

CAREERS 360

PREPARATION **Series**

AEEE 2025

Sample Paper

Physics

Q. 1



If the collision between A & B happens perfectly elastically. Then what is the value of $(v_2 - v_1)$

Option 1:
2m/s

Option 2:
4m/s

Option 3:
5m/s

Option 4:
6m/s

Correct Answer:
2m/s

Solution:

As we learned

Perfectly Elastic Collision -

$$e = 1$$

- wherein

e : coefficient of restitution

$$e = \frac{v_2 - v_1}{u_1 - u_2}$$

For perfectly elastic collision

$$e = 1 = \frac{v_2 - v_1}{4 - 2}$$

$$\text{So } (v_2 - v_1) = 2m/s$$

Q. 2 If for a heat engine source temperature is 300K and sink temperature is 200K. And if heat engine is given 300 cal of heat then how much heat would reject from heat engine

Option 1:

100 cal

Option 2:

200 cal

Option 3:

250 cal

Option 4:

275 cal

Correct Answer:

200 cal

Solution:

Relation between Heat and Temperature in Carnot cycle -

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

Q_1 = Heat absorbed

Q_2 = Heat released

T_2 = Low temperature

T_1 = Higher Temperature

$$Q_1 = 300 \text{ cal}$$

Q_2 = (To find out)

$$T_1 = 300 \text{ K}$$

$$T_2 = 200 \text{ K}$$

$$\text{as } \frac{Q_1}{Q_2} = \frac{T_1}{T_2}$$

$$Q_2 = Q_1 \left(\frac{T_2}{T_1} \right) = 300 \left(\frac{200}{300} \right)$$

$$Q_2 = 200 \text{ cal}$$

Q. 3 A series LCR circuit is tuned to resonance . The angular frequency of applied AC voltage is ω . If the resistance of the circuit in R, the impedance of circuit will be:

Option 1:

$$r$$

Option 2:

$$R + \omega L + \frac{1}{\omega L}$$

Option 3:

$$\sqrt{R^2 + \left(\omega L + \frac{1}{\omega L} \right)^2}$$

Option 4:

$$\sqrt{R^2 + \left(\omega L - \frac{1}{\omega L} \right)^2}$$

Correct Answer:

$$r$$

Solution:

As we learn

Impedence -

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega c} \right)^2}$$

-

$$\text{at resonance } \omega L = \frac{1}{\omega L}$$

$$\text{so, } Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega L}\right)^2} = Z = R$$

Q. 4 If we multiply any vector by -3 then ?

Option 1:

Direction reverses and magnitude tripled

Option 2:

Only magnitude tripled

Option 3:

Direction remains unchanged and magnitude same

Option 4:

Direction reverses and magnitude same

Correct Answer:

Direction reverses and magnitude tripled

Solution:

Vector Quantity -

Vector quantity can be added and subtracted with the help of algebra

- wherein

It specify direction

When we multiply any vector with -3 the magnitude tripled and due to (-ve) sign direction will reverse.

Correct option is 1

Q. 5 For the study of vibration of composite string when joint is a Node (N) , It was found that n_1 and n_2 are the number of loops in two cases for the length of parts as λ_1 and λ_2 respectively . Then what is the ratio of linear density in two parts

Option 1:

$$\frac{\mu_1}{\mu_2} = \frac{n_1}{n_2} \times \frac{\lambda_1}{\lambda_2}$$

Option 2:

$$\frac{\mu_1}{\mu_2} = \frac{n_1}{n_2} \times \frac{\lambda_2}{\lambda_1}$$

Option 3:

$$\frac{\mu_1}{\mu_2} = \left(\frac{n_1}{n_2} \times \frac{\lambda_2}{\lambda_1} \right)^2$$

Option 4:

$$\frac{\mu_1}{\mu_2} = \left(\frac{n_1}{n_2} \times \frac{\lambda_1}{\lambda_2} \right)^2$$

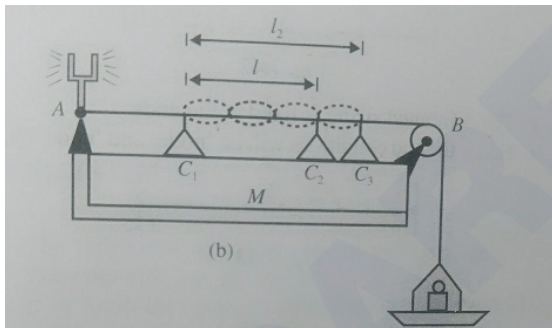
Correct Answer:

$$\frac{\mu_1}{\mu_2} = \left(\frac{n_1}{n_2} \times \frac{\lambda_2}{\lambda_1} \right)^2$$

Solution:

As we learned

Vibration of composite string when joint is a node (N) -



$$\frac{n_1}{n_2} = \frac{l_1}{l_2} \sqrt{\frac{\mu_1}{\mu_2}}$$

- wherein

n_1 and n_2 are number of loops in two cases

l_1 and l_2 are length of two parts

μ_1 and μ_2 are linear density in two parts

Q. 6 Choose correct option regarding photon:

Option 1:

It has zero rest mass

Option 2:

Its speed in vacuum is 3×10^8 m/s

Option 3:

Photons are not deviated by magnetic and electric fields

Option 4:

All of these

Correct Answer:

All of these

Solution:

As we learn

Mass -

It has zero rest mass

- wherein

Photon can not exist at rest

Velocity -

It travels at speed of light in vacuum

- wherein

3×10^8 m/sec

Fields of Photon -

Photons are not deviated by magnetic and electric fields.

- wherein

Independent of fields.

Q. 7 Electric potential at any point is $V = -5x + 3y + \sqrt{15}z$, then the magnitude of the electric field is

Option 1:

$$3\sqrt{2}$$

Option 2:

$$4\sqrt{2}$$

Option 3:

$$5\sqrt{2}$$

Option 4:

$$7$$

Correct Answer:

$$7$$

Solution:

As we learned

Relation between E and V in integral form -

$$dV = - \int_{r_1}^{r_2} \vec{E} \cdot \vec{dr} = - \int_{r_1}^{r_2} E dr \cos \theta$$

-

$$E_x = -\frac{dV}{dx} = -(-5) = 5; E_y = -\frac{dV}{dy} = -3$$

$$\text{and } E_z = -\frac{dV}{dz} = -\sqrt{15}$$

$$E_{net} = \sqrt{E_x^2 + E_y^2 + E_z^2} = \sqrt{(5)^2 + (-3)^2 + (-\sqrt{15})^2} = 7$$

Q. 8 According to Stefan's law the amount of radiation emitted by a perfectly black body is proportional to [T - absolute temperature]

Option 1:

T

Option 2:

t^2

Option 3:

$\frac{1}{T^4}$

Option 4:

T^4

Correct Answer:

T^4

Solution:

As we learn

Stefan's Law -

Radiant energy emitted by a perfectly black body per unit area per sec is directly proportional to 4th power of temperature of the body.

-

$$E = \sigma T^4$$

Q. 9 Choose the correct equation for entropy change for ideal gas in terms of T&P

Option 1:

$$nC_p \ln \left(\frac{T_2}{T_1} \right) + nr \ln \left(\frac{P_2}{P_1} \right)$$

Option 2:

$$nr \ln \left(\frac{T_2}{T_1} \right) + nc_p \ln \left(\frac{P_2}{P_1} \right)$$

Option 3:

$$nc_p \ln \left(\frac{T_2}{T_1} \right) - nr \ln \left(\frac{P_2}{P_1} \right)$$

Option 4:

$$nr \ln \left(\frac{T_2}{T_1} \right) - nc_p \ln \left(\frac{P_2}{P_1} \right)$$

Correct Answer:

$$nc_p \ln \left(\frac{T_2}{T_1} \right) - nr \ln \left(\frac{P_2}{P_1} \right)$$

Solution:

As we learned

Entropy change for ideal gas in terms of T & P -

$$\Delta S = nc_p \ln \left(\frac{T_2}{T_1} \right) - nR \ln \left(\frac{P_2}{P_1} \right)$$

-

Q. 10 Electric charges of $+10\mu C$, $+5\mu C - 3\mu C$ and $+8\mu C$ are placed at the corners of a square of side $\sqrt{2}m$. the potential at the centre of the square is

Option 1:

1.8 V

Option 2:

$1.8 \times 10^6 V$

Option 3:

$1.8 \times 10^5 V$

Option 4:

$$1.8 \times 10^4 V$$

Correct Answer:

$$1.8 \times 10^5 V$$

Solution:

As we learned

Potential of a System of Charge -

$$V = \sum_{i=1}^{i=n} \frac{kQ_i}{r_i}$$

-

Length of each side of square is $\sqrt{2}m$ so distance of it's centre from each corner is $\frac{\sqrt{2}}{\sqrt{2}} = 1m$

Potential at the centre

$$V = 9 \times 10^9 \left[\frac{10 \times 10^{-6}}{1} + \frac{5 \times 10^{-6}}{1} + \frac{3 \times 10^{-6}}{1} + \frac{8 \times 10^{-6}}{1} \right]$$

$$= 1.8 \times 10^5 V$$

Q. 11 An insect trapped in circular groove. If it completes its 20 revolutions in 1 min with constant speed then frequency of insect is :

Option 1:

$$1/3 \text{ rev/sec}$$

Option 2:

$$1/2 \text{ rev/sec}$$

Option 3:

$$1/4 \text{ rev/sec}$$

Option 4:

$$1 \text{ rev/sec}$$

Correct Answer:
1/3 rev/sec

Solution:

As we learn

Frequency -

No. of revolutions completed by the object on its circular path in unit time.

- wherein

Unit $\rightarrow S^{-1}$ or Hertz

Dimension $[T^{-1}]$

$$T = \frac{1}{n}$$

T = time period

$$n = 1/3 \text{ rev/s}$$

Q. 12 The resultant equation in damped motion is given by $x = A_0 e^{\frac{-bt}{2m}} \cos(\omega' t + \delta)$. A_0 is the amplitude & b is a constant. The value of frequency ω' is the best represented by.

Option 1:

$$\sqrt{\frac{k}{m} - \left(\frac{b}{2m}\right)^2}$$

Option 2:

$$\sqrt{\frac{K}{m}}$$

Option 3:

$$\sqrt{\frac{b}{2m}}$$

Option 4:

None of these

Correct Answer:

$$\sqrt{\frac{k}{m} - \left(\frac{b}{2m}\right)^2}$$

Solution:

As we have learnt

Resultant equation in damped motion -

$$x = A_0 \cdot e^{-\frac{bt}{2m}} \cdot \cos(\omega' t + \delta)$$

- wherein

$$\begin{aligned}\omega' &= \sqrt{\frac{K}{m} - \left(\frac{b}{2m}\right)^2} \\ &= \sqrt{\omega_0^2 - \left(\frac{b}{2m}\right)^2}\end{aligned}$$

Q. 13 A girl having weight w is sitting on an electric swing rotating in vertical plane . she feels her weight to have increased by 50 % as the swing goes up . what weight she would experience when the swing comes down

Option 1:

$3w/4$

Option 2:

$3w/2$

Option 3:

$5w/4$

Option 4:

$w/2$

Correct Answer:

$w/2$

Solution:

As we have learned

Weight -

Force with which earth attracts an object.

- wherein

Also called as gravity or gravitational force.

When the swing goes up

$$w + ma = 3/2 w$$

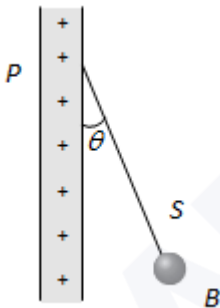
when the swing come down

$$w - ma = w^1$$

$$w - w/2 = w^1$$

$$\Rightarrow w^1 = w/2$$

-
- Q. 14** A charged ball B hangs from a silk thread S , which makes an angle θ with a large charged conducting sheet P , as shown in the figure. The surface charge density σ of the sheet is proportional to



Option 1:
 $\sin \theta$

Option 2:
 $\tan \theta$

Option 3:
 $\cos \theta$

Option 4:

$\cot \Theta$

Correct Answer:

$\tan \Theta$

Solution:

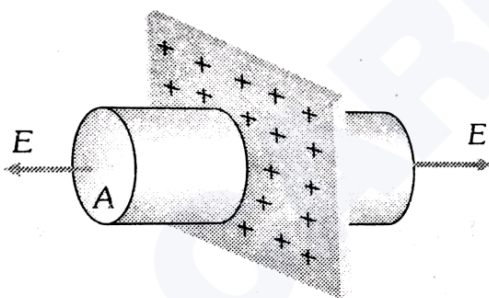
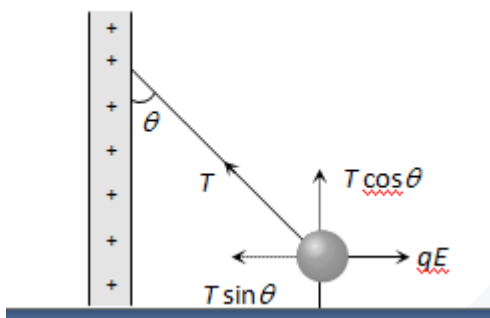
As we learned

infinite thin plate sheet of charge -

$$E = \frac{\sigma}{2\epsilon_0} \quad (E \propto r^0)$$

$$V = \frac{\sigma r}{2\epsilon_0} + c$$

- wherein



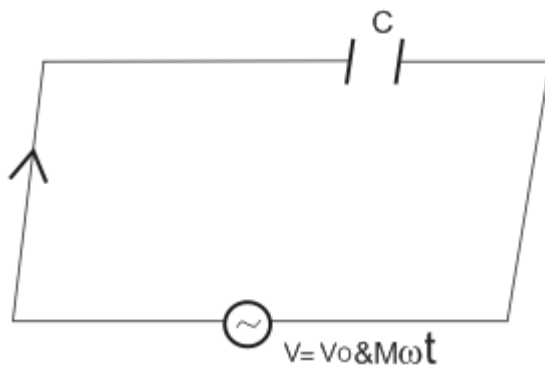
$$T \sin \theta = qE$$

$$T \cos \theta = mg$$

$$\Rightarrow \tan \theta = \frac{qE}{mg} = \frac{q}{mg} \left(\frac{\sigma}{2\epsilon_0} \right)$$

$$\Rightarrow \sigma \propto \tan \theta.$$

Q. 15 For the given circuit the value of peak current is equal to -



Option 1:

$$\frac{V_0}{\omega C}$$

Option 2:

$$\frac{\omega C}{V_0}$$

Option 3:

$$V_0 \omega C$$

Option 4:

$$\frac{\omega}{V_0 C}$$

Correct Answer:

$$V_0 \omega C$$

Solution:

