SOLUTION OF JEE MAIN OFFLINE EXAM 06/04/2014 BY SUHAG KARIYA

Code E English & Hindi Medium

Q.61. If $X = \{4^n - 3n - 1 : n \in N\}$ and $Y = \{9(n-1) : n \in N\}$ where N is the set of natural numbers, then $X \cup Y$ is equal to 1) X 2) Y 3) N 4) Y−X

Sol. (2) Put $n = 1, 2, 3, ----$

$X = \{0, 9, 54, ----\}$

$Y = \{0, 9, 18, ----\}$

So $X \cup Y = \{0, 9, 18, 27, ---\}$

So $X \cup Y = Y$

Q.61 Ans Y

Q.62. If z is complex number such that $|z| \geq 2$, then minimum value of $\left|z + \frac{1}{2}\right|$: 1) $> \frac{5}{2}$ 2) $< \frac{5}{2}$ & $> \frac{3}{2}$ 3) $\frac{5}{2}$ 4) lies in interval (1,2).

Sol. (2) let $z = r(\cos\theta + i\sin\theta)$; $r \geq 2$

$z + \frac{1}{2} = r\cos\theta + \frac{1}{2} + ir\sin\theta$

$\left|z + \frac{1}{2}\right| = \sqrt{\left(r\cos\theta + \frac{1}{2}\right)^2 + (r\sin\theta)^2}$ for $\left|z + \frac{1}{2}\right|$ min $r = 2$

min $\left|z + \frac{1}{2}\right| = \sqrt{\left(2 \cdot c + \frac{1}{2}\right)^2 + 2^2 s^2} = \sqrt{4c^2 + \frac{1}{4} + 2 \cdot 2 \cdot c \frac{1}{2} + 4s^2}$

$= \sqrt{4 + \frac{1}{4} + 2\cos\theta} = \sqrt{\frac{17}{4} + 2\cos\theta}$

Min ans max $\cos\theta = 1$

$\left|z + \frac{1}{2}\right| = \sqrt{\frac{17}{4} + 2} = \frac{5}{2}$

Min ans min $\left|z + \frac{1}{2}\right| = \sqrt{\frac{17}{4} - 2}$ ($\cos\theta = -1$) $= \sqrt{\frac{9}{4}} = \frac{3}{2}$

So lies betn $\frac{3}{2}$ to $\frac{5}{2}$

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Code E

Q.63. If $a \in R$ and the equation $-3(x-[x])^2+2(x-[x])+a^2=0$ ([x] is Greatest integer function) has no integral solutions, then all possible values of a } 1) $(-2,-1)$ 2) $(-\infty,-2)\cup(2,\infty)$ 3) $(-1,0)\cup(0,1)$ 4) $(1,2)$

Sol. (3)

$-3(x-[x])^2+2(x-[x])+a^2=0$; [x] is GIF

$x-[x]=\{x\}=t$ let. (FPF)

According to que x is not integer

$\{x\}\neq 0$

$0<\{x\}<1$

$0<t<1$

$0<t^2<1$

$t^2<t$

$-3t^2+2t+a^2=0$

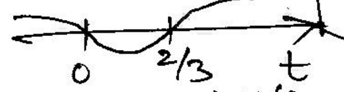
$a^2=3t^2-2t$

$y=3t^2-2t$

$0<a^2$

$0<3t^2-2t$

$0<t(3t-2)$

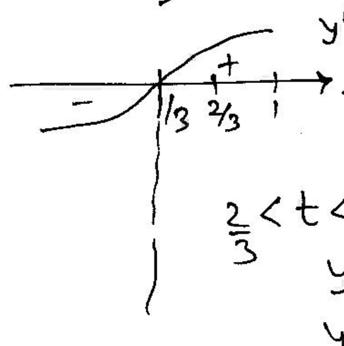


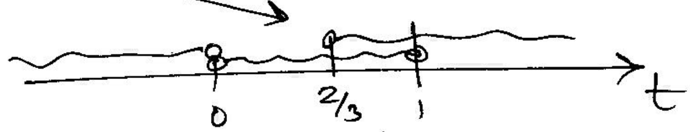
$t\in(-\infty,0)\cup(\frac{2}{3},\infty)$

