JEE-Main-31-01-2023 (Morning shift)
[MORNING SHIFT]

Physics

Question: A ball is projected with velocity is at an angle θ with horizontal. At highest point the velocity is $\frac{\sqrt{3}}{2}u$. The time of flight is

Options:

(a) $\frac{u}{g}$

(b) $\frac{2u}{g}$

(c) $\frac{u}{2g}$

(d) $\frac{u}{4g}$

Answer: (a)

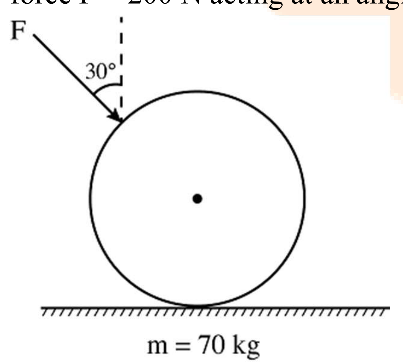
Solution: At top point $v = u\cos\theta$

$$\frac{\sqrt{3}}{2}u = u\cos\theta$$

$$\Rightarrow \theta = 30^\circ$$

$$T = \frac{2u\sin\theta}{g} = \frac{u}{g}$$

Question: Find the normal force exerted by the ground on the sphere, which has an external force F = 200 N acting at an angle of 30 with vertical. Take $g = 10 m/s^2$.



Options:

(a) 700 N

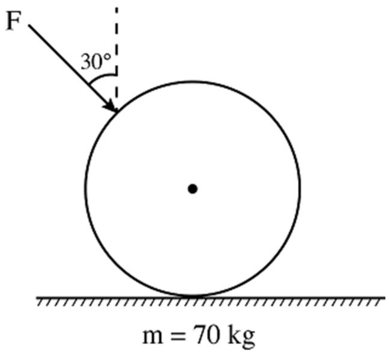
(b) 750 N

(c) 873 N

(d) 900 N

Answer: (c)

Solution:



$$N = mg + f\cos\theta$$

$$= 700 + 200\left(\frac{\sqrt{3}}{2}\right) = 873N$$

Question: On going down into the surface of earth by depth d towards the center, the value of gravity become 3 times the value of g at a distance of 3h from earth's surface. Find the value of d. (Radius of earth = 5400 km)

Options:

(a) $\frac{R}{3}$

(b) $\frac{3R}{16}$

(c) $\frac{13R}{16}$

(d) $\frac{15R}{16}$

Answer: (c)

Solution: Gravity at a depth $d = g\left(1 - \frac{d}{R}\right)$

Gravity at a height $(3R) = g.\frac{R^2}{(R+3R)^2}$

Given $\Rightarrow g\left(1-\frac{d}{R}\right) = 3\left[g\frac{R}{16R}\right]$

$$1-\frac{d}{R} = \frac{3}{16} \Rightarrow \frac{d}{R} = \frac{13}{16} \Rightarrow d = \frac{13R}{16}$$

Question: Speed of light in a medium is 0.2 times the speed of light in vacuum. What is the refractive index of the medium?

Options:

(a) 2

(b) 3

(c) 4
(d) 5
Answer: (d)
Solution:

$$\mu = \frac{c}{v} = \frac{v}{0.2v} = 5$$

Question: 1000 water drops of radii 1 mm each combine to form a large drop. If surface tension of water is 0.07 N/m. Then the change in surface energy is -
Options:
(a) $792 \times 10^{-6} J$
(b) $852 \times 10^{-6} J$
(c) $932 \times 10^{-6} J$
(d) $972 \times 10^{-6} J$
Answer: (a)

Solution: Radius of large drop $= (r)(1000)^{\frac{1}{3}} = 10r$

$= 10mm = 10 \times 10^{-3} m$
Area of large drop $= 4\pi\left(10 \times 10^{2}\right)$

$= 4\pi\left(10^{-4}\right)$

Area of 1000 small drops $= 1000(4\pi)\left(10^{-3}\right)^{2} = 4\pi \times 10^{-3} m^{2}$

$= T(\Delta A) = 0.07\left(4\pi \times 10^{-3} - 4\pi \times 10^{-4}\right)$

$= 0.07 \times 4\pi \times \left(9 \times 10^{-4}\right)$

$= 792 \times 10^{6}$

Question: A given solenoid has 400 turns in its coil which is having a length of 40 cm and an area of $2cm^{2}$. If the current flowing through the coil is 0.4 A and because of that flux through it is $4\pi \times 10^{-6}$. Find the relative permeability of the case of solenoid.
Options:
(a) 100
(b) 125
(c) 1250
(d) 2500
Answer: (b)

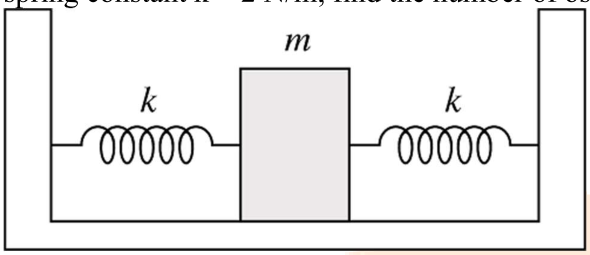
Solution: $\theta = B.A = \mu_r \mu_0 niA = \mu_r \mu_0 \frac{n}{l}.i.A$

$\Rightarrow 4\pi \times 10^{-6} = \mu_r 4\pi \times 10^{-7} \times \frac{400}{0.4}(0.4).2 \times 10^{-4}$

$$\frac{10^5}{400 \times 2} = \mu_r$$

$$\Rightarrow \mu_r = 125$$

Question: A block is attached to two springs as shown. If mass of the block is 490 gm and spring constant k = 2 N/m, find the number of oscillations in time 14$\boldsymbol{\pi}$ seconds.



Options:

(a) 5

(b) 10

(c) 20

(d) 25

Answer: (c)

Solution: Spring in parallel

$$\therefore K_{eq} = 2K = 4N/m$$

$$T = 2\pi\sqrt{\frac{490 \times 10^{-3}}{4}}$$

$$\therefore \eta = \frac{14gp}{\frac{2\pi}{2}\left(49 \times 10^{-2}\right)^{\frac{1}{2}}} = \frac{14}{7} \times 10 = 20$$

Question: Find the ratio of second line of Balmer series of He^+ ion with first line of Lyman series of H atom.