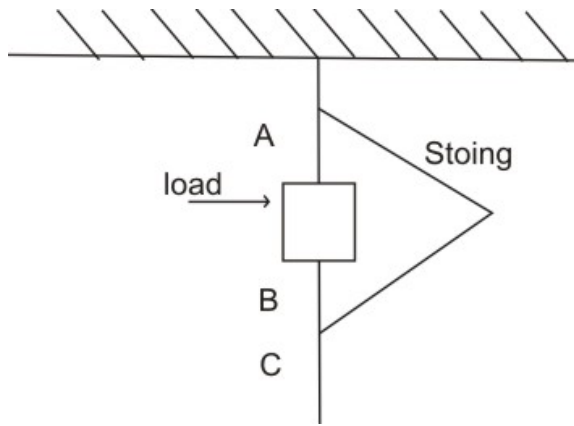
As we have learnt,

Peak current -

$$i'_0 = \frac{V_0}{z} = \frac{V_0}{\sqrt{R^2 + X_c^2}} = \frac{V_0}{\sqrt{R^2 + \frac{1}{4\pi^2 \nu^2 c^2}}}$$

$$i_0 = \frac{V_0}{X_C} = V_0 \omega C$$

Q. 16 In the given diagram if point c is pulled with sudden jerk then.



Option 1:

It will break fast from point A

Option 2:

It will break fast from point B

Option 3:

Can't say anything about breaking of string

Option 4:

Depend on load given

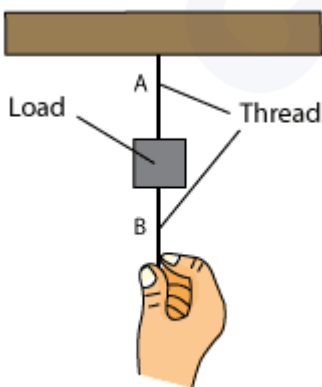
Correct Answer:

It will break fast from point B

Solution:

As we learn

Breaking of string -



* If pulled with sudden jerk then will experience Tension & due to inertia of rest of mass(ball) F will not be transmitted to point A, so it will break from B point

- wherein

* If pulled slowly string will break from point A.

Due to inertia of rest mass F will not be transmitted to point A , so it will break from point B.

Q. 17 Which of the following is not true about hydraulic lift -

Option 1:

It is used to lift heavy loads

Option 2:

It follows Pascal law

Option 3:

It followos Coloumb's Law

Option 4:

Bot (1) and (2) is true

Correct Answer:

It followos Coloumb's Law

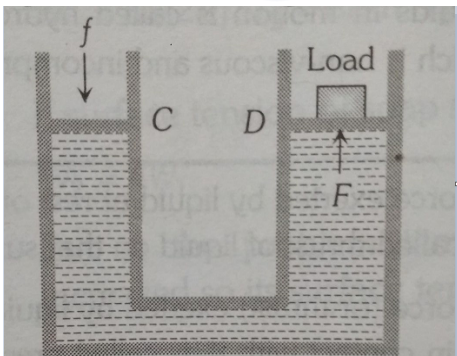
Solution:

As we learn

Hydraulic Lift -

It is used to lift the heavy loads

- wherein



It does not follow Coloumb's law.

Q. 18 A satellite of mass m is circulating around the earth with constant angular velocity. If radius of the orbit is R_0 and mass is M , the angular momentum about the center of the earth is

Option 1:
 $m\sqrt{GMR_0}$

Option 2:
 $M\sqrt{GMR_0}$

Option 3:
 $m\sqrt{\frac{GM}{R_0}}$

Option 4:
 $M\sqrt{\frac{GM}{R_0}}$

Correct Answer:
 $m\sqrt{GMR_0}$

Solution:

As we learn

Angular momentum of satellite -

$$L = mvr$$

$$L = \sqrt{m^2GMr}$$

l = Angular momentum

m → mass of satellite

- wherein

v depends on both the masses, mass of centre of body and mass of planet as well as radius of earth.

Angular momentum $L = mvR_0$

$$\begin{aligned} &= m\sqrt{\frac{GM}{R_0}}R_0 \\ &= m\sqrt{GMR_0} \end{aligned}$$

Q. 19 Which one of the statement is incorrect regarding mass.

Option 1:

It is scalar quantity

Option 2:

Value of mass not depends on gravity

Option 3:

mass of a body is given by $m = \frac{m_0}{\left(1 - \frac{v^2}{c^2}\right)}$, here symbol have their usual meaning.

Option 4:

mass can never be zero.

Correct Answer:

mass of a body is given by $m = \frac{m_0}{\left(1 - \frac{v^2}{c^2}\right)}$, here symbol have their usual meaning.

Solution:

As we learnt

Mass -

Quantity of matter contained in body

S.I. $\rightarrow [Kg]$

dimension $[M]$

- wherein

(i) Value does not change with g

(ii) Can never be zero

(iii) Scalar quantity

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Q. 20 A body executing SHM has maximum acceleration 24 m/s^2 and max velocity 16 m/s . The amplitude of SHM

Option 1:
 $\frac{32}{3}$

Option 2:
 $\frac{3}{32}$

Option 3:
 $\frac{1024}{9}$

Option 4:
 $\frac{64}{9}$

Correct Answer:
 $\frac{32}{3}$

Solution:

As we learnt in

Angular frequency -

The number of revolutions (expressed in radian) performed per unit time is known as Angular Frequency.

- wherein

It is represented by $w = \frac{2\pi}{T}$

$$a\omega^2 = 24$$

$$a\omega = 16$$

$$\Rightarrow \omega = \frac{16}{a} \Rightarrow a = \frac{32}{3} [\because a\omega = 16]$$

Q. 21 Which of the following is false about mechanical wave

Option 1:

Disturbance in water on dropping a pebble in it is an example for mechanical wave

Option 2:

It can be produced and propagated only in those material media which possess elasticity and inertia.

Option 3:

Mechanical wave can propagate through vacuum.

Option 4:

None of these.

Correct Answer:

Mechanical wave can propagate through vacuum.

Solution:

As we learned

Mechanical Wave -

It can be produced and propagated only in those material media which possess elasticity and inertia.

- wherein

e.g. disturbance in water on dropping a pebble in it.

Q. 22 Choose the correct eqⁿ for the specific heat in polytropic process ($PV^n = \text{constant}$)
where

C = molar specific heat

r = adiabatic expansion

Option 1:

$$C = \frac{R}{1-r} + \frac{R}{n-1}$$

Option 2:

$$C = \frac{R}{r-1} + \frac{R}{n-1}$$

Option 3:

$$C = \frac{R}{1-r} + \frac{R}{1-n}$$

Option 4:

$$C = \frac{R}{r-1} + \frac{R}{1-n}$$

Correct Answer:

$$C = \frac{R}{r-1} + \frac{R}{1-n}$$

Solution:

As we learned

Specific Heat in Isotropic Process -

$$C = C_V \frac{R}{r-1}$$

$(PV^r = \text{constant})$

- wherein

$$\therefore C_V = \frac{R}{r-1}$$

$$\therefore C_V = \frac{R}{\gamma-1} - \frac{R}{r-1}$$

$\gamma = \text{Adiabatic exponent}$

Q. 23 An observer moves towards a stationary source of sound, with a velocity one-fifth of the velocity of sound. What is the percentage increase in the apparent frequency

Option 1:

5%

Option 2:

20%

Option 3:

0%

Option 4:

0.5%

Correct Answer:

20%

Solution:

As we learnt in

Frequency when observer is stationary and source is moving away from observer -

$$\nu' = \nu_0 \cdot \frac{C}{C + V_s}$$

- wherein

C = speed of sound

V_s = speed of source

ν_0 = original frequency

ν' = apparent frequency

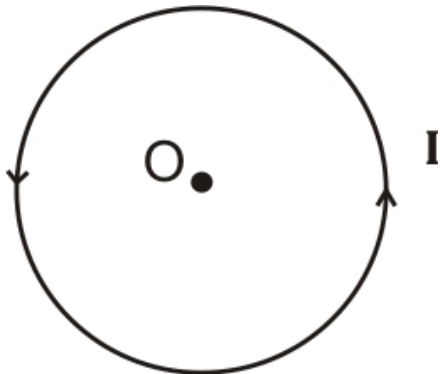
$$n' = \left[\frac{v + v_0}{v} \right] n \Rightarrow \left[\frac{v + v/5}{v} \right] n = 6/5n$$

$$\Rightarrow 1.2n$$

Increment in frequency = 0.2

$$50\% \text{ increment } \frac{0.2n}{n} \times 100 = 20\%$$

Q. 24 If current I is flowing in a circular loop then the direction of magnetic field at point O will be in the direction .



Option 1:
inwards to the plane of paper

Option 2:
outwards to the plane of paper

Option 3:
left side

Option 4:
right side

Correct Answer:
outwards to the plane of paper

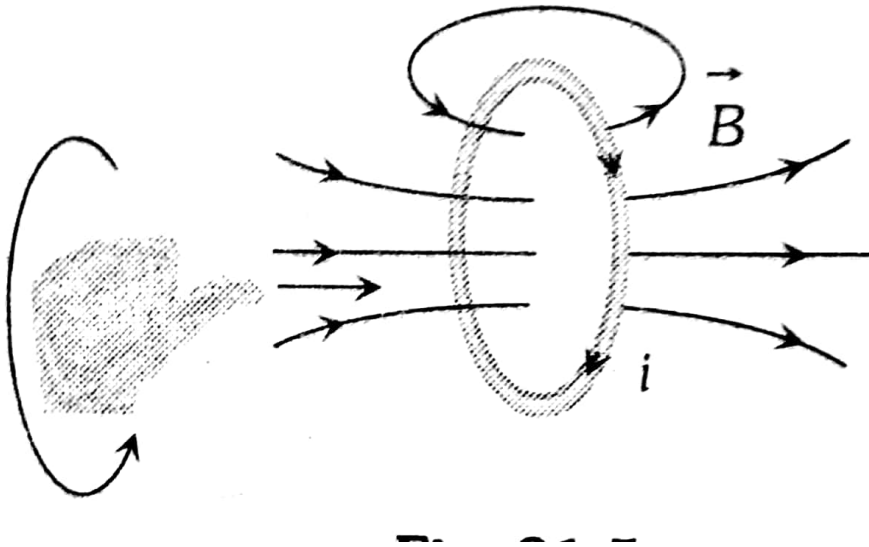
Solution:

As we have learned

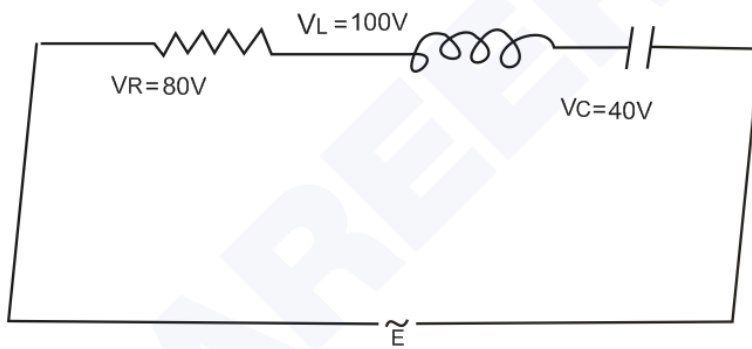
Right Hand Thumb Rule of Circular Currents -

Direction of magnetic field will be in the direction of stretched thumb

- wherein



Q. 25 What will be the value of voltage applied in the following circuit?



Option 1:
120 V

Option 2:
140 V

Option 3:
100 V

Option 4:
200 V

Correct Answer:
100 V

Solution:

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

$$E = \sqrt{V_R^2 + (V_L - V_C)^2} = \sqrt{(80)^2 + (100 - 40)^2} = 100V$$

Q. 26 If a particle is moving with constant speed then

Option 1:

The acceleration of particle is always positive

Option 2:

The acceleration of particles is always negative

Option 3:

The acceleration of particles is zero

Option 4:

none of the above

Correct Answer:

The acceleration of particles is zero

Solution:

As we have learned

Zero Acceleration -

When final velocity is equal to initial velocity.

For: $v_1 = v_2$

- wherein

When a bus is moving with uniform velocity.

For

$$v_1 = v_2$$

$$a = \frac{v_2 - v_1}{t_2 - t_1} = 0$$

Q. 27 5v of stopping potential needed for the photoelectrons emitted out of a surface of work function 2.2ev by the radiation of wavelength

Option 1:

1719A°

Option 2:

8.3444A°

Option 3:

861A°

Option 4:

3000A°

Correct Answer:

1719A°

Solution:

As we learned

Stopping Potential /Cut-off Potential -

It is defined as the potential necessary to stop any electron from reaching the other side.

