# NDA / NA

**National Defence Academy / Naval Academy**

## MATHEMATICS-I

## QUESTION PAPER 2025

**Time Allowed : 2 hrs 30 min** **Total Marks : 300**

***Instructions***

1. *This Test Booklet contains **120** items (questions). Each item is printed in **English**. Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each item.*
2. *You have to mark all your responses **ONLY** on the separate Answer Sheet provided. See directions in the Answer Sheet.*
3. ***All** items carry equal marks.*
4. *Before you proceed to mark in the Answer Sheet the response to the various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions.*
5. ***Penalty for wrong answers :***
   ***THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.***
   (i). *There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.*
   (ii). *If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.*
   (iii). *If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.*

**1.** If the sum of binomial coefficients in the expansion of $(x + y)^n$ is 256, then the greatest binomial coefficient occurs in which one of the following terms?
**(a)** Third **(b)** Fourth **(c)** Fifth **(d)** Ninth

**2.** If $k < (\sqrt{2}+1)^3 < k+2$, where $k$ is a natural number, then what is the value of $k$?
**(a)** 11 **(b)** 13 **(c)** 15 **(d)** 17

**3.** If $\begin{bmatrix} x & 1 & 1 \end{bmatrix}\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}\begin{bmatrix} 1 \\ 1 \\ x \end{bmatrix} = [45]$

then which one of the following is a value of $x$?
**(a)** $-2$ **(b)** $-1$ **(c)** 0 **(d)** 1

**4.** If $A = \begin{bmatrix} y & z & x \\ z & x & y \\ x & y & z \end{bmatrix}$

Where $x$, $y$ and $z$ are integers, is an orthogonal matrix, then what is the value of $x^2 + y^2 + z^2$?
**(a)** 0 **(b)** 1 **(c)** 4 **(d)** 14

**5.** Consider the following in respect of a non-singular matrix $M$:
**I.** $|M^2| = |M|^2$
**II.** $|M| = |M^{-1}|$
**I.** $|M| = |M^T|$
How many of the above are correct?
**(a)** None **(b)** One **(c)** Two **(d)** All three

**6.** If $f(\theta) = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ then what is $(f(\pi))^2$ equal to?

**(a)** $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$ **(b)** $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

**(c)** $\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$ **(d)** $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

**7.** If $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ then what is $A^2 - 4A$ equal to?
**(a)** $-5I_3$ **(b)** $-I_3$ **(c)** $I_3$ **(d)** $5I_3$
Where $I_3$ is the identity matrix of order 3.

**8.** If the number of selections of $r$ as well as $(n + r)$ things from $5n$ different things are equal, then what is the value of $r$?
**(a)** $n$ **(b)** $2n$
**(c)** $3n$ **(d)** $4n$

**9.** What is the number of selections of at most 3 things from 6 different things?
**(a)** 20 **(b)** 22 **(c)** 41 **(d)** 42

**10.** If $A = \begin{bmatrix} x & y & z \\ y & z & x \\ z & x & y \end{bmatrix}$ where $x$, $y$ and $z$ are integers

is an orthogonal matrix, then what is $A^2$ equal to?
**(a)** Null matrix **(b)** Identity matrix
**(c)** $A$ **(d)** $-A$

**Direction for Questions (11-13):** Consider the following for the three (03) items that follow:
Let $p = \tan 2\alpha - \tan\alpha$ and $q = \cot\alpha - \cot 2\alpha$.

**11.** What is $(p/q)$ equal to?

**(a)** $-\tan\alpha.\tan 2\alpha$ **(b)** $-\cot\alpha.\cot 2\alpha$
**(c)** $\tan\alpha.\tan 2\alpha$ **(d)** $\cot\alpha.\cot 2\alpha$

**12.** What is $(p + q)$ equal to?

**(a)** $\sec 4\alpha$ **(b)** $\operatorname{cosec} 4\alpha$
**(c)** $2\sec 4\alpha$ **(d)** $2\operatorname{cosec} 4\alpha$

**13.** What is $\tan^2\alpha$ equal to?

**(a)** $\frac{(pq)}{(p+q)}$ **(b)** $\frac{(p+2q)}{p}$

**(c)** $\frac{p}{(p+2q)}$ **(d)** $\frac{p}{(2p+q)}$

**Direction for Questions (14-15):** Consider the following for the two (02) times that follow:
Let $2\sin\alpha + \cos\alpha = 2$, where $0 < \alpha < 90°$

**14.** What is $\tan\alpha$ equal to?

**(a)** $\frac{1}{2}$ **(b)** 1

**(c)** $\frac{3}{4}$ **(d)** 2

**15.** What is $2\sin 2\alpha + \cos 2\alpha$ equal to?

**(a)** $\frac{11}{10}$ **(b)** $\frac{11}{5}$ **(c)** $\frac{12}{5}$ **(d)** $\frac{13}{5}$

**Direction for Questions (16-17):** Consider the following for the two (02) times that follow:
In a triangle $ABC$, two sides $BC$ and $CA$ are in the ratio 2 : 1, and their opposite corresponding angles are in the ratio 3 : 1.

**16.** One of the angles of the triangle is

**(a)** 15° **(b)** 30°
**(c)** 45° **(d)** 75°

**17.** Consider the following statements:

**I.** The triangle is right-angled.
**II.** One of the sides of the triangle is 3 times the other.
**III.** The angles $A$, $C$ and $B$ of the triangle are in $AP$.

Which of the statements give above is/are correct?

**(a)** I only **(b)** II and III only
**(c)** I and III only **(d)** I, II and III

**18.** A man at $M$ standing 100 m away from the base (P) of a chimney of height 50 m. He observes the angle of elevation of the highest point (Q) of the smoke to be 45°. The highest point of the chimney is at $R$. Further $P$, $R$ and $Q$ are in a straight line and the straight line is perpendicular to PM. What is the angle RMQ equal to?

**(a)** $\tan^{-1}\left(\frac{1}{2}\right)$ **(b)** $\tan^{-1}\left(\frac{1}{3}\right)$

**(c)** $\tan^{-1}\left(\frac{2}{3}\right)$ **(d)** $\tan^{-1}\left(\frac{3}{4}\right)$

**19.** If $k$ is a root of $x^2 - 4x + 1 = 0$, then what is $\tan^{-1} k + \tan^{-1}\frac{1}{k}$ equal to?

**(a)** $\frac{-\pi}{2}$ **(b)** 0 **(c)** $\frac{\pi}{4}$ **(d)** $\frac{\pi}{2}$

**20.** If $\tan^{-1} k + \tan^{-1}\frac{1}{2} = \frac{\pi}{4}$

**(a)** 1 **(b)** $\frac{1}{2}$ **(c)** $\frac{1}{3}$ **(d)** $\frac{1}{4}$

**21.** If a line in 3 dimensions makes angles $\alpha$, $\beta$ and $\gamma$ with the positive directions of the coordinate axes, then what is $\cos(\alpha + \beta)\cos(\alpha - \beta)$ equal to?

**(a)** $\cos^2\gamma$ **(b)** $-\cos^2\gamma$
**(c)** $\sin^2\gamma$ **(d)** $-\sin^2\gamma$

**22.** A(1, 2, –1), B(2, 5, –2) and C(4, 4, –3) are three vertices of a rectangle. What is the area of the rectangle?

**(a)** 8 square units
**(b)** 9 square units
**(c)** $\sqrt{66}$ square units
**(d)** $\sqrt{68}$ square units

**23.** $ABC$ is a triangle right-angled at $B$. If $A(k, 1, -1)$, $B(2k, 0, 2)$ and $C(2 + 2k, k, 1)$ are the vertices of the triangle, then what is the value of $k$?

**(a)** –3 **(b)** –1 **(c)** 1 **(d)** 3

**24.** If a line $\frac{x+1}{p} = \frac{y-1}{q} = \frac{z-2}{r}$

Where $p = 2q = 3r$ makes an angle with the position direction of the $y$-axis then what is $\cos 2\theta$ equal to?

**(a)** $\frac{-31}{49}$ **(b)** $\frac{-37}{49}$ **(c)** $\frac{31}{49}$ **(d)** $\frac{37}{49}$

**25.** What is the equation of the plane passing through the point (1, 1, 1) and perpendicular to the line whose direction ratio is (3, 2, 1)?

**(a)** $x + 2y + 3z = 6$
**(b)** $3x + 2y + z = 6$
**(c)** $x + y + z = 3$
**(d)** $3x + 2y + z = 0$

**26.** A line makes angles $\alpha$, $\beta$ and $\gamma$ with the positive directions of the coordinate axes.

If $\vec{a} = (\sin^2\alpha)\hat{i} + (\sin^2\beta)\hat{j} + (\sin^2\gamma)\hat{k}$ and $\vec{b} = \hat{i} + \hat{j} + \hat{k}$ then what is $\vec{a}.\vec{b}$ equal to?

**(a)** –2 **(b)** –1 **(c)** 1 **(d)** 2

**27.** Consider the following statements with respect to a vector $\vec{d} = (\vec{a} \times \vec{b}) \times \vec{c}$:

**I.** $\vec{d}$ is coplanar with $\vec{a}$ and $\vec{d}$
**II.** $\vec{d}$ is perpendicular to $\vec{c}$

Which of the statements given above is/are correct?

**(a)** I only **(b)** II only
**(c)** Both I and II **(d)** Neither I nor II

**28.** The position vectors of three points A, B and C are $\vec{a}, \vec{b}$ and $\vec{c}$, respectively, such that $3\vec{a} - 4\vec{b} + \vec{c} = \vec{0}$. What is AB : BC equal to?

**(a)** 3 : 1 **(b)** 1 : 3 **(c)** 3 : 4 **(d)** 1 : 4

**29.** The position vectors of three points A, B and C are $\vec{a}.\vec{b}$ and $\vec{c}$ respectively, where, $\vec{c} = (\cos^2\theta)\vec{a} + (\sin^2\theta)\vec{b}$. What is $(\vec{a}\times\vec{b}) + (\vec{b}\times\vec{c}) + (\vec{c}\times\vec{a})$ equal to?

**(a)** $\vec{o}$ **(b)** $2\vec{c}$
**(c)** $3\vec{c}$ **(d)** unit vector

**30.** Let $\vec{a}, \vec{b}$ and $(\vec{a}\times\vec{b})$ be unit vectors. What is $(\vec{a}.\vec{b})$ equal to?

**(a)** 0 **(b)** $\frac{1}{2}$ **(c)** 1 **(d)** 3

**31.** The sum of the first $k$ terms of a series is $3k^2 + 5k$. Which one of the following is correct?

**(a)** The terms of S form an arithmetic progression with common difference 14.
**(b)** The terms of S form an arithmetic progression with common difference 6.
**(c)** The terms of S form a geometric progression with a common ratio $\frac{10}{7}$.
**(d)** The terms of S form a geometric progression with a common ratio $\frac{11}{4}$.

**32.** The sum of the first 8 terms of a GP is 5 times the sum of its first 4 terms. If $r \neq 1$ is the common ratio, then what is the number of possible real values of $k$?

**(a)** One **(b)** Two
**(c)** Three **(d)** More than three

**33.** If one root of the equation $x^2 - kx + k = 0$ exceeds the other by $2\sqrt{3}$ then which one of the following is a value of $k$?

**(a)** 3 **(b)** 6
**(c)** 9 **(d)** 12

**34.** If $x + \frac{5}{y} = 4$ and $y + \frac{5}{x} = -4$, then what is $(x + y)$ equal to?

**(a)** 0 **(b)** 1 **(c)** 4 **(d)** 5

**35.** If the $5^{th}$, $7^{th}$ and $13^{th}$ terms of an $AP$ are in $GP$, then what is the ratio of its first term to its common difference?

**(a)** –3 **(b)** –2 **(c)** 2 **(d)** 3

**36.** If $p$, 1 and $q$ are in $AP$ and $p$ and 2 $q$ are in $GP$, then which of the following statements is/are correct?

**I.** $p$, 4, $q$ are in HP.
**II.** $\left(\frac{1}{p}\right), \frac{1}{4}, \left(\frac{1}{q}\right)$ are in AP.

Select the answer using the code given below:

**(a)** I only **(b)** II only
**(c)** Both I and II **(d)** Neither I nor II

**37.** If $x = (1111)_2$, $y = (1001)_2$ and $z = (110)_2$, then what is $x^3 - y^3 - z^3 - 3xyz$ equal to?

**(a)** $(1111001)_2$ **(b)** $(1001111)_2$
**(c)** $(1)_2$ **(d)** $(0)_2$

**38.** If $\Delta = \begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix}$ and $A$, $B$, $C$, $D$ and $G$ are the cofactors of the elements $a$, $b$, $c$, $d$ and g respectively, then what is $bB + cC - dD - gG$ equal to?

**(a)** 0 **(b)** 1 **(c)** $\Delta$ **(d)** $-\Delta$

**39.** Consider the following statements in respect of the determinant $\Delta = \begin{vmatrix} k(k+2) & 2k+1 & 1 \\ 2k+1 & k+2 & 1 \\ 3 & 3 & 1 \end{vmatrix}$

**I.** $\Delta$ is positive if $k > 0$.
**II.** $\Delta$ is negative if $k < 0$.
**III.** $\Delta$ is zero if $k = 0$.

How many of the statements given above are correct?

**(a)** None **(b)** One
**(c)** Two **(d)** All three

**40.** If $\begin{vmatrix} 2 & 3+i & 1 \\ 3-i & 0 & i-1 \\ -1 & -1-i & 1 \end{vmatrix} = A + iB$ where $i = \sqrt{-1}$ then what is $A + B$ equal to?

**(a)** –10 **(b)** –6 **(c)** 0 **(d)** 6

**Direction for Questions (41-43):** Consider the following for the three (03) items that follow:
Let $p = \sin 35°$, $q = \sin 25°$ and $r = \sin(-95°)$.

**41.** What is $(p + q + r)$ equal to?

**(a)** –1 **(b)** 0 **(c)** $2\sin 5°$ **(d)** $2\cos 5°$

**42.** What is $(pq + qr + rp)$ equal to?

**(a)** $\frac{-3}{4}$ **(b)** 0 **(c)** $\frac{1}{4}$ **(d)** $\frac{3}{4}$

**43.** What is $(p^2 + q^2 + r^2)$ equal to?

**(a)** $\frac{1}{2}$ **(b)** 1 (c) $\frac{3}{2}$ **(d)** 2

**Direction for Questions (44-45):** Consider the following for the two (02) items that follow:
Let $p = [\sin\alpha - \sin(\alpha - 90°)]$.

**44.** What is the minimum value of $p$?

**(a)** 0 **(b)** $\frac{1}{2}$ **(c)** $\frac{1}{\sqrt{2}}$ **(d)** 1

**45.** What is the maximum value of $p$?

**(a)** 1 **(b)** $\sqrt{2}$ **(c)** $\sqrt{3}$ **(d)** 2

**Direction for Questions (46-48):** Consider the following for the three (03) items that follow:
The sides of a triangle $ABC$ are $AB = 3$ cm, $BC = 5$ cm and $CA = 7$ cm.

**46.** Consider the following statements:

**I.** The triangle is an obtuse-angled triangle.

**II.** The sum of acute angles of the triangle is also acute.

Which of the statements given above is/are correct?

**(a)** I only **(b)** II only

**(c)** Both I and II **(d)** Neither I nor II

**47.** What is $\angle B$ equal to?

**(a)** 60° **(b)** 105° **(c)** 120° **(d)** 150°

**48.** What is the area of the area of the triangle?

**(a)** $\frac{15\sqrt{3}}{4}$ square cm **(b)** $\frac{15\sqrt{3}}{2}$ square cm

**(c)** $15\sqrt{3}$ square cm **(d)** $30\sqrt{3}$ square cm

**Direction for Questions (49-50):** Consider the following for the two (02) items that follow:
The top ($M$) of a tower is observed from three points $P$, $Q$ and $R$ lying in a horizontal straight line which passes directly a long the foot ($N$) of the tower. The angles of elevations of $M$ from $P$, $Q$ and $R$ are 30°, 45° and 60°, respectively. Let $PQ = a$ and $QR = b$.

**49.** What is $PN$ equal to?

**(a)** $\left(\frac{3-\sqrt{3}}{2}\right)a$ **(b)** $\left(\frac{3+\sqrt{3}}{2}\right)a$

**(c)** $\left(\frac{3-\sqrt{3}}{4}\right)a$ **(d)** $\left(\frac{3+\sqrt{3}}{4}\right)a$

**50.** What is MN equal to?

**(a)** $\left(\frac{3+\sqrt{3}}{2}\right)b$ **(b)** $\left(\frac{3-\sqrt{3}}{2}\right)b$

**(c)** $\left(\frac{3-\sqrt{3}}{4}\right)b$ **(d)** $\left(\frac{3+\sqrt{3}}{4}\right)b$

**Direction for Questions (51-52):** Consider the following for the two (02) items that follow:
The probabilities that A, B and C become managers are $\frac{3}{10}$, $\frac{1}{2}$ and $\frac{4}{5}$, respectively. The probabilities that the bonus scheme will be introduced if A, B and C become managers are $\frac{4}{9}$, $\frac{2}{9}$ and $\frac{1}{3}$, respectively.

**51.** What is the probability that the bonus scheme will be introduced?

**(a)** $\frac{17}{45}$ **(b)** $\frac{19}{45}$ **(c)** $\frac{23}{45}$ **(d)** $\frac{26}{45}$

**52.** If the bonus scheme has been introduced, then what is the probability that the manager appointed was B?

**(a)** $\frac{5}{23}$ **(b)** $\frac{6}{23}$ **(c)** $\frac{7}{23}$ **(d)** $\frac{8}{23}$

**53.** The arithmetic mean of 100 observations is 50. If 5 is subtracted from each observation and then divided by 20, then what is the new arithmetic mean?

**(a)** 2.25 **(b)** 3.5 **(c)** 4.25 **(d)** 5.5

**54.** The standard deviation of 100 observations is 10. If 5 is added to each observation and then divided by 20, then what will be the new standard deviation?

**(a)** 0.25 **(b)** 0.5 **(c)** 0.75 **(d)** 1.00

**55.** If $P(A) = \frac{1}{3}$, $P(B) = \frac{1}{2}$ and $P(A \cap B) = \frac{1}{4}$, then what is the value of $P(B|A^c)$?

**(a)** $\frac{1}{8}$ **(b)** $\frac{3}{8}$ **(c)** $\frac{5}{8}$ **(d)** $\frac{7}{8}$

**56.** If $P(A) = \frac{1}{3}$, $P(B) = \frac{1}{2}$ and $P(A \cap B) = \frac{1}{4}$, then what is the value of $P(A^c \cap B^c)$?

**(a)** $\frac{1}{4}$ **(b)** $\frac{5}{12}$ **(c)** $\frac{7}{12}$ **(d)** $\frac{11}{12}$

**57.** If two fair dice are tossed then what is the probability that the sum of the numbers on the faces of the dice is strictly greater than 7?

**(a)** $\frac{1}{3}$ **(b)** $\frac{5}{12}$

**(c)** $\frac{7}{12}$ **(d)** $\frac{3}{4}$

**58.** The probability of a man hitting a target is $\frac{1}{5}$. If the man fires 7 times, then what is the probability that he hits the target at least twice?

**(a)** $1-\left(\frac{3}{5}\right)\left(\frac{4}{5}\right)^6$ **(b)** $1-\left(\frac{3}{5}\right)\left(\frac{4}{5}\right)^7$

**(c)** $1-\left(\frac{11}{5}\right)\left(\frac{4}{5}\right)^6$ **(d)** $1-\left(\frac{11}{5}\right)\left(\frac{4}{5}\right)^7$

**59.** Let $X$ be a random variable following binomial distribution whose mean and variance are 200 and 160, respectively. What is the value of the number of trials ($n$)?

**(a)** 500 **(b)** 1000 **(c)** 1500 **(d)** 2000

**60.** What is the arithmetic mean of $8^2$, $9^2$, $10^2$, ... $15^2$?

**(a)** 133.5 **(b)** 135.5
**(c)** 137.5 **(d)** 139.5

**Direction for Questions (61-62):** Consider the following for the two (02) items

Let $y = \sin^{-1}\left(x - \frac{4x^3}{27}\right)$

**61.** What is $y$ equal to?

**(a)** $\sin^{-1} x$ **(b)** $\sin^{-1}\left(\frac{x}{3}\right)$

**(c)** $3\sin^{-1} x$ **(d)** $3\sin^{-1}\left(\frac{x}{3}\right)$

**62.** What is $\frac{dy}{dx}$ equal to?

**(a)** $\frac{1}{\sqrt{9-x^2}}$ **(b)** $\frac{1}{\sqrt{3-x^2}}$

**(c)** $\frac{3}{\sqrt{9-x^2}}$ **(d)** $\frac{9}{\sqrt{9-x^2}}$

**Direction for Questions (63-64):** Consider the following for the two (02) items that follow:
Let the function $f(x) = x^2 + 9$.

**63.** What if $\lim_{x\to 0} \frac{\sqrt{f(x)}-3}{\sqrt{f(x)+7}-4}$ equal to?

**(a)** $\frac{2}{3}$ **(b)** 2 **(c)** $\frac{4}{3}$ **(d)** 2

**64.** Consider the following statements:
I. $f(x)$ is an increasing function.
II. $f(x)$ has local maximum at $x = 0$
Which of the statements given above is/are correct?

**(a)** I only **(b)** II only
**(c)** Both I and II **(d)** Neither I nor II

**Direction for Questions (65-66):** Consider the following for the two (02) items that follow:

The function $f(x)$ satisfies $f\left(\frac{x}{y}\right) = \frac{f(x)}{f(y)}$ for all positive real values of $x$ and $y$, and $f(2) = 3$

**65.** What is $f(16)$ equal to?

**(a)** 18 **(b)** 27 **(c)** 54 **(d)** 81

**66.** What is $f(1)$ s $f(4)$ equal to?

**(a)** 4 **(b)** 8 **(c)** 9 **(d)** 18

**Direction for Questions (67-68):** Consider the following for the two (02) items that follow:
A function $f$ is such that $f(xy) = f(x + y)$ for all real values of $x$ and $y$ and $f(5) = 10$

**67.** What is $f(0)$ equal to?

**(a)** 0 **(b)** 1 **(c)** 5 **(d)** 10

**68.** What if $f(20) + f(-20)$ equal to?

**(a)** 0 **(b)** 10 **(c)** 20 **(d)** 40

**Direction for Questions (69-70):** Consider the following for the two (02) items that follow:
Let $f(x) = [x^2]$, where [,] is the greater integer function.

**69.** What is $\int_{\sqrt{2}}^{\sqrt{3}} f(x)$ equal to?

**(a)** $\sqrt{3}-\sqrt{2}$ **(b)** $2(\sqrt{3}-\sqrt{2})$

**(c)** $3-\sqrt{2}$ **(d)** 1

**70.** What is $\int_{\sqrt{2}}^{2} f(x)\,dx$ equal to?

**(a)** $6-\sqrt{3}-2\sqrt{2}$ **(b)** $6-\sqrt{3}-\sqrt{2}$

**(c)** $6-\sqrt{3}+2\sqrt{2}$ **(d)** $6+\sqrt{3}-2\sqrt{2}$

**71.** If $A^2 + B^2 + C^2 = 0$, then what is the value of the following?

$$\begin{vmatrix} 1 & \cos C & \cos B \\ \cos C & 1 & \cos A \\ \cos B & \cos A & 1 \end{vmatrix}$$

**(a)** –1 **(b)** 0 **(c)** 1 **(d)** 2

**72.** If ω is a non-real cube root of unity, then what is a root of the following equation?

$$\begin{vmatrix} x+1 & \omega & \omega^2 \\ \omega & x+\omega^2 & 1 \\ \omega^2 & 1 & x+\omega \end{vmatrix} = 0$$

**(a)** $x = 0$ **(b)** $x = 1$
**(c)** $x = \omega$ **(d)** $x = \omega^2$

**73.** What is $\left(\frac{\sqrt{3}+i}{\sqrt{3}-i}\right)^3$ equal to?

**(a)** –1 **(b)** 0 **(c)** 1 **(d)** 3

**74.** If $x^2 - x + 1 = 0$, then what is $\left(x-\frac{1}{x}\right)^2 + \left(x-\frac{1}{x}\right)^4 + \left(x-\frac{1}{x}\right)^8$ is equal to?

