CBSE SAMPLE PAPER - 04

Class 11 - Mathematics

Time Allowed: 3 hours **Maximum Marks: 80**

General Instructions:

1. This Question paper contains - five sections A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
2. Section A has 18 MCQ's and 02 Assertion-Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer (VSA)-type questions of 2 marks each.
4. Section C has 6 Short Answer (SA)-type questions of 3 marks each.
5. Section D has 4 Long Answer (LA)-type questions of 5 marks each.
6. Section E has 3 source based/case based/passage based/integrated units of assessment (4 marks each) with sub parts.

Section A

1. The range of the function f(x) = $\frac{x}{|x|}$ is **[1]**

a) {-1, 1}
b) R -{0}
c) R - {-1, 1}
d) None of these

2. Compare List I with List II and choose the correct answer using codes given below: **[1]**

List I (Complex number)	List II (Conjugate)
(i) arg(z_1z_2)	(p) $\frac{\pi}{2}$
(ii) arg$\left(\frac{z_1}{z_2}\right)$	(q) arg(z_1) -arg(z_2)
(iii) arg(z) + arg(z)	(r) arg(z_1) + arg(z_2)
(iv) arg (i)	(s) 2π

a) (i) - (r), (ii) - (q), (iii) - (s), (iv) - (p)
b) (i) - (q), (ii) - (r), (iii) - (s), (iv) - (p)
c) None of these
d) (i) - (r), (ii) - (q), (iii) - (p), (iv) - (s)

3. The solution set of 6x - 1 > 5 is : **[1]**

a) none of these
b) {x : x > 1, x ∈ R}
c) {x : x < 1, x ∈ N}
d) {x : x < 1, x ∈ W}

4. In a non-leap year, the probability of having 53 tuesdays or 53 wednesdays is **[1]**

a) $\frac{2}{7}$
b) None of these
c) $\frac{3}{7}$
d) $\frac{1}{7}$

5. If P, Q and R are subsets of a set A, then $R \times (P^c \cup Q^c)^c$ = ________ [1]

a) None of these

b) $(R \times P) \cap (R \times Q)$

c) $(R \times Q) \cap (R \times P)$

d) $(R \times P) \cup (R \times Q)$

6. The value of $\lim\limits_{x \to \pi/2} (\sec x - \tan x)$ is [1]

a) -1

b) 2

c) 1

d) 0

7. If $x = 99^{50} + 100^{50}$ and $y = (101)^{50}$ then [1]

a) x < y

b) x > y

c) x = y

d) $x \geq y$

8. The mean deviation of the numbers 3, 4, 5, 6, 7 from the mean is [1]

a) 25

b) 0

c) 1.2

d) 5

9. Let a, b and c be the 7th, 11th and 13th terms respectively of a non-constant AP. If these are also the three consecutive terms of a GP, then $\frac{a}{c}$ is equal to [1]

a) $\frac{1}{2}$

b) 4

c) $\frac{7}{13}$

d) 2

10. $\frac{\sin 3x - \sin x}{\cos x - \cos 3x}$ is equal to [1]

a) cot 2x

b) - cot 2x

c) - tan 2x

d) tan 2x

11. Given the 4 lines with equations x + 2y – 3 = 0, 2x + 3y – 4 = 0, 3x + 4y – 5 = 0, 4x + 5y – 6 = 0, then these lines are [1]

a) concurrent

b) the sides of a quadrilateral

c) sides of a parallelogram

d) none of these

12. $\lim\limits_{x \to \infty} \frac{\sin x}{x} =$ [1]

a) None of these

b) 1

c) ∞

d) 0

13. If a + ib = c + id, then [1]

a) $b^2 + c^2 = 0$

b) $b^2 + d^2 = 0$

c) $a^2 + c^2 = 0$

d) $a^2 + b^2 = c^2 + d^2$

14. If $f(x) = \frac{2^x + 2^{-x}}{2}$ Then f(x + y) f (x - y) is equals to [1]

a) $\frac{1}{2}\{f(2x) - f(2y)\}$

b) 1/2 {f (2x) + f(2y)}

c) $\frac{1}{4}\{f(2x) - f(2y)\}$

d) $\frac{1}{4}\{f(2x) + f(2y)\}$

15. The inclination of the line x – y + 3 = 0 with the positive direction of x-axis is [1]

a) –135°

b) 45°

c) 135°

d) – 45°

16. Let the integral part of $(8 + 3\sqrt{7})^n = 1$, then **[1]**

a) Nothing can be said about I

b) I is zero

c) I is an even integer

d) I is an odd integer

17. $\frac{d}{dx}\left(\frac{x}{2}\sqrt{x^2+a^2}+\frac{a^2}{2}\log\left(x+\sqrt{x^2+a^2}\right)\right)$ is equal to **[1]**

a) $\frac{1}{\sqrt{x^2+a^2}}$

b) $\sqrt{x^2+a^2}$

c) $\frac{1}{x+\sqrt{x^2+a^2}}$

d) $\sqrt{x^2-a^2}$

18. Solve the system of inequalities: $-15 < \frac{3(x-2)}{5} \leq 0$ **[1]**

a) $-13 < x < 13$

b) $-23 < x \leq 2$

c) $-23 < x < 23$

d) $-13 < x < 2$

19. If $A + B + C = 180^o$, then **[1]**

Assertion (A): $cos^2\frac{A}{2}+\cos^2\frac{B}{2}-\cos^2\frac{C}{2}=2\cos\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$.

Reason (R): $\cos C + \cos D = 2\cos\left(\frac{C+D}{2}\right)\cos\left(\frac{C-D}{2}\right)$.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

20. **Assertion (A):** The total number of positive integral solutions (zero included) of $x + y + z + \omega = 20$ without restriction is ${}^{23}C_{20}$. **[1]**

Reason (R): Number of ways of distributing n identical items among m persons when each person gets zero or more items = ${}^{m+n-1}C_{m-1}$.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

Section B

21. Prove that $\frac{\sin x+\sin 3x+\sin 5x}{\cos x+\cos 3x+\cos 5x}$ = tan 3x. **[2]**

22. Let A = {1, 2, 4, 5}, B = {2, 3, 5, 6}, C = {4, 5, 6, 7}. Verify: $A - (B \cap C) = (A - B) \cup (A - C)$ **[2]**

23. Three unbiased coins are tossed once. Find the probability of getting at most 2 tails or at least 2 heads. **[2]**

OR

Two unbiased dice are thrown. Find the probability that the total of the numbers on the dice is greater than 10.

