Class XI Session 2024-25
Subject - Applied Mathematics
Sample Question Paper - 2

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 is some internal choice 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) questions of 2 marks each.
4. Section C has 6 Short Answer(SA) questions of 3 marks each.
5. Section D has 4 Long Answer(LA) questions of 5 marks each.
6. Section E has 3 source based/case based/passage based/integrated units of assessment (04 marks each) with sub parts.
7. Internal Choice is provided in 2 questions in Section-B, 2 questions in Section-C, 2 Questions in Section-D. You have to attempt only one alternatives in all such questions.

Section A

1. The binary equivalent of the decimal number 10 is **[1]**

   a) 10 b) 010

   c) 0010 d) 1010

2. The mean of 100 observations is 50 and their standard deviation is 10. If 5 is added to each observation, then new mean and new standard deviation respectively will be **[1]**

   a) 50, 15 b) 50, 10

   c) 60, 10 d) 55, 10

3. A retailer purchases a fan for ₹ 1500 from a wholesaler and sells it to a consumer at 10% profit. If the sales are intra-state and the rate of GST is 12%, The cost of the fan to the consumer inclusive of tax is **[1]**

   a) ₹ 1650 b) ₹ 1830

   c) ₹ 1848 d) ₹ 1800

4. The following information relates to a sample of size 60: $\sum x^2 = 18000$, $\sum x = 960$. The variance is **[1]**

   a) 44 b) 22

   c) 6.63 d) 16

5. The relation R defined on the set A = {1, 2, 3, 4, 5) by R = {(a, b) : $|a^2 - b^2| < 7$} is given by **[1]**

   a) {(1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (1, 2), (2, b) {(3, 3), (4, 3), (5, 4), (3, 4)}

3)}

c) {(1, 1), (2, 1), (3, 1), (4, 1), (2, 3)}

d) {(2, 2), (3, 2), (4, 2), (2, 4)}

6. log 6 + log 5 is expressed as **[1]**

a) $\log \frac{5}{6}$

b) $\log \frac{6}{5}$

c) log 30

d) log 11

7. If (x - 2, y + 5) = $\left(-2, \frac{1}{3}\right)$ are two equal ordered pairs, then values of x and y are: **[1]**

a) x = 0 , y = $\frac{-4}{3}$

b) x = 4, y = $\frac{-14}{3}$

c) x = 0, y = $\frac{-14}{3}$

d) x = 4, y = $\frac{-4}{3}$

8. If the lines 2x + y - 3 = 0, 5x + ky - 3 = 0 and 3x - y - 2 = 0 are concurrent, then the value of k is **[1]**

a) 2

b) -3

c) -2

d) -1

9. The odd man in the number sequence 141, 273, 385, 462, 543, 672 is: **[1]**

a) 385

b) 141

c) 462

d) 543

10. If lower quartile, upper quartile, mean and mode of frequency distribution are 15, 28, 20 and 26 respectively, then Bowley's coefficient of Skewness is **[1]**

a) 0.067

b) 0.077

c) -0.077

d) -0.067

11. $\log(\frac{32}{4})$ is equal to **[1]**

a) $\frac{\log 32}{\log 4}$

b) log 32 - log 4

c) $\log^{32}$ - $\log^{4}$

d) 2^3

12. The difference between the simple and compound interest compounded annually on a certain sum of money for 2 years at 4% per annum is ₹ 1. The sum is: **[1]**

a) ₹ 640

b) ₹ 650

c) ₹ 630

d) ₹ 625

13. Deduction of tuition fees of two children is allowed under the section _____. **[1]**

a) 80E

b) 80C

c) 80TTA

d) 80D

14. Which of the following is equal to x? **[1]**

a) $x^{\frac{12}{7}} - x^{\frac{5}{7}}$

b) $\left(\sqrt{x^3}\right)^{\frac{2}{3}}$

c) $x^{\frac{12}{7}} \times x^{\frac{7}{12}}$

d) $\sqrt[12]{(x^4)^{\frac{1}{3}}}$

15. If A and B are two independent events such that P(A) = $\frac{1}{3}$ and P(B) = $\frac{1}{4}$, then $P\left(\frac{B'}{A}\right)$ is **[1]**

a) $\frac{1}{8}$

b) 1

c) $\frac{3}{4}$

d) $\frac{1}{4}$

16. The effective rate of return which is equivalent to nominal rate of 8% p.a. compounded quarterly is: [Given $(1.02)^4 = 1.0824$] **[1]**

a) 8.5%
b) 8.16%
c) 7.95%
d) 8.24%

17. Which of the following is the correct representation of a binary number? **[1]**

a) $(000)_2$
b) 110
c) $(110)^2$
d) $(124)_2$

18. A relation R is defined from {2, 3, 4, 5} to {3, 6, 7, 10} by x Ry $\Leftrightarrow$ x is relatively prime to y. Then, domain of R is **[1]**

a) {3, 5}
b) {2, 3, 4, 5}
c) {2, 3, 5}
d) {2, 3, 4}

19. **Assertion (A):** If A and B are events associated with a random experiment such that A $\subset$ B, then P(B - A) = P(B) - P(A). **[1]**
Reason (R): If A $\subset$ B, then A $\cap$ B = A.

