JEE-Main-29-01-2024 (Memory Based)
[MORNING SHIFT]

Physics

Question: A block of mass 100 kg is moved along a horizontal surface 10 m from the starting point. If coefficient of friction between ground and the block is 0.4 find work done against friction

Options:

(a) 3.9 kJ

(b) 4.2 kJ

(c) 3.7 kJ

(d) 4.1 kJ

Answer: (a)

Question: A particle is executing SHM with an amplitude A. If potential energy of the system is zero about mean position $x = 0$, Find ratio of total energy to kinetic energy at x = A/3

Options:

(a) 8/9

(b) 9/8

(c) $3/2\sqrt{2}$

(d) $2\sqrt{2}/3$

Answer: (b)

Question: i = 20 + 3/2 t Find charge flown in 20 S

Options:

(a) 1600 C

(b) 1200 C

(c) 1000 C

(d) 800 C

Answer: (c)

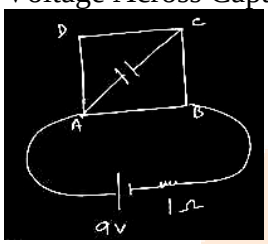
Question: Match the following

A	$\oint \underline{B} \cdot d\underline{A} = 0$	P	Faraday & Lenz's law
B	$\oint \underline{E} \cdot d\underline{A} = \frac{Qin}{\varepsilon_0}$	Q	Gauss law on magnetism
C	$\oint \underline{B} \cdot d\underline{l} = \mu . i_{enc}$	R	Ampere's law

D	$\oint \underline{E} \cdot d\underline{l} = -\frac{d\phi_B}{dt}$	S	Gauss law of electrostatics

Options:
(a) (A-Q),(B-S), (C-R), (D-P)
(b) (A-S),(B-Q), (C-R), (D-P)
(c) (A-Q),(B-R), (C-S), (D-P)
(d) (A-Q),(B-S), (C-P), (D-R)
Answer: (a)

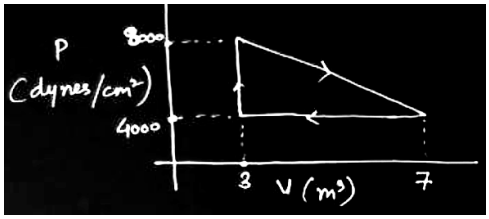
Question: In the Following Circuit the resistance of square loop ABCD is 16 Ohm. Find the Voltage Across Capacitor in steady State



Options:
(a) 4.5 V
(b) 4 V
(c) 3 V
(d) 1 V
Answer: (a)

Question: A Square loop of side 0.1 m is in East West Plane and magnetic field is along North East of 0.2 T. If B is Removed in 10 s find EMF Induced?
Options:
(a) 14 mV
(b) 0.14 mV
(c) 1 mV
(d) 0.2 mV
Answer: (b)

Question: If debroglie wavelength of an electron is same as wavelength of a photon and speed of the electron is 25% of speed of EM waves in vacuum. Find ratio of kinetic energy of electron & energy of photon.
Options:
(a) 1/8
(b) ¼
(c) ½
(d) 1
Answer: (a)
Question: P-V graph of a gas is given. Find the work done by the gas.



Options:
(a) 400 J
(b) 600 J
(c) 800 J
(d) 100 J
Answer: (c)

Question: A convex lens made of glass (μ glass = 1.5) has focal length of 20 cm in air If this lens is put inside a fluid of refractive index 1.6. The new focal length will be
Options:
(a) 160 cm
(b) -160 cm
(c) -180 cm
(d) 80 cm
Answer: (b)

Question: If R is the radius of Earth's and Particle has Equal weight at "d" distance below the surface of Earth's and "d" distance above it, find "d"
Options:
(a) $d = \sqrt{5}\ R/2$
(b) $d = \sqrt{3}\ R$
(c) $d = (\sqrt{5}-1)\ R/2$
(d) $d = R$
Answer: (c)