24. A point moves, so that the sum of its distances from (ae, 0) and (-ae, 0) is 2a, prove that the equation to its locus is $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, where $b^2 = a^2(1 - e^2)$. **[2]**

25. Find the domain and the range of the real function, $f(x)=\frac{1}{\sqrt{x+|x|}}$. **[2]**

Section C

26. Evaluate: $\sqrt{-2+2\sqrt{3}i}$. **[3]**

27. Solve the given system of equations in R: $|x - 1| + |x - 2| + |x - 3| \geq 6$ **[3]**

OR

To receive Grade 'A', in a course, one must obtain an average of 90 marks or more in five examinations (each of 100 marks). If Sunita's marks in first four examinations are 87, 92, 94. and 95, find minimum marks that Sunita must obtain in fifth examination to get Grade 'A' in the course.

28. Expand the given expression $(2x - 3)^6$ **[3]**

OR

Expand $(1 + x + x^2)^3$ using binomial expansion.

29. A plane makes intercepts -6,3,4 respectively on the coordinate axes. Find the length of the perpendicular from the origin on it. **[3]**

OR

Find the locus of the point which is equidistant from A(3, 4, 0) and B(5, 2, -3).

30. Three coins are tossed once. Describe the following events associated with this random experiment: **[3]**

A = Getting three heads, B = Getting two heads and one tail,

C = Getting three tails, D = Getting a head on the first coin.

i. Which pairs of events are mutually exclusive?
ii. Which events are elementary events?
iii. Which events are compound events?

31. Let A = {0, 1, 2} and B = {3, 5 ,7 ,9}. Let f = {(x, y) : $x \in A$, $y \in B$ and y = 2x + 3}. **[3]**

Write f as a set of ordered pairs. Show that f is a function from A to B. Find dom (f) and range (f).

Section D

32. The Arithmetic Mean, AM and Standard Deviation, SD of 100 items was recorded as 40 and 5.1, respectively. Later on, it was discovered that one observation 40 was wrongly copied down as 50. Find the correct SD. **[5]**

33. In a survey of 25 students, it was found that 15 had taken mathematics, 12 had taken physics and 11 had taken chemistry, 5 had taken mathematics and chemistry, 9 had taken mathematics and physics, 4 had taken physics and chemistry and 3 had taken all the three subjects. Find the number of students who had only chemistry. **[5]**

OR

In an examination, 56% of the candidates failed in English and 48% failed in science. If 18% failed in both English and science, find the percentage of those who passed in both the subjects.

34. A rod of length 12 m moves with its ends always touching the coordinates axes. Determine the equation of the locus of a point P on the rod, which is 3 cm from the end in contact with the X-axis. **[5]**

OR

Find the equation of the hyperbola whose foci are (6,4) and (- 4,4) and eccentricity is 2.

35. Prove that the differentiation of cosec x with respect to x is - cosec x cot x. **[5]**

Section E

36. **Read the text carefully and answer the questions:** **[4]**

A man deposited ₹ 10000 in a bank at the rate of 5% simple interest annually.

(i) What is the amount paid by him after 20^{th} year?

a) ₹ 20000
b) ₹ 17000
c) ₹ 21000
d) ₹ 25000

(ii) What is the amount paid by him after 15^{th} year?

a) ₹ 15000
b) ₹ 17000
c) ₹ 21000
d) ₹ 20000

(iii) What is the amount paid by him after 3^{rd} year?

a) ₹ 10500
b) ₹ 500
c) ₹ 20000
d) ₹ 11500

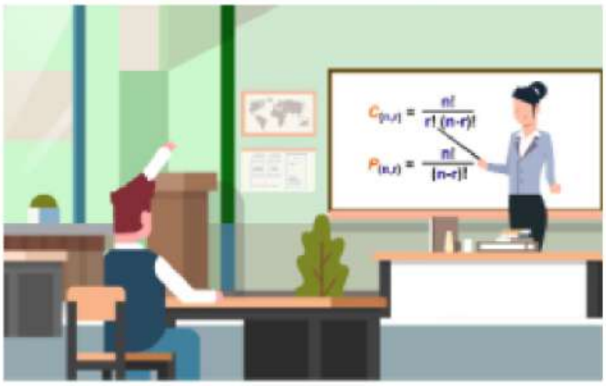
OR

What is the interest paid by him after 2^{nd} year?

a) ₹ 1500
b) ₹ 700
c) ₹ 1000
d) ₹ 500

37. **Read the text carefully and answer the questions:** **[4]**

During the math class, a teacher clears the concept of permutation and combination to the 11th standard students. After the class was over she asks the students some questions, one of the question was: how many numbers between 99 and 1000 (both excluding) can be formed such that:



(i) every digit is either 3 or 7.

a) 8 ways
b) 16 ways
c) 27 ways
d) 2 ways

(ii) there is no restriction.

a) 800 ways
b) 1000 ways
c) 900 ways
d) 700 ways

(iii) no digit is repeated.

a) 729 ways
b) 648 ways
c) 684 ways
d) 600 ways

OR

the digit in hundred's place is 7.

a) 80 ways
b) 70 ways
c) 100 ways
d) 90 ways

38. **Read the text carefully and answer the questions:** **[4]**

Sheetal and Sujata are revising trigonometric functions of compound angles. If $T_n = \sin^n \theta + \cos^n \theta$.

(i) Find T_3 - T_5.

(ii) Find $\frac{T_3 - T_5}{T_1}$.

Solution

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Class 11 - Mathematics

Section A

1. **(a)** {-1, 1}

   Explanation: We know that

   $|x| = -x$ in $(-\infty, 0)$ and $|x| = x$ in $[0, \infty)$

   So, $f(x) = \frac{x}{-x} = -1$ in $(-\infty, 0)$

   And $f(x) = \frac{x}{x} = 1$ in $(0, \infty)$

   As clearly shown above f(x) has only two values 1 and -1

   So, range of f (x) = {-1, 1}

2. **(a)** (i) - (r), (ii) - (q), (iii) - (s), (iv) - (p)

   Explanation:

   i. arg (z_1z_2) = arg (z_1) + arg (z_2)

   ii. arg $\left(\frac{z_1}{z_2}\right)$ = arg (z_1) + arg (z_2)

   iii. arg (z) + arg$(\bar{z})$ = 2π

   iv. arg (i) = $\frac{\pi}{2}$

   the correct answer is (i) - (r), (ii) - (q), (iii) - (s), (iv) - (p)

3. **(b)** $\{x : x > 1, x \in R\}$

   Explanation: 6x - 1 > 5

   $\Rightarrow$ 6x - 1 + 1 > 5 + 1

   $\Rightarrow$ 6x > 6

   $\Rightarrow$ x > 1

   Hence the solution set is $\{x : x > 1, x \in R\}$

4. **(a)** $\frac{2}{7}$

   Explanation: In a non-leap year, there are 365 days and we know that there are 7 days in a week

   $\therefore$ 365 ÷ 7 = 52 weeks + 1 day

   This 1 day can be Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday

   $\therefore$ Total Outcomes = 7

   If this day is a Tuesday or Wednesday, then the year will have 53 Tuesday or 53 Wednesday.