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):** Suresh plans to go from Lucknow to Kanpur by bus and return back to Lucknow by a different bus. If there are only 10 buses running between Lucknow and Kanpur, then total number of ways in which Suresh can plan his journey is 90. **[1]**
Reason (R): If an event can occur in m different ways and a second event can occur in n different ways, then either of the two events can occur in (m + n) ways.

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. Rohit takes twice as much time as Mohit and thrice as much time as Sonit to complete a piece of work. If working together, they can complete the work in 4 days, find the time taken by each of them separately to complete the work. **[2]**

22. Pointing to a girl, Rishabh said **Her mother's brother is the only son of my mother's father.** How is the girl's mother related to Rishabh? **[2]**

OR

In a certain code language 327 means **Truth is eternal**, 7983 means **'Enmity is not eternal'** and 9426 means **Truth does not perish**. What does **Enmity** mean in this language?

23. At what time between 5:00 and 6:00 will the hands of clock be at right angles? **[2]**

24. Find the derivative of the given function from the first principle: $\frac{ax+b}{cx+d}$ **[2]**

OR

Differentiate the function $\sqrt{x}\left(2x^2+3\right)$ with respect to x.

25. A bag contains 4 white and 2 black balls. Another contains 3 white and 5 black balls. If one ball is drawn from each bag, find the probability that one is white and one is black. **[2]**

Section C

26. How many numbers greater than 1000000 can be formed by using the digits 1, 2, 0, 2, 4, 2, 4? **[3]**

OR

Using the letters of the word, **ARRANGEMENT** how many different words (using all letters at a time) can be made such that both A, both E, both R and both H occur together.

27. Find A and B in the addition **[3]**

$$\begin{array}{r} 1\ 2\ A \\ +\ 6\ A\ B \\ \hline A\ 0\ 9 \end{array}$$

28. Find $\lim_{x \to 1}$ f(x), where f(x) = $\begin{cases} x^2 - 1, x \leq 1 \\ -x^2 - 1, x > 1 \end{cases}$ **[3]**

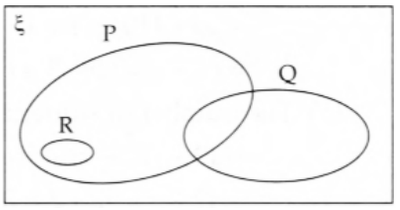
29. An industry in Delhi consumed 285kL of water in a month. Calculate the water bill for the month. The tariff plan for the industrial units in Delhi is as given below: **[3]**

Monthly Consumption (in kL)	**Service Charge**	**Water Consumption Charge per kL**
Up to 6	₹ 146.41	₹ 17.57
6 - 15	₹ 292.82	₹ 26.35
15 - 25	₹ 585.64	₹ 35.14
25 - 50	₹ 1024.87	₹ 87.85
50 - 100	₹ 1171.28	₹ 140.56
> 100	₹ 1317.69	₹ 175.69

A water cess is levied at ₹ 0.20/kL and the sewerage charge is 60% of the consumption charge.

30. ₹ 2000 is invested at annual rate of interest of 10%. What is the amount after two years if compounding is done (a) Annually (b) semi-annually (c) Quarterly (d) monthly. **[3]**

31. In the adjacent Venn diagram, if n (ξ) = 80, n(P) = 40, n(Q) = 28, n(P ∩ Q) = 12 and n(P ∩ R) = 10, **[3]**



i. mark the number of elements in each region.

ii. determine the value of n (P ∪ Q) and n ((Q ∪ R)').

Section D

32. There are n A.M.s between 3 and 17. The ratio of the last mean to the first mean is 3 : 1. Find the value of n. **[5]**

OR

If S_1, S_2, S_3 be respectively the sums of n, 2n, 3n terms of a G.P., then prove that $s_1^2 + s_2^2$ = $s_1(s_2 + s_3)$.

33. Find the domain and range of the real function: $f(x) = \sqrt{9 - x^2}$ **[5]**

34. Compute moment coefficient of Kurtosis for the following data: **[5]**

C.I.	2.5 - 7.5	7.5 - 12.5	12.5 - 17.5	17.5 - 22.5	22.5 - 27.5	27.5 - 32.5	32.5 - 37.5
f	8	15	18	29	23	17	5

OR

Calculate the standard deviation for the following data:

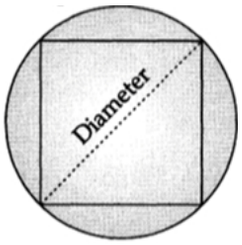
Class:	0-30	30-60	60-90	90-120	120-150	150-180	180-210
Frequency:	9	17	43	82	81	44	24

35. A shopkeeper buys an article whose list price is ₹8000 at some rate of discount from a wholesaler. He sells the article to a consumer at the list price. The sales are intra-state and the rate of GST is 18%. If the shopkeeper pay a tax (under GST) of ₹72 to the State Government, find the rate of discount at which he bought the article from the wholesaler. **[5]**

Section E

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

A farmer has a circular field in which a square area is there. In that square area, he was able to crop the field and rest of the area outside the square was not good for crops.



(a) If the coordinates of centre of the circle are (2, -3), then which of the following equation of the diameter will pass through the centre?

(b) If the centre of the circle is (2, -3) and radius is 8 then equation of circle will be?

(c) If radius of circle is double, then its area will be?

OR

If the square has side 2m, then find the difference between the area of circle and square?

