Class XI Session 2025-26
Subject - Applied Maths
Sample Question Paper - 5

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. Two dice are thrown once. If it is known that the sum of the numbers on the dice was less than 6 the probability of getting a sum 3 is **[1]**

   a) $\frac{5}{18}$ b) $\frac{1}{5}$

   c) $\frac{1}{18}$ d) $\frac{2}{5}$

2. In a group of students, mean weight of boys is 80 kg and mean weight of girls is 50kg. If the mean weight of all the students taken together is 60kg, then the ratio of the number of boys to that of the girls is **[1]**

   a) 3 : 2 b) 2 : 3

   c) 1 : 2 d) 2 : 1

3. The difference between compound and simple interest on an amount of ₹ 1000 for 2 years is ₹ 64. What is the rate of interest per annum? **[1]**

   a) 6% b) 9%

   c) 8% d) 10%

4. $2^{\frac{1}{2}} . 4^{\frac{3}{4}}$ is equal to **[1]**

   a) a negative integer b) 0

   c) a positive integer d) a fraction

5. Let R be a relation on N defined by x + 2y = 8. The domain of R is **[1]**

a) {2, 4, 6}
b) {1, 2, 3, 4}
c) {2, 4, 8}
d) {2, 4, 6, 8}

6. $2^4 = 16$ in logarithmic form is **[1]**

a) $\log_4 16 = 2$
b) $\log_2 16 = 4$
c) $\log_4 2 = 16$
d) $4 \log 2 = \log 16$

7. Six boys and six girls sit in a row randomly. The probability that the six girls sit together is: **[1]**

a) $\frac{131}{132}$
b) $\frac{1}{132}$
c) $\frac{17}{132}$
d) $\frac{15}{132}$

8. The area of the circle centred at (1,2) and passing through (4, 6) is **[1]**

a) 10π
b) 35π
c) 5π
d) 25π

9. Running at $\frac{3}{4}$th of his usual speed an athlete takes 5 minutes more, the time taken to run the same distance at usual speed is **[1]**

a) 25 minutes
b) 15 minutes
c) 12 minutes
d) 20 minutes

10. Following are the marks obtained by 9 students in a mathematics test: **[1]**
50, 69, 20, 33, 53, 39, 40, 65, 59
The mean deviation from the median is:

a) 14.76
b) 12.67
c) 9
d) 10.5

11. If $\log_{0.2} x = 3$, then value of x is **[1]**

a) 9
b) 0.08
c) 0.6
d) 0.008

12. The simple interest on a certain sum of money for 2 years at 10% per annum is half the compound interest on ₹ 5000 for 2 years at 10% per annum. The sum is: **[1]**

a) ₹ 2925
b) ₹ 2850
c) ₹ 2500
d) ₹ 2625

13. If ${}^nC_{12} = {}^nC_8$, then n is equal to **[1]**

a) 30
b) 6
c) 20
d) 12

14. An urn contains 9 red, 7 white and 4 black balls. A ball is drawn at random. The probability that the ball is drawn is neither black nor red is: **[1]**

a) $\frac{1}{5}$
b) $\frac{7}{20}$
c) $\frac{13}{20}$
d) $\frac{9}{20}$

15. A bag contains 5 red, 6 blue and 4 black balls. Three balls are drawn from the bag. Then the probability that **[1]**

none of them is red, is

a) $\frac{11}{91}$

b) $\frac{6}{35}$

c) $\frac{24}{91}$

d) $\frac{2}{91}$

16. The amount at the compound interest which is calculated yearly on a certain sum of money is ₹ 1250 is one year and ₹ 1375 in two years. The rate of interest per annum is: **[1]**

a) 8%

b) 11%

c) 9%

d) 10%

17. Everybody in a room shakes hands with everybody else. The total number of handshakes is 21. The total number of persons in the room is **[1]**

a) 6

b) 9

c) 7

d) 8

18. An ordered pair whose first entry is odd prime number less than 7 and second entry is 3 more than the first entry is **[1]**

a) (2, 5)

b) (3, 6)

c) (4, 7)

d) (15 , 18)

19. **Assertion (A):** The variance of 10 observations is 6. If each observation is multiplied by 3, then new variance is 54. **[1]**

Reason (R): If σ^2 is the variance of n observations $x_1, x_2, \ldots, x_n$, then variance of the observations $ax_1, ax_2 \ldots, ax_n$ is $a^2\sigma^2$.

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):** If 5th term of a G.P. is 9 and 11th term is 16, then 8th term is 12. **[1]**

Reason (R): In a G.P., $a_n = \frac{a_{n-k}+a_{n+k}}{2}$, n, k $\in$ N.

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. Find the angle between hour hand and minute hand at 11:30. **[2]**

22. In a group of 65 students, 40 like cricket, 10 like both cricket and tennis. How many like tennis only and not cricket? **[2]**

OR

If L = {1, 2, 3, 4}, M = {3, 4, 5, 6} and N = {1, 3, 5}, then verify that $L - (M \cup N) = (L - M) \cap (L - N)$

23. In an examination, a pupil's average marks were 63 per paper. If he had obtained 20 more marks for his Geography paper and 2 more marks for his History paper, his average marks per paper would be 65. How many papers were there in the examination. **[2]**

24. Find $\frac{dy}{dx}$: $x = t + \frac{1}{t}$, $y = t - \frac{1}{t}$ **[2]**

OR

Differentiate the functions with respect to x: $\log_x 3$

25. Represent the decimal number 36.8125 in a binary system. **[2]**

Section C

26. In an A.P., if the pth term is $\frac{1}{q}$ and qth term is $\frac{1}{p}$. Prove that the sum of first pq term is $\frac{1}{2}$ (pq + 1). **[3]**

OR

Find three numbers in G.P. whose product is 216 and the sum of their products in pairs is 156.