   $\therefore$ P(non-leap year has 53 Tuesdays or 53 Wednesdays) = $\frac{1}{7} + \frac{1}{7} = \frac{2}{7}$

   Hence, the correct option

5. **(c)** $(R \times Q) \cap (R \times P)$

   Explanation: $R \times (P^c \cup Q^c)^c = R \times [(P^c)^c \cap (Q^c)^c]$

   $= R \times (P \cap Q) = (R \times P) \cap (R \times Q) = (R \times Q) \cap (R \times P)$

6. **(d)** 0

   Explanation: $\lim\limits_{x \to \frac{\pi}{2}} (\sec x - \tan x)$

   $= \lim\limits_{h \to 0} \left(\sec\left(\frac{\pi}{2} - h\right) - \tan\left(\frac{\pi}{2} - h\right)\right)$

   $= \lim\limits_{h \to 0} (\text{cosec h} - \cot h)$

   $= \lim\limits_{h \to 0} \frac{1 - \cos h}{\sin h}$

   $= \lim\limits_{h \to 0} \frac{2\sin^2 \frac{h}{2}}{\sin h}$

   $= \lim\limits_{h \to 0} \frac{2\sin^2 \frac{h}{2}}{2\sin \frac{h}{2} \cos \frac{h}{2}}$

   $= \lim\limits_{h \to 0} \tan \frac{h}{2}$

   = 0

7. **(a)** x < y

Explanation: Given x = 99^{50} + 100^{50} and y = $(101)^{50}$

Now y = $(101)^{50}$ = $(100 + 1)^{50}$ = ${}^{50}C_0(100)^{50} + {}^{50}C_1(100)^{49}$ + ${}^{50}C_2(100)^{48}$ + ... + ${}^{50}C_{50}$ .....(i)

Also $(99)^{50}$ = $(100 - 1)^{50}$ = $={}^{50}C_0(100)^{50} - {}^{50}C_1(100)^{49}$ + ${}^{50}C_2(100)^{48}$ - .... + ${}^{50}C_{50}$ ....(ii)

Now subtract equation (ii) from equation (i), we get

$(101)^{50}$ - $(99)^{50}$ = 2 $\left[{}^{50}C_1 \quad (100)^{49} + {}^{50}C_3 \quad (100)^{47} + \ldots\right]$

= 2 $\left[50(100)^{49} + \frac{50\times49\times48}{3\times2\times1}(100)^{47} + \ldots\right]$

= $(100)^{50} + 2\left(\frac{50\times49\times48}{3\times2\times1}(100)^{47}\right)$

$\Rightarrow$ $(101)^{50}$ - $(99)^{50}$ > $(100)^{50}$

$\Rightarrow$ $(101)^{50}$ > $(100)^{50}$ + $(99)^{50}$

$\Rightarrow$ y > x

8. **(c)** 1.2

Explanation: Mean (X) = $\frac{3+4+5+6+7}{5}$

= $\frac{25}{5}$ = 5

Taking the absolute value of deviation of each term from the mean, we get:

MD = $\frac{|(3-5)|+|(4-5)|+|(5-5)|+|(6-5)|+|(7-5)|}{5}$

= $\frac{2+1+0+1+2}{5}$

= $\frac{6}{5}$

= 1.2

9. **(b)** 4

Explanation: Let A be the 1st term of AP and d be the common difference

$\therefore$ 7th term = a = A + 6d [$\because$nth term = A + (n - 1)d]

11th term = b = A+ 10d

13th term = c= A+ 12d

$\because$ a, b, c are also in GP

$\therefore$ b^2 = ac

$\Rightarrow$ $(A + 10d)^2$ = (A + 6d)(A+12d)

$\Rightarrow$ A^2 + 20Ad + $100d^2$ = A^2 + 18 Ad + $72d^2$

$\Rightarrow$ 2Ad + $28d^2$ = 0

$\Rightarrow$ 2d (A + 14d) = 0

$\Rightarrow$ d = 0 or A + 14d = 0

But d $\neq$ 0 [$\because$ the series is non constant AP]

$\Rightarrow$ A = -14d

$\therefore$ a = A + 6d = -14d + 6d = -8d

and c = A + 12d = -14d + 12d = -2d

$\Rightarrow$ $\frac{a}{c} = \frac{-8d}{-2d}$ = 4

10. **(a)** cot 2x

Explanation: Using sin C - sin D = 2 cos $\frac{(C+D)}{2}$sin $\frac{(C-D)}{2}$

and cos C - cos D = $-2\sin\frac{(C+D)}{2}\ \sin\frac{(C-D)}{2}$, we get

$\frac{\sin 3x - \sin x}{\cos x - \cos 3x} = \frac{2\cos\left(\frac{4x}{2}\right)\sin\left(\frac{2x}{2}\right)}{2\sin\left(\frac{4x}{2}\right)\sin\left(\frac{2x}{2}\right)} = \frac{\cos 2x \sin x}{\sin 2x \sin x}$ = cot 2x.

11. **(a)** concurrent

Explanation: The lines are concurrent

On solving the lies 1 and 2 we get the point of intersection as (-1, 2)

Similarly on solving lines 2 and 3, the point of intersection is (-1, 2)

Similarly solving lines 3 and 4, the point of intersection is (-1, 2)

On solving lines 1 and 4 the point of intersection is (-1, 2)

Since the point of intersection is the same for all the lines, the lines are concurrent.

