MATHEMATICS

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

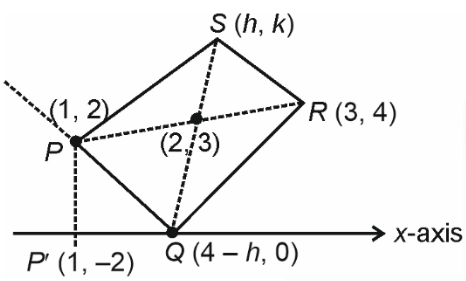
1. A ray of light passing through (1, 2) after reflecting on x-axis at point Q passes through $R(3, 4)$. If $S(h, k)$ is such that $PQRS$ is a parallelogram, then find the value of hk^2.

(1) 90 (2) 84

(3) 96 (4) 108

Answer (2)

Sol.



$\therefore \quad k = 6$ (using diagram)

P' lies on RQ

$$\frac{4}{h-1} = \frac{6}{2}$$

$\Rightarrow \quad 4 = 3h - 3$

$\Rightarrow \quad 3h = 7$

$\Rightarrow \quad h = \frac{7}{3}$

$$hk^2 = \frac{7}{3} \times 36 = 84$$

2. Tetrahedral dice having outcomes (1, 2, 3, 4) has 3 outcomes a, b, c (which are visible). Probability that $ax^2 + bx + c = 0$ has real roots is $\frac{m}{n}$. (m, n are coprime). Then $m + n$ =?

(1) 4 (2) 5

(3) 6 (4) 7

Answer (2)

Sol. $a, b, c \in \{1, 2, 3, 4\}$

And a, b, c are distinct

For real roots of $ax^2 + bx + c = 0$

$b^2 \geq 4ac$

So, we get (a, b, c) as (1, 3, 2),

(2, 3, 1), (1, 4, 2), (2, 4, 1), (1, 4, 3) and (3, 4, 1)

So, total 6 values of (a, b, c) are possible for required condition.

So, required probability $= \frac{6}{4!} = \frac{6}{24}$

$= \frac{1}{4} = \frac{m}{n}$

$m + n = 5$

3. A circle passes through (0, 0) and (1, 0) and touches the circle $x^2 + y^2 = 9$. Then the locus of the centre of the circle is

(1) Circle

(2) Parabola

(3) Hyperbola

(4) Straight line

Answer (1)

Sol. Circle will touch internally.

$C_1C_2 = |r_1 - r_2|$

$\sqrt{h^2+k^2} = 3-\sqrt{h^2+k^2}$

$\Rightarrow\ 2\sqrt{h^2+k^2} = 3$

$\Rightarrow\ x^2+y^2 = \frac{9}{4}$

4. $\vec{A}, \vec{B}$ and $\vec{C}$ are given as

$\vec{A} = \alpha\hat{i}+4\hat{j}+5\hat{k}$

$\vec{B} = 2\hat{i}+5\hat{j}+6\hat{k}$

$\vec{C} = \vec{A}+\vec{B}$

$|\vec{C}| = |\vec{A}-\vec{B}|$

The value of α and $|\vec{C}|^2$ is equal to

(1) 25, 731 (2) –25, 669

(3) –25, 731 (4) 25, 669

Answer (3)

Sol. $|\vec{C}| = |\vec{A}+\vec{B}|$

$|\vec{C}| = |\vec{A}-\vec{B}|$

$\Rightarrow\ \vec{A}\cdot\vec{B} = 0$

$\Rightarrow\ 2\alpha + 20 + 30 = 0$

$\Rightarrow\ \alpha = -25$

$|\vec{C}|^2 = |\vec{A}|^2 + |\vec{B}|^2 + 2\vec{A}\cdot\vec{B}$

$= \alpha^2 + 16 + 25 + 4 + 25 + 36$

$= 731$

5. If set $A = \{Z : |Z-1| \le 1\}$ and set $B = \{Z : |Z-5i| \le |Z-5|\}$, If $Z = a + ib$, (where $a, b \in I$) then sum of modulus squares of $A \cap B$ is