Question: The flow speeds on upper & lower surfaces of the wings are 70 m/s & 64 m/s respectively on an airplane in a wind tunnel. What is the lift force on the wing? Area of wing is 0.2 m^2 Given: density of air = 1.2 kg/m^3
Options:
(a) 16
(b) 36
(c) 81
(d) 144
Answer: (c)

Question: In a concave mirror of radius of curvature R = 30 cm the size of inverted image is half the size of object. Find the distance of the object from pole.
Options:
(a) 30
(b) 45
(c) 60
(d) 20
Answer: (b)

Question: A Galvanometer shows deflection corresponding to 25 division when a certain current is passed. The deflection becomes 5 divisions when galvanometer is shunted with 24Ω. Find the resistance of galvanometer

Options:

(a) 24 Ω

(b) 48 Ω

(c) 96 Ω

(d) 120 Ω

Answer: (c)

Question: In the given nuclear reaction, which of the following expression correctly represent the Q value

$^{6}_{3}\text{Li} + {}^{2}_{1}\text{H} \rightarrow 2\,{}^{4}_{2}\text{He}$

Given masses:

$^{6}_{3}$Li = 6.015122 amu, $^{4}_{2}$He = 4.00 2603 amu

$^{2}_{1}$H - 2.014101 amu, 1 amu = 931.5 MeV

Options:

(a) 22.37 MeV

(b) 21.42 MeV

(c) 22.02 MeV

(d) 21.90 MeV

Answer: (a)

Question: S1: When a capillary tube is dipped in cold water and then hot water, the height of water increases

S2: When a capillary tube is dipped in hot water and then cold water, the height of water decreases

[Assume negligible change in density of water or radius of capillary]

Options:

(a) 1 true, 2 false

(b) 1 false, 2 true

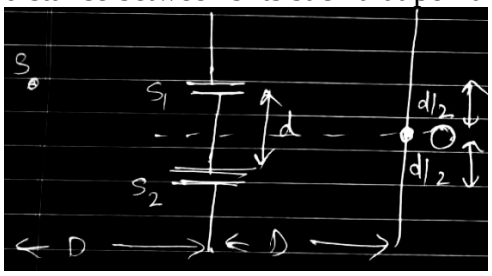
(c) Both false

(d) Both True

Answer: (c)

Question: In YDSE experiment source is placed exactly in front of one slit.

The distance between slits & screen is 0.2m. Wavelength used is 400 nm. Find the minimum distance between slits such that point O is dark



Options:

(a) 0.28 mm

(b) 0.36 mm

(c) 0.14 mm
(d) 0.49 mm
Answer: (a)

Question: A galvanometer with resistance $R_g = 8\Omega$ has a fall scale deflection current of $I_g = 3$ mA. What is the shunt resistance required to create an ammeter of 8 ampere range?
Options:
(a) 0.001 Ω
(b) 0.003 Ω
(c) 0.009 Ω
(d) 0.01 Ω
Answer: (b)

Question: Calculate the flux passing through a sphere of radius 4a whose center is at the origin, if two changes 5q and -2q are placed at
(2q, 0) and (-5q, 0) respectively
Options:
(a) $5q/\varepsilon_0$
(b) $-2q/\varepsilon_0$
(c) $7q/\varepsilon_0$
(d) $3q/\varepsilon_0$
Answer: (a)

Question: If the magnetic potential due to a small magnetic dipole along the axis at a distance of 20 cm is 1.5×10^{-5} J Am^{-1} find its magnetic dipole moment
Options:
(a) 4 Am^2
(b) 6 Am^2
(c) 8 Am^2
(d) 2 A^2
Answer: (b)

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Chemistry

Question: Which of the following pair will be formed by the decomposition of $KMnO_4$?
Options:
(a) MnO_4, MnO_2
(b) K_2 MnO_4 , MnO_2
(c) $KMnO_4$, MnO_2
(d) MnO_2 , H_2O
Answer: (b) K_2 MnO_4 , MnO_2
Solution:
Potassium permanganate forms dark purple (almost black) crystals which are isostructural with those of $KCLO_4$. The salt is not very soluble in water (6.4 g / 100 g of water at 293 K), but when heated it decomposes at 513 K.