Options:

(a) 1 : 4

(b) 1 : 2

(c) 1 : 1

(d) 2 : 1

Answer: (c)

Solution: 2nd line of Balmer for He^+

$$\frac{1}{\lambda} = R(2)^2\left[\frac{1}{2^2} - \frac{1}{4^2}\right]$$

$$= 4R\left[\frac{3}{16}\right] = \frac{3}{4}R$$

1st line of Lyman for H,

$$\frac{1}{\lambda'} = R\left[\frac{1}{12} - \frac{1}{2^2}\right] = R\left(\frac{3}{4}\right)$$

$\therefore$ Ratio = 1: 1

Question: A solid sphere of mass 1 kg is undergoing pure rolling with kinetic energy 7 mJ. Find the velocity of solid sphere in cm/s

Options:

(a) 5 cm/s

(b) 10 cm/s

(c) 15 cm/s

(d) 20 cm/s

Answer: (b)

Solution: $I = \frac{2}{5}(1)(R)^2$

Pure rolling $\Rightarrow V = R\omega$

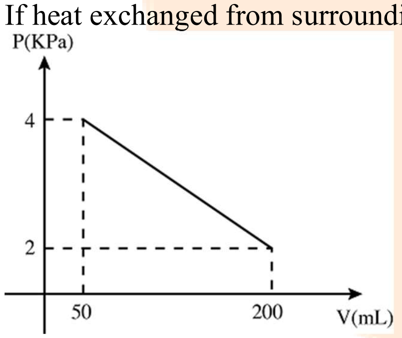
$$K.E = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

$$= \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{2}{5}\right)v^2$$

$$7 = \frac{7}{10}mv^2 \Rightarrow mv^2 = 10$$

$$\Rightarrow v^2 = 10m/s \,\text{or}\, 1000cm/s$$

Question: In a thermodynamic system, a gas expands through the process, as shown in figure. If heat exchanged from surrounding is zero then change in internal energy of system is



Options:

(a) $2.52\times10^{-6}(J)$

(b) $-1.25\times10^{-6}(J)$

(c) $-3.18\times10^{-6}(J)$

(d) $-3.18\times10^{-5}(J)$

Answer: (b)

Solution: $m = \tan\theta = \frac{4-2}{200-50} = \frac{2}{150\times10^{-9}}\left(\frac{N}{m^5}\right)$

$$C = \frac{10}{3}Pa$$

$$\therefore P = \frac{1}{75\times10^{-9}}V + \frac{10}{3}$$

$$\therefore W - D. = \int_{50}^{200} P dv$$

$$= \left| \frac{V^2}{150\times10^{-8}} + \frac{10}{3}V \right|_{50\times10^{-9}}^{200\times10^{-9}} = 1.25\times10^{-9}\left(J\right)$$

From 1st law, $\Delta Q = \Delta u + W$ as $\Delta Q = 0$

$$\Rightarrow \Delta u = -W \Rightarrow \Delta u = -1.25\times10^{-7}\left(J\right)$$

Question: A laser swing at 14 kw power is producing 10^{16} photons per second. Find the large in which the energy of photons fall into

Options:

(a) Gamma

(b) Radio

(c) U.V

(d) Micro

Answer: (a)

Solution: $\text{Power} = \frac{\text{Energy}}{\text{Time}}$

$$P = \frac{n\times hv}{t}$$

New $P = 14\times10^{2}\,w, \frac{n}{t} = 10^{16}$ photons/sec

$$\Rightarrow 14\times10^{2} = 10^{16}\times6.62\times10^{-34}v$$

$$\Rightarrow v = \frac{14\times10^{13}}{6.62\times10^{-18}} = 2.1\times10^{31}Hz$$

$\Rightarrow$ Gamma

Question: In A.M signal. $AC = 15\sin\left(1000\pi t\right), Am = 10\sin\left(4\pi t\right)$

Which frequencies are present in A.M. signal

(i) 250 Hz (ii) 500 Hz (iii) 502 Hz (iv) 498 Hz

Options:

(a) Both (i) and (ii)

(b) (ii) and (iii)

(c) (ii), (iii) and (iv)

(d) None

Answer: (c)

Solution: $\omega_c = 1000\pi; \omega_m = 4\pi$

Bandwidth $= 1000\pi \pm 4\pi$

$$\omega = \left(1004\pi, 996\pi\right)$$

$2\pi f = (1004\pi, 996\pi)$

$f = 502, 498$

Question: A conductor connected across a voltage source has electrons drifting with speed v_d. If now the area of cross-section is halved, new drift velocity is

Options:

(a) v_d

(b) $\frac{v_d}{2}$

(c) $2v_d$

(d) $\frac{v_d}{4}$

Answer: (a)

Solution: If area is halved $R' = 2R$

$I' = \frac{V}{2R} = \frac{I}{2}$

$I = neAv_d$

$I' = ne\frac{A}{2}v_d = \frac{I}{2}$

$\therefore v_{d'} = v_d$

Question: If n : number density of charge carriers.

A: cross sectional area of conductor

q: charge on each charge carrier

l: Current through the conductor

Then the expression of drift velocity is

Options:

(a) $\frac{nAq}{I}$

(b) $\frac{I}{nAq}$

(c) $nAqI$

(d) $\frac{IA}{nq}$

Answer: (b)

Solution: $I = nqAv_d$

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

Question: A gun is firing 100 bullets in one second, each of mass m at a wall in t second. After colliding with the wall the bullets return

With same speed in opposite direction. Find the force exerted on the wall.

Options:

(a) 100 mv/t

(b) 200 mv/t

(c) 100 mvt

(d) 200 mvt

Answer: (b)

Solution: $\frac{\Delta \vec{P}}{t} = \frac{2(100mv)}{t}$

$\therefore F = \frac{200mv}{t}$

Question: The total energy of a particle performing SHM is 25 J. Find its kinetic energy at $x = \frac{A}{2}$.

Options:

(a) $\frac{50}{3}J$

(b) $\frac{75}{2}J$

(c) $\frac{75}{4}J$

(d) $\frac{25}{2}J$

Answer: (b)

Solution: $\frac{1}{2}m\omega^2 A^2 = 25$

At $x = \frac{A}{2}$

$\frac{1}{2}m\omega^2\left(A^2 - \frac{A^2}{4}\right) = \frac{3}{4}m\omega^2 A^2$

$= \frac{3}{2} \times 25 = \frac{75}{4}J$

Question: For an intrinsic semiconductor if temperature is increased. Its number density (n) and resistivity (p) will

Options:

(a) Both n and p decreases

(b) n decreases but p increases

(c) Both n and p increases

(d) n increases and p decreases

Answer: (d)

Solution: Due to thermal agitation electrons will come to conduction band.

Question: The ratio of molar specific heat capacity at constant pressure $\left(C_p\right)$ to that at constant volume $\left(C_v\right)$ varies with temperature (T) as: [Assume temperature to be low]

Options:

(a) T^0

(b) $T^{\frac{1}{2}}$

(c) T^1

(d) $T^{\frac{3}{2}}$

Answer: (a)

Solution: $\frac{C_P}{C_V} = \text{Constant}$

Question: If R, X_L and X_C denote resistance, inductive reactance and capacitive reactance respectively. Then which of the following options shows the dimensionless physical quantity.

Options:

(a) $\frac{X_L X_C}{R}$

(b) $\frac{R}{\sqrt{X_L X_C}}$

(c) $\frac{R}{X_L X_C}$

(d) $\frac{R}{\left(X_L X_C\right)^2}$

Answer: (b)

Solution: X_L, X_C and R are all resistances (dimensionally)

Hence $\frac{R}{\sqrt{X_L X_C}}$ is dimensionless.