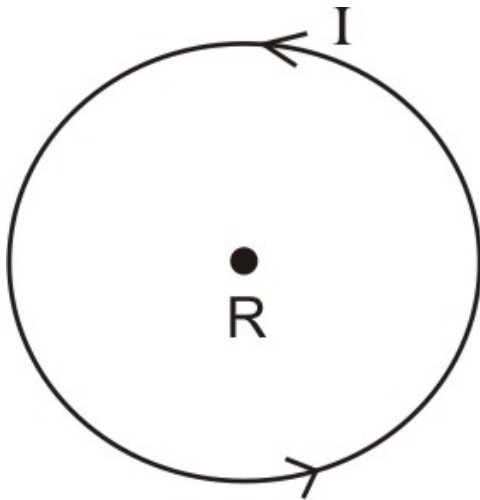
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$$h\nu = 5ev + 2.2ev = 7.2ev$$

$$7.2 = \frac{hc}{\lambda A^\circ} \Rightarrow \lambda = \frac{hc}{7.2(ev)} = \frac{12400}{7.2} A^\circ$$

$$\lambda = 1719A^\circ$$

Q. 28 As shown in diagram direction of currents is shown in current carrying wire then the direction of magnetic field at point R will be represented by



Option 1:



Option 2:



Option 3:



Option 4:



Correct Answer:



Solution:

As we learn

Meaning of Dot -

If magnetic field is directed Perpendicular and out of the plane of the paper.

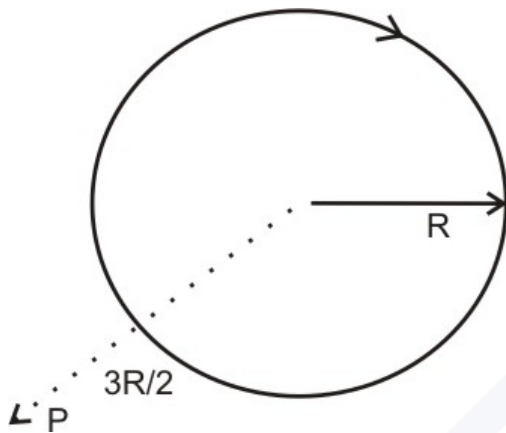
- wherein

It is represented by

According to the right hand thumb rule direction of magnetic field will be perpendicular outward to the plane shown as \odot .

Correct option is 4.

- Q. 29** Figure shows the cross-sectional area of a cylindrical wire of radius R . Cylinder is carrying uniformly distributed current i along its axis. The magnetic induction of distance $\frac{3R}{2}$ from the axis of cylinder will be:



Option 1:
$$\frac{\mu_0 i}{2\pi R}$$

Option 2:
$$\frac{\mu_0 i}{4\pi R}$$

Option 3:
$$\frac{\mu_0 i}{\pi R}$$

Option 4:
$$\frac{\mu_0 i}{3\pi R}$$

Correct Answer:
$$\frac{\mu_0 i}{3\pi R}$$

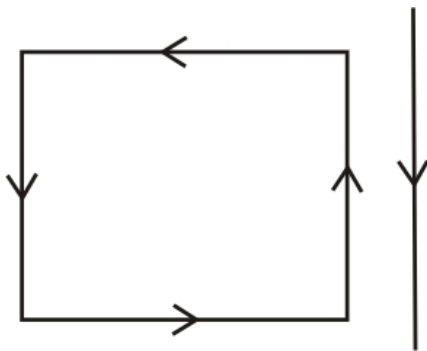
Solution:
As we learn

Magnetic field due to a cylindrical wire -

Magnetic field due to a cylindrical wire is obtained by the application of Ampere's law.

$$B_{\text{out}} = \frac{\mu_0 i}{2\pi R} \Rightarrow \frac{\mu_0 i}{2\pi \frac{3}{2}R} \Rightarrow \frac{\mu_0 i}{3\pi R}$$

Q. 30 As shown in figure, a current loop is placed near a long straight wire which also carries a current. The direction of current are shown:



Option 1:

The wire is repelled from the loop

Option 2:

The wire is attracted towards the loop

Option 3:

There is no net force between the loop and the wire

Option 4:

The force should have attraction or repulsion depending on the magnitudes of the currents.

Correct Answer:

The wire is repelled from the loop

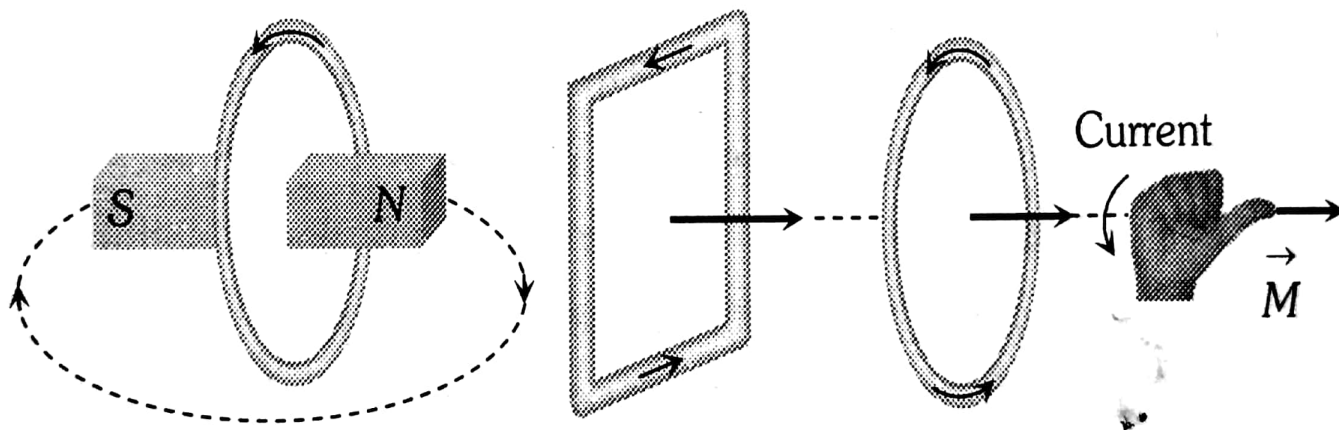
Solution:

As we learn

Behaviour of current loop in a magnetic field -

A rectangular current carrying coil having N turns and area A in uniform magnetic field \vec{b}

- wherein



Antiparallel current repel each other and parallel current attract each other.

Chemistry

Q. 1 Oxidation number of Iodine IO_3^- is

Option 1:

-1

Option 2:

+5

Option 3:

+3

Option 4:

+7

Correct Answer:

+5

Solution:

As we learned

Rules for Oxidation Number -

The algebraic sum of the oxidation number of all the atoms in a compound must be zero. In polyatomic ion the sum is equal to charge on the ion.

-



$$x + 3(-2) = -1$$

$$x = +5$$

Q. 2 Which base is present in RNA but not in DNA?

Option 1:

Uracil

Option 2:

Cytosine

Option 3:

Guanine

Option 4:

Thymine

Correct Answer:

Uracil

Solution:

As we learnt in

Deoxyribonucleic acid (DNA) -

Made up of nucleotides consisting of pentose sugar which is $\beta - D - 2$ -deoxyribose, Phosphoric acid and bases (Adenine , Guanine , cytosine and thymine)

-

Ribonucleic acid (RNA) -

Made up of nucleotides consisting of pentose sugar which is $\beta - D$ -ribose, Phosphoric acid and bases (Adenine , Guanine , cytosine and uracil)

-

In RNA uracil is present instead of thymine.

Q. 3 The true statement amongst the following is :

Option 1:

S is a function of temperature but δS is not a function of temperature.

Option 2:

Both δS and S are functions of temperature

Option 3:

Both S and δS are not functions of temperature.

Option 4:

S is not a function of temperature but δS is a function of temperature.

Correct Answer:

Both δS and S are functions of temperature

Solution:

$$\Delta S = \int \frac{dq}{T}$$

$$S_T = \int_0^T \frac{ncdT}{T}$$

Hence, option number (2) is correct.

Q. 4 The number of electrons in ground state electronic configuration of Boron for which $l = 1$

Option 1:

zero

Option 2:

1

Option 3:

2

Option 4:

3

Correct Answer:

1

Solution:

As we have learnt,

Boranes (Hydrides of Boron) -

Form hydrides of types B_nH_{n+4} and B_nH_{n+6} , known as boranes

- wherein

These are covalent in nature

Electronic configuration : $1s^2 s^2 2p^1$

for p-subshell $l = 1$

There is only one electron in p-subshell.

Q. 5 Which of the following is not heterogeneous

Option 1:

An Emulsion

Option 2:

True solution

Option 3:

Suspension

Option 4:

Colloidal sol

Correct Answer:

True solution

Solution:

True Solution is a homogeneous mixture of two or more substances in which substance dissolved (solute) in solvent has a particle size of less than 10^{-9} m or 1 nm. The simple solution of sugar in water is an example of the true solution. Particles of true solution cannot be filtered through filter paper and are not visible to the naked eye.

A colloidal solution is heterogeneous.

Emulsion and suspension are also heterogeneous.

So, option 2 is correct.

Q. 6 What is NOT the cause of non-equilibrium of the system:

Option 1:

Change of intensive properties within the system at a large extent

Option 2:

Presence of unbalanced forces between the system and surroundings

Option 3:

Constant chemical composition the system with respect to time

Option 4:

None of the above

Correct Answer:

Constant chemical composition the system with respect to time

Solution:

As we have learnt,

Thermodynamic Equilibrium -

Thermodynamic Equilibrium

A system in which the macroscopic properties do not undergo any change with time is called thermodynamic equilibrium.

If a system is heterogeneous and it is in equilibrium the macroscopic properties in the various phases remain unchanged with time.

Types: It is of three types-

(i) Mechanical Equilibrium

Here no mechanical work is done by one of the systems on another part of the system and it is possible if the pressure remains the same throughout the system that is, there is no flow of matter from one part to another

(ii) Thermal Equilibrium

There is no flow of heat from one part to another that is, the temperature is constant.

(iii) Chemical Equilibrium

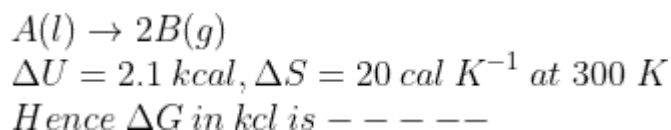
There is no change in the composition of any part of the system with time.

-

As we have learned the system is in thermodynamic equilibrium only if it is in thermal, chemical and mechanical equilibrium. Constant chemical composition is referring for the system to be in chemical equilibrium, hence it is NOT the cause of the non-equilibrium of the system

Hence, **option number (3) is correct**

Q. 7 For the reaction



Option 1:

-2.7 Kcal

Option 2:

3.3 Kcal

Option 3:

- 3.3 Kcal

Option 4:

2.7 Kcal

Correct Answer:

-2.7 Kcal

Solution:

We know:

$$\Delta G = \Delta H - T\Delta S$$

$$\Delta H = \Delta U + 2RT$$

Thus, we have:

$$\Delta G = \Delta U + 2RT - T\Delta S$$

On putting the given values we get:

$$\Delta G = 2.1 + 2 \times 2 \times 300 \times 10^{-3} - 300 \times 20 \times 10^{-3}$$

$$\Delta G = 2.1 + 4 \times 300 \times 10^{-3} - 300 \times 20 \times 10^{-3}$$

$$\Delta G = 1200 \times 10^{-3} - 6000 \times 10^{-3}$$

$$\Delta G = 2.1 + 1.2 - 6$$

$$\Delta G = 3.3 - 6$$

$$\Delta G = -2.7 \text{ Kcal}$$

Q. 8 Complete hydrolysis of cellulose gives

Option 1:

D-fructose

Option 2:

D-ribose

Option 3:

D-glucose

Option 4:

L-glucose.

Correct Answer:

D-glucose

Solution:

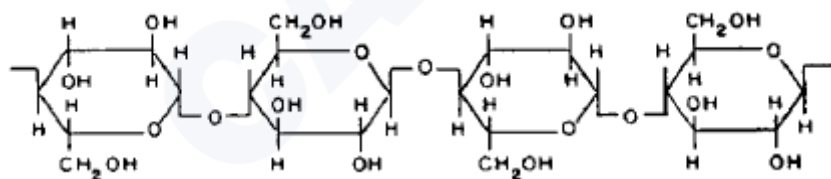
As we learnt in

Cellulose -

A straight chain polymer of $\beta - D - \text{glucose}$

- wherein

Constituent of plant cell wall



Linkage : $\beta - 1, 4 -$ linkage

Cellulose is a straight chain polymer of D-glucose, which upon hydrolysis gives its monomer (D-glucose)

Q. 9 The structural unit of quartz is:

Option 1:



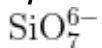
Option 2:



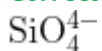
Option 3:



Option 4:



Correct Answer:



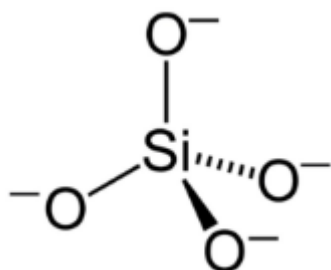
Solution:

As we have learnt,

Silicon Dioxide/ Silica/ Quartz -

Covalent, three dimensional solid network in which each silicon is covalently bond to four oxygen atoms (sp³ hybridisation) forming a tetrahedral structure

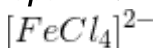
The structural unit of quartz is SiO₄⁴⁻



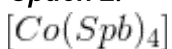
Therefore, **option (3) is correct.**

Q. 10 The d- electron configuration , $e^4t_2^3$ corresponds to the complex ion

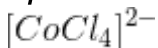
Option 1:



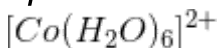
Option 2:



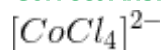
Option 3:



Option 4:



Correct Answer:

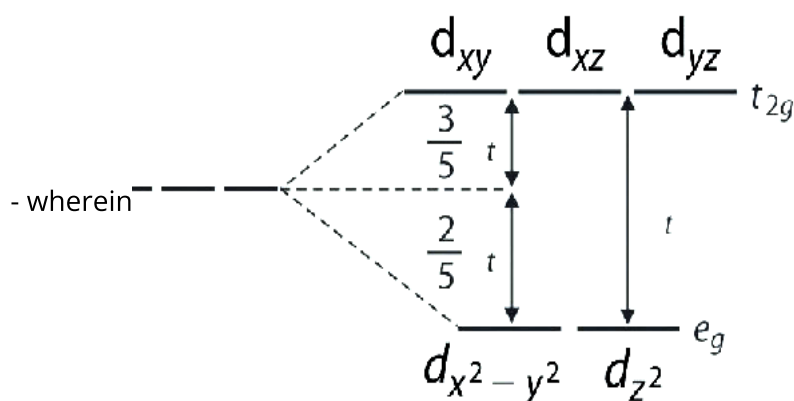


Solution:

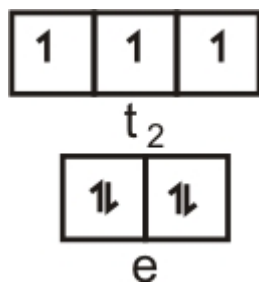
As we have learned

Crystal field splitting in tetrahedral complexes -

t_{2g} orbitals have more value of energies as compared to e_g



$Co^{2+} 4sp^3 d^2$ (high spin)



tetrahedral splitting

Q. 11 The osmotic pressure of solution increases, if

Option 1:

Temperature is decrease

Option 2:

Solution concentration is increase

Option 3:

The number of solute molecules is increase

Option 4:

Volume is increased

Correct Answer:

The number of solute molecules is increase

Solution:

As we learn

Osmotic Pressure -

Osmotic Pressure (π) is excess pressure developed on solution side due to osmosis.