$2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$

Question: Interaction b/w $\boldsymbol{\pi}$. Bond & lone pair l-s on adjacent atoms
Options:
(a) Resonance
(b) Hyper conjugation
(c) Inductive Effect
(d) Electronic Effect
Answer: (a) Resonance
Solution:

Question: Assertion. Electronegativity increase across a period
Reason. Effective increase in nuclear charge is more than effective shielding.
Options:
(a) Step 1: Electronegativity increase down the group 14 is to pb
(b) Step 2: Group 14 contains metals, non metals and also metalloids
Solution: Assertion true reason true
Step : 1 is incorrect but Step : 2 is correct

Question:

Column - I	**Column - II**
Ziegler Natta Catalyst	Rh
Blood Pigment	CO
Wilkinson Catalyst	Fe
Vitamin B12	Ti

Solution:
1 → Ti
2 → Fe
3 → Rh
4 → Co

Question: Appearance of Red colour on treatment with Na fusion extract of an organic compound with $FeSO_4$ in presence of conc. H_2SO_4 indicate element
Options:
(a) N
(b) Br
(c) S
(d) N & S
Answer: (d) N & S
Solution:(d) N & S

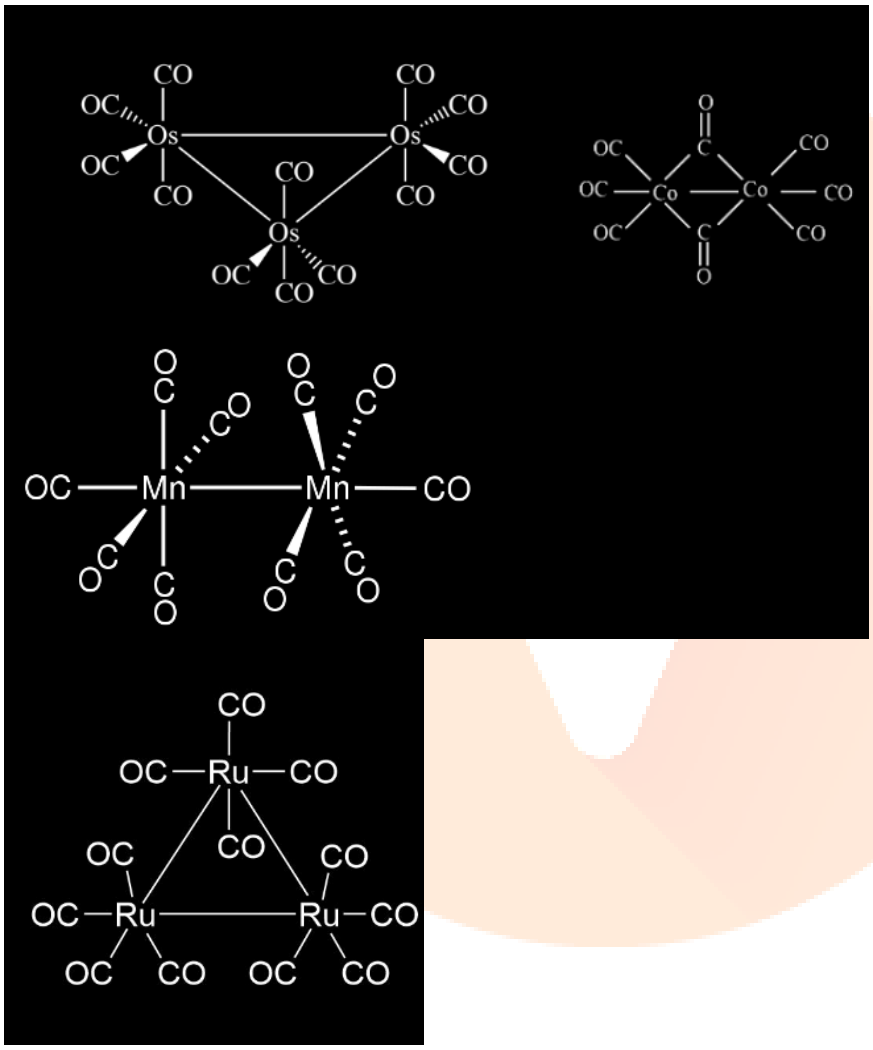
Question: Cl- shows disproportionation in alkaline meol :
a cl_2 + b OH^- → c cl O^- + d cl^- + H_2O
Options:
(a) 1 1 1 3
(b) 3 6 2 4
(c) 1 2 1 1
(d) 2 4 1 3
Answer: (b)
Solution: $3Cl_2 + 6OH^- \rightarrow 2ClO^-_3 + 4Cl^- + 3H_2O$