Question: Two identical cells are connected with an external resistance of 50 ohm. They flow the same current via external resistance whether the two cells are connected in resistor in series or parallel with each other. Find internal resistance of the cells.

Options:

(a) 2 ohm

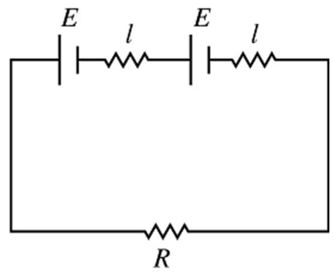
(b) 4 ohm

(c) 7 ohm

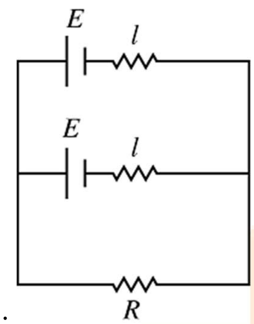
(d) 5 ohm

Answer: (d)

Solution: Let cells be having emf E and internal resistance r.



Series:



Parallel:

$$E_{eq} = \frac{\frac{E}{l} + \frac{E}{l}}{\frac{1}{l} + \frac{1}{l}} = E$$

$$E_{eq} = \frac{l}{2}$$

$$\Rightarrow i_2 = \frac{E}{R + \frac{1}{2}}$$

Question: A free isolated neutron can decay into a free proton and an electron, but a free, isolated proton cannot decay into a neutron because

Options:

(a) Proton has charge

(b) Neutron is neutral

(c) Proton has less mass

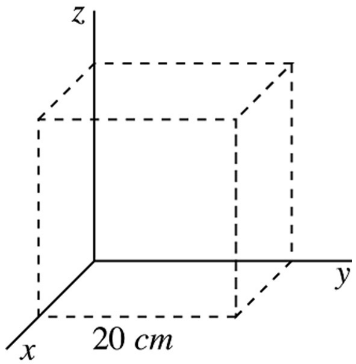
(d) Proton does not have spin

Answer: (c)

Solution: $m_N > m_P$

Question: Electric field in a region is $4000x^2 iN / C$. The flux through the cube is $\frac{x}{5} Nm^2 / C$.

Find x.



Options:

(a) 10

(b) 25

(c) 32

(d) 50

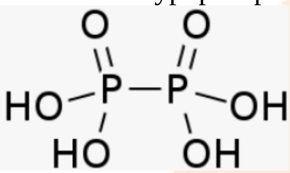
Answer: (c)

Solution: 32

JEE-Main-31-01-2023 (Memory Based) [Morning Shift]

Chemistry

Question: Oxidation state of Phosphorus in Hypophosphoric acid
Options:
(a) +4
(b) +2
(c) +6
(d) +8
Answer: (a)
Solution: Hypophosphoric $H_4P_2O_6$



Question: Which of the following is correct Configuration of Nd^{+2}?
Options:
(a) [Xe] $4f^4$ $6s^2$

(b) [Xe] $4f^4$ $6s^0$

(c) [Xe] $4f^3$ $6s^2$
(d) [Xe] $4f^5$ $6s^1$
Answer: (b)
Solution: Neodymium = Nd^{+2} = [Xe] $4f^4$ $6s^0$

Question: Order of basicity of V_2O_3, V_2O_5, V_2O_4?
Options:
(a) $V_2O_5 < V_2O_3 < V_2O_4$
(b) $V_2O_4 < V_2O_3 < V_2O_5$
(c) $V_2O_4 < V_2O_5 < V_2O_3$
(d) $V_2O_3 < V_2O_4 < V_2O_5$
Answer: (a)
Solution: V_2O_3 to less basic V_2O_4 and to amphoteric V_2O_5. V_2O_4 dissolves in acids to give VO^{2+} salts. Similarly, V_2O_5 reacts with alkalies as well as acids to give VO_4^{3-} and VO_4^{+} respectively. The well characterised CrO is basic but Cr_2O_3 is amphoteric.

Question: In which transition of hydrogen atom have same wavelength as in Balmer series transition of He^+ ion (n = 4 to n = 2)
Options:
(a) 4 to 2
(b) 3 to 2
(c) 2 to 1

(d) 4 to 1

Answer: (c)

Solution: For He+ ion we have

$$\frac{1}{\lambda} = Z^2 R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$= (2)^2 R_H \left[\frac{1}{2^2} - \frac{1}{4^2}\right]$$

$$= R_H \frac{3}{4} \; \ldots.(i)$$

Now for hydrogen atom $\frac{1}{\lambda} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] \ldots(ii)$

Equating equation (i) and (ii) we get

$$\frac{1}{n_1^2} - \frac{1}{n_2^2} = \frac{3}{4}$$

$n_1 = 1$ and $n_2 = 2$

$\therefore$ n = 2 to n = 1

Question: Which of the following is strongest artificial sweetener?

Options:

(a) Aspartame

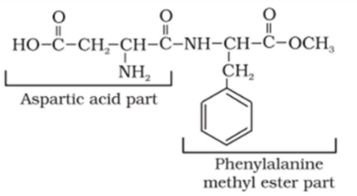
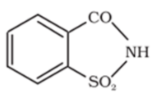
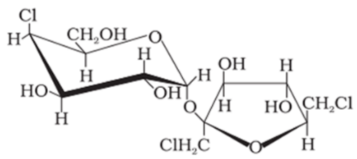
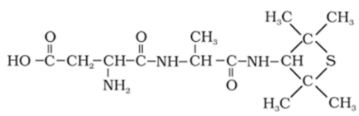
(b) Saccharin

(c) Sucralose

(d) Alitame

Answer: (d)

Solution:

Artificial sweetener	Structural formula	Sweetness value in comparison to cane sugar
Aspartame		100
Saccharin		550
Sucralose		600
Alitame		2000

Question: Ionic radii comparison, Cl^{-}, K^{+}, S^{2-}, Ca^{2+}

Options:

(a) $S^{2-} > Cl^{-} > K^{+} > Ca^{2+}$

(b) $Cl^{-} > S^{2-} > K^{+} > Ca^{2+}$

(c) $Cl^{-} > S^{2-} > Ca^{2+} > K^{+}$

(d) $Cl^{-} > Ca^{2+} > S^{2-} > K^{+}$

Answer: (a)

Solution: $R_{anion} > R_{cation}$

Question: Melting point order of

1,2 dichlorobenzene

1,3 dichlorobenzene

1,4 dichlorobenzene

Options:

(a) 1,4 dichlorobenzene > 1,2 dichlorobenzene > 1,3 dichlorobenzene

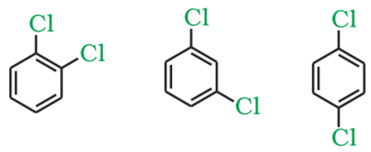
(b) 1,2 dichlorobenzene > 1,4 dichlorobenzene > 1,3 dichlorobenzene

(c) 1,3 dichlorobenzene > 1,4 dichlorobenzene > 1,2 dichlorobenzene

(d) 1,4 dichlorobenzene > 1,3 dichlorobenzene > 1,2 dichlorobenzene

Answer: (d)