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

A teacher conducted a surprise test of Mathematics, Physics and Chemistry for class XI on Monday.

The mean and standard deviation of marks obtained by 50 students of the class in three subjects are given below:

Subject	Mathematics	Physics	Chemistry
Mean	42	32	40.9
Standard deviation	12	15	20

(a) Which of the three subjects shows the highest variability?

(b) What is the coefficient of variation of marks obtained by the students in Chemistry?

(c) What is the coefficient of variation of marks obtained by the students in Physics?

OR

What is the coefficient of variation of marks obtained by the students in Mathematics?

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

Two students Ankit and Vinod appeared in an examination. The probability that Ankit will qualify the examination is 0.05 and that Vinod will qualify is 0.10. The probability that both will qualify is 0.02.

(a) Find the probability that atleast one of them will qualify the exam.

(b) Find the probability that atleast one of them will not qualify the exam.

(c) Find the probability that both Ankit and Vinod will not qualify the exam.

OR

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

A shopkeeper sells three types of flower seeds A_1, A_2, and A_3. They are sold as a mixture, where the proportions are 4 : 4 : 2 respectively. The germination rates of the three types of seeds are 45%, 60% and 35% respectively.

(a) Calculate the probability of randomly chosen seed to germinate.

(b) Calculate the probability that it is of the type A_2 given that randomly chosen seed does not germinate.

(c) Calculate the probability that it will not germinate given that the seed is of type A_1.

Solution

Section A

1.

(d) 1010

Explanation: To get the binary equivalent of any number, we need to divide the number by 2 and obtain remainder as:

2 | 10		
2 | 5	0	↑
2 | 2	1	
2 | 1	0	
0	1	

Now, we write the remainder in the reverse order as 1010.

2.

(d) 55, 10

Explanation: 5 is added to 100 observation each.

So $5 \times 100 = 500$ is added.

$\bar{x} = \frac{500}{100} = 5$

So mean increased by 5 hence, $\bar{x}$ becomes 55.

Standard deviation will remain same because every observation increased by 5 and mean also increased by 5.

So S.D = 10

i.e. Mean = 55

S.D = 10

3.

(c) ₹ 1848

Explanation: Cost of fan to the consumer inclusive

= ₹ 1650 + ₹ 99 + ₹ 99 = ₹ 1848

4. **(a)** 44

Explanation: Now we know standard deviation can be written as,

$$\sigma = \sqrt{\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2}$$

But given $\sum x^2$=18000, $\sum x$ = 960, N = 60, substituting these corresponding values, we get

$$\sigma = \sqrt{\frac{18000}{60} - \left(\frac{960}{60}\right)^2}$$

$$\sigma = \sqrt{300 - (16)^2}$$

$$\sigma = \sqrt{300 - 256}$$

$$\sigma = \sqrt{44}$$

Now for variance we will square on both sides, we get

$\sigma^2 = 44$

Hence the required variance is 44

5. **(a)** {(1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (1, 2), (2, 3)}

Explanation: R = {(x, y) : $|x^2 - y^2| < 7$}

R = {(1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (1, 2), (2, 3)}

6.

(c) log 30

Explanation: We know that

$\log_a(mn) = \log_a m + \log_a n$

Therfore, $\log 6 + \log 5 = \log (6 \times 5) = \log 30$

7.

(c) x = 0, y = $\frac{-14}{3}$

Explanation: Given that: (x - 2, y + 5) = (-2, 13)

$\Rightarrow x - 2 = -2 \Rightarrow x = 0$ and $y + 5 = \frac{1}{3} \Rightarrow y = \frac{1}{3} - 5 = \frac{-14}{3}$

8.

(c) -2

Explanation: Three lines are concurrent if they pass through a common point i.e., point of intersection of any two lines lies on the third line

It is given that lines

2x + y - 3 = 0 ...(i)

5x + ky - 3 = 0 ...(ii)

3x - y - 2 = 0 ...(iii)

So finding point of intersection of lines i and iii, we get (1, 1)

Since, lines (i), (ii) and (iii) are concurrent

Thus, the point will satisfy equation of line (ii)

Thus, 5(1) + k(1) - 3 = 0

k + 2 = 0

k = -2

9. **(a)** 385

Explanation: Every number is a multiple of 3 except 385

Therefore, 385 is a odd man.

10.

(c) -0.077

Explanation: Given data Q_1 = 15, Q_3 = 28

Mean = 20, Mode = 26

Mode = 3Median - 2Mean

26 = 3Median - 2 $\times$ 20

3Median = 26 + 40

Median = $\frac{66}{3}$ = 22

Median = 22

$S_{KB} = \frac{Q_3+Q_1-2M_d}{Q_3-Q_1}$

= $\frac{28+15-2(22)}{28-15}$

= $\frac{43-44}{13}$

= $\frac{-1}{13}$ = -0.077

11.

(b) log 32 - log 4

Explanation: We know that,

$\log_a\left(\frac{m}{n}\right) = \log_a m - \log_a n$

Therefore, $\log\left(\frac{32}{4}\right)$ = log 32 - log 4

12.

(d) ₹ 625

Explanation: Let the sum be P.