-

Osmotic Pressure (π) is excess pressure developed on solution side due to osmosis.

As soon as the solute molecules increases the osmotic pressure of solution increase.

Q. 12 CO is harmful for living body due to

Option 1:

It reacts with haemoglobin to form carboxy haemoglobin complex which is about 300 times more stable than oxyhaemoglobin

Option 2:

It reacts with HCl of stomach

Option 3:

It damages nerve

Option 4:

It reacts with N_2 to form producer gas

Correct Answer:

It reacts with haemoglobin to form carboxy haemoglobin complex which is about 300 times more stable than oxyhaemoglobin

Solution:

As we have learnt,

CO complex with haemoglobin

Forms carboxyhemoglobin that is highly stable and prevents oxygen carrying capacity of haemoglobin in RBCs, resulting in death.

Therefore, **option (1) is correct.**

Q. 13 Which of the following statement is true?

Option 1:

Due to the high difference of electronegativity in C-H they possess weak van der Waals forces.

Option 2:

C_1 to C_3 are gases at room temperature.

Option 3:

Hydrocarbon does not exist in a solid state at room temperature ?

Option 4:

None of these

Correct Answer:

C_1 to C_3 are gases at room temperature.

Solution:

As we learn

Physical Property of Alkane -

Due to weak Vander Waal force, the first four members, C_1 to C_4 are gases, C_5 to C_{17} are liquid and C_{18} to higher alkanes are solid.

- wherein

CH_4 To C_4H_{10} gas

C_5H_{12} to $C_{17}H_{36}$ liquid

$C_{18}H_{38}$ to higher are solid.

There is very little difference of electronegativity between C-H bond.

C_1 to C_4 are gases at room temp. Hydrocarbon containing 18 or more carbon are solid at $25^\circ C$.

The correct option is 2.

Q. 14 H_2SO_4 is work as

Option 1:

Dehydrating agent

Option 2:

Oxidising agent

Option 3:

Drying agent

Option 4:

All of these

Correct Answer:

All of these

Solution:

As we have learned

Properties of Sulfuric acid -

It acts as a strong dehydrating agent

-

H_2SO_4 is work as dehydrating agent , oxidising agent and drying agent

Q. 15 Which statement is incorrect about zeolites?

Option 1:

Zeolites occur naturally only and cannot be artificially created

Option 2:

Zeolites are aluminosilicates

Option 3:

Each zeolite contains channels of a specific size

Option 4:

A zeolite functions as an acid catalyst

Correct Answer:

Zeolites occur naturally only and cannot be artificially created

Solution:

Zeolites are found in nature as well as synthesised for catalytic selectivity

Hence, **the correct answer is Option (1)**

Q. 16 The volume of gas A is twice than that of gas B. The compressibility factor of gas A is thrice than that of gas B at same temperature. The pressures of the gases for equal number of moles are :

Option 1:

$$2P_A = 3P_B$$

Option 2:

$$3P_A = 2P_B$$

Option 3:

$$P_A = 2P_B$$

Option 4:

$$P_A = 3P_B$$

Correct Answer:

$$2P_A = 3P_B$$

Solution:

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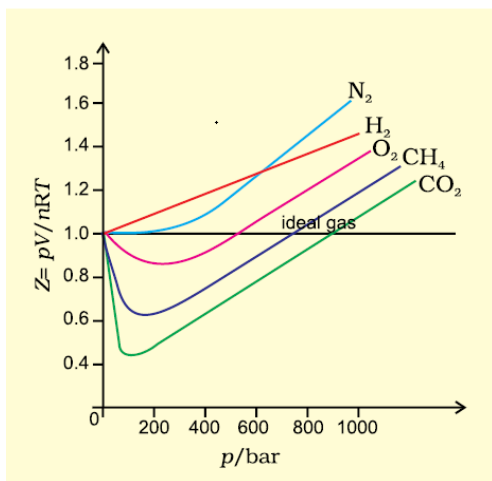
Compressibility Factor -

$$Z = \frac{V_{real}}{V_{ideal}}$$

-

Compressibility Factor -

at low pressures, all gases have Z less than 1.



As we know from ideal gas equation

$$Pv = ZnRT = P \frac{ZnRT}{P} \text{ at constant T and mol } P \propto \frac{Z}{V}$$

$$\text{There for } \frac{P_A}{P_B} = \frac{Z_A}{Z_B} \times \frac{V_B}{V_A} = \left(\frac{3}{1}\right) \times \left(\frac{1}{2}\right) = \frac{3}{2}$$

$$\therefore 2P_A = 3P_B$$

Q. 17 Oxidation involves:-

Option 1:

Loss of hydrogen

Option 2:

Loss of oxygen

Option 3:

Gain in Hydrogen

Option 4:

Gain in electrons

Correct Answer:

Loss of hydrogen

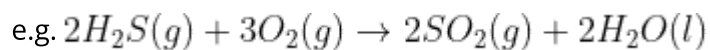
Solution:

As we learn

Oxidation -

It is defined as the addition of oxygen / electronegative element to a substance or removal of hydrogen / electropositive element from a substance.

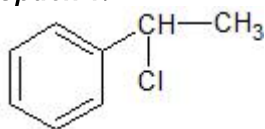
- wherein



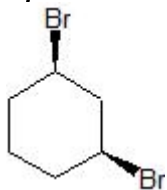
Addition of oxygen or removal of hydrogen from a substance called oxidation.

Q. 18 Which of the following molecule is chiral :

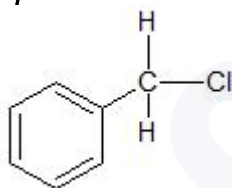
Option 1:



Option 2:



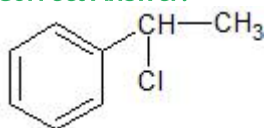
Option 3:



Option 4:



Correct Answer:



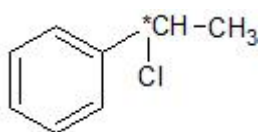
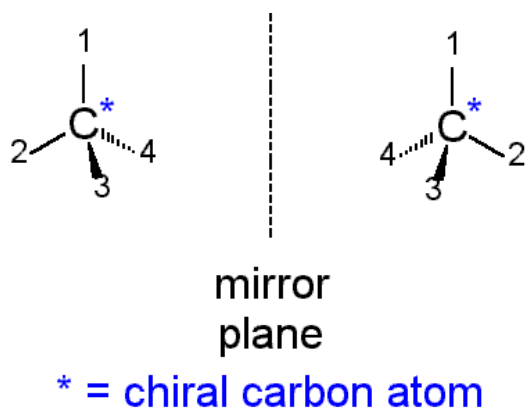
Solution:

As we learn

Chiral Carbon -

That carbon on which four different groups are present.

- wherein



It has a chiral center so there is no P.O.S, C.O.S, and A.A.O.S so it is a chiral molecule.

Q. 19 Which of the following is incorrect regarding branched chain polymer?

Option 1:

They contain linear chain having some branches.

Option 2:

They have low melting point.

Option 3:

They are high density polymers.

Option 4:

Glycogen is an example of branched chain polymer

Correct Answer:

They are high density polymers.

Solution:

As we have learned

Branched Chain Polymers -

- A linear chain of monomers with some branching.

- Low density and melting point.

- wherein

Low-density polyethylene, glycogen

Branched Chain Polymers generally low in density.

Q. 20 At low pressures (For 1 mole), the Vander Waal's equation is written as -

$$\left[p + \frac{a}{V^2} \right] V = RT$$

The compressibility factor is then equal to :

Option 1:
 $\left(1 - \frac{a}{RTV} \right)$

Option 2:
 $\left(1 - \frac{RTV}{a} \right)$

Option 3:
 $\left(1 + \frac{a}{RTV} \right)$

Option 4:
 $\left(1 + \frac{RTV}{a} \right)$

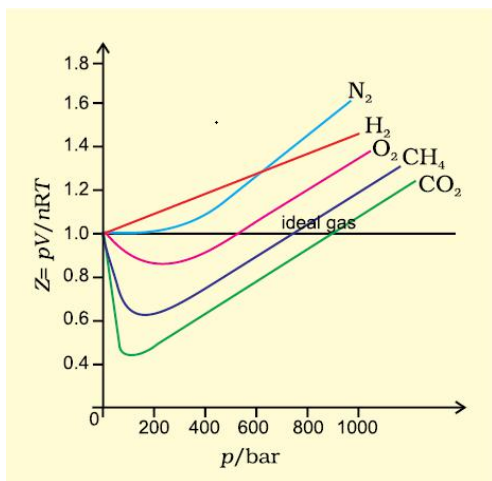
Correct Answer:
 $\left(1 - \frac{a}{RTV} \right)$

Solution:

As we learnt in

Compressibility Factor -

at low pressures, all gases have Z less than 1.



$$\left(P + \frac{a}{V^2}\right)(V) = RT$$

$$PV + \frac{a}{V} = RT$$

$$\frac{PV}{RT} = 1 - \frac{a}{VRT}$$

Q. 21 The nature of NaCl is :

Option 1:

Ionic

Option 2:

covalent

Option 3:

amphoteric

Option 4:

basic

Correct Answer:

Ionic

Solution:

As we learn-

Nature of compounds formed by alkali metals -

Form ionic compounds with non-metals (electronegative) elements

Halides of Na^+ is ionic in nature so NaCl is an ionic compound.

Q. 22 Temporary hardness of water is caused by presence of :

Option 1:
bicarbonate salts

Option 2:
chloride salts

Option 3:
sulphide salts

Option 4:
carbonate salts

Correct Answer:
bicarbonate salts

Solution:

Temporary hardness is caused by the presence of magnesium and calcium hydrogen carbonates

$\text{Mg}(\text{HCO}_3)_2$ and $\text{Ca}(\text{HCO}_3)_2$

Therefore, **option(1) is correct.**

Q. 23 Which is a abiotic factor ?

Option 1:
Plant

Option 2:
Mushroom

Option 3:
Animal

Option 4:
Temperature

Correct Answer:
Temperature

Solution:

As we learned from

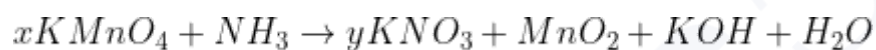
Abiotic components -

Non - living components

- wherein

Lithosphere, hydrosphere, atmosphere.

Q. 24 In the redox reaction :-



x and y are : -

Option 1:

x = 4 and y = 6

Option 2:

x = 3 and y = 8

Option 3:

x = 8 and y = 6

Option 4:

x = 8 and y = 3

Correct Answer:

x = 8 and y = 3

Solution:

As we learned

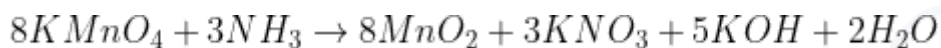
Balancing of Redox Reactions -

Oxidation number method

- wherein

1. Write the correct formula for each reactant and product.
2. Identify an atom whose oxidation number is changed.
3. Calculate increase/decrease in oxidation number per atom and for the entire molecule/ion in which it occurs.
4. Add H^+ / OH^- on an appropriate side so that the total ionic charges of reactants and products are equal.
5. Make numbers of hydrogen atoms in the expression on the two sides equal by adding H_2O to reactant or product

The balanced reaction is as follows



Q. 25 Nitrogen occurs in –

Option 1:

Chile salt peter

Option 2:

Indian salt peter

Option 3:

Ammonium chloride

Option 4:

All of these

Correct Answer:

All of these

Solution:

Nitrogen occurs in

Chile saltpeter (Sodium Nitrate) – $NaNO_3$

Indian saltpeter (Potassium Nitrate) – KNO_3

Ammonium chloride – NH_4Cl or $NH_4^+ Cl^-$.

Hence, Nitrogen occurs in all the given compounds.

Therefore, **option (4) is correct.**

Maths

Q. 1 Find the median of following discrete data
2,7,21,13,54,12

Option 1:
12

Option 2:
12, 13

Option 3:
13

Option 4:
21, 13

Correct Answer:
12, 13

Solution:
As we learned

MEDIAN -

For discrete data:

in case of discrete data let $x_1, x_2, x_3, \dots, x_n$

If the number of observations(n) is odd then the median is the value $\left(\frac{n+1}{2}\right)^{th}$ observations after the observations are arranged in ascending or descending order of magnitude.