**(a)** 81 **(b)** 85 **(c)** 87 **(d)** 90

**75.** How many 7-letter words (with or without meaning) can be constructed using all the letters of the word CAPITAL so that all consonants come together in each word?

**(a)** 360 **(b)** 300 **(c)** 288 **(d)** 240

**76.** If $z \neq 0$ is a complex number, then what is amp $(z)$ + amp $(\bar{z})$ equal to?

**(a)** 0 **(b)** $\frac{\pi}{2}$ **(c)** $\pi$ **(d)** $2\pi$

**77.** How many sides are there in a polygon which has 20 diagonals?

**(a)** 6 **(b)** 7 **(c)** 8 **(d)** 10

**78.** In how many ways can the letters of the word DELHI be arranged keeping the positions of vowels and consonants unchanged?

**(a)** 6 **(b)** 9 **(c)** 12 **(d)** 24

**79.** What is the number of positive integer solutions of $x + y + z = 5$?

**(a)** 3 **(b)** 5 **(c)** 6 **(d)** 9

**80.** What is the number of rational terms in the expansion of $(3^{1/2} + 5^{1/4})^{12}$?

**(a)** 2 **(b)** 3 **(c)** 4 **(d)** 6

**81.** Under what condition will the lines $m^2x + ny - 1 = 0$ and $n^2x - my + 2 = 0$ be perpendicular?

**(a)** $mn - 1 = 0$ **(b)** $mn + 1 = 0$

**(c)** $m + n = 0$ **(d)** $m - n = 0$

**82.** If $p$ and $q$ are real numbers between 0 and 1 such that the points $(p, 1)$, $(1, q)$ and $(0, 0)$ form an equilateral triangle, then what is $(p + q)$ equal to?

**(a)** $\sqrt{2}$ **(b)** $\sqrt{2} - 1$

**(c)** $2 - \sqrt{3}$ **(d)** $4 - 2\sqrt{3}$

**83.** The vertices of a triangle are $A(1, 1)$, $B(0, 0)$ and $C(2, 0)$. The angular bisectors of the triangle meet at $P$. What are the coordinates of $P$?

**(a)** $(1, \sqrt{2} - 1)$ **(b)** $(1, \sqrt{3} - 1)$

**(c)** $\left(1, \frac{1}{2}\right)$ **(d)** $\left(\frac{1}{2}, \sqrt{2} - 1\right)$

**84.** Let $A(3, -1)j$ and $B(1, 1)$ be the end points of line segment $AB$. Let $P$ be the middle point of the line segment AB. Let $Q$ be the point situated at a distance of $\sqrt{2}$ units from P on the perpendicular bisector line of $AB$. What are the possible coordinates of $Q$?

**(a)** (2, 1) **(b)** (3, 1) **(c)** (2, 2) **(d)** (1, 3)

**85.** ABC is an equilateral triangle and $AD$ is the altitude on $BC$. If the coordinates of $A$ are (1, 2) and that of $D$ are (–2, 6) then what is the equation of $BC$?

**(a)** $3x + 4y - 18 = 0$ **(b)** $4x + 3y - 1 = 0$

**(c)** $4x - 3y = 26$ **(d)** $3x - 4y + 30 = 0$

**86.** What is the equation of the circle whose diameter is 10 cm and the equation of two of its diameters are $x + y = 0$ and $x - y = 0$?

**(a)** $x^2 + y^2 = 0$

**(b)** $x^2 + y^2 = 25$

**(c)** $x^2 + y^2 = 100$

**(d)** $x^2 + y^2 - 2x - 2y - 23 = 0$

**87.** A square is inscribed in a circle $x^2 + y^2 + 2x + 2y + 1 = 0$ and its sides are parallel to coordinate axes. Which one of the following is a vertex of the square?

**(a)** (–2, 2)

**(b)** (–2, –2)

**(c)** $\left(-1 + \frac{1}{\sqrt{2},} - 1 - \frac{1}{\sqrt{2}}\right)$

**(d)** None of the above

**88.** A tangent to the parabola $y^2 = 4x$ is inclined at an angle of 45° with the positive direction of $x$-axis. What is point of contact of the tangent and the parabola?

**(a)** (1, 1) **(b)** $(2, \sqrt{2})$

**(c)** $\left(\frac{1}{2}, \frac{1}{\sqrt{2}}\right)$ **(d)** (1, 2)

**89.** What is the distance between the two foci of the hyperbola $25x^2 - 75y^2 = 225$?

**(a)** $2\sqrt{3}$ units **(b)** $4\sqrt{3}$ units

**(c)** $\sqrt{6}$ units **(d)** $2\sqrt{6}$ units

**90.** If any point on an ellipse is $(3\sin\alpha, 5\cos\alpha)$, then what is the eccentricity of the ellipse?

**(a)** $\frac{4}{3}$ **(b)** $\frac{4}{5}$ **(c)** $\frac{3}{4}$ **(d)** $\frac{1}{2}$

**Direction for Questions (91-94):** Consider the following for the four (04) times that follow: The frequency distribution of height of students of a class is given below:

| Height (in cm) | Number of students |
|---|---|
| 160–162 | 12 |
| 162–164 | 15 |
| 164–166 | 24 |
| 166–168 | 13 |

**91.** What is the total number of students whose height is less than or equal to 165 cm?

**(a)** 15 **(b)** 39

**(c)** 51 **(d)** None of the above

**92.** What is the median height of the class?

**(a)** 162.41 cm **(b)** 163.41 cm

**(c)** 164.41 cm **(d)** 165.41 cm

**93.** The height which occurs most frequently in the class is:

**(a)** 163.5 cm **(b)** 163.9 cm
**(c)** 164.5 cm **(d)** 164.9 cm

**94.** The most appropriate graphical representation of the given frequency distribution is:

**(a)** bar chart
**(b)** percentage bar chart
**(c)** histogram
**(d)** pie chart

**Direction for Questions (95-96):** Consider the following for the two (02) items that follow:
The sum and the sum of squares of the observation corresponding to length $X$ (in cm) and weight $Y$ (in gm) of 50 tropical tubers are given as $\Sigma X = 200$, $\Sigma Y = 250$, $\Sigma X^2 = 900$ and $\Sigma Y^2 = 1400$.

**95.** Which of the following is correct?

**(a)** Variance (X) > Variance (Y)
**(b)** Variance (X) < Variance (Y)
**(c)** Variance (X) = Variance (Y)
**(d)** Cannot be determined from the given data

**96.** Which one of the following statements is correct?

**(a)** Coefficient of variation of $X$ is strictly more than coefficient of variation of $Y$.
**(b)** Coefficient of variation of X is strictly less than coefficient of variation of Y.
**(c)** Coefficient of variation of X is the same as coefficient of variation of Y.
**(d)** Coeficient of variation cannot be determined from the given data.

**Direction for Questions (97-98):** Consider the following for the two (02) items that follow:
Let X be a random variable following binomial distribution with parameters $n = 6$ and $p = k$. Further, $9P(X = 4) = P(X = 2)$.

**97.** What is the value of $k$?

**(a)** $\frac{1}{2}$ **(b)** $\frac{1}{3}$ **(c)** $\frac{1}{4}$ **(d)** $\frac{1}{5}$

**98.** What is the value of $P(X = 3)$?

**(a)** $\frac{135}{1024}$ **(b)** $\frac{5}{128}$
**(c)** $\frac{45}{1024}$ **(d)** $\frac{70}{1024}$

**Direction for Questions (99-100):** Consider the following for the two (02) items that follow:
A committee of 6 members is formed from a group of 7 gentlemen and 4 ladies.

**99.** What is the probability that the committee includes exactly 3 gentlemen?

**(a)** $\frac{10}{33}$ **(b)** $\frac{30}{77}$ **(c)** $\frac{100}{231}$ **(d)** $\frac{5}{11}$

**100.** What is the probability that the committee includes at least 2 ladies?

**(a)** $\frac{41}{66}$ **(b)** $\frac{47}{66}$ **(c)** $\frac{49}{66}$ **(d)** $\frac{53}{66}$

**Direction for Questions (101-102):** Consider the following for the two (02) items that follow:
Let the function $y = (1 - \cos x)^{-1}$, where $x \neq 2n\pi$ and $n$ is an integer.

**101.** What is the range of the function?

**(a)** $[0, \infty)$ **(b)** $(0.5, \infty)$
**(c)** $[1, \infty)$ **(d)** $(-\infty, 0.5]$

**102.** What is $\int y dx$ equal to?

**(a)** $-\tan\left(\frac{x}{2}\right) + c$ **(b)** $-\cot\left(\frac{x}{2}\right) + c$
**(c)** $\tan\left(\frac{x}{2}\right) + c$ **(d)** $\cot\left(\frac{x}{2}\right) + c$

where $c$ is the constant of integration.

**Direction for Questions (103-104):** Consider the following for the two (02) items that follow:
Let the function $f(x) = \sin[x]$, where [.] is the greatest integer function and $g(x) = [x]$.

**103.** What is $\lim_{x \to 0}\{f(x)g(x)\}$ equal to?

**(a)** –1 **(b)** 0
**(c)** 1 **(d)** Limit does not exist

**104.** What is $\lim_{x \to 0} \frac{f(x)}{g(x)}$ equal to?

**(a)** –sin 1 **(b)** sin 1
**(c)** 0 **(d)** Limit does not exist

**Direction for Questions (105-106):** Consider the following for the two (02) items that follow:
Let the curve $f(x) = |x - 3|$.

**105.** What is the domain of the function $f(x)$?

**(a)** $(0, \infty)$ **(b)** $(3, \infty)$
**(c)** $(-\infty, \infty)$ **(d)** $(-\infty, \infty) - \{3\}$

**106.** What is the area bounded by the curved $f(x)$ and $y = 3$?

**(a)** 3 square units **(b)** 4.5 square units
**(c)** 7.5 square units **(d)** 9 square units

**Direction for Questions (107-108):** Consider the following for the two (02) items that follow:
Let $f = \{(1, 1), (2, 4), (3, 7), (4, 10)\}$

**107.** If $f(x) = px + q$, then what is the value of $(p + q)$?

**(a)** –1 **(b)** 0 **(c)** 1 **(d)** 5

**108.** Consider the following statements:

I. $f$ is an one-one function.

II. $f$ is onto function if the codomain is the set of natural numbers.

Which of the statements given above is/are correct?

**(a)** I only **(b)** II only

**(c)** Both I and II **(d)** Neither I nor II

**Direction for Questions (109-110):** Consider the following for the two (02) items that follow: Let the function $f(x) = x^2 - 1$.

**109.** What is $\lim_{x \to 1}\{f.f((x))\}$ equal to?

**(a)** $-1$ **(b)** 0 **(c)** 1 **(d)** 2

**110.** What is the area bounded by the function $f(x)$ and the $x$-axis?

**(a)** $\frac{1}{3}$ square units **(b)** $\frac{2}{3}$ square unit

**(c)** $\frac{4}{3}$ square units **(d)** 2 square units

**Direction for Questions (111-112):** Consider the following for the two (02) items that follow: Let $x = \sec\theta - \cos\theta$ and $y = \sec^4\theta - \cos^4\theta$,

**111.** What is $\left(\frac{dy}{dx}\right)^2$ equal to?

**(a)** $\frac{4(y^2+4)}{(x^2+4)}$ **(b)** $\frac{4(y^2-4)}{(x^2-4)}$

**(c)** $\frac{16(y^2+4)}{(x^2+4)}$ **(d)** $\frac{16(y^2-4)}{(x^2-4)}$

**112.** What is $\left(\frac{x^2+4}{y^2+4}\right)\frac{dy}{dx}\left[(x^2+4)\frac{d^2y}{dx^2} - 16y\right]$ equal to?

**(a)** $16x$ **(b)** $16y$ **(c)** $-16x$ **(d)** $-16y$

**Direction for Questions (113-114):** Consider the following for the two (02) items that follow: Let $ABC$ be a triangle right-angled at $B$ and $AB + AC = 3$ units.

**113.** What is $\angle A$ equal to if the area of the triangle is maximum?

**(a)** $\frac{\pi}{6}$ **(b)** $\frac{\pi}{4}$ **(c)** $\frac{\pi}{3}$ **(d)** $\frac{5\pi}{12}$

**114.** What is the maximum area of the triangle?

**(a)** $\frac{\sqrt{3}}{2}$ square unit **(b)** $\sqrt{3}$ square unit

**(c)** $\frac{\sqrt{6}}{2}$ square unit **(d)** $\sqrt{6}$ square unit

**Direction for Questions (115-116):** Consider the following for the two (02) items that follow: Let $(x + y)^{p+q} = x^p y^p$, where $p, q$ are positive integers.

**115.** The derivative of $y$ with respect to $x$:

**(a)** depends on $p$ only

**(b)** depends on $q$ only

**(c)** depends on both $p$ and $q$

**(d)** is independent of both $p$ and $q$

**116.** If $p + q = 10$, then what is $\frac{dy}{dx}$ equal to?

**(a)** $\frac{y}{x}$ **(b)** $xy$

**(c)** $x^{10}y^{10}$ **(d)** $\left(\frac{y}{x}\right)^{10}$

**Direction for Questions (117-118):** Consider the following for the two (02) items that follow: The slope of the tangent of the curve $y = f(x)$ at $(x, f(x))$ is 4 for every real number $x$ and the curve passes through the origin.

**117.** What is the nature of the curve?

**(a)** A straight line passing through (1, 4)

**(b)** A straight line passing through (–1, 4)

**(c)** A parabola with vertex at origin and focus at (2, 0)

**(d)** A parabola with vertex at origin and focus at (1, 0)

**118.** What is the area bounded by the curve the $x$-axis and the line $x = 4$?

**(a)** 8 square units **(b)** 16 square units

**(c)** 32 square units **(d)** 64 square units

**Direction for Questions (119-120):** Consider the following for the two (02) items that follow:

Let $f(x) = \begin{cases} x^3, & x^2 < 1 \\ x^2, & x^2 \geq 1 \end{cases}$

**119.** What is $\lim_{x \to 0} f'(x)$ equal to?

**(a)** 2 **(b)** 1

**(c)** 0 **(d)** Limit does not exist

**120.** Consider the following statements:

I. The function is continuous at $x = -1$

II. The function is differentiable at $x = 1$

**(a)** I only

**(b)** II only

**(c)** Both I and II

**(d)** Neither I nor II

# Answer Key

| Q. No | Answer Key | Q. No | Answer Key | Q. No | Answer Key | Q. No | Answer Key |
|---|---|---|---|---|---|---|---|
| 1 | c | 31 | b | 61 | d | 91 | c |
| 2 | b | 32 | b | 62 | c | 92 | c |
| 3 | d | 33 | a | 63 | c | 93 | d |
| 4 | b | 34 | a | 64 | d | 94 | c |
| 5 | c | 35 | b | 65 | d | 95 | b |
| 6 | d | 36 | c | 66 | c | 96 | b |
| 7 | d | 37 | d | 67 | d | 97 | c |
| 8 | b | 38 | a | 68 | c | 98 | a |
| 9 | c | 39 | a | 69 | b | 99 | a |
| 10 | b | 40 | b | 70 | a | 100 | d |
| 11 | c | 41 | b | 71 | b | 101 | b |
| 12 | d | 42 | a | 72 | a | 102 | b |
| 13 | c | 43 | c | 73 | a | 103 | b |
| 14 | b | 44 | a | 74 | c | 104 | d |
| 15 | b | 45 | b | 75 | c | 105 | c |
| 16 | b | 46 | c | 76 | a | 106 | d |
| 17 | c | 47 | c | 77 | c | 107 | c |
| 18 | a | 48 | a | 78 | c | 108 | a |
| 19 | d | 49 | b | 79 | c | 109 | a |
| 20 | c | 50 | a | 80 | c | 110 | c |
| 21 | b | 51 | c | 81 | a | 111 | c |
| 22 | c | 52 | b | 82 | d | 112 | c |
| 23 | d | 53 | a | 83 | a | 113 | c |
| 24 | a | 54 | b | 84 | b | 114 | a |
| 25 | b | 55 | b | 85 | d | 115 | d |
| 26 | d | 56 | b | 86 | b | 116 | a |
| 27 | c | 57 | b | 87 | c | 117 | a |
| 28 | b | 58 | c | 88 | d | 118 | c |
| 29 | a | 59 | b | 89 | b | 119 | c |
| 30 | a | 60 | c | 90 | a | 120 | d |

# NDA / NA

**National Defence Academy / Naval Academy**

**MATHEMATICS-I**

**QUESTION PAPER 2025**

## ANSWERS WITH EXPLANATIONS

**1. Option (c) is correct.**

*Explanation:* Put $x = 1$ and $y = 1$, we get

Sum of coefficients $= 2^n = 256$

Total terms $= 8 + 1 = 9$

$$\text{Greatest term} = \text{middle term} = \frac{9+1}{2}$$

$$= 5^{\text{th}} \text{ term}$$

**2. Option (b) is correct.**

*Explanation:* $k < (\sqrt{2}+1)^3 < k + 2$

$\Rightarrow k < 2\sqrt{2}+1+6+3\sqrt{2} < k + 2$

$\Rightarrow k < 5\sqrt{2} + 7 < k + 2$

$\Rightarrow k < 14.07 < k + 2$

$\Rightarrow k < 14.07$ and $k > 12.07$

$\therefore \quad k = 13, 14$

**3. Option (d) is correct.**

*Explanation:*

$$\begin{bmatrix} x & 1 & 1 \end{bmatrix}\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}\begin{bmatrix} 1 \\ 1 \\ x \end{bmatrix} = [45]$$

$$\Rightarrow [x + 11 + 2x + 13 + 3x + 15]\begin{bmatrix} 1 \\ 1 \\ x \end{bmatrix} = [45]$$

$\Rightarrow x + 11 + 2x + 13 + 3x^2 + 15x = 45$

$\Rightarrow \quad 3x^2 + 18x + 24 = 45$

$\Rightarrow \quad x^2 + 6x - 7 = 0$

$\Rightarrow \quad x = -7$ and $1$

**4. Option (b) is correct.**

*Explanation:* For orthogonal matrix.

$A^T = A^{-1} \Rightarrow AA^T = I$

$A^2 = I$ ($\therefore$ A is symmetric)

$$\begin{bmatrix} y & z & x \\ z & x & y \\ x & y & z \end{bmatrix}\begin{bmatrix} y & z & x \\ z & x & y \\ x & y & z \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} y^2+z^2+x^2 & yz+zx+xy & xy+yz+xz \\ yz+zx+xy & x^2+y^2+z^2 & xy+yz+zx \\ xy+yz+zx & xy+yz+zx & x^2+y^2+z^2 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$x^2 + y^2 + z^2 = 1$$

**5. Option (c) is correct.**

*Explanation:* For non-singular matrix we know that

$$|M^n| = |M|^n, |M^{-1}| = \frac{1}{|M|}$$

and $|M^T| = |M|$

**6. Option (d) is correct.**

*Explanation:*

$$f(\pi) = \begin{bmatrix} \cos\pi & \sin\pi \\ -\sin\pi & \cos\pi \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$$

$$[f(\pi)]^2 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

**7. Option (d) is correct.**

*Explanation:*

$$A^2 = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}\begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix} = \begin{bmatrix} 9 & 8 & 8 \\ 8 & 9 & 8 \\ 8 & 8 & 9 \end{bmatrix}$$

$$A^2 - 4A = \begin{bmatrix} 9 & 8 & 8 \\ 8 & 9 & 8 \\ 8 & 8 & 9 \end{bmatrix} - \begin{bmatrix} 4 & 8 & 8 \\ 8 & 4 & 8 \\ 8 & 8 & 4 \end{bmatrix} = \begin{bmatrix} 5 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 5 \end{bmatrix}$$

$$= 5I_3$$

**8. Option (b) is correct.**

*Explanation:* ${}^{5n}C_r = {}^{5n}C_{n+r}$

$n + r + r = 5n \Rightarrow 2r = 4n \Rightarrow r = 2n$

**9. Option (d) is correct.**

*Explanation:* Number of selections (at most 3 things)

$$= {}^6C_0 + {}^6C_1 + {}^6C_2 + {}^6C_3$$

$$= 1 + 6 + \frac{6 \cdot 5}{2 \cdot 1} + \frac{6 \cdot 5 \cdot 4}{3 \cdot 2 \cdot 1}$$

$$= 1 + 6 + 15 + 20 = 42$$

**10. Option (b) is correct.**

*Explanation:* We know that for orthogonal matrix

$$A^T = A^{-1} \Rightarrow AA^T = AA^{-1} = I$$

$$\Rightarrow \quad A^2 = I \ (\because A = A^T)$$

**11. Option (c) is correct.**

*Explanation:*

$$\frac{p}{q} = \frac{\tan 2\alpha - \tan\alpha}{\cot\alpha - \cot 2\alpha} = \frac{\tan 2\alpha - \tan\alpha}{\frac{1}{\tan\alpha} - \frac{1}{\tan 2\alpha}}$$

$$= \frac{(\tan 2\alpha - \tan\alpha)\tan\alpha\cdot\tan 2\alpha}{(\tan 2\alpha - \tan\alpha)}$$

$$= \tan\alpha \,.\, \tan 2\alpha$$

**12. Option (d) is correct.**

*Explanation:* $p + q = \tan 2\alpha - \tan\alpha + \cot\alpha - \cot 2\alpha$

$$= \left(\frac{\sin^2 2\alpha - \cos^2 2\alpha}{\sin 2\alpha\cdot\cos 2\alpha}\right) + \left(\frac{\cos^2\alpha - \sin^2\alpha}{\sin\alpha\cdot\cos\alpha}\right)$$

$$= \frac{\sin^2 2\alpha - \cos^2 2\alpha}{\sin 2\alpha\cdot\cos 2\alpha} + \frac{\cos^2\alpha - \sin^2\alpha}{\sin\alpha\cdot\cos\alpha}$$

$$= \frac{-2\cos 4\alpha}{\sin 4\alpha} + \frac{2\cos 2\alpha}{\sin 2\alpha}$$

$$= \frac{2(\sin 4\alpha\cdot\cos 2\alpha - \cos 4\alpha\cdot\sin 2\alpha)}{\sin 4\alpha\cdot\sin 2\alpha}$$

$$= \frac{2\sin(4\alpha - 2\alpha)}{\sin 4\alpha\cdot\sin 2\alpha} = \frac{2.\sin 2\alpha}{\sin 4\alpha\cdot\sin 2\alpha}$$

$$= 2\text{cosec } 4\alpha.$$

**13. Option (c) is correct.**

*Explanation:* $\frac{p}{p+2q} = \frac{1}{1+\frac{2q}{p}} = \frac{1}{1+\frac{2}{\tan\alpha\cdot\tan 2\alpha}}$

$$= \frac{\sin\alpha\cdot\sin 2\alpha}{\sin\alpha\cdot\sin 2\alpha + \cos\alpha\cdot\cos 2\alpha + \cos\alpha\cdot\cos 2\alpha}$$

$$= \frac{\sin\alpha\cdot\sin 2\alpha}{\cos\alpha + \cos\alpha\cdot\cos 2\alpha} = \frac{\sin\alpha\cdot 2\sin\alpha\cdot\cos\alpha}{\cos\alpha\cdot 2\cdot\cos^2\alpha}$$

$$= \tan^2\alpha.$$

**14. Option (c) is correct.**

*Explanation:* $\cos\alpha = 2(1 - \sin\alpha)$

$$\Rightarrow \quad \frac{\cos^2\alpha}{(1-\sin\alpha)^2} = 4$$

$$\frac{1+\sin\alpha}{1-\sin\alpha} = \frac{4}{1} \Rightarrow \sin\alpha = \frac{3}{5}$$

$$\tan\alpha = \frac{3}{\sqrt{25-9}} = \frac{3}{4}$$

**15. Option (b) is correct.**

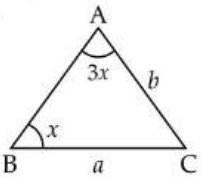
*Explanation:* $\therefore \sin\alpha = \frac{3}{5}$ and $\cos\alpha = \frac{4}{5}$

$$\therefore 2\sin 2\alpha + \cos 2\alpha = 4\sin\alpha.\cos\alpha + 1 - 2\sin^2\alpha$$

$$= \frac{48}{25} + 1 - \frac{18}{25} = \frac{48+25-18}{25} = \frac{55}{25} = \frac{11}{5}$$

**16. Option (b) is correct.**

*Explanation:*




$$\frac{a}{\sin 3x} = \frac{b}{\sin x}$$

$$\Rightarrow \quad \frac{a}{b} = \frac{\sin 3x}{\sin x}$$

$$\Rightarrow \quad 2 = \frac{\sin 3x}{\sin x} \Rightarrow 2\sin x = 3\sin x - 4\sin^3 x$$

$$\Rightarrow \sin x\,(1 - 4\sin^2 x) = 0 \Rightarrow \sin x = \frac{1}{2}$$

$$\Rightarrow \quad x = 30^\circ$$

**17. Option (c) is correct.**

*Explanation:* $\angle B = x = 30^\circ$, $\angle A = 3x = 90^\circ$, $\angle C = 180^\circ - 120^\circ = 60^\circ$

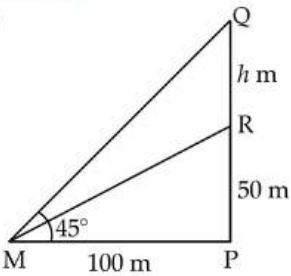
$\therefore$ Triangle is right-angled.