27. Find the equation of a straight line which passes through the point (a, 0) and whose perpendicular distance from (2a, 2a) is a. **[3]**

28. Find the domain and the range of the given function: f(x) = $\frac{x^2}{1+x^2}$ **[3]**

29. Vikram borrowed ₹ 20000 from a bank at 10% per annum simple interest. He lent it to his friend Venkat at the same rate but compounded annually. Find his gain after $2\frac{1}{2}$ years. **[3]**

30. The population of a town in the year 2014 was 150,500. If the annual increasing during three successive years he at the rate of 7%, 8% and 6% respectively, find the population at the end of 2017. **[3]**

31. Find the mean deviation about the mean for the following data : **[3]**

x_i	10	30	50	70	90
f_i	4	24	28	16	8

Section D

32. In a certain lottery 10,000 tickets are sold and ten equal prizes are awarded. What is the probability of not getting a prize if you buy **[5]**

i. One ticket?

ii. two tickets?

iii. 10 tickets?

OR

A doctor is to visit a patient. From the past experience, it is known that the probabilities that he will come by train, bus, scooter or by other means of transport are respectively $\frac{3}{10}$, $\frac{1}{5}$, $\frac{1}{10}$ and $\frac{2}{5}$. The probabilities that he will be late are $\frac{1}{4}$, $\frac{1}{3}$ and $\frac{1}{12}$ if he comes by train, bus and scooter respectively, but if he comes by other means of transport, then he will not be late. When he arrives, he is late. What is the probability that he comes by train?

33. Let f(x) = $\begin{cases} a+bx, & x<1 \\ 4, & x=1 \\ b-ax, & x>1 \end{cases}$ and if $\lim_{x\to1}$ f(x) = f(1), what are the possible values of a and b? **[5]**

34. Calculate Karl Pearson’s coefficient of skewness for the following data: **[5]**

Years	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Price index of wheat	83	87	93	104	106	109	118	124	126	130

OR

The variance of 20 observations is 5. If each observation is multiplied by 2, find the new variance of the resulting observation.

35. Find the equations of the lines passing through the point (3, -2) and inclined at an angle of 60^o to line $\sqrt{3x}$ + y = 1. **[5]**

Section E

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

During function lots of charts and displays are made with different colours, one such display is of concentric circles.

A circle is drawn whose equation is $x^2 + y^2 - 4x - 6y - 12 = 0$ and based on this other consecutive circles are drawn.

(a) Find the centre of given circle?

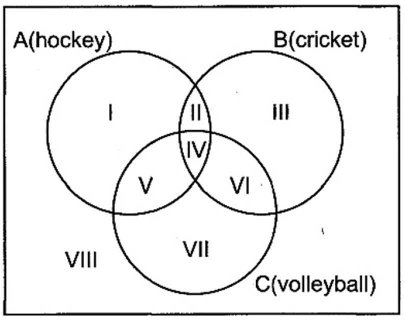
(b) Find the radius of given circle?

(c) Find the point which lies in the interior of circle?

(d) Find the Equation of a circle concentric with given circle, whose radius is double the radius of given circle?

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

To select the players for the sports tournament a school management asked the students to assemble in ground and stand according to the alloted area. In the ground three circular regions are marked as shown in figure and there are total eight segments for the players to stand according to their sports.



Circle A is for those who can play hockey. Circle B is for those who can play cricket. Circle C is for those who can play volleyball.

(a) If Rajnish can play all three games, then which segment Rajnish should be stand?

(b) Ram can play only hockey and cricket, then which segement he must be stand?

(c) If Sumit is standing in segment V, can he play?

(d) Harsh can not play any of the game he came to see the games, then which segment he must be stand?

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

Out of 7 boys and 5 girls a team of 7 students is to be made.

(a) Find the number of ways, if team contain at least 3 girls.

(b) Find the number of ways, if team contain exactly 3 girls.

(c) if exactly 3 girls are selected and are arranged in a row for photograph. Find number of ways if all girls and all the boys will stand together.

(d) The number of ways to arrange 3 girls and 4 boys if no two boys and girls will stand together.

OR

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

Out of 7 boys and 5 girls a team of 7 students is to be made.

(a) In how many ways Sunil can select all four cards from same suit?

(b) In how many ways Anita can select four cards from different suit?

(c) In how many ways Sunil can select all face cards?

(d) In how many ways Anita can select two cards of same colour?

Solution

Section A

1.

(b) $\frac{1}{5}$

Explanation:

As favourable cases for sum less than 6 are 10 and favourable for a total of 3 is 2.

2.

(c) 1 : 2

Explanation:

Let the no. of boys be x and no. of girls be y

Sum of weights of boys = 80x

Sum of weights of girls = 50y

Sum of weights of boys and girls together = 60(x + y)

Hence, 80x + 50 y = 60x + 60y

Which gives, 20x = 10 y

So, x : y = 1 : 2

3.