$y'=6t-2$

$0=6t-2$

$\frac{1}{3}=t$





finally $\frac{2}{3}<t<1$

$\frac{2}{3}<t<1$

$y'=+ve$

$y\uparrow$

$a^2\uparrow$

a^2 at Min value at $t=\frac{2}{3}$ is $a^2=3\left(\frac{2}{3}\right)^2-2\cdot\frac{2}{3}=0$

a^2 at Max value at $t=1$ is $a^2=3\cdot1-2\cdot1=1$

$a^2\in(1,0)$ to

$a\in(-1,0)\cup(0,1)$

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Q.64. Let α & β be the roots of equation $px^2+qx+r=0$, $p\neq 0$. If p, q, r are in A.P. and $\frac{1}{\alpha}+\frac{1}{\beta}=4$, then the value of $|\alpha-\beta|$

1) $\frac{\sqrt{34}}{9}$ 2) $\frac{2\sqrt{13}}{9}$ 3) $\frac{\sqrt{61}}{9}$ 4) $\frac{2\sqrt{17}}{9}$

Sol. (2)

$\frac{1}{\alpha}+\frac{1}{\beta}=4$

$\frac{\beta+\alpha}{\alpha\beta}=4$ → $\alpha+\beta=4\alpha\beta$

$\frac{-q/p}{r/p}=4$

$-\frac{q}{r}=4$

$q=-4r$

$p, q, r \to AP$

$p+r=2q$

$p+r=-8r$

$p=-9r \to \frac{r}{p}=-\frac{1}{9}$

$|\alpha-\beta|=\sqrt{(\alpha+\beta)^2-4\alpha\beta}=\sqrt{(4\alpha\beta)^2-(4\alpha\beta)}$

$=\sqrt{(16)\left(\frac{r}{p}\right)^2-4\left(\frac{r}{p}\right)}$

$=\sqrt{16\times\frac{1}{81}+\frac{4}{9}}=\sqrt{\frac{16+36}{81}}$

$=\frac{2\sqrt{13}}{9}$

Q.65. If $\alpha, \beta \neq 0$ and $f(n)=\alpha^n+\beta^n$ and $\begin{vmatrix} 3 & 1+f(1) & 1+f(2) \\ 1+f(1) & 1+f(2) & 1+f(3) \\ 1+f(2) & 1+f(3) & 1+f(4) \end{vmatrix}=K(1-\alpha)^2(1-\beta)^2(\alpha-\beta)^2$ then K is

1) 1 2) −1 3) $\alpha\beta$ 4) $\frac{1}{\alpha\beta}$

Sol. Put $\alpha=2$; $\beta=3$

$\begin{vmatrix} 3 & 6 & 14 \\ 6 & 14 & 36 \\ 14 & 36 & 98 \end{vmatrix}=K(4)(1)(1)$

$\boxed{K=1}$

(1)

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Q.66. If A is an 3×3 non singular Matrix such that $AA' = A'A$ and $B = A^{-1}A'$, then BB' equals 1) B^{-1} 2) $(B^{-1})'$ 3) $I+B$ 4) I

Sol. (4)

$B\cdot B' = (A^{-1}A')(A^{-1}A')' = (A^{-1}A')(A(A^{-1})') = A^{-1}A'A(A')^{-1}$

$= A^{-1}AA'(A')^{-1}$

$= I\cdot I$

$= I.$

Q.67. If the coeffecient of x^3 & x^4 in the expansion $(1+ax+bx^2)(1-2x)^{18}$ in powers of x are both zero, then (a,b) is equal to

17×14: 68, 17, 238

17×32: 34, 51, 544

Sol. (2)

$(1-2x)^{18} + a(x)(1-2x)^{18} + bx^2(1-2x)^{18}$

coff of $x^3 \longrightarrow {}^{18}C_3(-2)^3 + a\cdot{}^{18}C_2(-2)^2 + b\cdot{}^{18}C_1(-2)^1 = 0$

$a\cdot 18\cdot17\cdot2 + b\,18(-2) = \frac{18\cdot17\cdot16\cdot2\cdot2\cdot2}{2\cdot3\cdot3}$

$17a - b = \frac{544}{3}$

let $a = 16$

$17(16) - \frac{544}{3} = b$

$\frac{3\cdot272 - 544}{3} = b$

$b = \frac{272}{3}$

Option

1) $\left(14, \frac{272}{3}\right)$

2) $\left(16, \frac{272}{3}\right)$

3) $\left(16, \frac{251}{3}\right)$

4) $\left(14, \frac{251}{3}\right)$

P.T.O.