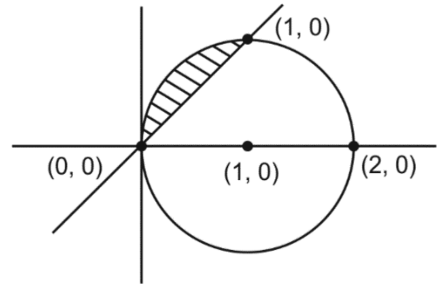
(1) 0 (2) 2

(3) 4 (4) 5

Answer (2)

Sol. $|Z-1| \le 1$

$|Z-5i| \le |Z-5|$



$\Rightarrow\ Z = a + ib,\ a, b \in I$

$\Rightarrow\ (a, b) = \{(0, 0), (1, 1)\}$

$\Rightarrow\ |Z| = \sqrt{a^2+b^2} \Rightarrow \sqrt{a^2+b^2} \leftarrow \{0, \sqrt{2}\}$

Sum of squares of modulus $= 0^2 + (\sqrt{2})^2 = 2$

6. If $\frac{1}{(1+d)(1+2d)} + \frac{1}{(1+2d)(1+3d)} + \ldots + \frac{1}{(1+9d)(1+10d)} = 1.$

The value of $50d$ is $(d > 0)$

(1) 50 (2) 60

(3) 25 (4) 30

Answer (3)

Sol. $\frac{1}{(1+d)(1+2d)} + \frac{1}{(1+2d)(1+3d)} + \frac{1}{(1+3d)(1+4d)} + \ldots + \frac{1}{(1+9d)(1+10d)} = 1.$

$$\frac{1}{d}\left[\left(\frac{1}{1+d}-\frac{1}{1+2d}\right)+\left(\frac{1}{1+2d}-\frac{1}{1+3d}\right)+\ldots\ldots + \left(\frac{1}{1+9d}-\frac{1}{1+10d}\right)\right] = 1$$

$$\frac{1}{d}\left[\frac{1}{1+d}-\frac{1}{1+10d}\right] = 1$$

$$\frac{9d}{d\cdot(1+d)(1+10d)} = 1 \Rightarrow 9 = (10d+1)(d+1)$$

$$\therefore 10d^2 + 11d - 8 = 0$$

$\Rightarrow\ d = \frac{1}{2}$

$\therefore\ 50d = \frac{1}{2}$

7. If $f(x) = \begin{cases} \left(\frac{8}{7}\right)^{\frac{\tan 8x}{\tan 7x}} & , \quad x \in \left(0, \frac{\pi}{2}\right) \\ a-8 & , \quad x = \frac{\pi}{2} \\ (1+|\cot x|)^{\frac{b}{a}|\tan x|} & , \quad x \in \left(\frac{\pi}{2}, \pi\right) \end{cases}$

If the function $f(x)$ is continuous at $x = \frac{\pi}{2}$ then $a^2 + b^2$ is equal to

(1) 97 (2) 85

(3) 81 (4) 100

Answer (4)

Sol. $\lim_{x\to\frac{\pi^-}{2}} f(x) = f\left(\frac{\pi}{2}\right) = \lim_{x\to\frac{\pi^+}{2}} f(x)$ for continuity at $x = \frac{\pi}{2}$

$\Rightarrow \lim_{x\to\frac{\pi^-}{2}} \left(\frac{8}{7}\right)^{\left(\frac{\tan 8x}{\tan 7x}\right)}$ Let $x = \frac{\pi}{2} - h$

$\Rightarrow \lim_{h\to 0}\left(\frac{8}{7}\right)^{\frac{\tan(4\pi-8h)}{\tan\left(3\pi+\frac{\pi}{2}h\right)}} = \lim_{h\to 0}\left(\frac{8}{7}\right)^{\frac{\tan(-8h)}{\cot(h)}} = \left(\frac{8}{7}\right)^0 = 1$

