#1328982

Two plane mirrors are inclined to each other such that a ray of light incident on the first mirror (M_1) and parallel to the second mirror (M_2) is finally reflected from the second mirror (M_2) parallel to the first mirror (M_1). The angle between the two mirrors will be :

A 90^o

B 45^o

C 75^o

D 60^o

Solution

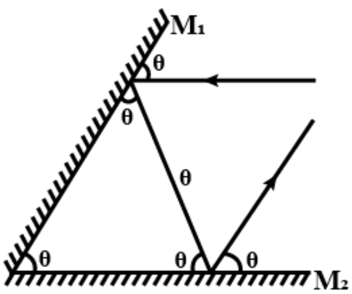
Assuming angles between two mirrors be θ as per geometry,

sum of angles of Δ

$\lambda 1+\lambda 2=360-20=180+\theta$

$3\theta=180^o$

$\theta=60^o$



#1329045

In a Young's double slit experiment, the slits are placed 0.320 mm apart. Light of wavelength $\lambda=500\,nm$ is incident on the slits. The total number of bright fringes that are observed in the angular range $-30^o\ \leq\theta\leq 30^o$ is :

A 320

B 641

C 321

D 640

Solution

Pam difference

$dsin\theta = n\lambda$

where d = seperation of slits

λ = wave length

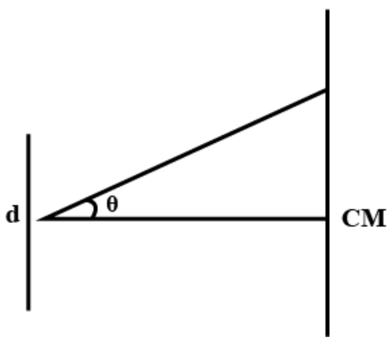
n = no. of maximas

$0.32 \times 10^{-3}\ sin30 = n \times 500 \times 10^{-9}$

$n = 320$

Hence total no. of maximas observed in angular range $-30^o\ \leq \theta \leq 30^o$ is

maximas = 320 + 1 + 320 = 641



#1329172

At a given instant, say t = 0, two radioactive substances A and B have equal activities. The ratio $\frac{R_B}{R_A}$ of their activities after time t itself decays with time t as e^{-3t}. [f the half-life of A is m_2, the half-life of B is:

A $\frac{ln2}{2}$

B $2ln2$

C $\frac{ln2}{4}$

D $4ln2$

Solution

Half life of $A = ln2$

$t_{1/2} = \frac{\ell n2}{\lambda}$

$\lambda_A = 1$

at $t = 0\ R_A = R_B$

$N_A e^{-\lambda AT} = N_B e^{-\lambda BT}$

$N_A = N_B$ at t = 0

at t= t $\frac{R_B}{R_A} = \frac{N_0 e^{-\lambda_B^t}}{N_0 e^{-\lambda_A^t}}$

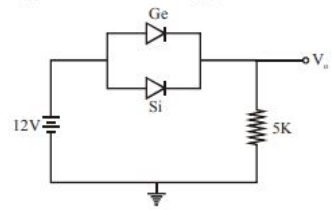
$e^{-(\lambda_B - \lambda_A)t} = e^{-t}$

$\lambda_B - \lambda_A = 3$

$\lambda_B = 3 + \lambda_A = 4$

$t_{1/2} = \frac{\ell n2}{\lambda_B} = \frac{\ell n2}{4}$

#1329202



Ge and Si diodes start conducting at 0.3 V and 0.7 V respectively. In the following figure if Ge diode connection are reversed, the value of V_o changes by : (assume that the Ge diode has large breakdown voltage)

A 0.6 v

B 0.8 V

C 0.4 V

D 0.2 V

Solution

For shown case

$Vo = 12 - 0.3 = 11.7$

In the second case

$Vo = 12 - 0.7 = 11.3$

So difference$= 11.7 - 11.3$

$= 0.4V$ is observed.

#1329288

A rod of mass 'M' and length '2L' is suspended at its middle by a wire. It exhibits torsional oscillations; If two masses each of 'm' are attached at distance $'L/2'$ from its centre on both sides, it reduces the oscillation frequency by 20%. The value of ratio m/M is close to :

A 0.175

B 0.375

C 0.575

D 0.775

Solution

Frequency of torsonal oscillations is given by

$$f = \frac{k}{\sqrt{I}}$$

$$f_1 = \frac{k}{\sqrt{\frac{M(2L)^2}{12}}}$$

$$f_2 = \frac{k}{\sqrt{\frac{M(2L)^2}{12} + 2m\left(\frac{L}{2}\right)^2}}$$

$$f_2 = 0.8 f_1$$

$$\frac{m}{M} = 0.375$$

#1329316

A 15 g mass of nitrogen gas is enclosed in a vessel at a temperature 27^oC. Amount of heat transferred to the gas, so that rms velocity of molecules is doubled, is about :

A 10 kJ

B 0.9 kJ

C 6 kJ

D 14 kJ

Solution

$Q = nC_v \Delta T$ as gas in closed vessel

$Q = \frac{15}{28} \times \frac{5 \times R}{2} \times (4T - T)$

$Q = 10000\ J = 10kJ$

#1329346

A particle is executing simple harmonic motion (SHM) of amplitude A, along the x-axis, about x = 0. When its potential Energy (PE) equals kinetic energy (KE), the position of the particle will be :

A $\frac{A}{2}$

B $\frac{A}{2\sqrt{2}}$

C $\frac{A}{\sqrt{2}}$

D A

Solution

Potential energy $(U) = \frac{1}{2}kx^2$

Kinetic energy $(K) = \frac{1}{2}kA^2 - \frac{1}{2}kx^2$

According to the question, $U = k$

$\therefore \frac{1}{2}kx^2 = \frac{1}{2}kA^2 - \frac{1}{2}kx^2$

$x = \pm \frac{A}{\sqrt{2}}$

#1329397

A musician using an open flute of length 50 cm produces second harmonic sound waves. A person runs towards the musician from another end of a hall at a speed of 10 km/h. If the wave speed is 330 m/s, the frequency heard by the running person shall be close to :

A 753 Hz

B 500 Hz

C 333 Hz

D 666 Hz

Solution

Frequency of the sound produced by flute,

$f = 2\left(\frac{v}{2\ell}\right) = \frac{2 \times 330}{2 \times 0.5} = 660Hz$

Velocity of observer, $v_0 = 10 \times \frac{5}{18} = \frac{25}{9} m/s$

$\therefore$ frequency detected by observer, $f' = \left[\frac{v + v_0}{v}\right] f$

$\therefore\ f' = \left[\frac{\frac{25}{9} + 330}{330}\right] 660$

$= 335.56 \times 2 \approx 666$

$\therefore$ closest answer is (4)

#1329444

In a communication system operating at wavelength 800 nm, only one percent of the source frequency is available as signal bandwidth. The number of channels accommodated for transmitting TV signals of bandwidth 6 MHz are (Take velocity of light $c = 3 \times 10^8 m/s, h = 6.6 \times 10^{-34} J - s$

A 3.75×10^6

B 4.87×10^5

C 3.86×10^6

D 6.25×10^5

Solution

$f = \dfrac{3 \times 10^8}{8 \times 10^{-7}} = \dfrac{30}{8} \times 10^{14} Hz$

$= 3.75 \times 10^{14} Hz$

1% of $f = 0.0375 \times 10^{14} Hz$

$= 3.75 \times 10^{12} Hz = 3.75 \times 10^6 MHz$

number of channels $= \dfrac{3.75 \times 10^6}{6} = 6.25 \times 10^5$

$\therefore$ correct answer is (4)

#1329785

Two point charges $q_1(\sqrt{10}\mu C)$ and $q_2(-25\mu C)$ are placed on the x-axis at x = 1 m and x = 4 m respectively. The electric field (in V/m) at a point y = 3 m on y-axis is,

$\left[take\ \dfrac{1}{4\pi\varepsilon_0} = 9 \times 10^9 N,^2\ C^{-2}\right]$

A $(-63\hat{i} + 27\hat{j}) \times 10^2$

B $(81\hat{i} - 81\hat{j}) \times 10^2$

C $(63\hat{i} - 27\hat{j}) \times 10^2$

D $(-81\hat{i} + 81\hat{j}) \times 10^2$

Solution

Let $\overrightarrow{E_1}$ & $\overrightarrow{E_2}$ are the values of electric field due to q_1 and q_2 respectively magnitude of $E_2 = \frac{1}{4\pi \in_0} \frac{q_2}{r^2}$

$E_2 = \frac{9 \times 10^9 \times (25) \times 10^{-6}}{(4^2 + 3^2)} V/m$

$E_2 = 9 \times 10^3 V/m$

$\therefore \overrightarrow{E_2} = 9 \times 10^3 (cos\theta_2 \hat{i} - sin\theta_2 \hat{j})$

$\therefore tan\theta_2 = \frac{3}{4}$

$\therefore \overrightarrow{E_2} = 9 \times 20^3 \left(\frac{4}{5}\hat{i} - \frac{3}{5}\hat{j}\right) = (72\hat{i} - 54\hat{j}) \times 10^2$

Magnitude of $E_1 = \frac{1}{4\pi \in_0} \frac{\sqrt{10} \times 10^{-6}}{(1^2 + 3^2)}$

$= (9 \times 10^9) \times \sqrt{10} \times 10^{-7}$

$= 9\sqrt{10} \times 10^2$

$\therefore \overrightarrow{E_1} = 9\sqrt{10} \times 10^2 [cos\theta_1(-\hat{i}) + sin\theta_1 \hat{j}]$

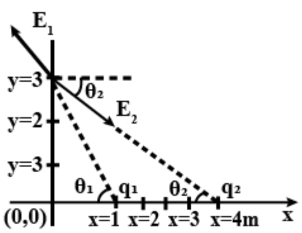
$\therefore tan\theta_1 = 3$

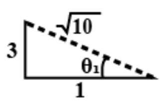
$E_1 = 9 \times \sqrt{10} \times 10^2 \left[\frac{1}{\sqrt{10}}(-\hat{i}) + \frac{3}{\sqrt{10}}\hat{j}\right]$

$E_1 = 9 \times 10^2[-\hat{i} + 3\hat{j}] = [-9\hat{i} + 27\hat{j}]10^2$

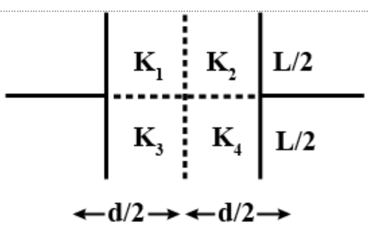
$therefore \vec{E} = \overrightarrow{E_1} + \overrightarrow{E_2} = (63\hat{i} - 27\hat{j}) \times 10^2 V/m$

