#1330388

A load of mass $M\,kg$ is suspended from a steel wire of length $2\ m$ and radius $1.0\ mm$ in Searle's apparatus experiment. The increase in length produced in the wire is $4.0\ mm$.

Now the load is fully immersed in a liquid of relative density 2. The relative density of the material of load is 8. The new value of the increase in the length of the steel wire is:

A 4.0 mm

[✓ B] 3.0 mm

C 5.0 mm

D Zero

Solution

$$\frac{F}{A} = y.\frac{\Delta \ell}{\ell}$$

$\Delta \ell \alpha F$ ...(i)

$T = mg$

$$T = mg - f_B = mg - \frac{m}{\rho_b}.\rho_l.g$$

$$= \left(1 - \frac{\rho_\ell}{\rho_b}\right)mg$$

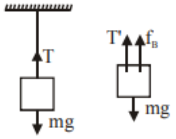
$$= \left(1 - \frac{2}{8}\right)mg$$

$$T' = \frac{3}{4}mg$$

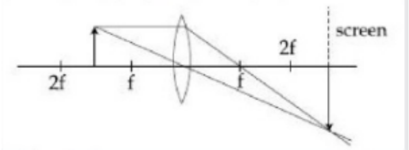
For (i),

$$\frac{\Delta \ell'}{\Delta \ell} = \frac{T'}{T} = \frac{3}{4}$$

$$\Delta \ell' = \frac{3}{4}.\Delta \ell = 3\ mm$$



#1330469



Formation of real image using a biconvex lens is shown below:

If the whole set up is immersed in water without disturbing the object and the screen position, what will one observe on the screen?

[✓ A] Image disappears

B No change

C Erect real image

D Magnified image

Solution

From $\frac{1}{f} = (\mu_{rel} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

Focal length of lens will change hence image disappears from the screen

---

#1330523

A vertical closed cylinder is separated into two parts by a frictionless piston of mass m and of negligible thickness. The piston is free to move along the length of the cylinder. The length of the cylinder above the piston is ℓ_1, and that below the piston is ℓ_2 , such that $\ell_1 > \ell_2$. Each part of the cylinder contains n moles of an ideal gas at equal temperature T. If the piston is stationary, its mass, m, will be given by :

(R is universal gas constant and g is the acceleration due to gravity)

A $\frac{nRT}{g}\left[\frac{1}{\ell_2} + \frac{1}{\ell_1}\right]$

$\boxed{\text{B}}$ $\frac{nRT}{g}\left[\frac{\ell_1 - \ell_2}{\ell_1\ell_2}\right]$

C $\frac{RT}{g}\left[\frac{2\ell_1 + \ell_2}{\ell_1\ell_2}\right]$

D $\frac{RT}{g}\left[\frac{\ell_1 - 3\ell_2}{\ell_1\ell_2}\right]$

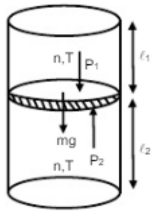
Solution

$P_2A = P_1A + mg$

$$\frac{nRT.A}{A\ell_2} = \frac{nRT.A}{A\ell_1} + mg$$

$$nRT\left(\frac{1}{\ell_2} - \frac{1}{\ell_1}\right) = mg$$

$$m = \frac{nRT}{g}\left(\frac{\ell_1 - \ell_2}{\ell_1\ell_2}\right)$$



#1330621

A simple motion is represented by:

$y = 5(\sin 3\pi t + \sqrt{3}\cos 3\pi t) cm$

The amplitude and time period of the motion are:

A $5\ cm, \frac{3}{2}s$

B $5\ cm, \frac{2}{3}s$

C $10\ cm, \frac{3}{2}s$

D $10\ cm, \frac{2}{3}s$

Solution

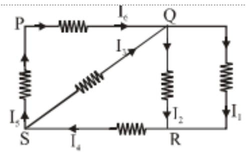
$y = 5[\sin(3\pi t) + \sqrt{3}\cos(3\pi t)]$

$= 10\sin\left(3\pi t + \frac{\pi}{3}\right)$

Amplitude $= 10\ cm$

$T = \frac{2\pi}{w} = \frac{2\pi}{3\pi} = \frac{2}{3}\sec$

#1330682



In the given circuit diagram, the currents, $I_1 = -0.3A$, $I_4 = 0.8A$ and $I_5 = 0.4A$ are flowing as shown. The currents $I_2 I_3$ and I_6 respectively, are:

A $1.1A, 0.4A, 0.4A$

B $-0.4A, 0.4A, 1.1A$

C $0.4A, 1.1A, 0.4A$

D $1.1A, -0.4A, 0.4A$

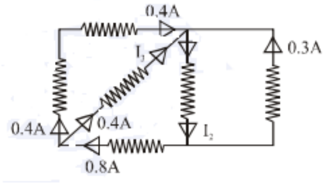
Solution

From $KCL, I_3 = 0.8 - 0.4 = 0.4A$

$I_2 = 0.4 + 0.4 + 0.3$

$= 1.1A$

$I_6 = 0.4A$



#1330755

A particle of mass $20\ g$ is released with an initial velocity $5\ m/s$ along the curve from the point A, as shown in the figure. The point A is at height h from point B. The particle slides along the frictionless surface. When the particle reaches point B, its angular momentum about O will be :

(Take $g = 10\ m/s^2$)

A $8\ kg - m^2/s$

B $6\ kg - m^2/s$

C $3\ kg - m^2/s$

D $2\ kg - m^2/s$

Solution

Work Energy Theorem from A to B

$mgh = \frac{1}{g}mv_B^2 - \frac{1}{g}mv_A^2$

$2gh = v_B^2 - v_A^2$

$2 \times 10 \times 10 = v_B^2 - 5^2$

$v_B = 15\ m/s$

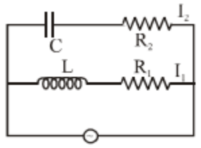
Angular momentum about 0

$L_0 = mvr$

$= 20 \times 10^{-3} \times 20$

$L_0 = 6\ kg.\ m^2/s$

#1330852



In the above circuit, $C = \frac{\sqrt{3}}{2}\mu F$, $R_2 = 20\Omega$, $L = \frac{\sqrt{3}}{10}H$ and $R_1 = 10\Omega$. Current in $L - R_1$ path is I_1 and in $C - R_2$ path it is I_2. the voltage of A.C. source is given by $V = 200\sqrt{2}\sin(100t)$ volts. The phase difference between I_1 and I_2 is:

A 30^o

B 0^o

[✓ **C**] 90^o

D 60^o

Solution

$x_e = \frac{1}{\omega_c} = \frac{4}{10^{-6} \times \sqrt{3} \times 100} = \frac{2 \times 10^4}{\sqrt{3}}$

$\tan\frac{\theta}{2}\frac{x_e}{R_e} = \frac{10^3}{\sqrt{3}}$

θ_1 is close to 90

For $L - R$ circuit

$x_L = w_L = 100 \times \frac{\sqrt{3}}{10} = \sqrt{3}$

$R_1 = 10$

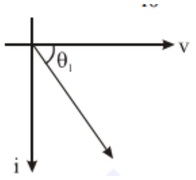
$\tan\theta_2 = \frac{x_e}{R}$

$\tan\theta_2 = \sqrt{3}$

$\Theta_2 = 60$

So phase difference comes out $90 + 60 = 150$.

Therefore Ans. is Bonus If R_2 is $20\ K\Omega$ then phase difference comes out to be $60 + 30 = 90^o$



#1331196

A paramagnetic material has $10^{28}\ atoms/\ m^3$. Its magnetic susceptibility at temperature $350\ K$ is 2.8×10^{-4}. Its susceptibility at $300\ K$ is:

A 3.676×10^{-4}

B 3.726×10^{-4}

$\boxed{\text{C}}$ 3.267×10^{-4}

D 3.672×10^{-4}

Solution

$X \propto \frac{1}{T_c}$

curie law for paramagnetic substane

$$\frac{x_1}{x_2}=\frac{T_{c2}}{T_{c1}}$$

$$\frac{2.8\times10^{-4}}{x_2}=\frac{300}{350}$$

$$x_2=\frac{2.8\times350\times10^{-4}}{300}$$

$=3.266\times10^{-4}$

#1331253

A $10\ m$ long horizontal wire extends from North East to South West. It is falling with a speed of $5.0\ ms^{-1}$, at right angles to the horizontal component of the earth's magnetic field, of $0.3\times10^{-4}\ Wb/\ m^2$. The value of the induced emf in wire is:

A $2.5\times10^{-3}V$

$\boxed{\text{B}}$ $1.1\times10^{-3}V$

C $0.3\times10^{-3}V$

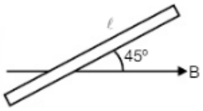
D $1.5\times10^{-3}V$

Solution

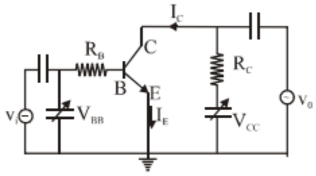
Induied emf $=Bv\ell sin45$

$=0.3\times10^{-4}\times5\times10\times\frac{1}{\sqrt{2}}$

$=1.1\times10^{-3}V$



#1331361



In the figure, given that V_{BB} supply can vary from 0 to$5.0\ V$, $V_{CC}=5V$, $\beta_{dc}=200$, $R_B=100\ k\Omega$, $R_C=1\ k\Omega$ and $V_{BE}=1.0\ V$. The minimum base current and the input voltage at which the transistor will go to saturation, will be respectively:

A $20\mu A$ and $3.5V$

B $25\mu A$ and $3.5V$

C $25\mu A$ and $2.5V$

D $20\mu A$ and $2.8V$

Solution

At saturation, $V_{CE} = 0$

$V_{CE} = V_{CC} - I_C R_C$

$$I_C = \frac{V_{CC}}{R_C} = 5 \times 10^{-3} A$$

Given

$$\beta_{dc} = \frac{I_C}{I_B}$$

$$I_B = \frac{5 \times 10^{-3}}{200}$$

$I_B = 25\ muA$

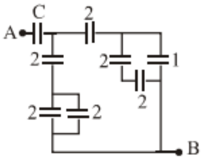
At input side

$V_{BB} = I_B R_B + V_{BE}$

$= (25\ mA)(100\ k\Omega) + 1V$

$V_{BB} = 3.5V$

#1331482



In the circuit shown, find C if the effective capacitance of the whole circuit is to be $0.5\ \mu F$. All values in the circuit are in μF.

