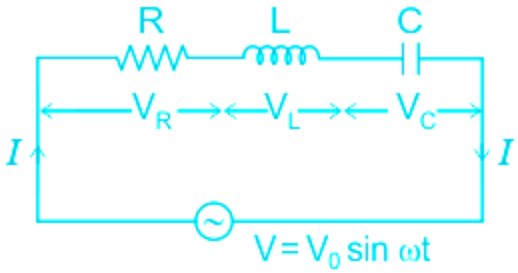
C. $2\pi(LC)$

D. $\frac{1}{2\pi\sqrt{LC}}$

Answer: D

Solution:

CONCEPT:



- The**ac circuit**containing the**capacitor**,**resistor,**and**inductor**is calledan**LCR circuit**.
- For a**series LCR circuit**, the**total potential differenceof the circuit**is given by:

$V = \sqrt{V_R^2 + (V_L - V_C)^2}$

Where V_R= potential difference across R, V_L=potential difference across L and V_C=potential difference across C

- For a**series LCR circuit**,**Impedance (Z) of the circuit**is given by:

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

Where R = resistance, X_L=induvtive reactance and X_C= capacitive reactive

CALCULATION:

- For a**series LCR circuit**,**Impedance (Z) of the circuit**is given by:

$\Rightarrow Z = \sqrt{R^2 + (X_L - X_C)^2}$

- **Inductive reactance**,

⇒ X_L= Lω

- **Capacitive reactance**

$\Rightarrow X_c = \frac{1}{C\omega}$

- **Resonance**will take place when**X_L= X_C.**

⇒ X_L= X_C

$\Rightarrow L\omega = \frac{1}{C\omega}$

$\Rightarrow \omega = \frac{1}{\sqrt{LC}}$

As we know,ω = 2πf

Where f = frequency

$\Rightarrow f = \frac{1}{2\pi\sqrt{LC}}$

Question 8

The propagation constant or the angular wave number is equal to _____.

Options:

A. 2πλ

B. λ / 2π

C. 2π / λ

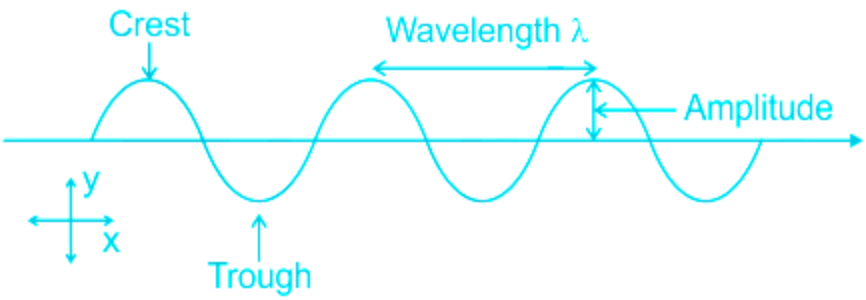
D. 1 / (2πλ)

Answer: C

Solution:

CONCEPT:

- **Transverse Wave:**Awavein which the medium particles move in a perpendicular direction to the direction that thewavemoves.



- **Equation of transverse wave**is given in the form

⇒ y(x, t) = Asin(kx − ωt + ϕ)

Where the amplitudeisA,ω is the angular frequency (ω = 2π/T), k is the **wave-number (k = 2π/λ)**,ϕ is the phase,and y is changing with respect to position x and time t.

- **Wavelength (λ):**The minimum distance of separation between two particles which are in the same phase is called awavelength.
- **The velocity of wave:**The velocity of a wave is given by

$\Rightarrow v = \frac{\lambda}{T} = \frac{\lambda 2\pi}{T2\pi} = \frac{\omega}{k}$

whereω is the angular frequency (ω = 2π/T) and**k is the wave-number (k = 2π/λ)**

EXPLANATION:

- **Wavenumber**: It is a constant term denoted by k.

$\Rightarrow k = \frac{2\pi}{\lambda}$

- So option 3 is correct

Question 9

The rms speed of gas at 27°C is V. If the temperature of the gas is raised to 327°C, then therms speed of a gas is

Options:

A. V

B. V/√2

C. V√2

D. 3V

Answer: C

Solution:

CONCEPT:

- **Root Mean Square Speed**is defined as the**square root of the mean of squares of the speed of different molecules**.
  - The**root-mean-square speed**takes into account both**molecular weight and temperature**, two factors that directly affect the**kinetic energy of a material**.
  - The**rms speed of any homogeneous gas sample**is given by:

$V_{rms} = \sqrt{\frac{3RT}{M}}$

Where R= universal gas constant, T = temperature and M = Molecular mass

CALCULATION:

Given - Initial rms velocity (V_{rms1}) = V,initial temperature (T_1) = 27°C = 300 K and final temperature(T_2) = 327°C = 600 K

- As the**sample**is the**same**, therefore the**molecular mass will be the same**. Hence,

$\Rightarrow V_{rms} \propto \sqrt{T}$

$\Rightarrow \frac{V_{rms1}}{V_{rms2}} = \sqrt{\frac{T_1}{T_2}}$

$\Rightarrow \frac{V}{V_{rms2}} = \sqrt{\frac{300}{600}} = \frac{1}{\sqrt{2}}$

$\Rightarrow V_{rms2} = V\sqrt{2}$

Question 10

Which law of thermodynamics defines the concept temperature?

Options:

A. First Law of Thermodynamics

B. Second Law of Thermodynamics

C. Zeroth Law of Thermodynamics

D. Third Law of Thermodynamics

Answer: C

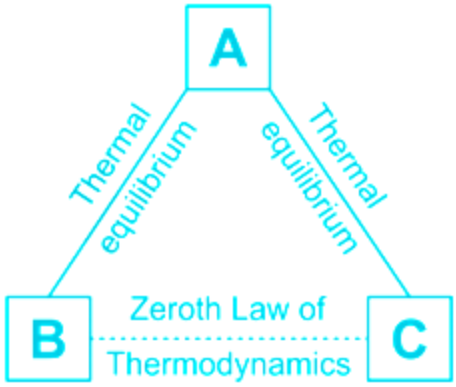
Solution:

CONCEPT:

There are 4 laws to thermodynamics:

Zeroth law of thermodynamics:

- If**two thermodynamic systems**are each in**thermal equilibrium**with a**third**, then they are in**thermal equilibrium with each other**.



First law of thermodynamics:

- **Energy can neither be created nor destroyed**. It can only**change forms**. In any process, the**total energy of the universe remains the same**.
- For a**thermodynamic cycle**, the**net heat supplied to the system isequals the net work done by the system**.

$\Delta Q = \Delta U + \Delta W$

whereΔQ = change in heat,ΔU = change in internal energy andΔW = change in work done

Second Law of Thermodynamics:

1. **Clausius statement**: It is**impossible**for a**self-acting machine**to**transfer heat from a colder body to a hotter one**without the aid of an external agency
2. **Kelvin-Planck's statement**: It is**impossible to design an engine**that**extracts heat**and**fully utilizes it into work**without producing any other effect.

Third law of thermodynamics:

- As the**temperature approaches absolute zero**, the**entropy of a system**approaches a**constant minimum**.
- $\mathbf{\Delta S_{T = 0K} = 0}$

WhereΔS = change in entropy

EXPLANATION:

- The **First Law of Thermodynamics** tells us about the **concept ofinternal energy**. Therefore option 1 is incorrect.
- The **Second Law of Thermodynamics** tells us that some form of **energy gets lost** whenever**energy is transferred or transformed**. Therefore option 2 is incorrect.
- From above it is clear that the **Zeroth Law of Thermodynamics**defines the **concept oftemperature**. Therefore option 3 is correct.
- The**Third Law of Thermodynamics**tells us about the**concept ofentropy**. Therefore option 4is incorrect.

Question 11

The ratio of length of two simple pendulums is 2 : 3. Find the ratio of their frequency.

Options:

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

B. $\sqrt{\frac{3}{4}}$

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

D. $\sqrt{\frac{2}{9}}$

Answer: C

Solution:

The correct option is 3.

CONCEPT:

- **Simple pendulum**: When a point mass is suspended with the help of a string or rod of negligible mass and does the to and fro motion about its mean position is called as a**simple pendulum**.
- For a simple pendulum, the**time period of swing of a pendulum depends on the length**of the string and acceleration due to gravity.

$T = 2\Pi\sqrt{\frac{l}{g}}$

The above formula is only valid for small angular displacements.

Where, T = Time period of oscillation, l = length of the pendulum and g = gravitational acceleration

- **Frequency (f):** The inverse of the time period is called frequency.

f = 1/T

Frequency of a simple pendulum (f):

$f = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$

CALCULATION:

Given that:

The ratio of lengths of two pendulums:

l_1/l_2= 2/3

$f = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$

$f \propto \frac{1}{\sqrt{l}}$

The **ratio of frequency** is given by:

So $\frac{f_1}{f_2} = \sqrt{\frac{l_2}{l_1}} = \sqrt{\frac{3}{2}}$

Question 12

The electric field strength and electrostatic potential due to a dipole depends upon distance r as

Options:

A. 1/r and $1/r^2$

B. $1/r^2$ and $1/r^3$

C. $1/r^3$ and $1/r^2$

D. $1/r^2$ and 1/r

Answer: C

Solution:

CONCEPT:

Electric Field Intensity:

- The**electric field intensity**at any point is the**strength of the electric field at the point**.
- It is defined as the**force experienced by the unit positive charge**placed at that point.

$\vec{E} = \frac{\vec{F}}{q_o}$

Where F = force and q_o= small test charge

Electric potential (V):

- The**potential difference between two points in an electric field**may be defined as the**amount of work done**in moving a**unit positive charge from one point to the otheragainst the electrostatic force**i.e.,

Electric dipole:

- When**two equal and opposite charges**are**separated by a small distance**then this**combination of charges**is calledan**electric dipole**.