$\therefore$ 30°, 60° and 90° are in A.P.

So options (I) and (III) are only correct.

**18. Option (a) is correct.**

*Explanation:*




$$\tan 45^\circ = \frac{50+h}{100}$$

$$100 = 50 + h \Rightarrow h = 50 \text{ m}$$

$$\tan\angle RMQ = \frac{50}{100} = \frac{1}{2}$$

$$\angle RMQ = \tan^{-1}\frac{1}{2}$$

**19. Option (d) is correct.**

*Explanation:* $\because x^2 - 4x + 1 = 0$

$$\Rightarrow x = 2 \pm \sqrt{3} > 0$$

$$\therefore \tan^{-1} k + \tan^{-1}\frac{1}{k} = \tan^{-1}\left(\frac{k+\frac{1}{k}}{1-k\times\frac{1}{k}}\right)$$

$$\tan^{-1}\infty = \frac{\pi}{2}$$

**20. Option (c) is correct.**

*Explanation:* $\tan^{-1}k + \tan^{-1}\frac{1}{2} = \frac{\pi}{4} = \tan^{-1}1$

$$\tan^{-1}k = \tan^{-1}\left(\frac{1-\frac{1}{2}}{1+\frac{1}{2}}\right) = \tan^{-1}\left(\frac{1}{2}\times\frac{2}{3}\right)$$

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

**21. Option (b) is correct.**

*Explanation:*

We know that $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$ ...(i)

and $\cos(\alpha+\beta)\cos(\alpha-\beta) = \cos^2\alpha - \sin^2\beta$

$= \cos^2\alpha + \cos^2\beta - 1 = 1 - \cos^2\gamma - 1 = -\cos^2\gamma.$

**22. Option (c) is correct.**

*Explanation:*

$$\text{Area} = AB \times BC$$
$$= \sqrt{1^2+3^2+1^2}\times\sqrt{2^2+1^2+1^2}$$
$$= \sqrt{11}\times\sqrt{6}$$
$$= \sqrt{66} \text{ sq. units}$$

**23. Option (d) is correct.**

*Explanation:* D.rs of AB = $k, -1, 3$

D.rs of BC = $2, k, -1$

$\because$ AB $\perp$ BC

$\therefore \quad 2k - k - 3 = 0 \Rightarrow k = 3$

**24. Option (a) is correct.**

*Explanation:* D.rs of line are $p, q, r$

where $p = 2q = 3r \Rightarrow \frac{p}{6} = \frac{q}{3} = \frac{r}{2}$

$\therefore$ D.rs of line are 6, 3, 2

$$\therefore \quad \cos\theta = \frac{3}{\sqrt{6^2+3^2+2^2}} = \frac{3}{7}$$

$$\cos2\theta = 2\cos^2\theta - 1 = \frac{18}{49} - 1 = \frac{-31}{49}$$

**25. Option (b) is correct.**

*Explanation:* Point (1, 1, 1) and d.rs of normal are <3, 2, 1>

$\therefore$ Equation of the plane is

$3(x-1) + 2(y-1) + 1(z-1) = 0$

$\Rightarrow \quad 3x + 2y + z = 6$

**26. Option (d) is correct.**

*Explanation:* $\because \cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$

$\Rightarrow \sin^2\alpha + \sin^2\beta + \sin^2\gamma = 2$

Now, $\vec{a}.\vec{b}. = \sin^2\alpha + \sin^2\beta + \sin^2\gamma = 2$

**27. Option (c) is correct.**

*Explanation:* $\vec{d} = (\vec{a}\times\vec{b})\times\vec{c} = (\vec{a}.\vec{c})\vec{b} - (\vec{b}.\vec{c})\vec{a}$ ...(i)

Since $\vec{d}$ is a linear combination of $\vec{a}$ and $\vec{b}$.

Therefore $\vec{d}$ lies in the plane formed by $\vec{a}$ and $\vec{b}$.

So, $\vec{d}$ is coplanar with $\vec{a}$ and $\vec{b}$.

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

$= (\vec{a}.\vec{c})(\vec{b}.\vec{c}) - (\vec{b}.\vec{c})(\vec{a}.\vec{c}) = 0$

So, $\vec{d}$ is perpendicular to $\vec{c}$

Hence both statements are true.

**28. Option (b) is correct.**

*Explanation:* $\because \quad 3\vec{a} - 4\vec{b} + \vec{c} = 0$

$\Rightarrow \quad 3\vec{a} - 3\vec{b} - \vec{b} + \vec{c} = 0$

$\Rightarrow \quad 3(\vec{a}-\vec{b}) = \vec{b}-\vec{c} \Rightarrow 3(\vec{b}-\vec{a}) = \vec{c}-\vec{b}$

$$\Rightarrow \quad \frac{\vec{b}-\vec{a}}{\vec{c}-\vec{b}} = \frac{1}{3} \Rightarrow \frac{\overline{AB}}{\overline{BC}} = \frac{1}{3}$$

**29. Option (a) is correct.**

*Explanation:* $(\vec{a}\times\vec{b}) + (\vec{b}\times\vec{c}) + (\vec{c}\times\vec{a})$

$= (\vec{a}\times\vec{b}) + (\vec{b}\times\vec{a})\times\vec{c}$

$= (\vec{a}\times\vec{b}) + (\vec{b}\times\vec{a})\times(\cos^2\theta\vec{a} + \sin^2\theta\vec{b})$

$= (\vec{a}\times\vec{b}) + \cos^2\theta(\vec{b}\times\vec{a}) - \sin^2\theta(\vec{a}\times\vec{b})$

$= (\vec{a}\times\vec{b}) - \cos^2\theta(\vec{a}\times\vec{b}) - \sin^2\theta(\vec{a}\times\vec{b})$

$= (\vec{a}\times\vec{b})\left[1 - (\cos^2\theta + \sin^2\theta)\right] = 0$

**30. Option (a) is correct.**

*Explanation:* $\therefore \quad |\vec{a}| = |\vec{b}| = |\vec{a}\times\vec{b}| = 1$

$$\sin\theta = \frac{|\vec{a}\times\vec{b}|}{|\vec{a}||\vec{b}|} = 1.$$

$$\therefore \quad \theta = \frac{\pi}{2}$$

Now, $\vec{a}.\vec{b} = |\vec{a}||\vec{b}|\cos\frac{\pi}{2} = 0$

**31. Option (b) is correct.**

*Explanation:*

$S_k = 3k^2 + 5k$

$S_1 = 3 + 5 = 8$

$S_2 = 12 + 10 = 22$

$S_3 = 27 + 15 = 42$

$a_1 = S_1 = 8$

$a_2 = S_2 - S_1 = 22 - 8 = 14$

$a_3 = S_3 - S_2 = 42 - 22 = 20$

$\therefore$ Series = 8 + 14 + 20 ..... are in A.P. with common difference = 14 – 8 = 6.

**32. Option (b) is correct.**

***Explanation:*** $S_8 = 5S_4$

$$\frac{a(r^8-1)}{r-1} = \frac{5.a(r^4-1)}{r-1}$$

$$\Rightarrow \quad \frac{r^8-1}{r^4-1} = 5 \Rightarrow \frac{(r^4-1)(r^4+1)}{r^4-1} = 5$$

$$\Rightarrow \quad r^4 = 4 \Rightarrow r = \pm\sqrt{2}, \pm\sqrt{2}i$$

**33. Option (b) is correct.**

***Explanation:*** Here, $\alpha + \beta = k$, $\alpha\beta = k$

and $\alpha - \beta = (2\sqrt{3})$

$\therefore \quad (\alpha-\beta)^2 = (\alpha+\beta)^2 - 4\alpha\beta$

$\Rightarrow \quad (2\sqrt{3})^2 = k^2 - 4k$

$\Rightarrow \quad k^2 - 4k - 12 = 0 \Rightarrow k^2 - 6k + 2k - 12 = 0$

$\Rightarrow \quad (k-6)(k+2) = 0 \Rightarrow k = -2, 6$

**34. Option (a) is correct.**

***Explanation:***

$$xy + 5 = 4y$$
$$xy + 5 = -4x$$
$$- \quad - \quad +$$
$$0 = 4(x+y)$$

$\Rightarrow \quad x + y = 0$

**35. Option (a) is correct.**

***Explanation:***

$a_5 = a + 4d$, $a_7 = a + 6d$ and $a_{13} = a + 12d$

$\therefore$ $a_5$, $a_7$ and $a_{13}$ are in G.P

$$(a_7)^2 = a_5 . a_{13}$$
$$(a+6d)^2 = (a+4d)(a+12d)$$
$$a^2 + 12ad + 36d^2 = a^2 + 16ad + 48d^2$$
$$12d^2 + 4ad = 0 \Rightarrow 3d + a = 0$$
$$a = -3d \Rightarrow \frac{a}{d} = -3$$

**36. Option (c) is correct.**

***Explanation:*** $\therefore$ $p$, 1 and $q$ are A.P.

$\Rightarrow \quad p + q = 2$ .... (i)

$p$, 2 and $q$ are G.P $\Rightarrow pq = 4$ ...(ii)

Now, $\frac{2pq}{p+q} = \frac{8}{2} = 4$

$\therefore \quad \frac{p+q}{2pq} = \frac{1}{4}$

$\therefore \frac{1}{p}, \frac{1}{4}$ and $\frac{1}{q}$ are in A.P.

$\therefore$ $p$, 4 and $q$ are in H.P.

Both statements are correct.

**37. Option (d) is correct.**

***Explanation:***

$x = (1111)_2 = 2^3 + 2^2 + 2^1 + 1 = 15$

$y = (1001)_2 = 2^3 + 0 + 0 + 1 = 9$

$z = (110)_2 = 2^2 + 2^1 + 0 = 6$

Now, $x^3 - y^3 - z^3 - 3xyz$

$= (15)^3 - (9)^3 - (6)^3 - 3 \times 15 \times 9 \times 6$

$= 3375 - 729 - 216 - 2430$

$= 0$

**38. Option (a) is correct.**

***Explanation:***

*Cofactors:* A = $ei - hf$, B = $gf - di$, C = $dh - ge$

D = $ch - bi$ and G = $bf - ec$

Now, $b$B + $c$C – $d$D – $g$G

$= bgf - bdi + cdh - cge - cdh + bdi - gbf + gec = 0$

**39. Option (a) is correct.**

***Explanation:***

$$\Delta = \begin{vmatrix} k^2+2k & 2k+1 & 1 \\ 2k+1 & k+2 & 1 \\ 3 & 3 & 1 \end{vmatrix}$$

$= (k^2 + 2k)(k + 2 - 3) - (2k + 1)(2k + 1 - 3) + (6k + 3 - 3k - 6)$

$= k^3 - k^2 + 2k^2 - 2k - 4k^2 + 4k - 2k + 2 + 3k - 3$

$= k^3 - 3k^2 + 3k - 1$

$= (k-1)^3$

(i) $\quad (k-1)^3 > 0 \Rightarrow k > 1$

(ii) $\quad (k-1)^3 < 0 \Rightarrow k < 1$

(iii) $\quad (k-1)^3 = 0 \Rightarrow k = 1$

**40. Option (b) is correct.**

***Explanation:***

$$\begin{vmatrix} 2 & 3+i & 1 \\ 3-i & 0 & i-1 \\ -1 & -1-i & 1 \end{vmatrix}$$

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

$= 2(-1 - 1) - (3 + i)\,2 + 3i - i^2 + 3 - i$

$= -4 - 6 - 2i + 3i + 1 + 3 - i$

$= -6 = -6 + 0i = A + iB$

$\therefore$ A + B = $-6 + 0 = -6$

**41. Option (b) is correct.**

***Explanation:*** $p + q + r = \sin 35° + \sin 25° + \sin(-95°)$

$= \sin 35° + \sin 25° - \sin 95°$

$= \sin 35° + 2\cos 60°.\sin(-35°)$

$= \sin 35° - 2 \times \frac{1}{2} \sin 35° = 0$

**42. Option (a) is correct.**

***Explanation:*** $pq + qr + rp = q(p + r) + rp$

$= -q^2 + rp = -\sin^2 25° - \sin 95°.\sin 35°$

$(\therefore p + q + r = 0)$

$$= \frac{1}{2}\ [-2\sin^2 25° - 2\sin 95°.\ \sin 35°]$$

$$= \frac{1}{2}\ [-1 + \cos 50° + \cos 130° - \cos 60°]$$

$$= \frac{1}{2}\ [-1 + \cos 50° - \cos 50° - \frac{1}{2}]$$

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

**43. Option (c) is correct.**

*Explanation:*

$$(p+q+r)^2 = p^2 + q^2 + r^2 + 2(pq + qr + rp)$$

$$\Rightarrow \quad 0 = p^2 + q^2 + r^2 + 2\left(\frac{-3}{4}\right)$$

$$\Rightarrow\ p^2 + q^2 + r^2 = \frac{3}{2}$$

**44. Option (a) is correct.**

*Explanation:*

$$p = |\sin\alpha - \sin(\alpha - 90°)|$$
$$= |\sin\alpha + \cos\alpha|$$
$$= \sqrt{2}\ |\sin 45° \sin\alpha + \cos 45° \cos\alpha|$$

$$p = \sqrt{2}\ |\sin(45°+\alpha)|$$
$$0 \le |\sin(45°+\alpha)| \le 1$$
$$0 \le \sqrt{2}\ |\sin(45°+\alpha)| \le \sqrt{2}$$

$\therefore$ Minimum value of $p$ is 0

**45. Option (b) is correct.**

*Explanation:* $p = \sqrt{2}\ |\sin 45° + \alpha|$

$$\Rightarrow \quad 0 \le p \le \sqrt{2}$$

$\therefore$ Maximum value $= \sqrt{2}$

**46. Option (c) is correct.**

*Explanation:* $a = 5$ cm, $b = 7$ cm, $c = 3$ cm

$$\cos B = \frac{a^2 + c^2 - b^2}{2ac}$$

$$= \frac{25+9-49}{2\times5\times3} = \frac{-15}{2\times15} = \frac{-1}{2}$$

$$B = 120°$$

$\therefore$ $A + C = 180° - 120° = 60°$ (acute)

So both statements are correct.

**47. Option (c) is correct.**

*Explanation:*

$$\cos B = \frac{a^2 + c^2 - b^2}{2ac}$$

$$= \frac{25+9-49}{2\times5\times3} = -\frac{1}{2}$$

$$B = 120°$$

**48. Option (a) is correct.**

*Explanation:*

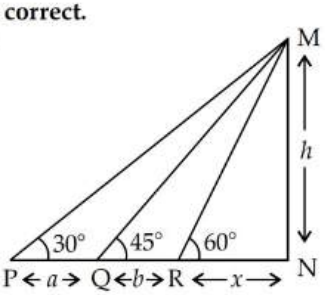
$$\text{Area of triangle} = \frac{1}{2}\times ac\sin B$$

$$= \frac{1}{2}\times5\times3\times\sin 120° = \frac{1}{2}\times15\times\sin 60°$$

$$= \frac{1}{2}\times15\times\frac{\sqrt{3}}{2} = \frac{15\sqrt{3}}{4}\text{cm}^2$$

**49. Option (b) is correct.**

*Explanation:*




$$\tan 60° = \frac{h}{x} \Rightarrow h = \sqrt{3}x$$

$$\tan 45° = \frac{h}{QN} \Rightarrow QN = h$$

$$\tan 30° = \frac{h}{PN}$$

$$PN = h\sqrt{3}$$
$$h + a = h\sqrt{3}$$

$$h = \frac{a}{\sqrt{3}-1} = \frac{a(\sqrt{3}+1)}{2}$$

$$PN = h\sqrt{3} = \frac{a(3+\sqrt{3})}{2}$$

**50. Option (a) is correct.**

*Explanation:*

$$\tan 60° = \frac{h}{x} \Rightarrow h = \sqrt{3}x$$

$$\tan 45° = \frac{h}{b+x}$$

$$\Rightarrow \quad h = b + x \Rightarrow \sqrt{3}x = b + x$$

$$x = \frac{b(\sqrt{3}+1)}{2}$$

$$\Rightarrow \quad h = MN = \sqrt{3}x = \left(\frac{3+\sqrt{3}}{2}\right)b$$

**51. Option (c) is correct.**

*Explanation:* P(Bonus introduced)

$$= \frac{3}{10}\times\frac{4}{9} + \frac{1}{2}\times\frac{2}{9} + \frac{4}{5}\times\frac{1}{3}$$

$$= \frac{2}{15}+\frac{1}{9}+\frac{4}{15} = \frac{6+5+12}{45} = \frac{23}{45}$$

**52. Option (b) is correct.**

*Explanation:* F: Bonus introduced

$$\therefore \quad P(A\backslash F) = \frac{\frac{2}{15}}{\frac{23}{45}} = \frac{2}{15}\times\frac{45}{23} = \frac{6}{23}$$

**53. Option (a) is correct.**

*Explanation:*

$$\text{New Mean} = \frac{50-5}{20} = \frac{45}{20} = 2.25$$

**54. Option (b) is correct.**

*Explanation:* When 5 is added to each observation then the standard deviation is not changed

$$\therefore \text{ New standard deviation} = \frac{10}{20} = 0.5$$

**55. Option (b) is correct.**

*Explanation:*

$$P(B/A') = \frac{P(BAA')}{P(A')} = \frac{P(B)-P(B\cap A)}{1-P(A)}$$

$$= \frac{\frac{1}{2}-\frac{1}{4}}{1-\frac{1}{3}} = \frac{1}{4}\times\frac{3}{2} = \frac{3}{8}$$

**56. Option (b) is correct.**

*Explanation:*

$$P(A'\cap B') = 1 - P(A\cup B)$$
$$= 1 - [P(A) + P(B) - P(A\cap B)]$$
$$= 1-\left[\frac{1}{3}+\frac{1}{2}-\frac{1}{4}\right] = 1-\left[\frac{4+6-3}{12}\right]$$
$$= 1 - \frac{7}{12} = \frac{5}{12}$$

**57. Option (b) is correct.**

*Explanation:*

$$n(s) = 6 \times 6 = 36$$

Sum strictly greater than 7

= {(2, 6), (3, 5), (3, 6), (4, 4), (4, 5), (4, 6), (5,3), (5, 4), (5, 5), (5, 6), (6, 2),(6, 3), (6, 4), (6, 5),(6, 6)}

$$n(E) = 15$$

$$\therefore \quad P(E) = \frac{15}{36} = \frac{5}{12}$$

**58. Option (c) is correct.**

*Explanation:* $P(X \geq 2) = 1 - P(X = 0) - P(X = 1)$

$$= 1 - {}^7C_0\left(\frac{1}{5}\right)^0\left(\frac{4}{5}\right)^7 - {}^7C_1\left(\frac{1}{5}\right)^1\left(\frac{4}{7}\right)^6$$

$$= 1-\left(\frac{4}{5}\right)^6\left[\frac{4}{5}+\frac{7}{5}\right] = 1-\left(\frac{11}{5}\right)\left(\frac{4}{5}\right)^6$$

**59. Option (b) is correct.**

*Explanation:*

$$\bar{x} = xp = 200 \qquad ...(i)$$
$$\sigma^2 = xpq = 160 ...$$
$$\Rightarrow \quad q = \frac{160}{200} = \frac{4}{5}$$
$$\Rightarrow \quad p = 1 - \frac{4}{5} = \frac{1}{5}$$
$$\Rightarrow \quad n = 1000$$

**60. Option (c) is correct.**

*Explanation:*

$$\text{Sum} = S_{15} - S_7$$
$$= \frac{15\times16\times31}{6} - \frac{7\times8\times15}{6}$$
$$= 1240 - 140 = 1100$$

So, $\text{mean} = \frac{1100}{8} = 137.5$

**61. Option (d) is correct.**

*Explanation:*

$$y = \sin^{-1}\left(x - \frac{4x^3}{27}\right)$$
$$= \sin^{-1}\left[3.\frac{x}{3} - 4\left(\frac{x}{3}\right)^3\right]$$
$$= 3\sin^{-1}\frac{x}{3}$$

**62. Option (c) is correct.**

*Explanation:*

$$y = 3\sin^{-1}\frac{x}{3}$$

$$\frac{dy}{dx} = 3\frac{1}{\sqrt{1-\frac{x^2}{9}}}\times\frac{1}{3} = \frac{3}{\sqrt{9-x^2}}$$

**63. Option (c) is correct.**

*Explanation:* $\lim_{x\to0}\frac{\sqrt{x^2+9}-3}{\sqrt{x^2+16}-4}$

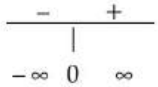
$$= \lim_{x\to0}\frac{x^2+9-9}{x^2+16-16}\times\frac{\sqrt{x^2+16}+4}{\sqrt{x^2+9}+3}$$

$$= \frac{\sqrt{16}+4}{\sqrt{9}+3} = \frac{8}{6} = \frac{4}{3}$$

**64. Option (d) is correct.**

*Explanation:* $f(x) = x^2 + 9$

$f'(x) = 2x = 0 \Rightarrow x = 0$




$\therefore f(x)$ is increasing on $[0, \infty]$

and $f(x)$ is decreasing on $(-\infty, 0)$

So, $f(x)$ is minimum at $x = 0$

Hence both statements are wrong.

