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NIMCET 2023

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Preface

Dear Students,

This booklet, containing **Actual official question paper of NIMCET 2023** along with its **detailed solution** has been prepared by the expert faculty of SANMACS under the supervision and guidance of Dr. Sanjay Aggarwal.

The main aim of the book is to help students to understand clearly the type of questions which are being asked in NIMCET and thereby making them able to master the exact pattern of NIMCET.

Detailed solutions provided herein will acquaint the students with the subject knowledge needed to crack the upcoming NIMCET with top ranks.

This booklet along with **the legendary Coaching by SANMACS (available in all modes - *Offline, Hybrid & Online*)** will make students much better prepared and trained for the ensuing NIMCET so as to be able to **Beat the Competition**.

Hope your learning from this booklet would be fruitful.

All the Best!

Academic Team
SANMACS GLOBAL Students Outreach

PART – A : MATHEMATICS

1. Let R be a reflexive relation on a set having 10 elements. If m is the number of ordered pairs in R, then

[NIMCET – 2023 (Mathematics)]

(A) $m = 10$ **(B)** $m \le 10$ **(C)** $m = 100$ **(D)** $m \ge 10$

Ans. (D)

Sol: The set consists of 10 elements and for relation to be reflexive it must have at least 10 ordered pairs. Since it has m ordered pairs, thus $m \ge 10$.

2. A point P in the first quadrant, lies on $y^2 = 4ax$, $a > 0$ and keeps a distance of $5a$ units from its focus. Which of the following point lies on the locus of P?

[NIMCET – 2023 (Mathematics)]

(A) $(0,1)$ **(B)** $(1,1)$ **(C)** $(2,0)$ **(D)** $(1,0)$

Ans. (B)

Sol: Let the point $P(h,k)$ on the parabola $y^2 = 4ax$, $a > 0$ keeps a distance of $5a$ units from the focus $S(a,0)$. Then,

$$k^2 = 4ah \qquad \ldots \text{(i)}$$

and

$$SP = \sqrt{(h-a)^2 + k^2} = 5a$$

$$\Rightarrow \quad \sqrt{\left(h - \frac{k^2}{4h}\right)^2 + k^2} = \frac{5k^2}{4h}, \text{ using (i)}$$

On replacing h by x and k by y, the required locus of the point P is given by

$$\sqrt{\left(x - \frac{y^2}{4x}\right)^2 + y^2} = \frac{5y^2}{4x}$$

which is satisfied by the point (1, 1).

3. The value of $\int_{-\frac{\pi}{3}}^{\frac{\pi}{3}} \frac{x\sin x}{\cos^2 x}dx$ is

[NIMCET – 2023 (Mathematics)]

(A) $\frac{1}{3}(4\pi+1)$ **(B)** $\frac{4\pi}{3}-2\log\tan\frac{5\pi}{12}$ **(C)** $\frac{4\pi}{3}+\log\frac{5\pi}{12}$ **(D)** $\frac{4\pi}{3}-\log\tan\frac{5\pi}{12}$

Ans. (B)

Sol: Let us consider that

$$I=\int_{-\frac{\pi}{3}}^{\frac{\pi}{3}} \frac{x\sin x}{\cos^2 x}dx$$

$$=\int_0^{\frac{\pi}{3}} \frac{x\sin x}{\cos^2 x}dx \qquad \because \int_{-a}^{a} f(x)dx = 2\int_0^a f(x)dx,\ if\ f(-x)=f(x)$$

$$=\int_0^{\frac{\pi}{3}} \underbrace{x}_{I}\left(\underbrace{\tan x\sec x}_{II}\right)dx$$

$$=(x\sec x)\Big|_0^{\frac{\pi}{3}} - \int_0^{\frac{\pi}{3}}(\sec x)dx$$

$$=2\left(\frac{2\pi}{3}-\log\tan\frac{5\pi}{12}\right).$$

4. Let a, b, c and 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 equidistance from the two axes, then

[NIMCET – 2023 (Mathematics)]

(A) $2ad-3bc=0$ **(B)** $ad-bc=0$ **(C)** $ad-bc=0$ **(D)** $a+b+c+d=0$

Ans. (A)

Sol: If the point of intersection P of the lines $4ax+2ay+c=0$ and $5bx+2by+d=0$ lies in the fourth quadrant and is equidistance from the two axes, then it is of the form $P(h,-h)$. Therefore,

$2ah+c=0$ and $3bh+d=0$

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

$\Rightarrow \quad 2ad-3bc=0$.

5. Which of the following number is the coefficient of x^{100} in the expansion of $\log_e\left(\frac{1+x}{1+x^2}\right)$, $|x|<1$?

[NIMCET – 2023 (Mathematics)]

(A) -0.03 **(B)** -0.01 **(C)** 0.01 **(D)** None of these

Ans. (C)

Sol: Given that

$$\log\left(\frac{1+x}{1+x^2}\right)=\log(1+x)-\log\left(1+x^2\right)$$

$$=\left(x-\frac{x^2}{2}+\frac{x^3}{3}-\ldots-\frac{x^{100}}{100}+\ldots\right)-\left(x^2-\frac{x^4}{2}+\frac{x^6}{3}-\ldots-\frac{x^{100}}{50}+\ldots\right)$$

Therefore, the coefficient of x^{100}

$$=-\frac{1}{100}+\frac{1}{50}=0.01.$$

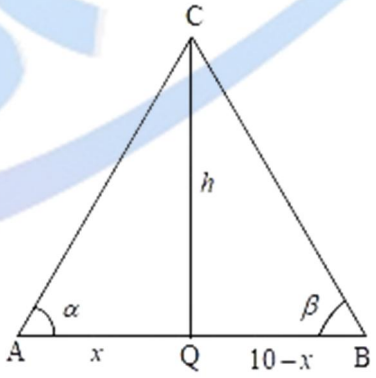
6. A line segment AB of length 10 meters is passing through the foot of the perpendicular of a pillar, which is standing at right angle to the ground. Tip of the pillar subtends angles $\tan^{-1}3$ and $\tan^{-1}2$ at A and B respectively, which of the following choice represents the height of the pillar?

[NIMCET – 2023 (Mathematics)]

(A) 15 **(B)** 12 **(C)** 10 **(D)** 8

Ans. (B)

Sol: The given information can be plotted as



where $\alpha = \tan^{-1} 3$ and $\beta = \tan^{-1} 2$, i.e., $\tan\alpha = 3$ and $\tan\beta = 2$. Now,

In ΔACQ

$$\tan\alpha = \frac{h}{x} = 3$$

$$\Rightarrow \quad x = \frac{h}{3} \qquad \ldots \text{(i)}$$

In ΔBCQ

$$\tan\beta = \frac{h}{10-x} = 2$$

$$\Rightarrow \quad h = 20 - 2x$$

$$\Rightarrow \quad h = 20 - 2h/3, \text{ using (i)}$$

$$\Rightarrow \quad h = 12.$$

7. The sum of infinite terms of decreasing G.P. is equal to the greatest value of the function $f(x) = x^3 + 3x - 9$ in the interval $[-2,3]$ and the difference between the first two terms is $f'(0)$ then the common ratio of the G.P. is

[NIMCET – 2023 (Mathematics)]

(A) $\frac{2}{3}$ **(B)** $-\frac{2}{3}$ **(C)** $-\frac{4}{3}$ **(D)** $\frac{4}{3}$

Ans. (A)

Sol: The function $f(x) = x^3 + 3x - 9$ is an strictly increasing function as

$$f'(x) = 3x^2 + 3 > 0 \ \ \forall \ x \in [-2,3]$$

$$\Rightarrow \quad f_{\max}(x) = f(3) = 27.$$

Let a be the first term and r be the common ratio of the decreasing G.P., then using the given conditions, we get

$$\frac{a}{1-r} = 27 \text{ and } a - ar = 3$$

$$\Rightarrow \quad 27(1-r) = \frac{3}{1-r}$$

$$\Rightarrow \quad \left(\frac{1}{1-r}\right)^2 = 9$$

$\Rightarrow \quad \frac{1}{1-r} = \pm 3$

$\Rightarrow \quad 1-r = \pm\frac{1}{3}$

$\Rightarrow \quad r = \frac{2}{3}$ or $r \neq \frac{4}{3}$ (as G.P. is decreasing).

8. If A and B are square matrices such that $B = -A^{-1}BA$, then $(A+B)^2 =$

[NIMCET – 2023 (Mathematics)]

(A) $A^2 + B^2$ **(B)** $A^2 - B^2$ **(C)** $A + B$ **(D)** $A - B$

Ans. (A)

Sol: Given that

$B = -A^{-1}BA$

$\Rightarrow \quad AB = -\left(AA^{-1}\right)BA$

$\Rightarrow \quad AB = -BA$

Therefore,

$(A+B)^2 = (A+B)(A+B)$

$= A^2 + AB + BA + B^2$

$= A^2 + B^2$.

9. In an examination of 9 papers, a candidate has to pass in more papers than the number of papers in which he falls in order to get the success. The number of ways in which he can be fail, is

[NIMCET – 2023 (Mathematics)]

(A) 255 **(B)** 256 **(C)** $9 \times 8!$ **(D)** 128

Ans. (B)

Sol: The candidates will be failed if he fails in at least 5 papers. Thus, the required number of ways to be unsuccessful

$= {}^9C_5 + {}^9C_6 + {}^9C_7 + {}^9C_8 + {}^9C_9$

$= \frac{1}{2}\left({}^9C_0 + {}^9C_1 + \ldots + {}^9C_9\right)$

$= \frac{1}{2} \times 2^9$ $\quad\quad \because {}^9C_0 + {}^9C_1 + ... + {}^9C_9 = 2^9$

$= 256$.

10. If $\vec{a}$ and $\vec{b}$ are tow unit vector and $2\vec{a}+\vec{b}$ is 3 units, then which of following statement is true?

[NIMCET – 2023 (Mathematics)]

(A) $\vec{a}$ and $\vec{b}$ are parallel

(B) $\vec{a}$ and $\vec{b}$ are perpendicular to each other

(C) $\vec{a}$ is perpendicular to $2\vec{a}+\vec{b}$

(D) $\vec{b}$ is parallel to $2\vec{a}+\vec{b}$

Ans. (A)

Sol: Since $\vec{a}$ and $\vec{b}$ are unit vector, thus $|\vec{a}| = |\vec{b}| = 1$. Now,

$2\vec{a}+\vec{b} = 3$

$\Rightarrow \quad |2\vec{a}+\vec{b}|^2 = 9$

$\Rightarrow \quad (2\vec{a}+\vec{b}).(2\vec{a}+\vec{b}) = 9$

$\Rightarrow \quad 4\vec{a}.\vec{a} + 4\vec{a}.\vec{b} + \vec{b}.\vec{b} = 9$

$\Rightarrow \quad 4|\vec{a}|^2 + 4|\vec{a}||\vec{b}|\cos\theta + |\vec{b}|^2 = 9$, where θ is the angle between the vectors $\vec{a}$ and **b**

$\Rightarrow \quad \cos\theta = 1$

$\Rightarrow$ the vectors $\vec{a}$ and $\vec{b}$ are parallel ($\theta = 0^0$).

11. Box A contains 4 green, 5 black and 6 white balls. Box B contains 5 green, 3 black and 2 white balls. A ball is chosen at random from the box A and placed in box B and then a ball is chosen at random from box B. What is the probability that a black ball was transferred from box A to box B given that the final ball chosen box B is green?

[NIMCET – 2023 (Mathematics)]

(A) $\frac{25}{79}$ **(B)** $\frac{30}{79}$ **(C)** $\frac{24}{79}$ **(D)** None of these

Ans. (A)

Sol: Box A contains 4G, 5B, 6W balls and Box B contains 5G, 3B, 2W. Using tree diagram for conditional probability for the Bayes rule, we have

$$\text{Experiment}\begin{cases}\xrightarrow[\text{ransffered to Box B}]{\text{green ball}} P(A)=\dfrac{4}{15}\xrightarrow[\text{Box B}(6G,3B,2W)]{\text{green ball taken}} P\left(\dfrac{E}{A}\right)=\dfrac{6}{11}\\ \xrightarrow[\text{ransffered to Box B}]{\text{black ball}} P(B)=\dfrac{5}{15}\xrightarrow[\text{Box B}(5G,4B,2W)]{\text{green ball taken}} P\left(\dfrac{E}{B}\right)=\dfrac{5}{11}\\ \xrightarrow[\text{ransffered to Box B}]{\text{white ball}} P(C)=\dfrac{3}{15}\xrightarrow[\text{Box B}(5G,3B,3W)]{\text{green ball taken}} P\left(\dfrac{E}{C}\right)=\dfrac{5}{11}\end{cases}$$

Thus, the required probability that a black ball was transferred from box A to box B given that the final ball chosen box B is green

$$=\frac{\frac{5}{15}\times\frac{5}{11}}{\frac{4}{15}\times\frac{6}{11}+\frac{5}{15}\times\frac{5}{11}+\frac{6}{15}\times\frac{5}{11}}$$
$$=\frac{25}{79}.$$

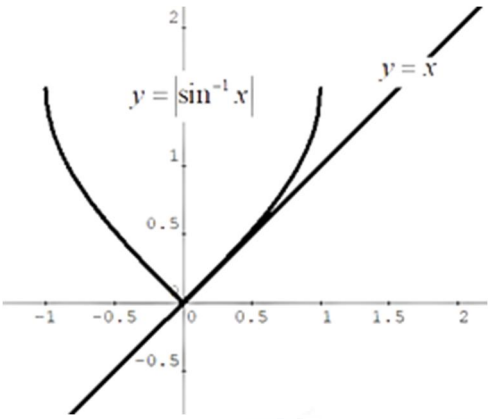
12. If n_1 and n_2 are the number of real valued solutions of equations $x=\left|\sin^{-1}x\right|$ and $x=\sin(x)$ respectively, then the value of n_2-n_1 is

[NIMCET – 2023 (Mathematics)]

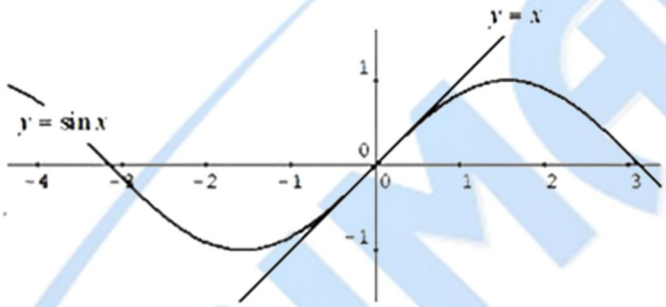
(A) 1 **(B)** 0 **(C)** 2 **(D)** 3

Ans. (B)

Sol: The graphs of the functions $y=x$, $y=\left|\sin^{-1}x\right|$ and $y=x$, $y=\sin x$ can be plotted as



and



Using the above graphs, we have

$n_1 = 1\,(at\,x = 0)$ and $n_2 = 1\,(at\,x = 0)$

Thus, $n_2 - n_1 = 0$.

13. The negation of $\sim s \vee (\sim r \wedge s)$ is equivalent to

[NIMCET – 2023 (Mathematics)]

(A) $s \vee (r \vee \sim s)$ **(B)** $s \wedge r$ **(C)** $s \wedge \sim r$ **(D)** $s \wedge (r \wedge \sim s)$

Ans. (B)

Sol: The negation of $\sim s \vee (\sim r \wedge s)$ is

$= \sim (\sim s \vee (\sim r \wedge s))$

$= s \wedge \sim (\sim r \wedge s)$

$= s \wedge \sim (\sim r \wedge s)$

$= s \wedge (r \vee \sim s)$

$= s \wedge r$.

14. If the numbers a, b, c and d are in harmonic progression and arithmetic mean of ab, bc and cd is 9, then which of the following number is the value of ad ?