$\Rightarrow$ $a - 8 = 1 \Rightarrow a = 9$

$\lim_{x\to\frac{\pi^+}{2}} (1+|\cot x|)^{\frac{b}{a}|\tan x|}$, $x = \frac{\pi}{2} + h$

$\lim_{h\to 0}(1-\tan h)^{-\frac{b}{9}\coth} = \lim_{h\to 0}(1-\tan h)^{-\frac{b}{9}\coth}$

$= \lim_{h\to 0}(1-\tan h)^{\left(\frac{-1}{\tan h}\right)\cdot(-\tan h)\cdot\left(\frac{-b}{9}\coth\right)}$

$= e^{\frac{b}{9}} = 1$ $\Rightarrow b = 0$

$\Rightarrow$ $a^2 + b^2 = 81 + 0 = 81$

8. If $\cos\theta\cos(60-\theta)\cos(60+\theta) \le \frac{1}{8}$. Find the sum of values of θ for which $\cos 3\theta$ is maximum

(1) 6π (2) 4π

(3) 3π (4) 7π

Answer (1)

Sol. $\cos\theta\cos(60-\theta)\cos(60+\theta) \le \frac{1}{8}$

$\Rightarrow \frac{1}{4}\cos 3\theta \le \frac{1}{8}$

$\cos 3\theta \le \frac{1}{2}$

$\because \cos 3\theta \le$ maximum

$\Rightarrow \cos 3\theta = \frac{1}{2}$, $3\theta = 2n\pi \pm \frac{\pi}{3}$, $n \in I$

$\therefore \theta = \frac{\pi}{9}, \frac{5\pi}{9}, \frac{7\pi}{9}, \frac{11\pi}{9}, \frac{13\pi}{9}, \frac{17\pi}{9}$

$= \frac{54\pi}{9} = 6\pi$

9. If $(x^2 + y^2)dy = 5xy\,dx$. Find the general solution of *DE*.

(1) $\frac{5}{8}\ln\left|\frac{y-2x}{y+2x}\right| = \frac{1}{4}\ln\left|\frac{y}{x}\right| - \ln|x| + C$

(2) $\frac{5}{8}\ln\left|\frac{y+2x}{y-2x}\right| = \frac{1}{4}\ln\left|\frac{y}{x}\right| - 2\ln|x| + C$

(3) $\frac{5}{8}\ln\left|\frac{y-2x}{y+2x}\right| = -\frac{1}{4}\ln\left|\frac{y}{x}\right| + \ln\left|x^2\right| + C$

(4) $\frac{5}{4}\ln\left|\frac{y-2x}{y+2x}\right| = \frac{1}{4}\ln\left|\frac{y}{x}\right| + 2\ln|x| + C$

Answer (1)

Sol. $\frac{dy}{dx} = \frac{5xy}{x^2+y^2}$

let $y = vx \Rightarrow \frac{dy}{dx} = v + x\frac{dv}{dx}$

$v + x\frac{dv}{dx} = \frac{5x\cdot vx}{x^2+v^2x^2} = \frac{5v}{1+v^2}$

$\Rightarrow x\frac{dv}{dx} = \frac{5v}{1+v^2} - v \Rightarrow \frac{4v-v^3}{1+v^2} = \frac{v\left(4-v^2\right)}{1+v^2}$

$$\int \frac{1+v^2}{v(2-v)(2+v)}dv = \int \frac{dv}{x} \Rightarrow \int \frac{1+v^2}{v(v-1)(v+2)} = -\int \frac{dx}{x}$$