If n is even then $\left(\frac{n}{2}\right)^{th}$ and $\left(\frac{n}{2} + 1\right)^{th}$ observations.

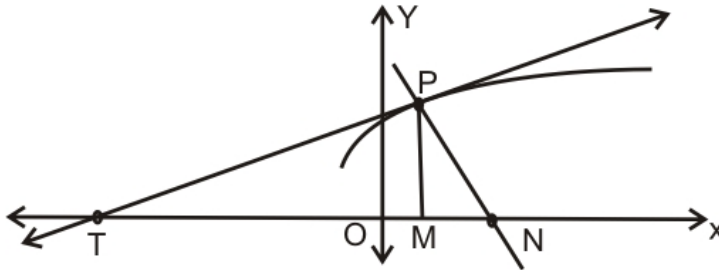
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Increasing orders: 2,7,12,13,21,54

$n=6$ so, 3rd and 4th observation.

Q. 2 Match the column for the following figure

- | | |
|----------|----------------|
| (i) PT | (p) Subnormal |
| (ii) TM | (q) tangent |
| (iii) PN | (r) Normal |
| (iv) MN | (s) Subtangent |



Option 1:

(i) - (p) ; (ii) - (q) ; (iii) - (r) ; (iv) - (s)

Option 2:

(i) - (q) ; (ii) - (p) ; (iii) - (s) ; (iv) - (r)

Option 3:

(i) - (q) ; (ii) - (s) ; (iii) - (r) ; (iv) - (p)

Option 4:

(i) - (s) ; (ii) - (r) ; (iii) - (q) ; (iv) - (p)

Correct Answer:

(i) - (q) ; (ii) - (s) ; (iii) - (r) ; (iv) - (p)

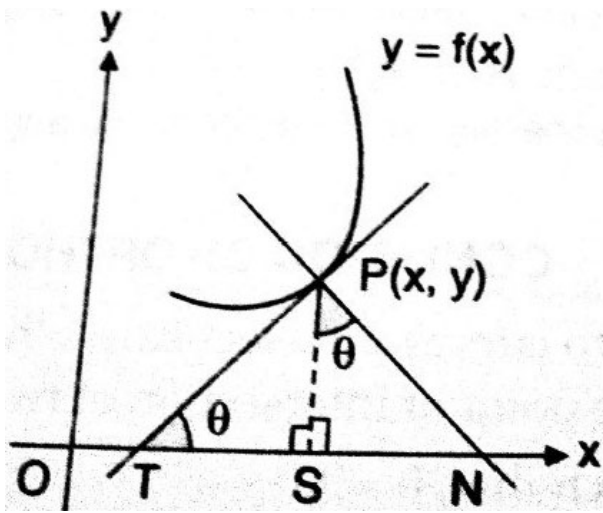
Solution:

As we learned

Concept of sub Tangent and sub Normal -

When Tangent and Normal cuts the x-axis at a point and perpendicular from point of contact to x-axis. Then this is sub Normal & Tangent. From fig TS and SN are known as sub tangent and sub normal.

- wherein



Q. 3 ${}^8C_0 \times {}^9C_8 + {}^8C_1 \times {}^9C_7 + {}^8C_2 \times {}^9C_6 + {}^8C_3 \times {}^9C_5 + {}^8C_4 \times {}^9C_4 + {}^8C_5 \times {}^9C_3 + {}^8C_6 \times {}^9C_2 + {}^8C_7 \times {}^9C_1 + {}^8C_8 \times {}^9C_0$

Option 1:

${}^{17}C_8$

Option 2:

${}^{72}C_0$

Option 3:

${}^{72}C_8$

Option 4:

none

Correct Answer:

${}^{17}C_8$

Solution:

As we have learned

Result of Binomial Theorem -

Sum of product of binomial coefficients in the expansion is ${}^{2n}C_{n+r}$

hence $c_0c_r + c_1c_{r+1} + \dots + c_{n-r}c_n = \frac{(2n)!}{(n-r)!(n+r)!}$

$$(1+x)^8 = {}^8C_0 + {}^8C_1x + {}^8C_2x^2 + {}^8C_3x^3 + \dots + {}^8C_8x^8$$

$$(1+x)^9 = {}^9C_0 + {}^9C_1x + {}^9C_2x^2 + {}^9C_3x^3 + \dots + {}^9C_8x^8 + {}^9C_9x^9$$

$$= {}^{17}C_8$$

Q. 4 If $f(x) = \int (4 + \frac{1}{2\sqrt{x}} + x\sqrt{x})dx$ Then domain of f(x) is

Option 1:
 $x \leq 0$

Option 2:
 $x > 0$

Option 3:
 $x < 0$

Option 4:
 $x \geq 0$

Correct Answer:
 $x \geq 0$

Solution:

As we have learned

Indefinite integrals for Algebraic functions -

$$\frac{d}{dx} \frac{(x^{n+1})}{n+1} = x^n \text{ so } \int x^n dx = \frac{x^{n+1}}{n+1}$$

- wherein

Where $n \neq -1$

$$f(x) = \int \left(4 + \frac{1}{2\sqrt{x}} + x\sqrt[4]{x}\right) dx$$

$$\int 4dx + \frac{1}{2} \int x^{-1/2} dx + \int x^{5/4} dx$$

$$4x + \frac{1}{2} \left[\frac{x^{-1/2+1}}{-1/2+1} \right] + \frac{x^{5/4+1}}{\frac{5}{4}+1} + C$$

$$f(x) = 4x + \sqrt{x} + 4/9x^{9/4} + C$$

To find domain of f(x)

$x^{9/4}$ can be written as $x^2\sqrt[4]{x}$

For $\sqrt[4]{x}$ to exist x must be ≥ 0

- Q. 5** Let C be the circle with centre at (1, 1) and radius = 1. If T is the circle centred at (0, y), passing through origin and touching the circle C externally, then the radius of T is equal to :

Option 1:

$$\frac{1}{2}$$

Option 2:

$$\frac{1}{4}$$

Option 3:

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

Option 4:

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

Correct Answer:

$$\frac{1}{4}$$

Solution:

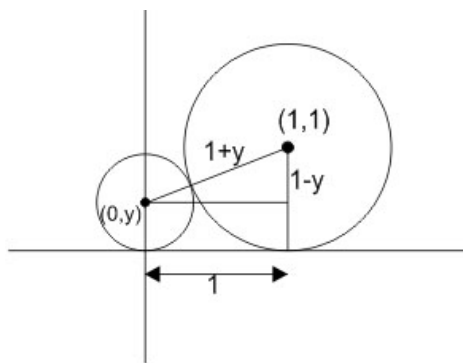
As we learnt in

Circle touching y-axis and having radius r -

$$x^2 + y^2 + 2gx \pm 2ry + g^2 = 0$$

- wherein

Where g is a variable parameter.



According to Pythagoras theorem,

$$(1 + y)^2 = (1 - y)^2 + 1$$

$$y = \frac{1}{4}$$

Q. 6 Find $\lim_{x \rightarrow 0} (e^x \cdot \log(x^x + x + 2))$

Option 1:

1

Option 2:

e

Option 3:

log 2

Option 4:

0

Correct Answer:

log 2

Solution:

As we learned

Limit of product / quotient -

Limit of product/quotient is the product/quotient of individual limits such that

$$\lim_{x \rightarrow a} (f(x) \cdot g(x))$$

$$= \lim_{x \rightarrow a} f(x) \cdot \lim_{x \rightarrow a} g(x), \text{ given that } f(x) \text{ and } g(x) \text{ are non-zero finite values}$$

$$\lim_{x \rightarrow a} \frac{f(x)}{g(x)} = \frac{\lim_{x \rightarrow a} f(x)}{\lim_{x \rightarrow a} g(x)}, \text{ given that } f(x) \text{ and } g(x) \text{ are non-zero finite values}$$

$$\text{Also } \lim_{x \rightarrow a} kf(x)$$

$$= k \lim_{x \rightarrow a} f(x)$$

-

$$= \lim_{x \rightarrow 0} (e^x \cdot \log(x^x + x + 2))$$

$$= \lim_{x \rightarrow 0} (e^x) \cdot \lim_{x \rightarrow 0} \log(x^x + x + 2)$$

$$= 1 * \log 2 = \log 2$$

Q. 7 If $\vec{a} \cdot \vec{b} = 8$, $|\vec{a}| = 4$, $|\vec{b}| = 4$, what is the angle between \vec{a} and \vec{b} ?

Option 1:
 $\frac{\pi}{6}$

Option 2:
 $\frac{\pi}{3}$

Option 3:
 $\frac{2\pi}{3}$

Option 4:
 $\frac{\pi}{2}$

Correct Answer:
 $\frac{\pi}{3}$

Solution:

As we have learnt

Angle between vector a and vector b -

$$\cos \Theta = \frac{\vec{a} \cdot \vec{b}}{|\vec{a}| |\vec{b}|}$$

- wherein

Here $0 \leq \Theta \leq \pi$???????

$$8 = 4 \times 4 \cos \theta$$

$$\frac{1}{2} = \cos \theta$$

$$\frac{\pi}{3} = \theta$$

Q. 8 The circular radius of 7 cm is cut and bend again into an arc of a circle of radius 12 cm. The angle subtended by an arc at the center of a circle is:

Option 1:

50°

Option 2:

210°

Option 3:

100°

Option 4:

60°

Correct Answer:

210°

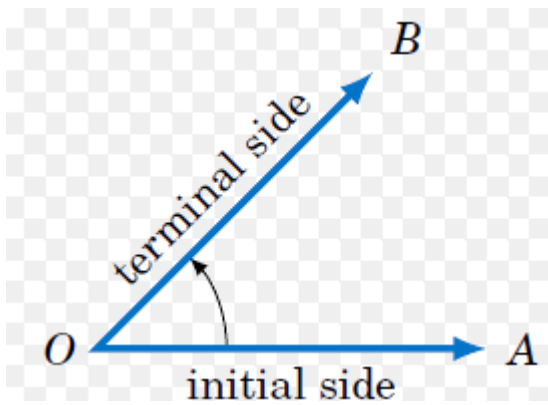
Solution:

As we learn

Angle -

Consider a ray \vec{OA} . If this ray rotates about its end point O and take the position OB, then the angle $\angle AOB$ has been generated.

- wherein



Given the diameter of a circular wire = 14 cm. Therefore length of the wire = 14π cm

$$\text{Hence, the required angle} = \frac{\text{Arc}}{\text{radius}} = \frac{14\pi}{12} = \frac{7\pi}{6} \text{radian} \Rightarrow \frac{7\pi}{6} \times \frac{180^\circ}{\pi} = 210^\circ$$

Q. 9

$$\text{If } f(\theta) = \begin{vmatrix} 1 & \cos \theta & 1 \\ -\sin \theta & 1 & -\cos \theta \\ -1 & \sin \theta & 1 \end{vmatrix} \text{ and}$$

A and B are respectively the maximum and the minimum values of $f(\theta)$, then (A, B) is equal to :

Option 1:

$$(3, -1)$$

Option 2:

$$(4, 2 - \sqrt{2})$$

Option 3:

$$(2 + \sqrt{2}, 2 - \sqrt{2})$$

Option 4:

$$(2 + \sqrt{2}, -1)$$

Correct Answer:

$$(2 + \sqrt{2}, 2 - \sqrt{2})$$

Solution:

As we learnt in

Value of determinants of order 3 -

DETERMINANT OF ORDER 3

The determinant of a 3 X 3 matrix

$$\begin{aligned}\Delta &= \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix} \\ &= a_{11}(a_{22}a_{33} - a_{23}a_{32}) \\ &\quad - a_{12}(a_{21}a_{33} - a_{31}a_{23}) \\ &\quad + a_{13}(a_{21}a_{32} - a_{31}a_{22})\end{aligned}$$

$$f(\theta) = \begin{vmatrix} 1 & \cos\theta & 1 \\ -\sin\theta & 1 & -\cos\theta \\ -1 & \sin\theta & 1 \end{vmatrix}$$

$$f(\theta) = 1(1 + \sin\theta\cos\theta) - \cos\theta(-\sin\theta - \cos\theta) + 1(-\sin^2\theta + 1)$$

$$= 1 + \sin\theta\cos\theta + \sin\theta\cos\theta + \cos^2\theta - \sin^2\theta + 1$$

$$2 + \sin 2\theta + \cos 2\theta$$

$$= 2 \pm \sqrt{2}$$

$$\text{So, min value} = 2 - \sqrt{2}$$

$$\text{max value} = 2 + \sqrt{2}$$

Q. 10 $\lim_{t \rightarrow 2} \frac{\sin(90^\circ - 45^\circ t)}{(2-t)} =$

Option 1:

60°

Option 2:

$$\frac{\pi}{4}$$

Option 3:

$$\frac{\pi}{2}$$

Option 4:

$$90^\circ$$

Correct Answer:

$$\frac{\pi}{4}$$

Solution:

As we learned

Condition for Trigonometric limit -

$$\lim_{x \rightarrow a} \frac{\sin(x - a)}{x - a} = 1$$

$$\text{It must be } \frac{\sin(\text{angle})}{(\text{angle})_{(\text{in radian})}}$$

-

$$\lim_{t \rightarrow 2} 2 \left(\frac{\sin\left(\frac{\pi}{2} - \frac{\pi}{4}t\right)}{(2-t)\frac{\pi}{4}} \right) \frac{\pi}{4}$$
$$= \frac{\pi}{4}$$