$\therefore$ correct answer is (3)





#1329943



A parallel plate capacitor with square plates is filled with four dielectrics of dielectric constants K_1, K_2, K_3, K_4 arranged as shown in the figure. The effective dielectric constant K will be :

A $K = \frac{(K_1 + K_2)(K_3 + K_4)}{2(K_1 + K_2 + K_3 + K_4)}$

B $K = \frac{(K_1 + K_2)(K_3 + K_4)}{(K_1 + K_2 + K_3 + K_4)}$

C $K = \frac{(K_1 + K_4)(K_2 + K_3)}{2(K_1 + K_2 + K_3 + K_4)}$

D $K = \frac{(K_1 + K_3)(K_2 + K_4)}{K_1 + K_2 + K_3 + K_4}$

Solution

$$C_{12} = \frac{C_1 C_2}{C_1 + C_2} = \frac{\dfrac{k_1 \in_0 \dfrac{L}{2} \times L}{d/2} \cdot \dfrac{k_2 \left[\in_0 \dfrac{L}{2} \times L\right]}{d/2}}{(k_1 + K_2)\left[\dfrac{\in_0 \cdot \dfrac{L}{2} \times L}{d/2}\right]}$$

$$C_{12} = \frac{k_1 k_2}{k_1 + k_2} \frac{\in_0 L^2}{d}$$

in the same way we get , $C_{34} = \frac{k_3 k_4}{k_3 + k_4} \frac{\in_0 L^2}{d}$

$$\therefore C_{eq} = C_{12} + C_{34} = \left[\frac{k_1 k_2}{k_1 + k_2} + \frac{k_3 k_4}{k_3 + k_4}\right] \frac{\in_0 L^2}{d}$$

Now if $k_{eq} - k,\ C_{eq} = \frac{k \in_0 L^2}{d}$

on comparing equation (i) to equation (ii) , we get

$$k_{eq} = \frac{k_1 k_2 (k_3 + k_4) + k_3 K_4 (k_1 + k_2)}{(k_1 + k_2)(k_3 + k_4)}$$

This does not match with any of the options so probably they have assumed the wrong combination

$$C_{13} = \frac{k_1 \in_0 L \dfrac{L}{2}}{d/2} + k_3 \in_0 \frac{L . \dfrac{L}{2}}{d/2}$$

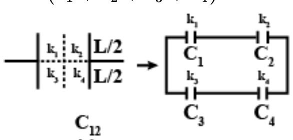
$$= (k_1 + k_3) \frac{\in_0 L^2}{d}$$

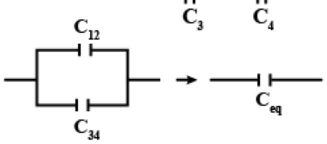
$$C_{24} = (k_2 + k_4) \frac{\in_0 L^2}{d}$$

$$C_{eq} = \frac{C_{13} C_{24}}{C_{13} C_{24}} = \frac{(K_1 + K_3)(k_2 + k_4)}{(k_1 + k_2 + k_3 + k_4)} \frac{\in_0 L^2}{d}$$

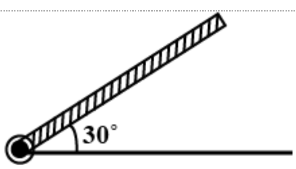
$$= \frac{k \in_0 L^2}{d}$$

$$k = \frac{(k_1 + k_3)(k_2 + k_4)}{(k_1 + k_2 + k_3 + k_4)}$$





#1329987



A rod of length 50 cm is pivoted at one end. It is raised such that if makes an angle of 30^o from the horizontal as shown and released from rest. Its angular speed when it passes through the horizontal (in rad s^{-1}) will be ($g = 10ms^{-2}$)

- **A** $\sqrt{30}$
- **B** $\sqrt{\frac{30}{2}}$
- **C** $\frac{\sqrt{30}}{2}$
- **D** $\frac{\sqrt{20}}{3}$

Solution

Work done by gravity from initial to final

position is,

$W = mg\frac{\ell}{2}sin30^o$

$= \frac{mg\ell}{4}$

According to work energy theorem

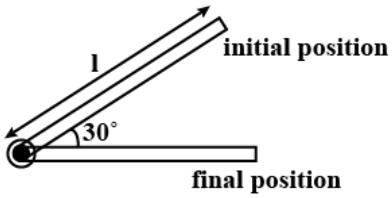
$W = \frac{1}{2}I\omega^2$

$\Rightarrow \frac{1}{2}\frac{m\ell^2}{3}\omega^2 = \frac{mg\ell}{4}$

$\omega = \sqrt{\frac{3g}{2\ell}} = \sqrt{\frac{3\times 10}{2\times 0.5}}$

$\omega = \sqrt{30}$ rad/sec

$\therefore$ correct answer is (1)



#1330023

One of the two identical conducting wires of length L is bent in the form of a circular loop and the other one into a circular coil of N identical turns. If the same current is passed in both, the ratio of the magnetic field at the central of the loop (B_L) to that at the centre of the coil (B_C), i.e. R $\frac{B_L}{B_C}$ will be

A $\frac{1}{N}$

B N^2

C $\frac{1}{N^2}$

D N

Solution

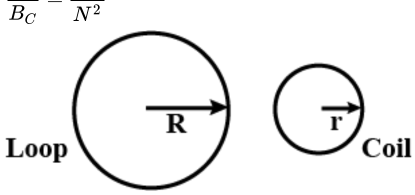
$L = 2\pi R \quad L = N\times 2\pi r$

$R = Nr$

$B_L = \frac{\mu_0 i}{2R} \quad B_C = \frac{\mu_0 Ni}{2r}$

$B_C = \frac{\mu_0 N^2 i}{2R}$

$\frac{B_L}{B_C} = \frac{1}{N^2}$



#1330108

The energy required to take a satellite to a height 'h' above Earth surface (radius of Earth = $6.4\times 10^3 km$) is E_1 and kinetic energy required for the satellite to be in a circular orbit at this height is E_2. The value of h for which E_1 and E_2 are equal, is:

A $1.28\times 10^4 km$

B $6.4\times 10^3 km$

C $3.2 \times 10^3 km$

D $1.6 \times 10^3 km$

Solution

$U_{surface} + E_1 = U_h$

KE of satelite is zero at earth surface & at height h

$-\frac{GM_e m}{R_e} + E_1 = -\frac{GM_e m}{(Re + h)}$

$E_1 = GM_e m\left(\frac{1}{R_e} - \frac{1}{R_e + h}\right)$

$E_1 = \frac{GM_e m}{(R_e + h)} \times \frac{h}{R_e}$

Gravitational attraction $F_G = ma_C = \frac{mv^2}{(R_e + h)}$

$E_2 \Rightarrow \frac{mv^2}{(R_e + h)} = \frac{GM_e m}{(R_e + h)^2}$

$mv^2 = \frac{GM_e m}{(R_e + h)}$

$E_2 = \frac{mv^2}{2} = \frac{GM_e m}{2(R_e + h)}$

$E_1 = E_2$

$\frac{h}{R_e} = \frac{1}{2} \Rightarrow h = \frac{R_e}{2} = 3200km$

#1330191

The energy associate with electric field is (U_E) and with magnetic field is (U_B) for an electromagetic wave in free space. Then :

A $U_E = \frac{U_B}{2}$

B $U_E < U_B$

C $U_E = U_B$

D $U_E > U_B$

Solution

Average energy density of magnetic field, $u_B = \frac{B_0^2}{2\mu_0}$, B_0 is maximum value of magnetic

field.

Average energy density of electric field,

Average energy density of electric field,

$u_E = \frac{\varepsilon_0 \in_0^2}{2}$

now, $\in_0 = CB_0,\ C^2 = \frac{1}{\mu_0 \in_0}$

$\mu_E = \frac{\in_0}{2} \times C^2 B_0^2$

$= \frac{\in_0}{2} \times \frac{1}{\mu_0 \in_0} \times B_0^2 = \frac{B_0^2}{2\mu_0} = \mu_B$

$u_E = u_B$

since energy density of electric & magnetic

field is same, energy associated with equal

volume will be equal.

$u_E = u_B$

#1330308

A series AC circuit containing an inductor (20 mH), a capacitor $(120\mu F)$ and a resistor (60Ω) is driven by an AC source of 24 V/50 Hz. The energy dissipated in the circuit in 60 s is :

A $2.26 \times 10^3 J$

B $3.39 \times 10^3 J$

C $5.65 \times 10^2 J$

D $5.17 \times 10^2 J$

Solution

$R = 60\Omega$ f = 50 Hz, $\omega = 2\pi f = 100\pi$

$x_C = \frac{1}{\omega C} = \frac{1}{100\pi \times 120 \times 10^{-6}}$

$x_C = 26.52\Omega$

$x_L = \omega L = 100\pi \times 20 \times 10^{-3} = 2\pi\Omega$

$x_C - x_L = 20.24 \approx 20$

$z = \sqrt{R^2 + (x_C - x_L)^2}$

$z = 20\sqrt{10}\Omega$

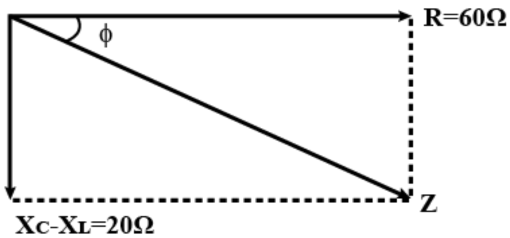
$cos\phi = \frac{R}{z} = \frac{3}{\sqrt{10}}$

$P_{avg} = VI\, cos\phi, I = \frac{v}{z}$

$= \frac{v^2}{z} cos\phi$

$= 8.64 watt$

$Q = P.t = 8.64 \times 60 = 5.18 \times 10^2$



#1330440

Expression for time in terms of G (universal gravitational constant), h (Planck constant) and c (speed of light) is proportional to :

A $\sqrt{\frac{Gh}{c^3}}$

B $\sqrt{\frac{hc^5}{G}}$

C $\sqrt{\frac{c^3}{Gh}}$

D $\sqrt{\frac{Gh}{c^5}}$

Solution

$F = \frac{GM^2}{R^2} \Rightarrow G = [M^{-1}L^3T^{-2}]$

$E = hv \Rightarrow h = [ML^2T^{-1}]$

$C = [LT^{-1}]$

$t \propto G^x h^y C^z$

$[T] = [M^{-1}L^3T^{-2}]^x [ML^2T^{-1}]^y [LT^{-1}]^z$

$[M^0L^0T^1] = [M^{-x+y}L^{3x+2y+z}T^{-2x-y-z}]$

on comparing the powers of M, L, T

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

$3x + 2y + z = 0 \Rightarrow 5x + z = 0$

$-2x - y - z = 1 \Rightarrow 3x + z = -1$

on solving (i) and (ii) $x = y = \frac{1}{2}, z = -\frac{5}{2}$

$t \propto \sqrt{\frac{Gh}{C^5}}$

#1330602

The magnetic field associated with a light wave is given, at the origin, by $B = B_0[sin(3.14 \times 10^7)ct + sin(6.28 \times 10^7)ct]$ If this light falls on a silver plate having a work function of $4.7eV$, what will be the maximum kinetic energy of the photo electrons ?