[NIMCET – 2023 (Mathematics)]

(A) 3 **(B)** 9 **(C)** 12 **(D)** 4

Ans. (B)

Sol: Since the numbers a, b, c and d are in harmonic progression, thus

$$b = \frac{2ac}{a+c} \text{ and } c = \frac{2bd}{b+d}$$

$$\Rightarrow \quad a+c = \frac{2ac}{b} \text{ and } b+d = \frac{2bd}{c}$$

$$\Rightarrow \quad (a+c)(b+d) = \frac{2ac}{b} \times \frac{2bd}{c} = 4ad$$

$$\Rightarrow \quad ac + bc + ca = 3ad$$

$$\Rightarrow \quad ad = \frac{ac+bc+ca}{3}$$

$\Rightarrow$ $ad = 9$, as the arithmetic mean of ab, bc and cd is 9.

15. If a vector having magnitude of 5 units, makes equal angle with each of the three mutually perpendicular axes, then the sum of the magnitude of the projections on each of the axis is

[NIMCET – 2023 (Mathematics)]

(A) $\frac{15}{3}$ unit **(B)** $5\sqrt{3}$ unit **(C)** $\frac{15\sqrt{3}}{2}$ unit **(D)** None of these

Ans. (B)

Sol: Since the vector makes equal angle with each of x, y and z axis, thus the components are also equal. Let the vector is $\vec{r} = a\hat{i} + a\hat{j} + a\hat{k}$, then

$$|\vec{r}| = 5$$

$$\Rightarrow \quad \sqrt{a^2 + a^2 + a^2} = 5$$

$$\Rightarrow \quad \sqrt{3}a = 5$$

$\Rightarrow \quad a = \frac{5}{\sqrt{3}}$

Therefore, the magnitude of the projection on each of the axis is $\frac{5}{\sqrt{3}}$ and the required sum is $5\sqrt{3}$.

16. The range of values of θ in the interval $(0, \pi)$ such that the points $(3,2)$ and $(\cos\theta, \sin\theta)$ lie on the same side of the line $x + y - 1 = 0$ is

[NIMCET – 2023 (Mathematics)]

(A) $\left(0, \frac{\pi}{4}\right)$ **(B)** $\left(0, \frac{3\pi}{4}\right)$ **(C)** $\left(0, \frac{\pi}{2}\right)$ **(D)** $\left(0, \frac{\pi}{3}\right)$

Ans. (C)

Sol: Since the points $(3,2)$ and $(\cos\theta, \sin\theta)$ lie on the same side of the line $x + y - 1 = 0$, therefore $3 + 2 - 1$ and $\cos\theta + \sin\theta - 1$ must be of the same sign. Thus,

$\cos\theta + \sin\theta - 1 > 0$

$\Rightarrow \quad \frac{1}{\sqrt{2}}\cos\theta + \frac{1}{\sqrt{2}}\sin\theta > \frac{1}{\sqrt{2}}$

$\Rightarrow \quad \sin\frac{\pi}{4}\cos\theta + \cos\frac{\pi}{4}\sin\theta > \frac{1}{\sqrt{2}}$

$\Rightarrow \quad \sin\left(\theta + \frac{\pi}{4}\right) > \frac{1}{\sqrt{2}}$

$\Rightarrow \quad \frac{\pi}{4} < \theta + \frac{\pi}{4} < \frac{3\pi}{4} \qquad \because 0 < \theta < \pi$

$\Rightarrow \quad 0 < \theta < \frac{\pi}{2}$

$\Rightarrow \quad \theta \in \left(0, \frac{\pi}{2}\right).$

17. Let $f(x) = \frac{x^2 - 1}{(|x| - 1)}$. Then, the value of $\lim_{x \to -1} f(x)$ is

[NIMCET – 2023 (Mathematics)]

(A) -1 **(B)** 1 **(C)** 2 **(D)** -2

Ans. (C)

Sol: Since $f(x)=\dfrac{x^2-1}{(|x|-1)}$, therefore

$$\lim_{x\to -1} f(x)=\lim_{x\to -1}\frac{x^2-1}{|x|-1}$$
$$=\lim_{x\to -1}\frac{(x+1)(x-1)}{-x-1}$$
$$=-\lim_{x\to -1}(x-1)$$
$$=2.$$

18. The largest value of $\cos^2\theta-6\sin\theta\cos\theta+3\sin^2\theta+2$ is

[NIMCET – 2023 (Mathematics)]

(A) 4 **(B)** 0 **(C)** $4-\sqrt{10}$ **(D)** $4+\sqrt{10}$

Ans. (D)

Sol: Let $f(\theta)=\cos^2\theta-6\sin\theta\cos\theta+3\sin^2\theta+2$, then

$$f(\theta)=\left(\frac{1+\cos 2\theta}{2}\right)-3\sin 2\theta+3\left(\frac{1-\cos 2\theta}{2}\right)+2=-\cos 2\theta-3\sin 2\theta+4$$

$\Rightarrow \quad -\sqrt{(-1)^2+(-3)^2}+4\le f(\theta)\le\sqrt{(-1)^2+(-3)^2}+4 \quad \because -\sqrt{a^2+b^2}\le a\cos x\pm b\sin x\sqrt{a^2+b^2} \quad \forall x\in\mathbb{R}$

$\Rightarrow \quad 4-\sqrt{10}\le f(\theta)\le 4+\sqrt{10}$

Hence, the required maximum value of $\cos^2\theta-6\sin\theta\cos\theta+3\sin^2\theta+2$ is $4+\sqrt{10}$.

19. If $\prod_{i=1}^{n}\tan(a_i)=1$ where $a_i\in\left[0,\dfrac{\pi}{2}\right]$ for all $i=1,2,...n$, then the maximum value of $\prod_{i=1}^{n}\sin(a_i)$ is

[NIMCET – 2023 (Mathematics)]

(A) 2^{-n} **(B)** $2^{-\frac{n}{2}}$ **(C)** 1 **(D** None of these

Ans. (B)

Sol: Given that

$$\prod_{i=1}^{n}\tan a_i=1$$
$\Rightarrow \quad \tan a_1.\tan a_2...\tan a_n=1$

$\Rightarrow \quad \sin a_1.\sin a_2...\sin a_n = \cos a_1.\cos a_2...\cos a_n$

$\Rightarrow \quad \sin^2 a_1.\sin^2 a_2...\sin^2 a_n = (\sin a_1 \cos a_1).(\sin a_2 \cos a_2)...(\sin a_n \cos a_n)$

$\Rightarrow \quad \sin^2 a_1.\sin^2 a_2...\sin^2 a_n = \frac{1}{2^n}(2\sin a_1 \cos a_1).(2\sin a_2 \cos a_2)...(2\sin a_n \cos a_n)$

$\Rightarrow \quad (\sin a_1.\sin a_2...\sin a_n)^2 = \frac{1}{2^n}(\sin 2a_1.\sin 2a_2...\sin 2a_n)$

$\Rightarrow \quad 0 \le (\sin a_1.\sin a_2...\sin a_n)^2 \le \frac{1}{2^n} \qquad \because 0 \le \sin 2a_i \le 1$ for all $a_i \in \left[0, \frac{\pi}{2}\right]$

$\Rightarrow \quad 0 \le \sin a_1.\sin a_2...\sin a_n \le \left(\frac{1}{2^n}\right)^{1/2}, \ a_i \in \left[0, \frac{\pi}{2}\right]$

$\Rightarrow \quad 0 \le \sin a_1.\sin a_2...\sin a_n \le 2^{-\frac{n}{2}}.$

Hence, the maximum value of $\prod_{i=1}^{n} \sin a_i$ is $2^{-\frac{n}{2}}$.

20. The foci of the graph represented by $x^2 - 4y^2 + 2x + 8y - 7 = 0$ is

[NIMCET – 2023 (Mathematics)]

(A) $\left(-1, -1 \pm \sqrt{5}\right)$ **(B)** $\left(1, -1 \pm \sqrt{5}\right)$ **(C)** $\left(1 \pm \sqrt{5}, 1\right)$ **(D)** $\left(-1 \pm \sqrt{5}, 1\right)$

Ans. (D)

Sol: The given second degree equation is

$x^2 - 4y^2 + 2x + 8y - 7 = 0$

$\Rightarrow \quad (x^2 + 2x + 1) - 4(y^2 - 2y + 1) - 4 = 0$

$\Rightarrow \quad (x+1)^2 - 4(y-1)^2 = 4$

$\Rightarrow \quad \frac{(x+1)^2}{(2)^2} - \frac{(y-1)^2}{(1)^2} = 1$

which represents an ellipse $\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$, with center $(h,k) = (-1,1)$, $a = 2$ and $b = 1$. Let e be the eccentricity of this ellipse, then

$$e = \sqrt{1 + \frac{b^2}{a^2}} = \sqrt{1 + \frac{1}{4}} = \frac{\sqrt{5}}{2}$$

Hence, the foci are $(h-ae,k)$ and $(h+ae,k)$, i.e., $\left(-1-\sqrt{5},1\right)$ and $\left(-1+\sqrt{5},1\right)$.

21. Let $\vec{a}=2\hat{i}+\hat{j}-2\hat{k}$ and $\vec{b}=\hat{i}+\hat{j}$. Let $\vec{c}$ be a vector such that $|\vec{c}-\vec{a}|=3$, $\left|\left(\vec{a}\times\vec{b}\right)\times\vec{c}\right|=3$ and the angle between $\vec{c}$ and $\vec{a}\times\vec{b}$ is 30^0, then $\vec{a}.\vec{c}$ is equal to

[NIMCET – 2023 (Mathematics)]

(A) 2 **(B)** $\frac{1}{8}$ **(C)** $\frac{25}{8}$ **(D)** 5

Ans. (A)

Sol: Given that

$$|\vec{c}-\vec{a}|=3$$

$$\Rightarrow \quad |\vec{c}-\vec{a}|^2=9$$

$$\Rightarrow \quad |\vec{c}|^2+|\vec{a}|^2+2\vec{c}.\vec{a}=9$$

$$\Rightarrow \quad |\vec{c}|^2+9+2\vec{c}.\vec{a}=9 \qquad \because \vec{a}=2\hat{i}+\hat{j}-2\hat{k}$$

$$\Rightarrow \quad |\vec{c}|^2+2\vec{c}.\vec{a}=0 \qquad \ldots \text{(i)}$$

Again,

$$\left|\left(\vec{a}\times\vec{b}\right)\times\vec{c}\right|=3$$

$$\Rightarrow \quad |\vec{a}\times\vec{b}||\vec{c}|\sin 30^0=3$$

$$\Rightarrow \quad \left\|\begin{matrix}\hat{i} & \hat{j} & \hat{k}\\ 2 & 1 & -2\\ 1 & 1 & 0\end{matrix}\right\|\frac{|\vec{c}|}{2}=3$$

$$\Rightarrow \quad \left|2\hat{i}-2\hat{j}+\hat{k}\right||\vec{c}|=6$$

$$\Rightarrow \quad 3|\vec{c}|=6$$

$$\Rightarrow \quad |\vec{c}|=2 \qquad \ldots \text{(ii)}$$

Hence, using (ii) in (i), we get

$$\vec{c}.\vec{a}=2.$$

22. If $\int x.\sin x.\sec^3 x\,dx = \frac{1}{2}\left[f(x)\sec^2 x + g(x)\left(\frac{\tan x}{x}\right)\right] + c$, where f and g are real valued functions of x and c is an arbitrary constant, then which of the following statement is true?

[NIMCET – 2023 (Mathematics)]

(A) $f(x) = g(x)$ **(B)** $f(x).g(x) = -1$ **(C)** $f(x) + g(x) = 0$ **(D)** $f(x) - g(x) = c$

Ans. (C)

Sol: Let us consider that

$$I = \int x.\sin x.\sec^3 x\,dx$$

$$\Rightarrow \quad I = \int \underbrace{x}_{I}.\underbrace{\tan x.\sec^2 x}_{II}\,dx$$

$$\Rightarrow \quad I = x\int \tan x.\sec^2 x\,dx - \int 1.\left(\int \tan x.\sec^2 x\,dx\right)dx \qquad \because \int I.II\,dx = I\int II\,dx - \int\left(\frac{dI}{dx}\int II\,dx\right)dx$$

$$\Rightarrow \quad I = x\int \underbrace{\tan x}_{f(x)}.\underbrace{\sec^2 x}_{f'(x)}\,dx - \int 1.\left(\int \underbrace{\tan x}_{f(x)}.\underbrace{\sec^2 x}_{f'(x)}\,dx\right)dx$$

$$\Rightarrow \quad I = \frac{1}{2}x\underbrace{\tan^2 x}_{=\sec^2 x-1} - \frac{1}{2}x\int \underbrace{\tan^2 x}_{=\sec^2 x-1}\,dx$$

$$\Rightarrow \quad I = \frac{1}{2}\left(x\sec^2 x - x - \tan x + x\right) + c$$

$$\Rightarrow \quad I = \frac{1}{2}\left(x\sec^2 x - \tan x\right) + c \qquad \ldots \text{(i)}$$

Since, it is given that

$$I = \frac{1}{2}\left(f(x)\sec^2 x + g(x)\left(\frac{\tan x}{x}\right)\right) + c \qquad \ldots \text{(ii)}$$

Therefore, on comparing (i) and (ii), we get

$$f(x) = x \text{ and } g(x) = -x$$

$$\Rightarrow \quad f(x) + g(x) = 0.$$

23. Let $f(x)$ be a polynomial of degree 4 and $f(n)=n+1$ for $n=1,2,3,4$. Now, if $f(0)=25$, then $f(5)$ is equal to

[NIMCET – 2023 (Mathematics)]

(A) 20 **(B)** 25 **(C)** 30 **(D)** None of these

Ans. (C)

Sol: Since $f(x)$ is a polynomial of degree 4 such that $f(n)=n+1$ for $n=1,2,3,4$, therefore

$$f(x)=a(x-1)(x-2)(x-3)(x-4)+x+1$$

Now,

$$f(0)=25$$

$$\Rightarrow \quad a(-1)(-2)(-3)(-4)+1=25$$

$$\Rightarrow \quad a=1$$

Thus,

$$f(x)=(x-1)(x-2)(x-3)(x-4)+x+1$$

$$\Rightarrow \quad f(5)=4.3.2.1+5+1=30.$$

24. An urn contains 5 yellow, 4 black and 3 white balls. 3 balls are drawn at random. The probability that no black ball is selected is

[NIMCET – 2023 (Mathematics)]

(A) $\frac{14}{55}$ **(B)** $\frac{1}{66}$ **(C)** $\frac{2}{9}$ **(D)** None of these

Ans. (A)

Sol: Out of given 12 balls containing 5 yellow, 4 black and 3 white balls, the probability that no black ball is selected is

$$=\frac{{}^{12-4}C_3}{{}^{12}C_3}$$

$$=\frac{{}^{8}C_3}{{}^{12}C_3}$$

$$=\frac{14}{55}.$$

25. If $\cos^{-1}\left(\frac{3}{\sqrt{20}}\right)$ is the angle between the vectors $\hat{i}-2x\hat{j}+3y\hat{k}$ and $x\hat{i}+\hat{j}+y\hat{k}$, where x, y are real numbers then which of the following points satisfies the locus of (x,y)?

[NIMCET – 2023 (Mathematics)]

(A) $(0,1)$ **(B)** $(-1,-1)$ **(C)** $(1,0)$ **(D)** $(1,1)$

Ans. (A)

Sol: Let $\theta=\cos^{-1}\left(\frac{3}{\sqrt{20}}\right)$ be the angle between the vectors $\vec{a}=\hat{i}-2x\hat{j}+3y\hat{k}$ and $\vec{b}=x\hat{i}+\hat{j}+y\hat{k}$, then

$$\cos\theta=\frac{\vec{a}.\vec{b}}{|\vec{a}||\vec{b}|}$$

$$\Rightarrow \quad \cos\left(\cos^{-1}\left(\frac{3}{\sqrt{20}}\right)\right)=\frac{\left(\hat{i}-2x\hat{j}+3y\hat{k}\right).\left(x\hat{i}+\hat{j}+y\hat{k}\right)}{\sqrt{1+4x^2+9y^2}.\sqrt{x^2+1+y^2}}$$

$$\Rightarrow \quad \frac{3}{\sqrt{20}}=\frac{3y^2-x}{\sqrt{1+4x^2+9y^2}.\sqrt{x^2+1+y^2}} \qquad \ldots \text{(i)}$$

Clearly, from the given options, (0, 1) satisfies the required equation (i), the locus of (x,y).