**65. Option (d) is correct.**

*Explanation:*

$$\frac{f(4)}{f(2)} = f\left(\frac{4}{2}\right) = f(2) \Rightarrow f(4) = 3 \times 3 = 9$$

$$\frac{f(16)}{f(4)} = f(4) \Rightarrow f(16) = 9 \times 9 = 81$$

**66. Option (c) is correct.**

*Explanation:*

$$\frac{f(4)}{f(2)} = f(2) \Rightarrow f(4) = 3 \times 3 = 9$$

$$\frac{f(2)}{f(2)} = f(1) \Rightarrow f(1) = 1$$

Now, $f(1)\, f(4) = 1 \times 9 = 9$

**67. Option (d) is correct.**

*Explanation:*

$f(0) = f(0 \times 5) = f(0 + 5) = f(5) = 10$

**68. Option (c) is correct.**

*Explanation:*

$f(0 \cdot 5) = f(0 + 5) = f(0) = f(5) = 10$

$f(0 \cdot 20) = f(0 + 20) \Rightarrow f(0) = f(20) = 10$

$f(0 \times -20) = f(0 - 20) \Rightarrow f(0) = f(-20) = 10$

$\therefore f(20) + f(-20) = 10 + 10 = 20$

**69. Option (b) is correct.**

*Explanation:*

$$\int_{\sqrt{2}}^{\sqrt{3}} [x^2]\, dx = \int_{\sqrt{2}}^{\sqrt{3}} 2dx = 2[x]_{\sqrt{2}}^{\sqrt{3}}$$

$$= 2\left(\sqrt{3} - \sqrt{2}\right)$$

**70. Option (a) is correct.**

*Explanation:*

$$\int_{\sqrt{2}}^{2} f(x)dx = \int_{\sqrt{2}}^{2} [x^2]dx = \int_{\sqrt{2}}^{\sqrt{3}} 2dx + \int_{\sqrt{3}}^{2} 3dx$$

$$= 2[x]_{\sqrt{2}}^{\sqrt{3}} + 3[x]_{\sqrt{3}}^{2}$$

$$= 2\sqrt{3} - 2\sqrt{2} + 6 - 3\sqrt{3}$$

$$= 6 - 2\sqrt{2} - \sqrt{3}$$

**71. Option (b) is correct.**

*Explanation:*

$\therefore A^2 + B^2 + C^2 = 0$

$\therefore A = B = C = 0$

$$\text{Now, } \begin{vmatrix} 1 & \cos C & \cos B \\ \cos C & 1 & \cos A \\ \cos B & \cos A & 1 \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{vmatrix} = 0$$

**72. Option (a) is correct.**

*Explanation:* $\begin{vmatrix} x+1 & \omega & \omega^2 \\ \omega & x+\omega^2 & 1 \\ \omega^2 & 1 & x+\omega \end{vmatrix} = 0$

(Applying $C_1 \to C_1 + C_2 + C_3$)

$$\begin{vmatrix} x+1+\omega+\omega^2 & \omega & \omega^2 \\ x+1+\omega+\omega^2 & x+\omega^2 & 1 \\ x+1+\omega+\omega^2 & 1 & x+\omega \end{vmatrix} = 0$$

$$\begin{vmatrix} x & \omega & \omega^2 \\ x & x+\omega^2 & 1 \\ x & 1 & x+\omega \end{vmatrix} = 0$$

$$x\begin{vmatrix} 1 & \omega & \omega^2 \\ 1 & x+\omega^2 & 1 \\ 1 & 1 & x+\omega \end{vmatrix} = 0$$

$\therefore x = 0$

**73. Option (a) is correct.**

*Explanation:*

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

$$= \left(\frac{\sqrt{3}}{2} + \frac{1}{2}i\right)^6$$

$$= \left(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right)^6$$

$$= \cos\pi + i\sin\pi = -1$$

**74. Option (c) is correct.**

*Explanation:* $x^2 - x + 1 = 0 \Rightarrow x = \dfrac{1 \pm \sqrt{3}i}{2}$

if $x = \dfrac{1+\sqrt{3}i}{2}$ then $\dfrac{1}{x} = \dfrac{1-\sqrt{3}i}{2}$

Now $x - \dfrac{1}{x} = \sqrt{3}i$

$$\left(x - \frac{1}{x}\right)^2 + \left(x - \frac{1}{x}\right)^4 + \left(x - \frac{1}{x}\right)^8$$

$= -3 + 9 + 81 = 87$

**75. Option (c) is correct.**

*Explanation:*

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$$\text{Total words} = \frac{4!}{2!} \times 4!$$

$$= \frac{24 \times 24}{2} = 288$$

**76. Option (a) is correct.**

*Explanation:* Let $\text{amp}(z) = \theta$

$\therefore$ $\text{amp}(\bar{z}) = -\theta$

Now $\text{amp}(z) + \text{amp}(\bar{z}) = 0$

**77. Option (c) is correct.**

*Explanation:* Number of diagonals

$$= {}^{n}C_2 - n = 20$$

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

$$= 20$$

$$\Rightarrow \quad n^2 - 3n - 40 = 0$$

$$\Rightarrow \quad n = 8$$

**78. Option (c) is correct.**

*Explanation:* Number of arrangements

$$= 3!2! = 12$$

**79. Option (c) is correct.**

*Explanation:*

$\therefore$ $x + y + z = 5$

$(1, 1, 3) \rightarrow \frac{3!}{2!} = 3$ ways

$(1, 2, 2) \rightarrow \frac{3!}{2!} = 3$ ways

Total ways $= 3 + 3 = 6$

**80. Option (c) is correct.**

*Explanation:*

$$T_{r+1} = {}^{n}C_r \left(3^{\frac{1}{2}}\right)^{12-r} \left(5^{\frac{1}{4}}\right)^{r}$$

$$= {}^{12}C_r 3^{\frac{12-r}{2}} 5^{\frac{r}{4}}$$

for rational term $\frac{12-r}{2}$ and $\frac{r}{4}$ is integer.

$\therefore$ Possible values of $r = 0, 4, 8, 12$

**81. Option (a) is correct.**

*Explanation:*

$$m_1 = \frac{-m^2}{n} \text{ and } m_2 = \frac{-n^2}{-m} = \frac{n^2}{m}$$

for perpendicular

$$-\frac{m^2}{n} \times \frac{n^2}{m} = -1 \Rightarrow mn - 1 = 0$$

**82. Option (d) is correct.**

*Explanation:*

$$\sqrt{p^2+1} = \sqrt{q^2+1} = \sqrt{(p-1)^2 + (q-1)^2}$$

$$\sqrt{p^2+1} = \sqrt{q^2+1} \Rightarrow p = q \; [\because p, q \in (0, 1)]$$

Now, $\sqrt{q^2+1} = \sqrt{(p-1)^2 + (q-1)^2}$

$$\Rightarrow p^2 + 1 = 2(p-1)^2$$

$$\Rightarrow p^2 - 4p + 1 = 0 \Rightarrow p = 2 \pm \sqrt{3}$$

Since, $0 < p < 1 \Rightarrow p = 2 - \sqrt{3} = q$

Now, $p + q = 2(2 - \sqrt{3}) = 4 - 2\sqrt{3}$

**83. Option (a) is correct.**

*Explanation:* $a = \text{BC} = \sqrt{(2-0)^2 + (0-0)^2} = 2$

$$b = \text{AC} = \sqrt{(2-1)^2 + (0-1)^2} = \sqrt{2}$$

$$c = \text{AB} = \sqrt{(1-0)^2 + (1-0)^2} = \sqrt{2}$$

$\therefore$ Coordinate of incentive

$$= \left(\frac{ax_1 + bx_2 + cx_3}{a+b+c}, \frac{ay_1 + by_2 + cy_3}{a+b+c}\right)$$

$$= \frac{2(1) + \sqrt{2}(0) + \sqrt{2}(2)}{2 + \sqrt{2} + \sqrt{2}}, \frac{2(1) + \sqrt{2}(0) + \sqrt{2}(0)}{2 + \sqrt{2} + \sqrt{2}}$$

$$= \left(\frac{2 + 2\sqrt{2}}{2 + 2\sqrt{2}}, \frac{2}{2 + 2\sqrt{2}}\right) = \left(1, \sqrt{2} - 1\right)$$

**84. Option (b) is correct.**

*Explanation:* Coordinate of P $= \left(\frac{3+1}{2}, \frac{-1+1}{2}\right)$

$= \text{P}(2, 0)$

Slope of AB $= \frac{1+1}{1-3} = -1$

Equation of AB is

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

Distance from Q$(x, y)$

$$\frac{x + y - 2}{\sqrt{2}} = \sqrt{2}$$

$$x + y - 2 = 2 \Rightarrow x + y = 4 \qquad \text{...(i)}$$

Slope of PQ $= \frac{y}{x-2}$

$\Rightarrow \text{PQ} \perp \text{AB}$

$$\therefore (-1)\left(\frac{y}{x-2}\right) = -1 \Rightarrow y = x - 2$$

From (i)

$x + x - 2 = 4 \Rightarrow x = 3$ and $y = 1$

Q(3, 1)

**85. Option (d) is correct.**

*Explanation:*

$$\text{Slope of AD} = \frac{6-2}{-2-1} = \frac{4}{-3}$$

$$\therefore \quad \text{Slope of BC} = \frac{3}{4}$$

Equation of BC is

$$y - 6 = \frac{3}{4}(x + 2) \Rightarrow 3x - 4y + 30 = 0$$

**86. Option (b) is correct.**

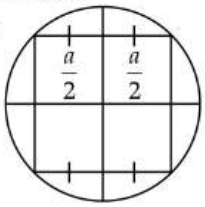
*Explanation:*

$$\text{Radius} = \frac{10}{2} = 5 \text{ cm}$$

On solving $x + y = 0$ and $x - y = 0$
we get centre (0, 0)
Now, the equation of circle
$x^2 + y^2 = 25$

**87. Option (c) is correct.**

*Explanation:*




Equation of circle is
$x^2 + y^2 + 2x + 2y + 1 = 0$

$$\therefore \quad \text{centre} = (-1, -1)$$

$$\text{Radius} = \sqrt{1+1-1} = 1$$

$$\text{Diagonal} = \text{diameter}$$

$$\sqrt{2}a = 2 \Rightarrow a = \sqrt{2}$$

Since the sides of the square are parallel to the co-ordinate axes, the vertices can be found by moving $\frac{a}{2}$ units from the centre along the axes.

$\therefore$ One of the vertices is

$$\left(-1+\frac{1}{\sqrt{2}}, -1-\frac{1}{\sqrt{2}}\right)$$

**88. Option (d) is correct.**

*Explanation:* Scope of tangent = $\tan 45° = 1$

$$y^2 = 4x \Rightarrow 2y\frac{dy}{dx} = 4$$

$$\Rightarrow \quad \frac{dy}{dx} = \frac{4}{2y} = 1 \Rightarrow y = 2$$

putting in $y^2 = 4x \Rightarrow x = 1$

$\therefore$ Point of contact = (1, 2)

**89. Option (b) is correct.**

*Explanation:*

$$25x^2 - 75y^2 = 225$$

$$\frac{x^2}{9} - \frac{y^2}{3} = 1$$

$$\therefore \quad a^2 = 9 \text{ and } b^2 = 3$$

$$c^2 = a^2 + b^2 = 9 + 3 = 12$$

$$c = 2\sqrt{3}$$

Distance between the two foci = $2c = 4\sqrt{3}$

**90. Option (a) is correct.**

*Explanation:* We know that the parametric point of ellipse is $(a \sin \alpha)\ b \cos \alpha)$

$\therefore a = 3$ and $b = 5$

$$b^2 = a^2(1 - e^2) \Rightarrow \frac{25}{9} = 1 - e^2$$

$$e^2 = 1 - \frac{25}{9} = \frac{16}{9} \Rightarrow e = \frac{4}{3}$$

**91. Option (c) is correct.**

*Explanation:* Total number of students whose height is less than or equal to 165 cm = 12 + 15 + 24 = 51

**92. Option (c) is correct.**

*Explanation:*

| C.I. | fi | C.F | |
|---|---|---|---|
| 160–162 | 12 | 12 | |
| 162–164 | 15 | 27 | |
| 164–166 | 24(M) | 51 | Median Class |
| 166–168 | 13 | 64 | |

$$\frac{N}{2} = \frac{64}{2} = 32$$

$$\therefore \quad \text{Median} = l + \frac{\frac{N}{2} - \text{C.F}}{f} \times h$$

$$= 164 + \frac{32-27}{24} \times 2$$

$$= 164 + \frac{5}{12} = 164.41 \text{ cm}$$

**93. Option (d) is correct.**

*Explanation:* Mode = $l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$

$$= 164 + \frac{24-15}{48-15-13} \times 2$$

$$= 164 + \frac{9}{20} \times 2$$

$$= 164.9 \text{ cm}$$

**94. Option (c) is correct.**

*Explanation:* Histogram is made from group frequency data.

**95. Option (b) is correct.**

*Explanation:*

$$\text{Variance of X} = \frac{\Sigma X^2}{N} - \left(\frac{\Sigma X}{N}\right)^2$$

$$= \frac{900}{50} - \left(\frac{200}{50}\right)^2$$

$$= 18 - 16 = 2$$

$$\text{Variance of Y} = \frac{\Sigma Y^2}{N} - \left(\frac{\Sigma Y}{N}\right)^2$$

$$= \frac{1400}{50} - \left(\frac{250}{50}\right)^2$$

$$= 28 - 25 = 3$$

$\therefore$ Variance (X) < Variance (Y)

**96. Option (b) is correct.**

*Explanation:*

$$\text{C.V(X)} = \frac{\sigma}{M} \times 100$$

$$= \frac{\sqrt{2}}{50} \times 100 = 2\sqrt{2}$$

$$\text{C.V(Y)} = \frac{\sigma}{M} \times 100$$

$$= \frac{\sqrt{3}}{50} \times 100 = 2\sqrt{3}$$

$\therefore$ C.V(X) < C.V(Y)

**97. Option (c) is correct.**

*Explanation:* $n = 6, p = k \Rightarrow q = 1 - k$

Now, $9.P(X = 4) = P(X = 2)$

$9.{}^6C_4 k^4 (1-k)^2 = {}^6C_2 k^2 (1-k)^4$

$9k^2 = (1-k)^2 \ (\because {}^6C_4 = {}^6C_2)$

$3k = 1 - k \Rightarrow k = \frac{1}{4}$

**98. Option (a) is correct.**

*Explanation:*

$$P(x = 3) = {}^6C_3 (k)^3 (1-k)^3$$

$$= \frac{6.5.4}{3.2.1}\left(\frac{1}{4}\right)^3\left(\frac{3}{4}\right)^3$$

$$= 20\left(\frac{3}{16}\right)^3 = 20 \times \frac{27}{16 \times 16 \times 16}$$

$$= \frac{135}{1024}$$

**99. Option (a) is correct.**

*Explanation:*

$$n(S) = {}^{11}C_6$$

$$n(E) = {}^7C_3 \times {}^4C_3$$

$$P(E) = \frac{{}^7C_3 \times {}^4C_3}{{}^{11}C_6} = \frac{10}{33}$$

**100. Option (d) is correct.**

*Explanation:* P(E)

$$= \frac{{}^4C_2 \times {}^7C_4 + {}^4C_3 \times {}^7C_3 + {}^4C_4 \times {}^7C_2}{{}^{11}C_6}$$

$$= \frac{53}{66}$$

**101. Option (b) is correct.**

*Explanation:* $y = (1 - \cos x)^{-1} = \frac{1}{1 - \cos x}$

$$= \frac{1}{2\sin^2\frac{x}{2}} = \frac{1}{2}\text{cosec}^2\frac{x}{2}$$

$\therefore \ \text{cosec}\frac{x}{2} \leftarrow (-\infty, -1) \cup (1, \infty)$

$\text{cosec}^2\frac{x}{2} \leftarrow (1, \infty)$

$\Rightarrow \frac{1}{2}\text{cosec}^2\frac{x}{2} \leftarrow (0.5, \infty)$

Range = $(0.5, \ \infty)$

**102. Option (b) is correct.**

*Explanation:*

$$I = \int y dx = \frac{1}{2}\int \text{cosec}^2\frac{x}{2} dx$$

$$= \frac{-\frac{1}{2}\cot\frac{x}{2}}{\frac{1}{2}} + C$$

$$= -\cot\frac{x}{2} + C$$

**103. Option (b) is correct.**

*Explanation:*

$$\lim_{x \to 0}\{f(x).g(x)\} = \lim_{x \to 0}\{f(x).g(x)\}$$

$$\textbf{L.H.L} = \lim_{h \to 0} \sin[0-h]|0-h|$$

$$= \lim_{h \to 0} \sin[0-h].0 = \mathbf{0}$$

$$\textbf{R.H.L} = \lim_{h \to 0} \sin[0+h]|0+h|$$

$$= \lim_{h \to 0} \sin 0.h = \mathbf{0}$$

$\therefore \quad \lim_{x \to 0}\{f(x)g(x)\} = 0$

**104. Option (d) is correct.**

*Explanation:* $\lim_{x\to 0}\frac{\sin[x]}{[x]}$

$$\text{L.H.L} = \lim_{h\to 0}\frac{\sin[0-h]}{(0-h)} = \text{infinity}$$

$$\text{R.H.L} = \lim_{h\to 0}\frac{\sin[0+h]}{(0+h)}$$

$$= \lim_{h\to 0}\frac{\sin 0}{(h)} = 0$$

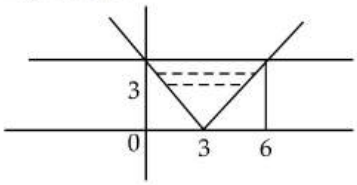
L.H.L ≠ R.H.L, limit does not exist.

**105. Option (c) is correct.**

*Explanation:* Domain of $f(x) = |x-3|$ is $(-\infty, \infty)$

**106. Option (d) is correct.**

*Explanation:*




Required area

$= 3\times 6 - \frac{1}{2}\times 3\times 3 - \frac{1}{2}\times 3\times 3$

$= 18 - 9 = 9$ square units

**107. Option (c) is correct.**

*Explanation:*

$$f(x) = px + q$$

$$\text{put } x = 1 \text{ and } y = 1$$

$$p + q = 1$$

**108. Option (a) is correct.**

*Explanation:*

$\therefore f(x) = px + q$ is linear polynomial so, $f(x)$ is one-one

$$\text{Range} = \{1, 4, 7, 10\}$$

$$\text{codomain} = \text{N}$$

So it is not onto.

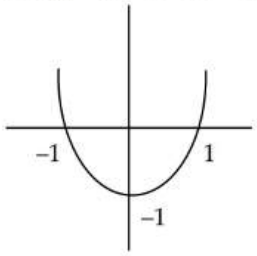
**109. Option (a) is correct.**

*Explanation:* $\lim_{x\to 1} f(f(x)) = \lim_{x\to 1}(x^2-1)^2 - 1$

$= (1-1)^2 - 1 = 0 - 1 = -1$

**110. Option (c) is correct.**

*Explanation:* Let $y = x^2 - 1 \Rightarrow x^2 = y + 1$




Required area $= \left|\int_{-1}^{1}(x^2-1)dx\right|$

$$= \left|\left[\frac{x^3}{3} - x\right]_{-1}^{1}\right| = \left|\left(\frac{1}{3}-1\right) - \left(-\frac{1}{3}+1\right)\right|$$

$$= \left|-\frac{2}{3} - \frac{2}{3}\right| = \left|-\frac{4}{3}\right| = \frac{4}{3} \text{ sq. units}$$

**111. Option (c) is correct.**

*Explanation:* We know that

If $x = \sec\theta - \cos\theta$ and $y = \sec^n\theta - \cos^n\theta$

then $(x^2+4)\left(\frac{dy}{dx}\right)^2 - n^2(y^2+4) = 0$

$$(x^2+4)\left(\frac{dy}{dx}\right)^2 - (4)^2(y^2+4) = 0$$

$$\left(\frac{dy}{dx}\right)^2 = \frac{16(y^2+4)}{x^2+4}$$

**112. Option (c) is correct.**

*Explanation:* $\therefore \left(\frac{dy}{dx}\right)^2 = \frac{16(y^2+4)}{x^2+4}$

$$2\left(\frac{dy}{dx}\right)\left(\frac{d^2y}{dx^2}\right)$$

$$= \frac{16(2y)(x^2+4)\frac{dy}{dx} - 16(y^2+4)(2x)}{(x^2+4)^2}$$

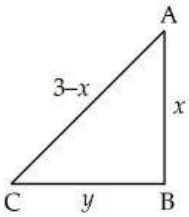
$$\frac{dy}{dx}\left(\frac{d^2y}{dx^2}\right)(x^2+4)^2 = 16y(x^2+4)\frac{dy}{dx} - 16x(y^2+4)$$

$$\frac{dy}{dx}\left(\frac{d^2y}{dx^2}\right)(x^2+4)^2 - 16y(x^2+4)\frac{dy}{dx} = -16x(y^2+4)$$

$$\frac{(x^2+4)}{y^2+4}\frac{dy}{dx}\left((x^2+4)\frac{d^2y}{dx^2} - 16y\right) = -16x$$

**113. Option (c) is correct.**

*Explanation:* $y = \sqrt{(3-x)^2 - x^2} = \sqrt{9-6x}$




$$\text{Area (A)} = \frac{1}{2}xy = \frac{1}{2}x\sqrt{9-6x}$$

$$A_1 = A^2 = \frac{1}{4}x^2(9-6x)$$

$$A_1 = \frac{1}{4}(9x^2 - 6x^3)$$

$$\frac{dA_1}{dx} = \frac{1}{4}(18x - 18x^2) = 0$$

$$18x(1-x) = 0$$

$$x = 0 \text{ (Not Possible)}$$

$\therefore \quad x = 1$

$\therefore$ Area is maximum

$\therefore \quad y = \sqrt{9-6} = \sqrt{3}$

$$\tan A = \frac{y}{x} = \frac{\sqrt{3}}{1}$$

$$\angle A = \frac{\pi}{3}$$

**114. Option (a) is correct.**

*Explanation:* Maximum area

$$= \frac{1}{2} \times y \times x = \frac{\sqrt{3}}{2} \text{ sq. units}$$

**115. Option (d) is correct.**

*Explanation:*

$$(x+y)^{p+q} = x^p y^q$$

$\therefore \quad (p+q)\log(x+y) = p\log x + q\log y$

$$\frac{p+q}{x+y}\left(1+\frac{dy}{dx}\right) = \frac{p}{x} + \frac{q}{y}\frac{dy}{dx}$$

$$\left(\frac{p+q}{x+y} - \frac{q}{y}\right)\frac{dy}{dx} = \frac{p}{x} - \frac{p+q}{x+y}$$

$$\frac{py+qy-qx-qy}{y(x+y)}\frac{dy}{dx} = \frac{px+py-px-qx}{x(x+y)}$$

$$\frac{py-qx}{y}\frac{dy}{dx} = \frac{py-qx}{x}$$

$\therefore \quad \frac{dy}{dx} = \frac{y}{x}$

which is independent of both $p$ and $q$.