A $\frac{7}{10}\mu F$

B $\frac{7}{11}\mu F$

C $\frac{6}{5}\mu F$

D $4\ \mu F$

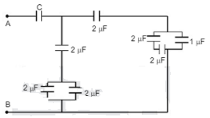
Solution

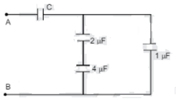
From equs.

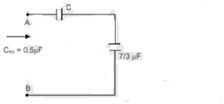
$$\frac{\frac{7C}{3}}{\frac{7}{3}+C}=\frac{1}{2}$$

$$\Rightarrow 14\,C = 7 + 3C$$

$$\Rightarrow C = \frac{7}{11}$$







#1331553

Two satellites, A and B, have masses m and $2m$ respectively. A is in circular orbit of radius R, and B is in a circular orbit of radius $2R$ around the earth. The ratio of their kinetic energies, $T_A/\,T_B$ is:

A 2

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

[✓ **C**] 1

D $\frac{1}{2}$

Solution

Orbital velocity $V=\sqrt{\frac{GMe}{r}}$

$$T_A=\frac{1}{2}m_AV_A^2$$

$$T_B=\frac{1}{2}m_BV_B^2$$

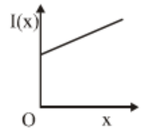
$$\Rightarrow \frac{T_A}{T_B}=\frac{m\times\frac{Gm}{R}}{2m\times\frac{Gm}{2R}}$$

$$\Rightarrow \frac{T_A}{T_B}=1$$

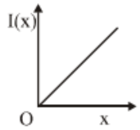
#1331597

The moment of inertia of a solid sphere, about an axis parallel to its diameter and at a distance of x from it, is $I(x)^{'}$. Which one of the graphs represents the variation of $I(x)$ with x correctly?

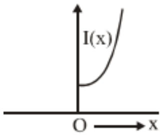
A



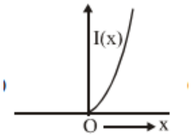
B



C



D



Solution

$I_x = I_{cm} + mx^2$

$I = \frac{2}{5}mR^2 + mx^2$

Parabola opening upward

#1331622

When a certain photosensitive surface is illuminated with monochromatic light of frequency v, the stopping potential for the photocurrent is $\frac{V_0}{2}$. When the surface is illuminated by monochromatic light of frequency $\frac{v}{2}$, the stopping potential is $-V_0$. the threshold frequency for photoelectric emission is:

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

B $2v$

C $\frac{4}{3}v$

D $\frac{5v}{3}$

Solution

$hv = W + \frac{v_o}{2}e$

$\frac{hv}{2} = W + v_o e$

on solving we get, $W = 3/2hv$

$hv_o = 3/2hv$

$v_o = 3/2v$

#1331679

A galvanometer, whose resistance is $50\ ohm$, has 25 division in it. When a current of $4 \times 10^{-4}A$ passes through it, is its needle (pointer) deflects by one division. To use this galvanometer as a voltmeter of range $2.5V$, it should be connected to a resistance of:

A 6250 ohm

B 250 ohm

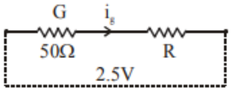
C 200 ohm

D 6200 *ohm*

Solution

$I_g = 4 \times 4 \times 10^{-4} \times 25 = 10^{-2}A$

$2.5 = (50 + R)10^{-2} \therefore = 200\Omega$



#1331690

A long cylindrical vessel is half filled with a liquid. When the vessel is rotated about its own vertical axis, the liquid rises up near the wall. If the radius of vessel is 5 cm and its rotational speed is 2 rotations per second, then the difference in the heights between the centre and the sides, in cm, will be:

A 1.2

B 0.1

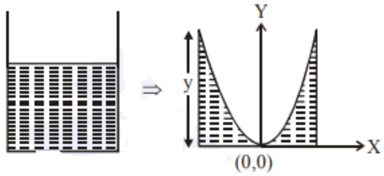
[✓ **C**] 2.0

D 0.4

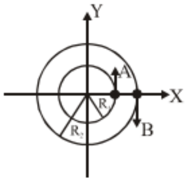
Solution

$$y = \frac{\omega^2 x^2}{2g} = \frac{(2 \times 2\pi)^2 \times (0.05)^2}{20} \sim 2\,cm$$

I.



#1331716



Two particles A, B are moving on two concentric circles of radii R_1 and R_2 with equal angular speed ω. At $t = 0$, their positions and direction of motion are shown in the figure:

The relative velocity $\vec{u}_A - \vec{v}_B$ at $t = \frac{\pi}{2\omega}$ is given by:

A $-\omega(R_1 + R_2)\hat{i}$

B $\omega(R_1 + R_2)\hat{i}$

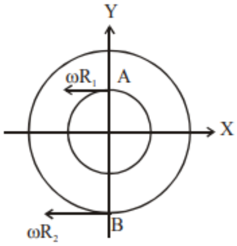
C $\omega(R_1 - R_2)\hat{i}$

[✓ **D**] $\omega(R_2 - R_1)\hat{i}$

Solution

$\theta = \omega t = \omega \frac{\pi}{2\omega} = \frac{\pi}{2}.$

$\vec{V}_A - \vec{V}S = \omega R_1(-\hat{i}) - \omega R_2(-\hat{i})$



#1331764

A plano-convex lens (focal length f_2, refractive index μ_2, radius of curvature R) fits exactly into a plano-concave lens (focal length f_1, refractive index μ_1, radius of curvature R). Their plane surfaces are parallel to each other. Then, the focal length of the combination will be :

A $f_1 - f_2$

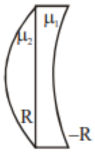
B $f_1 + f_2$

$\boxed{\textbf{C}}$ $\frac{R}{\mu_2 - \mu_1}$

D $\frac{2f_1f_2}{f_1 + f_2}$

Solution

$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1-\mu_1}{R} + \frac{\mu_2 - 1}{R}$



#1331921

Let ℓ, r, c and v represent inductance, resistance, capacitance and voltage, respectively. The dimension of $\frac{\ell}{rcv}$ is SI units will be:

A $[LTA]$

B $[LA^{-2}]$

$\boxed{\textbf{C}}$ $[A^{-1}]$

D $[LT^2]$

Solution

$\left[\frac{\ell}{r}\right] = T$

$[CV] = AT$

So, $\left[\frac{\ell}{rCV}\right] = \frac{T}{AT} = A^{-1}$

#1331967

In a radioactive decay chain, the initial nucleus is $^{232}_{90}Th$. At the end there are $6\alpha -$ particles and $4\beta -$ particles which are emitted. If the end nucleus, If $^{A}_{Z}X$, A and Z are given by:

A $A = 208; Z = 80$

B $A = 202; Z = 80$

C $A = 200; Z = 81$

$\boxed{D}$ $A = 208; Z = 82$

Solution

${}^{232}_{90}Th \rightarrow {}^{208}_{78}Y + {}^{4}_{2}He$

${}^{208}_{78}Y \rightarrow {}^{208}_{82}X + 4\beta$ particle

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#1332056

The mean intensity of radiation on the surface of the Sun is about $10^8\ W/m^2$. The rms value of the corresponding magnetic field is closest to:

A $10^2 T$

$\boxed{B}$ $10^{-4} T$

C $1T$

D $10^{-2} T$

Solution

$I = \varepsilon_0 C E^2_{rms} \& E_{rms} = cB_{rms}$

$I = \varepsilon_0 C^3 B^2_{rms}$

$$B_{rms} = \sqrt{\frac{1}{\epsilon_0 C^3}}$$

$B_{rms} \simeq 10^{-4}$

#1332071

A resonance tube is old and has jagged end. It is still used in the laboratory to determine velocity of sound in air. A tuning fork of frequency $512\ Hz$ produces first resonance when the tube is filled with water to a mark $11\ cm$ below a reference mark, near the open end of the tube. The experiment is repeated with another fork of frequency $256\ Hz$ which produces first resonance when water reaches a mark $27\ cm$ below the reference mark. The velocity of sound in air, obtained in the experiment, is close to:

$\boxed{A}$ $328\ ms^{-1}$

B $322\ ms^{-1}$

C $341\ ms^{-1}$

D $335\ ms^{-1}$

Solution

$\frac{\lambda_1}{4} = 11cm$ so, $\frac{v}{512 \times 4} = 11cm$____(1)

$\frac{\lambda_2}{4} = 27cm$ so, $\frac{v}{256 \times 4} = 27cm$____(2

(2) - (1)

$\frac{v}{256 \times 4} \times 0.5 = 0.16$

$v = 0.16 \times 2 \times 4 \times 256$

$v = 328m/s$

#1332082

An ideal gas is enclosed in a cylinder at pressure of $2\ atm$ and temperature, $300\ K$. The mean time between two successive collisions is $6 \times 10^{-8}\ s$. If the pressure is doubled and temperature is increased to $500\ K$, the mean time between two successive collisions will be close to:

[✓ A] $4 \times 10^{-8}\ s$

B $3 \times 10^{-6}\ s$

C $2 \times 10^{-7}\ s$

D $0.5 \times 10^{-8}\ s$

Solution

$t\alpha\frac{Volume}{Velocity}$

Volume $\alpha\frac{T}{P}$

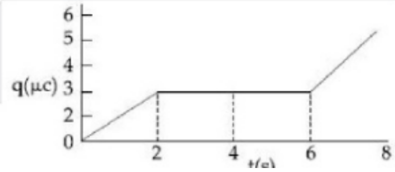
$\therefore\ t\alpha\frac{\sqrt{T}}{P}$

$$\frac{t_1}{6 \times 10^{-8}} = \frac{\sqrt{500}}{2P} \times \frac{P}{\sqrt{300}}$$

$t_1 = 3.8 \times 10^{-8}$

$\simeq 4 \times 10^{-8}$

#1332120



The charge on a capacitor plate in a circuit, as a function of time, is shown in the figure:

What is the value of current at $t = 4s$?