26. A real valued function is defined as $f(x)=\begin{cases}-1, & -2\le x\le 0\\ x-1, & 0<x\le 2\end{cases}$. Which of the following statement is FALSE?

[NIMCET – 2023 (Mathematics)]

(A) $f(|x|)=|x|-1$, if $0\le x\le 1$ **(B)** $|f(x)|=x-1$, if $1\le x\le 2$

(C) $f(|x|)+|f(x)|=1$, if $0\le x\le 1$ **(D)** $f(|x|)-|f(x)|=0$, if $1\le x\le 2$

Ans. (C)

Sol: Given that

$$f(x)=\begin{cases}-1, & -2\le x\le 0\\ x-1, & 0<x\le 2\end{cases}$$

$$\Rightarrow \quad f(|x|)=\begin{cases}-1, & -2\le|x|\le 0\\ |x|-1, & 0<|x|\le 2\end{cases}$$

$$\Rightarrow \quad f(|x|)=|x|-1,\ -2\le x\le 2 \qquad \ldots \text{(i)}$$

$$\Rightarrow \quad f(|x|)=\begin{cases}-x-1, & -2\le x<0\\ x-1, & 0\le|x|\le 2\end{cases} \qquad \ldots \text{(ii)}$$

and

$$|f(x)|=\begin{cases}|-1|, & -2\le x\le 0\\ |x-1|, & 0<x\le 2\end{cases}$$

$$\Rightarrow \quad |f(x)|=\begin{cases}1, & -2\le x\le 0\\ 1-x, & 0<x<1\\ x-1, & 1\le x\le 2\end{cases} \qquad \ldots \text{(iii)}$$

Using (i), (ii) and (iii), we get

a) $f(|x|)=|x|-1$

b) $|f(x)|=x-1$, if $1\le x\le 2$

c) $f(|x|)+|f(x)|=0$, if $0\le x\le 1$

d) $f(|x|)-|f(x)|=0$, if $1\le x\le 2$

Hence, from the given options, (C) is incorrect.

27. A circle C touches the x-axis and touches another circle with center at $(0,3)$ and radius 2. Then, the locus of the center of the circle C is

[NIMCET – 2023 (Mathematics)]

(A) an ellipse **(B)** a circle **(C)** a Parabola **(D)** a Hyperbola

Ans. (C)

Sol: Let the radius of the required circle is r_1 and center is $C_1(h,k)$ which touches the x-axis and another circle with center at $C_2(0,3)$ and radius $r_2=2$. Then, $r_1=k$ and

$$|C_1-C_2|=r_1+r_2$$

$$\Rightarrow \quad \sqrt{(h-0)^2+(k-3)^2}=k+2$$

$\Rightarrow \quad h^2 - 10k + 5 = 0$

Therefore, the required locus is $x^2 - 10y + 5 = 0$, i.e., $x^2 = 10\left(y - \frac{1}{2}\right)$, which is a parabola.

28. The value $\sum_{k=1}^{n} x_k$, where $x_k = \cos\left(\frac{2\pi k}{n}\right) + i\sin\left(\frac{2\pi k}{n}\right)$ is equal to

[NIMCET – 2023 (Mathematics)]

(A) 1 **(B)** -1 **(C)** 0 **(D)** None of these

Ans. (C)

Sol: Here,

$$\sum_{k=1}^{n} x_k = \sum_{k=1}^{n}\left(\cos\left(\frac{2\pi k}{n}\right) + i\sin\left(\frac{2\pi k}{n}\right)\right)$$

$$= \sum_{k=1}^{n} e^{\frac{2\pi ki}{n}} = e^{\frac{2\pi i}{n}} + e^{\frac{4\pi i}{n}} + \ldots + e^{\frac{2\pi ki}{n}} \text{ (G.P.)}$$

$$= e^{\frac{2\pi i}{n}} \frac{\left(1 - \left(e^{\frac{2\pi i}{n}}\right)^n\right)}{1 - e^{\frac{2\pi i}{n}}} = e^{\frac{2\pi i}{n}} \frac{\left(1 - e^{2\pi i}\right)}{1 - e^{\frac{2\pi i}{n}}}$$

$= 0$. $\quad \because e^{2\pi i} = 1 = \cos 2\pi + i\sin 2\pi$

29. Let $\vec{a} = \frac{\hat{i} - 2\hat{j}}{\sqrt{5}}$ and $\vec{b} = \frac{2\hat{i} + \hat{j} + 3\hat{k}}{\sqrt{14}}$ be two vectors, then the value of $\left(2\hat{a} + \hat{b}\right)\left[\left(\hat{a} \times \hat{b}\right) \times \left(\hat{a} - 2\hat{b}\right)\right]$ is

[NIMCET – 2023 (Mathematics)]

(A) 5 **(B)** 6 **(C)** 3 **(D)** 4

Ans. (A)

Sol: Given that

$$\vec{a}.\vec{b} = \frac{\left(\hat{i} - 2\hat{j}\right)}{\sqrt{5}} . \frac{\left(2\hat{i} + \hat{j} + 3\hat{k}\right)}{\sqrt{14}} = 0, \ |\vec{a}| = \frac{\sqrt{(1)^2 + (-2)^2 + (0)^2}}{\sqrt{5}} = 1 \text{ and } |\vec{b}| = \frac{\sqrt{(2)^2 + (2)^2 + (3)^2}}{\sqrt{17}} = 1.$$

Therefore,

$$\left(2\vec{a}+\vec{b}\right).\left[\left(\vec{a}\times\vec{b}\right)\times\left(\vec{a}-2\vec{b}\right)\right]=-\left(2\vec{a}+\vec{b}\right).\left[\left(\vec{a}-2\vec{b}\right)\times\left(\vec{a}\times\vec{b}\right)\right] \qquad \because \vec{a}\times\vec{b}=-\vec{b}\times\vec{a}$$

$$=-\left(2\vec{a}+\vec{b}\right).\left[\left(\left(\vec{a}-2\vec{b}\right).\vec{b}\right)\vec{a}-\left(\left(\vec{a}-2\vec{b}\right).\vec{a}\right)\vec{b}\right]$$

$$=-\left(2\vec{a}+\vec{b}\right).\left[\left(\vec{a}.\vec{b}-2\vec{b}.\vec{b}\right)\vec{a}-\left(\vec{a}.\vec{a}-2\vec{b}.\vec{a}\right)\vec{b}\right]$$

$$=-\left(2\vec{a}+\vec{b}\right).\left[-2\left|\vec{b}\right|^2\vec{a}-\left(\left|\vec{a}\right|^2\right)\vec{b}\right] \qquad \because \vec{a}.\vec{a}=\left|\vec{a}\right|^2,\vec{b}.\vec{b}=\left|\vec{b}\right|^2,\ \vec{a}.\vec{b}=\vec{b}.\vec{a}$$

$$=\left(2\vec{a}+\vec{b}\right).\left(2\vec{a}+\vec{b}\right)$$

$$=4\left|\vec{a}\right|^2+\left|\vec{b}\right|^2+4\vec{a}.\vec{b}$$

$$=4+1+0$$

$$=5.$$

30. A speaks truth in 60% and B in 50% of the cases. The probability that the contradict each other while narrating some incident is

[NIMCET – 2023 (Mathematics)]

(A) $\frac{1}{4}$ **(B)** $\frac{1}{3}$ **(C)** $\frac{2}{3}$ **(D)** $\frac{1}{2}$

Ans. (D)

Sol: Let E be that A speaks truth and F be the event that B speaks truth, then

$$P(E)=\frac{60}{100}=\frac{6}{10} \text{ and } P(F)=\frac{50}{100}=\frac{5}{10}.$$

Therefore, the probability that A and B contradict

$$=P\left(E\cap\overline{F}\right)+P\left(\overline{E}\cap F\right)$$

$$=P(E)P\left(\overline{F}\right)+P\left(\overline{E}\right)P(F) \text{ (independent events)}$$

$$=P(E)\left(1-P(F)\right)+\left(1-P(E)\right)P(F)$$

$$=\frac{6}{10}\left(1-\frac{5}{10}\right)+\left(1-\frac{6}{10}\right)\frac{5}{10}$$

$$=\frac{50}{100}$$

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

31. Let $f(x)=\dfrac{6^x-3^x-2^x+1}{\log_e 9(1-\cos x)}$ be a real number. Then, $\lim\limits_{x\to 0} f(x)$ equals

[NIMCET – 2023 (Mathematics)]

(A) 2 **(B)** 3 **(C)** $\log_e 2$ **(D)** $\log_e 3$

Ans. (C)

Sol: Since $f(x)=\dfrac{6^x-3^x-2^x+1}{\log_e 9(1-\cos x)}$, thus

$$\lim_{x\to 0} f(x)=\frac{1}{\log_e 9}.\lim_{x\to 0}\frac{6^x-3^x-2^x+1}{(1-\cos x)}$$

$$=\frac{1}{2\log_e 3}.\lim_{x\to 0}\frac{(3^x-1)(2^x-1)}{1-\cos x}$$

$$=\frac{1}{2\log_e 3}.\lim_{x\to 0}\frac{\dfrac{(3^x-1)}{x}\dfrac{(2^x-1)}{x}}{\dfrac{1-\cos x}{x^2}}$$

$$=\frac{1}{2\log_e 3}.\frac{\log_e 3.\log_e 2}{\frac{1}{2}}$$

$$=\log_e 2\,.$$

32. If $\lim\limits_{x\to 1}\dfrac{x^4-1}{x-1}=\lim\limits_{x\to k}\dfrac{x^3-k^3}{x^2-k^2}$, then $k=$

[NIMCET – 2023 (Mathematics)]

(A) 1 **(B)** $\dfrac{2}{3}$ **(C)** $\dfrac{8}{3}$ **(D)** $\dfrac{4}{3}$

Ans. (C)

Sol: Given that

$$\lim_{x\to 1}\frac{x^4-1}{x-1}=\lim_{x\to k}\frac{x^3-k^2}{x^2-k^2}\qquad\left(\frac{0}{0}\text{ form}\right)$$

$\Rightarrow \quad \lim\limits_{x\to 1}\dfrac{4x^3}{1}=\lim\limits_{x\to k}\dfrac{3x^2}{2x}$, using L'Hopital rule

$\Rightarrow \quad 4=\dfrac{3}{2}k$

$\Rightarrow \quad k=\dfrac{8}{3}.$

33. The mean of 5 observations is 5 and their variance is 124. If three of the observation are 1, 2, 6 then the mean deviation from the mean of the data is

[NIMCET – 2023 (Mathematics)]

(A) 2.8 **(B)** 2.4 **(C)** 2.6 **(D)** 2.5

Ans. All the given choices are incorrect.

Sol: Using the given data, none of the choices comes out to be correct. The variance should be 12.4 instead of 124 to get one of the given choices as answer. So, we are making the correction ourselves and taking Variance to be 12.4.

Now,

Mean $(\mu) = 5$

$\Rightarrow \quad \dfrac{1+2+6+x+y}{5}=5$

$\Rightarrow \quad x+y=16 \qquad \ldots$ (i)

Again,

Variance $(\sigma^2)=12.4$

$\Rightarrow \quad \dfrac{1^2+2^2+6^2+x^2+y^2}{5}-(5)^2=12.4$

$\Rightarrow \quad x^2+y^2=146$

$\Rightarrow \quad x^2+(16-x)^2=146$, using (i)

$\Rightarrow \quad x^2-16x+55=0$

$\Rightarrow \quad x=5 \text{ or } x=11$

Thus, $y=11$ or $y=5$. Hence, the mean deviation from the mean 5 of the data should be

$=\dfrac{4+3+1+0+6}{5}=2.8.$

Note: In actual NIMCET 2023 marking scheme, this question was eliminated as none of the choice was correct.

34. The equation of the tangent of any point of the curve $x = a\cos 2t$, $y = 2\sqrt{2}\,a\sin t$, with m as its slope, is

[NIMCET – 2023 (Mathematics)]

(A) $y = mx + a\left(m - \frac{1}{m}\right)$ **(B)** $y = mx - a\left(m + \frac{1}{m}\right)$

(C) $y = mx + a\left(m + \frac{1}{m}\right)$ **(D)** $y = amx + a\left(m - \frac{1}{m}\right)$

Ans. (B)

Sol: The parametric equation of given curve is

$$x = a\cos 2t \text{ and } y = 2\sqrt{2}\,a\sin t \quad \ldots \text{(i)}$$

Therefore,

$$m = \frac{dy}{dx} = \frac{dy/dt}{dx/dt} = \frac{2\sqrt{2}a\cos t}{-2a\sin 2t} = -\frac{\sqrt{2}a\cos t}{2a\sin t.\cos t} = -\frac{1}{\sqrt{2}\sin t} \quad \ldots \text{(ii)}$$

Now, using (ii) in (i), we get

$$x = a\cos 2t = a\left(1-2\sin^2 t\right) = a\left(1-\frac{1}{m^2}\right) \quad \text{and} \quad y = 2\sqrt{2}\,a\sin t = -\frac{2a}{m} \quad \ldots \text{(iii)}$$

Thus, the equation of tangent to the given curve at $(x,y) = \left(a\left(1-\frac{1}{m^2}\right), -\frac{2a}{m}\right)$ is

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

$$\Rightarrow \quad y = mx - a\left(m + \frac{1}{m}\right).$$

35. For a group of 100 candidates, the mean and standard deviation of scores were found to be 40 and 15 respectively. Later on it was found that the scores 25 and 35 were misread as 52 and 53, respectively. Then the corrected mean and standard deviation corresponding to the corrected figures are

[NIMCET – 2023 (Mathematics)]

(A) 39.5, 14 **(B)** 39.55, 14.97 **(C)** 39.9, 14.97 **(D)** 40.19, 15.1

Ans. (B)

Sol: Using the given information, we have

$n = 100$, Mean $(\bar{x}) = 40$ and $S.D.(\sigma) = 15$.