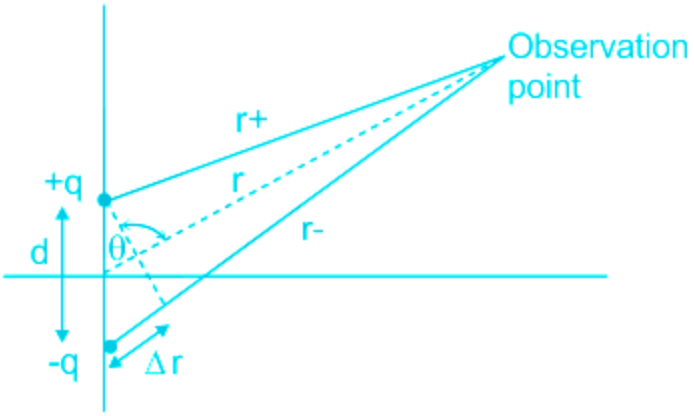
- The**strength of an electric dipole**is measured by a quantity known as a**dipole moment**i.e.

$\vec{P} = q \times \overrightarrow{2a}$

Where q = charge and 2a = distance between two charged particles

EXPLANATION:

- The**electric field intensity at any point due to a short electric dipole**is



$\Rightarrow |\vec{E}| = \frac{p\sqrt{3\,cos^2\,\theta+1}}{4\pi\epsilon_o r^3}$

Here p,π, and$\epsilon_o$are constant, therefore

$\Rightarrow E \propto \frac{1}{r^3}$

- The **electric potential due to point of dipole** given by

$\Rightarrow V = \frac{p\cos\theta}{4\pi\varepsilon_0 r^2}$

Here p,π, and$\epsilon_o$are constant, therefore

$\Rightarrow V \propto \frac{1}{r^2}$

📌 Important Points

1. The electric field at a distance r from a point charge q is given by :$\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\hat{r}$.
2. The electric field at distance r from the midpoint of an electric dipole of dipole moment p and length 2l is given by:
   - $E = \frac{1}{4\pi\varepsilon_0 K}\frac{2pr}{(r^2-l^2)^2}$ (in the case of axial line)
   - and$E = \frac{1}{4\pi\varepsilon_0 K}\frac{p}{(r^2-l^2)^{\frac{3}{2}}}$ (in the case of the equatorial line)
3. The electric potential at a distance r from a charge q is given by :$V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$
4. Electric potential, on the axial line of a dipole of dipole moment p and length 2l, at a distance r from the mid-point of the electric dipole, is given by$V = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^2-l^2}$
5. The electric potential at a point on the equatorial line of an electric dipole is zero.

Question 13

Which of the following satisfies the condition of partial equilibrium?

Options:

A. Rotational equilibrium

B. Translation equilibrium

C. Both 1 and 2

D. Neither 1 nor 2

Answer: C

Solution:

CONCEPT:

The first condition ofequilibrium:

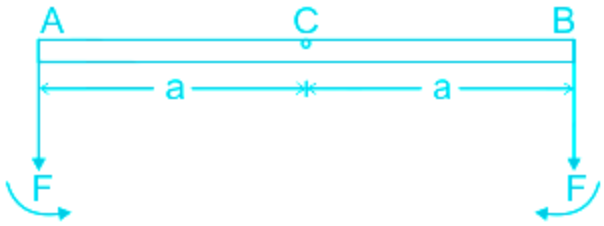
- A rigid body is said to be in**translational equilibrium**if it**remains at rest or moving with a constant velocity**in a particular direction.
  - For this, the net external force or the vector sum of all the external forces acting on the body must be zero.

The second condition ofequilibrium:

- A rigid body is said to be in**rotational equilibrium**if the body**does not rotate or rotates with constant angular velocity**.
  - For this, the net external torque or the vector sum of all the torques acting on the body is zero.

EXPLANATION:

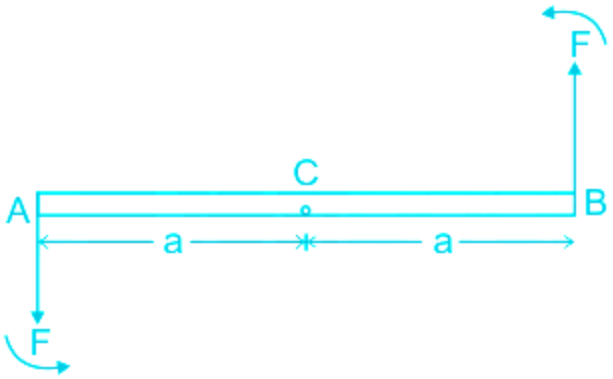
- Sometimes, a **rigid body may be in partial equilibrium**, i.e.,it may be in **translational equilibrium** and **not in rotational equilibrium** OR the body may be in **rotational equilibrium** and **not in translational equilibrium**.



- For example, let us consider a light rod AB of negligible mass with center at C. **Two parallel forces each of magnitude F** are applied at the ends perpendicular to the rod as shown in the above figure.

∴ Net external force = F + F = 2F≠ 0

- As ∑ F ≠ 0, therefore, the rod will not be in translational equilibrium.However, the moment offorces at A and B about fixed-point C will be equalwill in magnitude(= aF), but opposite in sense.
- Therefore,the net moment of forces on the rod will be zero. Hence the **rod will be in rotational equilibrium**.



- Let the force applied at end B of the rod be reversed as shown in the above figure. Here, the net external force on the rod = F - F = 0. Therefore the rod is in**translation equilibrium**.

Question 14

Which of the following expressions represents the energy stored in a stretched wire? (Y = Young's modulus, S = strain)

Options:

A. $\frac{1}{2}YS^2$

B. Y S^2

C. $\frac{3}{2}YS^2$

D. $\frac{1}{4}YS^2$

Answer: A

Solution:

CONCEPT:

- When we exert tensile stress on a wire, it will get stretched and work done in stretching the wire will be equal and opposite to the work done by inter-atomic restoring force. This work stored in the wire in the form of**Elastic potential energy**.

- Whereas**work done**can be derived as

$\Rightarrow W = \int F.dl$

Where F = force applied on wire and dl = change in length

EXPLANATION:

- Now by using the relation of**Young's Modulus**we can say that,

$\Rightarrow Y = \frac{F}{A} \times \frac{L}{l} \Rightarrow F = \frac{YAl}{L}$

Substituting the value of Y in the equation of work we get

$\Rightarrow W = \int \frac{YAl}{L} dl = \frac{YAl^2}{2L} = \frac{1}{2} \times Y \times \left(\frac{l}{L}\right)^2 \times LA$

$\Rightarrow W = Young's\ modulus \times strain^2 \times Volume\ of\ wire$

- Hence **work done per unit volume** is given as

$\Rightarrow U = \frac{W}{V} = \frac{1}{2} \times Young's\ modulus \times strain^2 = \frac{1}{2} YS^2$

So option 1 is correct.

Question 15

An electron is moving with a velocity v in a magnetic field B. The magnetic field is perpendicular to the velocity of the electron and the electron is moving on a circular path of radius r. Which of the following represent the charge per unit mass (e/m) of the electron?

Options:

A. rB/v

B. B/rv

C. v/rB

D. v/2rB

Answer: C

Solution:

CONCEPT:

- When a**moving charged particle enters a magnetic field**then the**path followed by the charged particle is circular**if the**magnetic field is perpendicular to the velocity**of the particle.
- **More the radius of the path followed by the particle, the lesser will be the curvature**, and the lesser the radius, the more will be curvature.
- To**perform the circular motion,**the required**centripetal force would be provided**by the**magnetic force on the moving charge**.
- The**radius of the path**followed by the charged particle moving in the magnetic field is given by:

$\Rightarrow \mathrm{r} = \frac{\mathrm{mv}}{\mathrm{Bq}}$

where r = radius, m = mass, v = velocity, B = strength of the magnetic field, q = charge on the particle.

EXPLANATION:

- The**radius of the path**followed by the electron moving in the magnetic field is given by:

$\Rightarrow \mathrm{r} = \frac{\mathrm{mv}}{\mathrm{Be}}$

The above equation can be written as

$\Rightarrow \frac{e}{m} = \frac{v}{rB}$

- Therefore option 3 is correct.

📌 Important Points

- The**relation between kinetic energy (KE) and the radius**followed by the charged particle is given by:

$\Rightarrow r = \frac{\sqrt{2m(KE)}}{qB}$

Question 16

TheEinstein’s photoelectric equation is$h\nu = \phi + k$. Here k represents- (h is planck's constant, c is speed of light,λ is wavelength, andϕ is work function)

Options:

A. Minimum kinetic energy of electrons

B. Maximum kinetic energy of electrons

C. Meankinetic energy of electrons

D. None of the above

Answer: B

Solution:

CONCEPT:

- When the photons fall on a metal surface then some electrons get ejected from the metal surface. This phenomenon is calledthe**photoelectric effect**.
- The minimum energy needed to remove electrons from the metal surface is called**work function(φ)**of that metal.
- The maximum energy of ejected electrons from the metal surface after ejection is called**maximum kinetic energy(KE_{max})**.
- **Einstein's equation of photoelectric equation:**

$\Rightarrow E = \varphi + KE_{max}$

Where E is the**incident energy**of photons, φ is the**work function of metal**and KE is the**maximum kinetic energy of electrons**.

$\Rightarrow E = h\nu$

Where h = Planck constant and ν = the frequency of incident radiation

EXPLANATION:

- Einstein's photoelectric equation is

$\Rightarrow h\nu = \phi + k$ ----(1)

- According to Einstein's photoelectric equation:

$\Rightarrow E = \varphi + KE_{max}$

$\Rightarrow E = h\nu$

$\Rightarrow h\nu = \varphi + KE_{max}$ ----(2)

On comparing equation 1 and 2, we get to know that,

$\Rightarrow k = KE_{max}$

- Therefore **k represents the maximum kinetic energy of electrons**. Hence option 2 is correct.

$KE_{max} = (h\nu - \varphi)$

- From theequation, it is clear that the**kinetic energy of the electrons emitted**is**directly proportional**to the**frequency of radiation**. Therefore option 1 is correct.
- The**maximum kinetic energydoesn't depend**upon the**intensity of incident radiations and**the**time for which light falls on the metal**.
- When we**increase the number of photons or intensity**of the incident radiations then the**number of electrons ejectedwill increase**but the**maximum kinetic energy**of electrons**will not change**.

Question 17

A ball is dropped from a height h and rebounds to a height which is 80 % of the initial height. Find the ratio of final potential energy to the initial potential energy of the ball.