A $3\mu A$

B $2\mu A$

[✓ C] Zero

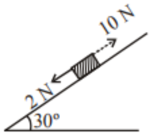
D $1.5\mu A$

Solution

Since $\frac{dq}{dt}|_{t=4s} = 0$

$\therefore\ current = 0$

#1332128



A block kept on a rough inclined plane, as shown in the figure, remains at rest upto a maximum force $2\ N$ down the inclined plane. The maximum external force up the inclined plane that does not move the block is $10\ N$. The coefficient of static friction between the block and the plane is : [Take $g = 10\ m/s^2$]

A $\frac{2}{3}$

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

C $\frac{\sqrt{3}}{4}$

D $\frac{1}{4}$

Solution

$2 + mg\sin 30 = \mu mg\cos 30^o$

$10 = mg\sin 30 + \mu mg\cos 30^o$

$= 2\mu mg\cos 30 - 2$

$6 = \mu mg\cos 30$

$4 = mg\sin 30$

$\frac{3}{2} = \mu \times \sqrt{3}$

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

#1332221

An alpha-particle of mass m suffers 1-dimensional elastic coolision with a nucleus at rest of unknown mass. It is scattered directly backwards losing, 64% of its intial kinetic energy. The mass of the nucleus is:-

A $4\,m$

B $3.5\,m$

C $2\,m$

D $1.5\,m$

Solution

$mv_0 = mv_2 - mv_1$

$\frac{1}{2}mV_1^2 = 0.36 \times \frac{1}{2}mV_0^2$

$v_1 = 0.6\,v_0$

$\frac{1}{2}MV_2^2 = 0.64 \times \frac{1}{2}mV_0^2$

$V_2 = \sqrt{\frac{m}{M}} \times 0.8\,V_0$

$mV_0 = \sqrt{mM} \times 0.8\,V_0 - m \times 0.6\,V_0$

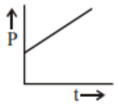
$\implies 1.6\,m = 0.8\sqrt{mM}$

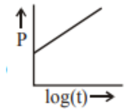
$4m^2 = mM$

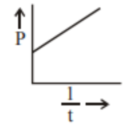
#1332252

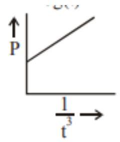
A soap bubble, blow by a mechanical pump at the mough of a tube, increases in volume, with time, at a constant rate. The graph that correctly depicts the time dependence of pressure inside the bubble is given by :-

A



B 

C 

[✓ D] 

Solution

$V = ct$

$4/3\pi r^3 = ct$

$r = kt^{1/3}$

$P = P_o + \frac{4T}{kt^{1/3}}$

$P = P_o + c\frac{1}{t^{1/3}}$

#1332264

To double the covering range of TV transmittion tower, its height shoould be multiplied by:-

A $\frac{1}{\sqrt{2}}$

[✓ B] 4

C $\sqrt{2}$

D 2

Solution

Range $= \sqrt{2hR}$

To double the range h have to be made 4 times

#1332270

A parallel plate capacitor with plates of area $1 m^2$ each, area t a separation of $0.1\ m$. If the electric field between the plates is $100\ N/C$, the magnitude of charge each plate is:-

$(Take\, \varepsilon_0 = 8.85 \times 10^{-12} \frac{c^2}{N-m^2})$

A $7.85 \times 10^{-10} C$

B $6.85 \times 10^{-10} C$

C $9.85 \times 10^{-10} C$

[✓ D] $8.85 \times 10^{-10} C$

Solution

$E = \frac{\sigma}{\epsilon_0} = \frac{Q}{A\ \epsilon_0}$

$Q = AE\ \epsilon_0$

$Q = (1)(100)(8.85 \times 10^{-12})$

$Q = 8.85 \times 10^{-19}\ C$

#1332328

In a Frank-Hertz experiments, an electron of energy $5.6\ eV$ passes through mercury vapour and emerges with an energy $0.7\ eV$. The minimum wavelength of photons emitted by mercury atoms is close to:-

A 2020 nm

B 220 nm

[✓ C] 250 nm

D 1700 nm

Solution

Energy retained by mercury vapour $= 5.6ev - 0.7ev = 4.9ev$

$\frac{12400}{4.9} = 2500A$

#1331238

Iodine reacts with concentrated HNO_3 to yield Y along with other products. The oxidation state of iodine in Y is:

$\boxed{\text{A}}$ 5

B 3

C 1

D 7

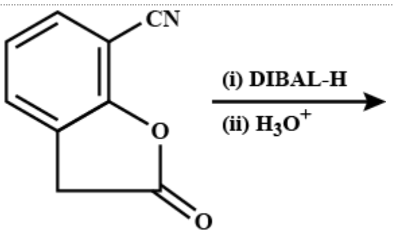
Solution

$I_2 + 10NHO_3 \rightarrow 2HIO_3 + 10NO_2 + 4H_2O$

Here the product Y is HIO_3.

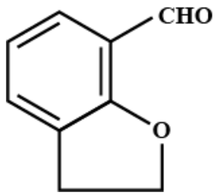
In HIO_3 oxidation state of iodine is $+5$.

#1331255

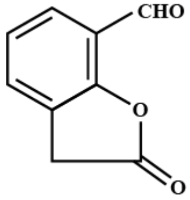


The major product of the following reaction is:

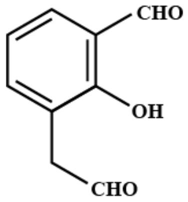
A



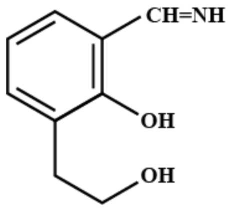
B



$\boxed{\text{C}}$

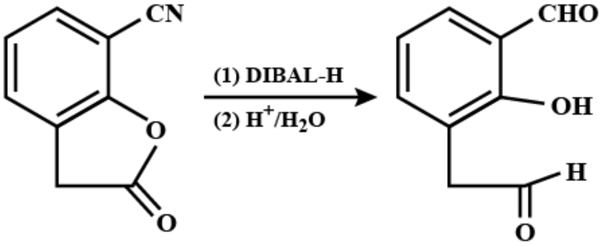


D



Solution

DIBAL-H will reduce cyanides and esters to aldehydes.



#1331317

In a chemical reaction, $A+2B \overset{K}{\rightleftharpoons} 2C+D$, the initial concentration of B was 1.5 times of the concentration of A, but the equilibrium concentrations of A and B were found to be equal. The equilibrium constant (K) for the aforesaid chemical reaction is:

A 16

[✓ B] 4

C 1

D $\frac{1}{4}$

Solution

$$\underset{\substack{t=0\ a_0\\ t=t_{eq}\ a_0-x}}{A} + \underset{\substack{1.5a_0\\ 1.5a_0-2x}}{2B} \rightleftharpoons \underset{\substack{0\\ 2x}}{2C} + \underset{\substack{0\\ x}}{D}$$

At equilibrium $[A]=[B]$

$$\underset{t=t_{eq}}{a_0-x} = \underset{0.5a_0}{1.5a_0} - \underset{0.5a_0}{2x} \Rightarrow \underset{a_0}{x} = \underset{0.5a_0}{0.5a_0}$$

$$K_C = \frac{[C]^2[D]}{[A][B]^2} = \frac{(a_0)^2(0.5a_0)}{(0.5a_0)(0.5a_0)^2} = 4.$$

#1331365

Two solids dissociated as follows

$A(s) \rightleftharpoons B(g)+C(g); K_{p_1} = x\ atm^2$

$D(s) \rightleftharpoons C(g)+E(g); K_{p_2} = y\ atm^2$

The total pressure when both the solids dissociate simultaneously is:

A $x^2+y^2 atm$

B $x^2-y^2 atm$

[✓ C] $2(\sqrt{x+y})atm$

D $\sqrt{x+y}atm$

Solution

$A(s) \rightleftharpoons \underset{P_1}{B(g)} + \underset{P_1}{C(g)}\ K_{P_1} = \underset{x=P_1(P_1+P_2)}{x = P_B \cdot P_C} \ldots\ldots(1)$

$D(s) \rightleftharpoons \underset{P_2}{C(g)} + \underset{P_2}{E(g)}\ K_{P_2} = \underset{y=(P_1+P_2)(P_2)}{y = P_C \cdot P_E} \ldots\ldots(2)$

Adding (1) and (2)

$x+y=(P_1+P_2)^2$

Now total pressure

$P_T = P_C + P_B + P_E$

$= (P_1+P_2)+P_1+P_2 = 2(P_1+P_2)$

$P_T = 2(\sqrt{x+y})$.