Thus,

$$\bar{x} = 40$$

$$\Rightarrow \quad \frac{\sum_{i=1}^{100} x_i}{100} = 40$$

$$\Rightarrow \quad \sum_{i=1}^{100} x_i = 4000 \qquad \ldots \text{(i)}$$

Therefore, corrected mean is

$$\frac{\sum_{i=1}^{100} x_i}{100} = \frac{4000 - (52+53) + (25+35)}{100} = 39.55.$$

Here, using the given options, only option (B) contains the corrected mean. Moreover,

$$S.D.(\sigma) = 15$$

$$\Rightarrow \quad \sqrt{\frac{1}{100}\sum_{i=1}^{100} x_i^2 - \left(\frac{\sum_{i=1}^{100} x_i}{100}\right)^2} = 15$$

$$\Rightarrow \quad \frac{1}{100}\sum_{i=1}^{100} x_i^2 - (40)^2 = 225$$

$$\Rightarrow \quad \sum_{i=1}^{100} x_i^2 = 182500 \qquad \ldots \text{(ii)}$$

Therefore, the corrected

$$\sum_{i=1}^{100} x_i^2 = 182500 - (52^2 + 53^2) + (25^2 + 35^2) = 178837.$$

Hence, the corrected standard deviation

$$= \sqrt{\text{corrected}\frac{\sum_{i=1}^{100} x_i^2}{100} - \left(\text{corrected}\frac{\sum_{i=1}^{100} x_i}{100}\right)^2} = \sqrt{1788.37 - (39.55)^2} = 14.97.$$

36. Odds in favour of an event A are 2 to 1 and odds in favour of $A \cup B$ are 3 to 1. Consider with this information, the bound for $P(B)$ is given by

[NIMCET – 2023 (Mathematics)]

(A) $\frac{1}{3} \le P(B) \le \frac{1}{2}$ **(B)** $\frac{1}{12} \le P(B) \le \frac{3}{4}$ **(C)** $0 \le P(B) \le \frac{3}{4}$ **(D)** $\frac{1}{6} \le P(B) \le \frac{1}{3}$

Ans. (B)

Sol: Since odds in favour of an event A are 2 to 1, thus

$$P(A) = \frac{1}{2+1} = \frac{1}{3}.$$

Again, since odds in favour of $A \cup B$ are 3 to 1, thus

$$P(A \cup B) = \frac{3}{3+1} = \frac{3}{4}.$$

Now,

$$0 \le P(A \cap B) \le P(A)$$

$$\Rightarrow \quad 0 \le P(A) + P(B) - P(A \cup B) \le P(A)$$

$$\Rightarrow \quad 0 \le \frac{2}{3} + P(B) - \frac{3}{4} \le \frac{2}{3}$$

$$\Rightarrow \quad 0 \le P(B) - \frac{1}{12} \le \frac{2}{3}$$

$$\Rightarrow \quad \frac{1}{12} \le P(B) \le \frac{3}{4}.$$

37. The coefficient of x^{50} in the expansion of $(1+x)^{1000} + 2x(1+x)^{999} + 3x^2(1+x)^{998} + \ldots + 1001x^{1000}$

[NIMCET – 2023 (Mathematics)]

(A) ${}^{1002}C_{50}$ **(B)** ${}^{1002}C_{51}$ **(C)** ${}^{1005}C_{50}$ **(D)** ${}^{1005}C_{48}$

Ans. (A)

Sol: The given series is a Arithmetic-geometric progression (A.G.P.) with common ratio $\frac{x}{1+x}$. Now,

$$S = (1+x)^{1000} + 2x(1+x)^{999} + 3x^2(1+x)^{998} + \ldots + 1001x^{1000} \quad \ldots \text{(i)}$$

$$\Rightarrow \quad \left(\frac{x}{1+x}\right)S = x(1+x)^{999} + 2x^2(1+x)^{998} + 3x^3(1+x)^{997} + \ldots + \frac{1001x^{1001}}{1+x} \qquad \ldots \text{(ii)}$$

On subtracting (ii) by (i), we get

$$\left(1-\frac{x}{1+x}\right)S = (1+x)^{1000} + x(1+x)^{999} + x^2(1+x)^{998} + \ldots + x^{1000} - \frac{1001x^{1001}}{1+x}$$

$$\Rightarrow \quad S = (1+x)^{1001} + x(1+x)^{1000} + x^2(1+x)^{999} + \ldots + x^{1000}(1+x) - 1001x^{1001}$$

$$\Rightarrow \quad S = (1+x)^{1001}\frac{\left(1-\left(\frac{x}{1+x}\right)^{1001}\right)}{1-\frac{x}{1+x}} - 1001x^{1001}$$

$$\Rightarrow \quad S = (1+x)^{1002}\left(1-\left(\frac{x}{1+x}\right)^{1001}\right) - 1001x^{1001}$$

$$\Rightarrow \quad S = (1+x)^{1002} - x^{1001}(1+x) - 1001x^{1001}$$

Therefore, the coefficient of x^{50} in the above expansion is ${}^{1002}C_{50}$.

38. If $\int f(x)\,dx = g(x)$, then $\int x^5 f\left(x^3\right)dx$ is equal to

[NIMCET – 2023 (Mathematics)]

(A) $\frac{1}{3}x^3 g\left(x^3\right) - \int x^3 g\left(x^3\right)dx + c$

(B) $\frac{1}{3}x^3 g\left(x^3\right) - \int x^2 g\left(x^3\right)dx + c$

(C) $\frac{1}{3}x^3 g\left(x^3\right) - 3\int x^4 g\left(x^3\right)dx + c$

(D) None of these

Ans. (B)

Sol: Let us consider that

$$I = \int x^5 \times f\left(x^3\right)dx = \frac{1}{3}\int 3x^2 \times x^3 \times f\left(x^3\right)dx$$

Now, on putting $x^3 = t$ and $3x^2dx = dt$, we get

$$I = \frac{1}{3}\int \underbrace{t}_{I} \times \underbrace{f(t)}_{II}\,dt$$

$$= \frac{t}{3}\int f(t)\,dt - \frac{1}{3}\int \psi(t)\,dt$$

$$= \frac{t}{3}\int f(t)\,dt - \frac{1}{3}\int\left(\frac{dt}{dt}\right)\times\left(\int f(t)\,dt\right)dt \qquad \because \int f(x)dx = \psi(x)$$

$$= \frac{x^3}{3}\int f(x^3)\,dt - \frac{1}{3}\int 3x^2\psi(x^3)\,dx \qquad \because t = x^3 \text{ and } dt = 3x^2dx$$

$$= \frac{x^3}{3}\int f(x^3)\,dt - \int x^2\psi(x^3)\,dx.$$

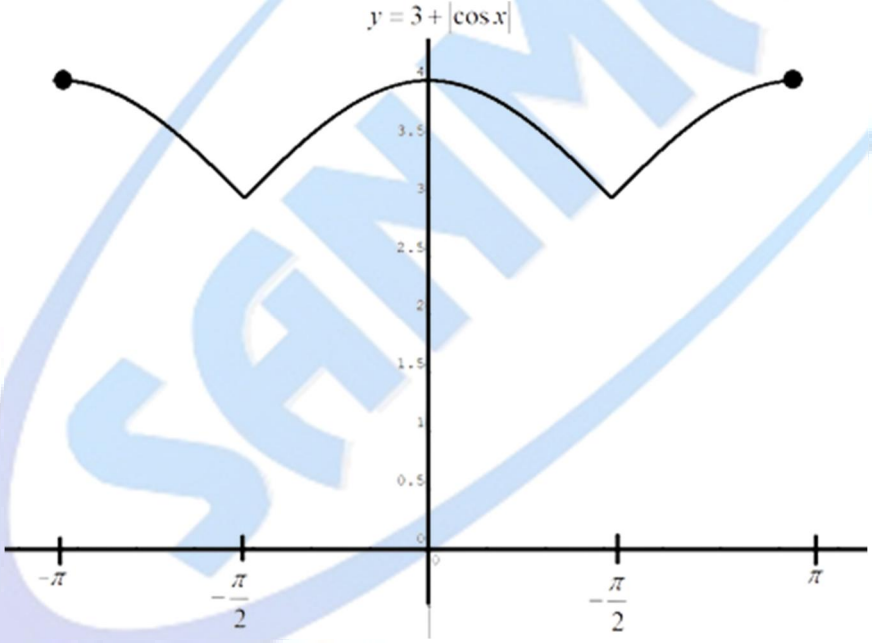
39. Number of non-differentiable points of the function $f(x) = 3 + |\cos(x)|$ in the interval $[-\pi, \pi]$ is

[NIMCET – 2023 (Mathematics)]

(A) 1 **(B)** 3 **(C)** 4 **(D)** None of these

Ans. (C)

Sol: The graph of the given function $f(x) = 3 + |\cos(x)|$ is



Clearly, the function $f(x) = 3 + |\cos x|$ is not-differentiable at $x = -\pi, \pi$ (boundary/corner points) and $x = -\frac{\pi}{2}, \frac{\pi}{2}$ (sharp points), i.e., at 4 points.

40. Between any two real roots of the equation $e^x \sin x - 1 = 0$, the equation $e^x \cos x + 1 = 0$ has

[NIMCET – 2023 (Mathematics)]

(A) At least one root **(B)** At most one root

(C) No root **(D)** Exactly one root

Ans. (A)

Sol: Given that

$$e^x \sin x = 1$$

$$\Rightarrow \quad \sin x = e^{-x}$$

$$\Rightarrow \quad \sin x - e^x = 0 \qquad \ldots \text{(i)}$$

Let $f(x) = \sin x - e^{-x}$, then $f(x) = 0$ at $x = \alpha$ and $x = \beta$, where $\alpha < \beta$. Therefore, using Rolle's theorem, there exist at least one $c \in (\alpha, \beta)$ for which

$$f'(c) = 0$$

$$\Rightarrow \quad \cos c + e^{-x} = 0$$

$$\Rightarrow \quad e^x \cos c + 1 = 0,$$

i.e., $e^x \cos x + 1 = 0$ has at least one root $c \in (\alpha, \beta)$ between two real roots α and β of $e^x \sin x - 1 = 0$.

41. If the maximum value of the function $f(x) = (x-1)^2 (x+1)^3$ is $\frac{2^p 3^q}{3125}$ then the value of (p, q) will be

[NIMCET – 2023 (Mathematics)]

(A) $(7,3)$ **(B)** $(4,4)$ **(C)** $(5,5)$ **(D)** $(3,7)$

Ans. (A)

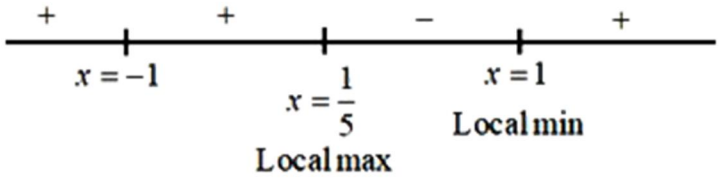
Sol: Given that

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

$$\Rightarrow \quad f(x) = 3(x-1)^2 (x+1)^2 + 2(x-1)(x+1)^3$$

$$= (x-1)(x+1)^2 \left[3(x-1) + 2(x+1)\right]$$

$$= (x-1)(x+1)^2 (5x-1).$$



Using the above real line of the first derivative, it is clear that the graph of the given function is not bounded, i.e., no global maximum value exists. Now, on considering the maximum value as the local maximum value, we get

$$f_{\max}(x)=f\left(\frac{1}{5}\right)=\left(\frac{1}{5}-1\right)^2\left(\frac{1}{5}+1\right)^3=\frac{4^2}{5^2}\times\frac{6^3}{5^3}=\frac{2^7.3^3}{3125}.$$

Since $f_{\max}(x)=\dfrac{2^p3^q}{3125}$, therefore $p=7$ and $q=3$.

42. $\vec{a}=\hat{i}-\hat{k}$, $\vec{b}=x\hat{i}+\hat{j}+(1-x)\hat{k}$ and $\vec{c}=y\hat{i}+x\hat{j}+(1+x-y)\hat{k}$, then $\left[\hat{a}\ \hat{b}\ \hat{c}\right]$ depends on

[NIMCET – 2023 (Mathematics)]

(A) Only x **(B)** Neither x nor y **(C)** Both x nor y **(D)** Only y

Ans. (B)

Sol: Here,

$$\left[\vec{a}\ \vec{b}\ \vec{c}\right]=\vec{a}.\left(\vec{b}\times\vec{c}\right)$$

$$=\begin{vmatrix}1 & 0 & -1\\ x & 1 & 1-x\\ y & x & 1+x-y\end{vmatrix}$$

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

$$=1$$

which is independent of x and y.

43. A computer producing factory has only two plants T_1 and T_2. Plant T_1 produces 20% and plant T_2 produces 80% of the total computer. Produced 7% of the computers produced in the factory turn out to be defective. It is known that P (computer turns out to be defective given that it is produced in plant T_1) $= 10P$ (computer turns out to be defective given that it is produced in plant T_2). A computer produced in the factory is randomly selected and it does not turn out to be defective. Then, the probability that is produced in plant T_2 is

[NIMCET – 2023 (Mathematics)]

(A) $\frac{47}{79}$ **(B)** $\frac{78}{93}$ **(C)** $\frac{36}{73}$ **(D)** $\frac{75}{83}$

Ans. (B)

Sol: Let x is the probability of computer turns out to be defective that it is produced in plant T_2. Then, using the given condition, we get

$$\frac{7}{100} = \frac{20}{100} \times (10x) + \frac{80}{100} \times x$$

$$\Rightarrow \quad x = \frac{7}{280} \qquad \ldots \text{(i)}$$

Let us also consider that A is the event that computer is produced in T_2 and B is the event that computer is not defective. Then, the probability that produced in T_2 but not defective

$$= P(A/B)$$

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

$$= \frac{\frac{4}{5}(1-x)}{\frac{1}{5}(1-10x) + \frac{4}{5}(1-x)}$$

$$= \frac{\frac{4}{5}\left(\frac{273}{280}\right)}{\frac{1}{5}\left(\frac{280-70}{280}\right) + \frac{4}{5}\left(\frac{273}{280}\right)}, \text{ using (i)}$$

$$= \frac{78}{93}.$$

44. If the equation $|x^2-6x+8|=a$ has four real solutions, then choose the correct option

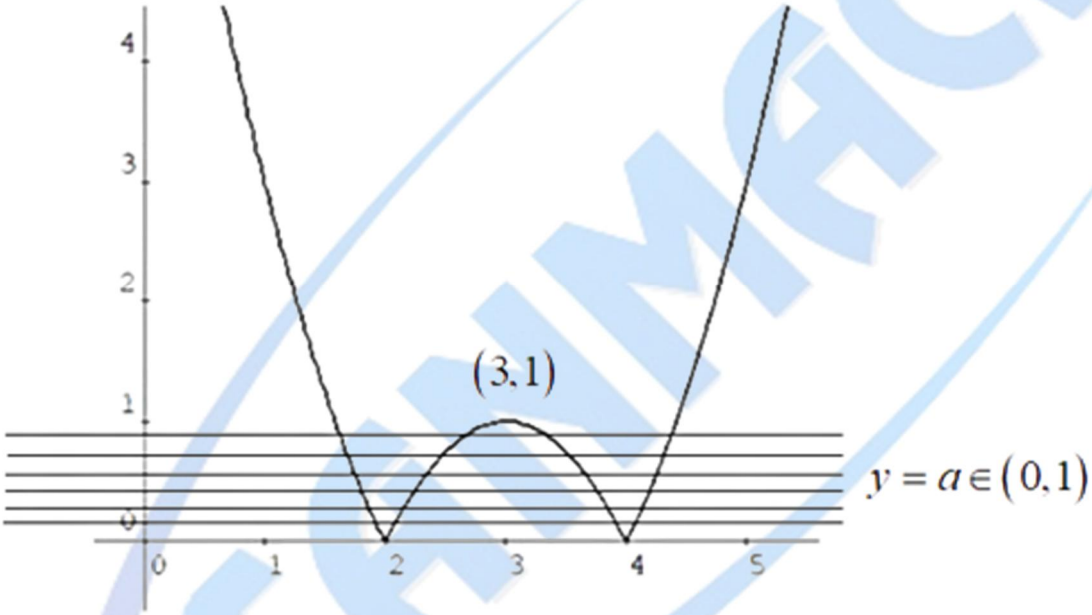
[NIMCET – 2023 (Mathematics)]

(A) $a=1$ **(B)** $a=0$ **(C)** $a\in(0,1)$ **(D)** $a\in[1,2]$

Ans. (C)

Sol: Let $f(x)=|x^2-6x+8|=|(x-2)(x-4)|$, then using graphical method, we have

$$f(x)=|x^2-6x+8|=|(x-2)(x-4)|$$



Therefore, the equation $|x^2-6x+8|=a$ or $f(x)=a$ will have four real solutions if the line $y=a$ intersect the graph f at exactly four times, i.e., $a\in(0,1)$.

45. Consider the following frequency distribution on tables

Class Interval	Frequency
10-20	180
20-30	f_1
30-40	34
40-50	180
50-60	136
60-70	f_2
70-80	50

If the total frequency is 685 and the median is 42.6 then the possible values of f_1 and f_2 are

[NIMCET – 2023 (Mathematics)]

(A) $82, 23$ **(B)** $80, 25$ **(C)** $83, 22$ **(D)** $79, 26$

Ans. (A)

Sol: The cumulative frequency table can be generated as

Class	Frequency	C.F
$10-20$	180	180
$20-30$	F_1	$180+F_1$
$30-40$	34	$214+F_1$
$40-50$	180	$394+F_1$
$50-60$	136	$530+F_1$
$60-70$	F_2	$530+F_1$
$70-80$	50	$580+F_1=F_2$

Here,

$$\frac{N}{2}=\frac{685}{2}=342.5.$$

Also, using the given condition, we get

$$580+F_1+F_2=685$$

$$\Rightarrow \quad F_1+F_2=105 \qquad \ldots(i)$$

Thus,

$$\text{Median}=42.6$$

$$\Rightarrow \qquad 42.6 = 40 + \left(\frac{342.5 - 214 - F_1}{180}\right) \times 10$$

$$\Rightarrow \qquad F_1 = 81.7 \qquad \ldots \text{(ii)}$$

Using (i) and (ii), we get

$$F_2 = 23.3 \qquad \ldots \text{(iii)}$$

Since the frequencies are always a whole number, the missing nearest frequencies are 82 and 23.