**116. Option (a) is correct.**

*Explanation:* Since $\frac{dy}{dx}$ is independent of both $p$ and $q$. So for $p + q = 10$

$$\frac{dy}{dx} = \frac{y}{x}$$

**117. Option (a) is correct.**

*Explanation:*

$\therefore \quad \frac{dy}{dx} = 4 \Rightarrow \int dy = \int 4dx$

$$y = 4x + c$$

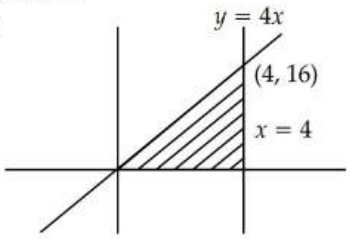
$\therefore$ it passes through (0, 0) then $c = 0$

$\therefore \quad y = 4x$

Hence it is an equation of a straight line passing through (1, 4)

**118. Option (c) is correct.**

*Explanation:*




$$\text{Required area} = \frac{1}{2} \times 4 \times 16$$

$$= 32 \text{ sq. units}$$

**119. Option (c) is correct.**

*Explanation:*

$$f(x) = \begin{cases} x^3 & -1 < x < 1 \\ x^2 & x \in (-\infty, -1) \cup (1, \infty) \end{cases}$$

$$f(x) = \begin{cases} 3x^2 & -1 < x < 1 \\ 2x & x \in (-\infty, -1) \cup (1, \infty) \end{cases}$$

$\therefore \quad \lim_{x \to 0} f'(x) = 3(0) = 0$

**120. Option (d) is correct.**

*Explanation:*

$$\text{L.H.S} = \lim_{x \to 1^-} x^2 = (-1)^2 = 1$$

$$\text{R.H.S} = \lim_{x \to -1^+} x^3 = (-1)^3 = -1$$

$\therefore \quad$ L.H.S $\neq$ R.H.S

So $f(x)$ is discontinuous at $x = -1$

$$\text{L.H.D} = 3(1) = 3$$

$$\text{R.H.D} = 2(1) = 2$$

$\therefore \quad$ L.H.D $\neq$ R.H.D

So, $f(x)$ is not differentiable at $x = 1$

Hence neither I nor II is true.

# NDA / NA

**National Defence Academy / Naval Academy**

## GENERAL ABILITY TEST

## QUESTION PAPER 2025

**Time: 50 min** **Total Marks: 200**

***Instructions***

1. *This Test Booklet contains **50** items (questions). Each item comprises four responses (answer). You will select the response that you want to mark on the Answer Sheet. In case you feel that there is more that there is more that one correct response, mark the response that you consider the best. In any case, choose **ONLY ONE** response for each item.*
2. *You have to mark all your responses **ONLY** on the separate Answer Sheet provided. See the directions in the Answer Sheet.*
3. ***All** items carry equal marks.*
4. *Before you proceed to mark in the Answer Sheet the response to the various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions.*
5. ***Penalty for wrong answers :***
   ***THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.***
   (i) *There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as a penalty.*
   (ii) *If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.*
   (iii) *If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.*

## ENGLISH

**Directions :** Each of the following items in this consists of a sentence, the parts, of which have been jumbled. Three parts have been labelled as P, Q, R and S. The parts are rearranged in four sequence, namely (*a*), (*b*), (*c*) and (*d*). You are required to select the most appropriate option that sequence the parts correctly and mark your response on the Answer Sheet accordingly.

**1.** participate in the function (P)
many of the people who had come to (Q)
the auditorium was over-crowded (R)
could not find a seat because (S)

**(a)** PRQS **(b)** PQRS
**(c)** QPSR **(d)** SPRQ

**2.** lay outside her existing life (P)
she knew that the answer (Q)
somewhere in the back of her mind (R)
to her question about life (S)

**(a)** R P Q S **(b)** Q S P R
**(c)** Q P S R **(d)** R Q S P

**3.** works of literature (P)
inside the pages of all good (Q)
lies the truth about some of (R)
the more challenging question posed by humanity (S)

**(a)** P R Q S **(b)** Q P R S
**(c)** Q P S R **(d)** R P S Q

**4.** takes on account of its economic successes (P)
to address continuing social inequality (Q)
for every stride of progress any nation (R)
it takes two back if it is unable (S)

**(a)** P R Q S **(b)** Q P R S
**(c)** R P S Q **(d)** R P Q S

**5.** the book value of a loan or (P)
an intangible asset over a set period of time (Q)

used to periodically lower

R

amortisation is an accounting technique

S

(a) S R P Q (b) R S P Q
(c) S R Q P (d) R P S Q

**Directions :** The following items have a blank space followed by four options. Select the most appropriate option to fill in the blank and mark your response on the Answer Sheet accordingly.

6. There is more than ..... to get the job done.
(a) one way (b) one ways
(c) any ways (d) any way

7. The class decided to organise .....
(a) picnic (b) a picnic
(c) picnics (d) the picnic

8. The accused ..... before the judge.
(a) tried (b) was trial
(c) sat trial (d) stood trial

9. The manner in which the demolitions have been carried out ..... scrutiny by the High Court.
(a) was under (b) under
(c) is under (d) however under

10. I ..... consider the opinions of all stakeholders before taking a final decision.
(a) will not (b) have
(c) will (d) shall

**Directions :**Given below are sentences that use discourse markers/expressions to make them complete. Identify the most appropriate answer and mark your response on the Answer Sheet accordingly.

11. ..... your transfer request is concerned, we'll be discussing it at the next meeting.
(a) As far as (b) To begin
(c) By the way (d) Talking about

12. ..... did you know Ravi has a new job?
(a) For one thing (b) By the way
(c) In the first place (d) As a result

13. ..... the wind, it was getting stronger, and I was getting colder.
(a) To begin with (b) By the way
(c) First of all (d) Speaking of

14. ..... what are you doing in my room?
(a) On the other hand (b) Excuse me
(c) Look there (d) Eventually

15. ..... an happy childhood leads to criminal behaviour.
(a) Still if (b) Even somewhat
(c) In some cases (d) In progression

16. ..... the problem is nothing but a wrong assumption about processes.
(a) In the meanwhile (b) Somewhat
(c) Engagingly (d) In other words

17. Many, ....., hesitate to publicly broach such questions for fear of nurturing discrimination.
(a) understandably (b) despite
(c) until (d) of course

18. ..... one notes that in the nineteenth century an important development of reflection and questioning gained momentum.
(a) Particularly speaking
(b) Generally speaking
(c) Otherwise
(d) Of course

19. ..... the situation has completely transformed over the past few years.
(a) Somewhat (b) Believably
(c) Thus (d) Predominantly

20. ..... the committee is of the opinion that all academic matters will be discussed in the Executive Body Meeting.
(a) Hence (b) But
(c) Later (d) Although

**Directions :** Given below are words, followed by their appropriate meanings. Identify the correct meaning and mark your answer on the Answer Sheet accordingly.

21. Cynosure :
(a) Person or thing that causes a change.
(b) Person or thing that attracts a lot of attention.
(c) Person or thing regarded as exact copy.
(d) Person or animal that lives in a particular place.

22. Coeval:
(a) Person of roughly the same age.
(b) Person or organisation that cooperates with others.
(c) Person employed to drive a private car.
(d) Person employed in taking.

23. Retrogression :
(a) Sudden sharp drop in price.
(b) Reverse pressure.
(c) Return to earlier state.
(d) Sudden occurrence of a past event.

24. Imprest :
(a) Surprise attack by people.
(b) Money used to manage small expense.
(c) Sudden occurrence of laughter.
(d) Sudden increase in activity.

**25.** Turgid :
**(a)** Determined or loyal
**(b)** Dirty or untidy
**(c)** Swollen or distended
**(d)** Excited or upset

**Directions :** In the following items, a sentence or a phrase is given with a word that is underlined, followed by four options. Select the most appropriate option that is nearest in meaning to the underlined word and mark your response on the Answer Sheet accordingly.

**26.** The Constitution of India ensures proportionate representation from all regions.
**(a)** balanced **(b)** partial
**(c)** unlikely **(d)** suffragette

**27.** There is a feeling of disenchantment among the members of the group.
**(a)** delight **(b)** disappointment
**(c)** idealism **(d)** unrelenting

**28.** She believed that it was imminent that he would be chosen as the leader of the group.
**(a)** timely **(b)** distant
**(c)** unlikely **(d)** inevitable

**29.** The brave soldiers left an indelible impression on the people of the land.
**(a)** permanent **(b)** fleeting
**(c)** hilarious **(d)** eradicable

**30.** The manager always provides instantaneous replied to all queries.
**(a)** immediate **(b)** delayed
**(c)** deliberate **(d)** unwanted

**Directions :** In this section each item consists of six sentences that comprise a passage. The first and sixth sentences are given in the beginning as Sl and S6. The sequence of the middle four sentences has been jumbled up and labelled as P, Q, R and S. You are required to find the proper sequence of the four sentences and mark your response on the Answer Sheet accordingly.

**31.** S1 : Although all sources of energy ultimately come from natural processes, non-renewable resources cannot be replaced naturally at the rate they are being used.
S6: The sustainable use of natural resources in a manner that provides the maximum benefit of these resources to humans over a period of time can be termed as conservation.
P : This will increases the time and cost of mining and once these resources are used up they cannot be replaced.
Q : Hence, we must remember that though our country is rich in mineral deposits. these resources are short-lived.
R : Extraction of these ores through the process of mining will soon become difficult and very expensive because these minerals have to be mined from greater depth over time.
S : Mineral resources can be said to be finite and non-renewable.
**(a)** Q P R S **(b)** S P Q R
**(c)** S Q R P **(d)** S Q P R

**32.** S1 : India, at present, has one of the largest road networks in the world.
S6 : It passes through Howrah, Delhi and Amritsar and terminates in Kabul (Afghanistan).
P : The importance of roads has been recognised in India since the ancient times.
Q : The Grand Trunk Road was built by Sher Shah Suri across the Indo-Gangetic plain, from Chittagong (Bangladesh) to Peshawar (Pakistan).
R : Kings such as Ashoka and Chandragupta built roads for easy transportation of goods and people.
S : Construction of roads continued as an important activity in the late medieval period.
**(a)** Q P R S **(b)** S P Q R
**(c)** P Q R S **(d)** P R S Q

**33.** S1 : National highways connect one state with another and are of national importance.
S6 : These road system are also known as primary road systems and are laid and operated under the supervision of the National Highways Authority of India.
P : They are important because, whereas they constitute merely two per cent of the total road networks, yet they carry 40 per cent of the total road traffic.
Q : The road infrastructure of the country is therefore crucial, and their construction and maintenance is of critical importance.
R : They bear the load of traffic because these roads connect long distance and pass through major cities and towns.
S : Since they cover the length and breadth of the nation and connect cities and towns, these highways are the primary facilitators of trade and connectivity.
**(a)** P R S Q **(b)** S P Q R
**(c)** P R Q S **(d)** S Q R S

**34.** S1 : The South African Constitution was inaugurated in December 1996.
S6 : A special constitutional court enforces the rights enshrined in the Constitution.
P : Its creation and promulgation took place at a time when South Africa still faced the threat of a civil war after the dissolution of the Apartheid Government.

Q : The South African Constitution says that its "Bill of Rights is a cornerstone of democracy in South Africa".
R : Apropos, it forbids discrimination on the grounds of "race, gender, pregnancy, marital status, ethnic or social origin, colour, age, disability, religion, conscience, belief, culture, language and birth".
S : The Bill of Rights grants perhaps the most extensive range of rights to the citizens.

**(a)** Q S R P **(b)** S P Q R
**(c)** P Q R S **(d)** P Q S R

**35.** S1 : Our Constitution reminds us of the necessity of representation in a large democracy.
S6 : Elections have today become the most visible symbol of the democratic process.
P : This is why election become important.
Q : Therefore, representatives are elected by the people.
R : Whenever we think of India as a democracy, our mind invariably turns to our successful election.
S : All citizens cannot participate in taking every decision.

**(a)** Q S R P **(b)** S P Q R
**(c)** P Q S R **(d)** S Q P R

**Directions :** The following items have a sentence in direct or indirect speech with four options. One of the options converts direct or indirect speech into indirect or direct correctly. Select the correct option and mark your response on the Answer Sheet accordingly.

**36.** Convert from direct speech to indirect speech :
Charu said to her friend, "I want you to be here at 6:00 p.m. tomorrow for the meeting".

**(a)** Chrau told her friend that she wanted her to be there at 6:00 p.m. the next day for the meeting.
**(b)** Charu told her friend that she wanted her to be there at 6:00 p.m. tomorrow for the meeting.
**(c)** Charu requested her friend that she wanted her to be there at 6:00 p.m. tomorrow for the meeting.
**(d)** Charu told her friend that she will want her to be here at 6:00 p.m. the next day for the meeting.

**37.** Convert from direct speech to indirect speech :
Nitin said to his brother, "What a beautiful painting it is"?

**(a)** Nitin wondered to his brother that what a beautiful painting it was.
**(b)** Nitin wondered before his brother that it was a beautiful painting.
**(c)** Nitin exclaimed that it is a beautiful painting.
**(d)** Nitin asked his brother whether it was beautiful painting.

**38.** Convert from indirect speech to direct speech :
The teacher asked her students why they had been quiet in the previous class.

**(a)** The teacher asked her students, "Why were they keeping quiet in the previous class"?
**(b)** The teacher said to her students, "Why were you quiet in the previous class"?
**(c)** The teacher said to her students, "Why had you been quiet in the previous class"?
**(d)** The teacher said to her students, "Why were you quiet in previous class"?

**Directions :** Following items have four sentences, one of which is correct. Find the correct option and mark your response on the Answer Sheet accordingly.

**39.** Which one of the following sentences is correct?

**(a)** He is considered as the brightest intellectual in the country.
**(b)** He is considered as one among the brightest intellectual in the country.
**(c)** He is considered as one among the brighter intellectual in the country.
**(d)** He is considered as one of the intellectual in the country.

**40.** Which one of following sentence is correct?

**(a)** No other mountain is taller than the Himalayas.
**(b)** No other mountain is tall than the Himalayas.
**(c)** No other mountains taller than the Himalayas.
**(d)** No other mountain is taller then the Himalayas.

**Directions :** In the following items, a pair of words is provided. You are required to select the options that appropriately describe the meaning of both words and mark your response on the Answer Sheet accordingly.

**41.** Confident and Confidant

**(a)** Confident means certain and confidant means close friend.
**(b)** Confidant means certain and confident means close friend.
**(c)** Confident means belief and confidant means an emissary.
**(d)** Confident means assurance and confidant means intimate person.

**42.** Broke and Brook

**(a)** Broke means abundance and brook means a flowing water body.
**(b)** Broke means bankrupt and brook means a stream.
**(c)** Broke means fractured and brook means nonsense.
**(d)** Broke means negotiate and brook means a stream.

**43.** Accept and Except

**(a)** Accept means apart from and expect means recognise.

**(b)** Accept means recognise and except means include.

**(c)** Accept means consent and except means apart from.

**(d)** Accept means allude and except means apart form.

**44.** Accord and Accrued

**(a)** Accord means collected and accrued means agreement.

**(b)** Accord means agreement and accrued means arrived.

**(c)** Accord means accepted and accrued means received.

**(d)** Accord means agreement and accrued means accumulated.

**45.** Guarantee and Warranty

**(a)** Guarantee is an agreement and warranty is a service contract.

**(b)** Guarantee is a business agreement and warranty is a service contract.

**(c)** Guarantee is a promise and warranty is a service contract.

**(d)** Guarantee is acceptance and warranty is a service contract.

**Directions :** Read the following passage carefully and answer the questions that follow by selecting the correct option from the given options, based solely on the passage. Mark your answer on the Answer Sheet accordingly.

An attempt to determine the number of languages in the world is affected by other factors. A new language do continue to be discovered even these days, as unexplored regions of the world begin to be opened up. The discovery does not usually take place straight away. Often there are similarities with an already known language which makes the investigators assume that what they have found is just a dialect of that language. Only after a considerable period of contact does it transpire that the speech is so different that it has to be considered a different language. It takes a language survey to establish the facts, and there are still many countries where such surveys are incomplete or have not even begun. The people may be known, but the identity of their language may not be. Because many such people are bilingual or multilingual, and converse with outsides in lingua franca, it may take a while before linguists come to realise that the there is an ethnic language there at all.

**46.** Which one of the following is NOT the reason for the difficulty in estimating the number of language of the world ?

**(a)** New language continue to be discovered.

**(b)** There are still unexplored regions.

**(c)** New language are considered a dialect of a known language.

**(d)** People who speak the language do not claim their language.

**47.** Which one of following is a way to establish the discovery of a new language?

**(a)** By establishing contact over a period of time with speakers of the language.

**(b)** By finding the similarities of the language with other languages.

**(c)** By comparing with the lingua franca of the region.

**(d)** By conducting a survey of all languages of the region.

**48.** Which one of the following statements is correct ?

**(a)** Language surveys have been conducted by all nations.

**(b)** There is hardly any language to be discovered in the world.

**(c)** All the languages are either complete language or dialects of other major languages.

**(d)** No new language needs to be discovered since all languages are known to the world.

**49.** "The people may be known, but the identity of their language may not be", means

**(a)** People are recognised as different ethnic group but not necessarily their language.

**(b)** People are recognised as different ethnic group and their language is recognised.

**(c)** People are not recognised as different ethnic group, and so are their languages.

**(d)** Because the people are not from different ethnic groups and their language is recognised.

**50.** Which one of the following words from passage means 'come to be known' ?

**(a)** transpire **(b)** lingua franca

**(c)** straight **(d)** variant

# GENERAL STUDIES

**Time: 1 hr 40 min** **Total Marks: 400**

***Instructions***

1. *This Test Booklet contains **100** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each item.*
2. *You have to mark all your responses **ONLY** on the separate Answer Sheet provided. See directions in the Answer Sheet.*
3. ***All** items carry equal marks.*
4. *Before you proceed to mark in the Answer Sheet, the response to the various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions.*
5. ***Penalty for wrong answers:***
   ***THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTIONS.***
   (i) *There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.*
   (ii) *If a candidate gives more than one answer, it will be treated as a **wrong answer,** even if one of the given answers happens to be correct and there will be same penalty as above to that question.*
   (iii) *If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.*

**1.** What happens when the sunlight travels through the Earth's atmosphere?
**(a)** The blue colour is scattered more compared to the red colour.
**(b)** The red colour is scattered more compared to the blue colour.
**(c)** Both the blue and the red colours are scattered equally.
**(d)** The blue colour is not scattered but the red colour is scattered the most.

**2.** When a solid body is partially or completely immersed in a fluid, the fluid exerts an upward force on the body. The magnitude of the force is equal to
1. The mass of the body
2. The weight of the displaced fluid by the body

Which of the above is/are correct?
**(a)** 1 only **(b)** 2 only
**(c)** Both 1 and 2 **(d)** Neither 1 nor 2

**3.** If the length of a copper wire is increased by twice, then its resistivity will be
**(a)** doubled **(b)** halved
**(c)** same **(d)** one-fourth

**4.** Which one of the following is dimensionless quantity?
**(a)** Stress **(b)** Strain
**(c)** Pressure **(d)** Force

**5.** A system that does NOT allow exchange of heat with its surrounding is called
**(a)** Adiabatic system
**(b)** Non-adiabatic system
**(c)** Equilibrium system
**(d)** Non-equilibrium system

**6.** If the speed of light in carbon disulphide and vacuum is X and Y, respectively, then
**(a)** $X < Y$ **(b)** $X > Y$
**(c)** $X \geq Y$ **(d)** $X = Y$

**7.** A current through a horizontal power line flow in east to west direction. What will be the direction of magnetic field at a point directly below when viewed from east end
**(a)** Clockwise in a plane perpendicular to the wire
**(b)** Anti-clockwise in a plane perpendicular to the wire
**(c)** Clockwise in a plane of parallel to the wire
**(d)** Anti-clockwise in a plane of parallel to the wire

**8.** Which one among the following elements is known to be discovered the earliest?
**(a)** Copper **(b)** Gold
**(c)** Oxygen **(d)** Uranium

**9.** When a light ray passes from air to water with a non-zero angle the ray will be
**(a)** bending towards the normal
**(b)** bending away from the normal

(c) propagating in straight line
(d) reflected towards the opposite direction

10. Which one of the following equations related to the motion of an objects is NOT correct? (Symbols carry their usual meanings)
(a) $s = ut + \frac{1}{2}at^2$
(b) $u = v - at$
(c) $v^2 - u^2 = 2ax$
(d) Distance travelled during $n^{th}$ second $= u + \frac{1}{2}a(2n-1)$

11. Which one of the following statements is NOT correct?
(a) An ammeter is always connected in series in the circuit to measure the current.
(b) A voltmeter is always connected to parallel in a circuit to measure the voltage.
(c) A voltmeter has a high resistance and an ammeter has a low resistance.
(d) A voltmeter has a low resistance and an ammeter has a high resistance.

12. Which one of the following is a non-conventional source of energy?
(a) Petroleum (b) Natural gas
(c) Tidal energy (d) Coal

13. If three resistors of 1 Ohm each, connect in parallel to each other, then resultant resistance is
(a) 1 Ohm (b) $\frac{1}{3}$ Ohm
(c) 3 Ohm (d) 9 Ohm

14. We hear an echo due to
(a) Refraction of sound waves
(b) Reflection of sound waves
(c) Diffraction of sound waves
(d) Resonance due to sound waves

15. At uniform speed the acceleration is
(a) maximum (b) minimum
(c) zero (d) constant

16. An object is placed between infinity and the pole (P) of a convex mirror. The position of the image is
(a) between pole (P) and the focus (F), behind the mirror
(b) between the focus (F) and infinity, behind the mirror
(c) between the pole (P) and the infinity, in front of the mirror
(d) at the focus (F), behind the mirror

17. The work done in moving a charge of 2 coulombs (C) from point A to point B is 24 J. What is the potential difference between A and B?
(a) 48 V (b) 6 V (c) 12 V (d) 0.08 V

18. Two conducting wires of the same material and of equal length and equal diameter are first connected in parallel and then in series in a circuit across the same potential difference. The ratio of heat produced in parallel and series combination is
(a) 2 : 1 (b) 4 : 1 (c) 1 : 2 (d) 1 : 4

19. The magnetic field inside a long, straight solenoid carrying current
(a) is zero.
(b) decreases as we move towards its end.
(c) increases as we move towards its end.
(d) is uniform inside the solenoid.

20. A car has an initial velocity of 12 m/s and is brought to rest over a distance of 45 m. The acceleration of the car is.
(a) + 1.6 m/s$^2$ (b) +3 – 2 m/s$^2$
(c) – 1.6 m/s$^2$ (d) –0.8 m/s$^2$

21. The universal constant of gravitation $G$ has the unit
(a) N (b) m/s
(c) Joule (d) Nm$^2$/ kg$^2$

22. Two bodies of unequal masses are dropped from a tower. At any instant, they have equal
(a) Momentum (b) Accleration
(c) Potential energy (d) Kinetic eneygy

23. The frequency ($f$), wavelength ($\lambda$) and speed ($v$) of a sound wave are related as
(a) $f = v\lambda$ (b) $\lambda = vf$
(c) $f = \frac{\lambda}{v}$ (d) $v = \lambda f$

24. The length of a simple pendulum is increased four times to its previous value while the mass is doubled. What is the ratio of the new and previous time period of the pendulum?
(a) 3 : 1 (b) 2 : 5 (c) 2 : 1 (d) 3 : 2

25. Which one of the following is NOT a basic property of electric charge?
(a) Charges can be added.
(b) Charge is conserved.
(c) Charge on a body is always an integral multiple of an electron or a proton charge.
(d) Charges can be created and destroyed in an isolated system.