#1331383

Freezing point of a 4% aqueous solution of X is equal to freezing point of 12% aqueous solution of Y. If molecular weight of X is A, then molecular weight of Y is:

A A

[✓ B] $3A$

C $4A$

D $2A$

Solution

For same freezing point, molality of both solution should be same.

$$m_x = m_y$$
$$\frac{4 \times 1000}{96 \times M_x} = \frac{12 \times 1000}{88 \times M_y}$$
or, $M_y = \dfrac{96 \times 12}{4 \times 88} M_x = 3.27\ A$

Closest option is $3A$.

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or, $M_y = \dfrac{96 \times 12}{4 \times 88} M_x = 3.27\ A$

Closest option is $3A$.

#1331403

Poly-β-hydroxybutyrate - co-β-hydroxyvalerate(PHBV) is a copolymer of __________.

A 3-hydroxybutanoic acid and 4-hydroxypentanoic acid

B 2-hydroxybutanoic acid and 3-hydroxypentanoic acid

C 3-hydroxybutanoic acid and 2-hydroxypentanoic acid

[✓ D] 3-hydroxybutanoic acid and 3-hydroxypentanoic acid

Solution

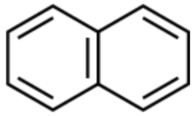
$PHBV$ is a polymer of $3-hydroxy\ butanoic$ acid and $3-Hydroxy\ pentanoic$ acid.

$PHBV$ is a polymer of $3-hydroxybutanoic$ acid and $3-Hydroxypentanoic$ acid.

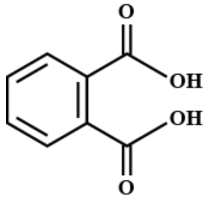
#1331411

Among the following four aromatic compounds, which one will have the lowest melting point?

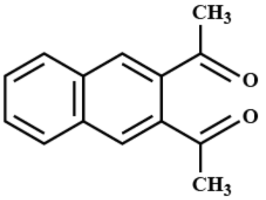
[✓ A]



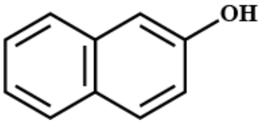
B



C



D

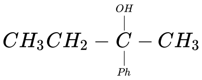


Solution

M.P. of Napthalene $\simeq 80^{\circ}C$.

All other compounds have higher molecular weight than Naphthalene and thus have a higher melting point.

#1331443



$CH_3CH_2-\overset{OH}{\underset{Ph}{C}}-CH_3$ cannot be prepared by:

[✓ A] $HCHO+PhCH(CH_3)CH_2MgX$

B $PhCOCH_2CH_3+CH_3MgX$

C $PhCOCH_3+CH_3CH_2MgX$

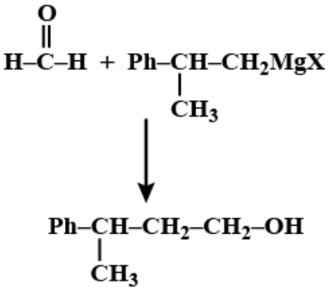
D $CH_3CH_2COCH_3+PhMgX$

Solution

Formaldehyde on reaction with Grignard's reagent always forms primary alcohol.

The required product is tertiary alcohol.

Thus formaldehyde cannot be used to prepare it.



#1331460

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:

[✓ A] $2P_A=3P_B$

B $P_A=3P_B$

C $P_A=2P_B$

D $3P_A=2P_B$

Solution

$V_A = 2V_B$

$Z_A = 3Z_B$

$$\frac{P_A V_A}{n_A RT_A} = \frac{3.P_B.V_B}{n_B.RT_B}$$

$2P_A = 3P_B.$

$V_A = 2V_B$

$Z_A = 3Z_B$

$$\frac{P_A V_A}{n_A RT_A} = \frac{3.P_B.V_B}{n_B.RT_B}$$

$2P_A = 3P_B.$

#1331471

The element with $Z = 120$ (not yet discovered) will be an/ a:

A transition metal

B inner-transition metal

[✓ **C**] alkaline earth metal

D alkali metal

Solution

$Z = 120$

Its general electronic configuration may be represented as $[Noble\ gas]ns^2$, like other alkaline earth metals.

Thus the given element will be an alkaline earth metal.

#1331490

Decomposition of X exhibits a rate constant of $0.05\mu g/year$. How many years are required for the decomposition of $5\mu g$ of X into $2.5\mu g$?

[✓ **A**] 50

B 25

C 20

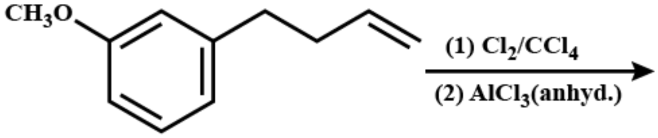
D 40

Solution

Rate constant $(K) = 0.05\mu g/year$ means zero order reaction

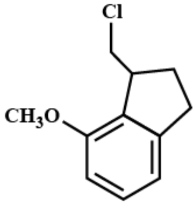
$$t_{1/2} = \frac{a_0}{2K} = \frac{5\mu g}{2 \times 0.05\mu g/year} = 50\ year.$$

#1331518

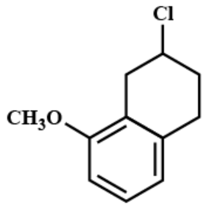


The major product of the following reaction is:

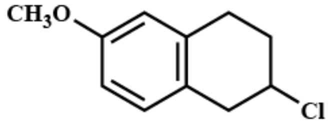
A



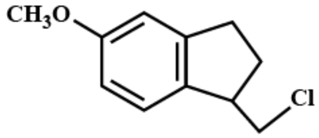
B



C



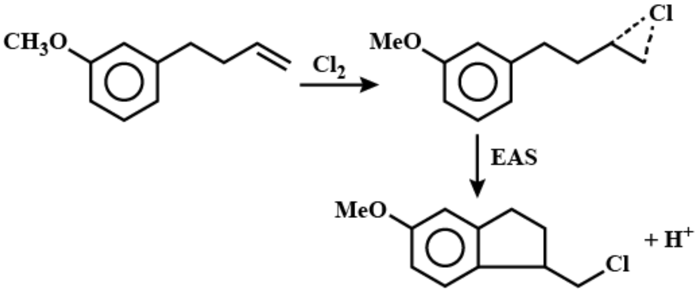
D



Solution

In the given reaction first, the chlorination of the compound takes place across double bond.

Once the chlorination is completed, the electrophilic aromatic substitution reaction takes place in presence of anhy. $AlCl_3$ to give the product.



#1331546

Given

Gas	H_2	CH_3	CO_2	SO_2
Critical	33	190	304	630

Temperature/ K

On the basis of data given above, predict which of the following gases shows least adsorption on a definite amount of charcoal?

A H_2

B CH_4

C SO_2

D CO_2

Solution

Smaller the value of a critical temperature of a gas, lesser is the extent of adsorption.

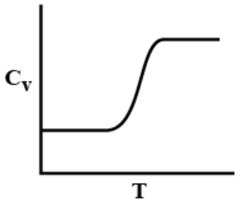
Here the critical temperature of the H_2 gas is lowest.

So least adsorbed gas is H_2.

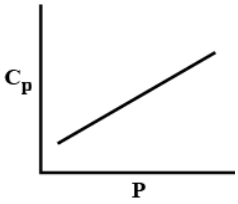
#1331563

For diatomic ideal gas in a closed system, which of the following plots does not correctly describe the relation between various thermodynamic quantities?

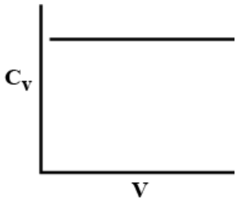
A



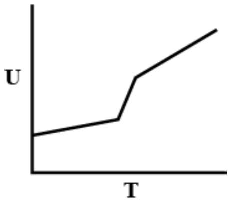
B



C



D



Solution

At higher temperature, rotational degree of freedom becomes active.

$C_P = \frac{7}{2}R$(Independent of P)

$C_V = \frac{5}{2}R$(Independent of V)

Variation of U vs T is similar as C_V vs T.

#1331586

The standard electrode potential $E^{\ominus}$ and its temperature coefficient $\left(\frac{dE^{\ominus}}{dT}\right)$ for a cell are $2V$ and $-5 \times 10^{-4} VK^{-1}$ at $300\ K$ respectively. The cell reaction is

$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq + Cu(s)$

The standard reaction enthalpy $(\triangle_r H^{\ominus})$ at $300\ K$ in $kJ\ mol^{-1}$ is:

$[Use\ R = 8jK^{-1}mol^{-1}$ and $F = 96,000\ Cmol^{-1}]$

A -412.8

B -384.0

C 206.4

D 192.0

Solution

We have,

$\Delta G = \Delta H - \Delta S$---------(1)

Also,

$\Delta G = -nFE_{cell} = -2 \times 96500 \times 2 = -4 \times 96500$

Now, $\Delta S = nF\frac{dE}{dT} = 2 \times 96500 \times (-5 \times 10^{-4}) = 96.5J$

Now from equation (1)

$\Delta H = \Delta G + T\Delta S = -4 \times 96500 + 298 \times (-96.5) \approx -412.8$

#1331592

The molecule that has minimum/no role in the formation of photochemical smog is:

A $CH_2 = O$

[✓ **B**] N_2

C O_3

D NO

Solution

Chiefly NO_2, O_3 and hydrocarbon is responsible for the build-up smog.