$(c = 3 \times 10^8 ms^{-1}.\ h = 6.6 \times 10^{-34} J - s)$

A 7.72 eV

B 8.52 eV

C 12.5 eV

D 6.82 eV

Solution

$B = B_0 sin\,(\pi \times 10^7 C)t + B_0 sin(2\pi \times 10^7 C)t$

since there are two EM waves with different

frequency, to get maximum kinetic energy we

take the photon with higher frequency

$B_1 = B_0 sin(\pi \times 10^7 C)t\ \ v_1 = \frac{10^7}{2}C$

$B_2 = B_0 sin(2\pi \times 10^7 C)t\ \ v_2 = 10^7 C$

Where C is speed of light $C = 3 \times 10^8$ m/s $v_2 > v_1$

so KE of photoelectron will be maximum for photon of higher energy.

$v_2 = 10^7 CHz$

$hv = \phi + KE_{max}$

energy of photon

$E_{ph} = hv = 6.6 \times 10^{-34} \times 10^7 \times 3 \times 10^9$

$e_{ph} = 6.6 \times 3 \times 10^{-19} J$

$= \frac{6.6 \times 3 \times 10^{-19}}{1.6 \times 10^{-19}} eV = 12.375eV$

$KE_{max} = E_{ph} - \phi$

$= 12.375 - 4.7 = 7.675eV\ \approx 7.72eV$

#1330776

Charge is distributed within a sphere of radius R with a volume charge density $\rho(r) = \frac{A}{r^2}e^{-2r/a}$, where A and a are constants. If Q is the total charge of this charge distribution, the radius R is :

A $\frac{a}{2} log\left(1 - \frac{Q}{2\pi a A}\right)$

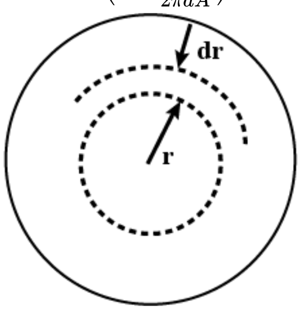
B $alog\left(1-\frac{Q}{2\pi aA}\right)$

C $alog\left(\frac{1}{1-\frac{Q}{2\pi aA}}\right)$

D $\frac{a}{2}log\left(\frac{1}{1-\frac{Q}{2\pi aA}}\right)$

Solution

$$Q = \int \rho dv$$
$$= \int_0^R \frac{A}{r^2} e^{-2r/a}(4\pi r^2 dx)$$
$$4\pi A \int_0^R e^{-2r/a} dx$$
$$= 4\pi A \left(\frac{e^{-2r/a}}{-\frac{2}{a}}\right)$$
$$= 4\pi A \left(-\frac{a}{2}\right)(e^{-2R/a} - 1)$$
$$Q = 2\pi aA(1 - e^{-2R/a})$$
$$R = \frac{a}{2}log\left(\frac{1}{1-\frac{Q}{2\pi aA}}\right)$$



#1330823

Two Carrnot engines A and B are operated in series. The first one, A, receives heat at $T_1(=600K)$ and rejects to a reservoir at temperature T_2. The second engine B receives heat rejected by the first engine and, in turn, rejects to a heat reservoir at $T_3(=400K)$. Calculate the temperature T_2 if the work outputs of the two engines are equal :

A 400 K

B 600 K

C 500 K

D 300 K

Solution

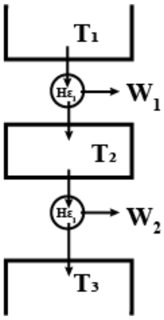
$w_1 = w_2$

$\Delta u_1 = \Delta u_2$

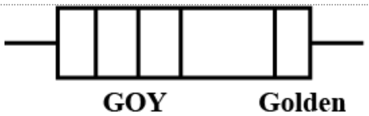
$T_3 - T_2 = T_2 - T_1$

$2T_2 = T_1 + T_3$

$T_2 = 500K$



#1330875



A carbon resistance has a following colour code. What is the value of the resistance ?

A $1.64M\Omega \pm 5\%$

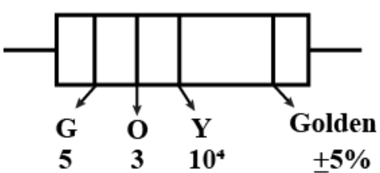
B $530k\Omega \pm 5\%$

C $64k\Omega \pm 10\%$

D $5.3M\Omega \pm 5\%$

Solution

$R = 53 \times 10^4 \pm 5\% = 530k\Omega \pm 5\%$



#1330902

A force acts on a 2 kg object so that its position is given as a function of time as $x = 3t^2 + 5$. What is the work done by this force in first 5 seconds ?

A 850 J

B 900 J

C 950 J

D 875 J

Solution

$x = 3t^2 + 5$

$v = \frac{dx}{dt}$

$v = 6t + 0$

$at\, t = 0 \quad v = 0$

t = 5 sec v = 30 m/s

W.D. = ΔKE

$W.D. = \frac{1}{2}mv^2 - 0 = \frac{1}{2}(2)(30)^2 = 900J$

#1330948

The position co-ordinates of a particle moving in a 3-D coordinate system is given by

x = a cos ω t

y = a sin ω t

and z = aωt

The speed of the particle is :

A $a\omega$

B $\sqrt{3}a\omega$

C $\sqrt{2}a\omega$

D $2a\omega$

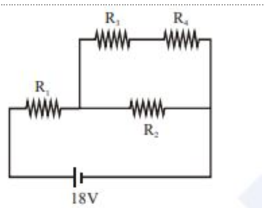
Solution

$v_x = -a\omega sin\omega t \Rightarrow v_y = a\omega cos\omega t$

$v_z = a\omega \qquad \Rightarrow v = \sqrt{v_x^2 + v_y^2 + v_z^2}$

$v = \sqrt{2}a\omega$

#1331011



In the given circuit the internal resistance of the 18 V cell is negligible. If $R_1 = 400\Omega, R_3 = 100\Omega$ and $R_4 = 500\Omega$ and the reading of an ideal voltmeter across R_4 is 5V, then the value R_2 will be :

A 300Ω

B 230Ω

C 450Ω

D 550Ω

Solution

$V_4 = 5V$

$i_1 = \frac{V_4}{R_4} = 0.01A$

$V_3 = i_1 R_3 = 1V$

$V_3 + V_4 = 6V = V_2$

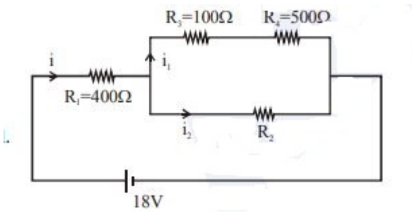
$V_1 + V_3 + V_4 = 18V$

$V_1 = 12V$

$i = \frac{V_1}{R_1} = 0.03Amp$

$i_2 = 0.02Amp$

$R_2 = \frac{V_2}{i_2} = \frac{6}{0.02} = 300\Omega$



#1331032

A mass of 10 kg is suspended vertically by a rope from the roof. When a horizontal force is applied on the rope at some point, the rope deviated at an angle of 45^o at the roof point. If the suspended mass is at equilibrium, the magnitude of the force applied is ($g = 10ms^2$)

A 200 N

B 100 N

C 140 N

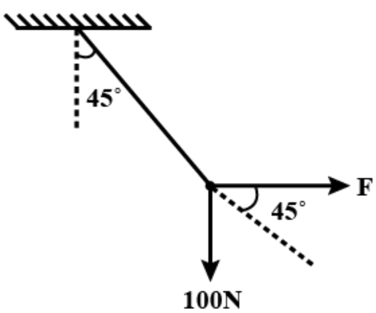
D 70 N

Solution

at equation

$tan45^o = \frac{100}{F}$

$F = 100N$



#1331133

In a car race on straight road, car A takes a times t less than car B at the finish and passes finishing point with a speed 'v' more than that of car B. Both the car start from rest and travel with constant acceleration a_1 and a_2 respectively. Then 'v' is equal to

A $\frac{a_1 + a_2}{2}t$

B $\sqrt{2a_1 a_2 t}$

C $\frac{2a_1 a_2}{a_1 + a_2}t$

D $\sqrt{a_1 a_2 t}$

Solution

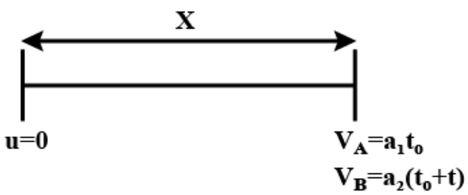
For A & B let time taken by A is t_0

from ques

$v_A - V_B = v = (a_1 - a_2)t_0 - a_2 t$
$x_B = x_A = \frac{1}{2}a_1 t_0^2 = \frac{1}{2}a_2(t_0 + t)^2$
$\Rightarrow \sqrt{a_1 t_0} = \sqrt{a_2}(t_0 + t)$
$\Rightarrow (\sqrt{a_2} - \sqrt{a_2})t_0 = \sqrt{a_2}t$

putting t_0 in equation

$v = (a_1 - a_2)\frac{\sqrt{a_2}t}{\sqrt{a_1} - \sqrt{a_2}} - a_2 t$
$= (\sqrt{a_1} + \sqrt{a_2})\sqrt{a_2}t - a_2 t \Rightarrow v = \sqrt{a_1 a_2 t}$
$\Rightarrow \sqrt{a_1 a_2}t + a_2 t - a_2 t$



#1331155

A power transmission line feeds input power t 2300 V to a step-down transformer with its primary windings having 4000 turns. The output power is delivered at 230 V by the transformer. If the current in the primary of the transformer is 5A and its efficiency is 90%, the output current would be :

A 25 A

B 50 A

C 35 A

D 45 A

Solution

$\eta = \frac{P_{out}}{P_{in}} = \frac{V_s I_s}{V_p I_p}$
$\Rightarrow 0.9 = \frac{23 \times I_s}{230 \times 5}$
$\Rightarrow I_s = 45A$