$\therefore \left(P\left(1+\frac{4}{100}\right)^2 - P\right) - \left(\frac{P\times4\times2}{100}\right) = 1$

$\Rightarrow P \times \frac{26\times26}{25\times25} - P - \frac{2P}{25} = 1$

$\Rightarrow$ 676 P - 625 P - 50 P = ₹ 625

$\Rightarrow$ P = ₹ 625

13.

(b) 80C

Explanation: Tuition fee qualifies for tax benefit under Section 80C of the Income-tax Act, 1961.

14.

(b) $\left(\sqrt{x^3}\right)^{\frac{2}{3}}$

Explanation: $\because \left(\sqrt{x^3}\right)^{\frac{2}{3}} = \left(x^{\frac{3}{2}}\right)^{\frac{2}{3}} = x^1 = x$

15.

(c) $\frac{3}{4}$

Explanation: $\frac{3}{4}$

16.

(b) 8.16%

Explanation: 8.16%

17. **(a)** $(000)_2$

Explanation: The binary numbers should comprise only two digits 0 and 1. Also, for the base, the value should be 2 and it should be written as a subscript enclosing the entire number. Hence, $(000)_2$ option gives the correct representation.

18.

(b) {2, 3, 4, 5}

Explanation: R: x R y $\Leftrightarrow$ x is relatively prime to y.

Two numbers are relatively prime if their Highest Common Factor is 1.

Then, R = {(2, 3), (2, 7), (3, 7), (3, 10), (4, 3), (4, 7), (5, 3), (5, 6), (5, 7)}

Therefore, the domain of R is {2, 3, 4, 5}

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

Explanation: We know that P(B - A) = P(B) - P(A $\cap$ B)

$\because\ A \subset B \Rightarrow A \cap B = A$

$\therefore$ R is true.

So, P(B - A) = P(B) - P(A)

$\therefore$ A is true and R is the correct explanation of A.

20.

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

Explanation: Number of ways of going from Lucknow to Kanpur by bus = 10

Number of ways of returning back by different bus = 9

$\therefore$ By fundamental principle of counting, total number of ways = $10 \times 9 = 90$

$\therefore$ A is true.

Also, R is true but R is not the correct explanation of A.

Section B

21. Suppose Rohit can complete the given piece of work in n days. Then, Mohit and Sonit alone take $\frac{n}{2}$ and $\frac{n}{3}$ days respectively to complete the same piece of work. It is given that all three working together can complete the work in 4 days.

$\therefore \frac{1}{4} = \frac{1}{n} + \frac{1}{\frac{n}{2}} + \frac{1}{\frac{n}{3}} \Rightarrow \frac{1}{4} = \frac{1}{n} + \frac{2}{n} + \frac{3}{n} \Rightarrow \frac{1}{4} = \frac{6}{n} \Rightarrow$ n = 24

Hence, Rohit, Mohit and Sonit alone can complete the work in 24 days, 12 days and 8 days respectively

22. Her mother's brother means a girl's maternal uncle.

Only son of my mother's father means Rishabh's maternal uncle.

So girl's maternal uncle is Rishabh's maternal uncle

$\Rightarrow$ girl's mother's brother is Rishabh's mother's brother

$\Rightarrow$ girl's mother and Rishabh's mother are sisters

girl's mother is the maternal Aunt of Rishabh.

OR

In the first and second statements, common codes are 3 and 7, and common words are 'is' and 'eternal'.

In the first and third statements, the common code is 2 and the common word is 'truth'.

So code 2 means 'truth'

In the second and third statements, the common code is 9 and the common word is 'not'.

So code 8 stands for the word 'Enmity'.

23. At 5 O'clock, the hour hand is at 5 and the minute hand is at 12. It means the angle between the two hands of the clock is 150^o.
The hands of the clock will be at right angles twice between 5:00 and 6:00

For the first time: The minute hand had to cover a relative distance of 60^o.
So the time required = $\frac{60}{5.5}$ minutes = $\frac{60\times2}{11}$ minutes = $10\frac{10}{11}$ minutes
= 10 min 55 sec
Hence, the hands of the clock are at right angles at 5:10:55

For the second time: The minute hand had to cover a relative distance of 240^o.
So the time required = $\frac{240}{5.5}$ minutes = $\frac{240\times2}{11}$ minutes = $43\frac{7}{11}$ minutes
= 43 min 38 sec
Hence, the hands of the clock are at right angles at 5:43:38.

24. Let f(x) = $\frac{ax+b}{cx+d}$, note that f is not defined at x = $\frac{d}{c}$

By def., f'(x) = $\lim\limits_{h\to0}\frac{f(x+h)-f(x)}{h} = \lim\limits_{h\to0}\frac{\frac{a(x+h)+b}{c(x+h)+d}-\frac{ax+b}{cx+d}}{h}$

$= \lim\limits_{h\to0}\frac{(ax+b+ah)(cx+d)-(cx+d+ch)(ax+b)}{h(cx+d+ch)(cx+d)}$

$= \lim\limits_{h\to0}\frac{ah(cx+d)-ch(ax+b)}{h(cx+d+ch)(cx+d)} = \lim\limits_{h\to0}\frac{ad-bc}{(cx+d+ch)(cx+d)}$