Options:

A. 5/4

B. 4/5

C. 25/4

D. 4/25

Answer: B

Solution:

The correct option is: 2

CONCEPT:

- **Potential energy**: The energy of an object due to its position is called potential energy. It is denoted by PE.
  - Mathematically**potential energy**can be written as
  - **P.E of object =m g h**

Where m = mass of an object, g = acceleration due to gravity, and h = height

CALCULATION:

Initial height = H

Initial Potential energy = PE_1= m g H

Final height (h) = H× 80 % = 0.8 H

Final potential energy = PE_2= m g h = 0.8 m g H

Ratio = PE_2/PE_1= (0.8 m g H)/(m g H) = 4/5

Question 18

The velocity of a particle varies with displacement as $v^2 = a + bx$, where a and b are constants. The acceleration of the particle is-

Options:

A. Non-uniform

B. Uniform

C. 1

D. 0

Answer: B

Solution:

The correct option is: 2

CONCEPT:

- **Velocity (v)**: The rate of change of displacement of a body is called the velocity of that body.
  - **Velocity**is a**vector quantity**that has both magnitudes as well as direction.
- **Acceleration (a)**: The rate of change of velocity is called theacceleration of the body.
  - **Acceleration**is also a**vector quantity**.
  - The**slope**of any velocity-timegraph gives an accelerationof the body

a = dv/dt

Velocity (v) = dx/dt

Where x is displacement and t is time

- **Uniform acceleration**: When the acceleration is constant then it is called uniform accelerated motion.
- **Non-uniform acceleration**: When the acceleration is not constant then the motion is non-uniform accelerated motion.

CALCULATION:

Given that:

$v^2 = a + bx$

Differential both sides with respect to x,

2v (dv/dx) = 0 + b × (dx/dx)

$v\frac{dv}{dx} = \frac{b}{2}$

Sincea = dv/dt, and Velocity (v) = dx/dt

Now$a = \frac{dv}{dt} = \frac{dv}{dx} \times \frac{dx}{dt} = v\frac{dv}{dx}$

Hence **acceleration (a) = v(dv/dx) = b/2**

- **Since b is constant so acceleration will be constant and hence uniform acceleration.**

Question 19

Two electrical resistances R and 2R are connected in parallel combination. This combination is connected in series with a battery of potential difference V. Find the ratio of heat dissipated in two resistances.

Options:

A. 2 : 1

B. 4 : 1

C. 1 : 4

D. 8 : 1

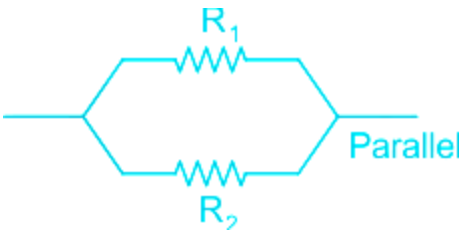
Answer: A

Solution:

The correct option is: 1

CONCEPT:

Resistances in parallel:



- When the**terminals of two or more resistances are connected at the same two points**and**the potential difference across them is equal**is called**resistances in parallel.**
- The**net resistance/equivalent resistance(R)**of resistances in parallel is given by:

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

- **Heating effect of electric current:**When a current is flowing in a circuit having resistancethere is heat dissipation due to the resistance. This is called the**heating effect of electric current**.
- The**heat dissipated**is given by**:**

$\Rightarrow Heat(H) = I^2Rt = \frac{V^2t}{R}$

Where I = the current flowing in the circuit, R = the resistance of the circuit, V is the potential difference, and t = the time taken

CALCULATION:

Given that:R_1= RΩ and R_2= 2R Ω

- Both are connected in parallel combination, so the **potential difference (V)will be the same** for both:

$\Rightarrow Heat(H) = \frac{V^2t}{R}$

Therefore,

$\Rightarrow \frac{H_1}{H_2} = \frac{R_2}{R_1} = \frac{2R}{R} = \frac{2}{1}$ (Since time t and Potential difference V are the same for both, hence those will cancel out in fraction)

Question 20

The dispersion is-

Options:

A. bending of light ray at a corner

B. reflection of light rays from a surface

C. bending of light ray towards normal when it travels from one medium to another

D. splitting of white light into its constituent colours

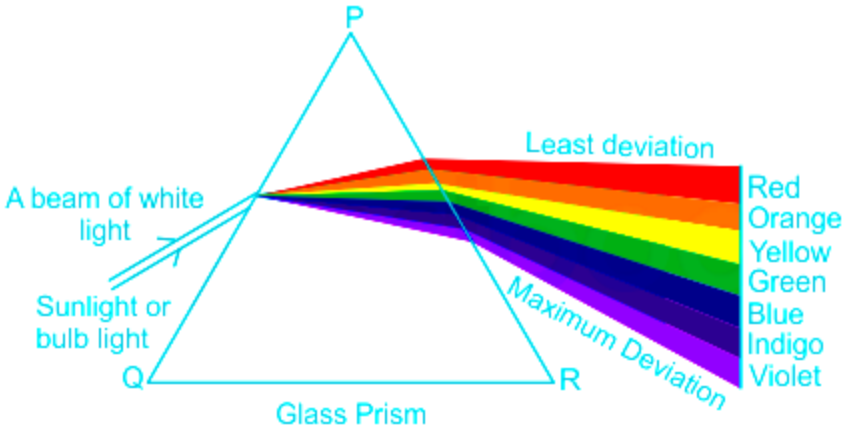
Answer: D

Solution:

The correct answer is **splitting of white light into its constituent colors**.

CONCEPT:

- **Dispersion of light**: Thesplittingofa composite beamoflightinto its constituentcolorsis called**dispersionoflight.**



- The**dispersionofwhitelightoccurs**because the**colorsofwhitelighttravel at different speeds through the glass prism**.
  - The**band of seven colors**is known as the**spectrum of light**.
  - **The dispersion**was discovered by**SirIssac Newton**.
  - **Newton**discovered that**lightis made upofseven different colors**.

EXPLANATION:

- From the above, it is clear thatthe**splittingofa composite beamoflightinto its constituentcolors**is called**dispersionoflight**.Therefore option 4 is correct.

Question 21

The number of turns in secondary coil and primary coil of a transformer are 200 and 500 respectively. If the electric current in the primary coil is 48 A then find the current in secondary coil.

Options:

A. 148 A

B. 130 A

C. 120 A

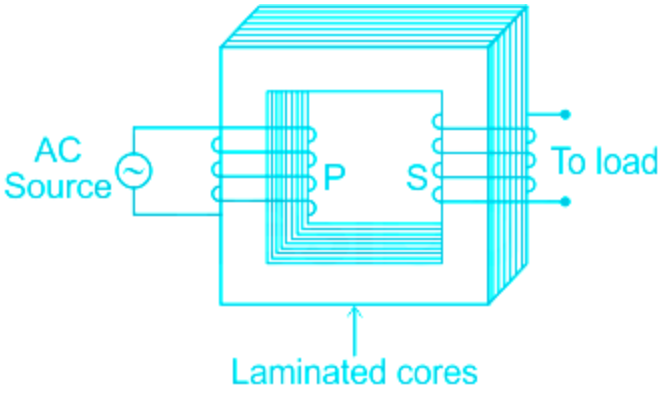
D. 100 A

Answer: C

Solution:

CONCEPT:

- A **Transformer** is used **to convert low voltage** (or high current) **to high voltage** (or low current) **and high voltage to low voltage**.
  - It works on the principle of **electromagnetic induction**.
  - The **primary coil** has **N_p turns** and the other coil, called the **secondary coil**, has **N_s turns**.
  - Generally, the **primary coil works as the input coil** and the **secondary coil** works as the **output coil of the transformer**.
- When an AC voltage is applied to the primary coil, the resulting current produces an alternating magnetic flux that links the secondary coil and induces an emf in it. The value of this emf depends on the number of turns in the secondary.



- In a transformer, the voltage in secondary is calculated by

$\Rightarrow \frac{N_s}{N_p} = \frac{V_s}{V_p} = \frac{i_p}{i_s}$

Where, N_p and N_s are the numbers of turns in the primary and secondary coils respectively, V_p and V_s are the rms voltages across the primary and secondary respectively, i_p and i_s are the current in the primary and secondary coil.

- In a transformer, the **load** is connected to the secondary coil while the primary coil of a transformer is connected to an AC source.

EXPLANATION:

Given - N_p = 500, N_s = 200 and i_p = 48 A

- The **ratio of current in the primary and secondary coil** is

$\Rightarrow \frac{i_p}{i_s} = \frac{N_s}{N_p}$

$\Rightarrow i_s = i_p(\frac{N_p}{N_s}) = 48 \times (\frac{500}{200}) = 120\, A$

- Therefore option 3 is correct.

Question 22

The efficiency of a Carnot heat engine is 75 %. If the temperature of sink is 300 K then find the temperature of heat source.

Options:

A. 75 K

B. 150 K

C. 300 K

D. 1200 K

Answer: D

Solution:

CONCEPT:

- **The efficiency of the Carnot cycle (η):**
  - It is defined as the ratio of**net mechanical work done per cycle of the gas (W) to the amount of heat energy absorbed per cycle from the source (Q_1)**i.e.,

$\eta = \frac{W}{Q_1}$

- As work done by the engine per cycle is

$\Rightarrow W = Q_1 - Q_2$

Where Q_1= amount of heat energy absorbed per cycle from the source and Q_2= energy absorbed per cycle from the sink.

$\Rightarrow \eta = \frac{Q_1 - Q_2}{Q_1} = 1 - \frac{Q_2}{Q_1}$

$\because \frac{Q_2}{Q_1} = \frac{T_2}{T_1}$

$\Rightarrow \eta = 1 - \frac{T_2}{T_1}$

Where T_1= temperature of the source and T_2= temperature of the sink.

EXPLANATION:

Given:η = 75% = 0.75 and temperature of the sink (T_2) = 300 K

- The**efficiency of the Carnot engine**:

$\Rightarrow \eta = 1 - \frac{T_2}{T_1}$

$\Rightarrow T_1 = \frac{T_2}{1-\eta} = \frac{300}{1-0.75} = \frac{300}{0.25} = 1200\,K$

Therefore **option4** is correct.

Question 23

The acceleration due to gravity reduces by 75% at a height h above the surface of the earth. Find h in terms of radius of earth (R).

Options:

A. R/2

B. 2 R

C. 3 R

D. R

Answer: D

Solution:

The correct option is 4.