#1331211

The top of a water tank is open to air and its water level is maintained. It is giving out $0.74m^3$ water per minute through a circular opening of 2 cm radius in its wall. The depth of the centre of the opening from the level of water in the tank is close to :

A 9.6 m

B 4.8 m

C 2.9 m

D 6.0 m

Solution

In flow volume = outflow volume

$\Rightarrow \frac{0.74}{60} = (\pi \times 4 \times 10^{-4}) \times \sqrt{2gh}$

$\Rightarrow \sqrt{2gh} = \frac{74 \times 100}{240\pi}$

$\Rightarrow \sqrt{2gh} = \frac{740}{24\pi}$

$\Rightarrow 2gh = \frac{740 \times 740}{24 \times 24 \times 10} (\pi^2 = 10)$

$\Rightarrow h = \frac{74 \times 74}{2 \times 24 \times 24}$

$\Rightarrow h \approx 4.8m$

#1331247

The pitch and the number of divisions, on the circular scale, for a given screw gauge are 0.5 mm and 100 respectively. When the screw gauge is fully tightened without any object, the zero of its circular scale lies 3 divisions below the mean line. The readings of the main scale and the circular scale, for a thin sheet, are 5.5 mm and 48 respectively, the thickness of this sheet is :

A 5.755 m

B 5.725 mm

C 5.740 m

D 5.950 mm

Solution

$LC = \frac{Pitch}{No. of division}$

$LC = 0.5 \times 10^{-2} mm$

+ve error = $3 \times 0.5 \times 10^{-2} mm$

$= 1.5 \times 10^{-2} mm = 0.015 mm$

Reading = MSR + CSR - (+ve error)

$= 5.5mm + (48 \times 0.5 \times 10^{-2}) - 0.015$

$= 5.5 + 0.24 - 0.015 = 5.725mm$

#1331311

A particle having the same charge as of electron moves in a circular path of radius 0.5 cm under the influence of a magnetic field of 0.5 T. If an electric field of 100 V/m makes it move in a straight path, then the mass of the particle is ____?

(Given charge of electron = $1.6 \times 10^{-19} C$)

A $2.0 \times 10^{-24} kg$

B $1.6 \times 10^{-19} kg$

C $1.6 \times 10^{-27} kg$

D $9.1 \times 10^{-31} kg$

Solution

$$\frac{mv^2}{R} = qvB$$

$$mv = qBR$$

Path is straight line

it qE = qvB

E = vB

From equation (i) & (ii)

$$m = \frac{qB^2R}{E}$$

$$m = 2.0 \times 10^{-24} kg$$

#1329159

Good reducing nature of H_3PO_2 tributed to the presence of:

A one $P-OH$ bonds

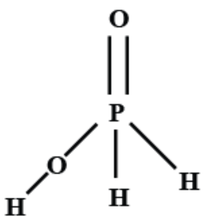
B one $P-H$ bonds

C two $P-H$ bonds

D two $P-OH$ bonds

Solution

H_3PO_2 is good reducing agent due to presence of two $P-H$ bonds



#1329198

The complex that has the highest crystal splitting energy (Δ), is:

A $K_3[Co(CN)_6]$

B $[Co(NH_3)_2(H_2O)]Cl_3$

C $[Co(NH_3)_3(H_2O)]Cl_3$

D $[Co(NH_3)_5Cl]Cl_2$

Solution

As complex $K_3[Co(CN)_6]$ have CN^- ligand which is strongfield ligand amongst the given ligand in other complexes.

#1329213

The metal that forms nitride by reacting directly with N_2 of air,is:

A K

B Cs

C Li

D Rb

Solution

Only Li react directly with N_2 out of alkali metals

$6Li + N_2 \rightarrow 2Li_3N$

#1329263

In which of the following processes the bond order has increased and paramagnetic character has charged to diamagnetic?

A $N_2 \rightarrow N_2^+$

B $NO \rightarrow NO^+$

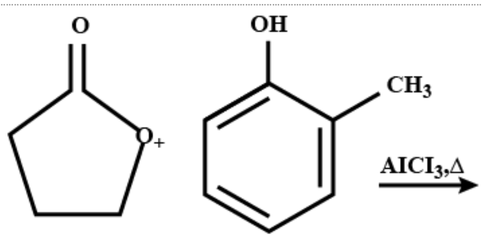
C $O_2 \rightarrow O_2^{2-}$

D $O_2 \rightarrow O_2^+$

Solution

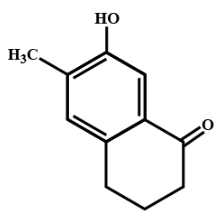
Process	Change in magnetic nature	Bond order change
$N_2 \rightarrow N_2^+$	*Dia* → *para*	3 → 2.5
$NO \rightarrow NO^+$	*Para* → *Dia*	2.5 → 3
$O_2 \rightarrow O_2^{-2}$	*Para* → *Dia*	2 → 1
$O_2 \rightarrow O_2^+$	*Para* → *Para*	2 → 2.5

#1329292

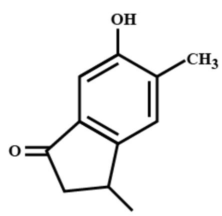


The major product of the following reaction is:

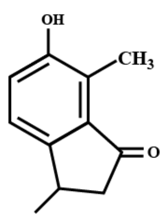
A



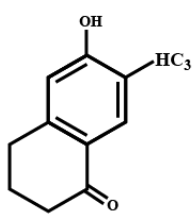
B



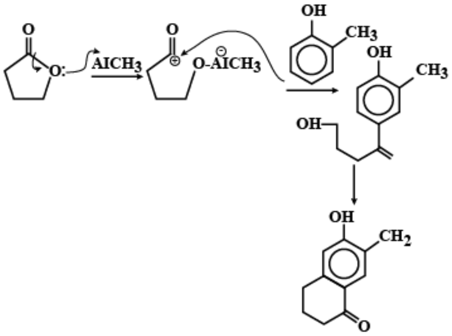
C



D



Solution



#1329314

The transition element that has lowest enthalpy compound $'X'$ is: of atomisation, is:

A Zn

B Cu

C V

D Fc

Solution

Since Zn is not transition element so transition element having lowest atomisation energy out of Cu,V,Fe is Cu.

#1329372

Which of the following combination of statements is true regarding the interpretation of the atomic orbitals?

(a)An electronic is an orbital of high angular momentum stays away from the nucleus than an electron in the orbital of lower angular momentum.

(b)For a given value of the principal quantum number , the size of the orbit is inversely proportional to the azimuthal quantum number.

(c)According to wave mechanics, the ground state angular momentum is h equal to $\frac{h}{2\pi}$.

(d)The plot of ψ Vs for various azimuthal quantum numbers, show peak shifting towards higher r value.

A b, c

B a, d

C a, b

D a, c

Solution

An electronic is an orbital of high angular momentum stays away from the nucleus than an electron in the orbital of lower angular momentum.

According to Bohr's theory, angular momentum is an integral multiple of $\frac{h}{2\pi}$. Hence,the ground state angular momentum is h equal to $\frac{h}{2\pi}$.

Statements b and c are incorrect. As we know principal quantum number depends on size whereas azimuthal quantum number doesn't depend on size.

Hence option D is the correct answer.

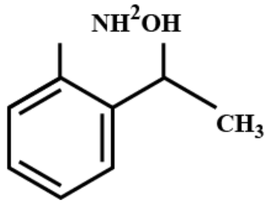
#1329420

The test performed on compound X and their Inference

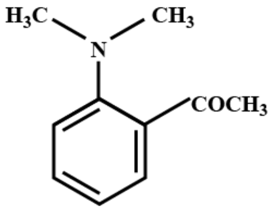
a-2,4-DNP test	Coloured precipitate
b-Iodoform test	Yellow precipitate
c-Azo-dye test	No dye formation

Compound X is:

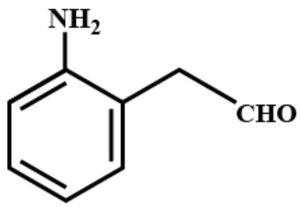
A



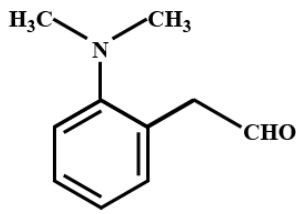
B



C



D

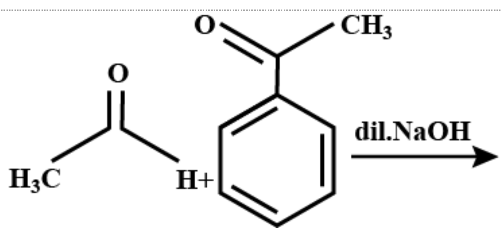


Solution

Ans(2) → $2,4-DNP$ test is given by aldehyde on krtone

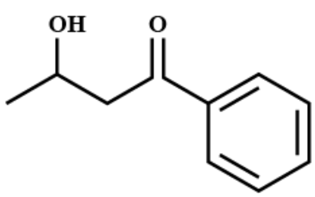
→ *Iodoform* test is given by compound having $CH_3 - C_{\|}O - group$.

#1329625

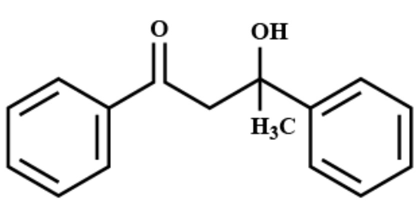


The major product formed in the following reaction is:

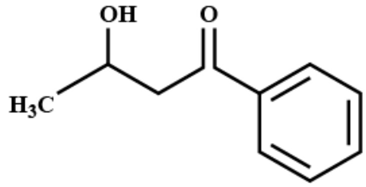
A



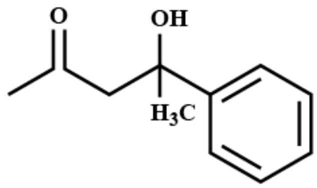
B



C



D



Solution

Aldehyde reacts at a faster rate than ketone during aldol and sterically less hindered anion will be better nucleophile so self-aldol at

$CH-\overset{O}{\underset{C}{||}}-H$ will be the major product.

#1329738

For the reaction, $2A + B \rightarrow products$, when the concentration of A and B both were doubled, the rate of t he reaction increased from $0.3\ mol\,L^{-1}s^{-1}$ to $2.4\ mol\,L^{-1}s^{-1}$.When the concentration of A alone is doubled, the rate increased from $0.3\ mol\,L^{-1}s^{-1}$ to $0.6\ mol\,L^{-1}s^{-1}$

Which of the following statements is correct?