Solution:



b.p / K	453	446	448
m.p / K	256	249	323

Question: Geometry of NH_4^+, XeF_4, SF_4, BF_3

Options:

(a) Tetrahedral, Square planar, Trigonal bipyramidal, Trigonal planar

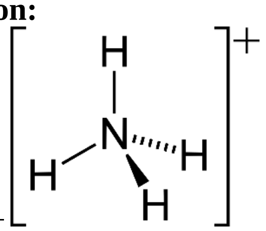
(b) Square planar, Tetrahedral, Trigonal bipyramidal, Trigonal planar

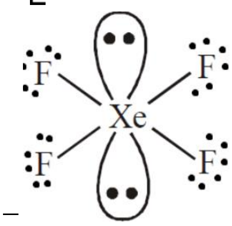
(c) Trigonal planar, Tetrahedral, Trigonal bipyramidal, Square planar

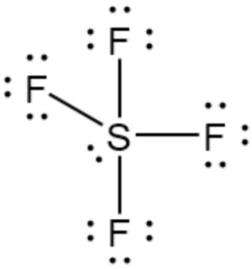
(d) Trigonal bipyramidal, Tetrahedral, Trigonal planar, Square planar

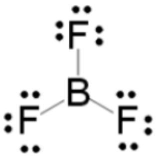
Answer: (a)

Solution:

NH_4^+ –


XeF_4 –


SF$_4$ – 

BF$_3$ – 

Question: Which of the following is not a method for concentrations of ore
Liquation, electrolysis, froth flotation, Leaching, Hydraulic washing
Options:
(a) Liquation, electrolysis
(b) froth flotation, Leaching
(c) froth flotation, Hydraulic washing
(d) Leaching, Hydraulic washing
Answer: (a)
Solution:
Concentration of ore:
1) Gravity separation
2) Magnetic separation
3) Froth flotation
4) Hydraulic washing
5) Leaching

Question: $Cl\dot{O} + NO_2 \rightarrow X$
$X + H_2O \rightarrow Y + HNO_3$
What is X and Y?
Options:
(a) $X = ClONO_2$, $Y = HOCl$
(b) $X = HOCl$, $Y = ClONO_2$
(c) $X = HCl$, $Y = ClNO_2$
(d) $X = HOCl$, $Y = ClNO_2$
Answer: (a)
Solution:

$Cl\dot{O}(g) + NO_2(g) \rightarrow ClONO_2(g)$

$\dot{C}l(g) + CH_4(g) \rightarrow \dot{C}H_3(g) + HCl(g)$

$ClONO_2(g) + H_2O(g) \rightarrow HOCl(g) + HNO_3(g)$

$ClONO_2(g) + HCl(g) \rightarrow Cl_2(g) + HNO_3(g)$

Question: $Cu^{+2} + KI \rightarrow X + Cu_2I_2$
$X + Na_2S_2O_3 \rightarrow Y$
X and Y are
Options:
(a) $X = Na_2S_4O_6$, $Y = I_2$
(b) $X = S_4O_6^{-2}$, $Y = I^-$
(c) $X = I_2$, $Y = Na_4S_4O_8$
(d) $X = I_2$, $Y = Na_2S_4O_6$
Answer: (d)
Solution:
$Cu^{+2} + KI \rightarrow I_2 + Cu_2I_2$

$I_2 + Na_2S_2O_3 \rightarrow Na_2S_4O_6$

Question: Find out E_a (activation energy) given that:
$T_1 = 200K$; $K_1 = 0.03$
$T_2 = 300K$; $K_2 = 0.05$
Options:
(a) 317.5
(b) 215.3
(c) 577.8
(d) 415.9
Answer: (d)
Solution: From the Arrhenius equation, we obtain

$$\log\frac{K_2}{K_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1T_2}\right]$$

$$\log\frac{0.06}{0.03} = \frac{E_a}{2.303R}\left[\frac{300-200}{300\times 200}\right]$$

$$\log 2 = \frac{E_a}{2.303R}\left[\frac{1}{600}\right]$$

$$0.3010\times 2.303\times 600\times R = E_a$$

$$415.9\,R$$

Question: Choose the correct information regarding the products obtained on electrolysis of brine solution
Options:
(a) Cl_2 at cathode
(b) O_2 at cathode
(c) H_2 at cathode
(d) OH^- at anode
Answer: (c)
Solution: $2\,NaCl(aq) + 2\,H_2O(l) \rightarrow 2\,NaOH(aq) + Cl_2(g) + H_2(g)$

During electrolysis, at the anode (positive electrode), Chlorine gas (Cl_2) will be discharged and at the cathode (negative electrode), Hydrogen gas (H_2) will be discharged. Sodium hydroxide (NaOH) solution is formed near the cathode.

Question: $SO_2(g) + \frac{1}{2} O_2(g) \rightleftharpoons SO_3(g)$

If $K_p = 2 \times 10^{12}$ and $K_c = x \times 10^{13}$, the value of x in terms of RT will be:

Options:

(a) $\frac{\sqrt{RT}}{4}$

(b) $\frac{1}{5\sqrt{RT}}$

(c) $\frac{\sqrt{RT}}{10}$

(d) $10\sqrt{RT}$

Answer: (b)

Solution:

$K_p = K_C(RT)^{\Delta n}$

$2 \times 10^{12} = x \times 10^{13} (RT)^{-0.5}$

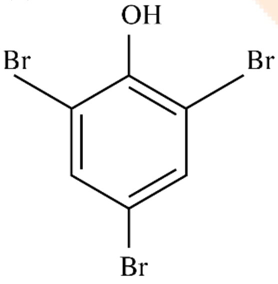
$$\frac{2 \times 10^{12}}{10^{13}(RT)^{0.5}} = x$$

$$\frac{1}{5\sqrt{RT}} = x$$

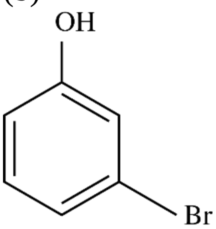
Question: When phenol reacts with Br_2 in low polarity solvent, which of the following will be the major product.

Options:

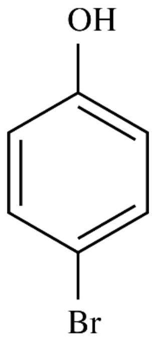
(a)



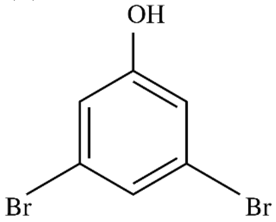
(b)



(c)



(d)



Answer: (c)
Solution: Phenol reacts with bromine in a presence of less polar solvent to form a mixture of o-bromophenol and p-bromophenol.