46. If $|x-6| = |x^2-4x| - |x^2-5x+6|$, where x is a real variable, then choose the correct option

[NIMCET – 2023 (Mathematics)]

(A) $x \in (2,5)$ **(B)** $x \in [2,3] \cup [6,\infty)$ **(C)** $x \in \mathbb{R} - [2,6]$ **(D)** None of these

Ans. (B)

Sol: Given that

$$|x-6| = \left|\underbrace{x^2-4x}_{x(x-4)}\right| - \left|\underbrace{x^2-5x+6}_{(x-2)(x-3)}\right|$$

$$\Rightarrow \begin{cases} -(x-6) = (x^2-4x) - (x^2-5x+6), & x \le 0 \\ -(x-6) = -(x^2-4x) - (x^2-5x+6), & 0 \le x \le 2 \\ -(x-6) = -(x^2-4x) + (x^2-5x+6), & 2 \le x \le 3 \\ -(x-6) = -(x^2-4x) - (x^2-5x+6), & 3 \le x \le 4 \\ -(x-6) = (x^2-4x) - (x^2-5x+6), & 4 \le x \le 6 \\ (x-6) = (x^2-4x) - (x^2-5x+6), & x \ge 6 \end{cases}$$

$$\Rightarrow \begin{cases} x = 6, & x \le 0 \\ x^2-5x+6 = 0, & 0 \le x \le 2 \\ -x+6 = -x+6, & 2 \le x \le 3 \\ x^2-5x+6 = 0, & 3 \le x \le 4 \\ x = 6, & 4 \le x \le 6 \\ x-6 = x-6, & x \ge 6 \end{cases}$$

$$\Rightarrow \begin{cases} x=6, & x\le 0 \\ x=2,3, & 0\le x\le 2 \\ 0=0\,(\text{identity}), & 2\le x\le 3 \\ x=2,3, & 3\le x\le 4 \\ x=6, & 4\le x\le 6 \\ 0=0\,(\text{identity}), & x\ge 6 \end{cases}$$

Therefore, the solution set of the given equation is $x\in[2,3]\cup[6,\infty)$.

47. In a ΔABC (a, b, c are the lengths of the opposite sides of angles A, B, C respectively), the perimeter of a ΔABC is 6 times the arithmetic mean of the sine values of its angles. if the side $a=1$, then the angle A is

[NIMCET – 2023 (Mathematics)]

(A) $\frac{\pi}{6}$ **(B)** π **(C)** $\frac{\pi}{3}$ **(D)** $\frac{\pi}{4}$

Ans. (A)

Sol: Given that

$$a+b+c=\frac{6(\sin A+\sin B+\sin C)}{3}$$

$$\Rightarrow \quad k(\sin A+\sin B+\sin C)=2(\sin A+\sin B+\sin C) \qquad \because \frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}=k$$

$$\Rightarrow \quad k=2 \qquad \because \sin A+\sin B+\sin\neq 0$$

Thus,

$$\frac{a}{\sin A}=2$$

$$\Rightarrow \quad \sin A=\frac{1}{2} \qquad \because a=1$$

$$\Rightarrow \quad A=\frac{\pi}{6}.$$

48. The graph of the real function $f(x)=\log_a\left(x^3+\sqrt{x^6+1}\right)$ is symmetric about the

[NIMCET – 2023 (Mathematics)]

(A) $x-$axis **(B)** Origin **(C)** $y-$axis **(D)** $y=x$ line

Ans. (B)

Sol: The given function f is an odd function as

$$f(-x)=\log_a\left((-x)^3+\sqrt{(-x)^6+1}\right)$$

$$=\log_a\left(\sqrt{x^6+1}-x^3\right)$$

$$=\log_a\left(\left(\sqrt{x^6+1}-x^3\right)\times\frac{\sqrt{x^6+1}+x^3}{\sqrt{x^6+1}+x^3}\right)$$

$$=\log_a\left(\frac{1}{\sqrt{x^6+1}+x^3}\right)$$

$$=\log_a\left(\sqrt{x^6+1}+x^3\right)^{-1}$$

$$=-\log_a\left(\sqrt{x^6+1}+x^3\right)$$

$$=-f(x).$$

Thus, it is symmetrical about origin.

49. Let A and B be two sets that $A\cap X=B\cap X=\phi$ and $A\cup X=B\cup X$ for some set X. Then

[NIMCET – 2023 (Mathematics)]

(A) $A\cup B=X$ **(B)** $B=X$ **(C)** $A=B$ **(D)** $A=X$

Ans. (C)

Sol: We know that

$A=A\cap(A\cup X)$

$=A\cap(B\cup X)$ $\because A\cup X=B\cup X$

$=(A\cap B)\cup(A\cap X)$, using Distributive rule

$=(A\cap B)\cup\phi$ $\because A\cap X=\phi$

$= A \cap B$ …(i)

Again,

$B = B \cap (B \cup X)$

$= B \cap (A \cup X)$ $\because A \cup X = B \cup X$

$= (B \cap A) \cup (B \cap X)$, using Distributive rule

$= (B \cap A) \cup \phi$ $\because B \cap X = \phi$

$= B \cap A$

$= A \cap B$ …(ii)

Therefore, using (i) and (ii), we get $A = B$.

50. The locus of mid-points of all chords of the parabola $y^2 = 4x$ which are drawn through its vertex, is

[NIMCET – 2023 (Mathematics)]

(A) $y^2 = 8x$ **(B)** $y^2 = 2x$ **(C)** $x^2 + 4y^2 = 16$ **(D)** $x^2 = 2y$

Ans. (B)

Sol: Let the mid-point of the a chord drawn from vertex $O(0,0)$ is $M(h,k)$ and the other end of the chord is $P(t^2, 2t)$. Thus,

$$(h,k) = \left(\frac{t^2+0}{2}, \frac{2t+0}{2}\right)$$

$\Rightarrow$ $h = \frac{t^2}{2}$ and $k = t$

$\Rightarrow$ $h = \frac{k^2}{2}$

$\Rightarrow$ $k^2 = 2ah$,

i.e., the required locus is $y^2 = 2ax$.

PART – B : ANALYTICAL ABILITY AND LOGICAL REASONING

51. For security reasons, a bank manager decided to encrypt the account number in the server. If A/C No. 46873 is coded as 91317157, then 52191 is coded as

[NIMCET – 2023 (Reasoning)]

(A) 4108041 **(B)** 1043293 **(C)** 5219152 **(D)** 1153193

Ans. (D)

Sol: The pattern of the given series is

$4 \xrightarrow{+5} 9$, $6 \xrightarrow{+7} 13$, $8 \xrightarrow{+9} 17$, $7 \xrightarrow{+8} 15$ and $3 \xrightarrow{+4} 7$.

Thus,

52191 will be coded as 1153193.

52. In a reality show, two judges independently provided marks based on the performance of the participants. If the marks provided by the second judge are given by $y = 1 + x$, where x is the marks provided by the first judge. Then for a participant

[NIMCET – 2023 (Reasoning)]

(A) Rank given by the first judge is more than of the second judge
(B) Rank given by the second judge is more than that of the first judge
(C) Rank given by both the judges differ by 2
(D) Rank given by both the judges are same.

Ans. (D)

Sol: Rank is independent of change of origin (addition/subtraction of a scalar to/from each data doesn't change the rank).

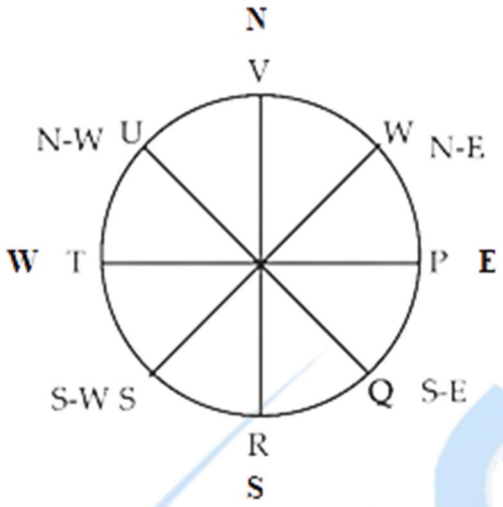
53. P, Q, R, S, T, U, V, W are sitting around a round table in the same order, for group discussion at equal distances. Their positions are clockwise. If V sits in the north, then what will be the position of S ?

[NIMCET – 2023 (Reasoning)]

(A) South–East **(B)** South **(C)** South–West **(D)** East

Ans. (C)

Sol: The given information can be described as



Here, V is sitting in North. For position of S we move in anti-clockwise direction. Hence, S will be in the South– West position.

54. Complete the series 3, 10, 24, 45, 73, …

[NIMCET – 2023 (Reasoning)]

(A) 69 **(B)** 121 **(C)** 91 **(D)** 108

Ans. (D)

Sol: The given series pattern is as follows

Thus, on adding consecutive multiples of 7 we will get the desired number.

55. Arrange the words given below in a meaningful sequence.

(1) Database
(2) Analysis
(3) Survey
(4) Policy formulation
(5) Interpretation

[NIMCET – 2023 (Reasoning)]

(A) 3, 1, 2, 4, 5 **(B)** 2, 1, 5, 3, 4 **(C)** 5, 4, 3, 1, 2 **(D)** 3, 1, 2, 5, 4

Ans. (D)

Sol: The correct sequence is:

Survey → Database → Analysis → Interpretation → Policy formulation.

56. A vessel contains total 95 litre mixture of milk & water in the ratio of 15:4 respectively. P litre of mixture taken out from the vessel and 18 litres water added in the remaining mixture, then the new ratio of milk to water becomes 3:2, find the value of P?

[NIMCET – 2023 (Reasoning)]

(A) 27.5 **(B)** 19 **(C)** 57 **(D)** 38

Ans. (D)

Sol: In the original mixture quantity of milk $=\frac{15}{19}\times 95=75$ litres and quantity of water $=\frac{4}{19}\times 95=20$ litres. If P units of mixture is removed, then

quantity of milk left $=75-\frac{15}{19}\times P$

and quantity of water left $=20-\frac{4}{19}\times P$.

$\therefore$ As per the given information

$$\frac{75-\frac{15}{19}P}{20-\frac{4}{19}P+18}=\frac{3}{2}$$

$\Rightarrow$ $P=38$ litres.

57. If 3 is subtracted from the middle digit of each of the following numbers and then the position of the digits is reversed, which of the following will be last digit of the middle number after they are arranged in descending order?

589 362 554 371 442

[NIMCET – 2023 (Reasoning)]

(A) 4 **(B)** 1 **(C)** 2 **(D)** 3

Ans. (D)

Sol: On subtracting 3 from the middle digits, the numbers become : 559, 332, 524, 341, 412
Now, on reversing the positions of digits, we get: 955, 233, 425, 143, 214
Again, on arranging these numbers in descending order, we get : 955, 425, 233, 214, 143
Thus, the middle number is 233 and its last digit is 3.

58. A sum of money is distributed among four-persons P, Q, R, S in the proportion 2:5:4:3. If Q gets Rs. 2000 more than S, then what will be the total amount?

[NIMCET – 2023 (Reasoning)]

(A) 18000 **(B)** 16000 **(C)** 14000 **(D)** 15000

Ans. (C)

Sol: Here

$$P:Q:R:S = 2:\underbrace{5:4:3}_{2\,\text{unit}} \Rightarrow +2 \text{ unit} \rightarrow 2000 \Rightarrow 1 \text{ unit} \rightarrow 1000$$

Thus, the total amount

$= 14 \text{ unit} \rightarrow 14 \times 1000$

$= 14000$.

59. Identify the next two numbers in the following sequence:

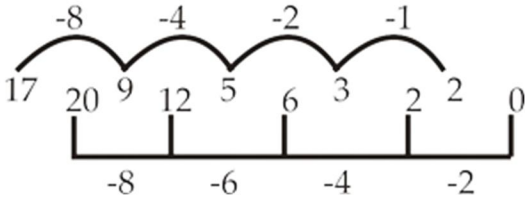
17, 20, 9, 12, 5, 6, 3, 2, _____, _____

[NIMCET – 2023 (Reasoning)]

(A) 2, 1 **(B)** 1, 2 **(C)** 0, 2 **(D)** 2, 0

Ans. (D)

Sol: The given series pattern is given as



Thus, the last two number will be 2 and 0.

60. In a certain language, DENMARK is coded as FCPKCPM. Find the code of SINGAPORE.

[NIMCET – 2023 (Reasoning)]

(A) UGPEDNQTC **(B)** UGPECNQTC **(C)** UGPFCNRPG **(D)** UGPECNQPG

Ans. (D)

Sol: Here,

DENMARK → F(+2) C(-2) P(+2) K(-2) C(+2) P(-2) M(+2)

Thus,

SINGAPORE → U(+2) G(-2) P(+2) E(-2) C(+2) N(-2) Q(+2) P(-2) G(+2)

61. A junior school is offering five after–School activities – Karate, Handwork, Music, Dance and Gymnastic. Each of the five students– Leena, Megan, Neha, Omar and Pixie, has subscribed to at least one activity. As per the school rules, anyone who subscribes to Gymnastic must also subscribe to Dance. Karate and Handwork must always be subscribed together. Music and Dance cannot to be subscribed together.

The following information is available about the students' subscriptions.

- Megan subscribed to four activities
- Leena subscribed to Gymnastic but not Karate
- Pixie subscribed to only one activity and is the only one to subscribe to that activity.
- Omar subscribed to three activities.
- Neha subscribed to only one activity

How many activities are subscribed by exactly two people each?

[NIMCET – 2023 (Reasoning)]

(A) 4 **(B)** 1 **(C)** 3 **(D)** 2

Ans. (B)

Sol: The given information can be summarised as

	Karate	Handwork	Music	Dance	Gym
Leena				✓	✓
Megan	✓	✓		✓	✓
Neha				✓	
Omar	✓	✓		✓	
Pixie			✓		

Therefore, only 3 activities are subscribed by exactly two people.

62. A 30 litres mixture of milk and water contains 10% water. How much milk should be added so that the percentage of water in the mixture comes down to 2% ?

[NIMCET – 2023 (Reasoning)]

(A) 90 litres **(B)** 60 litres **(C)** 120 litres **(D)** 80 litres

Ans. (C)

Sol:

(Initially) Water : Milk = $1 : 9$

constant + 40 added

(Final) Water : Milk = $1 : 49$

Here milk is added, but water remain constant.

$(1+9)$ unit $=10$ unit $\rightarrow 30$

1 unit $\rightarrow 3$

$\therefore$ Added milk 40 unit $\rightarrow 40\times 3$

$=120$ liters.

63. Statements:

Most teachers are boys.

Some boys are students.

Conclusions:

I. Some students are boys.

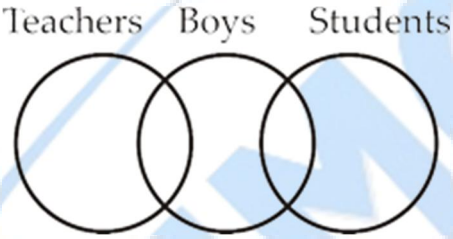
II. Some teachers are students.

[NIMCET – 2023 (Reasoning)]

(A) Neither I nor II follows
(B) Only II follows
(C) Either I or II follows
(D) Only I follows

Ans. (D)

Sol: Using Venn-diagram



Only Statement I follows.

64. Shweta, Yamini, Pooja and Rakhi are sisters. Yamini is older than at least two of her sisters. Pooja is younger than Rakhi, who is not the oldest. Shweta is older than Pooja but younger than Rakhi. Who is the oldest among them?