A Order of the reaction with respect to B is 2

B Order of the reaction with respect to A is 2

C Total Order of the reaction is 4

D Order of the reaction with respect to B is 1

Solution

$r = K[A]^x[B]^y$

$\Rightarrow 8 = 2^3 = 2^{x+y}$

$\Rightarrow x + y = 3$...(1)

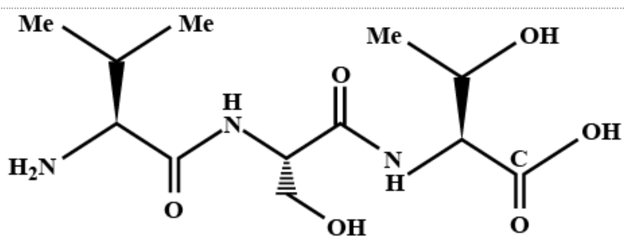
$\Rightarrow 2 = 2^x$

$\Rightarrow x = 1, y = 2$

Order w.r.t. $A = 1$

Order w.r.t. $B = 2$

#1329834



The correct sequence of amino acids presents in the tripeptide given below is:

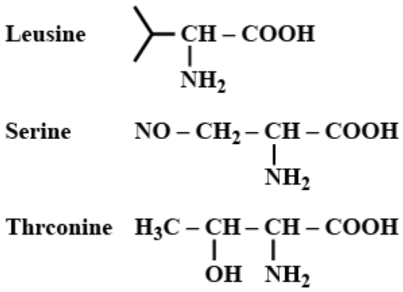
A Leu-Thr-Ser

B Leu-Ser-Thr

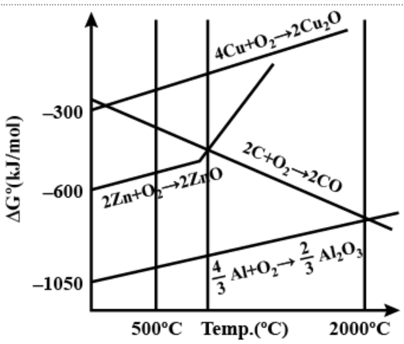
C Thr-Ser-Leu

D Val-Ser-Thr

Solution



#1329857



The correct statement regarding the given Ellingham diagram is:

A At 800^oC, Cu can be used for the extraction of Zn from ZnO

B At 500^oC,coke can be used for the extraction of Zn from ZnO

C Coke cannot be ussed for the extartion of Cu from Ca_2O.

D At 1400^oC, Al can be used for the extraction of Zn from ZnO

Solution

Ans.4 According to the given diagram Al can reduce ZnO.

$3ZnO + 2Al \rightarrow 3Zn + Al_2O_3$.

#1329899

For the following reaction, the mass of water produced from 445 g of $C_{57}H_{110}O_6$ is:

$2C_{57}H_{110}O_6(s) + 163O_2(g) \rightarrow 114CO_2(g) + 110H_2OP(l)$

A 495 g

B 490 g

C 890 g

D 445 g

Solution

Moles of $C_{57}H_{110}O_6(s) = \frac{445}{890} = 0.5\ moles$

$2C_{57}H_{110}O_6(s) + 163\ O_2(g) \rightarrow 114\ CO_2(g) + 110\ H_2OP(l)$

$n_{H_2O} = \frac{110}{4} = \frac{55}{2}$

$m_{H_2O} = \frac{55}{2} \times 18$

$= 495gm$

#1329932

The correct match between item I and item II is:

Item -I	Item-II
Benzaldehyde	Mobile phase
Alumina	Adsorbent
Acetonitrile	Adsorbate

A $A \rightarrow Q; B \rightarrow R; C \rightarrow P$

B $A \rightarrow P; B \rightarrow R; C \rightarrow Q$

C $A \rightarrow Q; B \rightarrow P; C \rightarrow R$

D $A \rightarrow R; B \rightarrow Q; C \rightarrow P$

Solution

Benzaldehyde is a substance which is absorbed, It acts as a adsorbate.

Alumina is a highly porous substance that adsorbs another substance, It acts as adsorbent.

Acetonitrile is used a mobile phase in chromatography.

#1330021

The increasing basicity under of the following compounds is:

$A - CH_3CH_2NH_2$

$B - CH_3CH_2 \underset{NH}{\overset{CH_2CH_3}{|}}$

$C - H_3C - \underset{N}{\overset{CH_3}{|}} - CH_3$

$D - Ph - \underset{N}{\overset{CH_3}{|}} - H$

A $D < C < A < B$

B $A < B < D < C$

C $A < B < C < D$

D $D < C < B < A$

Solution

$Ph - \underset{N}{\overset{CH_3}{|}} - H < CH_3 - \underset{N}{\overset{CH_3}{|}} - CH_3 < CH_3 - CH_2 - \underset{NH}{\overset{CH_2 - CH_3}{|}} < CH_3 - CH_2 - NH_2$

↑ ↑ ↑

lone pair delocalized more steric hinderence less solution energy

---

#1330046

For coagulation of arscnious sulphide sol, which one of the following salt solution will be most effective?

A $AlCl_3$

B $NaCl$

C $BaCl_2$

D Na_3PO_4

Solution

Sulphide is $-ve$ charged colloid so cation with maximum charge will be most effective for coagulation.

$Al^{3+} > Ba^{2+} > Na^{+}$ coagulatimg power.

#1330128

At 100^oC, copper (Cu) has FCC unit cell structure with cell edge length of $x\,\mathring{A}$. What is the approximate density of Cu ($in\, g\, cm^{-3}$) at this temperature?

[Atomic mass of Cu = 63.55 u]

A $\frac{105}{x^3}$

B $\frac{211}{x^3}$

C $\frac{205}{x^3}$

D $\frac{422}{x^3}$

Solution

Ans4. FCC unit cell $Z = 4$

$$d = \frac{63.5 \times 4}{6 \times 10^{23} \times x^3 \times 10^{-24}} g/cm^3$$

$$d = \frac{63.5 \times 4 \times 10}{6} g/cm^3$$

$$d = \frac{423.33}{x^3} \simeq (\frac{422}{x^3})$$

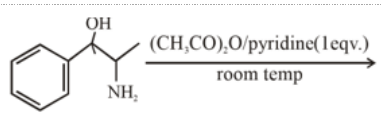
FCC unit cell $Z = 4$

$$d = \frac{63.5 \times 4}{6 \times 10^{23} \times x^3 \times 10^{-24}} g/cm^3$$

$$d = \frac{63.5 \times 4 \times 10}{6} g/cm^3$$

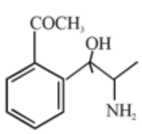
$$d = \frac{423.33}{x^3} \simeq (\frac{422}{x^3})$$

#1330212

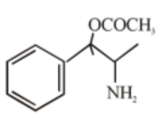


The major product obtained in the following reaction is:

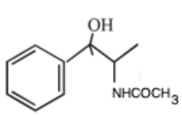
A



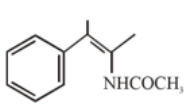
B



C

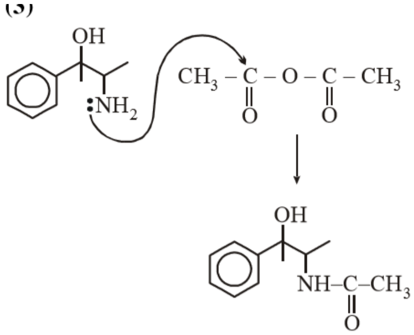


D



Solution

(3)



#1330254

Which of the following conditions in drinking water causes methemoglobinemia?

A $> 50\ ppm$ of load

B $> 100\ ppm$ of sulphate

C $> 50\ ppm$ of chloride

D $> 50\ ppm$ of nitrate

Solution

concentration of nitrate $> 50\ ppm$ in drinking water causes methemoglobinemia which is a blood disorder in which abnormal amount of methemoglobin is produced.

#1330321

Homoleptic octahedral complexes of a metal ion 'M^{3+}' with there monodententate ligands and L_1, L_2, L_3 absorb wavelength in the region of green,blue and red respectively.The increasing order of the ligand strength is:

A $L_2 < L_1 < L_3$

B $L_3 < L_2 < L_1$

C $L_3 < L_1 < L_2$

D $L_1 < L_2 < L_3$

Solution

Order of $\lambda_{abs} - L_3 > L_1 > L_2$

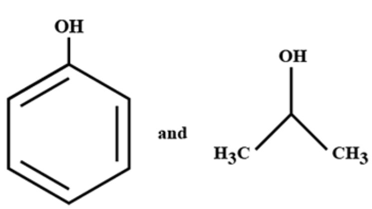
So Δ_o order will be $L_2 > L_1 > L_3$ (as $\Delta_o \infty \frac{1}{\lambda_{abs}}$)

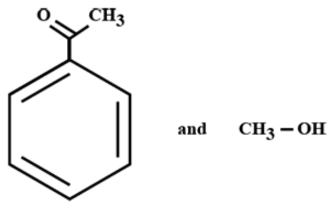
So order of ligand strength will be $L_2 > L_1 > L_3$

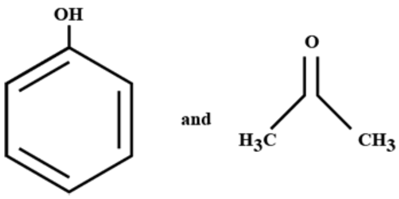
#1330373

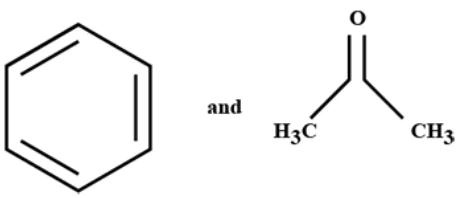
The product formed in the reaction of cumene with O_2 followed by treatment with dil.HCl are:

A



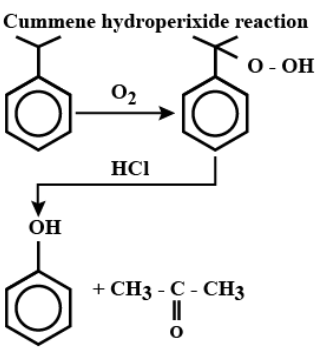
B 

C 

D 

Solution

Cummene hydroperoxide reaction



#1330433

The temporary hardness of water is due to:

A $Ca(HCO_3)_2$

B $NaCl$

C Na_2SO_4

D $CaCl_2$

Solution

Temporary hardness is caused by bicarbonates of calcium and magnesium. $Ca(HCO_3)_2$ is reponsible for temporary hardness of water.