$= \frac{ad-bc}{(cx+d+0)(cx+d)} = \frac{ad-bc}{(cx+d)^2}, x\neq-\frac{d}{c}$

OR

Let y = $\sqrt{x}\left(2x^2+3\right)$

$= 2x^{\frac{5}{2}} + 3x^{\frac{1}{2}}$

$\frac{dy}{dx} = 2\cdot\frac{5}{2}x^{\frac{3}{2}} + 3\times\frac{1}{2}\cdot x^{\frac{-1}{2}}$

$\Rightarrow \frac{dy}{dx} = 5x^{\frac{3}{2}} + \frac{3}{2\sqrt{x}}$

25. Consider the following events:
W_1 = Drawing a white ball from first bag, W_2 = Drawing a white ball from second bag.
B_1 = Drawing a black ball from first bag, B_2 = Drawing a black ball from second bag.
Clearly, P(W_1) = $\frac{4}{6}$, P(B_1) = $\frac{2}{6}$, P(W_2) = $\frac{3}{8}$ and P(B_2) = $\frac{5}{8}$.
Therefore, required probability is given by,
P(one white ball and one black ball)
= P[(black from 1st and white from 2nd) or (white from 1st and black from 2nd)]
= $P\left[(B_1\cap W_2)\cup(W_1\cap B_2)\right]$
= $P\left(B_1\cap W_2\right)+P\left(W_1\cap B_2\right)$ [By addition theorem for mutually exclusive events]
= P(B_1) P(W_2) + P(W_1) P(B_2) [$\because$ B_1 and W_2; B_2 & W_1 are pairs of independent events]
= $\frac{2}{6}\times\frac{3}{8}+\frac{4}{6}\times\frac{5}{8} = \frac{13}{24}$

Section C

26. There are seven digits - one 1, three 2's, one 0, and two 4's.
Since the number 1000000 has seven digits and the number greater than 1000000 must have at least 7 digits, so the required numbers are 7-digit numbers only.
All seven-digit numbers formed from given digits are greater than 1000000
The number of arrangements of given digits = $\frac{\lfloor\underline{7}}{\lfloor\underline{3}\times\lfloor\underline{2}}$
= $\frac{7\times6\times5\times4\times3\times2\times1}{3\times2\times1\times2\times1}$ = 420
But these include numbers which have 0 on the extreme left and hence are not of seven digits.
The number of such numbers = $\frac{\lfloor\underline{6}}{\lfloor\underline{3}\times\lfloor\underline{2}}$ = $\frac{720}{6\times2}$ = 60
Hence, the required number of numbers = 420 - 60 = 360

OR

There are 11 letters in the word 'ARRANGEMENT' out of which 2 A's, 2 E's, 2 R's and 2 M's.
Considering both A, both E, both R and both M together, 8 letters should be counted as 4.
So, there are total 7 letters (AA EE RR MM G M T)
These 7 letters can be arranged in 7! ways
Hence, total ways = 7!

$= 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

$= 5040$

27. Observe the unit column of the addition.

A + B cannot exceed 18 and the unit digit in the sum is 9, so A + B = 9

This is possible when

A = 1, B = 8; A = 2, B = 7, ..., A = 8, B = 1

Now, observe ten's column

As 2 + A cannot exceed 11 and the digit below the sum of ten's column is 0, therefore

2 + A = 10

$\Rightarrow$ A = 8

$\therefore$ A = 8, B = 1

Now check the sum

$$\begin{array}{r} 1\ 2\ \textcircled{8} \\ +\ 6\ \textcircled{8}\ \textcircled{1} \\ \hline \textcircled{8}\ 0\ 9 \end{array}$$

Hence, the required digits are A = 8, B = 1

28. When $x \leq 1$, $f(x) = x^2 - 1$.

x 0.09 0.099 0.999 0.9999

f(x) -0.19 -0.199 -001999 -0.00019999

$\therefore \lim\limits_{x \to 1^-} f(x) = 0$

when $x > 1$ $f(x) = -x^2 - 1$

x 1.1 1.01 1.001 10001

f(x) -2.21 -2.0201 -2.002001 -2.00020001

$\therefore \lim\limits_{x \to 1^+} f(x) = -2$

Since $\lim\limits_{x \to 1^-} f(x) \neq \lim\limits_{x \to 1^+} f(x)$

$\therefore \lim\limits_{x \to 1} f(x)$ does not exist.

29. Here, the consumption of water is given to be 285 kL

According to the given tariff plan:

Water consumption charge = ₹[(17.57 $\times$ 6) + (26.35$\times$9) + (35.14$\times$10) + (87.85$\times$25) + (140.56$\times$50) + (175.69$\times$185)]

= ₹(105.42 + 237.15 + 351.40 + 2196.25 + 7028.00 + 32502.65)

= ₹ 42420.87

The service charge for consumption above 100kL is ₹ 1317.69

$\therefore$ Service charge = ₹ 1317.69

Also, the sewerage charge is 60% of the consumption charge

$\therefore$ Sewerage charge = 60% of ₹ 42420.87

= ₹ 25452.52

Water Cess = ₹ 0.20 per kL

= ₹(285 $\times$0.20) = ₹57

$\therefore$ Total Water Bill = Water Consumption charge + Service charge + Sewerage charge + Water Cess