12. **(d)** 0

Explanation: $\lim\limits_{x \to \infty} \frac{\sin x}{x}$

Let $x = \frac{1}{y}$

$x \to \infty$

$\therefore y \to 0$

$= \lim\limits_{y \to 0} \frac{\sin \frac{1}{y}}{\frac{1}{y}}$

$= \lim\limits_{y \to 0} y \sin \frac{1}{y}$

$= \lim\limits_{y \to 0} y \times \lim\limits_{y \to 0} \sin \frac{1}{y}$

$= 0 \times \lim\limits_{y \to 0} \sin \frac{1}{y}$

= 0

13. **(d)** $a^2 + b^2 = c^2 + d^2$

Explanation: Given that: a + ib = c + id

$\Rightarrow$ |a + ib| = |c + id|

$\Rightarrow \sqrt{a^2 + b^2} = \sqrt{c^2 + d^2}$

Squaring both sides, we get $a^2 + b^2 = c^2 + d^2$

14. **(b)** 1/2 {f (2x) + f(2y)}

Explanation: $f(x+y) f(x-y) = \left(\frac{2^{x+y} + 2^{-(x+y)}}{2}\right)\left(\frac{2^{x-y} + 2^{-(x-y)}}{2}\right)$

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

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

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

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

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

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

$= \frac{1}{2}\{f(2x) + f(2y)\}$

15. **(b)** 45°

Explanation: The equation of the line x – y + 3 = 0 can be rewritten as y = x + 3 ⇒ m = tan θ = 1 and therefore $\theta = 45°$.

16. **(d)** I is an odd integer

Explanation: Let $(8 + 3\sqrt{7})^n = p + f$, where p ∈ I and f is a proper fraction.

Let $(8 - 3\sqrt{7})^n = f'$, a proper fraction $[\because 0 < 8 - 3\sqrt{7} < 1]$

Since, $(8 + 3\sqrt{7})^n + (8 - 3\sqrt{7})^n = p + f + f'$ is an even integer

⇔ p + 1 is an even integer ...

$[\because 0 < f < 1 \text{ and } 0 < f' < 1]$ $[\therefore 0 < f + f' < 2 \Rightarrow f + f' = 1]$

⇒ p is an odd integer.

17. **(b)** $\sqrt{x^2 + a^2}$

Explanation: $y' = \left(\frac{x}{2}\right) \cdot \left(\frac{2x}{2\sqrt{x^2+a^2}}\right) + \left(\sqrt{x^2 + a^2}\right) \cdot \left(\frac{1}{2}\right) + \left(\frac{a^2}{2}\right)\left[\frac{1 + \left(\frac{2x}{2\sqrt{x^2+a^2}}\right)}{x + \sqrt{x^2+a^2}}\right]$

$\Rightarrow \sqrt{x^2 + a^2}$

18. **(b)** $-23 < x \leq 2$

Explanation: $-15 < \frac{3(x-2)}{5} \leq 0$

$\Rightarrow -15 \cdot \frac{5}{3} < \frac{3(x-2)}{5} \cdot \frac{5}{3} \leq 0 \cdot \frac{5}{3}$

$\Rightarrow -25 < (x - 2) \leq 0 + 2$

$\Rightarrow -25 + 2 < x - 2 + 2 \leq 2$

$\Rightarrow -23 < x \leq 2$

19. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: $A + B + C = 180^o$

$\cos^2 \frac{A}{2} + \cos^2 \frac{B}{2} - \cos^2 \frac{C}{2}$

$= \cos^2 \frac{A}{2} + \sin\left(\frac{c}{2} + \frac{\pi}{2}\right) \cdot \sin\left(\frac{c}{2} - \frac{\pi}{2}\right)$ $\{\because \cos^2 B - \cos^2 A = \sin(A + B) \cdot \sin(A - B)\}$

$= \cos^2 \frac{A}{2} + \sin\left(90^\circ - \frac{A}{2}\right) \cdot \sin\left(\frac{C}{2} - \frac{B}{2}\right)$

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

$= \cos \frac{A}{2}\left[\cos \frac{A}{2} + \sin\left(\frac{C}{2} - \frac{B}{2}\right)\right]$

$= \cos \frac{A}{2}\left[\sin\left(\frac{C}{2} + \frac{B}{2}\right) + \sin\left(\frac{C}{2} - \frac{B}{2}\right)\right]$

$= \cos \frac{A}{2} \cdot 2 \sin \frac{C}{2} \cos \frac{B}{2}$

$= 2 \cos \frac{A}{2} \cdot \cos \frac{B}{2} \sin \frac{C}{2}$

Proved

20. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Given: $x + y + z + w = 20$

20 is divided in four groups.

Now if include zero values for all the integers here, then the total number of solutions

$= {}^{20+4-1}C_{4-1}$

Section B

21. To prove: $\frac{\sin x+\sin 3x+\sin 5x}{\cos x+\cos 3x+\cos 5x}$ = tan 3x.

Now, L.H.S = $\frac{\sin x+\sin 3x+\sin 5x}{\cos x+\cos 3x+\cos 5x}$

$= \frac{(\sin 5x+\sin x)+\sin 3x}{(\cos 5x+\cos x)+\cos 3x}$

$= \frac{2 \sin \frac{5x+x}{2} \cos \frac{5x-x}{2}}{2 \cos \frac{5x+3x}{2} \cos \frac{5x-3x}{2}}$

$= \frac{2 \sin 3x \cos x+\sin 3x}{\cos 3x \cos x+\sin 3x}$

$= \frac{\sin 3x(2 \cos x+1)}{\cos 3x(2 \cos x+1)}$

= tan 3x

22. A = {1, 2, 4, 5}, B = {2,3,5,6}, C = {4,5,6,7}

$B \cap C$ = {5,6}

A - $(B \cap C)$ = {1, 2, 4} ....(1)

(A - B) ={1, 4}

(A - C) = {1, 2}

$(A - B) \cup (A-C)$ = {1, 2, 4 } ...(2)

From eq. (1) and eq. (2), we get

$A - (B \cap C) = (A - B) \cup (A - C)$

23. We know that,

Probability of occurrence of an event = $\frac{\text{Total no.of Desired outcomes}}{\text{Total no.of outcomes}}$

Let T and H be the tails and heads respectively

Total possible outcomes = TTT, TTH, THT, HTT, THH, HTH, HHT, HHH

Desired outcomes are at least two heads or at most two tails. So, desired outputs are TTH, THT, HTT, THH, HTH, HHT, HHH

Total no.of outcomes are 8 and desired outcomes are 7

Probability of getting at most 2 tails or at least 2 heads = $\frac{7}{8}$

Conclusion: Probability of getting at least two heads or at most two tails is $\frac{7}{8}$

