BHU MCA

Solved Paper 2011

1. The Boolean expression $(A + C)(AB' + AC)(A'C' + B')$ can be simplified to

(a) $AB + A'C$
(b) $A'B + BC$
(c) $AB + BC$
(d) AB'

2. Let A be a set having n elements. The number of binary operations that can be defined on A is

(a) 2^{n^n} (b) n^{n^2}
(c) n^{2^n} (d) 2^{2^n}

3. The Boolean expression $X + X'Y$ equals

(a) $X + Y$ (b) $X + XY$
(c) $Y + YX$ (d) $X'Y + Y'X$

4. Which of the following codes uses 7 bits to represent a character?

(a) ASCII (b) BCD
(c) EBCDIC (d) GRAY

5. C is a

(a) high level language
(b) low level language
(c) high level language with some low level features
(d) machine language

6. Ten data items are to be read in a problem. The control structure needed is

(a) selection or repetition
(b) only sequential
(c) only selection
(d) sequential or repetition

7. The base of the binary number system is

(a) 2 (b) 16
(c) 8 (d) 10

8. The modern digital computer uses

(a) decimal system (b) octal system
(c) binary system (d) All of these

9. Main memory unit of a computer

(a) performs arithmetic
(b) stores a small amount of data and instructions
(c) stores bulk of data and instructions
(d) supervises the working of all the unit

10. The heart and the nerve centre of a computer is its

(a) output unit
(b) input unit
(c) CPU
(d) memory

11. In the following questions, the first and the last part of the sentence are numbered 1 and 6. The rest of the sentence is split up into four parts and named P, Q, R, and S. These four parts are not given in their proper order. Read the sentence and find out which part of the four combinations is correct. Then, find the correct answer and indicate it in the Answer Sheet.

1 : Religion has been used
P : both as a weapon of isolation
Q : to dull awareness
R : about real problems
S : and as morphia
6 : like education, health and employment

(a) PQRS (b) PSQR
(c) QPSR (d) RPQS

Directions (Q. Nos. 12-13) *In the following questions, choose the word which is most nearly the OPPOSITE in meaning to the* ***bold*** *word and mark it in the Answer Sheet.*

12. **Day**

(a) Year (b) Month
(c) Night (d) Hour

13. Lucy is a **smart** girl.

(a) Active (b) Indecent
(c) Casual (d) Lazy

Directions (Q. Nos. 14-15) *In the following questions, choose the word, which is most nearly the same in meaning to the* ***bold*** *word and mark it in the Answer Sheet.*

14. **High** .

(a) Tall (b) Short
(c) Thin (d) Fat

15. His style is quite **transparent.**

(a) Verbose (b) Involved
(c) Lucid (d) Witty

16. The Vikram Sarabhai Space Centre is located at

(a) Sriharikota (b) Trivandram
(c) Trombay (d) Bangalore

17. The first railway line was laid in India in

(a) 1836 (b) 1803
(c) 1853 (d) 1860

18. Marketing of agricultural produce in India is through

(a) Co-operatives (b) Businessmen
(c) Government (d) Individuals

19. Who was the first Indian to be the President of UN General Assembly?
(a) Natwar Singh
(b) Ramesh Bhandari
(c) Smt Vijai Lakshmi Pandit
(d) Pandit J L Nehru

20. The headquarters of the World Health Organization is located at
(a) Paris (b) Geneva
(c) Peru (d) Chicago

21. In the following question a number series is given. Which one of the alternatives will replace the question mark (?)?
4, 9, 19, 39, 79,....?
(a) 169 (b) 159
(c) 119 (d) 139

22. Letters of which of the alternative answers when placed at the blank places one after another will complete the given letter series?
a...bbc...aab...cca...bbcc
(a) acba (b) bacb
(c) caba (d) abba

23. In the following series a missing term is to be find out(?)
DKM, FJP, HIS, JHV, ...
(a) HGY (b) IGZ
(c) IGY (d) LGY

24. In the following number series one number is wrong. Find out the wrong number.
9, 15, 22, 30, 40, 49, 60
(a) 15 (b) 30
(c) 40 (d) 49

25. In the following series, find the term in place of question mark (?)
3, 8, 27, 112, 565, ?
(a) 3400 (b) 3396
(c) 1596 (d) 2266

26. If CAT is coded as TC, then how will SUN be coded?
(a) UN (b) NU
(c) US (d) NS

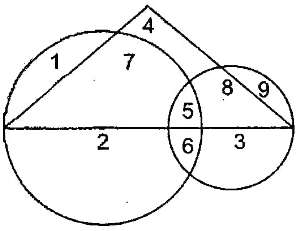
27. In a certain code language—'MTP' is coded as—'I am happy'. 'CTR' as—'That black happy' and 'NPS' as—'I very happily'. Then, which word is used for 'am'
(a) M (b) T
(c) P (d) C