Q.68. If $10^9 + 2(11)^1(10)^8 + 3(11)^2(10)^7 + \dots + 10(11)^9 = K(10)^9$

$\times \frac{11}{10}$: $1\cdot(11)^1(10)^8 + 2(11)^2(10)^7 + \dots + \dots + (11)^{10} = \frac{K\,10^8\cdot 11}{}$

find K

1) 100
2) 110
3) $\frac{121}{10}$
4) $\frac{441}{100}$

Ans (1)

$(10^9 + 11.(10)^8 + (11)^2(10)^7 + \dots + 11^9) - 11^{10} = -K\,10^8\cdot 11 + K10^9$

10 terms GP

$$\frac{10^9\left[\left(\frac{11}{10}\right)^{10} - 1\right]}{\frac{11}{10} - 1} - 11^{10} = -K\cdot 10^8\cdot 11 + K10^9$$

$$\frac{\left(11^{10}/10\right) - 10^9}{\frac{11-10}{10}} - 11^{10} = -K\cdot 10^8\cdot 11 + K10^9$$

$$11^{10} - 10^{10} - 11^{10} = K10^8[10 - 11]$$

$$-10^{10} = -K\cdot 10^8$$

$$100 = K$$

Q.69: Three positive numbers form increasing GP. If middle term in this GP is doubled, the new numbers are in AP. Find common ratio of GP 1) $2-\sqrt{3}$ B) $2+\sqrt{3}$ 3) $\sqrt{2}+\sqrt{3}$ 4) $3+\sqrt{2}$

Sol (2)

$a, ar, ar^2 \to$ GP & $a, 2ar, ar^2 \to$ AP

$a + ar^2 = 4ar$

$r^2 - 4r + 1 = 0$

$r = \frac{4 \pm \sqrt{16-4}}{2} = \frac{2 \pm \sqrt{3}}{1}$

$r = 2 + \sqrt{3}$

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code E

Q.70. (2)

$$\lim_{x\to 0} \frac{\sin(\pi\cos^2 x)}{x^2} = \lim_{x\to 0} \frac{\cos(\pi\cos^2 x).(-2\cos x\sin x)\pi}{2x} = \pi$$

1) $-\pi$ 2) π 3) $\pi/2$ 4) 1

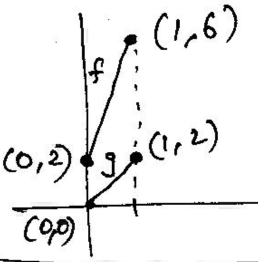
Q.71. (2) If g is the inverse of function f and $f'(x) = \frac{1}{1+x^5}$ then $g'(x)$ is equal to 1) $(1+g^5(x))^{-1}$ 2) $1+(g(x))^5$ 3) $1+x^5$ 4) $5x^4$

Sol. $f^{-1}(x) = g(x) \Longrightarrow x = f(g(x)) \Longrightarrow 1 = f'(g(x))\cdot g'(x)$

$\Longrightarrow \frac{1}{f'(g(x))} = g'(x) \Longrightarrow \frac{1}{\frac{1}{1+(g)^5}} = g'(x) = 1+(g(x))^5$

Q.72. If f and g are differentiable functions in [0, 1] Satisfying $f(0)=2=g(1)$, $g(0)=0$ and $f(1)=6$ then for some $c\in[0,1]$ 1) $f'(c)=g'(c)$ 2) $f'(c)=2g'(c)$ 3) $2f'(c)=g'(c)$ 4) $2f'(c)=3g'(c)$

Sol. (2)



$f' = \frac{6-2}{1-0} = 4$

$g' = \frac{2-0}{1-0} = 2$

$f' = 2g'$

Q.73. (1) If $x=-1$ and $x=2$ are extreme points of $f(x) = \alpha\log|x| + \beta x^2 + x$ then find α & β