[NIMCET – 2023 (Reasoning)]

(A) Yamini **(B)** Pooja **(C)** Shweta **(D)** Rakhi

Ans. (A)

Sol: Here

I	II	III	IV
Yamini	Rakhi	Shweta	Pooja
↓			
Oldest			

65. Book: Publisher: Film: ?

[NIMCET – 2023 (Reasoning)]

(A) Producer **(B)** Director **(C)** Writer **(D)** Editor

Ans. (A)

Sol: Book : Publisher : : Film : Producer

(Book is made by Publisher. Similarly, Film is made by Producer.)

66. Ritu purchased 20 dozens of bananas at the rate of Rs. 375 per dozen. She sold each one of them at the rate of Rs. 33. What was her profit percentage?

[NIMCET – 2023 (Reasoning)]

(A) 12.3% **(B)** 5.6% **(C)** 6.5% **(D)** 10%

Ans. (B)

Sol: Here,

Cost price of 20 dozen bananas $= 375 \times 20 = Rs.7500$

Selling price of 20 dozen bananas $= 33 \times 12 \times 20 = Rs.7920$

Thus,

Profit $= 7920 - 7500 = Rs.420$

and

Profit $\% = \dfrac{420}{7500} \times 100 = 5.6\%$.

67. In the given word "LAVISHLY", If all the consonants are replaced with its previous letter and all the vowels are replaced with its next letter, after that remove all the repeated letters and arrange them in alphabetical order then, which of the following letter is 3rd from the left end?

[NIMCET – 2023 (Reasoning)]

(A) U **(B)** R **(C)** J **(D)** G

Ans. (C)

Sol: Here,

$$\text{LAVISHLY} \rightarrow \underset{-1}{K}\ \underset{+1}{B}\ \underset{-1}{U}\ \underset{+1}{J}\ \underset{-1}{R}\ \underset{-1}{G}\ \underset{-1}{K}\ \underset{-1}{W}$$

After rearranging in alphabetic order, we get

B G J K R U W

Thus, the 3rd letter from the left end is J.

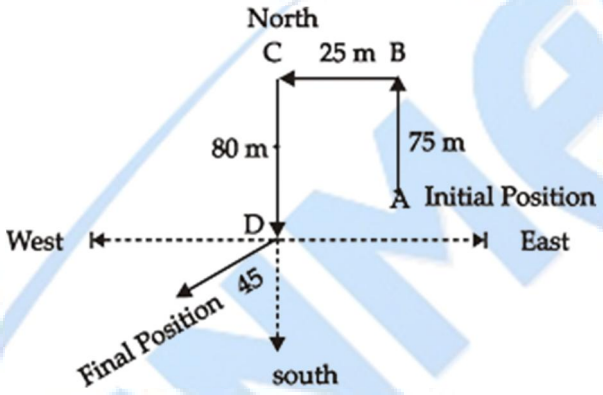
68. Deepa moved a distance of 75 meters towards the north. She then turned to the left and after walking for about 25 meters, turned left again and walked 80 meters. Finally, she turned to the right at an angle of 45^0. In which direction was she moving finally?

[NIMCET – 2023 (Reasoning)]

(A) South–West **(B)** South–East **(C)** North–West **(D)** North–East

Ans. (A)

Sol: We have



Deepa was moving in the South – West direction finally.

69. A university is offering elective courses in Mathematics, Economics and Sociology. Each of its 100 undergraduate students has to opt for at least one of these electives. Course enrollment data showed that 47 students enrolled for Mathematics, 47 students enrolled for Economics and 57 students enrolled for Sociology. If 7 students enrolled for all three courses, how many students enrolled for exactly one course?

[NIMCET – 2023 (Reasoning)]

(A) 56 **(B)** 58

(C) 60 **(D)** Cannot be determined

Ans. (A)

Sol: Let M, E and S denotes the number of students in Mathematics, Economics and Sociology, respectively. Here, we have

$n(M \cup E \cup S) = 100$, $n(M) = 47$, $n(E) = 47$, $n(S) = 57$, and $n(M \cap E \cap S) = 7$.

Therefore, the number of students enrolled for exactly one course

$$= n(M \cup E \cup S) - n(M \cap E) - n(E \cap S) - n(S \cap M) + 2n(M \cap E \cap S)$$
$$= 100 - 58 + 14$$
$$= 56.$$

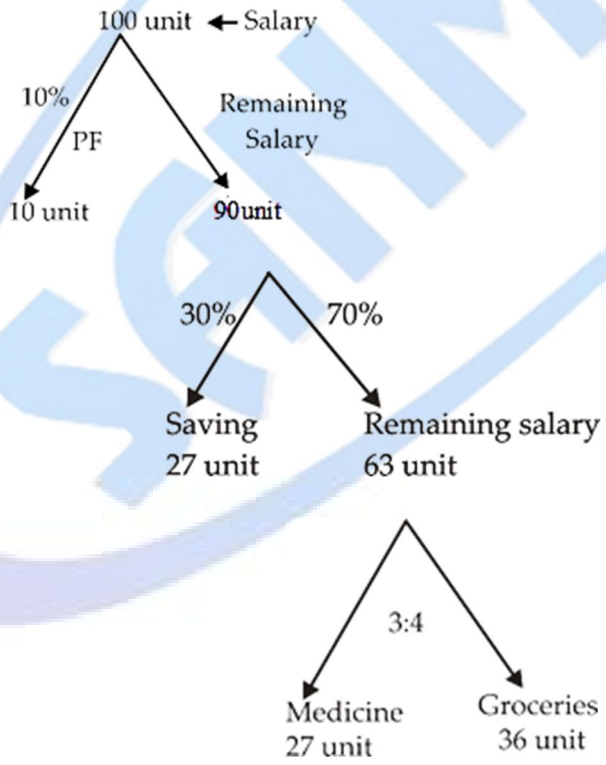
70. Hemant deposits 10% of his salary in PF, He saves 30% of the remaining salary. The ratio of his expense on medicine and groceries is 3:4 of the remaining salary after saving. If his expense on the medicine was Rs. 2700, then find monthly salary

[NIMCET – 2023 (Reasoning)]

(A) Rs. 30,000 **(B)** Rs. 10,000 **(C)** Rs. 15,000 **(D)** Rs. 20,000

Ans. (B)

Sol: We have



Thus,

$$27 \text{ unit} = 2700 \Rightarrow 1 \text{ unit} = 100 \Rightarrow 100 \text{ units (Salary)} = 100 \times 100 = 10000 .$$

71. Hari invested an amount at a certain rate of interest on simple Interest and he got 60% more amount after eight years. If he invests Rs. 9600 at the same rate of interest on simple interest, then find the total interest he would get after four years?

[NIMCET – 2023 (Reasoning)]

(A) Rs. 2520 **(B)** Rs. 2260 **(C)** Rs. 2880 **(D)** Rs. 2160

Ans. (C)

Sol: Here,

$$\text{Rate} = 60\% = \frac{60}{100} = \frac{3(\text{Simple Interest})}{5(\text{Principal})}$$

Now, for 8 years

$$P : S.I. = 5 : 3 \Rightarrow 5 \text{ unit} = 9600 \Rightarrow 1 \text{ unit} = 1920$$

Thus, for 8 years $(S.I.)$

$$3 \text{ unit} = 1920 \times 3 = 5760$$

Hence, for 4 years

$$\text{S. I.} = \frac{5760}{2} = 2880 .$$

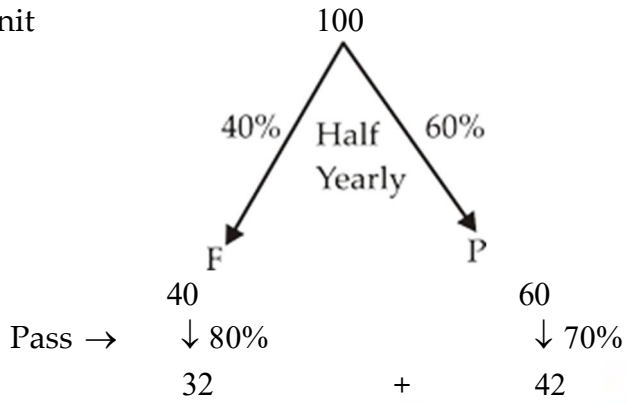
72. In the half yearly exam only 60% of the students were passed. Out of these (passed in half–yearly) only70% students are passed in annual exam, out of remaining students (who fail in half–yearly exam) 80% passed in annual exam. What percent of the students passed the annual exam?

[NIMCET – 2023 (Reasoning)]

(A) 65% **(B)** 72% **(C)** 76% **(D)** 74%

Ans. (D)

Sol: Total Student $=100$ unit



Total passed students in annual exam $=74$, i.e., 74% students passed the annual exam.

73. If $20-10$ means 200, $8\div4$ means 12, 6×2 means 4, then $100-10\times1000\div1000+100\times10=?$

[NIMCET – 2023 (Reasoning)]

(A) 0 **(B)** 20 **(C)** 1090 **(D)** None of these

Ans. (A)

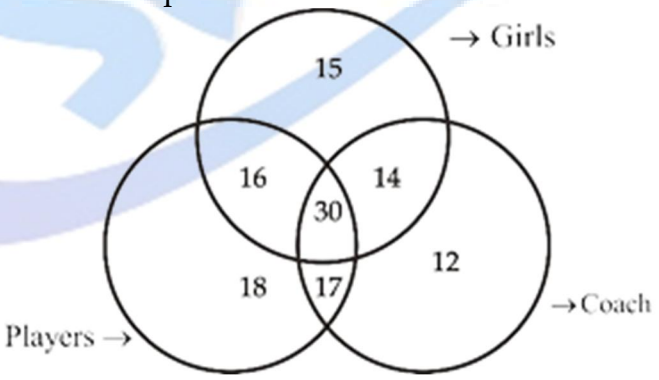
Sol: Here,

$$20\underset{\times=\square}{-}10=200,\ 8\underset{+=\square}{\div}4=12 \text{ and } 6\underset{-=\square}{\times}2=4.$$

Thus,

$$\begin{aligned}100-10\times1000\div1000+100\times10&=100-10\times1000\div1000+100\times10\\&=100\times10-1000+1000\div100-10 \text{ (Using coding given)}\\&=1000-1000+10-10 \text{ (Using BODMAS rule)}\\&=0.\end{aligned}$$

74. Study the diagram and answer the question that follows:



How many players are there who are girls but not a coach?

[NIMCET – 2023 (Reasoning)]

(A) 61 **(B)** 16 **(C)** 31 **(D)** 15

Ans. (B)

Sol: The players who are girls but not a coach represented (in shaded region) as follows:

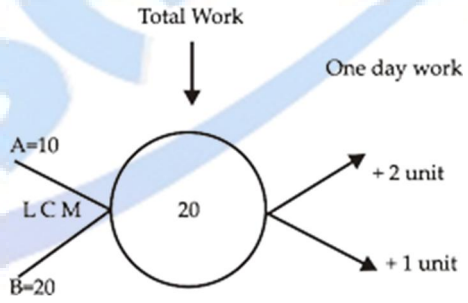
75. A can do a work in 10 days, B can do the same work in 20 days. After working for 4 days B left the job & C started working at the place of B, the remaining work was done by both A & C in 2 days. In how many days C alone do the work?

[NIMCET – 2023 (Reasoning)]

(A) 20 days **(B)** 10 days **(C)** 12 days **(D)** 15 days

Ans. (B)

Sol: Here



(i.e. we have assumed that total work is 20 units for easier calculations)

Now, (A + B)'s 4 days work $= 12$ units
$\therefore$ Remaining work to be done by A & C $= 8$ units
As per the given information, A & C do 8 units of work in 2 days.
$\Rightarrow$ A & C do 4 units of work in 1 day.
But A's rate is 2 units per day.
$\therefore$ C's rate is also 2 units per day.
$\Rightarrow$ A & C are equally efficient and hence 'C' takes same time as A.
i.e. 10 days.

76. Rakesh says to Mahesh, "I am as old as you were when I was one–third as old as you are." If the sum of their ages is 60 years, find the present age of Mahesh (in years).

[NIMCET – 2023 (Reasoning)]

(A) 30 **(B)** 24 **(C)** 45 **(D)** 36

Ans. (D)

Sol: Let x be the present age of Mahesh, Then, Rakesh present age is $60-x$. Again, when Mahesh age was $60-x$, Rakesh age should be $(60-x)-(2x-60)$. Now, according to the given condition

$$\frac{x}{3} = 120 - 3x$$
$$\Rightarrow \quad x = 360 - 9x$$
$$\Rightarrow \quad x = 36 \text{ years.}$$

77. How many meaningful words can be formed with the first, the third, the seventh and the ninth letters of the word SEPARATION using each letter once in each word?

[NIMCET – 2023 (Reasoning)]

(A) 2 **(B)** 3 **(C)** 4 **(D)** More than 4

Ans. (D)

Sol: The first, the third, the seventh and the ninth letters of the word SEPARATION are given as

$$\overset{1st}{S} \quad \overset{3rd}{P} \quad \overset{7th}{T} \quad \overset{9th}{O}$$

The meaningful words can be formed using them can be Post, Tops, Stop, Spot, Pots, etc., i.e., more than 4 words.

78. Fill the blanks with the most appropriate combination of options.
Further, to augment bond market liquidly, corporate need to be encouraged to _____ exiting bonds under the same International Securities Identification Number, to duly shore up floating_____

[NIMCET – 2023 (Reasoning)]

(A) reissue, Stocks
(B) abandon, imply
(C) precaution, abstract
(D) affect, negotiate

Ans. (A)
Sol: reissue, stocks

79. If the word IMPACT is coded as RNKZXG, then which of the following represents the code for the word DESCEND?

[NIMCET – 2023 (Reasoning)]

(A) WVHXVMW **(B)** MNBLNWM **(C)** MFBDNDM **(D)** MFBDFOM

Ans. (A)
Sol: Here,

I M P A C T → R N K Z X G (Opposite letter in English Alphabet)

Thus,

D E S C E N D → W V H X V M W (Opposite letter in English Alphabet)

80. Three persons A, B and C are standing in a queue. There are five persons between A and B eight persons between B and C. If there are three persons ahead of C and 21 behind A, then what could be the minimum number of persons in the queue?

[NIMCET – 2023 (Reasoning)]

(A) 28 **(B)** 27 **(C)** 40 **(D)** 41

Ans. (A)
Sol: Three persons A, B, C can be arranged in a queue in six different ways i.e., ABC, CBA, BAC, CAB, BCA, ACB. But since there are only 3 persons ahead of C, so C should be in front of the queue. Thus, there are only two possible arrangements i.e., CBA and CAB. We may consider the two cases as

Case I: 3 C 8 B 5 A 21

Total number of persons $= 21+5+8+3+3 = 40$

Case II: 3 C 2 A 5 B 15

Total number of persons $= 3+2+5+15+3 = 28$

Thus, 28 is the minimum number of persons in the queue.

81. Thirty–six vehicles are parked in a parking lot in a single row. After the first car, there is one scooter. After the second car, there are two scoters. After the third car, there are three scooters and so on. Work out the number of scooters in the second half row.

[NIMCET – 2023 (Reasoning)]

(A) 10 **(B)** 17 **(C)** 15 **(D)** 12

Ans. (C)

Sol: Let C and S denote car and scooter respectively. Then, the sequence of parking is

C S C S S C S S S C S S S S C S S S | S S C S S S S S S C S S S S S S S C

If we divide the above sequence into two equal halves, then numbers of scooters in second half of the row is equal to 15.

82. Statements:

No table is chair.

Not a single chair is stand.

Every stand is statue.

Conclusions: 1. Some statue which are stand are table as well.

2. Some statue are not chair.

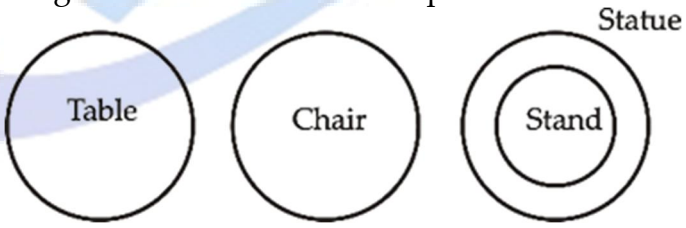
[NIMCET – 2023 (Reasoning)]

(A) Only conclusion 2 follows **(B)** None follows

(C) If only conclusion 1 follows **(D)** If neither conclusion 1 nor 2 Follows

Ans. (A)

Sol: Using Venn-diagram, the given statements can be represented as



Thus, only conclusion 2 follows.