OR

We have to find the probability that the total of the numbers on the dice is greater than 10.

given: three dice are rolled

formula: $P(E) = \frac{\text{favourable outcomes}}{\text{total possible outcomes}}$

so, we have to determine the probability of getting the sum of digits on dice greater than 10 total number of possible outcomes are $6^2 = 36$

therefore n(S) = 36

let E be the event of getting same number on all the three dice

E = {(5, 6), (6, 5), (6, 6)}

n(E) = 3

P(E) = $\frac{n(E)}{n(S)}$

P(E) = $\frac{3}{36} = \frac{1}{12}$

24. Let, P(h, k) be the moving point such that the sum of its distances from A(ae, 0) and B(-ae, 0) is 2a.

Then, PA + PB = 2a

$\Rightarrow \sqrt{(h-ae)^2+(k-0)^2} + \sqrt{(h+ae)^2+(k-0)^2} = 2a \left[\because \text{ distance } = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}\right]$

$\Rightarrow \sqrt{(h-ae)^2+k^2} = 2a - \sqrt{(h+ae)^2+k^2}$

$\Rightarrow (h - ae)^2 + k^2 = 4a^2 + (h + ae)^2 + k^2 - 4a\sqrt{(h+ae)^2+k^2}$ [squaring on both sides]

$\Rightarrow -4aeh - 4a^2 = -4a\sqrt{(b+ae)^2+k^2}$

$\Rightarrow (eh+a) = \sqrt{(h+ae)^2+k^2}$

$\Rightarrow (eh + a)^2 = (h + ae)^2 + k^2$ [again, squaring on both sides]

$\Rightarrow e^2 h^2 + 2aeh + a^2 = h^2 + a^2 e^2 + 2aeh + k^2$

$\Rightarrow h^2 (1 - e^2) + k^2 = a^2 (1 - e^2)$

$\Rightarrow \frac{h^2}{a^2} + \frac{k^2}{a^2(1-e^2)} = 1$

Hence, locus of point P (h, k) is

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

or $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, where $b^2 = a^2 (1 - e^2)$

25. Given, $f(x) = \frac{1}{\sqrt{x+|x|}}$

As we know, $|x| = \begin{cases} x, & \text{if } x \geq 0 \\ -x, & \text{if } x < 0 \end{cases}$

$\therefore \quad x+|x| = \begin{cases} x+x, \text{ if } x \geq 0 \\ x-x, \text{ if } x < 0 \end{cases}$

$\Rightarrow \quad x+|x| = \begin{cases} 2x, \text{ if } x \geq 0 \\ 0, \text{ if } x < 0 \end{cases}$ .... (i)

The function $f(x) = \frac{1}{\sqrt{x+|x|}}$ assumes real values, if $x+|x|>0$.

$\Rightarrow \quad 2x > 0 \Rightarrow \quad x > 0$ [using Eq. (i)]

$\therefore \quad x \in (0, \infty)$

$\therefore$ domain of $f = (0, \infty)$.

Section C

26. Let, $(a + ib)^2 = -2 + 2\sqrt{3}i$

$\Rightarrow a^2 + (bi)^2 + 2abi = -2 + 2\sqrt{3}i$ [$(a + b)^2 = a^2 + b^2 + 2ab$]

$\Rightarrow a^2 - b^2 + 2abi = -2 + 2\sqrt{3}i$ [$i^2 = -1$]

Now, separating real and complex parts, we get

$\Rightarrow a^2 - b^2 = -2$…………..eq.1

$\Rightarrow 2ab = 2\sqrt{3}$

$\Rightarrow a = \frac{\sqrt{3}}{b}$ ……..eq.2

Now, using the value of a in eq.1, we get

$\Rightarrow \left(\frac{\sqrt{3}}{b}\right)^2 - b^2 = -2$

$\Rightarrow 3 - b^4 = -2b^2$

$\Rightarrow b^4 - 2b^2 - 3 = 0$

Simplify and get the value of b^2, we get,

$\Rightarrow b^2 = -1$ or $b^2 = 3$

As b is real no. so, $b^2 = 3$

$b = \sqrt{3}$ or $b = -\sqrt{3}$

Put value of b in equation (2) ==> a = 1 or a = -1

Hence the square root of the complex no. is $1 + \sqrt{3}i$ and $-1 - \sqrt{3}i$.

27. We have,

$|x-1|+|x-2|+|x-3| \geq 6$ ....(i)

As, $|x-1|=\begin{cases}x-1, x \geq 1 \\ 1-x, x<1\end{cases}$

$|x-2|=\begin{cases}x-2, x \geq 2 \\ 2-x, x<2\end{cases}$

$|x-3|=\begin{cases}x-3, x \geq 3 \\ 3-x, x<3\end{cases}$

Now,

Case I: When x < 1

$1 - x + 2 - x + 3 - x \geq 6$

$\Rightarrow 6-3x \geq 6$

$\Rightarrow 3x \leq 0$

$\Rightarrow x \leq 0$

So, $x \in(-\infty, 0]$

Case II: When $1 \leq x<2$,

$x - 1 + 2 - x + 3 - x \geq 6$

$\Rightarrow 4-x \geq 6$

$\Rightarrow x \leq 4-6$

$\Rightarrow x \leq -2$

So, $x \in \phi$

Case III: When $2 \leq x<3$

$x - 1 + x - 2 + 3 - x \geq 6$

$\Rightarrow x \geq 6$

So, $x \in \phi$

Case IV: When $x \geq 3$,

$x - 1 + x - 2 + x - 3 \geq 6$

$\Rightarrow 3x-6 \geq 6$

$\Rightarrow 3x \geq 12$

$\Rightarrow x \geq \frac{12}{3}$

$\Rightarrow x \geq 4$

So, $x \in[4, \infty)$

So, from all the four cases,

$x \in(-\infty, 0] \cup[4, \infty)$

Solution set = $(-\infty,0] \cup [4,\infty)$

OR

Let the marks obtained by Sunita in fifth examination be x.

Then average of five examinations $=\frac{87+92+94+95+x}{5}$

Now $\frac{87+92+94+95+x}{5} \geqslant 90 \Rightarrow \frac{368+x}{5} \geqslant 90$

Multiplying both sides by 5, we have

$368+x \geqslant 450$

$\Rightarrow x \geqslant 450-368$

$\Rightarrow x \geqslant 82$

Thus the minimum marks needed to be obtained by Sunita = 82.