CONCEPT:

- **Acceleration due to gravity**: Theacceleration achieved by any object due to thegravitational force of attraction by any planet is calledacceleration due to gravityby the earth.
  - As each planet has a different mass and radius so the acceleration due to gravity will be different for a different planet.

Acceleration due to the gravity of**earth having mass M on the surface of the earth**is given by:

$g = \frac{GM}{R^2}$

Acceleration due to gravity at height (h) above the earth'ssurface is given by:

$Acceleration\ due\ to\ gravity\ at\ height\ \ (g') = \frac{g}{\left(1+\frac{h}{R}\right)^2}$

Where**G is the Universal gravitational constant**, R is the radius of the earth and**h is the height**

CALCULATION:

Given that:

Acceleration due to gravity reduces by 75 %.

So the **acceleration due to gravity at height a height (h)** = 25 % of g = 0.25 g = g/4

$Acceleration\ due\ to\ gravity\ at\ height\ \ (g') = \frac{g}{\left(1+\frac{h}{R}\right)^2} = \frac{g}{4}$

1 + h/R = 2

h/R = 1

Hence **h = R**

Question 24

A wire of length 2 m is bend to form a circular coil of single turn. Find the magnetic moment of the circular coil if the current in the coil is 1 A.

Options:

A. $\frac{2}{\pi}$

B. $\frac{3}{\pi}$

C. $\frac{1}{\pi}$

D. $\frac{1}{2\pi}$

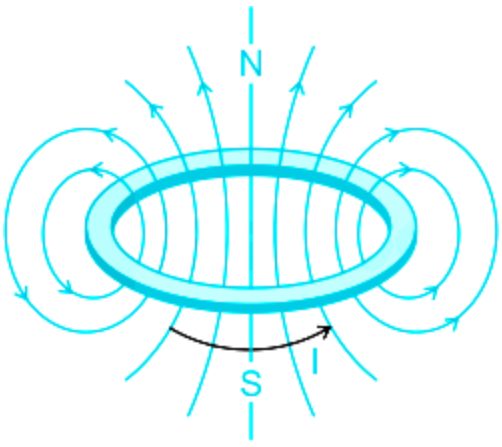
Answer: C

Solution:

The correct option is 3.

CONCEPT:

- When a**circular loop is associated with the current I, it starts to act as a magnet**and its magnetic moment is find as given below.



- **Magneticmoment (μ)**: The magnetic strength and orientation of a magnet or other object that produces a magnetic field.
    - It is avector quantity associated with themagneticproperties of electric current loops.
    - It is equal to the amount of current flowing through the loop multiplied by the area encompassed by the loop.

μ = N i A

where μ is the magnetic moment, A is the area of the coil, N is no. of turns and I is current in the coil.

- Its**direction is established by the right-hand rule**for rotations.

CALCULATION:

Given that:

Total length of wire (l) = 2 m

Number of turns (N) = 1

Curernt (i) = 1 A

Let the radius of the circular wire is r.

Perimeter = 2π r = length of the wire = 2

r = $1/\pi$

Area (A) =π r^2=π $(1/\pi)^2$=$1/\pi$

Mangetic moment (μ) = N i A = 1× 1× (1/π) = 1/π

Question 25

The drift velocity of electrons in a current-carrying wire of cross-sectional area A and current I is v. If the electric current and the cross-sectional area is doubled then-new drift velocity will-

Options:

A. become 2 times

B. become 4 times

C. become half

D. remain same

Answer: D

Solution:

The correct option is 4

CONCEPT:

Drift velocity: In a material,The average velocity attained by charged particlesdue to an electric field is called drift velocity.

Drift velocity of the electronsis calculated by:

$\Rightarrow v_d = \frac{I}{neA}$

WhereI = current in the wire, n =number density of free electrons in the wire, A = cross-sectional area of the wire, and e = charge on one electron

CALCULATION:

Drift velocity of electrons in a current-carrying wire of cross-sectional area A and current I is

$\Rightarrow v = \frac{I}{neA}$

Drift velocity of the electron, when electriccurrent and the cross-sectional area is doubled is

$\Rightarrow v' = \frac{I'}{neA'} = \frac{2I}{2neA} = v$

$[\because v = \frac{I}{neA}]$

Therefore the**new drift velocity willremain the same**. Hence option 4 is correct.

Mathematics

Question 26

Find $\frac{d^2(x^{20})}{dx^2}$

Options:

A. $370x^{187}$

B. $360x^{18}$

C. $380x^{18}$

D. $340x^{18}$

Answer: C

Solution:

Concept:

$\frac{dx^n}{dx} = nx^{n-1}$

Calculation:

To Find: $\frac{d^2(x^{20})}{dx^2}$

$\frac{d^2(x^{20})}{dx^2} = \frac{d}{dx}\left(\frac{dx^{20}}{dx}\right)$

$= \frac{d}{dx}(20x^{19}) = 20\frac{dx^{19}}{dx}$

$= 20\times 19\times x^{18}$

$= 380x^{18}$

Question 27

If k(3Median - Mode) = Mean then k is ?

Options:

A. 2

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

C. $\frac{1}{3}$

D. 3

Answer: B

Solution:

Concept:

Relation Between Mean Median and Mode:
Mean – Mode = 3 (Mean – Median)

Calculation:

As we know,

Mean – Mode = 3 (Mean – Median)

⇒ Mean – Mode = 3Mean – 3Median

⇒ 3Median - Mode = 2Mean

⇒ $\frac{1}{2}$(3Median - Mode) = Mean

∴ k = $\frac{1}{2}$

Question 28

Find value of cot ($\tan^{-1}x + \cot^{-1} x$)

Options:

A. 1

B. -1

C. 0

D. ∞

Answer: C

Solution:

Concept:

$\tan^{-1}x + \cot^{-1}x = \frac{\pi}{2}$

Calculation:

As we know$\tan^{-1}x + \cot^{-1}x = \frac{\pi}{2}$

∴ cot ($\tan^{-1}x + \cot^{-1}x$) = cot$\frac{\pi}{2}$ = 0

Question 29

Find the value of$\cot^{-1}\left(\sqrt{3}\right)$.

Options:

A. $\frac{\pi}{3}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{6}$

D. $\frac{\pi}{2}$

Answer: C

Solution:

Concept:

Principal Values of Inverse Trigonometric Functions:

Function	Domain	Range of Principal Value
$\sin^{-1}x$	[-1, 1]	[-π/2, π/2]
$\cos^{-1}x$	[-1, 1]	[0, π]
$\csc^{-1}x$	R - (-1, 1)	[-π/2, π/2] - {0}
$\sec^{-1}x$	R - (-1, 1)	[0, π] - {π/2}
$\tan^{-1}x$	R	(-π/2, π/2)
$\cot^{-1}x$	R	(0, π)

Calculation:

Let$\cot^{-1}\left(\sqrt{3}\right)=\theta$

$\Rightarrow \cot\theta=\sqrt{3}=\cot\frac{\pi}{6}$

$\therefore\theta=\frac{\pi}{6}$

Hence,$\cot^{-1}\left(\sqrt{3}\right)=\theta=\frac{\pi}{6}$

Question 30

$\int_0^{2\pi} \frac{\sin 2x}{a-b\cos x} dx$ **is equal to ?**

Options:

A. 6π

B. 4π

C. 2π

D. 0

Answer: D

Solution:

Concept:

$\int_a^b f(x)dx = \int_a^b f(a+b-x)dx$

Calculation:

Let I = $\int_0^{2\pi} \frac{\sin 2x}{a-b\cos x} dx$ ----(1)

Using property f(a + b – x),

I = $\int_0^{2\pi} \frac{\sin 2(2\pi-x)}{a-b\cos(2\pi-x)} dx$

As we know,sin (2π - x) = - sin x andcos (2π - x) = cos x

I = $\int_0^{2\pi} \frac{-\sin 2x}{a-b\cos x} dx$ ----(2)

I = -I

2I = 0

∴ I = 0

Question 31

$\int \sqrt{ax+b}\, dx$ **is equal to ?**

Options:

A. $\frac{(ax+b)^{3/2}}{3a} + c$

B. $\frac{2(ax+b)^{3/2}}{3} + c$

C. $\frac{2(ax+b)^{3/2}}{3a} + c$

D. None of the above

Answer: C

Solution:

Concept:

$\int x^n dx = \frac{x^{n+1}}{n+1} + c$

Calculation:

$I = \int \sqrt{ax + b}\, dx$

Let $ax + b = t^2$

Differenating with respect to x, we get

$\Rightarrow adx = 2tdt$

$\Rightarrow dx = \frac{2t}{a} dt$

Now,

$I = \int \sqrt{t^2} \times \frac{2t}{a} dt$

$= \frac{2}{a} \int t^2\, dt$

$= \frac{2}{a} \frac{t^3}{3} + c$

$= \frac{2(ax+b)^{3/2}}{3a} + c$

Question 32

Find the first order derivative of (x cos x)

Options:

A. -x sin x + cos x

B. x sin x + cos x

C. x cos x - sin x

D. -x cos x - sin x

Answer: A

Solution:

Concept:

Suppose that we have two functionsf(x) andg(x)and they are both differentiable.

- **Chain Rule:** $\frac{d}{dx}[f(g(x))] = f'(g(x))g'(x)$
- **Product Rule:** $\frac{d}{dx}[f(x)\,g(x)] = f'(x)\,g(x) + f(x)\,g'(x)$

Calculation:

Let f(x) = x cos x

Using product rule ofdifferentiating,

$f'(x) = \left[x\frac{d}{dx}(\cos x) + \cos x\frac{d}{dx}(x)\right]$

=-x sin x + cos x

Question 33

If n elements in a set A then the elements presents in power set are ?

Options:

A. $2^n - 1$

B. 2^n

C. n

D. None of the above

Answer: B

Solution:

Concept:

Power set:A power set is set of all subsets, empty set and the original set itself.

If there are n elements in a set A, then the **elements of power set** are equal to 2^n

Calculation:

Given:n elements in a set A

n (A) = n

To Find:Elements presents in power set

∴ n [P (A)] = 2^n

Question 34

What is the focus of the parabola $y^2 = -12x$?