(c) 8%

Explanation:

Let the rate be r% p.a.

$\therefore \left(10000\left(1+\frac{r}{100}\right)^2-10000\right)-\left(\frac{10000\times r\times 2}{100}\right)=64$

$\Rightarrow 10000\left[\frac{10000+200r+r^2-10000}{10000}\right]-200r=64$

$\Rightarrow r^2 + 200r - 200r = 64$

$\Rightarrow r^2 = 64 \Rightarrow r = 8\%$.

4.

(c) a positive integer

Explanation:

$2^{\frac{1}{2}} \cdot 4^{\frac{3}{4}} = 2^{\frac{1}{2}} \cdot \left(2^2\right)^{\frac{3}{4}}$

$= 2^{\frac{1}{2}} \cdot 2^{2\times\frac{3}{4}}$

[using $(a^m)^n = a^{mn}$]

$= 2^{\frac{1}{2}} \cdot 2^{\frac{3}{2}}$

$= 2^{\frac{1}{2}+\frac{3}{2}} = 2^{\frac{4}{2}} = 2^2 = 4$

[Using $a^m \times a^n = a^{m+n}$]

5. **(a)** {2, 4, 6}

Explanation:

We have , x + 2y = 8

y = $\frac{8-x}{2}$

since, x and y are Natural numbers, So x must be an even number.

if x = 2, y = 3;

if x = 4, y = 2;

if x = 6, y = 1.

So, relation R = {(2, 3), (4, 2), (6, 1)}
Hence, the domain of R is {2, 4, 6}.

6.

(b) $\log_2 16 = 4$

Explanation:

$2^4 = 16$ in logarithmic form.

As we know that

if $a^y = x$

then $\log_a x = y$

$\therefore \log_2 16 = 4$

7.

(b) $\frac{1}{132}$

Explanation:

Given 6 boys and 6 girls

$\therefore$ Number of ways in which 6 boys and 6 girls together sitting in a row = 7!

6 girls sitting arrangement = 6!

$\therefore$ Required probability = $\frac{7! \times 6!}{12!} = \frac{1}{132}$

8.

(d) 25π

Explanation:

Distance between points (1,2) and (4, 6)

$= \sqrt{(4-1)^2 + (6-2)^2} = \sqrt{9+16} = 5$

Since the circle passes through (4,6) and centred as (1, 2). So, this distance between these points will be radius.

Area of circle = $\pi \times (\text{radius})^2 = \pi \times 5^2 = 25\pi$

9.

(b) 15 minutes

Explanation:

Let time taken x minutes for distance of y meters

$\therefore$ Speed = $\frac{y}{x}$ m/min.

Speed when time is 5 minutes more

Speed = $\frac{y}{x+5}$ m/min.

$\frac{3}{4}\left(\frac{y}{x}\right) = \frac{y}{x+5}$

$\Rightarrow 3x + 15 = 4x$

$\Rightarrow x = 15$ minutes

10.

(b) 12.67

Explanation:

Given the marks obtained by 9 students in a mathematics test are 50, 69, 20, 33, 53, 39, 40, 65, 59

As number of students = 9, which is odd.

So median will be $\frac{9+1}{2} = 5^{th}$ term.

Arranging these in ascending order, we get

20, 33, 39, 40, 50, 53, 59, 65, 69

So the 5^{th} term after arranging is 50,

So median is 50.

This can be written in table form as,

Marks (x_i)	$d_i = \|x_i = \text{median}\|$
20	= |20 - 50| = 30
33	= |33 - 50| = 17
39	= |39 - 50| = 11
40	= |40 - 50| = 10
50	= |50 - 50| = 0
53	= |53 - 50| = 3
59	= |59 - 50| = 9
65	= |65 - 50| = 15
69	= |69 - 50| = 19
Total	$\sum d_i$ = 114

Hence Mean Deviation becomes,

M.D = $\frac{\sum d_i}{n} = \frac{114}{5}$ = 12.67

Therefore, the mean deviation about the median of the marks of 9 subjects is 12.67

11.

(d) 0.008

Explanation:

$\log_{0.2} x = 3$

$\log_{0.2} (0.2)^3 = 3$

$\log_{(0.2)} 0.008 = 3$

$\therefore$ x = 0.008

12.

(d) ₹ 2625

Explanation:

Let the sum be P, then

$\frac{P\times10\times2}{100} = \frac{1}{2}\left[5000\left(1+\frac{10}{100}\right)^2 - 5000\right]$

$\Rightarrow \frac{P}{5} = \frac{5000}{2}\left[\frac{11}{10}\times\frac{11}{10} - 1\right]$

$\Rightarrow$ P = $\frac{12500\times21}{100}$ = ₹ 2625.

13.

(c) 20

Explanation:

Given, ${}^nC_{12} = {}^nC_8$

$\Rightarrow {}^nC_{12} = {}^nC_{n-8}$

$[\because {}^nC_r = {}^nC_{n-r}]$

$\Rightarrow$ 12 = n - 8

$\Rightarrow$ n = 20.

14.

(b) $\frac{7}{20}$

Explanation:

There are 9 red, 7 white and 4 black balls

Total number of balls = 20

If balls are neither red nor black balls then balls should be white

$\therefore$ total white balls = 7

The probability that the ball is drawn is neither black nor red is $\frac{7}{20}$.