Q. 11 If A and B are two square matrices of order 3×3 which satisfy $AB = A$ and $BA = B$ then $(A + B)^7$ is

Option 1:

$$7(A + B)$$

Option 2:

$$7 \cdot I_{3 \times 3}$$

Option 3:

$$64I_{3 \times 3}$$

Option 4:

$$128 \cdot I_{3 \times 3}$$

Correct Answer:

$$128 \cdot I_{3 \times 3}$$

Solution:

Idempotent matrix -

$$A^2 = A$$

-

$$AB = A \Rightarrow A^{-1}AB = A^{-1}A$$

$$\Rightarrow IB = I \Rightarrow B = I$$

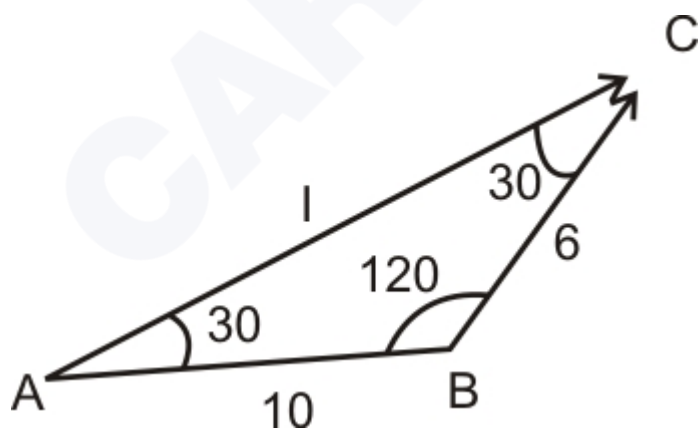
$$BA = B \Rightarrow B^{-1}BA = B^{-1}B$$

$$\Rightarrow IA = I \Rightarrow A = I$$

$$(A + B) = 2I$$

$$(A + B)^7 = (2I)^7 = 2^7 I = 128I$$

Q. 12 In a triangle ABC length of projection of \vec{AB} on BC is



Option 1:

5

Option 2:

3

Option 3:

$$5\sqrt{3}$$

Option 4:

$$3\sqrt{3}$$

Correct Answer:

5

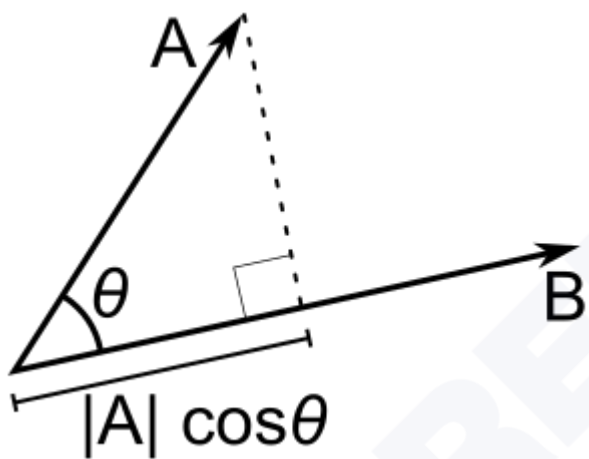
Solution:

As we have learned

Projection of vector a on vector b -

$$\vec{a} \cos \theta = \frac{\vec{a} \cdot \vec{b}}{|\vec{b}|}$$

- wherein



length of projection = $AB \cdot \cos 60$

= $AB / 2 = 5$

Q. 13 Which of the following is not an indeterminate form

Option 1:

$$1^\infty$$

Option 2:

$$0^\infty$$

Option 3:

$$\infty^1$$

Option 4:

$$\infty - \infty$$

Correct Answer:

$$\infty^1$$

Solution:

As we learned

Indeterminate forms -

The form

$\frac{0}{0}$, $\frac{\infty}{\infty}$, $0 \times \infty$, 1^∞ , 0^∞ , ∞^0 , $\infty - \infty$ are known as indeterminate form means

they do not exist directly

-

Q. 14 What are the coordinates of the mid points of the ellipse $x^2 + 4y^2 - 6x + 40y = 0$

Option 1:

$$(-3,5)$$

Option 2:

$$(3,-5)$$

Option 3:

(3,-20)

Option 4:

(-3,20)

Correct Answer:

(3,-5)

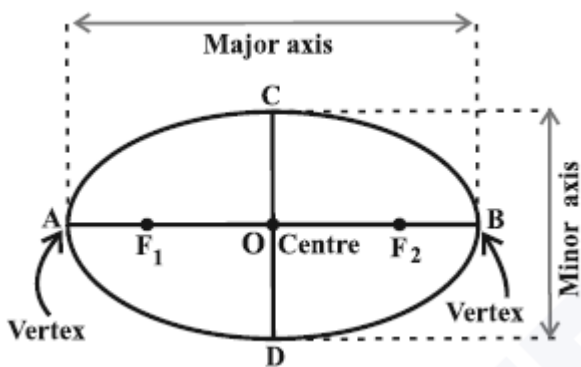
Solution:

As we have learned

Centre of Ellipse -

The mid-point of the two foci of ellipse.

- wherein



$$x^2 - 6x + 4(y^2 + 10y) = 0$$

$$x^2 - 6x + 9 + 4(y^2 + 10y + 25) = 100 + 9$$

$$(x - 3)^2 + 4(y + 5)^2 = 109$$

Centre is (3,-5)

Q. 15 For what values of k does the expression $f(x)$ cuts the x - axis twice ,where

$$f(x) = -x^2 + kx - 5$$

Option 1:

$$K \in \left| -2\sqrt{5}, 2\sqrt{5} \right|$$

Option 2:

$$K \in \left(-\infty, -2\sqrt{5} \right) \cup \left(2\sqrt{5}, \infty \right)$$

Option 3:

$$K = \pm 2\sqrt{5}$$

Option 4:

None of these

Correct Answer:

$$K \in \left(-\infty, -2\sqrt{5} \right) \cup \left(2\sqrt{5}, \infty \right)$$

Solution:

As we learned

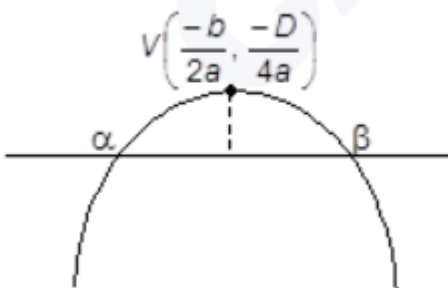
Quadratic Expression Graph when $a < 0$ & $D > 0$ -

Real and distinct roots of

$$f(x) = ax^2 + bx + c$$

$$\& D = b^2 - 4ac$$

- wherein



$$a = -1 < 0$$

For intersecting twice, $D > 0$

$$\rightarrow k^2 - 20 > 0$$

$$k > 2\sqrt{5} \text{ or,}$$

$$k < -2\sqrt{5}$$

Q. 16 If a circle passing through the point $(-1, 0)$ touches y -axis at $(0, 2)$, then the length of the chord of the circle along the x -axis is :

Option 1:

$$\frac{3}{2}$$

Option 2:

$$\frac{5}{2}$$

Option 3:

$$3$$

Option 4:

$$5$$

Correct Answer:

$$3$$

Solution:

As learnt in concept

Circle touching y -axis and having radius r -

$$x^2 + y^2 + 2gx \pm 2ry + g^2 = 0$$

- wherein

Where g is a variable parameter.

Equation of a circle -

$$(x - h)^2 + (y - k)^2 = r^2$$

- wherein

Circle with centre (h, k) and radius r .

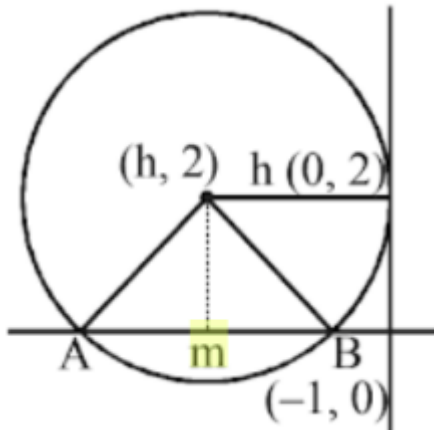
If the centre is $(h, 2)$ then

radius = $|h|$

equation of circle is

$$(x - h)^2 + (y - 2)^2 = h^2$$

and it passes through point $(-1, 0)$



putting values , we get

$$h = \frac{-5}{2}$$

So centre is

$$\left(\frac{-5}{2}, 2\right)$$

$$\text{equation } \left(x + \frac{5}{2}\right)^2 + (y - 2)^2 = \left(\frac{5}{2}\right)^2$$

AB is chord along x-axis

$$AB = 2(AM) = 2\sqrt{\frac{25}{4} - 4} = 3$$

Q. 17 Solve the D.E

$$y^2 \frac{dy}{dx} + 2y^3 = y^2 \cos x$$

Option 1:

$$y.e^{2x} = \frac{e^{2x}}{5} (2 \cos x + \sin x) + c$$

Option 2:

$$2y.e^{2x} = \frac{e^{2x}}{5} (2 \cos x + \sin x) + c$$

Option 3:

$$3y.e^{2x} = \frac{e^{2x}}{5} (2 \cos x + \sin x) + c$$

Option 4:

$$4y.e^{2x} = \frac{e^{2x}}{5} (2 \cos x + \sin x) + c$$

Correct Answer:

$$y.e^{2x} = \frac{e^{2x}}{5} (2 \cos x + \sin x) + c$$

Solution:

As we learnt

Linear Differential Equation -

Multiply by $e^{\int P dx}$ which is the Integrating factor

- wherein

P is the function of x alone

Write the D.E

$$\frac{dy}{dx} + 2y = \cos x \text{ of the form } \frac{dy}{dx} + Py = Q$$

$$I.F. = e^{\int P dx} = e^{2x}$$

General Solution

$$Y(IF) = \int \cos x e^{2x} dx + C$$

$$y.e^{2x} = \frac{e^{2x}}{5} (2 \cos x + \sin x) + C$$

Q. 18 If α, β are roots of $x^2 + 2x + 5 = 0$ then the equation whose roots are $(\alpha^4 - 12\alpha)$ and $(\beta^3 + \beta - 8)$ is

Option 1:

$$x^2 + 7x + 10 = 0$$

Option 2:

$$x^2 - 7x + 10 = 0$$

Option 3:

$$x^2 - 7x - 10 = 0$$

Option 4:

$$x^2 + 7x - 10 = 0$$

Correct Answer:

$$x^2 - 7x + 10 = 0$$

Solution:

As we learnt in

Degree reduction -

If α is a root of $ax^2 + bx + c = 0$ then $a\alpha^2 + b\alpha + c = 0 \Rightarrow a\alpha^2 = -b\alpha - c$ which can be used to reduce degree of α from 2 to 1.

-

$\therefore \alpha, \beta$ are roots, So $\alpha^2 = -2\alpha - 5$ and $\beta^2 = -2\beta - 5$.

$$\alpha^4 - 12\alpha = (\alpha^2)^2 - 12\alpha = (-2\alpha - 5)^2 - 12\alpha = 4\alpha^2 + 20\alpha + 25 - 12\alpha = 4\alpha^2 + 8\alpha + 25 = 4(-2\alpha - 5) + 8\alpha + 25 = 5$$

$$\beta^3 + \beta - 8 = \beta(-2\beta - 5) + \beta - 8 = -2\beta^2 - 4\beta - 8 = -2(-2\beta - 5) - 4\beta - 8 = 2$$

\therefore roots are 2 & 5

So equation is $x^2 - 7x + 10 = 0$

\therefore Option (B)

Q. 19 If $ax^2 + bx + c \leq \delta$ for $x \in R$; where 'a' is a negative real number and discriminant of the equation is non-positive real number. Then Δ should be

Option 1:

-1

Option 2:

c

Option 3:

$b^2 - 4ac$

Option 4:

0

Correct Answer:

0

Solution:

As we learned

Quadratic Expression $ax^2 + bx + c$ is non-positive -

$ax^2 + bx + c \leq 0$ for all $x \in R$ When $a < 0$ & $b^2 - 4ac \leq 0$ ($a, b, c \in R$)

-

Given, $a < 0$

& $D = b^2 - 4ac \leq 0$

Then $ax^2 + bx + c \leq 0$

$\forall x \in R$

Q. 20 What is the centre of hyperbola $y^2 - 4x^2 - 8x - 12y + 36 = 0$

Option 1:

(1,6)

Option 2:

(1,-6)

Option 3:

(-1,6)

Option 4:

$(-1, -6)$

Correct Answer:

$(-1, 6)$

Solution:

The given equation can be written as

$$y^2 - 12y + 36 - 4(x^2 + 2x + 1) = -4$$

$$4(x + 1)^2 - (y - 6)^2 = 4$$

$$(x + 1)^2 - \frac{1}{4}(y - 6)^2 = 1$$

This is a shifted hyperbola with Centre at $(-1, 6)$

Q. 21 If $2 + 3i$ is one of the roots of the equation, $2x^3 - 9x^2 + kx - 13 = 0$, $k \in R$ then the real root of this equation :

Option 1:

does not exist.