28. Using binomial theorem for the expansion of $(2x - 3)^6$ we have

$(2x-3)^6={}^6C_0(2x)^6+{}^6C_1(2x)^5(-3)+{}^6C_2(2x)^4(-3)^2+{}^6C_3(2x)^3(-3)^3$

$+{}^6C_4(2x)^2(-3)^4+{}^6C_5 2x^5(-3)^2+{}^6C_6(-3)^6$

$= 64x^6 + 6.32x^5 (-3) + 15.16x^4.9 + 20.8x^3 (-27) + 15.4x^2.81 + 6.2x (-243) + 729$

$= 64x^6 - 576x^5 + 2160x^4 - 4320x^3 + 4860x^2 - 2916x + 729$

OR

Let y = x + x^2. Then,

$(1 + x + x^2)^3 = (1 + y)^3 = {}^3C_0 + {}^3C_1\, y + {}^3C_2\, y^2 + {}^3C_3\, y^3 = 1 + 3y + 3y^2 + y^3$

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

$= 1 + 3(x + x^2) + 3(x^2 + 2x^3 + x^4) + \{{}^3C_0\, x^3 (x^2)^0 + {}^3C_1\, x^{3-1} (x^2)^1 + {}^3C_2\, x^{3-2} (x^2)^2 + {}^3C_3\, x^0 (x^2)^3\}$

$= 1 + 3(x + x^2) + 3(x^2 + 2x^3 + x^4) + (x^3 + 3x^4 + 3x^5 + x^6)$

$= x^6 + 3x^5 + 6x^4 + 7x^3 + 6x^2 + 3x + 1$

29. According to the question intercepts on the coordinate axes are $(-6, 3, 4)$, then equation of plane will be

$\frac{x}{-6} + \frac{y}{3} + \frac{z}{4} = 1$ or $\frac{x}{-6} + \frac{y}{3} + \frac{z}{4} - 1 = 0$

The distance of a point (x_1, y_1, z_1) from plane $ax + by + cz + d = 0$

$$D = \left|\frac{ax_1 + by_1 + a_1 + d}{\sqrt{a^2 + b^2 + c^2}}\right|$$

$\therefore$ The distance of origin from given plane

$$\left| = \frac{\left(\frac{-1}{6}\right)\cdot 0 + \left(\frac{1}{3}\right)0 + \left(\frac{1}{4}\right)0 - 1}{\sqrt{\left(\frac{-1}{6}\right)^2 + \left(\frac{1}{3}\right)^2 + \left(\frac{1}{4}\right)^2}}\right|$$

$$= \left|\frac{-1}{\sqrt{\frac{1}{36} + \frac{1}{9} + \frac{1}{16}}}\right| = \left|\frac{-1}{\sqrt{\frac{4+16+9}{144}}}\right| = \left|\frac{-1}{\sqrt{\frac{29}{144}}}\right| = \frac{12}{\sqrt{29}}$$

Required length of the perpendicular from origin to plane is $\frac{12}{\sqrt{29}}$ units.

OR

Let P (x, y, z) be any point which is equidistant from A(3, 4, 0) and B(5, 2, -3).

Now PA = PB $\Rightarrow PA^2 = PB^2$

$\therefore (x - 3)^2 + (y - 4)^2 + (z - 0)^2 = (x - 5)^2 + (y - 2)^2 + (z + 3)^2$

$\Rightarrow x^2 + 9 - 6x + y^2 + 16 - 8y + z^2 = x^2 + 25 - 10x + y^2 + 4 - 4y + z^2 + 9 + 6z$

$\Rightarrow 4x - 4y - 6z - 13 = 0$

30. Given: There are three coins tossed once.

Sample space is:

S = { HHH, HHT, HTH, HTT, THH, THT, TTH, TTT }

According to the question,

A = {HHH}

B = {HHT, HTH, THH}

C = {TTT}

D = {HHH, HHT, HTH, HTT}

Now, A ∩ B = ∅, A ∩ C = ∅, A ∩ D = {HHH}

B ∩ C = ∅, B ∩ D = {HHT, HTH}, C ∩ D = ∅

Since, If the intersection of two sets is null or empty it means both the sets are Mutually Exclusive.

i. Events A and B, Events A and C, Events B and C, and events C and D are mutually exclusive.
ii. Here, We know, If an event has only one sample point of a sample space, then it is called elementary events. So, A and C are elementary events.
iii. If there is an event that has more than one sample point of a sample space, it is called a compound event, So, B and D are compound events.

31. Here we have, A = {0, 1, 2} and B = {3, 5, 7, 9}

f = {(x, y) : x ∈ A, y ∈ B and y = 2x + 3}

For x = 0, we have

y = 2x + 3

y = 2(0) + 3

y = 3 ∈ B

For x = 1, we have

y = 2x + 3

y = 2(1) + 3

y = 5 ∈ B

For x = 2, we have

y = 2x + 3

y = 2(2) + 3

y = 7 ∈ B

∴ f = {(0, 3),(1, 5),(2, 7)}

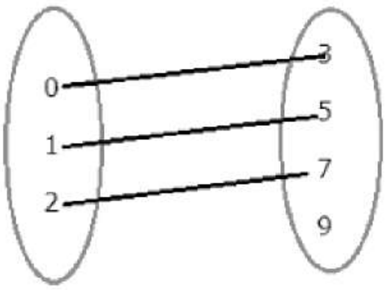
(0, 5),(0, 7),(0, 9),(1, 3),(1, 7),(1, 9),(2, 3),(2, 5),(2, 9) are not the members of 4 because they are not satisfying the given condition

y = 2x + 3

Now, we have to show that f is a function from A to B.

i. All elements of the first set are associated with the elements of the second set.
ii. An element of the first set has a unique image in the second set.

f = {(0, 3),(1, 5),(2, 7)}



Here, all elements of set A are associated with an element in set B.

An element of set A is associated with a unique element in set B.

∴ f is a function.