= ₹ 42420.87 + ₹ 1317.69 + ₹ 25452.52 + ₹ 57.00

= ₹ 69248.08

30. Here, P = ₹ 2000, i = 10% = $\frac{10}{100}$ = 0.1

a. Since, interest is compounded yearly

n = 2

Since, $A_n = P(1 + i)^n$

$\therefore A_2 = 2000(1 + 0.1)^2$

$= 2000\ (1.1)^2$

$= 2000 \times 1.21$

= ₹ 2420

b. For semi-annual compounding

n = 2 × 2 = 4

Since, i = $\frac{0.1}{2}$ = 0.05

∴ A = 2000 $(1 + 0.5)^4$

= 2000 × $(1.05)^4$

= 2000 × 1.2155

=₹ 2431

c. For quarterly compounding

n = 4 × 2 = 8

Since, i = $\frac{0.1}{4}$ = 0.025

∴ A_4 = 2000 × $(1 + 0.025)^8$

= 2000 × $(1.025)^8$

= 2000 × 1.2184

= ₹ 2436.80

d. For monthly compounding

n = 12 × 2 = 24

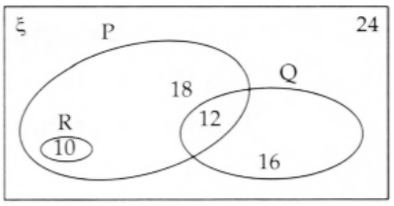
Since, i = $\frac{0.1}{12}$ = 0.00833

∴ A_{24} = 2000 × $(1 + 0.00833)^{24}$

= 2000 × 1.22029

= ₹ 2440.58

31. i. The number of elements in different regions are shown in the adjoining figure.



ii. From the Venn diagram, we get

n(P ∪ Q) = 10 + 18 + 12 + 16 = 56,

n(Q ∪ R) = 16 + 12 + 10 = 38

⇒ n((Q ∪ R)') = 80 - 38 = 42

Section D

32. As per the question, we can write it as,

Let the n A.M's between 3 and 17 be A_1, A_2, A_3, ..., A_n Then,

ATQ

$\frac{A_n}{A_1} = \frac{3}{1}$ ...(i)

We know that 3, A_1, A_2, A_3, ..., A_n, 17 are in A.P of n + 2 terms

So, 17 is the (n + 2)th terms. i.e. 17 = 3 + (n + 2 - 1) d [Using a_n = a + (n - 1) d]

or

d = $\frac{14}{(n+1)}$

A_n = 3 + (n + 1 - 1) d

= 3 + $\frac{14n}{n+1} = \frac{17n+3}{n+1}$

A_1 = 3 + d = $\frac{3n+17}{n+1}$

From (i), (iii) and iv

$\frac{A_n}{A_1} = \frac{17n+3}{3n+17} = \frac{3}{1}$

n = 6

There are 6 A.M.s between 3 and 17

OR

S_1 = sum of n terms,

S_1 = sum of 2n terms,

S_1 = sum of 3n terms,

Then, $s_1^2 + s_2^2$

= $(s_n)^2 + (s_{2n})^2$

= $\left(\frac{a(1-r^n)}{1-r}\right)^2 + \left(\frac{a(1-r^{2n})}{1-r}\right)^2$

= $\frac{a^2}{(1-r)^2}$ [$(1 - (r)^n)^2 + (1 - r^{2n})^2$]

= $\frac{a^2}{(1-r)^2}$ [$1 + r^{2n} - 2r^n + 1 + r^{4n} - 2r^{2n}$]

= $\frac{a^2}{(1-r)^2}$ [$2 - r^{2n} - 2r^n + r^{4n}$] ...(i)

Also, $S_1(S_2 + S_3)$

= $\frac{a(1-r^n)}{1-r}\left(\frac{a(1-r^{2n})}{1-r} + \frac{a(1-r^{3n})}{1-r}\right)$

= $\frac{a^2}{(1-r)^2}$[(1 - r)n (1 - r2^n) + (1 - r^n) (1 - r^{3n})]

= $\frac{a^2}{(1-r)^2}$ [$1 - r^{2n} - r^n + r^{3n} - r^{3n} - r^n + 1 + r^{4n}$]

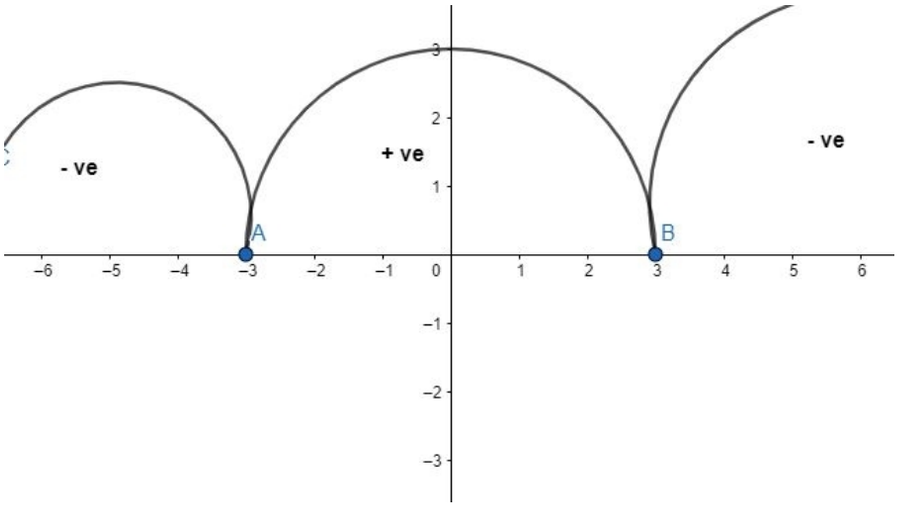
= $\frac{a^2}{(1-r)^2}$ [$2 - r^{2n} - 2r^n + r^{4n}$] ...(ii)

(i) = (ii) Hence, $s_1^2 + s_2^2 = s_1(s_2 + s_3)$

Hence, it is proved as per given condition.