Question: The correct set of 4 Quantum numbers of Valence e^- of Rb(37)
Options:
(a) n = 5 ., l= 0 ., m = 1.,
(b) n = 5., l = 0., m = 0.,
(c) n = 5., l = 1., m = 0.,
(d) n = 5., l = 1., m = 1.,
Answer:
Solution:
Rb ⇒ 5 sl
↓
n = 5
l = 0
Ml = 0
Mg = +1/2 or - 1/2
The electronic configuration of rubidium atom (Z = 37) is given by
Rb = [Kr] 5 s1
Hence, the quantum numbers for 5 s1 electron is given by
n = 5, I = 0, m = 0, s=+1/2 or - 1/2

Question: Type of amino acids obtained on hydrolysis of proteins
Options:
(a) **α**
(b) ***β***

(c) γ
(d) δ
Answer: (a)
Solution: Alpha amino acid

Question: CO forms a bridge b/w M atoms
Options:
(a) $Os_3 (CO)_{12}$
(b) $Co_2 (CO)_8$
(c) $Ru_3 (CO)_{12}$
(d) $Mn_2 (CO)_{10}$
Solution:



Question: Calculate the Molarity of a Solution having density = 1.25 g/ml. % (w/w) of Solute is 31.4% of H_2SO_4 solution
Options:
(a) 4
(b) 9
(c) 8
(d) 6
Answer: (a)
Solution:

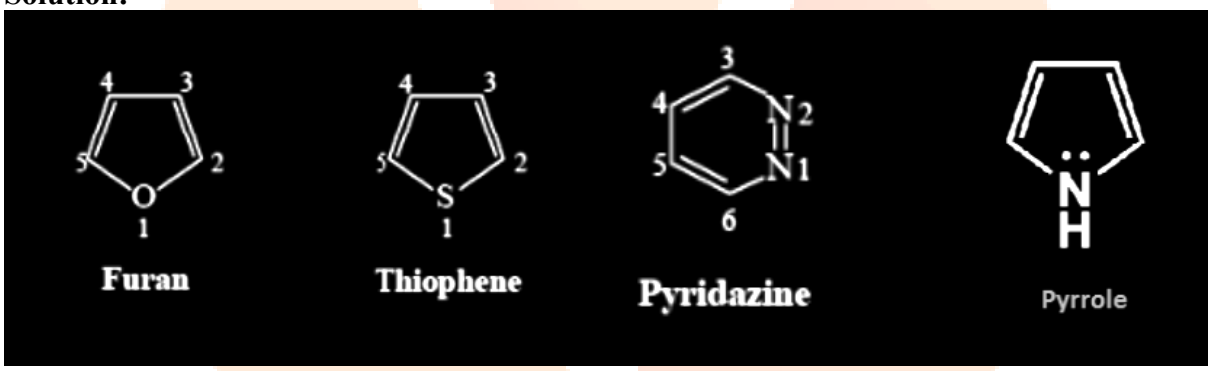
$$M = \frac{10 \times w/w\ \% \times d}{M_{solute}}$$