15.

(c) $\frac{24}{91}$

Explanation:

Total no. of balls = 5 + 6 + 4 = 15

If three balls are drawn, then Total number of cases = ${}^{15}C_3$

The numbers of cases that, none of the balls are red (6 blue +4 Black) = ${}^{10}C_3$

$P(\text{None of ball are Red}) = \frac{\text{Favourable cases}}{\text{Total no. I cases.}}$

$= \frac{10C_3}{15C_3}$

$= \frac{10!}{7!3!} \times \frac{12!3!}{15!}$

$= \frac{10.9 \cdot 8 \cdot 7!}{7!} \times \frac{12!}{15 \cdot 14 \cdot 13 \cdot 12!}$

$\frac{10.9.8}{15.14.13} = \frac{24}{91}$

16.

(d) 10%

Explanation:

₹ 1250 is the interest of first year and ₹ 1375 is the interest in second year. Here, the difference is of ₹ 125 which is the interest obtained ₹ 1250.

Let rate be r %

$\therefore \frac{1250 \times r \times 1}{100} = 125$

$\Rightarrow r = \frac{125 \times 100}{1250} = 10$.

17.

(c) 7

Explanation:

For a handshake, 2 people are required who will shake hands with each other.

Suppose there are n people in the room.

So we need to find the number of ways to make a pair out of n persons which is

${}^{n}C_2 = 21$

$\Rightarrow \frac{n!}{2! \times (n-2)!} = 21$

$\Rightarrow \frac{n(n-1)(n-2)!}{2 \times (n-2)!} = 21$

$\Rightarrow n^2 - n = 21 \times 2$

$\Rightarrow n^2 - n = 42$

$\Rightarrow n^2 - n - 42 = 0$

$\Rightarrow (n - 7)(n + 6) = 0$

$\Rightarrow n = 7, -6$

n cannot be negative.

So correct answer is 7

18.

(b) (3, 6)

Explanation:

(3, 6)

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

Explanation:

We know that if each observation is multiplied by a non-zero real number a, then variance is multiplied by a^2.

$\therefore$ R is true.

Now, given that variance of 10 observations is 6 and each observation is multiplied by 3. So, new variance is $3^2 \times 6$ i.e. 54.

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

20.

(c) A is true but R is false.

Explanation:

We know that in a G.P.

$a_n = \sqrt{a_{n-k} \cdot a_{n+k}}$

$\therefore$ Reason is false.

Given $a_5 = 9$ and $a_{11} = 16$.

So, $a_8 = \sqrt{a_{8-3} \times a_{8+3}}$

$\Rightarrow a_8 = \sqrt{9 \times 16} = \sqrt{144} \Rightarrow a_8 = 12$

$\therefore$ Assertion is true.

Section B

21. Time = 11:30 = $11\frac{1}{2}$ hrs = $\frac{23}{2}$ hrs

For hour hand: Angle formed by hour hand in 1 hour = 30^o

Angle formed by hour hand in $\frac{23}{2}$ hours = $30^o \times \frac{23}{2}$ = 345^o

For minute hand: Angle formed by minute hand in 1 minute = 6^o

Angle formed by minute hand in 30 minutes = $6^o \times 30$ = 180^o

$\therefore$ Difference = 345^o - 180^o = 165^o

22. Let C be the set of people who like cricket and T be the set of people who like tennis.

Here n(C) = 40, $n(C \cap T)$ = 10 and $n(C \cup T)$ = 65

We know that $n(C \cup T) = n(C) + n(T) - n(C \cap T)$

$\therefore$65 = 40 + n(T) - 10

$\therefore$n(T) = 65 - 30 = 35

$\therefore$ Number of people who like tennis = 35

Now number of people who like tennis only and not cricket

= n(T - C)

$= n(T) - n(C \cap T)$

= 35 - 10 = 25

OR

Given L = {1, 2, 3, 4}, M = {3, 4, 5, 6} and N = {1, 3, 5}

then M $\cup$ N = {3, 4, 5, 6, 1}

$\therefore$ L - (M $\cup$ N) = {1, 2, 3, 4} - {3, 4, 5, 6, 1} = {2}

Now L - M = {1, 2, 3, 4} - {3, 4, 5, 6} = {1, 2} and

L - N = {1, 2, 3, 4} - {1, 3, 5} = {2, 4}

$\therefore$ (L - M) $\cap$ (L - N) = {1, 2} $\cap$ {2, 4} = {2}

Hence, L - (M $\cup$ N) = (L - M) $\cap$ (L - N)

23. Let the number of papers be x.

Then, 63x + 20 + 2 = 65x

$\Rightarrow$ 2x = 22

$\Rightarrow$ x = 11

Hence, there are 11 papers in the examination.