Options:

A. (3, 0)

B. (0, 0)

C. (-3, 0)

D. (0, -3)

Answer: C

Solution:

Concept:

Parabola: The locus of a point which moves such that its distance from a fixed point is equal to its distance from a fixed straight line. (Eccentricity = e =1)

Equation	$y^2 = 4ax;$
Vertex	(0, 0)

Focus	(a, 0)
Equation of the directrix	x = -a
Equation of the axis	y = 0
Length of Latus rectum	4a
Focal distance	x + a

Calculation:

Given: $y^2 = -12x$

$\Rightarrow y^2 = 4 \times (-3) \times x$

Compare with standard equation of parabola $y^2 = 4ax$

So, a = -3

Therefore, Focus = (a, 0) = (-3, 0)

Question 35

Find middle termsin the expansion of $\left(x - \frac{2}{x}\right)^{10}$

Options:

A. $2^5 \times {}^{10}C_5$

B. ${}^{10}C_5$

C. $-2^5 \times {}^{10}C_5$

D. None of the above

Answer: C

Solution:

Concept:

General term: General term in the expansion of $(x + y)^n$ is given by

$T_{(r+1)} = {}^nC_r \times x^{n-r} \times y^r$

Middle terms: The middle terms is the expansion of $(x + y)^n$ depends upon the value of n.

- **If n is even**, then total number of terms in the expansion of $(x + y)^n$ is n +1. So there is only one middle term i.e. $\left(\frac{n}{2} + 1\right)^{th}$ term is the middle term.

- **If n is odd**, then total number of terms in the expansion of $(x + y)^n$ is n + 1. So there are two middle terms i.e. $\left(\frac{n+1}{2}\right)^{th}$ and $\left(\frac{n+3}{2}\right)^{th}$ are two middle terms.

Calculation:

Here, we have to find the middle termsin the expansion of $\left(x - \frac{2}{x}\right)^{10}$

Here n = 10 (n is even number)

$\therefore$ Middle term $= \left(\frac{n}{2} + 1\right) = \left(\frac{10}{2} + 1\right) = 6\text{th term}$

$T_6 = T_{(5+1)} = {}^{10}C_5 \times (x)^{(10-5)} \times \left(\frac{-2}{x}\right)^5$

$T_5 = -2^5 \times {}^{10}C_5$

Question 36

What is the sum offirst n odd natural numbers?

Options:

A. $n^2 - 1$

B. n^2

C. n^3

D. $\frac{n(n+1)}{2}$

Answer: B

Solution:

Concept:

Sum of the first n terms of an AP $= S = \frac{n}{2}[2a + (n - 1) \times d]$

Where, a = First term, d = Common difference, n = number of terms

Calculation:

To find:Sum offirst n odd natural numbers

Odd natural number starts from 1.

The series of odd natural numbers is 1 , 3 , 5 , 7, 9 ...

Above seriesis in AP (∵ Common difference are same)

a = First term = 1, d = Common difference = 2

As we know, $S_n=\frac{n}{2}[2a + (n - 1) \times d]$

Therefore, $S_n=\frac{n}{2}[2\times 1 + (n - 1) \times 2] =\frac{n}{2}\times 2n = n^2$

Question 37

What is the modulus of -2i, Where$i = \sqrt{-1}$

Options:

A. -2

B. 2

C. 0

D. 1

Answer: B

Solution:

Concept:

Let z = x + iy be a complex number, Where x is called real part of the complex number or Re (z) and y is called Imaginary part of the complex number or Im (z)

Modulus of z=|z| =$\sqrt{x^2 + y^2} = \sqrt{Re(z)^2 + Im(z)^2}$

Calculations:

Let z = x + iy =-2i

So, x = 0 and y = -2

As we know that if z = x + iy be any complex number, then its modulus is given by, |z| =$\sqrt{x^2 + y^2}$

∴ |z| =$\sqrt{(0)^2 + (-2)^2} = \sqrt{4} = 2$

Question 38

If vectors $\vec{a} = \vec{b}$ then a_3 is ?

Where $\vec{a} = 3\hat{i} - 2\hat{j} + a_3\hat{k}$ and $\vec{b} = \vec{3}\hat{i} - 2\hat{j} + \hat{k}$

Options:

A. -1

B. 1

C. 0

D. 2

Answer: B

Solution:

Concept:

Equal Vectors
Two or more vectors are said to be equal when their magnitude is equal and also their direction is the same.

Calculation:

Given: $\vec{a} = 3\hat{i} - 2\hat{j} + a_3\hat{k}$ and $\vec{b} = \vec{3}\hat{i} - 2\hat{j} + \hat{k}$

$\vec{a} = \vec{b}$

$3\hat{i} - 2\hat{j} + a_3\hat{k} = \vec{3}\hat{i} - 2\hat{j} + \hat{k}$

$\therefore a_3 = 1$

Question 39

Find the determinant of the matrix $\begin{vmatrix} 3 & 2 & 1 \\ 3 & 2 & 1 \\ 1 & 0 & 1 \end{vmatrix}$?

Options:

A. 0

B. 3

C. 5

D. None of these

Answer: A

Solution:

CONCEPT:

Properties of Determinant of a Matrix:

- If each entry in any row or column of a determinant is 0, then the value of the determinant is zero.
- For any square matrix say A, $|A| = |A^T|$.
- If we interchange any two rows (columns) of a matrix, then the determinant is multiplied by -1.
- If any two rows (columns) of a matrix are same then the value of the determinant is zero.

CALCULATION:

Here, we have to find the value of $\begin{vmatrix} 3 & 2 & 1 \\ 3 & 2 & 1 \\ 1 & 0 & 1 \end{vmatrix}$

As we can see that the first and the second row of the given matrix are equal.

We know that, ifany two rows (columns) of a matrix are same then the value of the determinant is zero.

So, $\begin{vmatrix} 3 & 2 & 1 \\ 3 & 2 & 1 \\ 1 & 0 & 1 \end{vmatrix} = 0$

Hence, **option A** is the correct answer.

Question 40

Find the value of x and y if $\begin{bmatrix} (x+3y) & y \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 4 & -1 \\ 0 & 1 \end{bmatrix}$?

Options:

A. x = 2 and y = 5

B. x = - 7 and y = 1

C. x = 7 and y = - 1

D. x = - 5 and y = - 2

Answer: C

Solution:

CONCEPT:

If two matrices A and B are said to be equal if the following conditions holds true:

- Order of matrix A = Order of matrix B
- Corresponding elementof matrix A = Corresponding element of matrix B

CALCULATION:

Given: $\begin{bmatrix} (x+3y) & y \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 4 & -1 \\ 0 & 1 \end{bmatrix}$

As we know that, if two matrices A and B are equal then their corresponding elements are also same.

⇒ x + 3y = 4 and y = - 1

By substituting y = - 1 in the equationx + 3y = 4 we get, x = 7

So, x = 7 and y = - 1

Hence, **option C** is the correct answer.

Question 41

Find thearea of the region bounded by the curves $y = x^3$, the line x = 2, x = 5 and the x - axis?

Options:

A. 173.50

B. 230.25

C. 175.35

D. 152.25

Answer: D

Solution:

CONCEPT:

- $\int \mathrm{x^n dx} = \frac{\mathrm{x^{n+1}}}{\mathrm{n+1}} + \mathrm{C}$

CALCULATION:

Here, we have to find thearea of the region bounded bythe curves y = x^3, the line x = 2, x = 5and the x - axis

So, the area enclosed by the given curves is given by$\int_2^3 x^3 \ dx$

As we know that,$\int \mathrm{x^n dx} = \frac{\mathrm{x^{n+1}}}{\mathrm{n+1}} + \mathrm{C}$

$\Rightarrow \int_2^5 x^3 \ dx = \left[\frac{x^4}{4}\right]_2^5$

$\Rightarrow \int_2^5 x^3 \ dx = \frac{1}{4} \ (625 - 16 \ ) = 152.25 \ sq. \ units$

Hence, **option D** is the correct answer.

Question 42

Evaluate: $\lim_{x \to 0} \left[\frac{\sin(ax)}{\sin(bx)}\right] = ?$

Options:

A. 1

B. $\frac{a}{b}$

C. $\frac{b}{a}$

D. 0

Answer: B

Solution:

CONCEPT:

- **L - Hospital's Rule**: If $\lim_{x \to a} f\left(x \right) = \frac{0}{0}\ or \frac{\infty}{\infty}$ then we have to differentiate both the numerator and denominator with respect to x unless and until $\lim_{x \to a} f\left(x \right) = l \neq \frac{0}{0}$ where l is a finite value.
- $\frac{d(\sin x)}{dx} = \cos x$

CALCULATION:

Here, we have to find the value of the limit $\lim_{x \to 0}\left[\frac{\sin(ax)}{\sin(bx)} \right]$

$\Rightarrow \lim_{x \to 0}\left[\frac{\sin(ax)}{\sin(bx)} \right] = \frac{0}{0}$

Now, according to **L-Hospital's rule** if $\lim_{x \to a} f\left(x \right) = \frac{0}{0}\ or \frac{\infty}{\infty}$ then we have to differentiate both the numerator and denominator with respect to x unless and until $\lim_{x \to a} f\left(x \right) = l \neq \frac{0}{0}$ where l is a finite value.

$\Rightarrow \lim_{x \to 0}\left[\frac{\sin(ax)}{\sin(bx)} \right] = \lim_{x \to 0}\left[\frac{a\cos(ax)}{b\cos(bx)} \right] = \frac{a}{b}$

Hence, **option B** is the correct answer.

Question 43

Find the order of the differential equation $\frac{d^3y}{dx^3} - 2\frac{d^2y}{dx^2} - y = 0$?

Options:

A. 3

B. 2

C. 1

D. None of these

Answer: A

Solution:

CONCEPT:

The highest order derivative occurring in a differential equation is called the **order** of a differential equation. The power of the highest order derivative which occurs in it after it is made free from radicals and fractions is called **degree** of a differential equation.

CALCULATION:

Given: $\frac{d^3y}{dx^3} - 2\frac{d^2y}{dx^2} - y = 0$

Here, we have to find the order of the given differential equation

As we know that, thehighest order derivative occurring in a differential equation is called the**order**of a differential equation.

For the given differential equation, the highest order derivative which is occurring in the equation is 3.

So, the order of the given differential equation is 3.

Hence, **option A** is the correct answer.

Question 44

Find the equation of the circle whose end points of the diameter are (-2, 4) and (4, 2) ?