Let $\frac{1+v^2}{v(v-2)(v+2)} = \frac{A}{v} + \frac{B}{v-2} + \frac{C}{v+2}$

$B = \frac{5}{8}, \quad A = \frac{1}{-4}, C = \frac{5}{8}$

$$\therefore \int \frac{1+v^2}{v(2-v)(2+v)}\,dv = -\frac{dx}{x}$$

$$= \int \left(-\frac{1}{4v} + \frac{5}{8(v-2)} + \frac{5}{8(v+2)} \right) dv = -\int \frac{dx}{x}$$

$$= -\frac{1}{4}\ln|v| + \frac{5}{8}\ln\left|\frac{(v-2)}{(v+2)}\right| = -\ln|x| + C$$

$$\Rightarrow -\frac{1}{4}\ln\left|\frac{y}{x}\right| + \frac{5}{8}\ln\left|\frac{y-2x}{y+2x}\right| = -\ln|x| + C$$

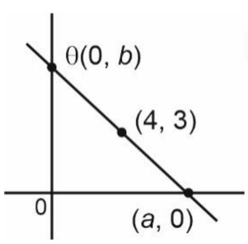
10. Find the maximum area (in sq. units) of a line pass through (4, 3)

(1) 30 (2) 31

(3) 24 (4) 32

Answer (3)

Sol.



$\frac{x}{a} + \frac{y}{b} = 1$

As line passes through (4, 3)

$\frac{4}{a} + \frac{3}{b} = 1$

$4b + 3a = ab$

$3a - ab = -4b$

$a = \frac{-4b}{3-b} = \frac{4b}{b-3}$

Now area of triangle = $\left|\frac{1}{2} \times a \times b\right|$

$= \left|\frac{1}{2} \times \frac{4b}{b-3} \times b\right|$

$\Rightarrow \quad f(b) = \frac{2b^2}{b-3}$

$\Rightarrow \quad f'(b) = \frac{2b(b-6)}{(b-3)^2} = 0$

[At $b = 6$ we get maximum area]

i.e. $\frac{1}{2} \times \frac{4 \times 6}{3} \times 6 = 24$ sq. units

11. $\int \frac{2+\tan x}{3+\tan x}dx = \frac{1}{2}\lambda x - \frac{1}{10}\log|a\sin x + b\cos x|$.

Then the value of $\lambda + \frac{a}{b}$ is equal to

(1) $\frac{13}{5}$ (2) $\frac{15}{26}$

(3) $\frac{26}{15}$ (4) $\frac{5}{13}$

Answer (3)

Sol. $\int \frac{2+\tan x}{3+\tan x}dx$

$$= \int \left(1 - \frac{1}{3+\tan x}\right)dx$$

$$= x - \int \frac{\cos x}{3\cos x + \sin x}dx$$

Consider $I' = \int \frac{\cos x}{3\cos x + \sin x}dx$

$\cos x = A(3\cos x + \sin x) + B(-3\sin x + \cos x)$

$A - 3B = 0$

$3A + B = 1$

$\Rightarrow \quad B = \frac{1}{10}, A = \frac{3}{10}$

$I' = \frac{3}{10}x + \frac{1}{10}\log|3\cos x + \sin x|$

$I = \frac{7x}{10} - \frac{1}{10}\log|3\cos x + \sin x|$

$= \frac{1}{2}\left(\frac{7x}{5}\right) - \frac{1}{10}\log|3\cos x + \sin x|$

$a = 1, b = 3, \ \lambda = \frac{7}{5}$

$\therefore \quad \lambda + \frac{a}{b}$

$= \frac{7}{5} + \frac{1}{3} = \frac{26}{15}$

12. If $y^2 = 4x$ and $x^2 + y^2 = 5$, then the area of smaller part of the circle cut by parabola is

(1) $\frac{2}{3} + \frac{5\pi}{2} + \sin^{-1}\frac{1}{\sqrt{5}}$

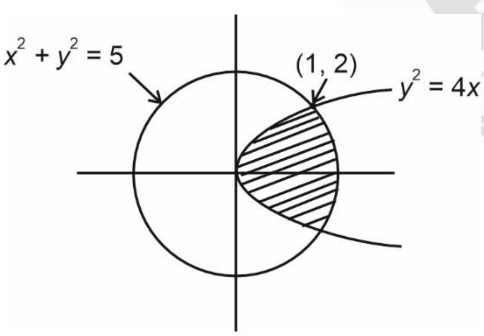
(2) $\frac{2}{3} + \frac{5\pi}{2} - 5\sin^{-1}\frac{1}{\sqrt{5}}$