Apart from these other compounds which are responsible for photochemical smog is $HCHO, O_3$, and NO.

#1331596

In the Hall-Heroult process, aluminium is formed at the cathode. The cathode is made out of:

A platinum

[✓ **B**] carbon

C pure aluminium

D copper

Solution

Hall-Heroult process is used for smelting of aluminium.

In the Hall-Heroult process the cathode is made of carbon. Also, here anode is also made up of carbon.

#1331611

Water samples with BOD values of $4ppm$ and $18ppm$, respectively, are:

A highly polluted and clean

B highly polluted and highly polluted

[✓ **C**] clean and highly polluted

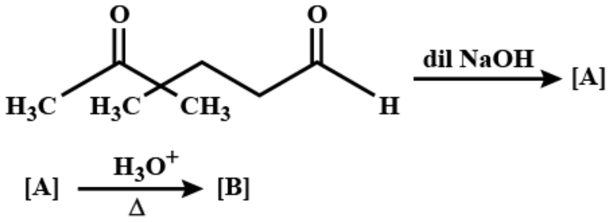
D clean and clean

Solution

Clean water would have BOD value of lass than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

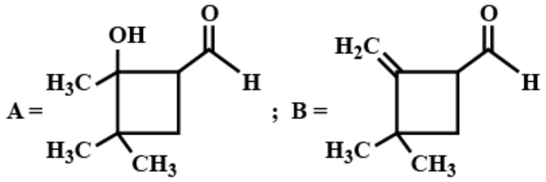
Clean water would have BOD value of lass than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

#1331621

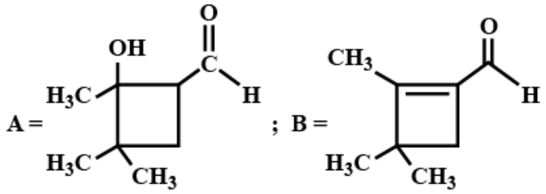


In the following reactions, products A and B are:

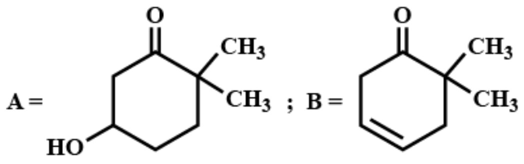
A



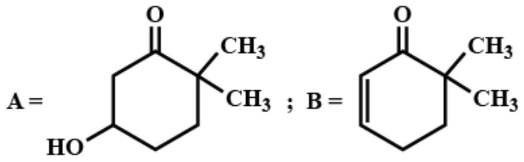
B



C

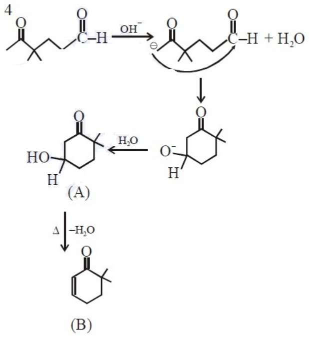


[✓ D]



Solution

In the given reaction, first cross aldol condensation takes place to form compound A which on hydrolysis gives the compound B.



#1331662

What is the work function of the metal if the light of wavelength $4000\overset{\circ}{A}$ generates photoelectrons of velocity $6\times10^5ms^{-1}$ form it?

(Mass of electron $= 9\times10^{-31}kg$

Velocity of light $= 3\times10^{8}ms^{-1}$

Planck's constant $= 6.626\times10^{-34}Js$

Charge of electron $= 1.6\times10^{-19}JeV^{-1}$).

A $0.9\,eV$

B $4.0\,eV$

[✓ C] $2.1\,eV$

D $3.1\,eV$

Solution

$hv = \phi + hv^{\circ}$
$\frac{1}{2}mv^2 = hc\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$
$hv = \phi + \frac{1}{2}mv^2$
$\phi = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{4000 \times 10^{-10}} - \frac{1}{2} \times 9 \times 10^{-31} \times (6 \times 10^5)^2$
$\phi = 3.35 \times 10^{-19} J = \phi \simeq 2.1\ eV.$

#1331667

Among the following compounds most basic amino acid is:

A lysine

B asparagine

C serine

$\boxed{D}$ histidine

Solution

Histidine is the most basic amino acid in the given compound. This can be attributed to the fact that the histidine contains the most number of a basic nitrogen atom.

#1331691

The metal d-orbitals that are directly facing the ligands in $K_3[Co(CN)_6]$ are:

A d_{xz}, d_{yz} and d_{z^2}

B d_{xy}, d_{xz} and d_{yz}

C d_{xy} and $d_{x^2-y^2}$

$\boxed{D}$ $d_{x^2-y^2}$ and d_{z^2}

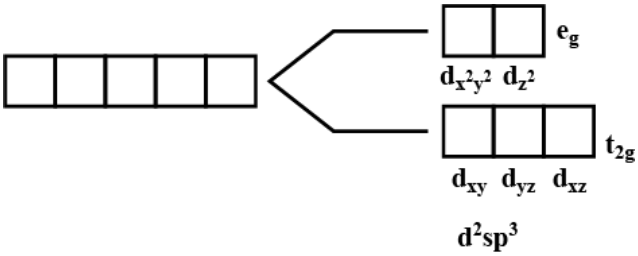
Solution

$K_3[Co(CN)_6]$

$Co^{+3} \to [Ar]_{18}3d^6$.

Here since the coordination number of Co is 6, thus it will form an octahedral complex.

Thus according to CFT, the orbitals which are in the direction of metal is $d_{x^2-y^2}$ and d_{z^2}.



#1331706

The hardness of a water sample (in terms of equivalents of $CaCO_3$) containing $10^{-3}M\ CaSO_4$ is:

(molar mass of $CaSO_4 = 136\ g\ mol^{-1}$).

$\boxed{A}$ $100\ ppm$

B $50\ ppm$

C $10\ ppm$

D $90\ ppm$

Solution

ppm of $CaCO_3$

$(10^{-3} \times 10^3) \times 100 = 100\,ppm$

#1331723

The correct order for acid strength of compounds $CH \equiv CH, CH_3 - C \equiv CH$ and $CH_2 = CH_2$ is as follows:

A $CH \equiv CH > CH_2 = CH_2 > CH_3 - C \equiv CH$

[✓ B] $HC \equiv CH > CH_3 - C \equiv CH > CH_2 = CH_2$

C $CH_3 - C \equiv CH > CH_2 = CH_2 > Hc \equiv CH$

D $CH_3 - C \equiv CH > CH \equiv CH > CH_2 = CH_2$

Solution

$CH \equiv CH > CH_3 - C \equiv CH > CH_2 = CH_2$

(Acidic strength order).

More is the s-character, more is the acidic strength.

The s-character is maximum in sp hybrid carbon atom followed by sp^2 and sp^3.

$CH \equiv CH > CH_3 - C \equiv CH > CH_2 = CH_2$

(Acidic strength order).

#1331730

$Mn_2(CO)_{10}$ is an organometallic compound due to the presence of:

A $Mn - Mn$ bond

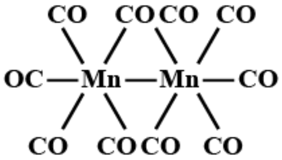
[✓ B] $Mn - C$ bond

C $Mn - O$ bond

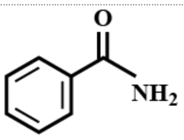
D $C - O$ bond

Solution

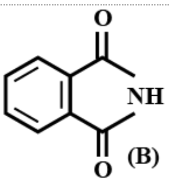
Compounds having at least one bond between carbon and metal are known as organometallic compounds.



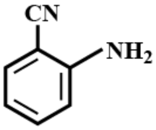
#1331744



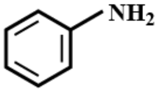
(A)



(B)



(C)



(D)

The increasing order of reactivity of the following compounds towards reaction with alkyl halides directly is:

A $(B) < (A) < (D) < (C)$

B $(B) < (A) < (C) < (D)$

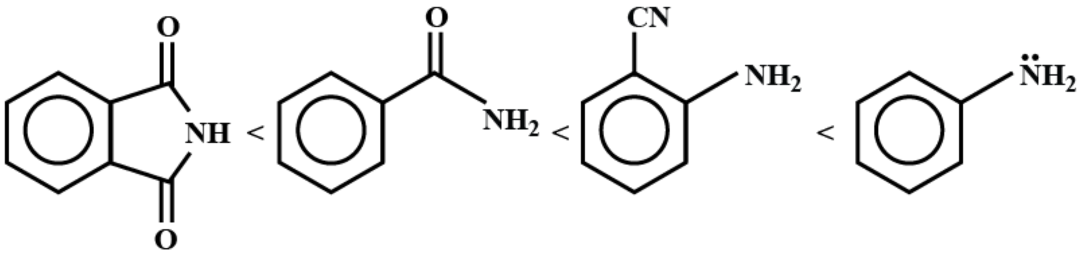
C $(A) < (C) < (D) < (B)$

D $(A) < (B) < (C) < (D)$

Solution

Nucleophiles are the compound which have excess of electron and are electron donating group.

here compound D is most nucleophile.