Question: In which of the following reactions H_2O_2 acts as a reducing agent
Options:
(a) $H_2O_2 + Mn^{2+} \rightarrow MnO_2 + H_2O$
(b) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$
(c) $Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + H_2O$
(d) $PbS + H_2O_2 \rightarrow PbSO_4 + H_2O$
Answer: (b)
Solution:
$2Fe^{2+}(aq) + 2H^+(aq) + H_2O_2(aq) \rightarrow 2Fe^{3+}(aq) + 2H_2O(l)$
$PbS(s) + 4H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(l)$
$2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$

$HOCl + H_2O_2 \rightarrow H_2O^+ + Cl^- + O_2$

JEE-Main-31-01-2023 (Memory Based) [Morning Shift]

Mathematics

Question: Find remainder when 5^{99} is divided by 11.
Answer: 9.00
Solution:

$$5^{99} = (5^3)^{33}$$
$$= (125)^{33}$$
$$= (121+4)^{33}$$
$$= 11\lambda + 4^{33}$$

Now, $4^{33} = 2^{66}$

$$= 2\times(2)^{65}$$
$$= 2\times(32)^{13}$$
$$= 2(33-1)^{13}$$
$$= 2\left[11k + (-1)^{13}\right]$$
$$= -2$$

$\therefore$ Remainder = 9

Question: A wire of length 20 m is cut into two pieces of lengths l_1 and l_2 respectively. The first piece is bent into a square and second piece into a circle with area A_1 and A_2 respectively. If $2A_1 + 3A_2$ is minimum, then the value of $\pi\times\frac{l_1}{l_2}$ is

Answer: 6.00
Solution:

Length of side of square $= l_1$

$\therefore$ Area of square, $A_1 = \left(\frac{l_1}{4}\right)^2$

Circumference of circle $= l_2$

$\Rightarrow 2\pi r = l_2$

$\Rightarrow r = \frac{l_2}{2\pi}$

Area of circle, $A_2 = \pi r^2 = \pi\left(\frac{l_2}{2\pi}\right)^2$

$$=\frac{l_2^{\ 2}}{4\pi}$$

Let $f=2A_1+3A_2$

$$\Rightarrow f=\frac{2l_1^{\ 2}}{16}+\frac{3l_2^{\ 2}}{4\pi} \qquad ....(1)$$

Given that $l_1+l_2=20$

$$\therefore\ f=\frac{l_1^2}{8}+\frac{3(20-l_1)^2}{4\pi}$$

Now, $f'=0$

$$\Rightarrow \frac{l_1}{4}=\frac{6(20-l_1)}{4\pi}$$

$$\Rightarrow l_1=\frac{6(20-l_1)}{\pi}$$

$$\Rightarrow \pi l_1=6l_2$$

$$\Rightarrow \pi\frac{l_1}{l_2}=6$$

Question: The sum and product of four consecutive values of GP are 126 and 1296 respectively. Then the common ratio of all possible GP are

Answer: 7.00

Solution:

Let the four terms of GP be $\frac{a}{r^3},\frac{a}{r},ar,ar^3$

Given that: $\frac{a}{r^3}\cdot\frac{a}{r}\cdot ar\cdot ar^3=1296$

$$\Rightarrow a^4=1296$$

$$\Rightarrow a=6$$

Also, $\frac{a}{r^3}+\frac{a}{r}+ar+ar^3=126$

$$\Rightarrow 6\left(\frac{1}{r^3}+\frac{1}{r}+r+r^3\right)=121$$

$$\Rightarrow\left(r+\frac{1}{r}\right)+\left(r^3+\frac{1}{r^3}\right)=21$$

Let $r+\frac{1}{r}=t$

$$\Rightarrow r^3+\frac{1}{r^3}+3\left(r+\frac{1}{r}\right)=t^3$$

$$\Rightarrow r^2+\frac{1}{r^3}=t^3-3t$$

$$\therefore\ t+t^3-3t=21$$

$\Rightarrow t^3 - 2t = 21$

$\Rightarrow t^3 - 2t - 21 = 0$

$\Rightarrow t = 3$ (Hit & trial)

$\therefore\ r + \dfrac{1}{r} = 3$

$r^2 - 3r + 1 = 0$

$\Rightarrow r_1 + r_2 = 3$

$r_1 r_2 = 1$

Now, common ratio is r^2

$\therefore$ Sum of possible values of common ratio is given by

$r_1^2 + r_2^2 = (r_1 + r_2)^2 - 2(r_1 r_2) = 9 - 2 = 7$

Question: Number of real roots of $\sqrt{x^2+4x+3} + \sqrt{x^2-9} = \sqrt{4x^2-14x+6}$ is

Answer: 1.00

Solution:

$\sqrt{x^2+4x+3} + \sqrt{x^2-9} = \sqrt{4x^2-14x+6}$

$\Rightarrow \sqrt{(x+1)(x+3)} + \sqrt{(x-3)(x+3)} = \sqrt{(4x+2)(x+3)}$

Thus, $x = -3$ is one root.

Now we have, $\sqrt{x+1} + \sqrt{x-3} = \sqrt{4x+2}$

Squaring both sides, we get

$x + 1 + x - 3 + 2\sqrt{(x+1)(x-3)} = 4x + 2$

$2x - 2 + 2\sqrt{(x+1)(x-3)} = 4x + 2$

$\Rightarrow 2\sqrt{(x+1)(x-3)} = 4x + 2 - 2x + 2$

$\Rightarrow \sqrt{(x+1)(x-3)} = x + 2$

Again squaring, we get

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

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

$\Rightarrow 6x = 7$

$\Rightarrow x = \dfrac{7}{6}$ (rejected)

$\therefore$ Number of real roots is 1.

Question: $\displaystyle\int_{\frac{\pi}{3}}^{\frac{\pi}{2}} \frac{2+3\sin x}{\sin x(1+\cos x)}dx$ is equal to

Answer: $\dfrac{10}{3} + \sqrt{3} + \log\sqrt{3}$

Solution:

$$I=\int_{\frac{\pi}{3}}^{\frac{\pi}{2}}\frac{2+3\sin x}{\sin x(1+\cos x)}dx$$

$$=\int_{\frac{\pi}{3}}^{\frac{\pi}{2}}\frac{2+3\left(\frac{2\tan\frac{x}{2}}{1+\tan^2\frac{x}{2}}\right)}{\frac{2\tan\frac{x}{2}}{1+\tan^2\frac{x}{2}}\left[1+\left(\frac{1-\tan^2\frac{x}{2}}{1+\tan^2\frac{x}{2}}\right)\right]}$$

$$=\int_{\frac{\pi}{3}}^{\frac{\pi}{2}}\frac{\left(2+2\tan^2\left(\frac{x}{2}\right)+6\tan^2\frac{x}{2}\right)\sec^2\frac{x}{2}}{2\tan\frac{x}{2}\times 2}dx$$