(3) $\frac{2}{3} + \frac{5\pi}{4} + \sin^{-1}\frac{1}{\sqrt{5}}$

(4) $\frac{2}{3} + \frac{5\pi}{4} - 5\sin^{-1}\frac{1}{\sqrt{5}}$

Answer (2)

Sol.



$$\text{Area} = 2\left[\int_0^1 2\sqrt{x}\,dx + \int_1^{\sqrt{5}} \sqrt{5 - x^2}\,dx\right]$$

$$= 2\left[\left(\frac{4}{3}x^{\frac{3}{2}}\right)_0^1 + \left(\frac{x}{2}\sqrt{5 - x^2} + \frac{5}{2}\sin^{-1}\left(\frac{x}{\sqrt{5}}\right)\right)_1^{\sqrt{5}}\right]$$

$$= 2\left[\frac{4}{3} + \frac{5\pi}{4} - 1 - \frac{5}{2}\sin^{-1}\left(\frac{1}{\sqrt{5}}\right)\right]$$

$$= \left(\frac{2}{3} + \frac{5\pi}{2} - 5\sin^{-1}\frac{1}{\sqrt{5}}\right)\text{sq. unit}$$

13. If $\frac{ydy}{dx} + 3 = \frac{2dy}{dx}$ is a parabola passing through (1, 0). Then, the vertices of the parabola satisfy the equation

(1) $3x + 2y = 6$

(2) $3x + 2y = -6$

(3) $3x + 2y = 9$

(4) $3x + 2y = -9$

Answer (3)

Sol. $ydy + 3dx = 2dy$

$\Rightarrow \quad \frac{y^2}{2} + 3x = 2y + c\Big|_{(1,0)}$

$\Rightarrow \quad c = 3$

$\therefore \quad (y - 2)^2 = -6\left(x - \frac{5}{3}\right)$

$\therefore \quad \text{Vertex} = \left(\frac{5}{3}, 2\right)$

14. If α, β are the roots of the equation $x^2 - 2\sqrt{2}x + 1 = 0$ then equation whose roots are $\alpha^4 + \beta^4$ and $\frac{\alpha^6 + \beta^6}{6}$ is

(1) $x^2 - 66x + 1110 = 0$

(2) $x^2 - 33x + 1122 = 0$

(3) $x^2 - 34x + 1122 = 0$

(4) $x^2 - 67x + 1122 = 0$

Answer (4)

Sol. $x^2 - 2\sqrt{2}x + 1 = 0 <^{\alpha}_{\beta}$

$$\alpha^4 + \beta^4, \frac{\alpha^6 + \beta^6}{6}$$

$\Rightarrow \alpha + \beta = 2\sqrt{2}$, $\alpha\beta = 1$

$\Rightarrow \alpha^2 + \beta^2 + 2\alpha\beta = 8 \Rightarrow \alpha^2 + \beta^2 = 6$

$\Rightarrow \alpha^4 + \beta^4 + 2\alpha^2\beta^2 = 36 \Rightarrow \alpha^4 + \beta^4 = 34$

$$\Rightarrow \frac{\alpha^6 + \beta^6}{6} = \frac{(\alpha^2 + \beta^2)}{6}(\alpha^4 + \beta^4 - \alpha^2\beta^2)$$

$$= \left(\frac{6}{6}\right)[34 - 1] = 33$$

$\Rightarrow$ roots of the equation are 33, 44

$\Rightarrow$ equation is

$x^2 - (33 + 34)x + 33.34 = 0$

$\Rightarrow x^2 - 67x + 1122 = 0$

15. If $f(x) = x^2 - 8$, $g(x) = \frac{x}{x-9}$ and $a = f(g(10))$ and $b = g(f(3))$ and e and l be eccentricity and length of latus rectum of conic $\frac{x^2}{|a|} + \frac{y^2}{|b|} = 1$, then $(92l^2 + 46e^2)$ is