$$M = \frac{10 \times 31.4 \times 125 \times 100}{98}$$

$= 4$

Question: Find all quantum numbers Z = 37
Options:
(a) n = 5 ., l= 0 ., m = 1.,
(b) n = 5., l = 0., m = 0.,
(c) n = 5., l = 1., m = 0.,
(d) n = 5., l = 1., m = 1.,
Answer: (a)

Question: Among the heterocyclic compound that contain Sulphur atom is :
Options:
(a) Pyradizine
(b) Furan
(c) Thiophene
(d) Pyrrole
Answer: (c)
Solution:



Question: Find weight of Zinc in Zinc sulphate electrolysis i = 0.015 A t = 15 minutes
Solution:
$Zn^{+2} + 2e^{-} \rightarrow Zn$
1 mol Zn = 65.3 gm = 2 F

$$\text{Number of Faradays} = \frac{0.015 \times 15 \times 60}{965}$$

= 0.00013 g F
= .0046

Question: Number of compound in which B.O = 1 and is paramagnetic
He_2^+., O_2^+, O_2^{-2}, N_2^+
Answer: 0
Solution:

	B.O	Magnetic nature
He_2^+	0.5	Paramagnetic
O^+_2	1.5	Paramagnetic
O^{2-}_2	1	Diamagnetic

N^{+}_{2} 2.5 Paramagnetic

Question: Number of compounds that gives positive fehling test Benzaldehyde, acetophenone, methanal

Answer: 1

Solution: Aliphatic aldehyde group. Aromatic aldehydes and ketones do not a give Fehling's test.

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Maths

Question: f(x) = $2^x - x^2$ m = number of solution such that f(x) with x axis
N = number of solutions such that f'(x) with x axis m + n ?
Answer: 5
Solution:

$f(x) = 2^x - x^2$

$f'(x) = 2^x \ell n^2 - 2x$

$m = 3$

$n = 2$

Question: $(1 + y^2)(1 + \ln x)\,dx + x\,dy = 0$
Answer:

Question: Find $I = \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \left(\frac{x^2 \cos x}{1+e^x} + \frac{1+\sin^2 x}{1+e^{\sin\left(x^{2023}\right)}} \right)$

Solution:

$$I = \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{x^2 \sin x}{1+e^x} + \frac{1+\cos^2 x}{1+e^{\sin(x2023)}} dx$$

$$I = \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{x^2 \sin x}{1+e^x} - e^x + \frac{1+\cos^2 x}{1+e^{\sin(x2023)}} dx$$

$$\alpha I = \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} x^2 \sin x + 1 + \cos^2 x$$

$$\cancel{\alpha} I = \cancel{\alpha} \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} x^2 \sin x + \cos^2 x\,dx$$

$$I = x^2(-\cos x) + (2x)(+\sin x) + 2(\cos x)\Big|_0^{\frac{\pi}{2}} + \frac{\pi}{2} + \frac{\pi}{4}$$

$$I = \left(0 + \cancel{2}.\frac{\pi}{\cancel{2}}\right) - (0 + 0 + 2) + \frac{3\pi}{4}$$

$$I = \frac{7\pi}{4} - 2$$

Question: If an AP with terms <ai>, $a_6 = 2$ and a_1, a_4 a_5 is maximum. Find the common difference.