Put $\tan\frac{x}{2}=t$

$$\Rightarrow \frac{1}{2}\sec^2\frac{x}{2}dx=dt$$

$$\therefore I=2\int_{\frac{1}{\sqrt{3}}}^{1}\frac{2t^2+6t+2}{4t}dt$$

$$=2\int_{\frac{1}{\sqrt{3}}}^{1}\left(\frac{t}{2}+\frac{3}{2}+\frac{1}{2t}\right)dt$$

$$=2\left[\frac{t^2}{4}+\frac{3t}{2}+\frac{1}{2}\ln|t|\right]$$

$$=2\left[\frac{1}{4}+\frac{3}{2}+\frac{1}{2}(0)-\frac{1}{12}-\frac{3}{2\sqrt{3}}-\frac{1}{2}\ln\left(\frac{1}{\sqrt{3}}\right)\right]$$

$$=2\left[\frac{7}{4}-\frac{1}{12}-\frac{\sqrt{3}}{2}+\frac{1}{2}\ln\sqrt{3}\right]$$

$$=2\left[\frac{20}{12}-\frac{\sqrt{3}}{2}+\frac{1}{2}\ln\sqrt{3}\right]$$

$$=\frac{10}{3}-\sqrt{3}+\ln\sqrt{3}$$

Question: If $f(x)+\int_{3}^{x}\frac{f(t)}{t}dt=\sqrt{x+1}$, then $12f(8)=?$

Answer: 17.00

Solution:

$$f(x)+\int_3^x \frac{f(t)}{t}dt=\sqrt{x+1}$$

By differentiating we get

$$f'(x)+\frac{f(x)}{x}=\frac{1}{2\sqrt{x+1}}$$

$$xf'(x)+f(x)=\frac{x}{2\sqrt{x+1}}$$

$$\frac{dy}{dx}+\frac{y}{x}=\frac{1}{2\sqrt{x+1}}$$

I.F. $=e^{\int\frac{1}{x}dx}=e^{\log x}=x$

$$\therefore\ y\cdot x=\int\frac{1}{2\sqrt{x+1}}\cdot x\,dx$$

$$y\cdot x=\frac{1}{2}\int\frac{x+1-1}{\sqrt{x+1}}dx$$

$$\Rightarrow y\cdot x=\frac{1}{2}\int\frac{x+1}{\sqrt{x+1}}dx-\frac{1}{2}\int\frac{1}{\sqrt{x+1}}dx$$

$$\Rightarrow y\cdot x=\frac{1}{2}\left[\frac{2}{3}(x+1)^{\frac{3}{2}}-2\sqrt{x+1}\right]+C \qquad \text{...(i)}$$

Now, $f(3)=2$

$\therefore$ (i) becomes

$$6=\frac{1}{2}\left[\frac{2}{3}\times 8-4\right]+C$$

$$\Rightarrow C=\frac{16}{3}$$

Now, for $x=8$, (i) becomes

$$8y=\frac{1}{2}\left[\frac{2}{3}\times 27-2\times 3\right]+\frac{16}{3}$$

$$\Rightarrow y=(9-3)+\frac{16}{3}$$

$$\Rightarrow 8y=6+\frac{16}{3}$$

$$\Rightarrow y=\frac{34}{24}$$

$$\therefore 12f(8)=12\times\frac{34}{24}$$

$$\Rightarrow 12f(8)=17$$

Question: Given that $\sin^{-1}\left(\frac{\alpha}{17}\right)+\cos^{-1}\left(\frac{4}{5}\right)=\tan^{-1}\left(\frac{77}{36}\right)$; $\alpha\in(0,13)$. Find $\sin^{-1}(\sin\alpha)+\cos^{-1}(\cos\alpha)$.

Answer: π

Solution:

$$\sin^{-1}\left(\frac{\alpha}{17}\right)+\cos^{-1}\left(\frac{4}{5}\right)=\tan^{-1}\left(\frac{77}{36}\right)$$

$$\sin^{-1}\left(\frac{\alpha}{17}\right)=\tan^{-1}\left(\frac{77}{36}\right)-\cos^{-1}\left(\frac{4}{5}\right)$$

$$\sin^{-1}\left(\frac{\alpha}{17}\right)=\tan^{-1}\left(\frac{77}{36}\right)-\tan^{-1}\left(\frac{3}{4}\right)$$

$$\sin^{-1}\left(\frac{\alpha}{17}\right)=\tan^{-1}\left(\frac{\frac{77}{36}-\frac{3}{4}}{1+\frac{77\times3}{36\times4}}\right)$$

$$\Rightarrow\sin^{-1}\left(\frac{\alpha}{17}\right)=\tan^{-1}\left(\frac{(77-27)4}{144+231}\right)$$

$$\Rightarrow\sin^{-1}\left(\frac{\alpha}{17}\right)=\tan^{-1}\left(\frac{200}{375}\right)$$

$$\Rightarrow\sin^{-1}\left(\frac{\alpha}{17}\right)=\tan^{-1}\left(\frac{8}{15}\right)$$

$$\Rightarrow\sin^{-1}\left(\frac{\alpha}{17}\right)=\sin^{-1}\left(\frac{8}{17}\right)$$

On comparing both sides, we get

$\alpha=8$

$\therefore\sin^{-1}(\sin\alpha)+\cos^{-1}(\cos\alpha)=\sin^{-1}(\sin 8)+\cos^{-1}(\cos 8)$

$=3\pi-8+8-2\pi$

$=\pi$

Question: For two vectors $\vec{a}$ and $\vec{b}$, it is given that $|\vec{a}|=\sqrt{6}$, $|\vec{b}|=\sqrt{14}$ and $|\vec{a}\times\vec{b}|=\sqrt{48}$. Find $|\vec{a}.\vec{b}|^2$

Answer: 36.00

Solution:

Given, $|\vec{a}|=\sqrt{6}$, $|\vec{b}|=\sqrt{14}$, $|\vec{a}\times\vec{b}|=\sqrt{48}$

We know that:

$$\left|\vec{a}\times\vec{b}\right|^2+\left(\vec{a}\cdot\vec{b}\right)^2=|\vec{a}|^2\left|\vec{b}\right|^2$$

$$\left(\sqrt{48}\right)^2+\left(\vec{a}\cdot\vec{b}\right)^2=\left(\sqrt{6}\right)^2\left(\sqrt{14}\right)^2$$

$$48+\left(\vec{a}\cdot\vec{b}\right)^2=14\times 6$$

$$\left(\vec{a}\cdot\vec{b}\right)^2=84-48$$

$$\left(\vec{a}\cdot\vec{b}\right)^2=36$$

Question: For any three vectors $\vec{a},\vec{b}$ & $\vec{c}$, if $\vec{a}=2\hat{i}+3\hat{j}-\hat{k}$, $\vec{b}$ & $\vec{c}\neq 0$, $\vec{b}.\vec{c}=0$ and $\left|\vec{a}+\vec{b}+\vec{c}\right|=\left|\vec{a}+\vec{b}-\vec{c}\right|$, then

Options:

(a) $|\vec{a}+\lambda\vec{c}|\geq|\vec{a}|$

(b) $\vec{a}$ & $\vec{c}$ always parallel

(c)

(d)

Answer: (a)

Solution:

Given: $\vec{a}=2\hat{i}+3\hat{j}-\hat{k}$, $\vec{b}\neq 0$ & $\vec{c}\neq 0$ & $\vec{b}.\vec{c}=0$