26. Gaja Dwar, Ashwa Dwar, Garuda Dwar, Makar Dwar, Shardula Dwar and Hamsa Dwar are located in a building at
(a) New Delhi (b) Varanasi
(c) Aurangabad (d) Thanjavur

27. Which dance form of India has been inscribed into UNESCO's Representative List of Intangible Cultural Heritage of Humanity?
(a) Kathakali (b) Garba
(c) Bhangra (d) Odissi

28. Which ministry has initiated the "Dhara": a special initiative dedicated to Indian Knowledge System (IKS)?
(a) The Ministry of Education
(b) The Ministry of Home Affairs
(c) The Ministry of Information and Broadcasting
(d) The Ministry of Culture

29. The scheme PRASHAD (Pilgrimage Rejuvenation and Spiritual Heritage Augmentation Drive) provides assistance for
(a) e-Visa facility
(b) Multilingual Tourist Infoline
(c) The development of tourism infrastructure in States and Union Territories
(d) Promoting Dekho Apna Desh scheme

30. The joint venture named 'ASHINT' to develop nuclear power facility in India is between
(a) NPCIL and NTPC (b) TMC and VECC
(c) HWB and BARC (d) IGACR and NTPC

31. Which one of the following statements about 'REJUPAVE' is correct?
(a) It's a joint venture between Food and Agriculture Organisation (FAO) and the Government of India to promote organic farming.
(b) It's the name given to the lightest surveillance aircraft development by DRDO.
(c) It's a centrally sponsored flagship programme of the Ministry of Women and Child Development, Government of India.
(d) It's an indigenously developed road construction technology at high altitudes.

32. Which of the following statements about 'C-Bot' is/are correct?
1. It's an underwater vehicle to monitor coral reefs.
2. It has been development by CSIR and NIO.
Select the answer using the code given below:
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

33. India's Gas Turbine Research Establishment (GTRE), part of the Defence Research and Development Organisation (DRDO) has developed an aero-engine, which will potentially make India self-reliance in aero-engine technology. What is the name of the engine?
(a) Ganga (b) Yamuna
(c) Krishna (d) Kaveri

34. Who among the following Presidents/Vice Presidents of the United States of America was awarded Nobel Peace Prize for work to find peaceful solutions to international conflicts, advance democracy and human rights, and to promote economic and social development?
(a) Jimmy Carter (b) Woodrow Wilson
(c) Barack Obama (d) Al Gore

35. Which of the the following agencies releases report on 'SAFE' Accommodation: Worker Housing for Manufacturing Growth ?
(a) RBI
(b) NITI Aayog
(c) National Housing Band
(d) Housing and Urban Development Corporation

36. The lactic acid that gets accumulated in the muscle cells during rigorous exercise causing muscle cramps is produced from
(a) ATP (b) Pyruvate
(c) Ethanol (d) Glucose

37. A chain of peptide containing linear sequences of amino acid linked by peptide bonds best represent the
(a) Primary structure
(b) Secondary structure
(c) Tertiary structure
(d) Quaternary structure

38. Cambium is an example of
(a) Lateral meristem (b) Apical meristem
(c) Intercalary meristem (d) Permanent tissue

39. What happens when the fat and oil-containing food materials are left outside for a long time?
(a) Fats and oils in the food get oxidised.
(b) Fats and oils in the food get reduced.
(c) Fats and oils in the food get ice-covered.
(d) No reaction takes place.

40. Which is the correct pairing found in a normal DNA molecule?
(a) Adenine pairs with thymine
(b) Adenine pairs with guanine
(c) Adenine pairs with cytosine
(d) Thymine pairs with guanine

41. Clotting of blood involves which one among the following clotting proteins?
(a) Pathogen (b) Fibrinogen
(c) Macrophage (d) Phagocytes

42. Initial discovery of antibiotic penicillin was done by
(a) Francis Crick (b) Maurice Wilkins
(c) Charles Darwin (d) Alexander Fleming

43. The vector of malaria parasites is
(a) Male Anopheles mosquito
(b) Male Culex mosquito
(c) Female Anopheles mosquito
(d) Female Culex mosquito

**44.** Which of the following pairs is/are correctly matched?
1. Malaria: Mycobacterium
2. TB: Plasmodium

Select the answer using the code given below:
**(a)** 1 only **(b)** 2 only
**(c)** Both 1 and 2 **(d)** Neither 1 nor 2

**45.** Vitamin B1 is also known as
**(a)** Riboflavin **(b)** Thiamin
**(c)** Retinol **(d)** Tocopherol

**46.** Consider the following lines of longitude and latitude:
1. Prime Meridian
2. Tropic of Cancer
3. Equator

Which of the above lines is/are a Great Circle?
**(a)** 1, 2 and 3 **(b)** 1 and 2 only
**(c)** 1 and 3 only **(d)** 3 only

**47.** Which of the following is the correct ascending order of the given minerals in terms of their presence in the Earth's crust?
1. Amphibolite 2. Mica
3. Pyroxene

Select the answer using the code given below:
**(a)** 2, 3, 1 **(b)** 1, 2, 3 **(c)** 2, 1, 3 **(d)** 1, 3, 2

**48.** Which of the following is/are the applied forces in mechanical weathering process?
1. Gravitational force
2. Expansion force
3. Force due to water pressure

Select the answer using the code given below:
**(a)** 1 only **(b)** 1 and 2 only
**(c)** 2 and 3 only **(d)** 1, 2 and 3

**49.** Which of the following is/are cold ocean current/currents?
1. Alaska Current
2. North Atlantic Drift
3. West Wind Drift

Select the answer using the code given below:
**(a)** 1 only **(b)** 1 and 2
**(c)** 2 and 3 **(d)** 3 only

**50.** Which one of the following latitudes will experience a minimum angle of the Sun's rays when it is Summer Solstice in the Northern Hemisphere?
**(a)** Arctic Circle **(b)** Equator
**(c)** Tropic of Cancer **(d)** Tropic of Capricorn

**51.** Which of the following statements with reference to Coriolis force is/are correct?
1. Coriolis force acts perpendicular to the pressure gradient force.
2. At the equator, the Coriolis force is zero and the wind blows perpendicular to the isobars.

Select the answer using the code given below:
**(a)** 1 only **(b)** 2 only
**(c)** Both 1 and 2 **(d)** Neither 1 nor 2

**52.** Which of the following statements with reference to sleet is/are correct?
1. Sleet is frozen raindrops and refrozen melted snow-water.
2. It occurs when a layer of air with the temperature below freezing point overlies a warm layer near the ground surface.

Select the answer using the code given below:
**(a)** 1 only **(b)** 2 only
**(c)** Both 1 and 2 **(d)** Neither 1 nor 2

**53.** Humid subtropical climate is NOT experienced in which one among the following regions?
**(a)** Coastal South Africa
**(b)** East Coast of Australia
**(c)** South Japan
**(d)** South Argentina

**54.** Mahendragiri, the highest peak of the Eastern Ghats, is located in which one of the following states?
**(a)** Andhra Pradesh **(b)** Odisha
**(c)** Telangana **(d)** Tamil Nadu

**55.** Temperate forests of South India, known as 'Sholas' are found in which of the following hills?
1. Anaimalai
2. Nilgiris
3. Palami

Select the answer using the code given below:
**(a)** 1 only **(b)** 1 and 2 only
**(c)** 2 and 3 only **(d)** 1, 2 and 3

**56.** As per the Annual Report 2023–24 of the Ministry of Mines, Government of India, which of the following states are the major producer of copper in the country?
**(a)** Rajasthan and Gujarat
**(b)** Rajasthan and Madhya Pradesh
**(c)** Jharkhand and Rajasthan
**(d)** Jharkhand and Madhya Pradesh

**57.** Which one among the following is NOT a major oil field located in Gujarat?
**(a)** Ankleshwar **(b)** Kosamba
**(c)** Mehsana **(d)** Moran

**58.** As per the Land Revenue Records, any land is categorised as Culturable Waste-Land if it is left fallow (uncultivated) for more than
**(a)** 2 years **(b)** 3 years
**(c)** 4 years **(d)** 5 years

**59.** Which one among the following is NOT included in the National Food Security Mission-Commercial Crops (NFSM-CC)?
**(a)** Cotton **(b)** Coffee
**(c)** Jute **(d)** Sugarcane

60. Consider the following statements with regard to a steel plant:
    1. It was set up in 1964 with Russian collaboration.
    2. It receives iron ore from the Rourkela region.
    3. Water and hydel power is supplied by the Damodar Valley Corporation.

    Identify the steel plant on the basis of the above facts:
    **(a)** Bhilai Steel Plant
    **(b)** Bokaro Steel Plant
    **(c)** Rourkela Steel Plant
    **(d)** Durgapur Steel Plant

61. An offshore terminal at Vadinar has been developed to reduce pressure from which to the following major ports in India?
    **(a)** Kandla Port
    **(b)** Cochin Port
    **(c)** Mormugao Port
    **(d)** New Mangalore Port

62. As per the India State of Forest Report 2021, which one of the following Himalayan states has the highest percentage of its geographical area under forest?
    **(a)** Arunachal Pradesh **(b)** Himachal Pradesh
    **(c)** Sikkim **(d)** Uttarakhand

63. Which of the following statements with reference to L-Wave or Long Wave generated by an earthquake is/are correct?
    1. They follow the Earth's circumference.
    2. They travel at more or less at a constant rate.

    Select the answer using the code given below:
    **(a)** 1 only **(b)** 2 only
    **(c)** Both 1 and 2 **(d)** Neither 1 nor 2

64. Which one of the following is formed when volcanic ash is carried by running water and is deposited as a sedimentary layer?
    **(a)** Basalt **(b)** Lapilli
    **(c)** Slate **(d)** Tuff

65. Condensation of water vapour into water is influenced by which of the following factor/ factors?
    1. Volume of air
    2. Humidity
    3. Temperature

    Select the answer using the code given below:
    **(a)** 1 only **(b)** 1 and 2 only
    **(c)** 2 and 3 only **(d)** 1, 2 and 3

66. Which one of the following statements is NOT correct?
    **(a)** The molecules of soap are sodium or potassium salts of long-chain fatty acids.
    **(b)** The molecules of soap contain both hydrophobic and hydrophilic ends.
    **(c)** Detergents are more effective than soaps in hard water.
    **(d)** In micelles the ionic-end of the molecules is towards oil droplet while the other end faces outside.

67. Which one of the following statements is correct?
    **(a)** A neutron is formed by combination of an electron and a proton. Therefore, it is neutral.
    **(b)** The mass of an electron is about $\frac{1}{2000}$ times that of a proton.
    **(c)** An isotope of cobalt is used in the treatment of goiter.
    **(d)** J.J. Thomson proposed that the nucleus of an atom contains only neutrons.

68. Which one of the following particles in the nucleus of an atom was discovered by J. Chadwick?
    **(a)** Electron **(b)** Proton
    **(c)** Positron **(d)** Neutron

69. Which one of the following findings is NOT observed in Rutherford's Nuclear Model of Atom?
    **(a)** There is a neutral centre in an atom called nucleus.
    **(b)** Nearly all the mass of an atom resides in the nucleus.
    **(c)** The electrons revolve around the nucleus in a circular path.
    **(d)** The size of a nucleus is very small as compared to the size of the atom.

70. Element X forms a chloride with the formula $XCl_2$, which is a solid with high melting point. X would most likely be in the same group of periodic table as
    **(a)** Na **(b)** Al **(c)** Mg **(d)** K

71. Which one of the following oxides is a neutral oxide?
    **(a)** CO **(b)** $CO_2$ **(c)** $Na_2O$ **(d)** MgO

72. Which one of the following is also known as dry ice in its solid form?
    **(a)** $SiO_2$ **(b)** $CO_2$ **(c)** CaO **(d)** MgO

73. Which one of the following statements is NOT correct?
    **(a)** A scale measuring hydrogen ion concentration in a solution is called pH scale.
    **(b)** The higher the hydrogen ion concentration in a solution higher is its pH
    **(c)** We can measure pH generally from 0 to 14 on a pH scale.
    **(d)** The 'p' in pH stands for 'potenz' in German meaning power.

**74.** Which one of the following statements is NOT correct ?

**(a)** Half mole of nitrogen gas is measured 11.2 litres at STP.

**(b)** 17 grams of ammonia gas contains $6.022 \times 10^{23}$ molecules at STP.

**(c)** 22.4 litres of $CO_2$ gas at STP contains 44 grams of molecules.

**(d)** 4 grams of hydrogen gas contains $6.022 \times 10^{23}$ molecules.

**75.** Which one of the following statements about a compound is NOT correct?

**(a)** A compound is a substance composed of two or more elements chemically combined in a fixed proportion.

**(b)** Properties of a compound are different from its constituent elements.

**(c)** A compound is an impure substance.

**(d)** The constituents of a compound can be separated only by chemical or electrochemical reactions.

**76.** Match List-I with List-II and select the answer using the code given below the lists :

| List I (Chemical Name) | | List II (Chemical Formula) | |
|---|---|---|---|
| **A.** | Washing soda | **1.** | $CaOCl_2$ |
| **B.** | Baking soda | **2.** | $NaHCO_3$ |
| **C.** | Bleaching powder | **3.** | $Na_2CO_3\,10H_2O$ |
| **D.** | Gypsum | **4.** | $CaSO_4 2H_2O$ |

*Code:*

| | A | B | C | D |
|---|---|---|---|---|
| **(a)** | 4 | 2 | 1 | 3 |
| **(b)** | 4 | 1 | 2 | 3 |
| **(c)** | 3 | 1 | 2 | 4 |
| **(d)** | 3 | 2 | 1 | 4 |

**77.** Which one of the following nitrogen oxides may dimerise?

**(a)** $N_2O$ **(b)** $NO_2$ **(c)** $N_2O_3$ **(d)** $N_2O_5$

**78.** Which one of the following statements regarding oxidation and reduction reaction is NOT correct?

**(a)** If a substance loses hydrogen during reaction, it is reduced.

**(b)** If a substance loses oxygen during reaction, it is reduced.

**(c)** If a substance gains hydrogen during reaction, it is reduced.

**(d)** If a substance gains oxygen during reaction, it is oxidised.

**79.** Match List-I with List-II and select the answer using the code given below the lists :

| List I (Physical Name) | | List II (SI Unit) | |
|---|---|---|---|
| **A.** | Temperature | **1.** | Kelvin |
| **B.** | Weight | **2.** | Kilogram |
| **C.** | Mass | **3.** | Pascal |
| **D.** | Pressure | **4.** | Newton |

*Code:*

| | *A* | *B* | *C* | *D* |
|---|---|---|---|---|
| **(a)** | 1 | 2 | 4 | 3 |
| **(b)** | 3 | 4 | 2 | 1 |
| **(c)** | 1 | 4 | 2 | 3 |
| **(d)** | 3 | 2 | 4 | 1 |

**80.** For acid rain, the pH of rain water should be less than

**(a)** 7.0 **(b)** 6.6 **(c)** 5.6 **(d)** 8.0

**81.** Which of the following main industry/industries was/were developed in the Second Industrial Revolution that took place after about 1850?

**(a)** Coal and iron

**(b)** Cotton spinning and weaving

**(c)** Chemical and electrical

**(d)** Steam engines

**82.** Which among the following materials was used in making the Harappan seals?

**(a)** Sandstone **(b)** Lapis lazuli

**(c)** Jasper **(d)** Steatite

**83.** Which one among the following Mahajanapadas in ancient India was an oligarchy?

**(a)** Vajji **(b)** Kosala

**(c)** Gandhare **(d)** Magadha

**84.** Which one of the following sculptures found at Sanchi Stupa is NOT directly inspired by Buddhist ideas?

**(a)** Empty seat **(b)** Shalbhanjika

**(c)** Tree **(d)** Wheel

**85.** In British India, which one among the following Acts permitted detention without trial for up to two years?

**(a)** Regulating Act, 1773

**(b)** Rowlatt Act, 1919

**(c)** Pitt's Indian Act, 1784

**(d)** Government of India Act, 1935

**86.** Which one of the following statements about the Bhoodan Movement is correct?

**(a)** The target was to get one-sixth of cultivable land in India as donation.

**(b)** It was approved through a Central Government Act.

**(c)** It was ensured that the donated land was free from all litigation.

**(d)** The first donation of land was in Bihar.

87. The Constitution (Seventy-third Amendment) Act provides for
(a) an elaborate system of establishing municipal self-government.
(b) an elaborate system of establishing panchayats as units of self-government.
(c) establishing a Commission for Linguistic Minorities.
(d) the creation of the Jharkhand State.

88. BHARATPOL portal has been developed by
(a) The Election Commission of India
(b) The Central Bureau of Investigation
(c) The Enforcement Directorate
(d) The Securities and Exchange Board of India

89. Which one of the following statements about the Parliament of India is correct?
(a) A majority of members of Rajya Sabha are elected by a system of proportional representation by mean of single transferable vote.
(b) The Deputy Chairperson of the Rajya Sabha is nominated by the President from among the members of the Rajya Sabha.
(c) The Lok Sabha cannot be dissolved before the completion of its five-year term.
(d) The members of Lok Sabha also vote in the election of the members of Rajya Sabha.

90. Which one among the following does NOT figure among the Five Principles of Panchsheel?
(a) Mutual respect for each other's territorial integrity and sovereignty
(b) Equality and mutual benefit
(c) Peaceful coexistence
(d) Nuclear non-proliferation

91. Maize (makka) was introduced in India in the seventeenth century via
(a) Portugal (b) Africa and Spain
(c) China and Mongolia (d) Turkey

92. Match List-I with List-II and select the answer using the code given below the lists:

| | List I (Five-Year Plan) | | List II (Objective) |
|---|---|---|---|
| A. | Fifth Five-Year Plan | 1. | Towards Faster and More Inclusive |
| B. | Seventh Five-Year Plan | 2. | Garibi Hatao (Removal of Poverty) |
| C. | Ninth Five-Year Plan | 3. | Food, Work and Productivity |
| D. | Eleventh Five-Year Plan | 4. | Growth With Social Justice and Equality |

*Code:*

| | *A* | *B* | *C* | *D* |
|---|---|---|---|---|
| (a) | 1 | 4 | 3 | 2 |
| (b) | 2 | 3 | 4 | 1 |
| (c) | 2 | 4 | 3 | 1 |
| (d) | 1 | 3 | 4 | 2 |

93. Which of the following statements about Srimanta Shankardeva is/are correct?
1. In the late fifteenth century Shankardeva emerged as one of the leading proponents of Vaishnavism in Assam.
2. He was the founder of Gaudiya Vaishnavism.
3. His teachings are known as Bhagavati Dharma.
4. He encouraged the establishment of Satra and Namghar.
Select the answer using the code given below:
(a) 1 and 2 only (b) 2 and 3
(c) 1, 3 and 4 only (d) 1, 2, 3, and 4

94. At which one among the following places did the British East India Company found its factory in the year 1611?
(a) Madras (b) Masulipatam
(c) Bombay (d) Balasore

95. Chronologically arrange the following political events related to Indian National Movement beginning from the earliest.
1. Formation of Swaraj Party
2. Communal Award
3. Lucknow Pact
4. Simla Conference
Select the answer using the code given below:
(a) 3, 1, 2, 4 (b) 1 , 3, 2, 4
(c) 2, 1, 4, 3 (d) 1, 2, 3, 4

96. Which among the following Acts provided for the establishment of a Supreme Court of Justice at Calcutta for Europeans, their employees and the citizens of India?
(a) The Regulating Act of 1773
(b) The Charter Act of 1793
(c) The Charter Act of 1813
(d) Government of India Act of 1858

97. Who among the following introduced a resolution in 1882, which is also called the Magna Carta of Local Self-Government in India?
(a) Lord Macaulay
(b) Lord Canning
(c) Lord Ripon
(d) Lord William Bentinck

98. Which one of the following terms is associated with the practice of Sufism?
(a) Jizya (b) Ijma
(c) Muqaddam (d) Murid

**99.** Consider the following features:

**1.** Consent of the governed

**2.** Political equality

**3.** Accountability of the ruled to the ruler

Which of the above feature/features outline democratic rule?

**(a)** 1 and 2 only **(b)** 2 and 3 only

**(c)** 1, 2 and 3 **(d)** 3 only

**100.** Placing the earliest first, arrange the following countries in the chronological order in which they granted universal adult franchise:

**1.** USA **2.** Sri Lanka

**3.** Japan **4.** India

Select the answer using the code given below:

**(a)** 1, 2, 3, 4 **(b)** 2, 3, 4, 1

**(c)** 1, 3, 4, 2 **(d)** 3, 4, 1, 2

# Answer Key

## ENGLISH

| Q. No | Answer | Q. No | Answer | Q. No | Answer | Q. No | Answer | Q. No | Answer |
|---|---|---|---|---|---|---|---|---|---|
| 1 | c | 2 | b | 3 | b | 4 | c | 5 | a |
| 6 | b | 7 | b | 8 | d | 9 | a | 10 | c |
| 11 | a | 12 | b | 13 | d | 14 | b | 15 | c |
| 16 | d | 17 | a | 18 | b | 19 | c | 20 | a |
| 21 | b | 22 | a | 23 | c | 24 | b | 25 | c |
| 26 | b | 27 | a | 28 | d | 29 | a | 30 | a |
| 31 | a | 32 | d | 33 | a | 34 | d | 35 | d |
| 36 | a | 37 | b | 38 | b | 39 | a | 40 | a |
| 41 | a | 42 | b | 43 | c | 44 | d | 45 | c |
| 46 | d | 47 | a | 48 | d | 49 | a | 50 | a |

## GENERAL STUDIES

| Q. No | Ans | Q. No | Ans | Q. No | Ans | Q. No | Ans | Q. No | Ans |
|---|---|---|---|---|---|---|---|---|---|
| 1 | a | 2 | b | 3 | c | 4 | b | 5 | a |
| 6 | a | 7 | a | 8 | a | 9 | a | 10 | d |
| 11 | d | 12 | c | 13 | b | 14 | b | 15 | c |
| 16 | a | 17 | c | 18 | d | 19 | d | 20 | c |
| 21 | d | 22 | b | 23 | d | 24 | c | 25 | d |
| 26 | a | 27 | b | 28 | d | 29 | c | 30 | a |
| 31 | d | 32 | c | 33 | d | 34 | a | 35 | b |
| 36 | d | 37 | a | 38 | a | 39 | a | 40 | b |
| 41 | d | 42 | c | 43 | d | 44 | b | 45 | c |
| 46 | c | 47 | c | 48 | d | 49 | d | 50 | d |
| 51 | c | 52 | a | 53 | d | 54 | b | 55 | d |
| 56 | b | 57 | d | 58 | d | 59 | b | 60 | b |
| 61 | a | 62 | c | 63 | d | 64 | d | 65 | d |
| 66 | d | 67 | a | 68 | c | 69 | a | 70 | c |
| 71 | a | 72 | b | 73 | b | 74 | d | 75 | c |
| 76 | d | 77 | b | 78 | a | 79 | c | 80 | c |
| 81 | c | 82 | d | 83 | a | 84 | b | 85 | b |
| 86 | a | 87 | b | 88 | b | 89 | a | 90 | d |
| 91 | b | 92 | b | 93 | c | 94 | b | 95 | a |
| 96 | a | 97 | c | 98 | d | 99 | a | 100 | b |

# NDA/NA

**National Defence Academy / Naval Academy**

## GENERAL ABILITY TEST

## QUESTION PAPER 2025

## ANSWERS WITH EXPLANATIONS

### ENGLISH

1. **Option (c) is correct.**
*Explanation:* The correct order begins with "Q" to introduce the subject, i.e., many people who came to the function. "P" follows to explain what they came for, which is to participate in the function. "S" describes the problem, that they couldn't find a seat, and "R" explains why-due to the overcrowded auditorium. This makes **QPSR** the correct sequence.
2. **Option (b) is correct.**
*Explanation:* The sentence starts with "Q," where the speaker knows the answer to her questions. "S" follows, asserting that the answer is related to life. "P" then explains that the answer lies outside her existing life, and "R" concludes by specifying that the answer resides in the back of her mind. The correct sequence is **QSPR**.
3. **Option (b) is correct.**
*Explanation:* The sentence starts with "Q," introducing the idea that inside the pages of good literature lies the truth. "P" follows to specify the type of literature being discussed. "R" then explains what the literature reveals—truth about challenging questions posed by humanity. Finally, "S" elaborates on those questions. Therefore, the correct sequence is **QPRS**.
4. **Option (c) is correct.**
*Explanation:* The sentence begins with "R," with the mention of a nation making progress, "P" follows by highlighting the kind of progress—economic success. "S" then explains a setback: two steps back if social inequality isn't addressed. "Q" concludes with the core issue—addressing ongoing inequality. This sequence logically presents the contrast between progress and setbacks, making **RPSQ** correct.
5. **Option (a) is correct.**
*Explanation:* The sentence starts with "S," defining amortisation as an accounting technique. "R" follows, while explaining its purpose—to reduce value over time. "P" then introduces what is being reduced, such as the book-value of a loan. "Q" completes the idea by adding that it can also apply to intangible assets over a period. Hence, **SRPQ** is correct.
6. **Option (a) is correct.**
*Explanation:* The correct phrase is "more than one way," a common expression meaning there are multiple solutions or approaches to a problem. It is grammatically correct and idiomatic. "Any way" is incorrect here because it doesn't fit the structure of the phrase naturally.
7. **Option (b) is correct.**
*Explanation:* Here, "a picnic" does justice to the requirement of the blank because "picnic" is a singular countable noun and requires an article "a" before it. The class decides to organise any / a certain picnic. Therefore, indefinite article suits the need of the sentence.
8. **Option (d) is correct.**
*Explanation:* The phrase "stood trial" is a legal idiom meaning someone faced formal judicial proceedings. "Sat trial" and "was trial" are grammatically incorrect. "Tried" could work in another context, but not for appearing in court; thus, "stood trial" is correct.
9. **Option (c) is correct.**
*Explanation:* "Is under scrutiny" is the correct grammatical structure in present tense, showing that the High Court is currently examining the demolitions. Here, the demolitions must have occurred in recent past (as seen in the use of "have"), so present tense does justice to the blank. The verb "is" agrees with the singular subject "manner." Other options like just "under" or "was under" are either incomplete or in past tense.
10. **Option (d) is correct.**
*Explanation:* "Shall" is used to express a strong intention or commitment, especially in formal contexts. Here, it shows the speaker's determination to consider everyone's opinions before deciding. It's more appropriate than "have," which implies obligation, or "will," which is more casual and less formal in tone.
11. **Option (a) is correct.**
*Explanation:* The phrase "As far as your transfer request is concerned" is a formal way to introduce the topic. It narrows the focus of the sentence to a specific matter before providing details.
12. **Option (b) is correct.**
*Explanation:* "By the way" introduces a new but slightly off-topic piece of information. Here, it brings up a casual question about Ravi's new job, which is not directly related to the previous context.
13. **Option (d) is correct.**
*Explanation:* The sentence is connecting the topic of "the wind" to something previously mentioned. "Speaking of" is the correct discourse marker to continue discussing or linking to the current subject.
14. **Option (b) is correct.**
*Explanation:* "Excuse me" is used when politely getting someone's attention or interrupting. In this context, it fits naturally as someone is politely trying to ask a question about what the other person is doing.
15. **Option (c) is correct.**
*Explanation:* The phrase "In some cases" is appropriate here because the sentence is

making a non-universal statement. It shows that an unhappy childhood can lead to criminal behaviour, but not always. This softens the claim and introduces a generalisation accurately, making it the best fit.