Option 2:

exists and is equal to

$$\frac{1}{2}$$

Option 3:

exists and is equal to

$$-\frac{1}{2}$$

Option 4:

exists and is equal to

$$1$$

Correct Answer:

exists and is equal to

$$\frac{1}{2}$$

Solution:

As we have learned

Sum of roots of cubic Equation -

$$\alpha + \beta + \gamma = \frac{-b}{c}$$

- wherein

$$ax^3 + bx^2 + cx + d = 0$$

is the cubic equation

Product of roots of cubic equation -

$$\alpha\beta\gamma = \frac{-d}{a}$$

- wherein

$$ax^3 + bx^2 + cx + d = 0$$

is the cubic equation

$$\alpha = 2 + 3i;$$

$$\beta = 2 - 3i;$$

$$\gamma = ?$$

$$\alpha + \beta + \gamma = 9/2$$

$$\text{and } \alpha\beta\gamma = 13/2$$

$$(4 + 9)\gamma = 13/2$$

$$\gamma = 1/2$$

Q. 22 If α, β are roots of $x^2 + x + 2 = 0$, then the equation whose roots are $\alpha^2 + 1$ & $\beta^2 + 1$ is

Option 1:

$$x^2 - x - 2 = 0$$

Option 2:

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

Option 3:

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

Option 4:

$$x^2 + x + 2 = 0$$

Correct Answer:

$$x^2 + x + 2 = 0$$

Solution:

As we learnt in

To form a Quadratic Equation given the roots -

$$x^2 - Sx + P = 0$$

where, S = Sum of roots and P = Product of roots

Now,

$$S = (\alpha^2 + 1) + (\beta^2 + 1) = (\alpha + \beta)^2 - 2\alpha\beta + 2$$

$$S = 1 - 2(2) + 2 = -1 \Rightarrow S = -1$$

$$P = (\alpha^2 + 1)(\beta^2 + 1) = (\alpha\beta)^2 + (\alpha^2 + \beta^2) + 1$$

$$P = (\alpha\beta)^2 + (\alpha + \beta)^2 - 2\alpha\beta + 1$$

$$P = 4 + 1 - 2(2) + 1 = 2 \Rightarrow P = 2$$

$$\therefore \text{Equation} : x^2 + x + 2 = 0$$

Alternative method:

Let X be the new root

$$X = \alpha^2 + 1$$

$$\alpha = \pm\sqrt{X-1}$$

As α is a root of $x^2 + x + 2 = 0$, so

$$\alpha^2 + \alpha + 2 = 0$$

$$(X - 1) \pm \sqrt{X - 1} + 2 = 0$$
$$\pm \sqrt{X - 1} = X + 1$$

Squaring

$$X - 1 = X^2 + 2X + 1$$

$$X^2 + X + 2 = 0$$

Q. 23 For which of the following condition matrix A is nilpotent matrix of order 2 where

$$A = \begin{bmatrix} a & b \\ c & -a \end{bmatrix}.$$

Option 1:

$$a = b$$

Option 2:

$$-a^2 + bc = 0$$

Option 3:

$$a^2 = -ab$$

Option 4:

All the above.

Correct Answer:

$$a = b$$

Solution:

As we have learnt

Nilpotent matrix -

$$A^m = O$$

- wherein

m is the least positive integer and m is called the index

$$A^2 = 0$$

$$\begin{bmatrix} a & b \\ c & -a \end{bmatrix} \begin{bmatrix} a & b \\ c & -a \end{bmatrix} = \begin{bmatrix} a^2 + bc & ab - ba \\ ac - ca & -ab + a^2 \end{bmatrix}$$

$$a^2 + bc = 0, ab = ba, ac = ca, a^2 = ab$$

$$a = b$$

Q. 24 Solve $(x + y)^2 \frac{dy}{dx} = 4$

Option 1:

$$y = \tan^{-1} \left(\frac{x + y}{4} \right) + c$$

Option 2:

$$y = 2 \tan^{-1} \left(\frac{x + y}{2} \right) - C$$

Option 3:

$$y = 4 \tan^{-1} \left(\frac{x + y}{4} \right) .c$$

Option 4:

None of these

Correct Answer:

$$y = 2 \tan^{-1} \left(\frac{x + y}{2} \right) - C$$

Solution:

As we learnt

Solution of Differential Equation -

$$\frac{dy}{dx} = f(ax + by + c)$$

put

$$Z = ax + by + c$$

- wherein

Equation with convert to

$$\int \frac{dz}{bf(z) + a} = x + c$$

Put $x+y=Z$

$$1 + \frac{dy}{dx} = \frac{dZ}{dx}$$

$$Z^2 \left\{ \frac{dZ}{dx} - 1 \right\} = 4 \Rightarrow Z^2 \frac{dZ}{dx} = 4 + Z^2$$

$$\int dx = \int \frac{Z^2}{4 + Z^2} dZ \Rightarrow x = \int \left(1 - \frac{4}{4 + Z^2} \right) dZ$$

$$x = Z - 2 \tan^{-1} \left(\frac{Z}{2} \right) + C$$

$$\text{i.e } x = x + y - 2 \tan^{-1} \left(\frac{x + y}{2} \right) + C$$

$$y = 2 \tan^{-1} \left(\frac{x + y}{2} \right) - C$$

Q. 25 The locus of the point of intersection of the lines, $\sqrt{2}x - y + 4\sqrt{2}k = 0$ and $\sqrt{2}kx + ky - 4\sqrt{2}k = 0$ (k is any non-zero real parameter), is :

Option 1:

an ellipse whose eccentricity is $\frac{1}{\sqrt{3}}$

Option 2:

an ellipse with length of its major axis $8\sqrt{2}$

Option 3:

a hyperbola whose eccentricity is $\sqrt{3}$

Option 4:

a hyperbola with length of its transverse axis $8\sqrt{2}$

Correct Answer:

a hyperbola with length of its transverse axis $8\sqrt{2}$

Solution:

As we have learned

Locus -

Path followed by a point $p(x,y)$ under given condition (s).

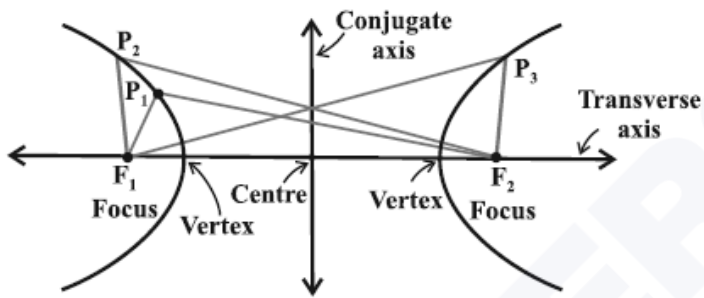
- wherein

It is satisfied by all the points (x,y) on the locus.

Transverse axis -

The line through the foci of the hyperbola.

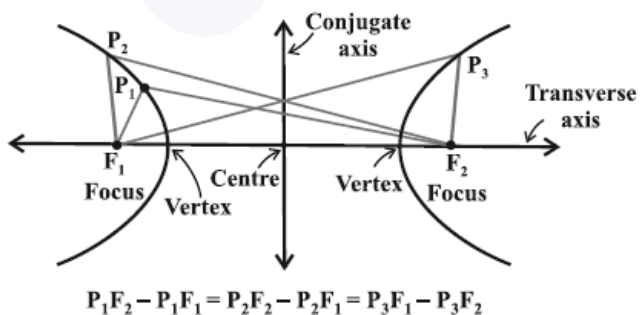
- wherein



Hyperbola -

Hyperbola is locus of all the points in a plane, the difference of whose distance from two fixed points is constant.

- wherein



$$\sqrt{2}x - y = -4\sqrt{2}k$$

$$k(\sqrt{2}x + y) = 4\sqrt{2}$$

$$\text{also } (\sqrt{2}x + y)(\sqrt{2}x - y) = -16 \cdot 2$$

$$2x^2 - y^2 = -32$$

$$\frac{y^2}{32} - \frac{x^2}{16} = 1$$

this is hyperbola $a^2 = 32 \Rightarrow a = 4\sqrt{2}$

transverse axis = $2a = 8\sqrt{2}$

Q. 26

Let $a \neq b \neq c \neq 0$. Then find the value of x such that

$$\pm \begin{bmatrix} 1 & b^2 & b^3 \\ 1 & c^2 & c^3 \\ 1 & a^2 & a^3 \end{bmatrix} = 0$$

$$\begin{bmatrix} x^3 & x^3 & x^3 \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{bmatrix}$$

Option 1:

Real value

Option 2:

Purely imaginary

Option 3:

Complex no

Option 4:

both (1) and (3)

Correct Answer:

both (1) and (3)

Solution:

As we have learnt

Property of determinant -

If rows be changed into columns and columns into the rows , then the values of the determinant remains unaltered.

-

Take x^3 common from r_1

$$x^3 \begin{vmatrix} 1 & 1 & 1 \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix} - \begin{vmatrix} 1 & b^2 & b^3 \\ 1 & c^2 & c^3 \\ 1 & a^2 & a^3 \end{vmatrix} = 0$$

Interchanging row and column of 2nd det.

$$x^3 \begin{vmatrix} 1 & 1 & 1 \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix} - \begin{vmatrix} 1 & 1 & 1 \\ b^2 & c^2 & a^2 \\ b^3 & c^3 & a^3 \end{vmatrix} = 0$$

Apply *Apply* $R_1 \leftrightarrow R_2, R_2 \leftrightarrow R_3$ and $R_3 \leftrightarrow R_1$ on 2nd matrix

$$x^3 \begin{bmatrix} 1 & 1 & 1 \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{bmatrix} - \begin{vmatrix} 1 & 1 & 1 \\ a^3 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix} = 0$$

$$(x^3 - 1)[\] = 0$$

$$x^3 = 1 \quad \omega = \text{cube root of unity}$$

$$x = 1, \omega \text{ and } \omega^2$$

Q. 27 Equation of the curve for which is such that its length of subnormal is equal to length of its subtangent.

Option 1:

$$y^{2/3} = \frac{2}{3}x + c$$

Option 2:

$$y^{3/2} = \frac{2}{3}x + c$$

Option 3:

$$y^3 = \frac{2}{3}x^2 + c$$

Option 4:

$$y^{3/2} = \frac{3}{2}x + c$$

Correct Answer:

$$y^{3/2} = \frac{2}{3}x + c$$

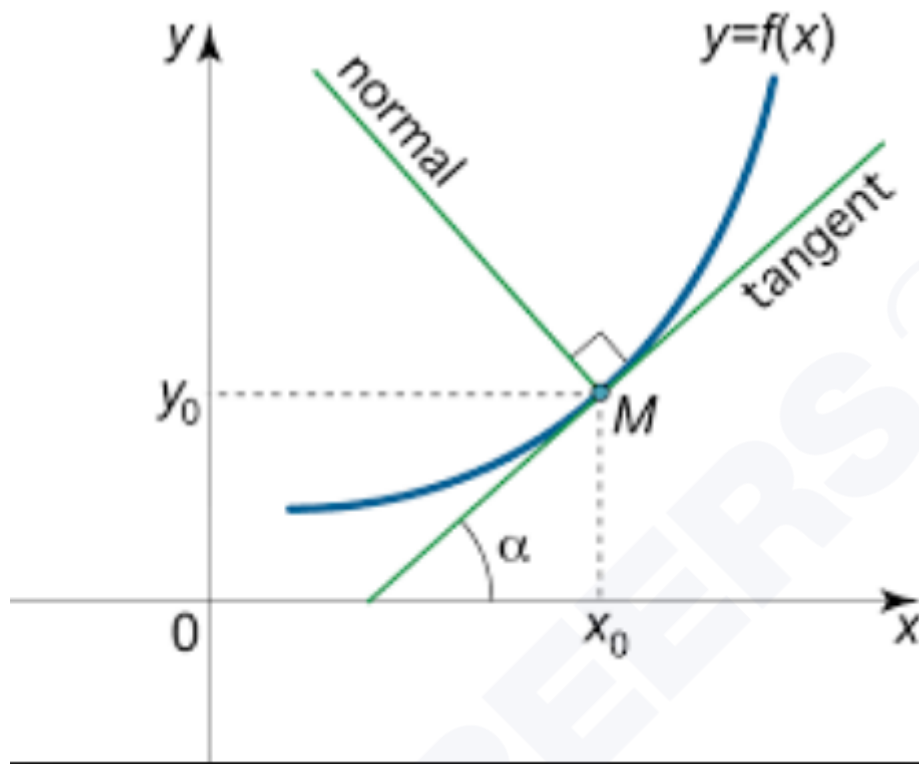
Solution:

As we learnt

Subnormal -

$$\text{Length} = y \tan \alpha = y \frac{dy}{dx}$$

- wherein



According to the given que

$$y \frac{dy}{dx} = y^2 \left(\frac{dy}{dx} \right)^2$$

$$\left(\frac{dy}{dx} \right)^3 = y \Rightarrow \frac{dy}{y^{1/3}} = dx$$

Integrate both side

$$3y^{3/2} = 2x + C \Rightarrow y^{3/2} = \frac{2}{3}x + C$$

Q. 28 If the reflections of points $(3/2, 2)$ in x axis and y axis are points Q and R then find length QR

Option 1:

3.5

Option 2:

5

Option 3:

4

Option 4:

3

Correct Answer:

5

Solution:

As we have learned

Abscissa -

The distance from a point to the vertical or y-axis.

- wherein

The x coordinate.