Now, $\left|\vec{a}+\vec{b}+\vec{c}\right|=\left|\vec{a}+\vec{b}-\vec{c}\right|$

Squaring both sides, we get

$$a^2+b^2+c^2+2\left(\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}\right)=a^2+b^2+c^2+2\left(\vec{a}\cdot\vec{b}-\vec{a}\cdot\vec{c}-\vec{b}\cdot\vec{c}\right)$$

$$\Rightarrow \vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}=-\left(\vec{a}\cdot\vec{c}+\vec{b}\cdot\vec{c}\right)$$

$$\Rightarrow 0+\vec{c}\cdot\vec{a}=-\vec{a}\cdot\vec{c}+0$$

$$\Rightarrow 2\left(\vec{c}\cdot\vec{a}\right)=0$$

$$\Rightarrow \vec{c}\cdot\vec{a}=0 \text{ or } \vec{a}\cdot\vec{c}=0$$

Now,

$$|\vec{a}+\lambda\vec{c}|=\sqrt{a^2+\lambda^2c^2+0}$$

$$\geq|\vec{a}|$$

Question: If $f(x)=\dfrac{x+|x|}{2}$; $g(x)=\begin{cases} x & ; \quad x<0 \\ x^2 & ; \quad x\geq 0 \end{cases}$, then area bounded by $y=f\left(g(x)\right)$, $2y-x=15$ and $y=0$ is

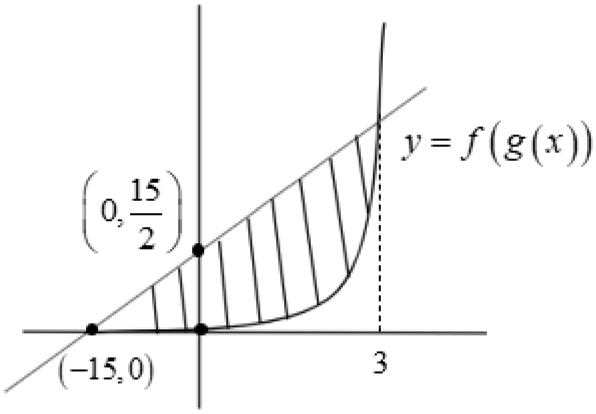
Answer: 72.00

Solution:

$$f(x)=\frac{x+|x|}{2};\ g(x)=\begin{cases} x & ; \quad x<0 \\ x^2 & ; \quad x\geq 0 \end{cases}$$

Or $f(x)=\begin{cases} x & ; & x\ge 0 \\ 0 & ; & x<0 \end{cases}$

$f(g(x))=\begin{cases} x^2 & ; & x\ge 0 \\ 0 & ; & x<0 \end{cases}$



Required Area $=\frac{1}{2}\times 15\times\frac{15}{2}+\int_0^3\left[\left(\frac{x+15}{2}\right)-x^2\right]dx$

$=\frac{225}{4}+\left[\frac{x^2}{4}+\frac{15x}{2}-\frac{x^3}{3}\right]_0^3$

$=\frac{225}{4}+\left[\frac{9}{4}+\frac{45}{2}-\frac{27}{3}\right]$

$=\frac{225}{4}+\frac{9}{4}+\frac{45}{2}-9$

$=\frac{225+9+90-36}{4}$

$=\frac{288}{4}$

$=72$

Question: How many 4-digit numbers less than 2800 are there which are divisible by 11 or 3?

Answer: 710.00

Solution:

4 digit numbers less than 2800 are from 1000 & 2799

Now, number of 4 digit numbers divisible by 3 or 11 is given by

$n(3)+n(11)-n(33)$, where

$n(3)=$ No. of 4-digit numbers less than 2800 which are divisible by 3

Now, 4-digit numbers less than 2800 & divisible by 3 are

1002, 1005, …. 2799

Thus, $1002+(n-1)3=2799$

$\Rightarrow 3n-3=1797$

$\Rightarrow 3n=1800$

$\Rightarrow n=600$

Similarly for $n(11)$, we have

$1001,1012,...2794$

Thus, $1001+(n-1)11=2794$

$\Rightarrow 11n-11=1793$

$\Rightarrow 11n=1804$

$\Rightarrow n=164$

$\therefore n(11)=164$

And for $n=33$

$1023,1065,...,2772$

Thus, $1023+(n-1)33=2772$

$\Rightarrow 1023+33n-33=2772$

$\Rightarrow 33n=1782$

$\Rightarrow n=54$

$\therefore n(33)=54$

$\therefore$ Required numbers $=600+164-54=710$

Question: Six balls are in a bag. 2 balls are randomly drawn and found to be black. Find the probability that at least 5 balls in the bag are black.

Answer: $\frac{5}{7}$

Solution:

Let A = 2 Black balls drawn

B = atleast 5 balls in Bag are black

$$P\left(\frac{B}{A}\right)=\frac{P(A\cap B)}{P(A)}$$

$$P(A)=\frac{{}^2C_2}{{}^6C_2}+\frac{{}^3C_2}{{}^6C_2}+...+\frac{{}^6C_2}{{}^6C_2}={}^7C_3=35$$

$$P(A\cap B)=\frac{{}^5C_2}{{}^6C_2}+\frac{{}^6C_2}{{}^6C_2}=25$$

$$\therefore\ P\left(\frac{B}{A}\right)=\frac{P(A\cap B)}{P(A)}=\frac{25}{35}=\frac{5}{7}$$

Question: The relation given by $(a,b)R(c,d)$ iff $ad(b-c)=bc(a-d)$, $a,b,c,d\in N$, is

Options:

(a) Not Reflexive

(b) Symmetric

(c) Transitive

(d) Equivalence

Answer: (a)

Solution:

$$ad(b-c)=bc(a-d)$$

$$\frac{1}{c}-\frac{1}{b}=\frac{1}{d}-\frac{1}{a}$$

$$\frac{1}{a}-\frac{1}{b}=\frac{1}{d}-\frac{1}{c}$$

Now checking for Reflexivity

$$(a,b)R(a,b)\Rightarrow\frac{1}{a}-\frac{1}{b}=\frac{1}{b}-\frac{1}{a}$$

Which is not possible

Thus, R is not reflexive

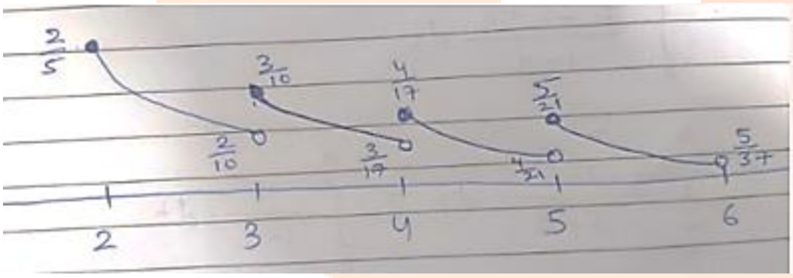
Question: A function with domain $[2,6)$ is given by $f(x)=\frac{[x]}{1+x^2}$. Find range, where $[\cdot]$ is GIF.