16. **Option (d) is correct.**
*Explanation:* "In other words" is used to rephrase or clarify a statement, which is exactly what this sentence is doing. It simplifies or restates a more complex idea. The sentence aims to explain the problem more clearly, so this discourse marker fits perfectly.
17. **Option (a) is correct.**
*Explanation:* "Understandably" expresses that the hesitation is reasonable or expected given the context of fearing discrimination. It shows sympathy toward those who avoid discussing sensitive topics. Other options either don't match the tone or break the sentence structure, making "understandably" the most appropriate choice.
18. **Option (b) is correct.**
*Explanation:* "Generally speaking" emphasises a a broad observation. In this case, it draws attention to a broader historical development in the nineteenth century.
19. **Option (c) is correct.**
*Explanation:* "Thus" is used to show a conclusion or result. It indicates that the situation has changed as a consequence of earlier developments. The word fits logically and grammatically. Other options like "Somewhat" or "Predominantly" do not match the idea of a complete transformation.
20. **Option (a) is correct.**
*Explanation:* "Hence" is appropriate because the sentence expresses a formal opinion or decision likely based on earlier reasoning. It acts as a connector showing result or conclusion. "Although" would require a second clause to complete the contrast, making it unsuitable by its own here.
21. **Option (b) is correct.**
*Explanation:* "Cynosure" refers to someone or something that is the centre of admiration or attention. It comes from the Greek word for the North Star, which is a guiding point. The other options refer to unrelated ideas like change or copying, which do not fit the meaning.
22. **Option (a) is correct.**
*Explanation:* "Coeval" means a person or thing that existed at the same time as another, usually of the same age or period. It comes from Latin roots meaning "of the same age." Option (b) implies co-operation but not age, which changes the meaning entirely.
23. **Option (c) is correct.**
*Explanation:* "Retrogression" means going backward to a worse or more primitive condition. It describes decline or regression, often in behaviour, development or quality. A sudden drop in price Option (a) or reverse pressure Option (b) are specific effects but don't capture the full meaning of the word.
24. **Option (b) is correct.**
*Explanation:* An "imprest" is a small sum of money given in advance to cover minor expenses, especially in business settings. It's usually replenished regularly. Options like "surprise attack" or "laughter" are unrelated to finance and misrepresent the actual meaning of the term.
25. **Option (c) is correct.**
*Explanation:* "Turgid" literally means swollen, especially due to fluid. It can also be used figuratively to describe overly complex or pompous writing. Other options such as "determined", "dirty" or "upset" do not relate to the physical or stylistic qualities implied by "turgid."
26. **Option (b) is correct.**
*Explanation:* "Proportionate" means corresponding in size or amount to something else. "Partial" is the closest in meaning here, implying a share or part, as in partial representation. "Balanced" implies fairness, not quantity. "Unlikely" and "suffragette" are unrelated.
27. **Option (b) is correct.**
*Explanation:* "Disenchantment" refers to the loss of belief or disappointment after being let down. It conveys a sense of disillusionment, which aligns closely with "disappointment". Other options like "delight", "idealism" and "unrelenting" do not match the negative sentiment.
28. **Option (d) is correct.**
*Explanation:* "Imminent" means something that is about to happen very soon and cannot be avoided. The most appropriate synonym is "inevitable", which conveys a sense of something certain to occur. "Timely" doesn't capture the urgency or certainty. "Delayed" and "deliberate" are opposite in meaning.
29. **Option (a) is correct.**
*Explanation:* Indelible" means something that cannot be removed or forgotten. "Permanent" is the best synonym here. "Fleeting", "hilarious" and "eradicable" either contradict the meaning or are irrelevant in this context.
30. **Option (a) is correct.**
*Explanation:* "Instantaneous" means occurring instantly or without delay. The correct synonym is "immediate". "Delayed" and "deliberate" imply slowness or intentionality, and "unwanted" does not fit the meaning at all.
31. **Option (c) is correct.**
*Explanation:* The correct sequence is **SQRP**. The passage begins with the idea that non-renewable resources cannot be replaced easily (S1). Sentence **S** continues by stating they are finite. **Q** builds on this by highlighting the temporary nature of even abundant mineral deposits. **R** logically follows, explaining the difficulties of extraction. **P** then discusses the rising costs and irreplacability, which coherently leads to the concluding idea of sustainable use in S6.
32. **Option (d) is correct.**
*Explanation:* The correct sequence is **PRSQ**. The paragraph begins with S1 claiming that India is one of the largest road networks in the world. **P** validates this by taking us back to importance of roads in India since the ancient times. **R** validates the claim in the examples of Ashoka and Chandragupta, who built roads for easy transportation of goods and people. **S** follows the chronology till the time when road was as

an important activity in the late medieval period. **Q** showcases another great example- the Grand Trunk Road . This is elucidated in S6.

33. **Option (a) is correct.**
*Explanation:* The correct sequence is **PRSQ**. S1 introduces national highways and their significance. **P** follows, explaining their importance during congestion. **R** supports this with a fact that they carry 40% of total traffic. **S** stresses the need for proper maintenance due to this heavy usage. **Q** adds that although they make up only 2% of the road network, they are vital. S6 then concludes by labelling them as primary road systems.

34. **Option (d) is correct.**
*Explanation:* The correct sequence is **PQSR**. S1 states the inauguration of the South African Constitution. **P** logically follows, giving the historical context of its creation after apartheid. **Q** then highlights the significance of the Bill of Rights within the Constitution. **S** expands on this by stating that it grants a wide range of rights. **R** concludes with specifics, listing the types of discrimination it forbids, leading smoothly into S6 about enforcing these rights.

35. **Option (d) is correct.**
*Explanation:* The correct sequence is **SQPR**. S1 discusses the need for representation in a democracy. **S** logically follows, explaining that not all citizens can take every decision. **Q** continues, stating that representatives are elected to act on behalf of the people. **P** then explains why elections are important in this system. **R** wraps up the idea by highlighting how India's successful elections are a symbol of democracy, leading smoothly to S6.

36. **Option (a) is correct.**
*Explanation:* Charu's sentence is a request, not a command. In indirect speech, "I want you to…" changes to "she wanted her to…" and "tomorrow" becomes "the next day." So, (a) is correct as it follows proper tense change and indirect structure.

37. **Option (b) is correct.**
*Explanation:* Although the sentence shows admiration, the question mark makes it a rhetorical question. So "said to" changes to "wondered before," and the question becomes a statement. Tense is correctly shifted from "is" to "was."

38. **Option (b) is correct.**
*Explanation:* To convert indirect to direct speech, use the reporting verb "said" (not "asked") for neutral tone and retain the original question with correct punctuation.

39. **Option (a) is correct.**
*Explanation:* It clearly states that he is the top intellectual. "Considered as" is accepted in informal usage, and "the brightest intellectual in the country" expresses a superlative idea without awkward or redundant phrasing.

40. **Option (a) is correct.**
*Explanation:* It uses the proper comparative form "taller than" to compare one mountain with the Himalayas. The sentence is complete, logical and grammatically accurate, clearly emphasising the unmatched height of the Himalayas.

41. **Option (a) is correct.**
*Explanation:* "Confident" means self-assured or having strong belief in oneself. "Confidant" is a person with whom one shares personal secrets—an intimate or trusted individual. This option correctly captures both meanings in a clear and precise way.

42. **Option (b) is correct.**
*Explanation:* "Broke" means having no money—bankrupt. "Brook" refers to a small, natural stream of water. This option accurately matches the meanings of both words and avoids the confusion caused by less common or metaphorical meanings in other options.

43. **Option (c) is correct.**
*Explanation:* "Accept" means to receive or agree to something—showing consent. "Except" means to exclude or leave out, which can also mean "apart from." This option provides the most accurate and commonly understood meanings for both words.

44. **Option (d) is correct.**
*Explanation:* "Accord" means a formal agreement or harmony between parties. "Accrued" means accumulated or gathered over time, especially in financial contexts. This option best captures the accurate meanings of both words in commonly accepted usage, especially in official settings.

45. **Option (c) is correct.**
*Explanation:* A "guarantee" is a promise, often legal, ensuring the quality or outcome of something. A "warranty" is a written service contract offering repair or replacement. This option clearly reflects this distinction in usage between promise and service coverage.

46. **Option (d) is correct.**
*Explanation:* It is not mentioned in the passage. Nowhere does it say that people who speak the language do not claim it. The other options (a, b and c) are discussed as valid reasons for the difficulty in estimating the number of languages.

47. **Option (a) is correct.**
*Explanation:* The passage explains that only after a considerable period of contact does it become clear that the speech is different enough to be a new language. Hence, establishing contact over time with speakers helps discover new languages.

48. **Option (c) is correct.**
*Explanation:* The passage mentions that many languages are still unrecorded or misclassified, implying that existing languages are often grouped under dialects. Hence, it's accurate that all languages are either complete languages or dialects of other major languages.

49. **Option (a) is correct.**
*Explanation:* The line "The people may be known, but the identity of their language may not be" suggests that while ethnic groups are known, their specific languages aren't necessarily recognised.

50. **Option (a) is correct.**
*Explanation:* In the passage, "transpire" is used in the sense of something gradually becoming known or revealed — "Only after a considerable period of contact does it transpire..." So the word means "come to be known," fitting the question perfectly.

## ANSWERS WITH EXPLANATIONS

# GENERAL STUDIES

1. **Option (a) is correct.**
   *Explanation:* As wavelength of blue colour is the shortest, it scatters the most, while red colour scatters least.

2. **Option (b) is correct.**
   *Explanation:* According to Archimedes principle, the Buoyant force experienced by a body is equal to weight of fluid displaced by it.

3. **Option (c) is correct.**
   *Explanation:* Resistivity depends upon the material and temperature and is independent of the length and area of wire.

4. **Option (b) is correct.**
   *Explanation:* $\text{Strain} = \dfrac{\text{Change in length}}{\text{Original length}}$
   It is a unitless and hence dimensionless quantity.

5. **Option (a) is correct.**
   *Explanation:* In adiabatic process no heat exchange takes place between system and surrounding.

6. **Option (a) is correct.**
   *Explanation:* Speed of light in vacuum is the highest and always more than that in any medium.
   Hence, X < Y

7. **Option (a) is correct.**
   *Explanation:* As per right hand thumb rule, direction of magnetic field lines as seen from east end wire will be in clock wise direction in the plane perpendicular to the wire.

8. **Option (a) is correct.**
   *Explanation:* Copper was discovered earliest. Its use dates back to around 9000 BCE.

9. **Option (a) is correct.**
   *Explanation:* When light enters from a rarer medium to denser medium (here from air to water) at non-zero angle, it bends towards normal. At zero angle, it goes in a straight line without any deviation.

10. **Option (d) is correct.**
    *Explanation:* The distance covered in $n^{\text{th}}$ second is not a fundamental equation of motion; it is derived from second equation of motion (position–time relation).

11. **Option (d) is correct.**
    *Explanation:* A voltmeter has a very high resistance and is always connected in parallel to measure voltage.
    An ammeter has nearly zero resistance and is connected in series to measure current.

12. **Option (c) is correct.**
    *Explanation:* Energy harnessed from the tides is called tidal and is a non-conventional, renewable source of energy. Coal, petroleum, biogas, natural gas and wood are conventional sources.

13. **Option (b) is correct.**
    *Explanation:* $$\frac{1}{R_{eq}} = \frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$$
    $$= \frac{1}{1}+\frac{1}{1}+\frac{1}{1} = \frac{3}{1}$$
    $$\Rightarrow \quad R_{eq} = \frac{1}{3}\Omega$$

14. **Option (b) is correct.**
    *Explanation:* An echo is observed when we hear the same sound twice, which is due to the reflection of sound waves.

15. **Option (c) is correct.**
    *Explanation:* In linear motion, at uniform speed $a = 0$
    When the object moves at a constant speed, there is no change in the velocity.

16. **Option (a) is correct.**
    *Explanation:* In case of convex mirror:
    When the object is at infinity, its image always forms at the focus. For any other position of object, the image always forms between pole and focus, and behind the mirror.

17. **Option (c) is correct.**
    *Explanation:* $V_{AB} = \dfrac{W_{AB}}{Q} = \dfrac{24}{2} = 12\ \text{V}$

18. **Option (b) is correct.**
*Explanation:* Since both wires are identical; they have same resistance ($R$).

In parallel: $R_p = \frac{R \times R}{R + R} = \frac{R}{2}$

In series: $R_s = R + R = 2R$

Since, the voltage applied in both the cases in same and let suppose it to be "V".

The power consumed in series connection

$$= \frac{V^2}{2R}$$

The power consumed in parallel connection

$$= \frac{V^2}{\frac{R}{2}} = \frac{2V^2}{R}$$

The ratio of heat produced in parallel and series respectively $= \frac{4}{1} = 4:1$

19. **Option (d) is correct.**
*Explanation:* Magnetic field is uniform inside an ideal solenoid and is zero outside of it.

20. **Option (c) is correct.**
*Explanation:* Here, $u = 12\ \text{ms}^{-1}$, $v = 0\ \text{ms}^{-1}$, $s = 45\ \text{m}$

Applying $v^2 - u^2 = 2as$

$\Rightarrow 0^2 - 12^2 = 2 \times a \times 45$

$\Rightarrow -144 = 90a$

$\Rightarrow a = -\frac{144}{90} = -1.6\ \text{ms}^{-2}$

21. **Option (d) is correct.**
*Explanation:* $\frac{Fd^2}{m_1 m_2} = \frac{\text{Nm}^2}{\text{kg}^2}$

22. **Option (b) is correct.**
*Explanation:* In case of free fall, $a = g = 9.8\ \text{ms}^{-2}$

Both objects will have same acceleration irrespective of mass.

Momentum, PE and KE depends upon mass of object.

23. **Option (d) is correct.**
*Explanation:* Speed of wave is given by $v = f\lambda$.

24. **Option (c) is correct.**
*Explanation:* Time period, $T = 2\pi\sqrt{\frac{l}{g}}$

If length is increased 4 times,then new time period will be

$$T' = 2\pi\sqrt{\frac{4l}{g}} = 2T$$

$$T' : T = 2:1$$

Also, T is independent of the mass of bob.

25. **Option (d) is correct.**
*Explanation:* In an isolated system, charge is conserved which means it can't be created or destroyed.

26. **Option (a) is correct.**
*Explanation:* The six gates, Gaja Dwar, Ashwa Dwar, Garuda Dwar, Makar Dwar, Shardula Dwar and Hamsa Dwar, are located in the new Parliament building in New Delhi. Each gate is symbolically named after a creature (real or mythological), representing values such as power, wisdom, speed and courage, reflecting the ethos of Indian democracy.

27. **Option (b) is correct.**
*Explanation:* In 2023, Garba, a traditional dance form from Gujarat, was inscribed into UNESCO's Representative List of the Intangible Cultural Heritage of Humanity. Garba is performed especially during the Navratri festival and represents devotion, community participation and cultural expression. Although other dance forms like Kathakali and Odissi are classical and culturally significant, Garba is the one recently recognised by UNESCO under this specific list.

28. **Option (d) is correct.**
*Explanation:* The Ministry of Culture initiated the "Dhara: An Ode to Indian Knowledge Systems" initiative, under the aegis of Azadi Ka Amrit Mahotsav. This flagship programme aims to revive and promote India's rich civilisational knowledge by organising lectures and discussions on diverse themes, including mathematics, metallurgy, agriculture and ancient economic thought. While the Indian Knowledge Systems (IKS) Division of the Ministry of Education serves as a key execution partner for Dhara events, the initiative itself was conceptualised and launched by the Ministry of Culture.

29. **Option (c) is correct.**
*Explanation:* The PRASHAD (Pilgrimage Rejuvenation and Spiritual Heritage Augmentation Drive) scheme is a Central Sector Scheme launched by the Ministry of Tourism in 2014–2015. It provides financial assistance to State Governments and Union Territory Administrations for the development of tourism infrastructure at identified pilgrimage destinations and heritage cities.

30. **Option (a) is correct.**
*Explanation:* The joint venture named ASHVINI (Anushakti Vidhyut Nigam Ltd.) is a collaboration between the Nuclear Power Corporation of India Limited (NPCIL) and the National Thermal Power Corporation (NTPC). Established in September 2024, this partnership aims to construct, own and operate nuclear power plants across India, aligning with the provisions of the Atomic Energy Act. In this venture, NPCIL holds a 51% stake, while NTPC holds 49%.

31. **Option (d) is correct.**
*Explanation:* REJUPAVE is an innovative, indigenous road construction technology developed by the CSIR-Central Road Research Institute (CSIR-CRRI) under the Ministry of Science and Technology. It is specifically designed to facilitate the construction of bituminous roads in high-altitude and sub-zero temperature regions, such as Arunachal Pradesh and Ladakh.

32. **Option (c) is correct.**
*Explanation:* Statement 1 is correct: "It's an underwater vehicle to monitor coral reefs." The C-Bot is an autonomous underwater vehicle (AUV) designed to monitor coral reefs. It is equipped with advanced sensors and cameras to collect data on coral health, aiding in the study of coral bleaching and other environmental factors affecting reef ecosystems.
Statement 2 is correct: "It has been developed by CSIR and NIO." The C-Bot was developed by the National Institute of Oceanography (NIO), which operates under the Council for Scientific and Industrial Research (CSIR). This collaboration combines CSIR's scientific expertise with NIO's focus on oceanographic research.
Therefore, both statements are correct.

33. **Option (d) is correct.**
*Explanation:* The Kaveri engine is the name of the aero-engine developed by India's Gas Turbine Research Establishment (GTRE), part of the Defence Research and Development Organisation (DRDO). The Kaveri engine is intended to power the Indian Light Combat Aircraft (LCA) Tejas. The engine has been cleared for in-flight testing, marking a significant step towards India's self-reliance in aero-engine technology.

34. **Option (a) is correct.**
*Explanation:* Jimmy Carter, the 39$^{th}$ President of the United States, was awarded the Nobel Peace Prize in 2002 for his decades of work to find peaceful solutions to international conflicts, promote democracy and human rights, and advance economic and social development. Carter's efforts included facilitating peace negotiations, such as the Camp David Accords, and his work through the Carter Centre, which promotes global health and human rights.

35. **Option (b) is correct.**
*Explanation:* NITI Aayog, the National Institution for Transforming India, released the report titled "S.A.F.E. Accommodation: Worker Housing for Manufacturing Growth" in December 2024. This report emphasises the importance of providing Secure, Affordable, Flexible and Efficient (S.A.F.E.) housing solutions for industrial workers to support and enhance India's manufacturing sector. It proposes actionable recommendations, including the establishment of a Viability Gap Funding (VGF) scheme to facilitate the development of such housing projects in a Public–Private Partnership (PPP) model. The initiative aims to improve worker welfare and contributes to the growth of the manufacturing industry.

36. **Option (d) is correct.**
*Explanation:* During anaerobic respiration (absence of oxygen), muscle cells convert glucose into lactic acid to release energy. This build-up of lactic acid causes cramps.

37. **Option (a) is correct.**
*Explanation:* The primary structure of a protein is the linear sequence of amino acids linked by peptide bonds. It determines the protein's unique structure and function.

38. **Option (a) is correct.**
*Explanation:* Cambium is a type of lateral meristem that causes secondary growth in plants, increasing the thickness of stems and roots.

39. **Option (a) is correct.**
*Explanation:* When exposed to air, fats and oils undergo oxidation, leading to rancidity, making the food smell and taste bad.

40. **Option (a) is correct.**
*Explanation:* In DNA, adenine (A) pairs with thymine (T) through two hydrogen bonds, and cytosine (C) pairs with guanine (G) through three hydrogen bonds.

41. **Option (b) is correct.**
*Explanation:* Fibrinogen is a soluble plasma protein that gets converted into insoluble fibrin threads during blood clotting, helping to form a clot.

42. **Option (d) is correct.**
*Explanation:* Alexander Fleming discovered penicillin in 1928 from the fungus Penicillium notatum. It was the first antibiotic discovered.

43. **Option (c) is correct.**
*Explanation:* Female Anopheles mosquitoes transmit the malaria-causing parasite Plasmodium to humans through their bites. Males do not bite or transmit malaria.

44. **Option (d) is correct.**
*Explanation:* Malaria is actually caused by a protozoan parasite called Plasmodium, which is transmitted through the bite of an infected female Anopheles mosquito. It is not caused by *Mycobacterium.* On the other hand, tuberculosis (TB) is caused by a bacterium called *Mycobacterium tuberculosis*, not Plasmodium.