#1330605

The entropy change associated with the conversion of $1\,kg$ of ice at $273\,K$ to water vapours at $383\,K$ is:

(Specific heat of water liquid and water liquid and water vapour are $4.2\,kJ\,K^{-1}\,kg^{-1}$ and $2.0\,kJ\,K^{-1}\,kg^{-1}$; heat of liquid fusion and vapourisation of water are $344\,kj\,kg^{-1}$ and $2491\,kJ\,kg^{-1}$, respectively).

($log\,273 = 2.436$, $log373 = 2.572$, $log, 383 = 2.583$)

A $7.90\,kJ\,kg^{-1}\,K^{-1}$

B $72.64\,kJ\,kg^{-1}\,K^{-1}$

C $78.49\ kJ\,kg^{-1}K^{-1}$

D $4.26\ kJ\,kg^{-1}K^{-1}$

Solution

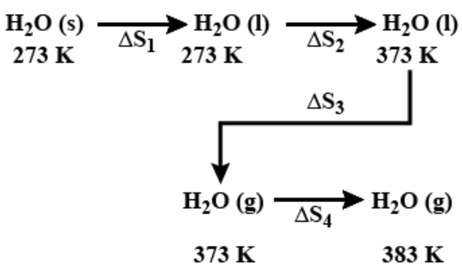
$$\Delta s_1 = \frac{\Delta H_{fusion}}{273} = \frac{334}{273}1.22$$

$$\Delta s_2 = 4.2 lN\frac{363}{273} = 1.31$$

$$\Delta s_3 = \frac{\Delta H_{vap}}{2491}373 = 6.67$$

$$\Delta s_4 = 2.0 ln\frac{383}{373} = 0.05$$

$$\Delta s_{total} = 4.26\ kJ\,kg^{-1}K^{-1}$$



#1330651

The pH of rain water, is approximately:

A 6.5

B 7.5

C 5.6

D 7.0

Solution

Rain water becomes acidic because gases present in environment are dissolved so it's pH will be less than 7. pH of rain water is approximate 5.6

#1330739

If the standard electrode potential constant for a cell is $2\ V$ at $300\ K$ the equilibrium constant (K) for the reaction

$Zn(s) + Cu^{2+}(aq) \rightleftharpoons Zn^{2+}(aq) + Cu(s)$ at $300\ K$ is approximately.

$(R = 8\ JK^{-1}mol^{-1}, F = 96000\ C\,mol^{-1})$

A e^{160}

B e^{320}

C e^{-160}

D e^{-80}

Solution

$$\Delta G^o = -RT\,lnk = -nFE^o_{cell}$$

$$lnk = \frac{n \times F \times E^o}{R \times T} = \frac{2 \times 96000 \times 2}{8 \times 300}$$

$$lnk = 160$$

$$e = e^{160}$$

#1330785

26. A solution containing $62\ g$ ethyal glycol in $250\ g$ water is cooled to -10^oC. If K_f for water is $1.86\ K\ kg\ mol^{-1}$, the amount of water ($in\ g$) separated as ice is:

A 32

B 48

C 16

D 64

Solution

Ans(4) $\Delta T_f = K_f.\ m$

$$10 = 1.86 \times \frac{62/62}{W_{kg}}$$

$W = 0.186\ kg$

$\Delta W = (250 - 186) = 64\ gm$

#1330849

When the first electron gain enthalpy ($\Delta_{eg}H$) of oxygen is $-141\ kJ/mol$, its second electron gain enthalpy is:

A Almost the same as that of the first

B Negative, but less negative than the first

C A positive value

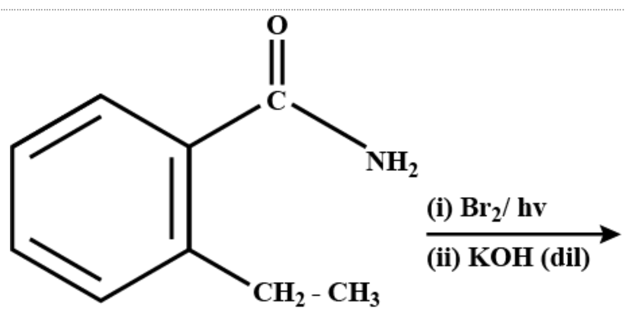
D A more negative value than the first

Solution

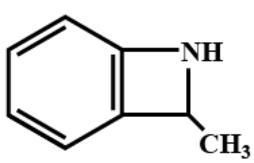
Second electron gain enthalpy is always positive for every element.

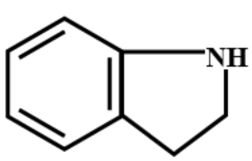
$O_g^- + e^- \rightarrow O_g^{-2}$; $\Delta H = positive$

#1330903

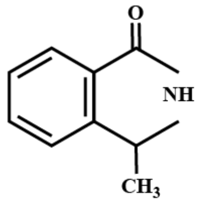


The major product of the following reaction is:

A 

B 

C



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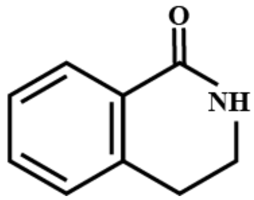
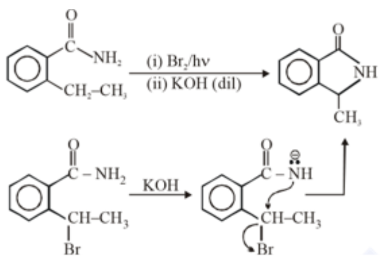


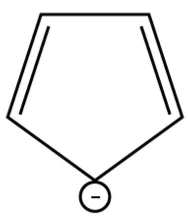
Solution



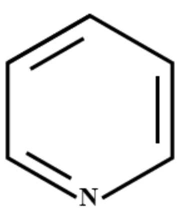
#1330945

Which of the following compounds is not aromatic?

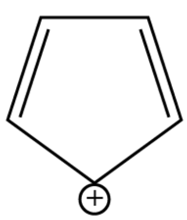
A



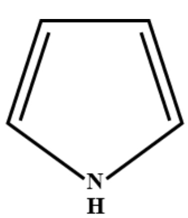
B



C



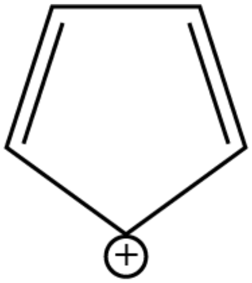
D



Solution

Ans(3) Do not have $(4n + 2)\pi$ electron it has $4n\pi$ electrons

So it is Anti aromatic.



#1331064

. Consider the following reversible chemical reactions:

$$A_2(g) + Br_2(g) \overset{K_1}{\rightleftharpoons} 2AB(g) \ldots (1)$$

$$6AB(g) \overset{K_2}{\rightleftharpoons} 3A_2(g) + 3B_2 \ldots (2)$$

The relation between K_1 and K_2 is:

A $K_2 = K_1^3$

B $K_2 = K_1^{-3}$

C $K_1K_2 = 3$

D $K_1K_2 = \frac{1}{3}$

Solution

Ans(2) $A_2(g) + Br_2(g) \overset{K_1}{\rightleftharpoons} 2AB(g) \ldots (1)$

$\Rightarrow eq.(1) \times 3$

$$6AB(g) \overset{K_2}{\rightleftharpoons} 3A_2(g) + 3B_2 \ldots (2)$$

$$\Rightarrow \left(\frac{1}{K_1}\right)^3 = k_2 \Rightarrow k_2 = (k_1)^{-3}$$

#1328994

Let f be differentiable function from R to R such that $|f(x)-f(y)| \leq 2|x-y|^{\frac{3}{2}}$, for all $x, y\,\varepsilon$ R.

If $f(0)=1$ then $\int_0^1 f^2(x)dx$ is equal to :

A 0

B $\frac{1}{2}$

C 2

D 1

Solution

$|f(x)-f(y)| \leq 2|x-y|\frac{3}{2}$ divide both side by $|x-y|$

$\left|\frac{f(x)-f(y)}{x-y}\right| \leq 2|x-y|\frac{1}{2}$

Apply limit $x \to y$

$|f'(y)| \leq 0 \Rightarrow f'(y)=0 \Rightarrow f(y)=c \Rightarrow f(x)=1$

$\int_0^1 1.dx = 1$

#1329015

If $\int_0^{\frac{\pi}{3}} \frac{\tan\theta}{\sqrt{2k\sec\theta}}d\theta = 1-\frac{1}{\sqrt{2}}, (k>0)$,then the value of k is :

A 2

B $\frac{1}{2}$

C 4

D 1

Solution

$\frac{1}{\sqrt{2k}}\int_0^{\frac{\pi}{3}} \frac{\tan\theta}{\sqrt{\sec\theta}}d\theta = \frac{1}{\sqrt{2k}}\int_0^{\frac{\pi}{3}} \frac{\sin\theta}{\sqrt{\cos\theta}}d\theta$

$= -\frac{1}{\sqrt{2k}}2\sqrt{\cos\theta}|_0^{\frac{\pi}{3}} = \frac{\sqrt{2}}{\sqrt{k}}\left(\frac{1}{\sqrt{2}}-1\right)$

given it is $1-\frac{1}{\sqrt{2}} \Rightarrow k=2$

#1329090

The coefficient of t^4 in the expansion of $\left(\frac{1-t^6}{1-t}\right)^3$ is

A 12

B 15

C 10

D 14

Solution

$(1-t^6)^3(1-t)^{-3}$

$(1-t^{18}-3t^6+3t^{12})(1-t)^{-3}$

$\Rightarrow$ coefficient of t^4 in $(1-t)^{-3}$ is

${}^{3+4-1}C_4 = {}^6C_2 = 15$

#1329122

For each $x\varepsilon R$, let $[x]$ be the greatest integer less than or equal to x.Then

$\lim_{x\to 0^-} \dfrac{x([x]+|x|)\sin[x]}{|x|}$ is equal to

A $-\sin 1$

B 0

C 1

D $\sin 1$

Solution

$\lim_{x\to 0^-} \dfrac{x([x]+|x|)\sin[x]}{|x|}$

When $x \to 0^-$

$[x] = -1$

$|x| = -x$

$\Rightarrow \lim_{x\to 0^-} \dfrac{x(-x-1)\sin(-1)}{-x} = -\sin 1$

#1329168

If the both roots of the quadratic equation $x^2 - mx + 4 = 0$ are real and distinct and they lie in the interval $[1, 5]$, then m lies in the interval:

A $(4, 5)$

B $(3, 4)$

C $(5, 6)$

D $(-5, -4)$

Solution

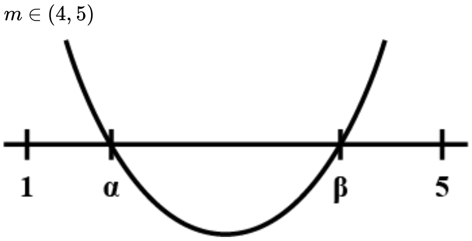
$m^2 - 16 > 0 \therefore m \in (-\infty, 4) \cup (4, \infty)$

$1 < -\dfrac{-m}{2} < 5 \quad 2 < m < 10$

$1 - m + 4 > 0$ and $25 - m + 4 > 0$

$m < 4$ and $m < \dfrac{29}{5}$

$m \in (4, 5)$



#1329280

If $\begin{bmatrix} e^t & e^{-t}\cos t & e^{-t}\sin t \\ e^t & -e^{-t}\cos t - e^{-t}\sin t & -e^{-t}\sin t + e^{-t}\cos t \\ e^t & 2e^{-t}\sin t & -2e^{-t}\cos t \end{bmatrix}$ Then A is -

A Invertible only if $t = \dfrac{\pi}{2}$

B not invertible for any $t \varepsilon R$

C invertible for all $t \varepsilon R$

D invertible only if $t = \pi$

Solution

$$|A| = e^{-t}\begin{bmatrix} 1 & \cos t & \sin t \\ 1 & -\cos t - \sin t & -sint + \cos t \\ 1 & 2\sin t & -2\cos t \end{bmatrix}$$

$= e^{-t}[5\cos^2 t + 5\sin^2 t] \forall t \in R$

$= 5e^{-t} \neq 0 \, \forall t \in R$

#1329318

The area of the region

$A = [(x, y) : 0 \leq y \leq x|x| + 1$and $-1 \leq x \leq 1]$ in sq . units is :

A $\frac{2}{3}$

B $\frac{1}{3}$

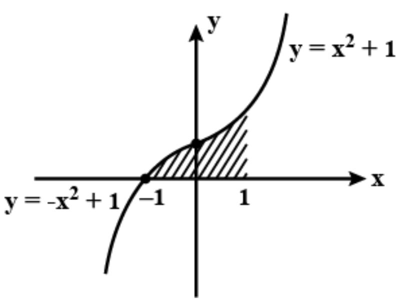
C 2

D $\frac{4}{3}$

Solution

The graph is as follows:

$\int_{-1}^{0}(-x^2+1)dx + \int_{0}^{1}(x^2+1)dx = 2$



#1329358

Let z_0 be a root of the quadratic equation $x^2 + x + 1 = 0$ If $z = 3 + 6iz_0^{81} - 3iz_0^{93}$, then arg z is equal to :

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

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

C 0

D $\frac{\pi}{6}$

Solution

$z_0 = \omega$ or ω^2 (where ω is a non real cube root of unity)

$z = 3 + 6i(\omega)^{81} - 3i(\omega)^{93}$

$z = 3 + 3i$

$\Rightarrow arg\ z = \frac{\pi}{4}$

#1329414

Let $\vec{a}=\vec{i}+\vec{j}+\sqrt{1}\hat{k}, \vec{b}=b_1\hat{i}+b_1\hat{j}+\sqrt{2}\hat{k}$and $\vec{c}=5\hat{i}+\hat{j}+\sqrt{2}\hat{k}$be three vectors such that the projection vector of $\vec{b}$ on $\vec{a}$ is $\vec{a}$. If $\vec{a}+\vec{b}$ is perpendicular to $\vec{c}$, the $|\vec{b}|$ is equal to :

A $\sqrt{22}$

B 4

C $\sqrt{32}$

D 6

Solution

Projection of $\vec{b}$ on $\vec{a}=\dfrac{\vec{a}.\vec{b}}{|\vec{b}|}=|\vec{a}|\Rightarrow b_1+b_2=2$......(1)and $(\vec{a}+\vec{b})\perp\vec{c}\Rightarrow(\vec{a}+\vec{b}.\vec{c})=0\Rightarrow 5b_1+b_2=-10$.....(2)from (1) and $(2)\Rightarrow b_1=-3$ and $b_2=5$ then
$|\vec{b}|=\sqrt{b_1^2+b_2^2+2}=6$

#1329697

Let $A(4,-4)$ and $B(9,6)$ be point on the parabola, $y^2=4x$. Let C be chosen the arc AOB of the parabola, where O is the origin ,such that the area of $\triangle ACB$ is maximum.Then, the area (in sq.units) of $\triangle ACB$ is:

A $31\frac{3}{4}$

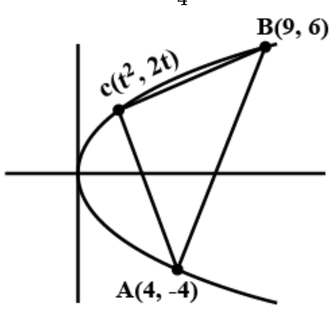
B 32

C $30\frac{1}{2}$

D $31\frac{1}{4}$

Solution

Area $=5|t^2-t-6|$
$=5|(t-\frac{1}{2})^2-\frac{25}{4}|$
Area is maximum when $t=\frac{1}{2}$
therefore Area $=31\frac{1}{4}$



#1329783

The logical statement $[\sim(\sim p\vee q)\vee(p\wedge r)\wedge(\sim q\wedge r)]$is equivalent to:

A $(p\wedge r)\wedge\sim q$

B $(\sim p\wedge\sim q)\wedge r$

C $\sim p\vee r$

D $(p\wedge\sim q)\vee r$

Solution

$s[\sim(\sim p \vee q) \wedge (p \wedge r)] \cap (\sim q \wedge r)$

$\equiv [(p \wedge \sim q) \vee (p \wedge r)] \wedge (\sim q \wedge r)$

$\equiv [p \wedge (\sim q \vee r)] \wedge (\sim q \wedge r)$

$\equiv p \wedge (q \sim \wedge r)$

$\equiv (p \wedge r) \sim q$

#1329835

An urn contains 5 red and 2 green balls. A ball is drawn at random from the urn. If the drawn ball is green, then a red ball is added to the urn and if the drawn ball is red, then a green ball is added to the urn; the original ball is not returned to the urn. Now, a second ball is drawn at random from it. The probability that the second ball is red, is :

A $\frac{26}{49}$

B $\frac{32}{49}$

C $\frac{27}{49}$

D $\frac{21}{49}$

Solution

E_1 : Event of drawing a Red ball and placing a

green ball in the bag

E_2 : Event of drawing a green ball and placing a

red ball in the bag

E: Event of drawing a red ball in second draw

$P(E) = P(E_1) \times P\left(\frac{E}{E_1}\right) + P(E_2) \times P\left(\frac{E}{E_2}\right)$

$= \frac{5}{7} \times \frac{4}{7} + \frac{2}{7} \times \frac{6}{7} = \frac{32}{49}$

#1329862

If $0 \leq x < \frac{\pi}{2}$, the the number of values of x for which $\sin x - \sin 2x + \sin 3x = 0$ is

A 2

B 1

C 3

D 4

Solution

$\sin x - \sin 2x + \sin 3x = 0$

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

$\Rightarrow 2\sin x . \cos x - \sin 2x = 0$

$\Rightarrow \sin 2x(2\cos x - 1) = 0$

$\Rightarrow \sin 2x = 0$ or $\cos x = \frac{1}{2}$

$\Rightarrow x = 0, \frac{\pi}{3}$

#1329886

The equation of the plane containing the straight $\frac{x}{2} = \frac{y}{3} = \frac{z}{4} =$ line and perpendicular to the plane containing the straight lines $\frac{x}{3} = \frac{y}{4} = \frac{z}{2}$ and $\frac{x}{4} = \frac{y}{2} = \frac{z}{3}$ is:

A $x + 2y - 2z = 0$

B $x-2y+z=0$

C $5x+2y-4z=0$

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

Solution

Plane 1: $ax+by+cz=0$ contains line $\dfrac{x}{2}=\dfrac{y}{3}=\dfrac{z}{4}$

$\therefore 2a+3b+4c=0\ \cdots\ (i)$

Plane 2: $a'x+b'y+c'z=0$ is perpendicular to plane containing lines.

$\dfrac{x}{3}=\dfrac{y}{4}=\dfrac{z}{2}$ and $\dfrac{x}{4}=\dfrac{y}{2}=\dfrac{z}{3}$

$\therefore 3a'+4b'+2c'=0$ and $4a'+2b'+3c'=0$

$\Rightarrow \dfrac{a'}{12-4}=\dfrac{b'}{8-9}=\dfrac{c'}{6-16}$

$\Rightarrow 8a-b-10c=0\cdots$(ii)

From (i) and (ii), we get

$$\frac{a}{-30+4}=\frac{b}{32+20}=\frac{c}{-2-24}$$

$\Rightarrow$ Equation of plane $x-2y+z=0$

#1329912

Let the equations of two sides of a triangle be $3x-2y+6=0$ and $4x+5y-20=0$ If the orthocentre of this triangle is at $(1,1)$, then the equation of its third side is :

A $122y-26x-1675=0$

B $26x+61y+1675=0$

C $122y+26x+1675=0$

D $26x-122y-1675=0$

Solution

As orthocenter is the intersection of altitudes

Let Triangle be ΔABC

In which CM is perpendicular to AB

and BN is perpendicular to AC

At first we have to find altitude perpendicular to line 4x+5y-20=0 and passing through (1,1) that means we have to equation of CM :- $5x-4y-1=0$

Same way we have to find the altitude perpendicular to the line $3x-2y+6=0$

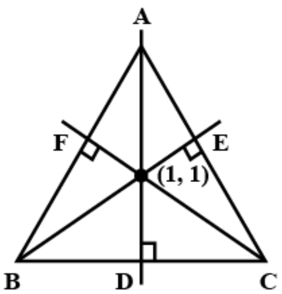
and passing through (1,1) that means we have to find equation of BN which we get BN :- $2x+3y-5=0$

Now we have to find the intersection point of AC and CM which we get coordinate of Point C which is $(-13, \frac{-33}{2})$

Same way we have to find the intersection point of AB and BN which we get coordinate of point B which is $(\frac{35}{2}, -10)$

Now as we have to find the equation of line BC and we know point B and C i.e. B$(\frac{35}{2}, -10)$ and C$(-13, \frac{-33}{2})$

By two point form of line we get equation of line BC and that will be $26x-122y-1675=0$



#1329939

If $x=3\ \tan t$ and $y=3\ \sec t$, the the value of $\frac{d^2y}{dx^2}$ at $t=\frac{\pi}{4}$, is :