Answer: $\left[\frac{5}{37},\frac{2}{5}\right)$

Solution:

$$f(x)=\frac{[x]}{1+x^2}$$

$$\frac{2}{1+x^2}\qquad\frac{3}{1+x^2}\qquad\frac{4}{1+x^2}\qquad\frac{5}{1+x^2}$$



$\therefore$ Range $=\left[\frac{5}{37},\frac{2}{5}\right)$

Question: 5-digit numbers are formed using digits 0, 1, 2, 4, 7, 9 (repetition is allowed). If the numbers obtained are arranged in ascending order then find the rank of 29471.

Answer: 2510.00

Solution:

$\underline{1}\ \_\ \_\ \_\ \_ = 6^4$

$\underline{2}\ \underline{0}\ \_\ \_\ \_ = 6^3$

$\underline{2}\ \underline{1}\ \_\ \_\ \_ = 6^3$

$\underline{2}\ \underline{2}\ \_\ \_\ \_ = 6^3$

$\underline{2}\ \underline{4}\ \_\ \_\ \_ = 6^3$

$\underline{2}\ \underline{7}\ \_\ \_\ \_ = 6^3$

$\underline{2}\ \underline{9}\ \underline{0}\ \_\ \_ = 6^2$

$\underline{2}\ \underline{9}\ \underline{1}\ \_\ \_ = 6^2$

$\underline{2}\ \underline{9}\ \underline{2}\ \_\ \_ = 6^2$

$\underline{2}\ \underline{9}\ \underline{4}\ \underline{0}\ \_ = 6$

$\underline{2}\ \underline{9}\ \underline{4}\ \underline{1}\ \_ = 6$

$\underline{2}\ \underline{9}\ \underline{4}\ \underline{2}\ \_ = 6$

$\underline{2}\ \underline{9}\ \underline{4}\ \underline{4}\ \_ = 6$

$\underline{2}\ \underline{9}\ \underline{4}\ \underline{7}\ \underline{0} = 1$

$\underline{2}\ \underline{9}\ \underline{4}\ \underline{7}\ \underline{1} = 1$

$\therefore$ Required rank of 29471 $= 6^4 \times 5 \times 6^3 + 3 \times 6^2 + 4 \times 6 + 2$

$= 1296 + 1080 + 108 + 24 + 2$

$= 2510$

Question: We have two curves $C_1 : |z| = 4$ and C_2 : locus of $z + \frac{1}{z}$, then

Options:

(a) C_1 and C_2 intersect at 4 points

(b) C_2 is inside C_1

(c) C_1 and C_2 don't intersect

(d) C_1 and C_2 intersect exactly once

Answer: (a)

Solution:

(a)

Question: $P(a) = \left(a + \frac{a^2}{2} + \frac{a^3}{2} + \ldots + \frac{a^{50}}{50}\right)$, and $B = \ln(1-a)$, then $\int_0^a \frac{t^{50}}{1-t} dt$ equals:

Options:

(a) $-B + P(a)$

(b) $B - P(a)$

(c) $-P(a) - B$

(d)

Answer: (c)

Solution:

$\int_0^a \frac{t^{50}}{1-t} dt$

$$=\int_0^a\left(\frac{t^{50}-1+1}{1-t}\right)dt$$

$$=\int_0^a\frac{-\left(1-t^{50}\right)}{1-t}dt+\int_0^a\frac{1}{1-t}dt$$

$$=\int_0^a-\left(1+t+t^2+\ldots+t^{49}\right)-\ln\left(1-t\right)\Big|_0^a$$

$$=-\left(t+\frac{t^2}{2}+\frac{t^3}{3}+\ldots+\frac{t^{50}}{50}\right)_0^a-\ln\left(1-a\right)$$

$$=-\left(a+\frac{a^2}{2}+\frac{a^3}{3}+\ldots+\frac{a^{50}}{50}\right)-\ln\left(1-a\right)$$

$$=-P\left(a\right)-B$$

Question: $y=f\left(x\right)$ is a parabola with focus $\left(-\frac{1}{2},0\right)$ & directrix $y=-\frac{1}{2}$ then find the number of solutions of: $\tan^{-1}\sqrt{f\left(x\right)}+\sin^{-1}\sqrt{f\left(x\right)+1}=\frac{\pi}{2}$

Answer: 2.00
Solution:

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

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

$$y=x^2+x$$

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

$$\cos^{-1}\frac{1}{\sqrt{x^2+x+1}}+\sin^{-1}\sqrt{x^2+x+1}=\frac{\pi}{2}$$

$$x^2+x+1=1$$

$$x=0,-1$$

$\therefore$ The total number of solutions are 2.

Question: The direction ratios of two lines which are parallel are given by $\langle 2,1,-1\rangle$ and $\langle\alpha+\beta,1+\beta,2\rangle$. Then the value of $|2\alpha+3\beta|$ is

Answer: 11.00
Solution:
Direction ratios of parallel lines will be equal

$$\frac{\alpha+\beta}{2}=\frac{\beta+1}{1}=\frac{2}{-1}$$

$\alpha+\beta=-4;\ \ \beta+1=-2$

$\alpha+\beta=-4;\ \beta=-3$

$\alpha=-1;\ \beta=-3$

Substitute in $|2\alpha+3\beta|$

$|2\alpha+3\beta|=|2(-1)+3(-3)|=|-2-9|=11$

Question: α is the smallest positive integer such that $\left(x^{\frac{2}{3}}+\frac{2}{x^3}\right)^{30}$ contains a term $\beta x^{-\alpha}$.

Find α.

Answer:

Solution:

$T_{k+1}={}^{30}C_k\left(x^{23}\right)^{30-k}\left(\frac{2}{x^3}\right)^k \quad ....(1)$

$={}^{30}C_k\left(x\right)^{20-\frac{2}{3}k-3k}$

Here $20-\frac{2}{3}k-3k<0$

$60-11k<0$

$k>5.5$

$k=6$

Now, put $k=6$ in (1)

$T_7={}^{30}C_6x^{-2}$

By comparing with $\beta x^{-\alpha}$ we get

$\alpha=2$

Question: If $a_1,a_2,...,a_n$ be an AP with $a_5=2a_7$ and $a_{11}=18$, then

$12\left[\left(\frac{1}{\sqrt{a_{10}}+\sqrt{a_{11}}}\right)+\left(\frac{1}{\sqrt{a_{11}}+\sqrt{a_{12}}}\right)+...+\left(\frac{1}{\sqrt{a_{17}}+\sqrt{a_{18}}}\right)\right]=?$

Answer: 8.00

Solution:

$a_5=2a_7$

$a+4d=2(a+6d)$

$a+8d=0$

$a+10d=18$

$d=9$

$a=-72$

$=\frac{12}{-9}\left(\sqrt{a10}-\sqrt{a_{11}}+\sqrt{a_{11}}-\sqrt{a_{12}}+...+\sqrt{a_{17}}-\sqrt{a_{18}}\right)$

$= \frac{-4}{3}\left(\sqrt{9}-\sqrt{81}\right)$

$= \frac{-4}{3}(3-9)$

$= 8$