45. **Option (b) is correct.**
*Explanation:* Vitamin B1 is scientifically known as thiamin. It plays a crucial role in energy metabolism and nerve function. A deficiency of vitamin B1 can lead to a condition known as beriberi, which affects the nervous and cardiovascular systems. The other options are names of different vitamins – riboflavin is vitamin B2, retinol is vitamin A and tocopherol is vitamin E.

46. **Option (c) is correct.**
*Explanation:* The Prime Meridian is a Great Circle because it is a line of longitude that divides the Earth into the Eastern and Western Hemispheres. Being a vertical line, it passes through the centre of the Earth, making it a great circle.
The Tropic of Cancer is NOT a great circle. It is a parallel of latitude, specifically located at 23.5° North of the equator, and does not divide the Earth into two halves, thus not forming a Great Circle.
The equator is a Great Circle because it is a line of latitude that divides the Earth into the Northern and Southern Hemispheres and is equidistant from the North and South Poles. It is the longest latitude and passes through the Earth's centre, forming a great circle.

47. **Option (c) is correct.**
*Explanation:* Based on the abundance of minerals in the Earth's crust, the correct ascending order is Mica < Amphibole < Pyroxene. Pyroxene, which makes up about 10% of the crust, is the most abundant, followed by amphibole at 7%. Mica, forming around 4% of the Earth's crust, is the least abundant of the three. These minerals are crucial components of igneous and metamorphic rocks and have various industrial applications, including in electronics and the asbestos industry.

48. **Option (d) is correct.**
*Explanation:* The correct answer is (d) 1, 2 and 3. In mechanical weathering, various applied forces break down rocks physically. Gravitational force contributes to mass wasting events like landslides. Expansion force occurs when rocks expand and contract due to temperature changes, causing stress and cracks. Additionally, force due to water pressure, especially in freeze–thaw cycles, exerts pressure on rocks, leading to their fragmentation. These forces all play key roles in the mechanical weathering process.

49. **Option (d) is correct.**
*Explanation:* Alaska Current (1): The Alaska Current is a warm ocean current, flowing from the North Pacific Ocean along the coast of Alaska. It brings warmer water to the region, so it is not a cold current.
- North Atlantic Drift (2): The North Atlantic Drift is a warm ocean current, which is part of the Gulf Stream system. It brings warm water from the tropics to the North Atlantic, so it is not a cold current.
- West Wind Drift (3): The West Wind Drift, also known as the Antarctic Circumpolar Current, is a cold current. It flows around Antarctica, moving cold water westward, making it the only cold current among the options.

50. **Option (d) is correct.**
*Explanation:* During the summer solstice in the Northern Hemisphere, the Sun is directly overhead at the Tropic of Cancer (23.5°N). As a result, regions farther south receive the Sun's rays at increasingly oblique angles. The Tropic of Capricorn (23.5°S), being in the Southern Hemisphere, experiences the minimum angle of the Sun's rays and the shortest day of the year at this time. Hence, it receives the least direct sunlight among the given options.

51. **Option (c) is correct.**
*Explanation:* The Coriolis force arises due to Earth's rotation and deflects moving objects like wind to the right in the Northern Hemisphere and the left in the Southern Hemisphere. It acts perpendicular to the pressure gradient force, influencing the direction of wind flow. At the equator, the Coriolis force is zero, so the wind is not deflected and generally flows perpendicular to the isobars. Therefore, both statements 1 and 2 are correct.

52. **Option (a) is correct.**
*Explanation:* Sleet is frozen raindrops and refrozen melted snow-water. Hence, Statement 1 is correct.
When a layer of air with a temperature above the freezing point overlies a subfreezing layer near the ground, precipitation takes place in the form of sleet. Raindrops, which leave the warmer air, encounter the colder air below. Hence, Statement 2 is not correct.

53. **Option (d) is correct.**
*Explanation:* Humid subtropical climate (Cfa/Cwa in Köppen classification) is typically found on the east coasts of continents between 25° and 40° latitudes, characterised by hot, humid summers and mild winters. Regions like the East Coast of Australia, South Japan and Coastal South Africa fall under this category. However, South Argentina, especially the Patagonia region, experiences a cold desert or steppe climate, not a humid subtropical one. Thus, South Argentina does not experience this climate type.

54. **Option (b) is correct.**
*Explanation:* Mahendragiri, the highest peak of the Eastern Ghats, is located in the Gajapati district of Odisha. It rises to a height of about 1,501 metres and holds mythological significance in Indian epics like the Ramayana. The Eastern Ghats are a discontinuous range of mountains running along India's eastern coast, and Mahendragiri stands out as the tallest among them. Therefore, the correct answer is Odisha.

55. **Option (d) is correct.**
*Explanation:* Shola forests are a type of stunted tropical montane forest found in the high-altitude regions of South India, typically above 1,900 metres. These temperate forests occur in valleys amid rolling grasslands and are known for their rich biodiversity. They are commonly found in the Anaimalai Hills, Nilgiri Hills and Palani Hills of the Western Ghats. These forests play a crucial role in water conservation and are part of a fragile ecosystem. Hence, the correct answer is 1, 2 and 3.

56. **Option (b) is correct.**
*Explanation:* As per the Annual Report 2023–24 of the Ministry of Mines, Government of India, the major producers of copper in the country are Rajasthan and Madhya Pradesh. These states host significant copper mining operations, with Rajasthan's Khetri Copper Complex and Madhya Pradesh's Malanjkhand Copper Project being prominent contributors. These mining activities are primarily managed by Hindustan Copper Limited (HCL), a public sector enterprise under the Ministry of Mines.

57. **Option (d) is correct.**
*Explanation:* Among the options provided, Ankleshwar, Kosamba and Mehsana are prominent oil fields located in Gujarat, contributing significantly to India's onshore oil production. In contrast, Moran is situated in the Dibrugarh district of Assam and is one of the major oil fields in the northeastern region of India. Therefore, Moran is not located in Gujarat, making it the correct choice for this question.

58. **Option (d) is correct.**
*Explanation:* Culturable Wasteland refers to land that has remained fallow (uncultivated) for more than five years, as per Land Revenue Records. Although not currently used for farming, this type of land has the potential to be brought back under cultivation through reclamation and improvement practices. It differs from barren land in that it retains some fertility and usability if properly managed. Thus, it holds promise for increasing cultivable area with the right investment.

59. **Option (b) is correct.**
*Explanation:* Under the National Food Security Mission-Commercial Crops (NFSM-CC), the Government of India focuses on enhancing the production and productivity of specific commercial crops. The crops included in this mission are cotton, jute and sugarcane. Coffee is not part of this initiative. Therefore, among the options provided, coffee is the crop that is not included in the NFSM-CC.

60. **Option (b) is correct.**
*Explanation:* The Bokaro Steel Plant, located in Jharkhand, was set up in 1964 with Russian collaboration, making it one of India's key public sector steel units. It receives iron ore from the Rourkela region, particularly from mines in Odisha. Water and hydro power for its operations are supplied by the Damodar Valley Corporation (DVC). These features collectively identify the plant as Bokaro, distinguishing it from Bhilai, Rourkela and Durgapur steel plants.

61. **Option (a) is correct.**
*Explanation:* The offshore terminal at Vadinar, located on the western coast of India in Gujarat, has been developed to reduce the cargo handling pressure on Kandla Port, one of the busiest major ports in India. Vadinar primarily handles crude oil imports and serves as a strategic terminal for nearby refineries, including those of Reliance and Essar. Its development has helped in easing congestion at Kandla, improving efficiency in oil and energy logistics along the west coast.

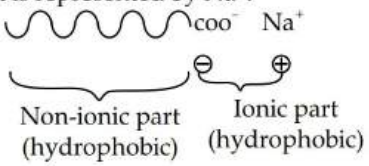
62. **Option (a) is correct.**
*Explanation:* According to the India State of Forest Report 2021, Arunachal Pradesh has the highest percentage of its geographical area under forest cover among the Himalayan states, with approximately 79.33% of its land area covered by forests.

63. **Option (c) is correct.**
*Explanation:* L-Waves (Long Waves) are surface seismic waves generated by earthquakes.
L-waves are surface waves that travel along the Earth's surface, often following the curvature of the Earth. They are responsible for most of the destruction during an earthquake.
Compared to body waves (P-waves and S-waves), L-waves travel at a slower but relatively consistent speed along the Earth's surface, depending on the properties of the ground they move through.
Hence, both statements are correct.

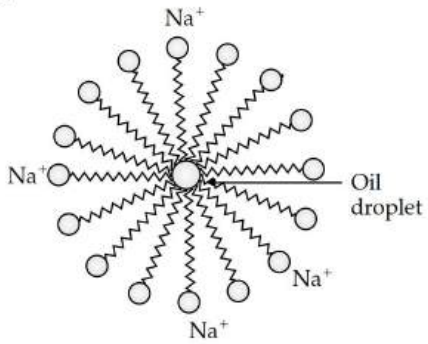
64. **Option (d) is correct.**
*Explanation:* Tuff is a type of sedimentary rock formed from volcanic ash that has been carried by wind or water and then deposited and compacted into layers. It often forms in areas near volcanic activity and can include small fragments of lava and minerals embedded in the ash. Basalt is an igneous rock. Lapilli are small fragments of lava, but not a sedimentary deposit. Slate is a metamorphic rock. Therefore, Tuff is the correct choice.

65. **Option (d) is correct.**
*Explanation:* Condensation of water vapour into water droplets is influenced by:
Volume of air: Larger volumes can hold more moisture; changes in volume affect pressure and temperature, which influence condensation.
Humidity: Higher relative humidity means the air is closer to saturation, increasing the likelihood of condensation.
Temperature: When air is cooled to its dew point, condensation occurs. Lower temperatures facilitate condensation.
Thus, all three factors affect condensation.

66. **Option (d) is correct.**
*Explanation:* The molecules of soap are sodium or potassium salts of long-chain fatty acids having general formula of R-COONa. It contains both hydrophilic and hydrophobic ends. It is represented by $Na^-$.




During micelle formation, the ionic part of the soap is present outside, while the non-ionic part of the soap present inside to make hydrophobic care.




67. **Option (b) is correct.**
*Explanation:* The mass of one electron is about $\frac{1}{2000}$ times that of a proton.

68. **Option (d) is correct.**
*Explanation:* James Chadwick discovered neutron in 1932 by bombarding a thin sheet of beryllium by α-particles when electrically neutral particles having a mass slightly greater than that of protons were emitted.
He named these particles as neutrons.
$Be^9_4 + He^{2+} \rightarrow {}_6C^{12} + n_0^1$ chargeless, massless particles.

**69. Option (a) is correct.**

***Explanation:*** Rutherford's nuclear model of atom explains that in the centre of an atom nucleus is present in which the mass of an atom resides and it is made up of positive part of an atom, i.e., proton and around it $e^-$ revolves.

**70. Option (c) is correct.**

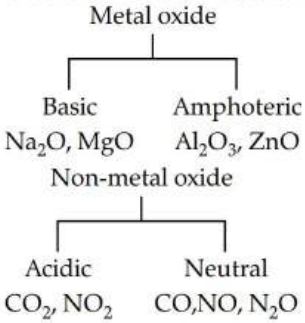
***Explanation:*** The formula of the chloride is $XCl_2$, which suggests that the element present in it having a valency of 2.

| Element | Valency |
|---|---|
| Na | 1 |
| Al | 3 |
| Mg | 2 |
| K | 1 |

Here, magnesium metal has a valency a valency of 2 the correct answer is 2.

**71. Option (a) is correct.**

***Explanation:*** Metal oxide are either basic or amphoteric in nature, while non-metal oxides are either neutral or acidic in nature.




Here, CO is a neutral oxide of carbon atom.

**72. Option (b) is correct.**

***Explanation:***

| | | |
|---|---|---|
| (a) | $SiO_2$ | Silica |
| (b) | $CO_2$ | Dry ice |
| (c) | CaO | Quick lime or lime |
| (d) | MgO | Magnesium oxide |

**73. Option (b) is correct.**

***Explanation:*** Soren Sorensen, a Swedish chemist, introduced the pH scale based on the power of 10 in 1909.

He introduced pH scale where "*p*" stands for Potenz or potent, which is a German word stands for power.

He introduced pH scale ranging from 0 to 14, which represents the concentration of hydrogen ions in a solution.

Mathematically $pH = -\log[H^+]$ or $[H^+] = 10^{-pH}$ from above it is clear that pH is inverse of $H^+$ ion concentration. Higher the concentration of $H^+$ ion, lower is the pH value and vice versa.

$$pH \propto \frac{1}{[H^+]}$$

**74. Option (d) is correct.**

***Explanation:*** According to Avogadro's Law, volume of one mole gas is directly related to the number of molecules not standard connection of temperature and pressure.

At STP 1 mole $N_2$ = 22.4 L

0.5 mole $N_2$ = 11.2 L

Statement (a) is correct.

1 mole of substance = Molar mass of substance
= Avogadro's number
= $6.02 \times 10^{23}$ entities

At STP

$6.022 \times 10^{23}$ molecules = 17 g ammonia

Statement (b) is correct.

Similarly 44 gram $CO_2$ = 22.4L at STP.

Statement (c) is correct.

(d) Here, 4 g of $H_2$ gas & 2 moles $H_2$ gas

1 mole $H_2$ = $6.022 \times 10^{23}$

2 moles $H_2$ = $2 \times 6.022 \times 10^{23}$
= $12.044 \times 10^{23}$

So, 4 grams $H_2$ molecule = $12.044 \times 10^{23}$ molecules.

**75. Option (c) is correct.**

***Explanation:*** A compound is a substance composed of two or more elements in a fixed proportion and it is a pure substance.

The properties of a compound are different from its constituent elements and they can be separated only by chemical or electrochemical reaction, because the bond present among elements is a strong covalent or ionic bond, which do not break down through physical method.

For example, $H_2$ is a combustible gas, while $O_2$ is a supporter of combustion but $H_2O$ is neither combustible nor supporter of combustion.

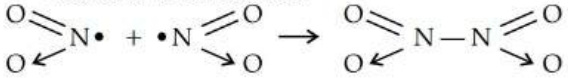
$2H_2O + O_2 \rightarrow 2H_2O$

**76. Option (d) is correct.**

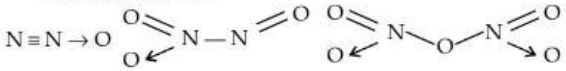
***Explanation:***

| | | | |
|---|---|---|---|
| A | Washing soda | 1. | $Na_2CO_3 \cdot 10H_2O$ |
| B | Baking soda | 2. | $NaHCO_3$ |
| C | Bleaching powder | 3. | $CaOCl_2$ |
| D | Gypsum | 4. | $CaSO_4.2H_2O$ |

77. **Option (b) is correct.**
*Explanation:* $NO_2$ is an odd $e^-$ species, here N-atom contain an odd $e^-$ in its valence shell, which combines with odd $e^-$ at another $NO_2$ molecule to form dimer.



Other molecules like $N_2O$, $N_2O_3$ and $N_2O_5$ do not from dimer.



78. **Option (a) is correct.**
*Explanation:*

| Oxidation | Reduction |
|---|---|
| → Addition of oxygen | → Removal of oxygen |
| → Removal of hydrogen | → Addition of hydrogen |
| → Addition of electronegative element | → Removal of electronegative |
| → Removal of electropositive element | → Addition of electropositive |
| → Removal or loss of $e^-$ | → Addition or gain of $e^-$ |

79. **Option (c) is correct.**
*Explanation:*

| | List-I | | List-II |
|---|---|---|---|
| (A) | Temperature | 1. | Kelvin |
| (B) | Weight | 4. | Newton |
| (C) | Mass | 2. | Kilogram |
| (D) | Pressure | 3. | Pascal |

80. **Option (a) is correct.**
*Explanation:* The pH of rain water is around 5.6, which is acidic in nature due to dissolved oxides of sulphur and nitrogen.

81. **Option (c) is correct.**
*Explanation:* The Second Industrial Revolution, which occurred after 1850 and continued into the early 20th century, was marked by the development of new industries, notably:
Chemical industry (e.g., synthetic dyes, fertilisers)
Electrical industry (e.g., electric power, light bulbs, telegraph and telephone)
These industries represented a significant shift from the First Industrial Revolution, which focused more on coal, iron, steam engines and textile manufacturing (like cotton spinning and weaving).

82. **Option (d) is correct.**
*Explanation:* Steatite, also known as soapstone, was the primary material used in making Harappan seals. It is a soft stone that could be easily carved and then hardened by firing. The seals often featured intricate engravings of animals, script and religious symbols, and were likely used for trade, identification or administrative purposes.

83. **Option (a) is correct.**
*Explanation:* Vajji was one of the ancient Mahajanapadas that had an oligarchic form of government, known as Gana-Sangha. Unlike monarchies like Magadha or Kosala, Vajji was ruled by a group of nobles or clan leaders rather than a single king. The Lichchhavis, a prominent clan within Vajji, played a key role in its governance. This republican system is often considered an early form of participatory government in Indian history.

84. **Option (b) is correct.**
*Explanation:* Shalbhanjika is a female figure depicted as holding or touching a branch of a tree. While it appears in Buddhist sites like Sanchi, it is primarily a folk or fertility motif associated with nature worship and pre-Buddhist traditions, not directly stemming from Buddhist ideology. In contrast, the empty seat, tree and wheel are direct symbolic representations of the Buddha, his enlightenment and his teachings (Dharma).

85. **Option (b) is correct.**
*Explanation:* The Rowlatt Act of 1919, officially known as the Anarchical and Revolutionary Crimes Act, allowed the British Government in India to detain individuals without trial for up to two years on mere suspicion of involvement in revolutionary activities. This act was widely opposed across India and led to widespread protests, including the infamous Jallianwala Bagh massacre. The act was seen as a direct attack on civil liberties.

**86. Option (a) is correct.**

*Explanation:* The Bhoodan Movement (Land Gift Movement), launched by Acharya Vinoba Bhave in 1951, was a voluntary movement that encouraged landowners to donate one-sixth of their cultivable land to the landless poor. It began at Pochampally village in present-day Telangana, but the movement gained significant momentum in Bihar, where some of the earliest major land donations were made. It was a non-violent and non-legislative effort to address land inequality in rural India.

**87. Option (d) is correct.**

*Explanation:* The Constitution (Seventy-third Amendment) Act, 1992, came into effect on 24 April 1993 and provided a constitutional status to Panchayati Raj Institutions (PRIs). It introduced Part IX in the Constitution titled "The Panchayats" and added the Eleventh Schedule, detailing the powers and responsibilities of Panchayats, thus laying down an elaborate framework for grassroots-level self-governance in rural areas.

**88. Option (b) is correct.**

*Explanation:* BHARATPOL is a portal developed by the Central Bureau of Investigation (CBI) to connect law enforcement agencies across India and to share information about cases, including those related to corruption and criminal activities. It aims to enhance coordination and efficiency among various law enforcement agencies.

**89. Option (a) is correct.**

*Explanation:* The correct answer is: (a) A majority of members of Rajya Sabha are elected by a system of proportional representation by means of single transferable vote.

The Deputy Chairperson of the Rajya Sabha is elected by the members of the Rajya Sabha, not nominated by the President.

The Lok Sabha can be dissolved before the completion of its five-year term by the President, on the advice of the Prime Minister.

The members of the Lok Sabha do not vote in the election of Rajya Sabha members. Only the members of the State Legislative Assemblies, the members of the Electoral College for Union Territories and the members of Rajya Sabha itself vote in Rajya Sabha elections.

**90. Option (d) is correct.**

*Explanation:* The Five Principles of Panchsheel, which were agreed upon in 1954 between India and China, emphasise the core values of mutual respect for territorial integrity and sovereignty, equality and mutual benefit, peaceful coexistence, non-interference in each other's internal affairs and mutual respect for cultural values. These principles laid the foundation for bilateral relations based on respect and cooperation. However, nuclear non-proliferation is not included in these principles; it pertains to a different set of global agreements and discussions related to controlling the spread of nuclear weapons.

**91. Option (a) is correct.**

*Explanation:* Maize (makka) was introduced into India in the seventeenth century through the Portugal. It gained acceptance in India because of its high adaptability.

**92. Option (b) is correct.**

*Explanation:* (a) Fifth Five Year Plan → 2. Garibi Hatao (Removal of Poverty)

(b) Seventh Five-Year Plan → 3. Food, Work and Productivity

(c) Ninth Five-Year Plan → 4. Growth With Social Justice and Equality

(d) Eleventh Five-Year Plan → 1. Towards Faster and More Inclusive Growth

**93. Option (c) is correct.**

*Explanation:* Statement 1: True. Shankardeva was indeed a prominent proponent of Vaishnavism in Assam during the late $15^{th}$ century.

Statement 2: False. Shankardeva was not the founder of Gaudiya Vaishnavism. Gaudiya Vaishnavism was founded by Chaitanya Mahaprabhu in Bengal, although Sankardeva's Vaishnavism shared similarities.

Statement 3: True. His teachings are indeed known as Bhagavati Dharma, emphasising devotion to Lord Vishnu.

Statement 4: True. He encouraged the establishment of satra (Vaishnavite monasteries) and naamghar (prayer halls).

**94. Option (b) is correct.**

*Explanation:* The British East India Company established its first factory in Masulipatam in 1611. This was part of its early efforts to expand trade in India before it moved to other locations like Madras and Bombay.

**95. Option (a) is correct.**

***Explanation:*** The correct chronological order of the events is: (a) 3, 1, 2, 4

Lucknow Pact (1916) – A significant agreement between the Indian National Congress and the All India Muslim League, marking a key moment in the Indian freedom struggle.

Formation of Swaraj Party (1923) – The Swaraj Party was formed within the Indian National Congress to demand greater self-rule from the British.

Communal Award (1932) – An order by British Prime Minister, Ramsay MacDonald, who granted separate electorates for minorities, including Muslims, Sikhs and others.

Simla Conference (1945) – A conference between the British and Indian leaders to discuss the political future of India during World War II.

**96. Option (a) is correct.**

***Explanation:*** The Regulating Act of 1773 provided for the establishment of a Supreme Court of Justice at Calcutta. This court was specifically created for Europeans, their employees and the citizens of India, marking an important step in the development of the judicial system in British India.

**97. Option (c) is correct.**

***Explanation:*** In 1882, Lord Ripon, who was the British Viceroy of India, introduced a resolution that is often referred to as the "Magna Carta of Local Self-Government" in India. This resolution aimed at decentralising power and promoting local self-governance, particularly in the rural areas, by giving more autonomy to local bodies like municipalities and district boards.

**98. Option (d) is correct.**

***Explanation:*** In Sufism, the term Murid refers to a disciple or follower of a Sufi master. The Murid seeks spiritual guidance from the Sufi teacher (Sheikh) and follows the teachings of Sufism to attain closeness to God through practices like meditation, remembrance of God (dhikr) and spiritual exercises.

**99. Option (a) is correct.**

***Explanation:*** Consent of the governed and political equality are fundamental features of a democratic system. In a democracy, the government derives its legitimacy from the consent of the governed, meaning that the people give their approval through voting and participation in the political process. Political equality ensures that all citizens have equal rights and opportunities in the political sphere.

Accountability of the ruled to the ruler is not typically a feature of democracy. In a democratic system, it is the ruler (or government) who is accountable to the ruled (the people), not the other way around. The government is accountable to the citizens through elections, checks and balances, and other democratic mechanisms.

Thus, features 1 and 2 outline democratic rule.

**100. Option (b) is correct.**

***Explanation:*** The correct chronological order in which these countries granted universal adult franchise is:

Sri Lanka (1931)

USA (1965)

Japan (1946)

India (1950)

So the correct answer should be (b) 2, 3, 4, 1.