83. If yellow is called white, white is called black is called green, green is called pink, pink is called blue and blue is called water, what is the colour of sky?

[NIMCET – 2023 (Reasoning)]

(A) White **(B)** Water **(C)** Blue **(D)** Black

Ans. (B)

Sol: Since the colour of sky is Blue and blue is called water, thus the answer is water.

84. Pointing towards a person in the photograph, Anjali said, "He is the only son of the father of my sister's brother." How is that person related to Anjali?

[NIMCET – 2023 (Reasoning)]

(A) Cousin **(B)** Father **(C)** Mother **(D)** None of these

Ans. (D)

Sol: The relations may be analyzed as follows:

My sister's brother $\Rightarrow$ My brother

My brother's father $\Rightarrow$ My father

My father's son $\Rightarrow$ My brother

So, the person in the photograph is Anjali's brother.

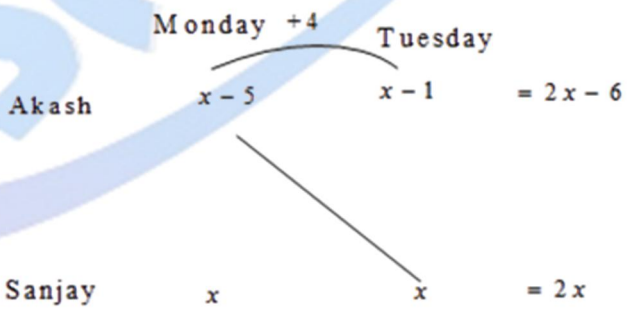
85. On Monday, Akash ran 4 km less than the distance he ran on Tuesday. Sanjay, who ran the same distance on Monday and Tuesday, ran 5 km more on Tuesday than the distance Akash ran on Monday. Find the difference between the distances covered by Akash and Sanjay over then two days.

[NIMCET – 2023 (Reasoning)]

(A) 5 km **(B)** 6 km **(C)** 9 km **(D)** 4 km

Ans. (B)

Sol:



Thus, the difference between the distances covered by Akash and Sanjay over then two days is 6 km.

86. Rajdhani Train running at a speed of 54 km/hr crosses a platform of length same as that of the train in 36 sec. If a Duronto train, which is 230 meters long crosses the same platform is 25 sec, then find speed of Duronto train (in km/hr)?

[NIMCET – 2023 (Reasoning)]

(A) 54 km/hr **(B)** 84 km/hr **(C)** 90 km/hr **(D)** 72 km/hr

Ans. (D)

Sol: When a train crosses a platform then the total distance travelled by train
= length of train + length of Platform

Case I (Rajdhani):

$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\Rightarrow \quad 2x = 54 \times \frac{5}{18} \times 36 \qquad \because 1\text{km/h} = \frac{5}{18}\text{m/sec}$$

$$\Rightarrow \quad 2x = 540$$

$$\Rightarrow \quad \text{(length of platform) } x = 270 \text{ meters.}$$

Case II (Duronto**):**

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\Rightarrow \quad \text{Speed} = \frac{230 + 270}{25} = 20 \text{ meter/sec}$$

$$\Rightarrow \quad \text{Speed} = 20 \times \frac{18}{5} = 72 \text{ km/hr.}$$

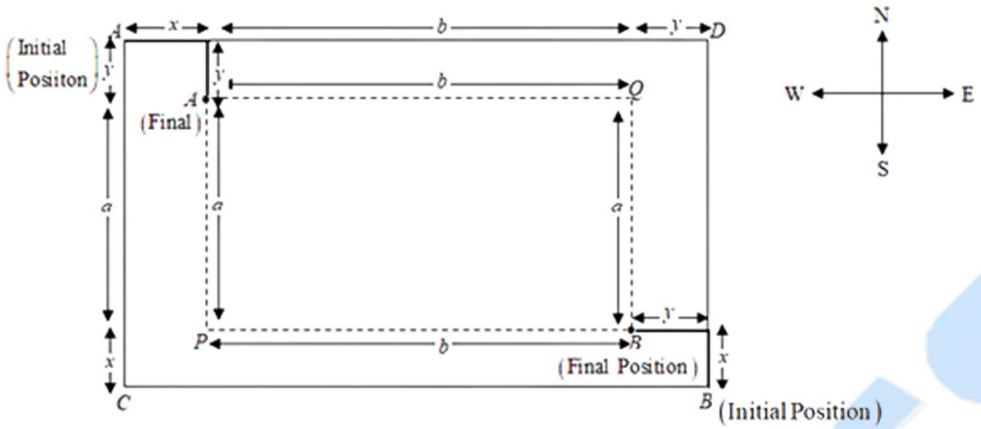
87. Two friends A and B were standing at the diagonally opposite corners of a rectangular plot whose perimeter is 100 m. A first walked x meters along the length of the plot towards East and then y meters towards the South. B walked x meters along the breadth towards North and then y meters towards West. At the end of their walks, A and B were standing at the diagonally opposite corners of a smaller rectangular plot whose perimeter is 40 m. How much distance did A walk?

[NIMCET – 2023 (Reasoning)]

(A) 15 **(B)** 50 **(C)** 25 **(D)** 40

Ans. (A)

Sol: Using the given information, we have



In this case, the perimeter of larger rectangle $=100\,\text{m}$

$\Rightarrow \quad 4x+4y+2a+2b=100\,\text{m}$ … (i)

Also, the perimeter of the smaller rectangle $=40\,\text{m}$

$\Rightarrow \quad 2a+2b=40\,\text{m}$ … (ii)

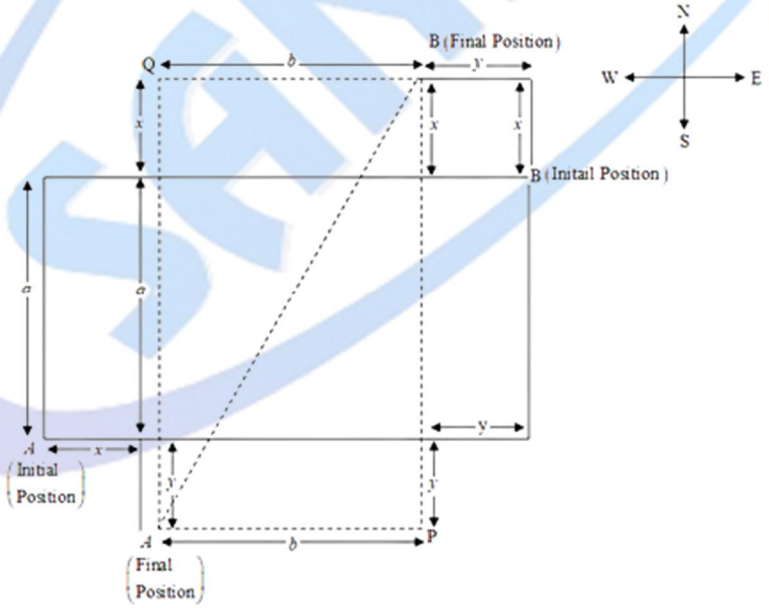
Thus, by solving (i) and (ii), we get

$4x+4y=60$

$\Rightarrow \quad x+y=15$

Hence, the total distance travelled by A is 15 m.

Note: In this question, if we consier the initial position of A and B in other diagonal, then using the given information we will get



In this case, the both of the resultant rectangles will have same perimeter (does not fulfil the condition of the given problem).

88. Find a number from the given options which best completes the series:

39, 416, 525, …, 749, 864

[NIMCET – 2023 (Reasoning)]

(A) 436 **(B)** 439 **(C)** 636 **(D)** 644

Ans. (C)

Sol: Here, we have

$39 = 33^2$

$416 = 44^2$

$525 = 55^2$

So next term should be $66^2 = 636$.

89. Which word among the following words can be formed from the letters of "RECOMMENDATION"?

[NIMCET – 2023 (Reasoning)]

(A) REMINDER **(B)** MEDICINE **(C)** COMMUNICATE **(D)** MEDIATE

Ans. (D)

Sol: Clearly, MEDIATE can be formed using the word RECOMMENDATION.

90. If 'E' stands for '+', 'F' stands for '–', 'M' stands for '×', 'N' stands for '÷', then 19M5E39N3F8=?

[NIMCET – 2023 (Reasoning)]

(A) 95 **(B)** 106 **(C)** 100 **(D)** 90

Ans. (C)

Sol: From the given information, we get

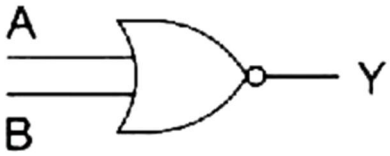
$19M5E39N3F8 = 19 \times 5 + 39 \div 3 - 8$

$= 95 + 13 - 8$

$= 100$.

PART– C : COMPUTER AWARENESS

91. Consider the circuit shown below and find minimum number of NAND gates required to design it.

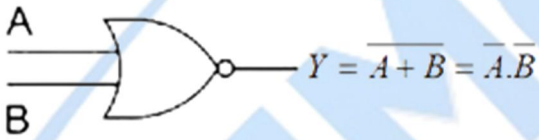


[NIMCET – 2023 (Computer)]

(A) 3 **(B)** 5 **(C)** 4 **(D)** 6

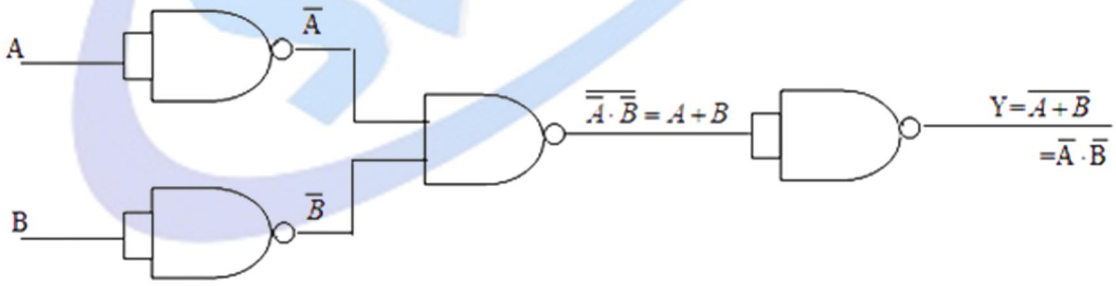
Ans. (C)

Sol: For the given NOR gate, we have



For NAND gate, using DE Morgan's law, we have

Construction of NOR gate using NAND gate can be performed as follows.



Hence, the minimum number of NAND gates required to design given NOR gate is 4.

92. Suppose we have a 10-bit computer that uses 10-bit floating point computation unit (Float number uses, IEEE floating–point arithmetic where a floating point number has 1 sign bit, 5 exponent bits, and 4 fraction bits). The representation for $+\infty$ (Plus infinity) is

[NIMCET – 2023 (Computer)]

(A) 0 00000 1111 **(B)** 0 11111 1111 **(C)** 0 10011 0000 **(D)** 0 11111 0000

Ans. (D)

Sol: For positive infinity, we have

0	11111	0000
Sign (0 for +, 1 for –)	Exponent	Mantissa

93. The maximum and minimum value represented in 16–bit 2s compliment representation are

[NIMCET – 2023 (Computer)]

(A) -16384 and 16383 **(B)** 0 and 65535 **(C)** -32678 and 32767 **(D)** 0 and 32767

Ans. All the given choices are incorrect.

Sol: The signed range of integer values that can be stored in 16 bits is $-32,768\left(-2^{15}\right)$ through $32,767\left(2^{15}-1\right)$. Hence, from the given options of this question, there is no correct option.

Note: In actual NIMCET 2023 marking scheme, this question was eliminated as none of the choice was correct.

94. What is the name of the storage device that compensates the difference in rates of flow of data from one device to another?

[NIMCET – 2023 (Computer)]

(A) RAM **(B)** Buffer **(C)** Cache **(D)** Concentrator

Ans. (B)

Sol: Buffer device

95. The number of minterms in a **n** variable truth table is

[NIMCET – 2023 (Computer)]

(A) n^2 **(B)** $(n-1)^2$ **(C)** 2^n **(D)** 2^{n-1}

Ans. (C)

Sol: This is because each variable can be either 0 or 1, giving 2 possibilities, and there are n variables, so the total number of possible combination is 2^n.

96. A bulb in the staircase has two switches, one switch is at the ground floor and the other one is at the first floor. The bulb can be turned ON and also can be turned OFF by any of the switches irrespective of the stage of the other switch. The logic of the switching of the bulb resembles.

[NIMCET – 2023 (Computer)]

(A) AND gate **(B)** OR gate **(C)** XOR gate **(D)** XNOR gate

Ans. (C)

Sol: Truth table of XOR gate is

A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

Thus, from the above XOR gate truth table, it is clear that the bulb be turned ON and also can be turned OFF by one of the switches irrespective of the state of the other switch.

97. Suppose we have a $10-$bit computer that uses $10-$bit **int** (2's complement representation). The number representation of -35 is

[NIMCET – 2023 (Computer)]

(A) 0000 100011 **(B)** 1100100011 **(C)** 1111011101 **(D)** 1111011101

Ans. (C), (D)

Sol: Two's complement (10-bit) $\rightarrow -35$

Step 1: Positive Binary

Step 2: Flip bits $(0 \rightarrow 1, 1 \rightarrow 0)$

Step 3: Binary add 1 bit

Now, take positive binary of 35

	2^5	2^4	2^3	2^2	2^1	2^0	
	32	16	8	4	2	1	
+ve binary $\rightarrow$	1	0	0	0	1	1	(six digit)

(10 – bits) :	0	0	0	0	1	0	0	0	1	1
Flip :	1	1	1	1	0	1	1	1	0	0
Add :										+1
–35 $\leftarrow$	1	1	1	1	0	1	1	1	0	1

Hence, options (C) and (D) are correct as both are the same.

Note: In actual NIMCET 2023 marking scheme, both the choices (C) and (D) were taken to be correct.

98. The time required for fetching and execution of one machine instruction is:

[NIMCET – 2023 (Computer)]

(A) CPU cycle **(B)** Delay time **(C)** Seek time **(D)** Real time

Ans. (A)

Sol: The time required for the fetching and execution of one simple machine instruction is CPU cycle. The speed of computer processor, or CPU, is determined by the clock cycle. Which is the amount of time between two pulses of an oscillator. Generally speaking, the higher number of pulses per second, the faster the computer processor will be able to process information. Cycles per instruction (Aka clock cycles per instruction, clocks per instruction, or CPI) is one aspect of a processor's performance: the average number of clock cycles per instruction for program or program fragment. It is the multiplicative inverse of instructions per cycle.

99. What is a potential problem of $1's$ complement representation of numbers?

[NIMCET – 2023 (Computer)]

(A) There are two different representation of zero
(B) Multiplication of two numbers cannot be carried
(C) Binary additions are not possible
(D) Binary subtractions are not possible

Ans. (A)

Sol: 1st complement notation is not very simple to understand because it is very much different from conventional way of representing signed numbers. The other disadvantage is that there are two notations for 0 $(0000$ and $1111)$, which is very inconvenient when the computer wants to Test for a 0 result.