Dom (f) = 0, 1, 2

Range (f) = 3, 5, 7

Section D

32. Number of items = 100

Incorrect mean $(\overline{x})$ = 40

Incorrect SD = 5.1

Incorrect item = 50

Correct item = 40

Now, $\overline{x} = \frac{\sum x}{n} \Rightarrow 40 = \frac{\sum x}{100}$

$\Rightarrow$ Incorrect $\sum x$ = 4000

$\Rightarrow$ Correct $\sum x$ = 4000 - 50 + 40 = 3990

∴ Correct mean = $\frac{3990}{100}$ = 39.9

Now, Incorrect SD = $\sqrt{\frac{\sum(x_i-\overline{x})^2}{n}} = \sqrt{\frac{\sum x^2}{n} - (\overline{x})^2}$

$\Rightarrow 5.1 = \sqrt{\frac{\text{Incorrect } \sum x^2}{100} - (40)^2}$

$\Rightarrow 26.01 = \frac{\text{Incorrect } \sum x^2}{100} - 1600$

∴ Incorrect $\sum x^2$ = 162601

Now, correct $\sum x^2$ = 162601 - $(50)^2$ + $(40)^2$ = 161701

and Correct SD = $\sqrt{\frac{161701}{100} - (39.9)^2} = \sqrt{1617.01 - 1592.01} = 5$

33. Let M be the set of students who had taken mathematics, P be the set of students who had taken physics and C be the set of students who had taken chemistry.

Here n(U) = 25, n(M) = 15, n(P) = 12, n(C) = 11, $n(M \cap C) = 5$,

$n(M \cap P) = 9,\ n(P \cap C) = 4,\ n(M \cap P \cap C) = 3,$

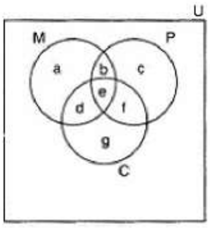
From the Venn diagram, we have

n(M) = a + b + d + e = 15

n(P) = b + c + e + f = 12

n(C) = d + e + f + g = 11

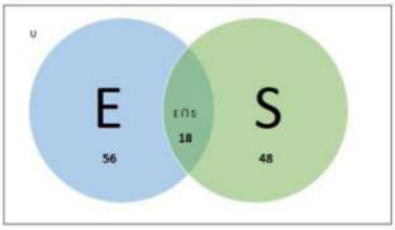
$n(M \cap C) = d + e = 5,$
$n(M \cap P) = b + e = 9,$
$n(P \cap C) = e + f = 4$
$n(M \cap P \cap C) = e = 3$
Now e = 3



$d + e = 5 \Rightarrow d + 3 = 5 \Rightarrow d = 5 - 3 \Rightarrow d = 2$
b +e = 9⇒b + 3 = 9 ⇒b = 9 - 3 ⇒ b = 6
e + f = 4 ⇒ 3 + f = 4 ⇒ f = 4 - 3 ⇒ f = 1
a +b + d + e = 15 ⇒ a + 6 + 2 + 3 = 15 ⇒ a = 15 - 14 = 4
b + c + e + f = 12 ⇒ 6 + c + 3 + 1 = 12 ⇒ c = 12 - 10 = 2
d + e + f + g = 11 ⇒ 2 + 3+ 1+ g = 11 ⇒g = 11 - 6 = 5
∴ g = 5

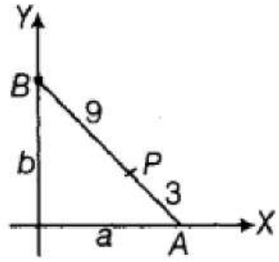
OR

Now, suppose that
Percentage of candidates who failed in English = n(E) = 56
Percentage of candidates who failed in Science = n(S) = 48
Percentage of candidates who failed in English and Science both
= n(E ∩ S) = 18
Percentage of candidates who failed in English only = n(E - S)
Percentage of candidates who failed in Science only = n(S - E)
Venn diagram:

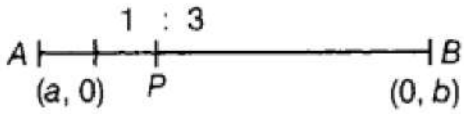


Now, we have
n(E - S) = n(E) - n(E ∩ S)
= 56 – 18 = 38
n(S - E) = n(S) - n(E ∩ S)
= 48 - 18 = 30
Thus,we have
Percentage of total candidates who failed = n(E - S) + n(S - E) + n(E ∩ S)
= 38 + 30 + 18 = 86%
Now, we have
The percentage of candidates who passed in both English and Science = 100 - 86 = 14%
Therefore, The percentage of candidates who passed in both English and Science = 14%

34. Let l be the length of the rod and which at any position meet X-axis at A (a, 0) and also meets the Y-axis at B (0, b), therefore we have
$l^2 = a^2 + b^2$
$\Rightarrow (12)^2 = a^2 + b^2$ ...(i) [∵ l = 12]



Let P be the point on AB which is 3 cm from A and hence 9 cm from B.
This means that the point P divides AB in ratio 3 : 9 i.e., 1 : 3.
If P = (x, y), then by section formula, we have



(x, y) = $\left(\frac{1\times0+3\times a}{1+3}, \frac{1\times b+3\times0}{1+3}\right)$
$\Rightarrow$ (x, y) = $\left(\frac{3a}{4}, \frac{b}{4}\right)$
$\Rightarrow$ x = $\frac{3a}{4}$, y = $\frac{b}{4}$ $\Rightarrow$ a = $\frac{4x}{3}$ and b = 4y
On putting the values of a and b in Equation (i), we get
144 = $\left(\frac{4x}{3}\right)^2$ + $(4y)^2$
$\Rightarrow \frac{x^2}{81} + \frac{y^2}{9} = 1$
which is required equation.

OR

The centre of the hyperbola is the mid-point of the line joining the two foci.
So, the coordinates of the centre are $\left(\frac{6-4}{2}, \frac{4+4}{2}\right)$ i.e., (1, 4).
Let 2a and 2b be the length of transverse and conjugate axes and let e be the eccentricity. Then, the equation of the hyperbola is,
$\frac{(x-1)^2}{a^2} - \frac{(y-4)^2}{b^2} = 1$ ....(i)
Now, the distance between two foci = 2ae
$\Rightarrow \sqrt{(6+4)^2+(4-4)^2}$ = 2ae [$\because$ Foci = (6, 4) and (-4, 4)]
$\Rightarrow \sqrt{(10)^2}$ = 2ae
$\Rightarrow$ 10 = 2ae
$\Rightarrow$ 2ae = 10
$\Rightarrow$ 2a $\times$ 2 = 10 [$\because$ e = 2]
$\Rightarrow$ a = $\frac{10}{4}$
$\Rightarrow$ a = $\frac{5}{2}$
$\Rightarrow a^2 = \frac{25}{4}$
Now,
$b^2 = a^2 (e^2 - 1)$
$\Rightarrow b^2 = \frac{25}{4}(2^2 - 1)$
$= \frac{25}{4}(4 - 1)$
$= \frac{25}{4} \times 3 = \frac{75}{4}$
Putting $a^2 = \frac{25}{4}$ and $b^2 = \frac{75}{4}$ in equation (i), we get
$\frac{(x-1)^2}{\frac{25}{4}} - \frac{(y-4)^2}{\frac{75}{4}} = 1$
$\Rightarrow \frac{4(x-1)^2}{25} - \frac{4(y-4)^2}{75} = 1$
$\Rightarrow \frac{4\times3(x-1)^2-4(y-4)^2}{75} = 1$
$\Rightarrow 12(x-1)^2 - 4(y-4)^2 = 75$
$\Rightarrow 12[x^2 + 1 - 2x] - 4[y^2 + 16 - 8y] = 75$