Solution:

$a_6 = 2 \& a_1 a_4 a_5 = \max.(\text{given})$

$\Rightarrow M = (a_6 - 5d)(a_6 - 2d)(a_6 - d)$

$= (2 - sd)(2 - 2d)(2 - d)$

$M = 2\left(-5d^3 + 17d^2 - 16d + 4\right)$

$\frac{dM}{dQ} = 2\left(-15d^2 + 24d + 10d - 16\right) = 0$

$= 2\left(-3d(5d - 8) + 2(sd - 8)\right) = 0$

$= -2(3d - 2)(5d - 8) = 0$

$d = \frac{8}{5}$

Question: $\frac{{}^{11}C_1}{2} + \frac{{}^{11}C_2}{3} + \text{-------} + \frac{{}^{11}C}{9} = \frac{n}{m}$

gcd (M, n) = 1, find m + n.

Solution:

$(1+x)^{11} = \sum_{r=0}^{r=11} {}^{h}C_r x^r$

$\int_0^1 (1+x)^{11}\, dx = \sum_{r=0}^{r=11} \frac{{}^{11}C_r x^r}{r+1}\Big|^{l}$

$\frac{2^{12} - 1}{12} = \sum_{r=0}^{r=11} \frac{{}^{11}C_r}{r+1}$

$= \frac{{}^{11}C_0}{1} + (5) + \frac{{}^{11}C_g}{10} + \frac{{}^{11}C_{10}}{11} + \frac{{}^{11}C_{11}}{12}$

$\frac{2^{12} - 1}{12} = 5 + \frac{91}{12} \Rightarrow 5 = \frac{4096 - 91}{12} = \frac{4095}{12} = \frac{1365}{4}$

$m + n = 1369$

Question: $f(x) = \frac{\left(2^x + 2^{-x}\right)(\tan x)\sqrt{\tan^{-1}\left(x^2 - x + 1\right)}}{\left(x^3 - x^2 + 1\right)^3}$

Find f'(a) =

Solution:

$$f(x)=\frac{\left(2^x+2^{-x}\right)\tan x\sqrt{\tan^{-1}\left(x^2-x+1\right)}}{\left(x^3-x^2+1\right)^3}$$

$$f(0)=0$$

$$f'(0)=\lim_{x\to 0}\frac{f(x)}{x}=\frac{2\cdot 1\cdot\sqrt{\frac{\pi}{4}}}{1}=\sqrt{\pi}$$

Question:

$$\left.\begin{aligned}x^2+y^2&=46,\\ \frac{x^2}{16}+\frac{y^2}{b^2}&=1\end{aligned}\right\}$$

POI lives on $y^2 = 3x^2$ find $3\sqrt{3}$ times of areas of rectangle formed by POI of conics

Question:

$$\lim_{x\to\frac{\pi}{2}}\frac{1.\int_{x^3}^{\left(\frac{\pi}{2}\right)^3}\cos\left(x^{\frac{1}{3}}\right)dx}{\left(x-\frac{\pi}{2}\right)^2}$$

Solution:

$$=\frac{3\pi^2}{8}$$

Question: GTWENTY, find rank of GTWENTY

Solution:

2 4 5 1 3 4 6

$G\ T\ W\ N\ T\ Y$

$\frac{1}{2}!\ \frac{2}{2}!\ 3\ 0\ 0\ 0\ 0$

$$\text{Rank}=\frac{1}{2!}\times 6!+\frac{2}{2!}\times 5!+3\times 4!+1$$

$$=360+120+72+1$$

$$=480+73=553$$

Question:

$A\cdot A^T=I$ Value of $\left(\frac{1}{2}A\right)\left[\left(A+A^T\right)^2+\left(A-A^T\right)^2\right]$

Options:

(a) $A^3 + AT$

(b) $(A^3 + AT)^2$

(c) (A^3+I)

(d) A^3

Solution:

$A \cdot A^T = I$

$\frac{1}{2} A\left(\left(A + A^T\right)^2 + \left(A - A^T\right)\right)^2$

$\frac{1}{2} A\left(A^2 + \left(A^T\right)^2 + 2I + A^2 (AT)^2 - 2I\right)$

$A\left(A^2 + \left(A^T\right)^2\right) \qquad A^T = A^{-1}$

$= A^3 + AA^T A^T$

$= A^3 + A^T$

Question:

$\begin{bmatrix} 1 & 0 & 0 \\ 0 & \beta & \alpha \\ 0 & \alpha & \beta \end{bmatrix} = A \det(2A)^3 = 2^{21}$

Find one of value of
α(or β) α, β both integers.