B A C D

#1331769

The pair of metal ions that can give a spin only magnetic moment of $3.9\ BM$ for the complex $[M(H_2O)_6]Cl_2$, is:

A Cr^{2+} and Mn^{2+}

B V^{2+} and Co^{2+}

C V^{2+} and Fe^{2+}

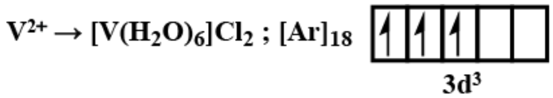
D Co^{2+} and Fe^{2+}

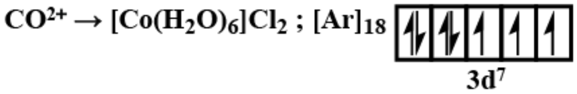
Solution

Spin only magnetic moment given as $\mu = \sqrt{n(n+1)}$

where $n =$ number of unpaired electron

3 unpaired e^-, spin only magnetic moment $= 3.89\ B.M.$





#1331801

In the following reaction

$Aldehyde + Alcohol \xrightarrow{HCl} Acetal$

Aldehyde Alcohol

$HCHO$ ^tBuOH

CH_3CHO $MeOH$

The best combinations is:

A $HCHO$ and $MeOH$

B $HCHO$ and ^tBuOH

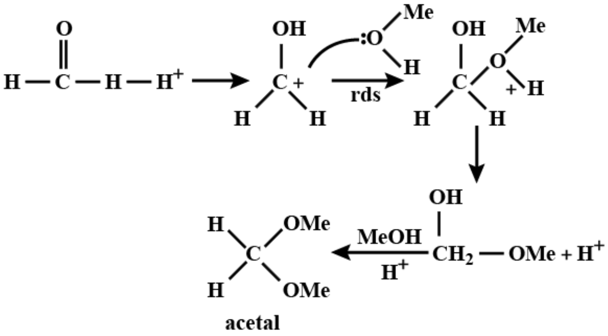
C CH_3CHO and $MeOH$

D CH_3CHO and ^tBuOH

Solution

$rate \propto \frac{1}{\text{steric crowding of aldehyde}}$

$t-butanol$ can show formation of carbocation in acidic medium.



#1331830

$50\ mL$ of $0.5\ M$ oxalic acid is needed to neutralize $25\ mL$ of soidum hydroxide solution. The amount of $NaOH$ in $50\ mL$ of the given sodium hydroxide solution is:

A $4\ g$

B $20\ g$

C $80\ g$

D $10\ g$

Solution

$H_2C_2O_4 + 2NaOH \rightarrow Na_2C_2O_4 + 2H_2O$

m_{eq} of $H_2C_2O_4 = m_{eq}NaOH$

$50 \times 0.5 \times 2 = 25 \times M_{NaOH} \times 1$

$\therefore M_{NaOH} = 2\ M$

Now $1000\ ml$ solution $= 2 \times 40\ gram\ NaOH$

$\therefore 50\ ml$ solution $= 4\ gram\ NaOH.$

#1331843

A metal on combustion in excess air forms X, X upon hydrolysis with water yields H_2O_2 and O_2 along with another product. The metal is:

A Rb

B Na

C Mg

D Li

Solution

The metal is Rb.

$Rb + O_{2(excess)} \rightarrow RbO_2$

Here product X is RbO_2.

$2RbO_2 + 2H_2O \rightarrow 2RbOH + H_2O_2 + O_2$

#1330489

For $x > 1$, if $(2x)^{2y} = 4e^{2x-2y}$, then $\left(1+\log_e 2x\right)^2\frac{dy}{dx}$ is equal to :

A $\log_e 2x$

B $\dfrac{x\log_e 2x + \log_e 2}{x}$

C $x\log_e 2x$

[✓ **D**] $\dfrac{x\log_e 2x - \log_e 2}{x}$

Solution

$(2x)^{2y} = 4e^{2x-2y}$

$2y\ell n2x = \ell n4 + 2x - 2y$

$y = \dfrac{x + \ell n2}{1 + \ell n2x}$

$y' = \dfrac{(1+\ell n2x) - (x+\ell n2)\frac{1}{x}}{(1+\ell n2x)^2}$

$y'(1+\ell n2x)^2 = \left[\dfrac{x\ell n2x - \ell n2}{x}\right]$

#1330529

The sum of the distinct real values of μ, for which the vectors, $\mu\hat{i}+\hat{j}+\hat{k}$, $\hat{i}+\mu\hat{j}+\hat{k}$, $\hat{i}+\hat{j}+\mu\hat{k}$ are co-planer, is :

A 2

B 0

[✓ **C**] -1

D 3

Solution

$$\begin{vmatrix} \mu & 1 & 1 \\ 1 & \mu & 1 \\ 1 & 1 & \mu \end{vmatrix} = 0$$

$\mu\left(\mu^2 - 1\right) - 1(\mu - 1) + 1(1 - \mu) = 0$

$\mu^3 - \mu - \mu + 1 + 1\mu = 0$

$\mu^3 - 3\mu + 2 = 0$

$\mu^3 - 1 - 3(\mu - 1) = 0$

$\mu = 1, \mu^2 + \mu - 2 = 0$

$\mu = 1, \mu = -2$

sum of distinct solutions $= -1$

#1330611

Let S be the set of all points in $(-\pi, \pi)$ at which the function, $f(x) = \min\{\sin x, \cos x\}$ is not differentiable. Then S is a subset of which of the following?

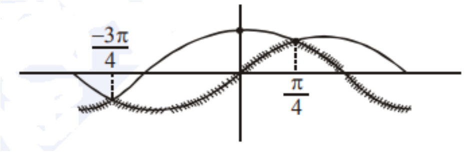
[✓ **A**] $\left\{-\dfrac{3\pi}{4}, -\dfrac{\pi}{4}, \dfrac{3\pi}{4}, \dfrac{\pi}{4}\right\}$

B $\left\{-\dfrac{3\pi}{4}, -\dfrac{\pi}{2}, \dfrac{\pi}{2}, \dfrac{3\pi}{4}\right\}$

C $\left\{-\frac{\pi}{2}, -\frac{\pi}{4}, \frac{\pi}{4}, \frac{\pi}{2}\right\}$

D $\left\{-\frac{\pi}{4}, 0, \frac{\pi}{4}\right\}$

Solution



#1330669

The product of three consecutive terms of a $G.P.$ is $512.$ If 4 is added to each of the first and the second of these terms, the three terms now from an $A.P.$ Then the sum of the original three terms of the given $G.P.$ is

A 36

B 24

C 32

[✓ D] 28

Solution

Let terms be

$\frac{a}{r}, a, ar \rightarrow G.P$

$\therefore a^3 = 512 \Rightarrow a = 8$

$\frac{8}{r} + 4, 12, 8r \rightarrow$ A. P.

$24 = \frac{8}{r} + 4 + 8r$

$r = 2, r = \frac{1}{2}$

$r = 2(4, 8, 16)$

$r = \frac{1}{2}(16, 8, 4)$

Sum = 28

#1330727

The integral $\int \cos\left(\log_e x\right) dx$ is equal to :

(where C is a constant of integration)

A $\frac{x}{2}\left[\sin\left(\log_e x\right) - \cos\left(\log_e x\right)\right] + C$

[✓ B] $\frac{x}{2}\left[\cos\left(\log_e x\right) + \sin\left(\log_e x\right)\right] + C$

C $x\left[\cos\left(\log_e x\right) + \sin\left(\log_e x\right)\right] + C$

D $x\left[\cos\left(\log_e x\right) - \sin\left(\log_c x\right)\right] + C$

Solution

$I = \int \cos(\ell nx)dx$

$I = \cos(\ln x) \cdot x + \int \sin(\ell nx)dx$

$\cos(\ell nx)x + [\sin(\ell nx) \cdot x - \int \cos(\ell nx)dx]$

$I = \frac{x}{2}[\sin(\ell nx) + \cos(\ell nx)] + C$

#1330777

Let $S_k = \frac{1+2+3+\ldots+k}{k}$. If $S_1^2 + S_2^2 + \ + S_{10}^2 = \frac{5}{12}A$ then A is equal to :

$\boxed{\text{A}}$ 303

B 283

C 156

D 301

Solution

$S_K = \frac{K+1}{2}$

$\Sigma S_k^2 = \frac{5}{12}A$

$\Sigma_{k=1}^{10}\left(\frac{K+1}{2}\right)^2 = \frac{2^2+3^2+ - - +11^2}{4} = \frac{5}{12}\text{A}$

$\frac{11 \times 12 \times 23}{6} - 1 = \frac{5}{3}\text{A}$

$505 = \frac{5}{3}\text{A}, \quad \text{A} = 303$

#1330825

Let $S = \{1, 2, 3, \ldots, 100\}$. The number of non-empty subsets A of S such that the product of elements in A is even is :-

$\boxed{\text{A}}$ $2^{50}\left(2^{50}-1\right)$

B $2^{100}-1$

C $2^{50}-1$

D $2^{50}+1$

Solution

$S = \{1, 2, 3 - \ldots - 100\}$

= Total non empty subsets-subsets with product of element is odd

$= 2^{100} - 1 - 1\left[\left(2^{50} - 1\right)\right]$

$= 2^{100} - 2^{50}$

$= 2^{50}\left(2^{50} - 1\right)$

#1330868

If the sum of the deviations of 50 observations from 30 is $50,$ then the mean of these observation is :

A 50

B 51

C 30

[✓ **D**] 31

Solution

$\Sigma_{i=1}^{50}\left(x_i - 30\right) = 50$

$\Sigma x_i - 50 \times 30 = 50$

$\Sigma x_i = 50 + 50 \times 30$

Mean $= \bar{x} = \frac{\Sigma x_i}{n} = \frac{50 \times 30 + 50}{50} = 30 + 1 = 31$

#1330908

If a variable line, $3x + 4y - \lambda = 0$ is such that the two circles $x^2 + y^2 - 2x - 2y + 1 = 0$ and $x^2 + y^2 - 18x - 2y + 78 = 0$ are on its opposite sides,then the set of all values of λ is the interval :-

[✓ **A**] [12, 21]

B (2, 17)