In $\triangle PQR$

$$\begin{aligned}(QR)^2 &= (PR)^2 + (PQ)^2 \\ &= 3^2 + 4^2\end{aligned}$$

$$QR = 5$$

Q. 29 write the equation of the tangent at $(3,-1)$ to the curve $x^2 = -9y$

Option 1:

$$x + 2y - 1 = 0$$

Option 2:

$$x + 3y = 0$$

Option 3:

$$2x + 3y - 3 = 0$$

Option 4:

$$x = 4y$$

Correct Answer:

$$2x + 3y - 3 = 0$$

Solution:

As we learned

Equation of the tangent -

To find the equation of the tangent we need either one slope + one point or two points.

$$\therefore (y - y_0) = m(x_0 - y_0)$$

$$\text{or } (y - y_2) = \frac{y_2 - y_1}{x_2 - x_1}(x - x_2)$$

- wherein

Where (x_0, y_0) is the point on the curve and $M = M_T$ slope of tangent.

$$-9 \frac{dy}{dx} = 2x \Rightarrow \frac{dy}{dx} \Big|_{3,-1} = \frac{-2}{3}$$

$$\text{so, } y + 1 = \frac{-2}{3}(x - 2) \text{ is tangent}$$

$$\Rightarrow 2x + 3y - 3 = 0$$

Q. 30 $\frac{1 - 2i}{2 + i} + \frac{4 - i}{3 + 2i} =$

Option 1:
 $\frac{24}{13} + \frac{10}{13}i$

Option 2:
 $\frac{24}{13} - \frac{10}{13}i$

Option 3:
 $\frac{10}{13} + \frac{24}{13}i$

Option 4:
 $\frac{10}{13} - \frac{24}{13}i$

Correct Answer:
 $\frac{10}{13} - \frac{24}{13}i$

Solution:

As we learn

Division of Complex Numbers -

$$\frac{a + ib}{c + id} = \frac{ac + bd}{c^2 + d^2} + i \frac{bc - ad}{c^2 + d^2}$$

-

$$\frac{1 - 2i}{2 + i} + \frac{4 - i}{3 + 2i} = \frac{(1 - 2i)(3 + 2i) + (4 - i)(2 + i)}{(2 + i)(3 + 2i)} = \frac{50 - 120i}{65} = \frac{10}{13} - \frac{24}{13}i$$

Q. 31 The sine of the angle between the vectors $a = 3i + j + k, b = 2i - 2j + k$ is

Option 1:
 $\sqrt{\frac{74}{99}}$

Option 2:
 $\sqrt{\frac{25}{99}}$

Option 3:

$$\sqrt{\frac{37}{99}}$$

Option 4:

$$\frac{5}{\sqrt{41}}$$

Correct Answer:

$$\sqrt{\frac{74}{99}}$$

Solution:

As we learn

Vector Product of two vectors(cross product) -

If \vec{A} and \vec{B} are two vectors and θ is the angle between them, then $\vec{a} \times \vec{b} = |\vec{a}| |\vec{b}| \sin \Theta \hat{n}$

- wherein

\hat{n} is unit vector perpendicular to both \vec{a} and \vec{b}

$$a \times b = \begin{vmatrix} i & j & k \\ 3 & 1 & 1 \\ 2 & -2 & 1 \end{vmatrix} = 3i - j - 8k; \sin \Theta = \frac{|a \times b|}{|a| |b|} = \frac{\sqrt{74}}{\sqrt{11} \cdot \sqrt{9}} = \sqrt{\frac{74}{99}}$$

Q. 32 $\lim_{x \rightarrow 2} \frac{|x-2|}{x-2} =$

Option 1:

1

Option 2:

-1

Option 3:

Does not exit

Option 4:

None of these

Correct Answer:

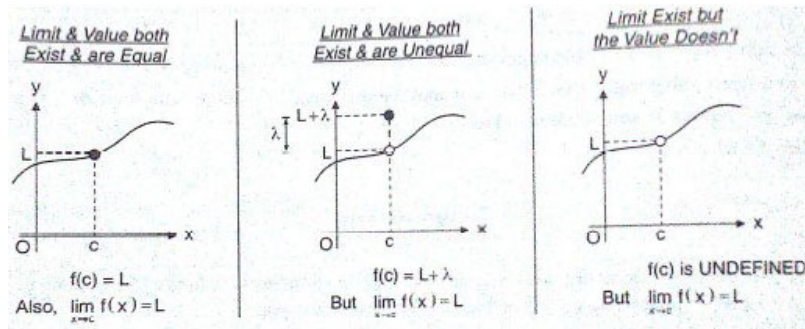
Does not exit

Solution:

As we learned

Condition of Geometrical limit -

Limits describe the behaviour of a function near a particular point not necessarily at the point itself.



$$L.H.L = \lim_{x \rightarrow 2^-} \frac{|x-2|}{x-2} = \lim_{h \rightarrow 0} \frac{|2-h-2|}{2-h-2} = \lim_{h \rightarrow 0} \frac{h}{-h} = -1 \dots \dots \dots (i)$$

$$\text{and, } R.H.L = \lim_{x \rightarrow 2^+} \frac{|x-2|}{x-2} = \lim_{h \rightarrow 0} \frac{|2+h-2|}{2+h-2} = \lim_{h \rightarrow 0} \frac{h}{h} = 1 \dots \dots \dots (ii)$$

From (i) and (ii) $L.H.L. \neq R.H.L.$ i.e. $\lim_{x \rightarrow 2} \frac{|x-2|}{x-2}$ does not exist

Q. 33 If one root of $ax^2 + 2bx + c = 0$ is double the other root. Then

Option 1:

$$9b^2 = 8ac$$

Option 2:

$$8b^2 = 9ac$$

Option 3:

$$8a^2 = 9bc$$

Option 4:

$$8c^2 = 9ab$$

Correct Answer:

$$8b^2 = 9ac$$

Solution:

Let α & 2α be the roots of equation

Using sum of roots formula on given equation

$$\therefore \alpha + 2\alpha = \frac{-2b}{a} \Rightarrow 3\alpha = \frac{-2b}{a} \Rightarrow \alpha = \frac{-2b}{3a}$$

$\therefore \alpha$ is root of quadratic, So it will satisfy the equation.

$$a \left(\frac{4b^2}{9a^2} \right) - \frac{4b^2}{3a} + c = 0$$

$$\Rightarrow c = \frac{4b^2}{3a} - \frac{4b^2}{9a} \Rightarrow c = \frac{8b^2}{9a}$$

$$\Rightarrow 8b^2 = 9ac$$

\therefore Option (B)

Q. 34 If $\sin \theta = \frac{-1}{2}$, then general solution is :

Option 1:

$$n\pi + (-1)^{n+1} \frac{\pi}{6}$$

Option 2:

$$n\pi + (-1)^n \frac{\pi}{6}$$

Option 3:

$$2n\pi \pm \frac{\pi}{6}$$

Option 4:

$$n\pi + \frac{\pi}{6}$$

Correct Answer:

$$n\pi + (-1)^{n+1} \frac{\pi}{6}$$

Solution:

As we have learnt

General Solution of Trigonometric Ratios -

$$\sin \Theta = \sin \alpha$$

$$\Theta = n\pi + (-1)^n \alpha, n \in I$$

- wherein

α is the given angle

$$\sin \theta = \sin\left(-\frac{\pi}{6}\right); \theta = n\pi + (-1)^n\left(-\frac{\pi}{6}\right) = n\pi + (-1)^{n+1}\left(\frac{\pi}{6}\right)$$

Q. 35 If ${}^{15}C_0 + {}^{15}C_2 + {}^{15}C_4 + \dots + {}^{15}C_{14} = A$; ${}^{15}C_1 + {}^{15}C_3 + {}^{15}C_5 + \dots + {}^{15}C_{15} = B$ Then $\frac{A^2 + B^2}{AB} = ?$

Option 1:

1

Option 2:

2

Option 3:

multiple of 15

Option 4:

none of these

Correct Answer:

2

Solution:

As we have learned

Properties of Binomial Theorem -

Sum of the binomial coefficients of the odd term is equal to sum of the binomial coefficients of even term and each is equal to 2^{n-1} .

- wherein

$$c_0 + c_2 + c_4 + \dots + c_{14}$$

$$= c_1 + c_3 + c_5 + \dots + c_{15}$$

$$= 2^{n-1}$$

$$A = B = 2^{14}; \text{ Thus}$$

$$\frac{(2^{14})^2 + (2^{14})^2}{2^{14} \times 2^{14}} = 2$$

Q. 36 What is the angle between a normal and a tangent at point P on the curve $y = f(x)$

Option 1:

$$\frac{\pi}{4}$$

Option 2:

$$0$$

Option 3:

$$\frac{\pi}{2}$$

Option 4:

$$\frac{-\pi}{6}$$

Correct Answer:

$$\frac{\pi}{2}$$

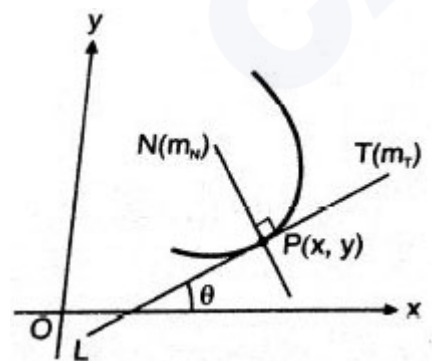
Solution:

As we learned

NORMAL -

The normal to the curve at any point P on it is the straight line which passes through P and is perpendicular to the tangent to the curve at P

- wherein



Q. 37 If $f(x) = \frac{2}{x-3}$, $g(x) = \frac{x-3}{x+4}$, $h(x) = -\frac{2(2x+1)}{x^2+x-12}$ then

$\lim_{x \rightarrow 3} [f(x) + g(x) + h(x)]$ is

Option 1:

-2

Option 2:

-1

Option 3:

$-\frac{2}{7}$

Option 4:

0

Correct Answer:

$-\frac{2}{7}$

Solution:

As we learned

Limit of Sum and Difference -

Limit of sum and difference equals sum difference of the individual limits.

$$\lim_{x \rightarrow a} (f(x) \pm g(x)) = \lim_{x \rightarrow a} f(x) \pm \lim_{x \rightarrow a} g(x)$$

$$\text{we have } f(x) + g(x) + h(x) = \frac{x^2 - 4x + 17 - 4x - 2}{x^2 + x - 12} = \frac{x^2 - 8x + 15}{x^2 + x - 12} = \frac{(x-3)(x-5)}{(x-3)(x+4)}$$

$$\therefore \lim_{x \rightarrow 3} [f(x) + g(x) + h(x)] = \lim_{x \rightarrow 3} \frac{(x-3)(x-5)}{(x-3)(x+4)} = -\frac{2}{7}$$

Q. 38

Consider the system of equation

$$x + 2y - z = 6$$

$$2x + 3y + z = 3$$

$$3x + 5y + \lambda z = \mu \text{ then system has}$$

Option 1:

Infinite solutions, if $\lambda = 0, \mu = 9$

Option 2:

No solution, if $\lambda \neq 0, \mu = 9$

Option 3:

Unique solution, if $\lambda \neq 0, \mu \neq 9$

Option 4:

All of these

Correct Answer:

All of these

Solution:

As we have learned

Inconsistent system of linear equation -

If the system of equations has no solutions

-

If $\lambda = 0$, then 3rd equation is I + II, so, for infinite solutions $\mu = 6 + 3$

Similarly other cases.

Q. 39 $\sec^{-1}\left(\sec\left(-\frac{\pi}{4}\right)\right) =$

Option 1:

$$\frac{3\pi}{4}$$

Option 2:

$$\frac{\pi}{4}$$

Option 3:

$$-\frac{\pi}{4}$$

Option 4:

None of these

Correct Answer:

$$\frac{\pi}{4}$$

Solution:

As we have learnt

Important Results of Inverse Trigonometric Functions -

$$\sec^{-1}(\sec \Theta) = \Theta$$

- wherein

$$\text{if } 0 \leq \Theta < \frac{\pi}{2}$$

$$\text{or } \frac{\pi}{2} < \Theta \leq \pi$$

$$\sec^{-1}\left(\sec\left(-\frac{\pi}{4}\right)\right) = \sec^{-1}\left(\sec \frac{\pi}{4}\right) = \frac{\pi}{4}$$

Q. 40 Two circles with equal radii intersecting at the points (0,1) and (0,-1). The tangent at the point (0,1) to one of the circles passes through the centre of the other circle. Then the distance between the centres of these circles is:

Option 1:

$$2$$

Option 2:

$$2\sqrt{2}$$

Option 3:

$$\sqrt{2}$$

Option 4:

1

Correct Answer:

2

Solution:

Let centre of circles are $(c, 0)$ & $(-c, 0)$

\Rightarrow equation of circles are

$$(x - c)^2 + (y - 0)^2 = c^2 + 1$$

and

$$(x + c)^2 + (y - 0)^2 = c^2 + 1$$

\Rightarrow since circles are orthogonal so ,

$$2(c)(-c) + (0)(0) = (-1) + (-1)$$

$$\Rightarrow c^2 = 1 \Rightarrow c = \pm 1$$

Distance between $(-1, 0)$ & $(1, 0)$ is 2

English

Q. 1 Find out the part which contains an error of subject-verb agreement:

Many a student of this school are supposed to be promoted to the next standard on the basis of good performance.

Option 1:

No error

Option 2:

are supposed to be promoted

Option 3:

on the basis of good performance

Option 4:

to be promoted to the next standard

Option 5:

Many a student of this school

Correct Answer:

are supposed to be promoted

Solution:

Student is singular, thus, the verb 'are' should be replaced with 'is'.

Q. 2 Find out the synonym for the given word:

Poverty

Option 1:

Thwart

Option 2:

Skinflint

Option 3:

Penury

Option 4:

Blatant

Option 5:

Obviate

Correct Answer:

Penury

Solution:

Penury means poverty.

Q. 3 Find out the correct antonym for the given word:

Relegate

Option 1:

Devalue

Option 2:

Demean

Option 3:

Elevate

Option 4:

Demean

Option 5:

Belittle

Correct Answer:

Elevate

Solution:

Relegate means to reduce the status of someone. Elevate means to raise someone to a higher standard.

Q. 4 Find out the synonym for the given word:

Criticize

Option 1:

Exalt

Option 2:

Implore

Option 3:

Censure

Option 4:

Ensure

Option 5:

Exhort

Correct Answer:

Censure

Solution:

Censure means to criticize.

Q. 5 Find out the part which contains an error of subject-verb agreement:

The boss of the company as well as his employees are planning to take an action against the people who pelted stones.

Option 1:

his employees are planning

Option 2:

to take an action against

Option 3:

No error

Option 4:

The boss of the company as well as

Option 5:

the people who pelted stones

Correct Answer:

his employees are planning

Solution:

With as well as, the farther subject rule is applied. Thus, the verb has to agree with boss, which is singular. The correction thus, is 'is'.

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