	α	β
1	2	$-1/2$
2	2	$1/2$
3	-6	$1/2$
4	-6	$-1/2$

Sol. Differentiation $f'(x) = \frac{\alpha}{x} + 2\beta x + 1$

Given $x = 1, 2$ extremum

$f'(1) = 0$ & $f'(2) = 0$

$\frac{\alpha}{1} + 2\beta + 1 = 0$ & $\frac{\alpha}{2} + 4\beta + 1 = 0$

Check options $\alpha = 2$ & $\beta = -\frac{1}{2}$

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Q.74. The integral $\int \left(1+x-\frac{1}{x}\right)e^{x+\frac{1}{x}}dx$ is equal to

Sol. Using Classic Integral second

(4)

$$\int e^{g(x)}\left(g'(x).f(x)+f'(x)\right) = e^{g(x)}.f(x)+c$$

$$\int e^{x+\frac{1}{x}}\left(x-\frac{1}{x}+1\right)$$

$$\int e^{\left(x+\frac{1}{x}\right)}\left(x\left(1-\frac{1}{x^2}\right)+1\right) = \left(e^{x+\frac{1}{x}}\right).x+C$$

Ans

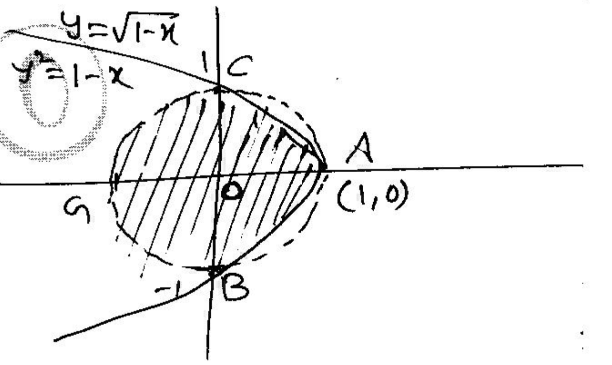
Q.75. The integral $I=\int_0^{\pi}\sqrt{1+4\sin^2\frac{x}{2}-4\sin\frac{x}{2}}$

(2)

$$I=\int_0^{\pi}\left|2\sin\frac{x}{2}-1\right|dx = -\int_0^{\pi/3}\left(2\sin\frac{x}{2}-1\right)+\int_{\pi/3}^{\pi}\left(2\sin\frac{x}{2}-1\right)=4\sqrt{3}-4-\frac{\pi}{3}$$

Ans

Q.76. The area of the region described by $A=\{(x,y): x^2+y^2\le 1$ and $y^2\le 1-x\}$



Sol. area GCOBG + Parabola BACOB

(3)

$$\frac{\pi.1^2}{2}+\int_{-1}^{1}(1-y^2)\,dy$$

$$\frac{\pi}{2}+2\int_0^1 1-y^2=\frac{\pi}{2}+2\left[y-\frac{y^3}{3}\right]_0^1$$

$$=\frac{\pi}{2}+2\left[1-\frac{1}{3}\right]=\frac{\pi}{2}+\frac{4}{3}$$

P.T.O.

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Q.77. Let the population of rabbits surviving at a time t be governed by the differential equation

$$\frac{d(P(t))}{dt} = \frac{1}{2}P(t) - 200$$

if $P(0) = 100$ then $P(t) =$

1) $600 - 500e^{t/2}$
2) $400 - 300e^{-t/2}$
3) $400 - 300e^{t/2}$
4) $300 - 200e^{-t/2}$

(3)

Sol.

$$\frac{dp(t)}{dt} = \frac{1}{2}p(t) - 200$$

$$\int_{100}^{P}\frac{d\,p(t)}{\frac{1}{2}(p(t)-200)} = \int_0^t dt$$

$$2\left[\ln|P-400|\right]_{100}^{P} = [t]_0^t$$

$$2\left[\ln|P-400| - \ln|300|\right] = t$$

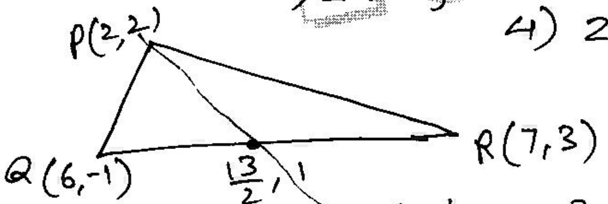
$$\ln\left(-\frac{(P-400)}{300}\right) = \frac{t}{2}$$