Options:

A. $x^2 + y^2 - 2x + 6y = 0$

B. $x^2 + y^2 + 2x - 6y = 0$

C. $x^2 + y^2 - 2x - 6y = 0$

D. $x^2 + y^2 + 2x + 6y = 0$

Answer: C

Solution:

CONCEPT:

Let us suppose (x_1, y_1) and (x_2, y_2) be the end points of the diameter of a circle. Then the equation of such a circle is given by: $(x - x_1) \cdot (x - x_2) + (y - y_1)(y - y_2) = 0$

CALCULATION:

Given: The points (- 2, 4) and (4, 2) are the end points of the diameter of the circle.

Here, we have to find the equation of the circle whoseend points of the diameter are (- 2, 4) and (4, 2).

As we know that, if(x_1, y_1) and (x_2, y_2) be the end points of the diameter of a circle. Then the equation of such a circle is given by: $(x - x_1) \cdot (x - x_2) + (y - y_1)(y - y_2) = 0$

Here, $x_1 = -2$, $y_1 = 4$, $x_2 = 4$ and $y_2 = 2$

So, the equation of the required circle is: $(x + 2) \times (x - 4) + (y - 4) \times (y - 2) = 0$

$\Rightarrow x^2 - 2x - 8 + y^2 - 6y + 8 = 0$

$\Rightarrow x^2 + y^2 - 2x - 6y = 0$

So, the equation of the required circle is $x^2 + y^2 - 2x - 6y = 0$

Hence, **option C** is the correct answer.

Question 45

A bag contains 9 white balls and 12 red balls. If one ball is drawn at random from the bag what is the probability the ball drawn is white in colour ?

Options:

A. 5/7

B. 2/7

C. 1/7

D. 3/7

Answer: D

Solution:

CONCEPT:

Let S be a sample space and E be an event such that n(S) = n, n(E) = m and each outcome is equally likely. Then $P(E) = \frac{n(E)}{n(S)} = \frac{m}{n}$

CALCULATION:

Given: Abag contains 9 white balls and 12 red balls.

No. ways to draw a white ball from the bag = C (9, 1) = 9

No. of ways to draw a ball from the bag = C (21, 1) = 21

So, probability of the ball drawn from the bag is white in colour = 9/21 = 3/7

Hence, **option D** is the correct answer.

Question 46

In how many ways can 8 persons sit in a row ?

Options:

A. 7!

B. 8!

C. 6!

D. None of these

Answer: B

Solution:

CONCEPT:

No. of ways to arrange n different things is given by n!

CALCULATION:

Here, we have to find the number of ways in which 8 persons can sit in a row.

As we know that, number ofways to arrange n different things is given by n!

Here, n = 8

So, number of ways to make 8 persons sit in a row = 8!

Hence, **option B** is the correct answer.

Question 47

If the distance between the points (3, 4) and (a, 2) is 8 units then find the value of a

Options:

A. $3 \pm 2\sqrt{15}$

B. $2 \pm 2\sqrt{15}$

C. $1 \pm \sqrt{15}$

D. None of these

Answer: A

Solution:

CONCEPT:

Let A (x_1, y_1) and B (x_2, y_2) be any two points in the XY – plane, then the distance between A and B is given by:

$|AB| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

CALCULATION:

Given: Thedistance between the points (3, 4) and (a, 2) is 8 units

Here, we have to find the value of a.

As we know that, thedistance between two pointsA (x_1, y_1) and B (x_2, y_2) is given by

$|AB| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$\Rightarrow \sqrt{(a - 3)^2 + (2 - 4)^2} = 8$

By squaring both the sides we get

$\Rightarrow (a - 3)^2 + 4 = 64$

$\Rightarrow a^2 + 9 - 6a - 60 = 0$

$\Rightarrow a^2 - 6a - 51 = 0$

$\Rightarrow a = \frac{6 \pm \sqrt{240}}{2} = 3 \pm 2\sqrt{15}$

Hence, **option A** is the correct answer.

Question 48

The maximum value of the function $f(x) = x^3 + 2x^2 - 4x + 6$ exists at

Options:

A. x = -2

B. x = 1

C. x = 2

D. x = -1

Answer: A

Solution:

Concept:

Following steps to **finding maxima**using derivatives.

- Find the derivative of the function.
- Set the derivative equal to 0 and solve. This gives the values of the maximum and minimum points.
- Now we have to find the second derivative.
- f''(x) is less than 0 then the given function is said to be maxima

Calculation:

Here,$f(x) = x^3 + 2x^2 - 4x + 6$

$f'(x) = 3x^2 + 4x - 4$

Set$f'(x) = 0$

$3x^2 + 4x - 4 = 0$

$\Rightarrow 3x^2 + 6x - 2x - 4 = 0$

$\Rightarrow 3x(x + 2) - 2(x + 2) = 0$

$\Rightarrow (3x - 2)(x + 2) = 0$

So, x = -2 OR x = 2/3

Now, $f''(x) = 6x + 4$

$f''(-2) = -12 + 4 = -8 < 0$

$\therefore$ At x = -2, Maximum value of f(x) exists.

Hence, option (1) is correct.

Question 49

$\int \log x \, dx =$

Options:

A. xlog x - 1 + c

B. xlog x + x + c

C. xlog x - x + c

D. None of the above

Answer: C

Solution:

Concept:

1. Integration by parts: Integration by parts is a method to find integrals of products

The formula for integrating by parts is given by;

$\Rightarrow \int u \, vdx = u \int vdx - \int \left(\frac{du}{dx} \int vdx\right) dx$

Where u is the function u(x) and v is the function v(x)

2. ILATE Rule: Usually, the preference order of this rule is based on some functions such as Inverse, Logarithm, Algebraic, Trigonometric and Exponent.

3. Formulas:

$\frac{d\cot^{-1}x}{dx} = \frac{-1}{1+x^2} \int \frac{1}{x} dx = \log x + c$

Calculation:

Let I = $\int \log x \, dx$

Apply by parts

= log x x - $\int \frac{1}{x} \times x \, dx$

= log x x - $\int dx$

= xlog x - x + c

Question 50

If $\tan(A - B) = \frac{1}{\sqrt{3}}$ **and** $\tan(A + B) = \sqrt{3}$**, then the values of A and B are respectively:**

Options:

A. 45°, 15°

B. 30°, 60°

C. 30°, 30°

D. 40°, 20°

Answer: A

Solution:

Concept:

Values of Trigonometric Ratios for Common Angles:

	0°	30°	45°	60°	90°
sin	0	1/2	1/√2	√3/2	1
cos	1	√3/2	1/√2	1/2	0
tan	0	1/√3	1	√3	∞
csc	∞	2	√2	2/√3	1
sec	1	2/√3	√2	2	∞
cot	∞	√3	1	1/√3	0

Calculation:

Using the above table:

tan (A - B) = 1/√3

⇒ tan(A - B) = tan 30°

⇒ A - B = 30° ... (1)

Andtan (A + B) = √3

⇒ tan(A + B) = tan 60°

⇒ A +B = 60° ... (2)

Adding equations (1) and (2), we get:

$(A - B) + (A + B) = 30^\circ + 60^\circ$

$\Rightarrow 2A = 90^\circ$

$\Rightarrow \mathbf{A = 45^\circ}$

$\therefore \mathbf{B = 60^\circ - 45^\circ = 15^\circ}$

English

Question 51

A sentence has been given in Active/Passive Voice. Out of the four alternatives suggested, select the one which best expresses the same sentence in Passive/Active voice.

The people made him President.

Options:

A. He is made President by the people.

B. He was made President by the people.

C. The people had made him President.

D. The people will make him President.

Answer: B

Solution:

The correct answer is**He was made President by the people.**

Key Points

The sentence is in the**ActiveVoice**and in the simple past tense.

It needs to be changed into Passive Voice.

On conversion intoPassive Voice, the given sentence will become: *He **was made** President by the people.*

When converting the statement into Passive Voice:

- a)the subjectmust be written afterthe object
- b) the original sentence structure,**Subject+verb+object**, changes to**Object+verb+subject.**
- c) the tense of the statement is changed accordingly(simple past will change into past participle along with the addition of a helping verb and 'by')

📌 Important Points

Given below are the rules of tense conversion from Active to Passive Voice and vice verse:

TENSE	SENTENCE IN THEACTIVE VOICE	SENTENCE IN THE PASSIVE VOICE
SIMPLE PRESENT	He**sells**flowers. He**does not sell**books. **Does**he**sell**flowers?	Flowers**are sold**by him. Books**are not sold**by him. **Are**flowers**sold**by him?
PRESENT PROGRESSIVE	He**is selling**flowers. He**is not selling**books. **Does**he**not sell**books?	Flowers**are being sold**by him. Books**are not being sold**by him. **Are**books**notsold**by him?
PRESENT PERFECT	He**has completed**the work. He**has not completed**the work. **Has**he**completed**the work?	The work**has been completed**by him. The work**has not been completed**by him. **Has**the work**been completed**by him?
SIMPLE PAST	He**completed**the work. He**did not complete**the work. **Did**he**complete**the work?	The work**was completed**by him. The work**wasnot completed**by him. **Was**the work**completed**by him?
PAST PROGRESSIVE	He**was reading**a book. He**was not reading**a book. **Was**he**reading**a book?	A book**was being read**by him. A book**was not being read**by him. Wasa book**being read**by him?
PAST PERFECT	He**had read**the book He**hadnot read**the book.	The book**had been read**by him.

	Hadhe**read**the book?	The book**had not been read**by him. **Had**the book**been read**by him?
SIMPLE FUTURE	She**will write**a letter. She**will not write**a letter. **Will**she**write**the letter?	A letter**will be written**by her. A letter**will not be written**by her. **Will**the letter**be written**by her?
FUTURE PERFECT	He**will have written**a letter. He**will not have written**a letter. **Will**he**have written**a letter?	A letter**will have been written**by him. A letter**will not have been written**by him. **Will**a letter**have been written**by him?

Question 52

Select the segment of the sentence that contains an error. if there is no error, mark 'No error' as your answer.

Towns after towns (A) wasaffected (B) bythe rapidly-spreading Bubonic plague. (C) No Error (D)

Options:

A. A

B. B

C. C

D. No Error

Answer: A

Solution:

The correct answer is **A.**

Key Points

As a rule, when we are dealing with a Noun-Preposition-Noun structure, the nouns present on either side should be singular in number. Also, the verb following this structure should agree with the singular nouns in number.