24. Given: $x = t + \frac{1}{t}$ and $y = t - \frac{1}{t}$

We have to find: $\frac{dy}{dx}$

Now, x = $t + \frac{1}{t}$

Diff. w.r.t. 't', we get

$\frac{dx}{dt} = \frac{d}{dt}(t) + \frac{d}{dt}\left(\frac{1}{t}\right)$

$\frac{dx}{dt} = 1 - \frac{1}{t^2}$ .... (1)

Again, take y = $t - \frac{1}{t}$

diff. w.r.t. 't', we get

$\frac{dy}{dt} = \frac{d}{dt}(t) - \frac{d}{dt}\left(\frac{1}{t}\right)$

$\frac{dy}{dt} = 1 + \frac{1}{t^2}$ ..... (2)

From (1) and (2), we get

$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$

$\frac{dy}{dx} = \frac{t^2+1}{t^2} \times \frac{t^2}{t^2-1}$

$\frac{dy}{dx} = \frac{t^2+1}{t^2-1}$

OR

Let y = $\log_x 3$

$\Rightarrow$ y = $\frac{\log 3}{\log x}$ [$\because \log_a b = \frac{\log b}{\log a}$]

Differentiate it with respect to x, we get,

$\frac{dy}{dx} = \frac{d}{dx}\left(\frac{\log 3}{\log x}\right)$

= $\log 3 \frac{d}{dx}(\log x)^{-1}$

= $\log 3 \times [-1(\log x)^{-2}] \frac{d}{dx}(\log x)$ [using chain rule]

= $-\frac{\log 3}{(\log x)^2} \times \frac{1}{x}$

= $-\left(\frac{\log 3}{\log x}\right)^2 \times \frac{1}{x} \times \frac{1}{\log 3}$

= $-\frac{1}{x \log 3 (\log_3 x)^2}$ $\left[\because \frac{\log b}{\log a} = \log_a b\right]$

So, $\frac{d}{dx}(\log_x 3) = -\frac{1}{x \log 3 (\log_3 x)^2}$

25. Consider number 36.8125

For integral part

2	36	
2	18	0
2	9	0
2	4	1
2	2	0
	1	0

For decimal part

$0.8125 \times 2 = \boxed{1}.6250$

$0.6250 \times 2 = \boxed{1}.2500$

$0.2500 \times 2 = \boxed{0}.5000$

$0.5000 \times 2 = \boxed{1}.0000$

$\therefore$ 36.8125 = $(100100.1101)_2$

Section C

26. $\because T_n = a + (n - 1)d$

Therefore, $T_p = a + (p - 1)d = \frac{1}{q}$ (given) ...(i)

and a + (q - 1) = $\frac{1}{p}$ (given) ...(ii)

Subtracting Eq. (i) from Eq.(ii),

d(p - 1 - q + 1) = $\frac{1}{q} - \frac{1}{p}$

$\Rightarrow d(p-q) = \frac{p-q}{pq} \Rightarrow d = \frac{1}{pq}$

Putting the value of d in Eq. (i) we get

$a + \frac{(p-1)}{pq} = \frac{1}{q}$

$\Rightarrow a = \frac{1}{q} - \frac{p-1}{pq}$

$\Rightarrow a = \frac{p-p+1}{pq} = \frac{1}{pq}$

Now,

$\Rightarrow S_{pq} = \frac{pq}{2}[2a + (pq-1)d]$

$(\because S_n = \frac{n}{2}[2a + (n-1)d])$

= $\frac{pq}{2}\left[2 \times \frac{1}{pq} + (pq-1)\frac{1}{pq}\right]$

= $\frac{pq}{2} \times \frac{1}{pq}$(2 + pq - 1)

= $\frac{1}{2}$ (pq + 1)

OR

Let three numbers in G.P. be $\frac{a}{r}$, a, ar

$\therefore$ Their product = $\frac{a}{r}$·a·ar = 216 (given)

$\Rightarrow$ $a^3 = 216 = (6)^3$ $\Rightarrow$ a = 6.

Also sum of their products in pairs = 156 (given)

$\Rightarrow$ $\frac{a}{r}\cdot$ a + a · ar + ar $\cdot\frac{a}{r}$ = 156

$\Rightarrow a^2\left(\frac{1}{r} + r + 1\right)$ = 156

$\Rightarrow 6^2 \cdot \frac{1+r^2+r}{r}$ = 156

$\Rightarrow 3 \cdot \frac{r^2+r+1}{r}$ = 13

$\Rightarrow$ $3r^2 + 3r + 3 = 13r$

$\Rightarrow$ $3r^2 - 10r + 3 = 0$

$\Rightarrow$ (r - 3)$\left(r - \frac{1}{3}\right)$ = 0 $\Rightarrow$ r = 3, $\frac{1}{3}$

When r = 3, numbers are 2, 6,18 and when r = $\frac{1}{3}$, numbers are 18, 6, 2

27. Let the straight line be Ax + By + C = 0 ...(i)

Since, (i) passes through (a, 0), so

A.a + B.0 + C = 0

$\Rightarrow$ Aa + C = 0

$\Rightarrow$ C = - Aa ...(ii)

Also, the $\perp$ distance of (i) from (2a, 2a) is a.