(1) 48 (2) 46

(3) 45 (4) 92

Answer (2)

Sol. $f(x) = x^2 - 8$

$$g(x) = \frac{x}{x-9}$$

$\Rightarrow f(g(10)) = f(10) = a = 92$

$$g(f(3)) = g(1) = b = -\frac{1}{8}$$

$\Rightarrow$ conic :

$$\frac{x^2}{92} + \frac{y^2}{1/8} = 1$$

$$l(\text{L}\cdot\text{R}) = \frac{2(1/8)}{\sqrt{92}} = \frac{1}{4\sqrt{92}} \Rightarrow l^2 = \frac{1}{16(92)}$$

$$e^2 = 1 - \frac{1/8}{92} = \frac{92\times 8 - 1}{92\times 8}$$

$$\Rightarrow 92l^2 + 46e^2 = \frac{1}{16} + \frac{735}{16}$$

$$= \frac{736}{16} = 46$$

16.

17.

18.

19.

20.

SECTION - B

Numerical Value Type Questions: This section contains 10 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. The remainder when $(428)^{2024}$ is divided by 21 is

Answer (1)

Sol. $(428)^{2024} \equiv 8^{2024}$ (mod 21)

$(8^2) \equiv 1$ (mod 21)

$(8)^{2024} \equiv 1$ (mod 21)

$\therefore$ remainder = 1.

22. If A is 3×3 matrix,

$\det(3adj(2adjA)) = 2^{-13} \cdot 3^{-10}$ and

$\det'(3adj(2A)) = 2^m \cdot 3^n$, then $2m + 2n$ is equal to

Answer (14.00)

Sol. $P \Rightarrow |3adj(2A)| = 3^3 \cdot |adj2A| = 3^3 \cdot |2A|^2 = 3^3 \cdot 2^6|A|^2$

$|3adj(2adj(A))| = 3^3 \cdot |adj(2adjA)| = 3^3 \cdot |(2adjA)|^2$

$= 3^3 \cdot (2^3)^2|adjA|^2$

$= 3^3 \cdot 2^6(|A|^2) = 3^3 \cdot 2^6|A|^4$

$= 2^{-13} \cdot 3^{-10}$

$\Rightarrow |A|^4 = 3^{-13} \cdot 2^{-19}$

$\Rightarrow |A|^2 = 3^{-6.5} \cdot 2^{-9.5}$

$\Rightarrow P = 3^3 \cdot 2^6 \cdot 3^{-6.5} \cdot 2^{-9.5} = 3^{-3.5} \cdot 2^{-3.5} = 2^m \cdot 3^n$

$\Rightarrow m = 3.5, n = 3.5$

$\Rightarrow 2m + 2n = 14$

23. If $f(x) = 3ax^3 + bx^2 + cx + 41$ and $f(1) = 41$,

$f'(1) = 2$ and $f''(1) = 4$ then $(a^2 + b^2 + c^2)$ is

Answer (08.00)

Sol. $f(1) = 3a + b + c + 41 = 41 \Rightarrow 3a + b + c = 0$

$f'(x) = 9ax^2 + 2bx + c \Rightarrow f'(1) = 9a + 2b + c = 2$

$f''(x) = 18ax + 2b \Rightarrow f''(1) = 18a + 2b = 4$

$\Rightarrow (4 - 9a) + c = 2$

$3a + c + (2 - 9a) = 0$

$\Rightarrow c - 6a + 2 = 0 \Rightarrow a = 0$

$c - 9a + 2 = 0 \quad c = -2$

$b = 2$

$\Rightarrow a^2 + b^2 + c^2 = 0 + 4 + 4 = 8$

24. If domain of $f(x) = \sin^{-1}\left(\frac{x-1}{2x+3}\right)$ is $R - (\alpha, \beta]$ then $12\alpha\beta$ is equal to