Eg. Village after village *was* devastated in the Great Fire of 1677.

Mistake Point

*Many of you might mark **option 2- B** as the correct answer. **This is incorrect.***

Question 53

Read the passage given below and answer the questions that follow. Some words may be highlighted. Read carefully.

It was once said that "Judging a person doesn't define who they are…it defines who you are." Unfortunately, we all fall into the category of judging other people at some point in our lives. We have also been affected at various times by the ways that other people have judged us. We all need to be more aware of "rushing to judgment" and remember to first understand the real situation and/or the other person's intent before making a conclusion.

One day, a lovely little girl was holding two apples with both hands. Her mom came in the room and softly asked her little daughter with a smile, "My sweetie, could you give your mom one of your two apples?" The girl looked up at her mom for some seconds; then she suddenly took a quick bite on one apple, and then quickly on the other. The mom felt the smile on her face freeze. She tried hard not to **reveal** her disappointment. Then the little girl handed one of her bitten apples to her mom, and said, "Here you go, mommy. This is the sweeter one." Her mother realized the **blunder** she had made and embraced her with open arms.

What is the antonym of the word 'reveal?

Options:

A. Expose

B. Show

C. Exhibit

D. Hide

Answer: D

Solution:

The correct answer is **Hide.**

Key Points

- **Reveal**:make (previously unknown or secret information) known to others
- **Hide**:prevent (an emotion or fact) from being apparent or known; keep secret

Thus we can see that Reveal and Hide are antonyms.

Additional Information

The meaning of the other words:

- **Expose**:make (something) visible by uncovering it
- **Show**:allow or cause (something) to be visible
- **Exhibit**:manifest clearly (a quality or a type of behaviour); reveal

Thus, we can see that Options 1, 2 and 3 are synonyms or near-synonyms of 'reveal'.

Question 54

Read the passage given below and answer the questions that follow. Some words may be highlighted. Read carefully.

It was once said that “Judging a person doesn’t define who they are…it defines who you are.” Unfortunately, we all fall into the category of judging other people at some point in our lives. We have also been affected at various times by the ways that other people have judged us. We all need to be more aware of “rushing to judgment” and remember to first understand the real situation and/or the other person’s intent before making a conclusion.

One day, a lovely little girl was holding two apples with both hands. Her mom came in the room and softly asked her little daughter with a smile, “My sweetie, could you give your mom one of your two apples?” The girl looked up at her mom for some seconds; then she suddenly took a quick bite on one apple, and then quickly on the other. The mom felt the smile on her face freeze. She tried hard not to **reveal** her disappointment. Then the little girl handed one of her bitten apples to her mom, and said, “Here you go, mommy. This is the sweeter one.” Her mother realized the **blunder** she had made and embraced her with open arms.

What did the girl do after she tasted both the apples?

Options:

A. She threw the apples down on the ground.

B. She handed both the apples to her mother.

C. She handed one of the bitten apples to her mother.

D. She left the room and never talked to her mother ever again.

Answer: C

Solution:

The correct answer is**She handed one of the bitten apples to her mother.**

Key Points

The answer can the found in the line- "Then the little girl handed **one of her bitten apples to her mom**"

The other options have not been mentioned anywhere in the passage.

Question 55

Read the passage given below and answer the questions that follow. Some words may be highlighted. Read carefully.

It was once said that “Judging a person doesn’t define who they are…it defines who you are.” Unfortunately, we all fall into the category of judging other people at some point in our lives. We have also been affected at various times by the ways that other people have judged us. We all need to be more aware of “rushing to judgment” and remember to first understand the real situation and/or the other person’s intent before making a conclusion.

One day, a lovely little girl was holding two apples with both hands. Her mom came in the room and softly asked her little daughter with a smile, “My sweetie, could you give your mom one of your two apples?” The girl looked up at her mom for some seconds; then she suddenly took a quick bite on one apple, and then quickly on the other. The mom felt the smile on her face freeze. She tried hard not to **reveal** her disappointment. Then the little girl handed one of her bitten apples to her mom, and said, “Here you go, mommy. This is the sweeter one.” Her mother realized the **blunder** she had made and embraced her with open arms.

What is the meaning of the word 'blunder'?

Options:

A. Looting

B. Mistake

C. Stone

D. None of these

Answer: B

Solution:

The correct answer is **Mistake**

Key Points

Blunder: A stupid, careless and thoughtless mistake

Additional Information

- **Looting**:stealing goods from (a place), typically during a war or riot
- **Stone**: a hard solid non-metallic mineral matter of which rock is made, especially as a building material

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Question 56

Read the passage given below and answer the questions that follow. Some words may be highlighted. Read carefully.

It was once said that "Judging a person doesn't define who they are…it defines who you are." Unfortunately, we all fall into the category of judging other people at some point in our lives. We have also been affected at various times by the ways that other people have judged us. We all need to be more aware of "rushing to judgment" and remember to first understand the real situation and/or the other person's intent before making a conclusion.

One day, a lovely little girl was holding two apples with both hands. Her mom came in the room and softly asked her little daughter with a smile, "My sweetie, could you give your mom one of your two apples?" The girl looked up at her mom for some seconds; then she suddenly took a quick bite on one apple, and then quickly on the other. The mom felt the smile on her face freeze. She tried hard not to **reveal** her disappointment. Then the little girl handed one of her bitten apples to her mom, and said, "Here you go, mommy. This is the sweeter one." Her mother realized the **blunder** she had made and embraced her with open arms.

What do we need to be more aware of?

Options:

A. Rushing to judgment

B. Staying in shape

C. How to cook fish

D. None of these

Answer: A

Solution:

The correct answer is**Rushing to judgment.**

Key Points

The correct answer can be found in the line- "*We all need to be more aware of* ***"rushing to judgment"*** *and remember to first understand the real situation and/or the other person's intent before making a conclusion.*"

The other options have not been mentioned anywhere in the passage.

Question 57

Fill in the blank with the appropriate word.

Do you want _____ to help?

Options:

A. I

B. Me

C. Mine

D. Myself

Answer: B

Solution:

The correct answer is **Me.**

Key Points

Assertive sentences follow the structure of Subject+Verb+Object. Here, 'you' is the subject of the sentence which is followed by the verb 'want'. Hence, 'want' should be followed by a noun or a pronoun in its objective case. Hence, the correct form of the pronoun is 'me'.

Additional Information

A noun orpronounis said to be inobjectivecase if itexistsandfunctionsas a grammatical objectof a sentence.

- Example: Please pass me the pepper.
  - In theaboveexample,*pepper*is thedirectobject and we can say that it isexistingorfunctioningas anobjectivecase in theabovesentence.

A noun orpronouncanexistinthreestates of theobjectivecase;directobject,indirectobject andobjectof pronoun.

Direct Object

- When a noun orpronounisexistingas adirectobject i.e. the word onwhichthe verb isactingupon, it isreferredto as adirectobject.
- Example: Shelikessoup.
    - In theabovesentence, the verb*likes*isactingupon the noun*soup*so thatdepictsthat soup isexistingin theobjectivecase.

Indirect Object

- Thesecondaryobject of thesentenceisknownas theindirectobject. Theindirectobject is the onewhichreceivesactivityfrom thedirectobject. A simpletrick toidentifythe indirect objectof thesentenceis byidentifyingthedirectobject andaskingthequestionwhat or who?
- Example: Sara felt herheartbeat faster.
    - In theaboveexample, thedirectobject is*heart*which wefiguredout by asking*felt*what? (*felt*=verb). Now ask*heart*what? answer*: beat faster*. Thus*beat faster*is theindirectobject of thissentenceand isexistingas anobjectivecase in this sentence.

Object ofPreposition

- When a noun orpronouncomesaftera preposition, it isreferredto as theobjectof thepreposition.
- Example: She isstandingbeside me.
    - In theaboveexample,*me*is theobjectof theprepositionas it isprecededby*beside*(a preposition). Thus*me*isexistingas anobjectivecase in this example.

Question 58

In the following question, a sentence has been given in Direct/Indirect speech. Out of the four alternatives suggested, select the one which best expresses the same sentence in Indirect/Direct speech.

I said to my sister, "I brought you a doll yesterday."

Options:

A.

I said to my sister I brought her a doll yesterday.

B.

I told my sister that I brought you a doll the day before.

C.

I said to my sister that I brought her the doll yesterday

D.

I told my sister that I had brought her a doll the previous day.

Answer: D

Solution:

The correct answer is**I told my sister that I had brought her a doll the previous day.**

Key Points

The given sentence is an assertive sentence inthe direct mode of narration. The reporting verb is in the simple past tense and the verb in the reported speech is in the simple past tense as well.

When we convert such a sentence from the direct to the indirect speech, we make the following changes:

- a. *Quotation marks are omitted* and the sentence ends *in a full stop.*
- b. The conjunction ***'that'*** is added to introduce the succeeding clause.
- c. *Adverbs of time(yesterday, today, tomorrow) are changed into 'the day before'/'the previous day', 'this day' and 'the day after'/'the following day' respectively.*
- d. When we have an object for the reporting verb 'said'('sister' in this case), we change it to *'told' in the indirect speech.*
- e. The tense of the verb in the reported speech undergoes changes based upon the tense of the reporting verb. If the reporting verb is in the past tense, the tense of the verb in the reported speechundergoes a backshift. In this case, *simple past is changed into past perfect.*
- f. The *second-person subjective pronoun 'you' is changed into third-person objective pronoun 'her'.*

I told my sister that I had brought her a doll the previous day. ✓

Question 59

In the following question, out of the four alternatives, select the word opposite in meaning to the word given.

Abrupt

Options:

A.

Gradual

B.

Unanticipated

C.

Startling

D.

Unexpected

Answer: A

Solution:

The correct answer is **Gradual.**

Key Points

Abrupt:sudden and unexpected

Gradual:taking place or progressing slowly or by degrees; not sudden

Thus we can see that Abrupt and Gradual are antonyms.

Additional Information

The meaning of the other words:

- **Unanticipated**:not expected or predicted
- **Startling**:very surprising, astonishing, or remarkable
- **Unexpected**:not expected or regarded as likely to happen

A**brup**t	meeting with **rub** [God] cannot be **abrupt**.
Gradual	**graduation** is a **gradual** process.
Startling	John **started** startling looking at evening **star** for the first time.