100. If a processor clock is rated 2500 million cycles per second, then its clock period is

[NIMCET – 2023 (Computer)]

(A) 2.50×10^{-10} sec **(B)** 4.00×10^{-10} sec **(C)** 1.00×10^{-10} sec **(D)** 5.00×10^{-10} sec

Ans. (B)

Sol: Given, the clock frequency of the processor

$= 2500$ million cycles per second

$= 2500\times10^{6}$ per second $\quad\because 1 \text{ million} = 10^{6}$

Then, clock period

$$= \frac{1}{\text{clock Frequency}}$$

$$= \frac{1}{2500\times10^{6}}$$

$$= 0.004\times10^{-6} \text{ sec.}$$

$$= 4.00\times10^{-10} \text{ sec.}$$

101. Equivalent of the decimal number $(25.375)_{10}$ in binary form

[NIMCET – 2023 (Computer)]

(A) $(11001.011)_2$ **(B)** $(11101.011)_2$ **(C)** $(11011.111)_2$ **(D)** $(11001.101)_2$

Ans. (A)

Sol: We have,

$$\begin{array}{l|l|l} 2 & 25 & 1 \\ 2 & 12 & 0 \\ 2 & 6 & 0 \\ 2 & 3 & 0 \\ 2 & 1 & 1 \\ & 1 & 1 \end{array} \uparrow \quad \Rightarrow \quad (25)_{10} = (11001)_2$$

Decimal Number:

$0.375 \times 2 = 0 + 0.75$

$0.75 \times 2 = 1 + 0.5$

$0.5 \times 2 = 1 + 0$

Here, the answer to 0.375 decimal to binary number is 0.011. Therefore, decimal number $(25.375)_{10}$ in binary form is $(11001.011)_2$.

102. A CPU generates 32-bit virtual address. The page size is 4 kb. The processor has a translation look–aside buffer (TLB) which can hold a total of 128 page table entries and is $4-$way set associative. The minimum size of the TLB tag is

[NIMCET – 2023 (Computer)]

(A) 15 bits **(B)** 13 bits **(C)** 11 bits **(D)** 20 bits

Ans. (A)

Sol: Since TLB is 4 ways set associative and can hold total $128(2^7)$ page table entries, number of sets in cache

$$= \frac{2^7}{4} = \frac{2^7}{2^5} = 2^5.$$

So, 5 bits are needed to address a set and $15(=20-5)$ bits are needed for tag.

103. Let $\oplus$ and $\odot$ denote the exclusive–OR and Exclusive–NOR operations respectively. Which one of the following is not correct?

[NIMCET – 2023 (Computer)]

(A) $\overline{P}\oplus\overline{Q}=P\odot Q$

(B) $\overline{P\oplus Q}=P\odot Q$

(C) $\overline{P}\oplus\overline{Q}=P\oplus Q$

(D) $\left(P\oplus\overline{P}\right)\oplus Q=\left(P\odot\overline{P}\right)\odot\overline{Q}$

Ans. (A), (D)

Sol: Using the exclusive–OR and Exclusive–NOR operations, we get

1) $\overline{P}\oplus\overline{Q}=\left(\overline{P}\right)\overline{Q}+\overline{P}\left(\overline{Q}\right)=P\overline{Q}+\overline{P}Q=P\oplus Q$.

Hence option (A) is incorrect and option (C) is correct.

2) $\overline{P\oplus Q}=\left(\overline{P\overline{Q}+\overline{P}Q}\right)=\left(\overline{P}+Q\right)\left(P+\overline{Q}\right)=P\overline{P}+\overline{P}\,\overline{Q}+QP+Q\overline{Q}=PQ+\overline{P}\,\overline{Q}=P\odot Q$.

Hence option (B) is correct.

3) $\left(P\oplus\overline{P}\right)\oplus Q=\left(P\left(\overline{P}\right)+\overline{P}\,\overline{P}\right)\oplus Q=\left(P+\overline{P}\right)\oplus Q=1\oplus Q=1.\overline{Q}+0.Q=\overline{Q}$

4) $\left(P\odot\overline{P}\right)\odot\overline{Q}=\left(P\overline{P}+\overline{P}\left(\overline{P}\right)\right)\odot\overline{Q}=0\odot\overline{Q}=0.\overline{Q}+1.\left(\overline{Q}\right)=Q$

Hence, using (3) and (4), option (D) is incorrect.

Note: In actual NIMCET 2023 marking scheme, both the choices (A) & (D) were taken to be correct.

104. Which of the following is true about Von–Neumann architecture?

[NIMCET – 2023 (Computer)]

(A) It has separate memory for data and instructions

(B) It has a separate processing unit for data and instruction

(C) It has a single memory unit for both data and instructions

(D) It has separate storage for input/output operations

Ans. (C)

Sol: Von–Neumann architecture is a computer that is based on the design Proposed by John Von Neumann in 1945. It is a theoretical model of a computer that uses a single bus to connect the CPU, memory, and input output devices. The Von–Neumann architecture uses a shared bus between program memory and data memory. This means that both program instruction and data are stored in the same memory and are accessed through the same bus.

105. Consider the following minterm expression for $F: F(P,Q,R,S)=\Sigma 0,2,5,7,8,10,13,15$. The minterms 2, 7, 8 and 13 are don't care terms. The minimal sum of product form of F is

[NIMCET – 2023 (Computer)]

(A) $\overline{Q}\,\overline{S}+Q\overline{S}$ **(B)** $\overline{Q}\,\overline{S}+QS$

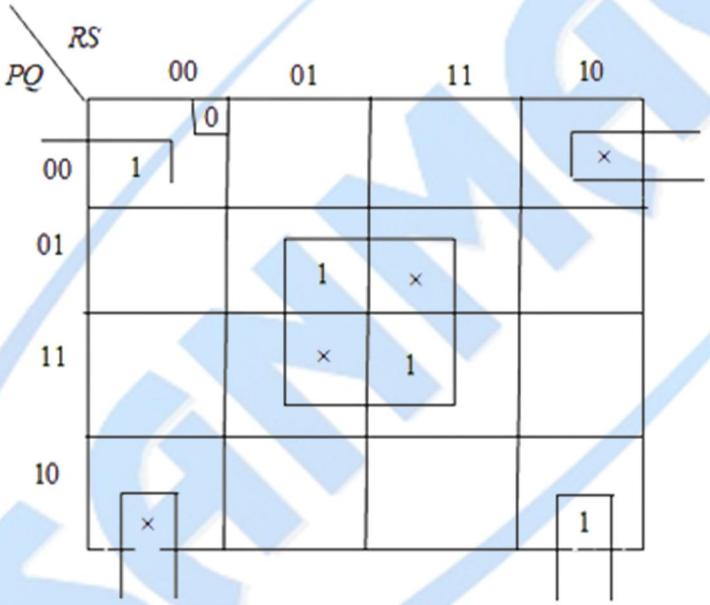
(C) $\overline{Q}\overline{R}\overline{S}+\overline{Q}R\overline{S}+Q\overline{R}S+QRS$ **(D)** $PQS+PQS+PQS+PQS$

Ans. (B)

Sol: Here, we have

$$F(P,Q,R,S)=\Sigma 0,2,5,7,8,10,13,15$$

Don't care min terms are 2, 7, 8, 13. By Plotting $K-$map. The minimal SOP (Sum of products):



By solving $K-$ map, we have

$$\overline{P}\overline{Q}\overline{R}\overline{S}+P\overline{Q}\overline{R}\overline{S}+\overline{P}\overline{Q}R\overline{S}+P\overline{Q}R\overline{S}+\overline{P}Q\overline{R}S+\overline{P}QRS+PQ\overline{R}S+PQRS$$

$$\Rightarrow \quad \overline{Q}\overline{R}\overline{S}\left(\overline{P}+P\right)+\overline{Q}R\overline{S}\left(\overline{P}+P\right)+\ \overline{P}QS\left(\overline{R}+R\right)+PQS\left(\overline{R}+R\right)$$

$$\Rightarrow \quad \overline{Q}\overline{R}\overline{S}+\overline{Q}R\overline{S}+\overline{P}QS+PQS \qquad \because x+\overline{x}=1$$

$$\Rightarrow \quad \overline{Q}\overline{S}\left(\overline{R}+R\right)+QS\left(\overline{P}+P\right)$$

$$\Rightarrow \quad \overline{Q}\overline{S}+QS.$$

106. A wrong sentence related to FAT 32 and NTFS file system is

[NIMCET – 2023 (Computer)]

(A) FAT 32 store individual files size up to 32 GB
(B) Read and write speeds of NTFS are faster than that of FAT32
(C) NTFS stands for new Technology file system
(D) FAT 32 has lower disk utilization compared to NTFS

Ans. (D)
Sol: FAT 32 store individual files size up to 4 GB.

107. The reduced form of the Boolean function $F = xyz + xyz' + x'yz + xy'z$ is

[NIMCET – 2023 (Computer)]

(A) $xy + yz + xz$ **(B)** $x + yz + xz$ **(C)** $xy + yz$ **(D)** $x + y + z$

Ans. (A)
Sol: We have,

$$\begin{aligned} F &= xyz + xyz' + x'yz + xy'z \\ &= xy(z + z') + x'yz + xy'z && \because\ z + z' = 1 \\ &= xy(1) + x'yz + xy'z \\ &= xy + x'yz + xy'z \\ &= xy + x'yz(x + x') + xy'z && \because\ x.x' = 1 \\ &= xy + x.x'yz + x''yz + xy'z && \because\ x'' = x \\ &= xy + yz + xyz + xy'z \\ &= xy + yz + xz(y + y') \\ &= xy + yz + zx\ . \end{aligned}$$

108. Consider the following Boolean expression for $F : F(P, Q, R, S) = PQ + \overline{P}QR + \overline{P}Q\overline{R}S$. The minimum sum of products form of F is

[NIMCET – 2023 (Computer)]

(A) $PQ + QR + QS$ **(B)** $P + Q + R + S$ **(C)** $\overline{P} + \overline{Q} + \overline{R} + \overline{S}$ **(D)** $\overline{P}R + \overline{P}\overline{R}S + P$

Ans. (A)

Sol: We have

$$F(P,Q,R,S) = PQ + \bar{P}QR + \bar{P}Q\bar{R}S$$
$$= Q\left(P + \bar{P}R + \bar{P}\bar{R}S\right)$$
$$= Q\left(P + R + \bar{P}\bar{R}S\right) \qquad \because x + \bar{x}y \Rightarrow x + y, \text{ by Absorption law}$$
$$= Q\left(P + R + \bar{R}S\right)$$
$$= Q\left(P + R + S\right)$$
$$= QP + QR + QS$$
$$= PQ + QR + QS\,.$$

109. How many $32k \times 1$ RAM chips are needed to provide a memory capacity of $256k$ –bytes?

[NIMCET – 2023 (Computer)]

(A) 128 **(B)** 8 **(C)** 32 **(D)** 64

Ans. (D)

Sol: RAM chip's capacity $= 32K \times 1 = 32 \times 1024 \times 1$ bits

Memory Capacity $= 256\,\text{K bytes} = 256 \times 1024 \times 8$ bits

$$\text{No. of chips needed} = \frac{\text{Memory Capacity}}{\text{RAM Chip's Capacity}}$$

$$\text{No. of chips needed} = \frac{256 \times 1024 \times 8}{32 \times 1024 \times 1} = 64 \text{ chips.}$$

110. Which of the following registers is used to keep track of address of the memory location where the next instruction is located?

[NIMCET – 2023 (Computer)]

(A) Instruction counters
(B) Memory Data Register
(C) Memory Address Register
(D) Program Counter

Ans. (D)

Sol: Program Counter registers is used to keep track of address of the memory location where the next instruction is located. A program counter is a register in a computer processor that contains the address (location) of the instruction being executed at the current time. As program counter (CPC), commonly

called the instruction pointer (IP) in Intel *x*86 and Itanium microprocessors, and sometimes called the instruction address register (IAR), the instruction counter, or just part of the instruction sequencer, is a processor register that indicates where a computer is in its program the program counter is simply the location of the instruction being executed, and so it will change based on the processor architecture. That is, a 64 bit architecture will need 64 bits to hold the program counter, a 32–bit will need 32, and so on.

PART – D : GENERAL ENGLISH

Comprehension for Ques. Nos. 111 – 112: Read the following passage carefully and answer the questions: Science and religion–the two terms have come to signify a mutual antagonism. The two it is commonly declared, are poles apart; their spheres of activity and their methods differ widely, so much so that they are considered to be irreconcilable.

On the face of it, science and religion appear to be the two opposite poles of men's consciousness. Science is basically concerned with the material world: its efforts are directed towards unravelling the "how" of reality while religion is concerned with the "why" of reality. Science deals with analyzing tangible into its minutest parts, and then arrives at conclusions about the way in which tangibles realities are organized. While science is analytical reason takes the ultimate reality for granted. Religion follows the metaphysical path: the concept of god is ultimately a matter of faith and it is this faith which is the basis of the religious man's attribution of a design of meaning for the reality.

The modes of action are different in science and region. Science relies on experiment whereas region is based on experience. Science benefits mankind by providing material comforts. The frontiers of science do not end in knowledge but are extended to the formation of appliances for actual use. Science, it has been somewhat unfairly charged, cultivates the materialistic thinking. However, it has to be admitted that the mental attitude promoted by religion is entirely different. While the basis of scientific progress is unbridled curiosity and courageous endeavor, the truly religious sprit cavils at such presumption that man's mind can penetrate the mysteries of the universe. Science promotes fearless inquiry, while an essential ingredient of religion is the humility born of fear of God. Science incorporates a love of experimental knowledge, while religion does not believe in the rational approach.

111. Which of the following statement according to the passage is correct:

[NIMCET – 2023 (English)]

(A) Science follows the metaphysical path.
(B) Religion believes in ultimate reality.
(C) The religious spirit assumes that human mind can penetrate the mysteries of the universe.
(D) Science believes in the humility born of fear of God.

Ans. (B)

112. Which of the following reasons according to the passage provide material comforts to people in case of science?

[NIMCET – 2023 (English)]

(A) Promotion of fearless inquiry by science
(B) The subjectivity of science
(C) Tangible proofs of the theories of science
(D) Materialistic thinking being cultivated by science

Ans. (C)

113. Choose the best option that indicates the change of voice for the sentence given below:

They sent for a doctor because Pamela had fainted.

[NIMCET – 2023 (English)]

(A) A doctor was sent for them because Pamela had fainted
(B) Pamela fainted and a doctor was sent for
(C) A doctor was sent for because Pamela had fainted
(D) Pamela had sent for a doctor because they had fainted

Ans. (C)

114. Select the most appropriate preposition to fill in the blank.
A baby sitter is someone who looks _____ other people's children

[NIMCET – 2023 (English)]

(A) on **(B)** over **(C)** for **(D)** after

Ans. (D)

115. Select the most appropriate meaning of the underlined idiom in the given sentence:

Off and on, I take a break from my hectic schedule to refresh myself.

[NIMCET – 2023 (English)]

(A) Periodically **(B)** Rarely **(C)** Seldom **(D)** Immediately

Ans. (A)

116. Select the most appropriate preposition to fill in the blank.
We haven't been to Delhi _____ almost five years.

[NIMCET – 2023 (English)]

(A) to **(B)** from **(C)** since **(D)** for

Ans. (D)

117. Synonym for "Nonplussed" is

[NIMCET – 2023 (English)]

(A) Dumbfounded **(B)** Flummoxed **(C)** Befuddled **(D)** Oriented

Ans. (A), (B), (C)
Note: In actual NIMCET 2023 marking scheme, all the three choices (A), (B) & (C) were taken to be correct.

118. Antonym for "Spendthrift" is:

[NIMCET – 2023 (English)]

(A) Profligate **(B)** Extravagant **(C)** Frugal **(D)** Squanderer

Ans. (C)

119. Meaning of "Abrogate" is:

[NIMCET – 2023 (English)]

(A) Adsorb **(B)** Abolish **(C)** Ablaze **(D)** Abstract

Ans. (B)

120. I have _____ umbrella. I bought it _____ year ago.

[NIMCET – 2023 (English)]

(A) An, The **(B)** An, A **(C)** The, An **(D)** A, An

Ans. (B)

ANSWER KEY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D	B	B	A	C	B	A	A	B	A	A	B	B	B	B
16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
C	C	D	B	D	A	C	C	A	A	C	C	C	A	D
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
C	C	NA	B	B	B	A	B	C	A	A	B	B	C	B
46	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
B	A	B	C	B	D	D	C	D	D	D	D	C	D	D
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**
C	C	D	A	A	B	C	A	A	B	C	D	A	B	B
76	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
D	D	A	A	A	C	A	B	D	B	D	A	C	D	C
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
C	D	NA	B	C	C	CD	A	A	B	A	A	AD	C	B
106	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**
D	A	A	D	D	B	C	C	D	A	D	ABC	C	B	B

IMPORTANT NOTE

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