Options:

(a) 3
(b) 17
(c) 9
(d) 6

Solution:

$\begin{bmatrix} 1 & 0 & 0 \\ 0 & \beta & \alpha \\ 0 & \alpha & \beta \end{bmatrix} = A$

$\text{Net}(2A)^3 = |2A|^3$

$= \left(8|A|\right)^3 = 2^{21}$

$= 2^9 \cdot |A|^3 = 2^{21}$

$\Rightarrow |A|^3 = 2^{12}$

$= \beta^2 - \alpha^2 = 2^4 = 16$

Question:

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

$S-1\ f\left[\frac{1}{2}; 1\right] \to R$; f(x) intersection x axis at 1 point S-2 f(x) intersection x axis at

$x = \cos\frac{\pi}{12}$

Solution:

$S-1$

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

$f\left(\frac{1}{2}\right)=4\sqrt{2}\times\frac{1}{8}-2\sqrt{2}\times\frac{1}{2}-1=\sqrt{2}-\sqrt{2}-1=-14$

$f(1)=4\sqrt{2}-2\sqrt{2}-1$

$f\left(\frac{1}{2}\right)\cdot f(1)<0$

$f'(x)=12\sqrt{2}x^2-2\sqrt{2}=0$

$=x^2=\frac{1}{6}$

$x=\pm\frac{1}{\sqrt{6}}\notin\left[\frac{1}{2},1\right]$

$=2\sqrt{2}-1>0$

$S-1$ is true

Question: Sum of all 64 terms is 7(sum of terms at odd), find common ratio.
Options:
(a) 6
(b) 7
(c)
(d)
Solution:

$$\frac{a\left(r^{04}-1\right)}{r-1}=7\frac{ar\left(r^{64-1}\right)}{r-1}\Rightarrow r=\frac{1}{7}$$

Question: Event of tossing a dice and setting 2 in even no of throws.
Options:
(a) $\frac{5}{11}$
(b) $\frac{6}{11}$

Question: (1 +y^2) (1 + ln x) dx + x dy = 0 Passes thrown (1, 1) find $f(e)=\frac{\alpha\tan-\frac{3}{2}}{\beta+\tan^{-1}\frac{3}{2}}$.

Find $\alpha + 2\beta$

Question: $Z=\frac{1}{2}+2i,|z+1|=\alpha z+\beta(l+i)$

Find $\alpha + 2\beta$ or $2\alpha + \beta$
Solution:

$$Z=\frac{1}{2}+2i, |z+1|=\alpha z+\beta+\beta i$$

$$Z+1=\frac{3}{2}+2i, \sqrt{\frac{9}{4}+4}=\alpha\left(\frac{3}{2}+2i\right)+\beta+\beta i$$

$$\frac{3\alpha}{2}+\beta=\frac{5}{2}, 2\alpha+\beta=0 \Rightarrow \beta=-2d$$

$$\Rightarrow 3\alpha-4\alpha=5 \Rightarrow \alpha=-5, \beta=-10$$

Question: (a, b) R(c, d) a, b, c, d ∈ Z ab - bd is divided by 5.
Options:
(a) S, R not T
(b) Not Transitive
Solution: Not Transitive

Question: $x^2 + y^2 = 169$, $5x - y = 13$, find area inside circle lying below the line.

Question: $4\cos\theta + 5\sin\theta = 1$, x is a solution Find tan x. $\in \left[\frac{-\pi}{2}, \frac{\pi}{2}\right]$

Question: $4\left[\frac{1-f^2}{1+f^2}\right]+5\left[\frac{2f}{1+f^2}\right]=I$ when $f=\tan\frac{x}{2}$