$\therefore a = \left|\frac{A.2a+B.2a+C}{\sqrt{A^2+B^2}}\right|$

$\Rightarrow a = \left|\frac{Aa+2aB}{\sqrt{A^2+B^2}}\right|$ [C = -Aa]

$\Rightarrow 1 = \left|\frac{A+2B}{\sqrt{A^2+B^2}}\right|$

$\Rightarrow$ $A^2 + B^2 = A^2 + 4AB + 4B^2$

$\Rightarrow$ $-3B^2 = 4AB$

$\Rightarrow$ $4AB + 3B^2 = 0$

$\Rightarrow$ B(4A + 3B) = 0

$\Rightarrow$ B = 0 or 4A + 3B = 0

If 4A + 3B = 0

$\Rightarrow B = -\frac{4A}{3}$

Substituting the values of B and C in eq. (i), we get

$Ax - \frac{4}{3}$ Ay - Aa = 0

$\Rightarrow$ 3x - Ay - 3a = 0

$\therefore$ Equation of line is 3x - 4y - 3a = 0

Similarly, if B = 0, then substituting the values of B and C in eq. (i), we get

Ax = - 0.y + Aa

$\Rightarrow$ A(x - a) = 0

$\Rightarrow$ x - a = 0

$\therefore$ Equation of required line is x + a = 0.

28. Given f(x) = $\frac{x^2}{1+x^2}$

For D_f, f(x) must be a real number $\Rightarrow$ $\frac{x^2}{1+x^2}$ must be a real number

$\Rightarrow$ D_f = **R** ($\because$ $x^2 + 1 \neq 0$ for all x $\in$ **R**)

For R_f, let y = $\frac{x^2}{1+x^2}$ $\Rightarrow$ $x^2y + y = x^2$

$\Rightarrow$ (y - 1) x^2 = -y $\Rightarrow$ $x^2 = -\frac{y}{y-1}$, y $\neq$ 1

But $x^2 \geq 0$ for all x $\in$ **R** $\Rightarrow$ $-\frac{y}{y-1} \geq 0$, y $\neq$ 1 (Multiply both sides by $(y - 1)^2$, a positive real number)

$\Rightarrow$ -y (y - 1) $\geq$ 0 $\Rightarrow$ y (y - 1) $\leq$ 0

$\Rightarrow$ (y - 0) (y - 1) $\leq$ 0 $\Rightarrow$ 0 $\leq$ y $\leq$ 1 but y $\neq$ 1

$\Rightarrow$ 0 $\leq$ y < 1 $\Rightarrow$ R_f = [0, 1)

29. First case

Principal = ₹ 20000

Rate = 10% p.a

Period = $2\frac{1}{2}$ = $\frac{5}{2}$ years

We know that

Simple interest = $\frac{PRT}{100}$

= $\frac{20000\times10\times5}{100\times2}$ = 5000

Second case

Principal = ₹ 20000

Rate = 10% p.a.

Period = $2\frac{1}{2}$ = $\frac{5}{2}$years

at compound interest

We know that

Amount = $P(1 + \frac{r}{100})^n$

for 2 years

$= 20000(1 + \frac{10}{100})^2$

$= 20000 \times \frac{11}{10} \times \frac{11}{10}$

= ₹ 24200

Interest in half-year I = $\frac{PRT}{100}$

I=$\frac{24200\times10\times1}{2\times100}$ = ₹1210

A = P + I

A = 24200 + 1210 = 25410

Here

Compound interest = A - P

Substituting the values

= 25410 - 20000

= ₹ 5410

So his gain after 2 years = CI - SI

We get

= 5410 - 5000

= ₹ 410

30. Let P be the population at the end of 2017. Here,

P_0 = 150,500, r_1 = 7, r_2 = 8 and r_3 = 6

$\therefore$ P = $P_0\left(1 + \frac{r_1}{100}\right)\left(1 + \frac{r_2}{100}\right)\left(1 + \frac{r_3}{100}\right)$

$\Rightarrow$ P = 150,500$\left(1 + \frac{7}{100}\right)\left(1 + \frac{8}{100}\right)\left(1 + \frac{6}{100}\right)$ = 150500$\left(\frac{107}{100} \times \frac{108}{100} \times \frac{106}{100}\right)$

$\Rightarrow$ P = $\frac{1505\times107\times108\times106}{10000}$

$\Rightarrow$ log P = log$\left(\frac{1505\times107\times108\times106}{10^4}\right)$

$\Rightarrow$ log P = log 1505 + log 107 + log 108 + log 106 - log 10^4

$\Rightarrow$ log P = log 1505 + log 107 + log 108 + log 106 - 4 log 10

$\Rightarrow$ log P = 3.4775 + 2.0294 + 2.0334 + 2.0253 - 4 = 5.2656

$\Rightarrow$ P = antilog (5.2656) = 184,400

31. To calculate mean, we require $f_i x_i$ values; then to find mean deviation, we will require $|x_i = \bar{x}|$ values and $f_i\,|x_i - \bar{x}|$ values. Hence, we make the following table. (Note that 4th column is added after calculating $\bar{x}$, then 5th column is added).

x_i	f_i	$f_i x_i$	$\lvert x_i - \bar{x}\rvert$	$f_i \lvert x_i - \bar{x}\rvert$
10	4	40	40	160
30	24	720	20	480
50	28	1400	0	0
70	16	1120	20	320
90	8	720	40	320
	80	4000		1280

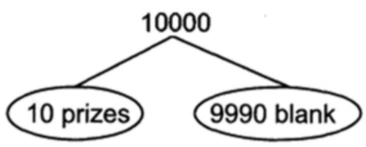
Here n = Σf_i = 80 and $\Sigma f_i x_i$ = 4000

$\therefore \bar{x} = \frac{\Sigma f_i x_i}{n} = \frac{400}{80}$ = 50

Mean deviation about the mean,

M.D. $(\bar{x}) = \frac{\sum f_i |x_i - \bar{x}|}{n} = \frac{1280}{80}$ = 16

Section D

32. 