33. Here the given function is: $f(x) = \sqrt{9 - x^2}$

Domain: These are the values of x for which f(x) is defined. From the given f(x) we can say that, f(x) should be real and for that, 9 - $x^2 \geq 0$ [since a value less than 0 will give an imaginary value] (3 + x)(3 - x) ≥ 0. Now there are two critical points, x = +3 and x = -3. Taking a value less than -3 and putting in the expression we get, (3 - 5)(3 + 5) = -ve value and thus plotting these on number line we have



Since, f(x) is defined for all real numbers that are greater than or equal to -3 and less than or equal to 3, the domain of f(x) is [-3, 3].

Range: The values of f(x) obtained by putting possible values of x. From the f(x) we can see that, the values obtained will only be positive and can be any positive number less than 3. Hence the range of f(x) = [0, 3).

34. Table for finding mean

C.I.	x_i	f_i	$d_i = \frac{x_1 - 20}{5}$	$f_i d_i$
2.5 - 7.5	5	8	-3	-24
7.5 - 12.5	10	15	-2	-30
12.5 - 17.5	15	18	-1	-18
17.5 - 22.5	(20)	29	0	0
22.5 - 27.5	25	23	1	23
27.5 - 32.5	30	17	2	34

32.5 - 37.5	35	5	3	15
		115		0

$\therefore \bar{x} = A + \frac{\sum_{i=1}^{n} f_i d_i}{\sum_{i=1}^{n} f_i} \times h = 20 + \frac{0}{115} \times 5 = 20$

Table for finding first four moments

x_i	f_i	x_i - 20	$f_i(x_i - 20)$	$f_i(x_i - 20)^2$	$f_i(x_i - 20)^3$	$f_i(x_i - 20)^4$
5	8	-15	-120	1800	-27000	405000
10	15	-10	-150	1500	-15000	150000
15	18	-5	-90	450	-2250	11250
20	29	0	0	0	0	0
25	23	5	115	575	2875	14375
30	17	10	170	1700	17000	170000
35	5	15	75	1125	16875	253125
	115		0	7150	10000	1003750

$\mu_2 = \frac{1}{N} \sum_{i=1}^{n} f_i (x_i - 20)^2 = \frac{1}{115} \times 7150 = 62.17$; $\mu_4 = \frac{1}{N} \sum_{i=1}^{n} f_i (x_i - 20)^4 = \frac{1}{115} \times 1003750 = 8728.26$

$\beta_2 = \frac{\mu_4}{\mu_2^2} = \frac{8728.26}{(62.17)^2} = 2.26 < 3$; Nature of kurtosis is platykurtic.

OR

1st of all we prepare the following table.

Class	f_i	Mid point (x_i)	$y_i = \frac{x_i - 105}{30}$	y_i^2	$f_i y_i$	$f_i y_i^2$
0-30	9	15	-3	9	-27	81
30-60	17	45	-2	4	-34	68
60-90	43	75	-1	1	-43	43
90-120	82	105	0	0	0	0
120-150	81	135	1	1	81	81
150-180	44	165	2	4	88	176
180-210	24	195	3	9	72	216
	$\sum f_i = N = 300$				$\sum f_i y_i = 137$	$\sum f_i y_i^2 = 665$

Mean,

$\bar{x} = a + h \left(\frac{1}{N} \Sigma f_i y_i\right) = 105 + 30 \left(\frac{137}{300}\right) = 118.7$

Variance:

$\sigma^2 = \frac{h^2}{N^2} \left[N \sum f_i y_i^2 - (\sum f_i y_i)^2\right]$

$= \frac{900}{90000}$ [300 × 665 - 18769]

$= \frac{1}{100}$ [199500 - 18769]

$= \frac{180731}{100} = 1807.31$

SD , $\sigma = \sqrt{1807.31} = 42.51$

35. Given:

List of price of an article = ₹8000

Let the rate of discount given by wholesaler = x%

So,

Discount = x% of ₹8000

$= (\frac{x}{100}) \times$ ₹8000

= ₹80x

CP of an article for shopkeeper = ₹8000 – ₹80x

It is given that, CP of article for consumer = ₹8000

Since the sales are intra-state, rate of GST = 18%

CGST = SGST = 9%

Amount of GST paid by shopkeeper to wholesaler,

SGST = CGST = 9% of [₹8000 – ₹80x]

$= (\frac{9}{100}) \times$ [₹8000 - ₹80x]

Amount of GST paid by consumer to shopkeeper,

CGST = SGST = 9% of ₹8000

$= (\frac{9}{100}) \times$ ₹8000 = ₹720

So, the tax paid by shopkeeper to state government = ₹720 - $(\frac{9}{100}) \times$ [₹8000 – ₹80x]

Also, tax paid by shopkeeper to state government = ₹72

₹72 - 720 - $(\frac{9\times80}{100})$ (100 - x)

720 - 72 = $(\frac{720}{100})$ (100 - x)

648 = $(\frac{72}{10})$ (100 - x)

100 - x = $\frac{648\times10}{72}$

100 - x = 90

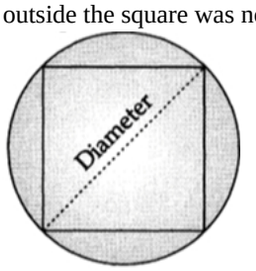
x = 100 - 90 = 10

Hence, the required rate of discount = 10%

Section E

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

A farmer has a circular field in which a square area is there. In that square area, he was able to crop the field and rest of the area outside the square was not good for crops.