$\Rightarrow 12x^2 + 12 - 24x - 4y^2 - 64 + 32y = 75$

$\Rightarrow 12x^2 - 4y^2 - 24x + 32y - 52 - 75 = 0$

$\Rightarrow 12x^2 - 4y^2 - 24x + 32y - 127 = 0$

This is the equation of the required hyperbola.

35. Let f(x) = cosec x. Then, f(x + h) = cosec (x + h)

$\therefore \frac{d}{dx}(f(x)) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$

$\Rightarrow \frac{d}{dx}(f(x)) = \lim_{h\to 0} \frac{\text{cosec}(x+h) - \text{cosec}\, x}{h}$

$\Rightarrow \frac{d}{dx}(f(x)) = \lim_{h\to 0} \frac{\frac{1}{\sin(x+h)} - \frac{1}{\sin x}}{h}$

$\Rightarrow \frac{d}{dx}(f(x)) = \lim_{h\to 0} \frac{\sin x - \sin(x+h)}{h \sin x \sin(x+h)}$

$\Rightarrow \frac{d}{dx}(f(x)) = \lim_{h\to 0} \frac{2\sin\left(\frac{x-x-h}{2}\right)\cos\left(\frac{x+x+h}{2}\right)}{h \sin x \sin(x+h)}$

$\Rightarrow \frac{d}{dx}(f(x)) = \lim_{h\to 0} \frac{2\sin(-h/2)\cos(x+h/2)}{h \sin x \sin(x+h)}$

$\Rightarrow \frac{d}{dx}(f(x)) = -\lim_{h\to 0} \frac{\sin(h/2)}{h/2} \times \lim_{h\to 0} \frac{\cos(x+h/2)}{\sin x \sin(x+h)} \left[\because \sin\left(-\frac{h}{2}\right) = -\sin\frac{h}{2}\right]$

$\Rightarrow \frac{d}{dx}(f(x)) = (-1) \times \frac{\cos x}{\sin x \sin x} = -\cot x \,\text{cosec}\, x.$

Hence, $\frac{d}{dx}(\text{cosec}\, x) = -\text{cosec}\, x \cot x.$

Section E

36. **Read the text carefully and answer the questions:**

A man deposited ₹ 10000 in a bank at the rate of 5% simple interest annually.

(i) **(a)** ₹ 20000

Explanation: Amount after 20 yr = 10000 + 20 × 500

= 10000 + 10000

= ₹ 20000

(ii) **(b)** ₹ 17000

Explanation: The amount in the account of man in first, second and third year are ₹ 1000, ₹ 10500, ₹ 11000, ...

It is an A.P., where a = 10000 and d = 500

Amount in 15^{th} yr = T_{15}

= a + 14d

= 10000 + 14 × 500

= 10000 + 7000

= ₹ 17000

(iii) **(d)** ₹ 11500

Explanation: Interest on ₹ 10000 after 3 yr

$= \frac{10000 \times 5 \times 3}{100}$

= ₹ 1500

∴ Amount after 3 yr = 10000 + 1500 = ₹ 11500

OR

(c) ₹ 1000

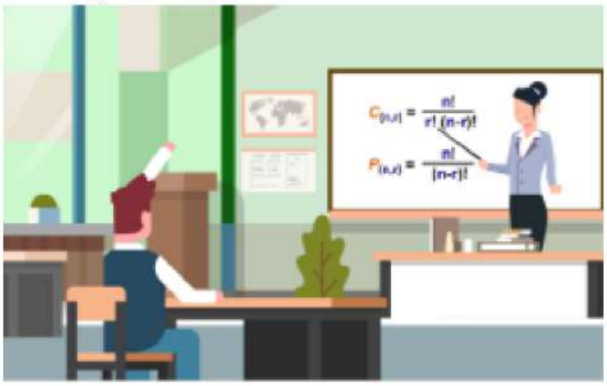
Explanation: Now, interest on ₹ 10000 after 2 yr

$= \frac{10000 \times 5 \times 2}{100}$

= ₹ 1000

37. **Read the text carefully and answer the questions:**

During the math class, a teacher clears the concept of permutation and combination to the 11th standard students. After the class was over she asks the students some questions, one of the question was: how many numbers between 99 and 1000 (both excluding) can be formed such that:



(i) **(a)** 8 ways

Explanation: 8 ways

(ii) **(c)** 900 ways

Explanation: 900 ways

(iii) **(b)** 648 ways

Explanation: 648 ways

OR

(c) 100 ways

Explanation: 100 ways

38. **Read the text carefully and answer the questions:**

Sheetal and Sujata are revising trigonometric functions of compound angles. If $T_n = \sin^n \theta + \cos^n \theta$.

(i) $\sin^2 \theta \cdot \cos^2 \theta(\sin \theta + \cos \theta)$

$T_3 - T_5 = \left(\sin^3 \theta + \cos^3 \theta\right) - \left(\sin^5 \theta + \cos^5 \theta\right)$

$= \sin^3 \theta \left(1 - \sin^2 \theta\right) + \cos^3 \theta \left(1 - \cos^2 \theta\right)$

$= \sin^3 \theta \cdot \cos^2 \theta + \cos^3 \theta \cdot \sin^2 \theta$

$= \sin^2 \theta \cdot \cos^2 \theta(\sin \theta + \cos \theta)$

(ii) $\frac{T_3 - T_5}{T_1} = \frac{\sin^2 \theta \cos^2 \theta(\sin \theta + \cos \theta)}{(\sin \theta + \cos \theta)}$

$= \sin^2 \theta \cdot \cos^2 \theta$