i. P(no prize when one ticket is bought)

$= \frac{9990}{10000} = \frac{999}{1000}$

ii. P(no prize if two tickets are bought)

$= \frac{{}^{10}C_0 \times {}^{9990}C_2}{{}^{10000}C_2} = \frac{{}^{9990}C_2}{{}^{10000}C_2}$

iii. P(no prize if ten tickets are bought)

$= \frac{{}^{10}C_0 \times {}^{9990}C_{10}}{{}^{10000}C_{10}} = \frac{{}^{9990}C_{10}}{{}^{10000}C_{10}}$

OR

E_1: train, E_2: bus, E_3: scooter,

E_4: other means; E: arrives late

$P(E_1) = \frac{3}{10}$; $P(E_2) = \frac{1}{5}$; $P(E_3) = \frac{1}{10}$; $P(E_4) = \frac{2}{5}$;

$P(\frac{E}{E_1}) = \frac{1}{4}$; $P(\frac{E}{E_2}) = \frac{1}{3}$; $P(\frac{E}{E_3}) = \frac{1}{12}$; $P(\frac{E}{E_4}) = 0$

Using Bayes' Theorem, probability that doctor is late and come by train

$$P(\frac{E_1}{E}) = \frac{P(E_1)\cdot P\left(\frac{E_1}{E_1}\right)}{P(E_1)\cdot P(E_1)+P(E_2)\cdot P\left(\frac{E_2}{E_2}\right)+P(E_3)\cdot P(E_3)+P(E_4)\cdot P\left(\frac{E_4}{E_4}\right)}$$

$$= \frac{\frac{3}{10}\times\frac{1}{4}}{\frac{3}{10}\times\frac{1}{4}+\frac{1}{5}\times\frac{1}{3}+\frac{1}{10}\times\frac{1}{12}+\frac{2}{5}\times 0} = \frac{1}{2}$$

33. Given f(x) = 4 when x = 1 i.e. f(1) = 4

$\lim\limits_{x\to1^-} f(x) = \lim\limits_{x\to1^-} (a + bx)$ ($\because$ f(x) = a + bx for x < 1)

= a + b $\times$ 1 = a + b

and $\lim\limits_{x\to1^+} f(x) = \lim\limits_{x\to1^+} (b - ax)$ ($\because$ f(x) = b - ax for x > 1)

= b - a $\times$ 1 = b - a

Since $\lim\limits_{x\to1} f(x) = f(1)$ (given) $\Rightarrow \lim\limits_{x\to1^-} f(x) = \lim\limits_{x\to1^+} f(x) = f(1)$

$\Rightarrow$ a + b = b - a = 4

$\Rightarrow$ a + b = 4 and b - a = 4

Solving these equations simultaneously, we get a = 0, b = 4

34. Price index: 83, 87, 93, 104, 106, 109, 118, 124, 126, 130

Mean = $\frac{83+87+93+104+106+109+118+124+126+130}{10} = \frac{1080}{10}$ = 108

For median: n = 10 (even) or $\frac{2(10+1)}{4}$ = 5.5 lies between 5 and 6.

Median = $\frac{\text{Value of variate at 5 th place} + \text{Value of variate at 6 th place}}{2}$

= $\frac{106+109}{2}$ = $\frac{215}{2}$ = 107.5

For σ:

x_i	$d_i = x_i - 108$	d_i^2
83	-25	625
87	-21	441
93	-15	225
104	-4	16
106	-2	4
109	1	1
118	10	100
124	16	256
126	18	324
130	22	484
	0	2476

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} d_i^2}{n} - \left(\frac{\sum_{i=1}^{n} d_i}{n}\right)^2} = \sqrt{\frac{2476}{10} - 0} = \sqrt{247.6}$$

σ = 15.74 = $\frac{1.5}{15.74}$

$\therefore S_{kp} = \frac{3(\text{ Mean } - \text{ Median })}{\sigma} = \frac{3(108-107.5)}{15.74}$ = 0.09

OR

Let the observations be $x_1, x_2, x_3 ..., x_{20}$ and x be their mean,

Variance = 5 and n = 20

Variance = $\frac{1}{n} \sum (x_i - x)^2$

5 = $\frac{1}{20} \sum (x_i - x)^2$

$\therefore \sum (x_i - x)^2$ = 100 ...(i)

If each observation is multiplied by 2, we get new observations.

Let new observations by $y_1, y_2, y_3, ..., y_{20}$

Where, $y_i = 2(x_i)$ ...(ii)

We need to find variance of new observations

i,e. New variance = $\frac{1}{n} \sum (y_i - y)^2$

Calculating y = $\frac{1}{n} \sum y_i$

y = $\frac{1}{20} \sum 2x_i$

y = 2 $\frac{1}{20} \sum x_i$

y = 2x ...(iii)

$\sum (x_i - x)^2$ = 100 [from (i)]

$\sum (\frac{1}{2}y_i - \frac{1}{2}y_i)^2$ = 100 [from (ii) and (iii)]