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

B $\frac{1}{3\sqrt{2}}$

C $\frac{1}{6}$

D $\frac{1}{6\sqrt{2}}$

Solution

$\frac{dx}{dt}=3\sec^2 t$

$\frac{dy}{dt}=3\sec t\tan t$

$\frac{dy}{dx}=\frac{\tan t}{\sec t}=\sin t$

$\frac{d^2y}{dx^2}=\cos t\frac{dt}{dx}$

$=\frac{\cos t}{3\sec^2 t}=\frac{\cos^3 t}{3}=\frac{1}{3.2}=\frac{1}{6\sqrt{2}}$

#1329976

If $x=\sin^{-1}(\sin 10)$ and $y=\cos^{-1}(\cos 10)$, then $y-x$ is equal to:

A π

B 7π

C 0

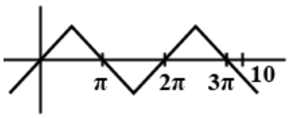
D 10

Solution

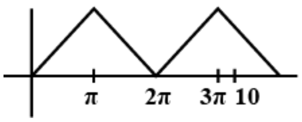
$x=\sin^{-1}(\sin 10)=3\pi-10$

$y=\cos^{-1}(\cos 10)=4\pi-10$

$y-x=\pi$



$$\mathbf{x=\sin^{-1}(\sin 10)=3\pi-10}$$



#1330033

If the lines $x=ay+b, z=cy+d$ and $x=a'z+b', y=c'z+d'$ are perpendicular, then:

A $cc'+a+a'=0$

B $aa'+c+c'=0$

C $ab'+bc'+1=0$

D $bb'+cc'+1=0$

Solution

Line $x=ay+b, z=cy+d \Rightarrow \frac{x-b}{a}=\frac{y}{1}=\frac{z-d}{c}$

Line $x=a'z+b', y=c'z+d'$

$\rightarrow \frac{x-b'}{a'}=\frac{y-d'}{c'}=\frac{z}{1}$

Given both line are perpendicular

$\Rightarrow aa'+c'+c=0$

#1330072

The number of all possible positive integral values of α for which the roots of the quadratic equation, $6x^2-11x+\alpha=0$ are rational numbers is

A 2

B 5

C 3

D 4

Solution

$6x^2 - 11x + \alpha = 0$

given roots are rational

$\Rightarrow D$ must be the perfect square

$\Rightarrow \quad 121 - 24\alpha = \lambda^2$

$\Rightarrow$ maximum value of α is 5

$\alpha = 1 \Rightarrow \lambda \notin I$

$\alpha = 2 \Rightarrow \lambda \notin I$

$\alpha = 3 \Rightarrow \lambda \in I$

$\alpha = 4 \Rightarrow \lambda \in I$

$\alpha = 5 \Rightarrow \lambda \in I \Rightarrow 3$ intergral value

#1330134

A hyperbola has its centre at the origin, passes through the point $(4, 2)$ and has transverse axis of length 4 along the x-axis. Then the eccentricity of the hyperbola is :

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

B $\frac{3}{2}$

C $\sqrt{3}$

D 2

Solution

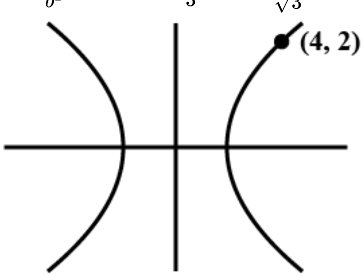
$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

$2a = 4 = 2$

$\frac{x^2}{4} - \frac{y^2}{b^2} = 1$

Passes through $(4, 2)$

$4 = \frac{4}{b^2} = 1 \Rightarrow b^2 = \frac{4}{3} \Rightarrow e = \frac{2}{\sqrt{3}}$



#1330182

Let $A = \{x \varepsilon R : x$ is not a positive integer$\}$

Define a function $f : A \rightarrow R$ as $f(x) = \dfrac{2x}{x-1}$ then f is

A injective but not surjective

B not injective

C surjective but not injective

D neither injective nor surjective

Solution

$f(x) = 2\left(1 + \dfrac{1}{x-1}\right)$

$f'(x) = -\dfrac{2}{(x-1)^2}$

$\Rightarrow$ f is one - one but not onto

#1330248

If $f(x) = \int \dfrac{5x^8 + 7x^6}{(x^2 + 1 + 2x^7)^2} dx, (x \geq 0)$ and $f(0) = 0$, the the value of $f(1)$ is:

A $-\dfrac{1}{2}$

B $\dfrac{1}{2}$

C $-\dfrac{1}{4}$

D $\dfrac{1}{4}$

Solution

$$\int \frac{5x^8 + 7x^6}{(x^2 + 1 + 2x^7)^2} dx$$

$$\int \frac{5x^{-6} + 7x^{-8}}{\left(\frac{1}{x^7} + \frac{1}{x^5} + 2\right)^2} dx = \frac{1}{2 + \frac{1}{x^5} + \frac{1}{x^7}} + C$$

As $f(0) = 0, f(x) = \dfrac{x^7}{2x^7 + x^2 + 1}$

$f(1) = \dfrac{1}{4}$

#1330266

If the circles $x^2 + y^2 - 16x - 20y + 164 = r^2$ and $(x-4)^2 + (y-7)^2 = 36$ intersect at two distinct point then:

A $0 < r < 11$

B $1 < r < 11$

C $r > 11$

D $r = 11$

Solution

$x^2 + y^2 - 16x - 20y + 164 = r^2$

$A(8, 10), R_1 = r$

$(x-4)^2 + (y-7)^2 = 36$

$B(4, 7), R_2 = 6$

$|R_1 - R_2| < AB < R_1 + R_2$

$\Rightarrow 1 < r < 11$

#1330333

Let S be the set of all triangles in the xy-plane, each having one vertex at the origin and the other two vertices lie on coordinate axes with integral coordinates. If each triangle in S has area 50sq. units, then the number of elements in the set S is:

A 9

B 18

C 32

D 36

Solution

Let $A(\alpha, 0)$ and $B(0, \beta)$

be the vectors of the given triangle AOB

$\Rightarrow |\alpha\beta| = 100$

$\Rightarrow$ Number of triangle

$= 4\times$ (number of divisors of 100)

$4 \times 9 = 36$

#1330395

The sum of the following series $1 + 6 + \dfrac{-(1^2+2^2+3^2)}{7} + \dfrac{12(1^2+2^2+3^2+4^2}{9} + \dfrac{15(1^2+2^2+....+5^2}{11} + ...$ up to 15 terms is:

A 7820

B 7830

C 7520

D 7510

Solution

$$T_n = \frac{(3+(n-1)\times 3)(1^2+2^2+...+n^2)}{(2n+1)}$$

$$T_n = \frac{3.\dfrac{n(n+1)(2n+1)}{6}}{2n+1} = \frac{n^2(n+1)}{2}$$

$$S_{15} = \frac{1}{2}\sum_{n=1}^{15}(n^3+n^2) = \frac{1}{2}\left[\left(\frac{15(15+1)}{2}\right)^2 + \frac{15\times 16\times 31}{6}\right]$$

$= 7820$

#1330501

Let a, b and c be the $7th, 11th$ and $13th$ terms respectively of a non-constant A.P. If these are also the three consecutive terms of a G.P., then $\dfrac{a}{c}$ is equal to:

A $\dfrac{1}{2}$

B 4

C 2

D $\dfrac{7}{13}$

Solution

$a = A + 6d$

$b = A + 10d$

$c = A + 12d$

a, b, c are in G.P

$\Rightarrow (A + 10d)^2 = (A + 6d)(a + 12d)$

$\Rightarrow \dfrac{A}{d} = -14$

$\dfrac{a}{c} = \dfrac{A + 6d}{A + 12d} = \dfrac{6 + \dfrac{A}{d}}{12 + \dfrac{A}{d}} = \dfrac{6 - 14}{12 - 14} = 4$

#1330580

If the system of linear equation $x - 4y + 7z = g, 3y - 5z = h$ and $-2x + 5y - 9z = k$ is consistent ,then :

A $g + h + k = 0$

B $2g + h + k = 0$

C $g + h + 2k = 0$

D $g + 2h + k = 0$

Solution

$P_1 \equiv x - 4y + 7z - g = 0$

$P_2 \equiv 3x - 5y - h = 0$

$P_3 \equiv 2x + 5y - 9z - k = 0$

Here $\Delta = 0$

$2P_1 + P_2 + P_3 = 0$

$2g + h + k = 0$

#1330665

Let $f : [0, 1] \to R$ be such that $f(xy) = f(x).\, f(y)$ for all x,y,∈[0,1], and $f(0) \neq 0$. If $y = y(x)$ satisfies the differential equation , $\dfrac{dy}{dx} = f(x)$ with $y(0) = 1$, then $y\left(\dfrac{1}{4}\right) + y\left(\dfrac{3}{4}\right)$ is equal to

A 4

B 3

C 5

D 2

Solution

$f(xy) = f(x).\, f(y)$

$f(0) = 1$ as $f(0) \neq 0$

$\Rightarrow f(x) = 1$

$\dfrac{dy}{dx} = f(x) = 1$

$\Rightarrow y = x + c$

At, $x = 0, y = 1 \Rightarrow c = 1$

$y = x + 1$

$\Rightarrow y\left(\dfrac{1}{4}\right) + y\left(\dfrac{3}{4}\right) = \dfrac{1}{4} + 1 + \dfrac{3}{4} + 1 = 3$

#1330799

A data consists of n observation: $x_1, x_2, \ldots\ldots\ldots, x_n$.If $\sum_{i=1}^{n}(x_i+1)^2 = 9n$ and $\sum_{i=1}^{n}(x_i-1)^2 = 5n$, then the standard deviation of this data is:

A 5

B $\sqrt{5}$

C $\sqrt{7}$

D 2

Solution

$\sum(x_i+1)^2 = 9n$......(1)

$\sum(x_i-1)^2 = 5n$.....$(2))$

$(1)+(2) \Rightarrow \sum(x_1^2+1) = 7n$

$\Rightarrow \dfrac{\sum x_i^2}{n} = 6$

$(1)-(2) \Rightarrow 4\sum x_i = 4n$

$\Rightarrow \dfrac{\sum x_i}{n} = 1$

$\Rightarrow$ variance $= 6-1 = 5$

$\Rightarrow$ Standard deviation $= \sqrt{5}$

#1330846

The number of natural numbers less than $7,000$ which can be formed by using the digits$0, 1, 3, 7, 9$(repitition of digits allowed) is equal to :

A 250

B 374

C 372

D 375

Solution

a_1	a_2	a_3

Number of numbers $5^3 - 1$

a_4	a_1	a_2	a_3

2 ways for a_4

Number of number $= 2 \times 5^3$

Required number $5^3 + 2 \times 5^3 - 1 = 374$