$$-\frac{(P-400)}{300} = e^{t/2}$$

$$P = -300e^{t/2} + 400$$

Q.78. Let PS be the median of the triangle with vertices P(2,2), Q(6,-1), R(7,3). The equation of the line passing through (1,-1) and parallel to PS is
1) $4x + 7y + 3 = 0$
2) $2x - 9y - 11 = 0$
3) $4x - 7y - 11 = 0$
4) $2x + 9y + 7 = 0$

Sol. (4)



$$\frac{2-1}{2-\frac{13}{2}} = -\frac{2}{9}$$

Only option 4 has slope 2/9

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Q.79. Let a, b, c, d be non zero numbers. If the point of intersection of the lines $4ax + 2ay + c = 0$ and $5bx + 2by + d = 0$ lies in the fourth quadrant and is equidistant from both the axes then 1) $3bc - 2ad = 0$ 2) $3bc + 2ad = 0$ 3) $2bc - 3ad = 0$ 4) $2bc + 3ad = 0$

Sol. according to que point is $(k, -k)$

(1)

$$4ak - 2ak + c = 0 \qquad 5bk - 2bk + d = 0$$

$$2ak + c = 0 \qquad 3bk + d = 0$$

$$k = \frac{-c}{2a} \qquad k = \frac{-d}{3b}$$

$$\frac{-c}{2a} = \frac{-d}{3b}$$

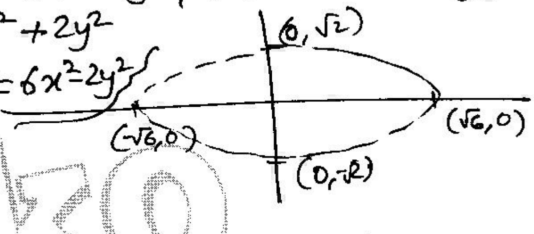
$$3bc = 2ad$$

$$3bc - 2ad = 0$$

Q.80. The locus of the foot of perpendicular drawn from the centre of the ellipse $x^2 + 3y^2 = 6$ on any tangent to it is 1) $(x^2+y^2)^2 = 6x^2 + 2y^2$ 2) $(x^2+y^2)^2 = 6x^2 - 2y^2$ 3) $(x^2-y^2)^2 = 6x^2 + 2y^2$ 4) $(x^2-y^2)^2 = 6x^2 - 2y^2$

Sol. (1)

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



at extreme points of Major & minor axis option 2 & 4 will not satisfy

Check in (1)

$$\left(\frac{3}{4} + \frac{9}{4}\right)^2 = 6 \cdot \frac{3}{4} + 2 \cdot \frac{9}{4}$$

$$\left(\frac{12}{4}\right)^2 = \frac{9}{2} + \frac{9}{2}$$

$$9 = 9 \quad ✓$$

~~tangent at~~ $(\sqrt{3}, 1)$

$$1x\sqrt{3} + 3 \cdot y = 6$$

Normal from (0,0): $x3 - y\sqrt{3} = 0$

$$3\sqrt{3}x - 3y = 0$$

$$4\sqrt{3}x = 6$$

$$x = \frac{6}{4\sqrt{3}} = \frac{\sqrt{3}}{2}$$

$$x\sqrt{3} = y$$

$$\frac{3}{2} = y$$

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Q.81. Let C be the circle at (1,1) and radius = 1. If T is the circle centred at (0, y), passing through origin and touching the circle C externally, then the radius of T is

1) $\frac{1}{2}$ 2) $\frac{1}{4}$ 3) $\frac{\sqrt{3}}{\sqrt{2}}$ 4) $\frac{\sqrt{3}}{2}$