Abrupt, unanticipated, Startling and Unexpected are all synonyms or near-synonyms.

Question 60

In the following question, out of the four alternatives, select the word similar in meaning to the word given.

Chaos

Options:

A. Method

B. Disorder

C. System

D. Order

Answer: B

Solution:

The correct answer is **Disorder.**

Key Points

Chaos:complete disorder and confusion (पूर्ण विकार और भ्रम)

Disorder:a state of confusion; chaos (भ्रम की स्थिति; अराजकता)

Thus we can see that Chaos and Disorder are synonyms.

The meaning of the other words:

- **Method**:the quality of being well organized and systematic in thought or action (अच्छी तरह से संगठित और विचार या कार्रवाई में व्यवस्थित होने की गुणवत्ता)
- **System**:organized planning or behaviour; orderliness (संगठित योजना या व्यवहार; सुव्यवस्था)
- **Order**:a state in which everything is in its correct or appropriate place; methodical system (एक ऐसी अवस्था जिसमें सब कुछ अपने सही या उचित स्थान पर हो; विधि प्रणाली)

Method, System and Order are all antonyms of Chaos.

Question 61

Select the segment of the sentence that contains an error. if there is no error, mark 'No error' as your answer.

My mother (A) does not likeme (B) coming home late at night. (C) No Error (D)

Options:

A.

A

B.

B

C.

C

D.

No Error

Answer: B

Solution:

The correct answer is **B.**

Key-Points

In the given sentence, 'coming' is a gerund. Whenever we have an object preceding a gerund, we have to use the object(here, a pronoun) in the possessive form. Thus, 'me' needs to be replaced with 'my' to make the sentence correct.

Additional Information

A gerund is a verb form ending in*ing*, such as*being*,*doing*,*having*,*going*,*reading*or*writing*. Although it is a verb form, a gerund does not act as a verb. Instead, it acts as a noun and can do whatever a noun can do. For example, a gerund can be the subject or object of a verb or the object of a preposition:

- *Leaving*was a wise decision. [Leaving*is the subject of the verb*was.]
- We celebrated*winning*. [Winning*is the object of the verb*celebrated.]
- Natalie objects to*borrowing*. [Borrowing*is the object of the preposition*to.]

Using the possessive before a gerund

We often put a noun or pronoun in front of a gerund to show who or what is doing the action in the gerund. This noun or pronoun is called the*subjectof the gerund*. In formal writing, the subject of the gerund should be in the possessive form:

- ***Your****leaving*early was a wise decision.
- We celebrated***Gord's****winning*the contest.
- Natalie objected to***my****borrowing*her hockey stick.

My motherdoes not likemycoming home late at night. ✓

Question 62

Choose the correct spelling.

Options:

A. Benifitted

B. Benneffited

C. Benefitted

D. Beniffited

Answer: C

Solution:

The correct answer is **Benefitted.**

Key Points

The correct spelling is '**benefitted**'.

Additional Information

Benefitted:received an advantage; profited

Question 63

In the following question, out of the four alternatives, the phrase given below is aptly described by just one word. Select the choice which gives the meaning most appropriately.

A place where pigs live

Options:

A. Sty

B. Burrow

C. Kennel

D. Hive

Answer: A

Solution:

The correct answer is **Sty.**

Key Points

Sty: a pen or enclosure for pigs

Additional Information

- **Burrow**:a hole or tunnel dug by a small animal, especially a rabbit, as a dwelling
- **Kennel**:a small shelter for a dog
- **Hive**:anest of bees

Question 64

Give the noun form of the word 'compel'.

Options:

A.

Compelling

B.

Compelled

C.

Compulsion

D.

Compulsive

Answer: C

Solution:

The correct answer is **Compulsion.**

Key Points

'Compel' is a verb. It means *to force or oblige (someone) to do something.*

The corresponding noun form is 'compulsion'. It means *the action or state of forcing or being forced to do something; constraint.* It is an abstract noun.

Important Points

- **Compelling**: forcing or obliging (someone) to do something. It may be used as a gerund or a present participle.
- **Compelled**: forced or obliged (someone) to do something. It may be used as the past form of the base verb 'compel', or as a past participle of the same verb.
- **Compulsive**: resulting from or relating to an irresistible urge. It is an adjective.

Additional Information

Compelling may also be used as an adjective. As an adjective, it means *evoking interest, attention, or admiration in a powerfully irresistible way.*

- *Abstract nouns* are intangible ideas. They're not things people can see, smell, hear, or touch. Common examples include emotions, social concepts, political theories, and character traits. Here is one example: ***anger*** *is an emotion that can inspire change*.
- **abstract nouns:**
  love, *creativity*, *democracy*

Question 65

Fill in the blank.

He was astonished _____ his failure.

Options:

A. With

B. For

C. In

D. At

Answer: D

Solution:

The correct answer is **At.**

Key Points

- Astonished takes the preposition 'at' after it.
- He was astonished ***at*** his failure.

Therefore, the complete sentence is*He was astonished **at** his failure.*

Question 66

Directions - A sentence is given in Active/Passive voice. Out of the four alternatives suggested, select the one which best expresses the same sentence in Active/Passive voice.

Who plays cricket?

Options:

A. By whom is cricket played?

B. By whom was cricket played?

C. By who is cricket played?

D. By who were cricket played?

Answer: A

Solution:

Here the correct answer is **By whom is cricket played?**

Key Points

:-

- In the above given sentence, the correct passive voice of the given sentence will be **'By whom is cricket played?**

- It is so because whenever a sentence contains **'who'**, the passive voice of that sentence starts with **'By whom'.**
- Structure of active voice - **Who + verb + Object?**
- Structure of passive voice - **By whom + helping verb + Object + V_3?**
- **For Example:-**
- Active Voice - Who writes a letter?
- Passive voice - By whom is the letter written?

Therefore, **the correct sentence is** 'By whom is cricket played?'

Additional Information

- When we convert active voice to passive voice, **three things need to be kept in mind**:-
  - Change **object** into **subject**.
  - Change **subject** into **object**.
  - Always use **third form of verb** in passive voice.
  - Use **'by'** before the new object.

Question 67

Choose the correct collective noun for the phrase given below.

A _____ of keys

Options:

A. Flock

B. Fleet

C. Bunch

D. Pride

Answer: C

Solution:

The correct answer is **Bunch.**

Key Points

Bunch: It is the collective noun used with plural nouns such as'keys', 'grapes' etc.

Important Points

- **Flock**: It is the collective noun used with plural nouns such as 'sheep', 'birds' etc.
- **Fleet**: It is the collective noun used with plural nouns such as 'ships', 'cars'. etc.
- **Pride**: It is the collective noun used with the plural noun 'lions'.

Additional Information

A collective noun is used to refer to an entire group of persons, animals or things; it, therefore, includes more than one member. For example, the collective noun*family*stands for parents and children. A*pack*contains many wolves. A*flotilla*is made up of several boats.

Here are some examples of common collective nouns:

- People:*board, choir, class, committee, family, group, jury, panel, staff*
- Animals:*flock, herd, pod, swarm*
- Things:*bunch, collection, fleet, flotilla, pack, set*

Question 68

In the following question, out of the four alternatives, choose the alternative which best expresses the meaning of the idiom /Phrase.

All at sea

Options:

A. Confused

B. Ecstatic

C. Sad

D. Lonely

Answer: A

Solution:

The correct answer is **Confused.**

Key Points

All at sea is an idiom which means***confused or unable to decide what to do.*** One of its variants is *'at sea' which means the same thing.*

Additional Information

Ecstatic:feeling or expressing overwhelming happiness or joyful excitement; very happy and excited

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Question 69

In the following question, parts of a sentence have been jumbled and labeled as P, Q, R, and S. You are required to rearrange the jumbled parts of the sentence and mark your response accordingly by selecting the correct option.

P. photographers clicked her pictures

Q. to interview her and

R. as the family watched in amazement,

S. newspaper reporters came

Options:

A. RSQP

B. RSPQ

C. SPQR

D. SQRP

Answer: A

Solution:

The correct answer is **option 1) i.e. RSQP**

Key Points

- While arranging the parts of the sentence given in options, we have to find some **grammatical or contextual connections** between them, so as we look at all of the parts, we find that **part 'Q' cannot come at last** as it ends with 'and' which has to be followed by some part.
- The given sentence will **start with part 'R'** as it establishes the subject matter well and will be followed by part 'S' as it provides the reason **'why the family watched in amazement'.**
- Moreover, part 'S' will be **followed by part 'Q'** as **'reporters came to interview her'** sounds logically correct.
- The sentence will **end with part 'P'** as with the reporters, photographers also came to clicked her pictures.
- Thus, the correct order is **RSQP.**

The correct sentence – *As the family watched in amazement, newspaper reporters came to interview her and photographers clicked her pictures.*

Question 70

In the following question, a sentence is given in Direct/Indirect speech. Out of the four alternatives choose the one which best expresses the sentence in Indirect/Direct Speech.

The old woman said, "Alas! I have been robbed.

Options:

A.

The old woman exclaimed that she has been robbed.

B.

The old woman exclaimed with joy that she has been robbed.

C.

The old woman exclaimed with sorrow that she has been robbed.

D.

The old woman exclaimed with sorrow that she had been robbed.

Answer: D

Solution:

The correct answer is **option 4)**

Key Points

- While changing the narration of an **exclamatory sentence**, we need to follow the given steps-
  - The conjunction**'that'** should be used in place of a comma (,) and inverted commas (“ ”).
  - **'Said'** will be changed into **exclaimed with sorrow** as **Alas!** is used to express sadness or sorrow.
  - **1st person** (I) is changed into **she** i.e. according to the **subject** of the **reporting verb** (old woman).
  - **Present perfect continuous** (have been) will be changed into **past perfect continuous** (had been).

The correctsentence-*The old woman exclaimed with sorrow that she had been robbed.*

Additional Information

- In exclamatory sentences, **direct speech** is changed into **indirect speech** as follows-
  - Said, “What! / “How! Exclaimed
  - Said, “Wow! / “Hurray! Exclaimed with joy
  - Said, “Alas! Exclaimed with sorrow
  - Said, “Fi! / “Ugh! Exclaimed with disgust/ despise
  - Said, “Oh! Exclaimed with regret/ surprise
  - Said, “Bravo! / “Well done Applauded + object + saying + that

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