$(\frac{1}{2})^2 \sum (y_i - y)^2 = 100$

$\sum (y_i - y)^2 = 400$

Now, new variance = $\frac{1}{n} \sum (y_i - y)^2$

$= \frac{1}{20} \times 400$

$= 20$

35. Let line passing through the point (3, -2) and having slope m is y + 2 = m(x - 3) ...(i)

Line makes an angle of 60^o with the line $\sqrt{3}$ x + y = 1

$\tan(\pm 60^o) = \frac{m-(-\sqrt{3})}{1+m(-\sqrt{3})}$

$\Rightarrow \pm\sqrt{3} = \frac{m+\sqrt{3}}{1-\sqrt{3}m}$

Case I: $\sqrt{3} = \frac{m+\sqrt{3}}{1-\sqrt{3}m}$

$\Rightarrow \sqrt{3} - 3m = m + \sqrt{3}$

$\Rightarrow -4m = 0 \Rightarrow m = 0$

Substituting in (i), we get

y + 2 = 0(x - 3)

$\Rightarrow$ y + 2 = 0 is the required equation.

Case II: $-\sqrt{3} = \frac{m+\sqrt{3}}{1-\sqrt{3}m}$

$\Rightarrow -\sqrt{3} + 3m = 3 + \sqrt{3}$

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

$\Rightarrow m = \sqrt{3}$

Substituting in (i), we get

$y + 2 = \sqrt{3}(x - 3)$

$\Rightarrow y + 2 = \sqrt{3}x - 3\sqrt{3}$

$\Rightarrow \sqrt{3}x - y - 3\sqrt{3} - 2 = 0$ is the required equation.

Section E

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

During function lots of charts and displays are made with different colours, one such display is of concentric circles.

A circle is drawn whose equation is $x^2 + y^2 - 4x - 6y - 12 = 0$ and based on this other consecutive circles are drawn.

(i) $x^2 + y^2 - 4x - 6y - 12 = 0$

Here, 2g = -4, 2f = -6, c = -12

g = -2, f = -3, c = -12

Centre (-g, -f) = (2, 3)

(ii) $r = \sqrt{4+9+12} = \sqrt{25} = 5$ units

(iii) as $\sqrt{(2-0)^2+(3-3)^2} < 5$

hence, (0,3) lies inside the circle.

(iv) Radius of given circle = 5

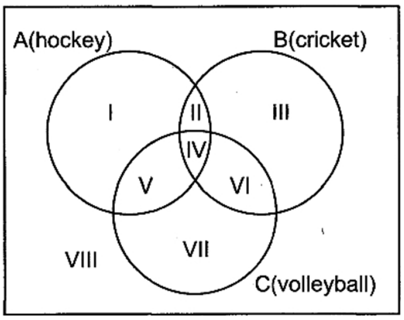
Radius of required circle = 10

$\therefore$ Circle is $(x - 2)^2 + (y - 3)^2 = (10)^2$

$\Rightarrow x^2 + y^2 - 4x - 6y - 87 = 0$

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

To select the players for the sports tournament a school management asked the students to assemble in ground and stand according to the alloted area. In the ground three circular regions are marked as shown in figure and there are total eight segments for the players to stand according to their sports.



Circle A is for those who can play hockey. Circle B is for those who can play cricket. Circle C is for those who can play volleyball.

(i) IV as this segment denote $A \cap B \cap C$

(ii) II as this segment denote $(A \cap B) - C$

(iii) as segment V denote $(A \cap C) - B$

(iv) VIII as Harsh does not belongs to any of the given sets.

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

Out of 7 boys and 5 girls a team of 7 students is to be made.

(i) 7 boys, 5 girls

ways to select at least 3 girls

= 3 girls 4 boys or 4 girls 3 boys or 5 girls 2 boys

$= {}^5C_3 \times {}^7C_4 + {}^5C_4 \times {}^7C_3 + {}^5C_5 \times {}^7C_2$

$= 10 \times 35 + 5 \times 35 + 1 \times 21$

$= 350 + 175 + 21$

$= 546$

(ii) Ways to select exactly three girls

= 3 girls 4 boys

$= {}^5C_3 \times {}^7C_4 = 350$

(iii) Ways of arranging 3 girls and 4 boys if all girls and boys stand together

$= 2! \times 3! \times 4!$

$= 2 \times 6 \times 24$

$= 288$

Total ways of selecting and arranging

$= 288 \times 350$

$= 100800$

(iv) Ways to arrange boys = 4!

B _ B _ B _ B

Ways to arrange girls = 3!

Total ways of selecting and arranging

$= 4! \times 3! \times 350$

$= 24 \times 6 \times 350$

$= 50400$

OR

Read the text carefully and answer the questions:

Out of 7 boys and 5 girls a team of 7 students is to be made.

(i) Sunil can choose four cards from same suit in $4 \times {}^{13}C_4$ ways

$= 4 \times \frac{13!}{9! \times 4!}$

$= 4715 = 2860$

(ii) Here one card to be selected from each suit therefore, he can select in ${}^{13}C_1 \times {}^{13}C_1 \times {}^{13}C_1 \times {}^{13}C_1$ ways

$= ({}^{13}C_1)^4 = 28561$

(iii) There are 12 face cards and 4 are to be selected out of these 12 cards. This can be done in ${}^{12}C_4$ ways

$= \frac{12!}{8!4!} 495$

(iv) Anita can select two cards of same colour in ${}^{26}C_2 + {}^{26}C_2$ ways = 325 + 325 = 650