(i) Coordinates which satisfy the equation of the line is x + y = -1.

(ii) Equation of circle : $(x - 2)^2 + (y + 3)^2 = 8^2$

$x^2 + y^2 - 4x + 6y - 51 = 0$

(iii) Let the radius = a, then area = πa^2

If the radius be double, then area = $\pi(2a)^2 = 4(\pi 4a)^2$

Therefore change in area is four times.

OR

Area of square = 4 m^2

Area of circle = $\pi(\sqrt{2})^2 = 2\pi$

Required area = 2π - 4

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

A teacher conducted a surprise test of Mathematics, Physics and Chemistry for class XI on Monday.

The mean and standard deviation of marks obtained by 50 students of the class in three subjects are given below:

Subject	Mathematics	Physics	Chemistry
Mean	42	32	40.9
Standard deviation	12	15	20

(i) The subject with greater C.V. is more variable than others.

Therefore, the highest variability in marks is in Chemistry.

(ii) Standard deviation of Chemistry = 20

C.V. (in Chemistry) = $\frac{20}{40.9} \times 100 = 48.89$

(iii) Standard deviation of Physics = 15

The coefficient of variation, C.V. = $\frac{\text{Standard deviation}}{Mean} \times 100$

C.V. (in Physics) = $\frac{15}{32} \times 100 = 46.87$

OR

Standard deviation of Mathematics = 12

The coefficient of variation, C.V. = $\frac{\text{Standard deviation}}{Mean} \times 100$

C.V. (in Mathematics) = $\frac{12}{42} \times 100 = 28.57$

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

Two students Ankit and Vinod appeared in an examination. The probability that Ankit will qualify the examination is 0.05 and that Vinod will qualify is 0.10. The probability that both will qualify is 0.02.

(i) Let E_1 and E_2 denotes the events that Ankit and Vinod will respectively qualify the exam.

$P(E_1 \cup E_2)$ = P(E_1) + P(E_2) − P($E_1 \cap E_2$)

= 0.05 + 0.10 - 0.02 = 0.13

(ii) Let E_1 and E_2 denotes the events that Ankit and Vinod will respectively qualify the exam.

Probability of atleast one of them does not qualify

$= P(E_1' \cup E_2') = P((E_1 \cap E_2)')$

= 1 - p($E_1 \cap E_2$) = 1 - 0.02 = 0.98

(iii) Let E_1 and E_2 denotes the events that Ankit and Vinod will respectively qualify the exam.

$= P(E_1' \cap E_2') = P((E_1 \cup E_2)')$

= 1 - P($E_1 \cup E_2$) = 1 - 0.13 = 0.87

OR

Read the text carefully and answer the questions:

A shopkeeper sells three types of flower seeds A_1, A_2, and A_3. They are sold as a mixture, where the proportions are 4 : 4 : 2 respectively. The germination rates of the three types of seeds are 45%, 60% and 35% respectively.

(i) Here, P(A_1) = $\frac{4}{10}$, P(A_2) = $\frac{4}{10}$, P(A_3) = $\frac{2}{10}$,

and P(G | A_1) = $\frac{45}{100}$, P(G | A_2) = $\frac{60}{100}$, P(G | A_3) = $\frac{35}{100}$

where G is the event that seeds germinate.

P(G) = P(A_1)·P(G | A_1) + P(A_2)·P(G | A_2) + P(A_3)·P(G | A_3)

= $\frac{4}{10} \times \frac{45}{100} + \frac{4}{10} \times \frac{60}{100} + \frac{2}{10} \times \frac{35}{100} = \frac{490}{1000} = 0.49$

(ii) Here, P(A_1) = $\frac{4}{10}$, P(A_2) = $\frac{4}{10}$, P(A_3) = $\frac{2}{10}$,

and P(G | A_1) = $\frac{45}{100}$, P(G | A_2) = $\frac{60}{100}$, P(G | A_3) = $\frac{35}{100}$

where G is the event that seeds germinate.

Required probability = P(A_2 | G') = $\frac{P(A_2) \cdot P(G'|A_2)}{P(A_1) \cdot P(G'|A_1) + P(A_2) \cdot P(G'|A_2) + P(A_3) \cdot P(G'|A_3)}$

= $\frac{\frac{4}{10} \times \frac{40}{100}}{\frac{4}{10} \times \frac{55}{100} + \frac{4}{10} \times \frac{40}{100} + \frac{2}{10} \times \frac{65}{100}} = \frac{160}{510} = \frac{16}{51} = 0.314$

(iii) P(seeds of type A_1 will not germinate) = 1 - $\frac{45}{100} = \frac{55}{100}$.