C (23, 31)

D [13, 23]

Solution

Centre of circles are opposite side of line

$(3 + 4 - \lambda)(27 + 4 - \lambda) < 0$

$(\lambda - 7)(\lambda - 31) < 0$

$\lambda \in (7, 31)$

distance from S_1

$\left|\frac{3 + 4 - \lambda}{5}\right| \geq 1 \Rightarrow \lambda \in (-\infty, 2] \cup [(12, \infty]$

distance from S_2

$\left|\frac{27 + 4 - \lambda}{5}\right| \geq 2 \Rightarrow \lambda \in (-\infty, 21] \cup [41, \infty)$

so $\lambda \in [12, 21]$

#1330944

A ratio of the 5^{th} term from the beginning to the 5^{th} term from the end in the binomial expansion of $\left(2^{1/3} + \frac{1}{2(3)^{1/3}}\right)^{10}$ is :

A $1 : 4(16)\frac{1}{3}$

B $1 : 2(6)\frac{1}{3}$

C $2(36)\frac{1}{3} : 1$

$\boxed{\text{D}}$ $4(36)\frac{1}{3} : 1$

Solution

$$\frac{T_5}{T_5^1} = \frac{{}^{10}C_4\left(2^{1/3}\right)^{10-4}\left(\frac{1}{2(3)^{1/3}}\right)^4}{{}^{10}C_4\left(\frac{1}{2\left(3^{1/3}\right)}\right)^{10-4}\left(2^{1/3}\right)^4} = 4.\,(36)^{1/3}$$

#1330984

let C_1 and C_2 be the centres of the circles $x^2 + y^2 - 2x - 2y - 2 = 0$ and $x^2 + y^2 - 6x - 6y + 14 = 0$ respectively. If P and Q are the points of intersection of these circles, then the area(in sq. units) of the quadrilateral PC_1QC_2 is :

A 8

B 6

C 9

$\boxed{\text{D}}$ 4

Solution

$C_1 = \left(\frac{2}{2}, \frac{2}{2}\right) = (1, 1)$

$C_2 = \left(\frac{6}{2}, \frac{6}{2}\right) = (3, 3)$

Radius $r_1 = \sqrt{1^2 + 1^2 + 2} = 2$

Similarly radius $r_2 = 2$

Here the quadrilateral is rhombus as all sides are equal

As we can see that PC_1, PC_2, QC_1, QC_2 are radii of two circles

Here $PC_1 = r_1 = 2$

And diagonals bisect at $O = \left(\frac{1+3}{2}, \frac{1+3}{2}\right) = (2, 2)$

$\Rightarrow PC_1^2 = PO^2 + OC_1^2$ (as diagonals are perpendicular in rhombus)

$\Rightarrow PO^2 = 2^2 - \sqrt{2}^2$

$\Rightarrow PO = \sqrt{2}$

$\Rightarrow PQ = d_1 = 2\sqrt{2},\ C_1C_2 = d_2 = 2\sqrt{2}$

$\Rightarrow$ Area of rhombus $= \frac{1}{2} d_1 d_2$

$\Rightarrow$ Area of rhombus $= \frac{1}{2} \times 2\sqrt{2} \times 2\sqrt{2}$

$\Rightarrow$ Area of rhombus $= 4$

#1331016

In a random experiment, a fair die is rolled until two fours are obtained in succession. The probability that the experiment will end in the fifth throw of the die is equal to :

A $\frac{150}{6^5}$

[✓ B] $\frac{175}{6^5}$

C $\frac{200}{6^5}$

D $\frac{225}{6^5}$

Solution

$$\frac{1}{6^2}\left(\frac{5^3}{6^3} + \frac{2C_1 \cdot 5^2}{6^3}\right) = \frac{175}{6^5}$$

Ans-Option B

#1331039

If the straight line, $2x - 3y + 17 = 0$ is perpendicular to the line passing through the points $(7, 17)$ and $(15, \beta)$, then β equals :-

A -5

B $-\frac{35}{3}$

C $\frac{35}{3}$

[✓ **D**] 5

Solution

Slope of given line is $\frac{2}{3}$

Lines are perpendicular so

$$\frac{17 - \beta}{-8} \times \frac{2}{3} = -1$$

$\beta = 5$

#1331075

Let f and g be continuous functions on $[0, a]$ such that $f(x) = f(a - x)$ and $g(x) + g(a - x) = 4,$ then $\int_0^a f(x)g(x)dx$ is equal to :-

A $4\int_0^a f(x)dx$

[✓ **B**] $2\int_0^a f(x)dx$

C $-3\int_0^2 f(x)dx$

D $\int_0^a f(x)dx$

Solution

$I = \int_0^a f(x)g(x)dx$

$I = \int_0^a f(a - x)g(a - x)dx$

$I = \int_0^a f(x)(4 - g(x)dx$

$I = 4\int_0^a f(x)dx - I$

$\Rightarrow I = 2\int_0^a f(x)dx$

#1331114

The maximum area (in sq. units) of a rectangle having its base on the x-axis and its other two vertices on the parabola, $y = 12 - x^2$ such that the rectangle lies inside the parabola, is :-

A $20\sqrt{2}$

B $18\sqrt{3}$

[✓ **C**] 32

D 36

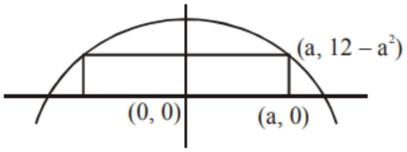
Solution

$f(a) = 2a(12 - a^2)$

$f'(a) = 2\left(12 - 3a^2\right)$

maximum at $a = 2$

maximum area $= f(2) = 32$



#1331137

The Boolean expression $((p \wedge q) \vee (p \vee \sim q)) \wedge (\sim p \wedge \sim q)$ is equivalent to :

A $p \wedge (\sim q)$

B $p \vee (\sim q)$

[✓ **C**] $(\sim p) \wedge (\sim q)$

D $p \wedge q$

Solution

By Using Truth Tables for the mentioned Boolean expression we prove that the truth table for $(\sim p) \wedge (\sim q)$ mathces.

Hence the correct answer is Option C

#1331188

$\lim_{x \to \pi/4} \frac{\cot^3 x - \tan x}{\cos(x + \pi/4)}$ is

A 4

B $8\sqrt{2}$

[✓ **C**] 8

D $4\sqrt{2}$

Solution

$$\lim_{x \to \pi/4} \frac{\cot^3 x - \tan x}{\cos\left(x + \frac{\pi}{4}\right)}$$

$$\lim_{x \to \pi/4} \frac{\left(1 - \tan^4 x\right)}{\cos(x + \pi/4)}$$

$$2 \lim_{x \to \pi/4} \frac{\left(1 - \tan^2 x\right)}{\cos(x + \pi/4)}$$

$$R \quad \lim_{x \to \pi/4} \frac{\cos^2 x - \sin^2 x}{\frac{\cos x - \sin x}{\sqrt{2}}} \frac{1}{\cos^2 x}$$

$$4\sqrt{2} \lim_{x \to \pi/4}(\cos x + \sin x) = 8$$

#1331228

Considering only the principal values of inverse functions, the set

$A = \left\{x \geq 0 : \tan^{-1}(2x) + \tan^{-1}(3x) = \frac{\pi}{4}\right\}$

A is an empty set

B Contains more than two elements

C Contains two elements

$\boxed{\text{D}}$ is a singleton

Solution

$\tan^{-1}(2x) + \tan^{-1}(3x) = \pi/4$

$\Rightarrow \frac{5x}{1 - 6x^2} = 1$

$\Rightarrow 6x^2 + 5x - 1 = 0$

$x = -1$ or $x = \frac{1}{6}$

$x = \frac{1}{6} \quad \because x > 0$

#1331264

An ordered pair (α, β) for which the system of linear equations

$(1 + \alpha)x + \beta y + z = 2$

$\alpha x + (1 + \beta)y + z = 3$

$\alpha x + \beta y + 2z = 2$ has a unique solution is

A $(1, -3)$

B $(-3, 1)$

$\boxed{\text{C}}$ $(2, 4)$

D $(-4, 2)$

Solution

For unique solution

$$\Delta \neq 0 \Rightarrow \begin{vmatrix} 1+\alpha & \beta & 1 \\ \alpha & 1+\beta & 1 \\ \alpha & \beta & 2 \end{vmatrix} \neq 0$$

$$\begin{vmatrix} 1 & -1 & 0 \\ 0 & 1 & -1 \\ \alpha & \beta & 2 \end{vmatrix} \neq 0 \Rightarrow \alpha + \beta \neq -2$$

#1331308

The area (in sq. units) of the region bounded by the parabola, $y = x^2 + 2$ and the lines, $y = x + 1, x = 0$ and $x = 3,$ is :

A $\frac{15}{4}$

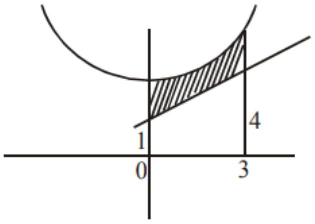
[✓ **B**] $\frac{15}{2}$

C $\frac{21}{2}$

D $\frac{17}{4}$

Solution

Req. area $= \int_0^3 \left(x^2 + 2\right) dx - \frac{1}{2} \cdot 5.3 = 9 + 6 - \frac{15}{2} = \frac{15}{2}$



#1331342

If λ be the ratio of the roots of the quadratic equation in $x, 3m^2x^2 + m(m-4)x + 2 = 0,$ then the least value of m for which $\lambda + \frac{1}{\lambda} = 1,$ is :

A $2 - \sqrt{3}$

[✓ **B**] $4 - 3\sqrt{2}$

C $-2 + \sqrt{2}$

D $4 - 2\sqrt{3}$

Solution

$3m^2x^2 + m(m-4)x + 2 = 0$

$\lambda + \frac{1}{\lambda} = 1, \frac{\alpha}{\beta} + \frac{\beta}{\alpha} = 1, \alpha^2 + \beta^2 = \alpha\beta$

$(\alpha + \beta)^2 = 3\alpha\beta$

$\left(-\frac{m(m-4)}{3m^2}\right)^2 = \frac{3(2)}{3m^2}, \frac{(m-4)^2}{9m^2} = \frac{6}{3m^2}$

$(m-4)^2 = 18, m = 4 \pm \sqrt{18}, 4 \pm 3\sqrt{2}$

#1331373

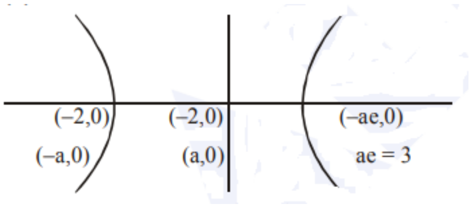
If the vertices of a hyperbola be at $(-2, 0)$ and $(2, 0)$ and one of its foci be at $(-3, 0),$ then which one of the following points does not lie on this hyperbola ?