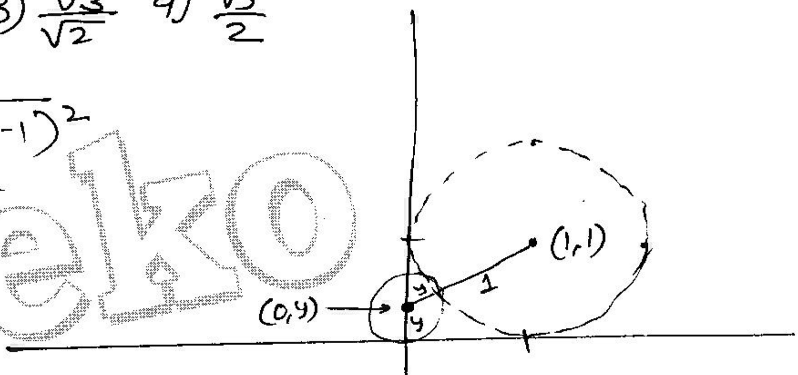
Sol. (2)

$y + 1 = \sqrt{(1-0)^2 + (y-1)^2}$

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

$4y = 1$

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



Q.82. The slope of the line touching both the parabolas $y^2 = 4x$ and $x^2 = -32y$ is:

Sol. (3)

$y = mx + \frac{1}{m}$ Put in $x^2 + 32y = 0$

$x^2 + 32\left(mx + \frac{1}{m}\right) = 0$

$mx^2 + 32m^2x + 32 = 0$

$D = 0$

$b^2 - 4ac = 0$

$(32m^2)^2 - 4 \cdot m \cdot 32 = 0$

$32 \cdot 32 \cdot m^4 = 4 \cdot m \cdot 32$

$m^3 = \frac{1}{8}$

$m = \frac{1}{2}$

P.T.O.

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Q.83 The image of the line $\frac{x-1}{3}=\frac{y-3}{1}=\frac{z-4}{-5}$ in the plane $2x-y+z+3=0$ is the line

Sol. (3) Here line & Plane are parallel

$2(3)-(1)-5=0$

Point on Given line is $(1, 3, 4)$

Put in Plane

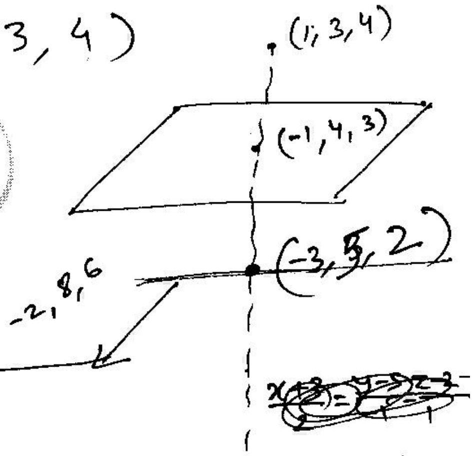
$2(2\lambda+1)-(-\lambda+3)+(\lambda+4)+3=0$

$4\lambda+2+\lambda-3+\lambda+4+3=0$

$6\lambda=-6$

$\lambda=-1$

Ans $\frac{x+3}{3}=\frac{y-5}{1}=\frac{z-2}{-5}$



$\frac{x-1}{2}=\frac{y-3}{-1}=\frac{z-4}{1}=\lambda$

$x=2\lambda+1 = -1 \quad (\lambda=-1)$

$y=-\lambda+3=4$

$z=\lambda+4=3$

Q.84 The angle between the lines whose direction cosines stisfies the equation $l+m+n=0$ & $l^2=m^2+n^2$

1) $\frac{\pi}{6}$ 2) $\frac{\pi}{2}$ 3) $\frac{\pi}{3}$ 4) $\frac{\pi}{4}$

Sol. (3)

$l^2-m^2-n^2=0$

$l^2+m^2+n^2=1$

$2l^2=1$

$l=\pm\frac{1}{\sqrt{2}}$

$l=-(m+n)$

$l^2=(m+n)^2$

$m^2+n^2=m^2+n^2+2mn$

$m=0$ or $n=0$

$l \to \pm\frac{1}{\sqrt{2}}$ | $\pm\frac{1}{\sqrt{2}}$

$m \to 0$ | $\mp\frac{1}{\sqrt{2}}$

$n \to \mp\frac{1}{\sqrt{2}}$ | 0

$\cos\theta = l_1l_2+m_1m_2+n_1n_2$

$=\frac{1}{2}+0+0$

$=\frac{1}{2}$

$\theta=60^\circ=\frac{\pi}{3}$

P.T.O.