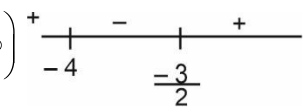
Answer (32.00)

Sol. $f(x) = \sin^{-1}\left(\frac{x-1}{2x+3}\right)$

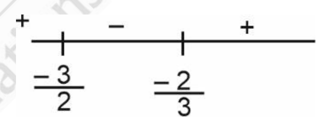
$\Rightarrow 2x + 3 \neq 0$ and $-1 \leq \frac{x-1}{2x+3} \leq 1$

$\Rightarrow \frac{x-1-2x-3}{2x+3} \leq 0 \Rightarrow \frac{x+4}{2x+3} \geq 0$

$\Rightarrow x \in (-\infty, -4] \cup \left(\frac{-3}{2}, \infty\right)$



Also, $0 \leq \frac{x-1+2x+3}{2x+3} \Rightarrow \frac{3x+2}{2x+3} \geq 0$



$\Rightarrow x \in \left(-\infty, \frac{-3}{2}\right) \cup \left[\frac{-2}{3}, \infty\right)$

$\Rightarrow$ domain $\Rightarrow x \in (-\infty, -4] \cup \left(\frac{-2}{3}, \infty\right)$

$\Rightarrow R - \left(-4, \frac{-2}{3}\right]$

$\Rightarrow \alpha = -4, \quad \beta = \frac{-2}{3}$

$\Rightarrow 12 \times (-4)\left(\frac{-2}{3}\right) = 32$

25. $A = \{2, 4, 6, 8\}$

$B = \{3, 7, 6, 9\}$

$R : A \times B \to A \times B$ such that

$(a_1, b_1)\ R(a_2, b_2) \Rightarrow a_1 + a_2 = b_1 + b_2$

$(a_1, b_1) \in A$ and $(a_2, b_2) \in B.$

Then the number of elements in the relation is

Answer (9)

Sol. $A = \{2, 4, 6, 8\}$

$B = \{3, 7, 6, 9\}$

$(a_1, b_1)\ R(a_2, b_2)$ when $a_1 + a_2 = b_1 + b_2$

(2, 6) R(7, 3)

(2, 4) R(9, 7)

(4, 8) R(7, 3)

(4, 6) R(9, 7)

(6, 2) R(3, 7)

(6, 4) R(7, 9)

(6, 8) R(9, 7)

(8, 4) R(3, 7)

(8, 6) R(7, 9)

So total 9 elements are in the relation.

26. If $f(m + n) = f(m) + f(n)$, $f(1) = 1$

then $\sum_{k=1}^{2022} f(\lambda + k) \le (2022)^2$, then $\lambda_{max} \in I$ is

Answer (1010)

Sol. $f(m + n) = f(m) + f(n)$

$\Rightarrow f(x) = kx$

$\because f(1) = 1 \Rightarrow k = 1$

$\therefore f(x) = x$

Now, $\sum_{k=1}^{2022} f(\lambda + k) \le (2022)^2$

$\Rightarrow \sum_{k=1}^{2022} (\lambda + k) \le (2022)^2$

$= \underbrace{\lambda + \lambda + ... + \lambda}_{2022} + (1 + 2 + 3 + ... + 2022) \le (2022)^2$

$2022\lambda + \frac{2022 \times 2023}{2} \le (2022)^2$

$\lambda \le \left(2022 - \frac{2023}{2}\right)$

$\Rightarrow \lambda \le \frac{2021}{2}$

$\lambda \le 1010.5$

$\therefore \lambda_{max} = 1010$

27.

28.

29.

30.

❑ ❑ ❑