- **A** $(4, \sqrt{15})$
- **B** $(-6, 2\sqrt{10})$
- [✓ **C**] $(6, 5\sqrt{2})$
- **D** $(2, 5\sqrt{2})$

Solution

$ae = 3, e = \frac{3}{2}, b^2 = 4\left(\frac{9}{4} - 1\right), b^2 = 5$

$\frac{x^2}{4} - \frac{y^2}{5} = 1$



#1331398

If $\frac{z-\alpha}{z+\alpha}(\alpha \in R)$ is a purely imaginary number and $|z| = 2,$ then a value of α is :

- **A** 1
- [✓ **B**] 2
- **C** $\sqrt{2}$
- **D** $\frac{1}{2}$

Solution

$\frac{z-\alpha}{z+\alpha} + \frac{\bar{z}-\alpha}{\bar{z}+\alpha} = 0$

$z\bar{z} + z\alpha - \alpha\bar{z} - \alpha^2 + z\bar{z} - z\alpha + \bar{z}\alpha - \alpha^2 = 0$

$|z|^2 = \alpha^2, \quad \alpha = \pm 2$

#1331447

Let $P(4, -4)$ and $Q(9, 6)$ be two points on the parabola, $y^2 = 4x$ and let X be any point on the arc POQ of this parabola, where O is the vertex of this parabola, such that the area of ΔPXQ is maximum. Then this maximum area (in sq.units) is :

A $\frac{125}{4}$

B $\frac{125}{2}$

C $\frac{625}{4}$

D $\frac{75}{2}$

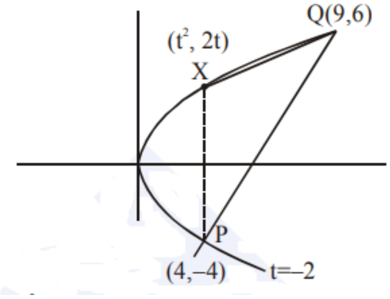
Solution

$y^2 = 4x$

$2yy' = 4$

$y' = \frac{1}{t} = 2, t = \frac{1}{2}$

$$\text{Area } = \frac{1}{2}\begin{vmatrix} \frac{1}{4} & 1 & 1 \\ 9 & 6 & 1 \\ 4 & -4 & 1 \end{vmatrix} = \frac{125}{4}$$



#1331478

The perpendicular distance from the origin to the plane containing the two lines,

$\frac{x+2}{3} = \frac{y-2}{5} = \frac{z+5}{7}$ and $\frac{x-1}{1} = \frac{y-4}{4} = \frac{z+4}{7}$ is :

A $\frac{11}{\sqrt{6}}$

B $6\sqrt{11}$

C 11

D $11\sqrt{6}$

Solution

$$\begin{array}{ccc} i & j & k \\ \hline \end{array}$$

$$\begin{vmatrix} 3 & 5 & 7 \\ 1 & 4 & 7 \end{vmatrix}$$

$\hat{i}(35 - 28) - \hat{j}(21.7) + \hat{k}(12 - 5)$

$7\hat{i} - 14\hat{j} + 7\hat{k}$

$\hat{i} - 2\hat{j} + \hat{k}$

$1(x + 2) - 2(y - 2) + 1(z + 15) = 0$

$x - 2y + z + 11 = 0$

$$\frac{11}{\sqrt{4 + 1 + 1}} = \frac{11}{\sqrt{6}}$$

#1331502

The maximum value of $3\cos\theta + 5\sin\left(\theta - \frac{\pi}{6}\right)$ for any real value of θ is :

$\boxed{\text{A}}$ $\sqrt{19}$

B $\frac{\sqrt{79}}{2}$

C $\sqrt{31}$

D $\sqrt{34}$

Solution

$$y = 3\cos\theta + 5\left(\sin\theta\frac{\sqrt{3}}{2} - \cos\theta\frac{1}{2}\right)$$

$$\frac{5\sqrt{3}}{2}\sin\theta + \frac{1}{2}\cos\theta$$

$$y_{\max} = \sqrt{\frac{75}{4} + \frac{1}{4}} = \sqrt{19}$$

#1331535

A tetrahedron has vertices $P(1, 2, 1), Q(2, 1, 3), R(-1, 1, 2)$ and $O(0, 0, 0)$. The angle between the faces OPQ and PQR is :

A $\cos^{-1}\left(\frac{9}{35}\right)$

$\boxed{\text{B}}$ $\cos^{-1}\left(\frac{19}{35}\right)$

C $\cos^{-1}\left(\frac{17}{31}\right)$

D $\cos^{-1}\left(\frac{7}{31}\right)$

Solution

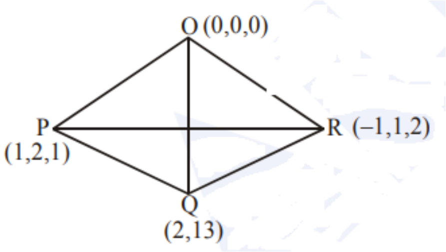
$\overrightarrow{OP} \times \overrightarrow{OQ} = (\hat{i} + 2\hat{j} + \hat{k}) \times (2\hat{i} + \hat{j} + 3\hat{k})$

$5\hat{i} - \hat{j} - 3\hat{k}$

$\overrightarrow{PQ} \times \overrightarrow{PR} = (\hat{i} - \hat{j} + 2\hat{k}) \times (-2\hat{i} - \hat{j} + \hat{k})$

$\hat{i} - 5\hat{j} - 3\hat{k}$

$$\cos\theta = \frac{5 + 5 + 9}{(\sqrt{25 + 9 + 1})^2} = \frac{19}{35}$$



#1331584

Let $y = y(x)$ be the solution of the differential equation, $x\frac{dy}{dx} + y = x\log_e x, (x > 1)$. If $2y(2) = \log_e 4 - 1$, then $y(e)$ is equal to :-

A $\frac{e^2}{4}$

$\boxed{\text{B}}$ $\frac{e}{4}$

C $-\frac{e}{2}$

D $-\frac{e^2}{2}$

Solution

$\frac{dy}{dx} = \frac{y}{x} = \ell nx$

$e^{\int \frac{1}{x} dx} = x$

$xy = \int x\ell nx + C$

$\ell n \times \frac{x^2}{2} - \int \frac{1}{x} \cdot \frac{x^2}{2}$

$xy = \frac{x}{2}\ell nx - \frac{x^2}{4} + C$, for $2y(2) = 2\ell n2 - 1$

$\Rightarrow C = 0$

$y = \frac{x}{2}\ell nx - \frac{x}{4}$

$y(e) = \frac{e}{4}$

#1331632

Let $P = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ 9 & 3 & 1 \end{bmatrix}$ and $Q = \left[q_{ij}\right]$ be two 3×3 matrices such that $Q - P^5 = I_3$. Then $\frac{q_{21} + q_{31}}{q_{32}}$ is equal to:

A 15

B 9

C 135

$\boxed{\text{D}}$ 10

Solution

$$P = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ 9 & 3 & 1 \end{bmatrix}$$

$$P^2 = \begin{bmatrix} 1 & 0 & 0 \\ 3+3 & 1 & 0 \\ 9+9+9 & 3+3 & 1 \end{bmatrix}$$

$$P^n = \begin{bmatrix} 1 & 0 & 0 \\ 3n & 1 & 0 \\ \frac{n(n+1)}{2}3^2 & 3n & 1 \end{bmatrix}$$

$$P^5 = \begin{bmatrix} 1 & 0 & 0 \\ 5.3 & 1 & 0 \\ 15.9 & 5.3 & 1 \end{bmatrix}$$

$Q = P^5 + I_3$

$$Q = \begin{bmatrix} 2 & 0 & 0 \\ 15 & 2 & 0 \\ 135 & 15 & 2 \end{bmatrix}$$

$$\frac{q_{21} + q_{31}}{q_{32}} = \frac{15 + 135}{15} = 10$$

#1331677

Consider three boxes, each containing 10 balls labelled $1, 2, \ldots, 10.$ Suppose one ball is randomly drawn from each of the boxes.Denote by $n_i,$ the label of the ball drawn from the i^{th} box, $(i = 1, 2, 3).$ Then, the number of ways in which the balls can be chosen such that $n_1 < n_2 < n_3$ is :

A 82

B 240

C 164

$\boxed{\text{D}}$ 120

Solution

No. of ways $= 10C_3 = 120$