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Q.85 If $|\vec{a}\times\vec{b} \cdot \vec{b}\times\vec{c} \;\; \vec{c}\times\vec{a}| = \lambda |\vec{a}\;\vec{b}\;\vec{c}|^2$ then find $\lambda \Rightarrow$ 1) 0 2) 1 3) 2 4) 3

Sol. (2) let consider $\vec{a} = \hat{i}$, $\vec{b} = \hat{j}$, $\vec{c} = \hat{k}$ $\quad \lambda = 1$

Q.86 Let A and B be two events such that $P(\overline{A\cup B}) = \frac{1}{6}$, $P(A\cap B) = \frac{1}{4}$ and $P(\bar{A}) = \frac{1}{4}$ where $\bar{A}$ stands for the complement of the event A. Then the event A and B are 1) independent but not equally likely 2) independent & equally likely 3) Mutually exclusive and independent 4) equally likely but not independent

Sol. (1)

$$P(A\cup B) = 1 - P(\overline{A\cup B}) = 1 - \frac{1}{6} = \frac{5}{6}$$

$$P(A) + P(B) - P(A\cap B) = \frac{5}{6}$$

$$\left(1 - \frac{1}{4}\right) + P(B) - \frac{1}{4} = \frac{5}{6}$$

$P(A) \neq P(B)$

$$P(B) = \frac{5}{6} + \frac{1}{4} + \frac{1}{4} - 1 = \frac{5}{6} + \frac{1}{2} - 1 = \frac{5}{6} - \frac{1}{2} = \frac{2}{6} = \frac{1}{3}$$

$$P(A)\times P(B) = \frac{3}{4}\times\frac{1}{3} = \frac{1}{4} = P(A\cap B)$$ Independent Even

Q.87 on Page 13

Q.88. Let $f_k(x) = \frac{1}{k}(\sin^k x + \cos^k x)$ where $x \in R$ and $k \geq 1$ then find $f_4(x) - f_6(x)$ equals 1) 1/4 2) 1/12 3) 1/6 4) 1/3

(2)

Sol. Put $x = 0$ & get Ans $\frac{1}{12}$ option (2)

Q.89 on Page 13

Que 90. The statement $\sim(p \leftrightarrow \sim q)$ is 1) A tautology 2) A fallacy 3) equivalent to $p \leftrightarrow q$ 4) equivalent to $\sim p \leftrightarrow q$

Sol 90. (3) we know that

$$\sim(p \leftrightarrow q) \equiv p \leftrightarrow \sim q.$$

so

$$\sim(p \leftrightarrow \sim q) \equiv p \leftrightarrow \sim(\sim q) \equiv p \leftrightarrow q.$$

SOLUTION OF JEE MAIN OFFLINE EXAM 06/04/2014 BY SUHAG KARIYA

The variance of - - -

Q.87 The variance of first 50 even natural numbers is
1) 437 2) $\frac{437}{4}$ 3) $\frac{833}{4}$ 4) 833

Q.87 (4)

Variance $= \left(\frac{\Sigma x^2}{n}\right) - \left(\frac{\Sigma x}{n}\right)^2$

$= \frac{\Sigma (2n)^2}{n} - \left(\frac{\Sigma 2n}{n}\right)^2$

$= \frac{4 \times n(n+1)(2n+1)}{n \times 6} - \left(\frac{2n(n+1)}{2n}\right)^2$

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

$= (n+1)\left[\frac{4n}{3} + \frac{2}{3} - n - 1\right]$

$(n+1)\left(\frac{n}{3} - \frac{1}{3}\right)$

Put $n = 50$

$(50+1)\left(\frac{50}{3} - \frac{1}{3}\right)$

$(51)\frac{(49)}{3} = 17 \times 49$

$= 833$ Q. 9. Ans. (4)

Q.89 A bird is sitting on the top of a vertical Pole 20 m high and its elevation from a point O on the ground is 45°. it flies horizontally straight away from the point O. After one second the elevation of the bird from O is 30 degree. Then speed of bird in (m/s) is

Sol. (2) Using Suhag's Cake & Supari Concept solve only in figure.

Ans $20\sqrt{3} - 20$

$20(\sqrt{3} - 1)$ m/s

Q.88 & 90 on page 12