28. If the code word for BOMBAY in a certain code is 58, then what will be the code word for TROMBAY ?
(a) 89 (b) 94 (c) 95 (d) 84

29. If 'MASTER' is written as '412536' and 'SERVANT' is written as '2367185,' then how will 'REVERENT' be written in the same code language?
(a) 6 3 7 3 6 3 8 5 (b) 3 6 7 3 3 6 8 5
(c) 8 5 3 3 6 5 3 8 (d) 6 3 5 3 6 3 8 5

30. If PERILOUS is written as RGTKNQWU in a code language, then how will OLYMPIC be written in that language?
(a) Q N O A K R E (b) Q O N A R K E
(c) Q N A O R K E (d) Q K N O A R E

Directions (Q. Nos. 31-35) *The following five questions are based on the following diagram in which the triangle represents female graduates, small circle represents self-employed females and the big circle represents self-employed females with bank loan facility. Numbers are shown in the different sections of the diagram. On the basis of these numbers, answer the following.*



31. How many non-graduate self-employed females are with bank loan facility?
(a) 3 (b) 8
(c) 9 (d) 12

32. How many self-employed female graduates are with bank loan facility?
(a) 5 (b) 7
(c) 12 (d) 20

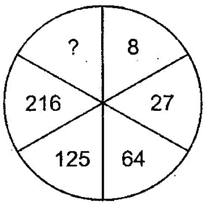
33. How many non-graduate females are self-employed?
(a) 9 (b) 11
(c) 12 (d) 21

34. How many female graduates are not self-employed?
(a) 4 (b) 10
(c) 12 (d) 15

35. How many female graduates are self-employed?
(a) 12 (b) 13
(c) 15 (d) 20

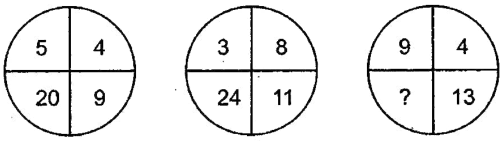
Directions (Q. Nos. 36-40) *Which number should come in place of question mark (?) in the following questions?*

36.



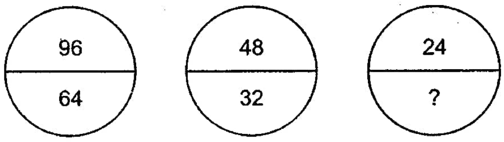
(a) 729 (b) 343
(c) 305 (d) 4

37.



(a) 26 (b) 36
(c) 52 (d) 117

38.



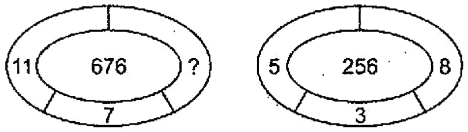
(a) 8 (b) 10
(c) 16 (d) 21

39.

1	7	9
2	14	?
3	105	117

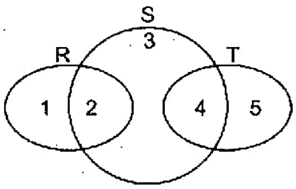
(a) 12 (b) 26 (c) 16 (d) 20

40.



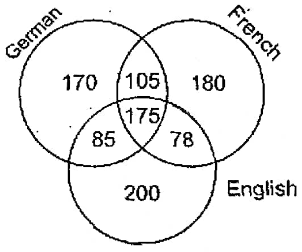
(a) 8 (b) 7 (c) 6 (d) 4

41. The following diagram, R represents businessmen, S represents rich men, T represents honest men. Which number will represent honest rich men?



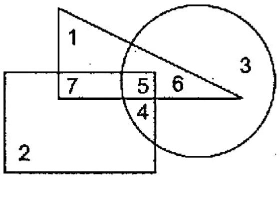
(a) 2 (b) 3
(c) 5 (d) 4

42. A survey was conducted on a sample of 1000 persons with reference to their knowledge of English, French and German. The result is presented in the Venn diagram. The ratio of the number of persons who do not know the three languages to those who know all the three languages is



(a) $\frac{1}{27}$ (b) $\frac{1}{25}$ (c) $\frac{7}{550}$ (d) $\frac{175}{1000}$

Directions (Q. Nos. 43-45) *These questions are based on the diagram given below. In the diagram, the triangle stands for graduates, square for membership of professional organisations and the circle for membership of social organisations. Read each statement and find out the appropriate numbers to represent the people covered by statement.*



43. Number of graduates in professional organisations is represented by
(a) 5 and 7 (b) 4, 5 and 6
(c) 6 and 7 (d) 5, 6 and 7

44. Number of graduates in social organisations only, is represented by
(a) 3 (b) 4
(c) 5 (d) 6

45. Number of graduates in social organisations is represented by
(a) 1 (b) 5
(c) 6 (d) 5 and 6

Directions (Q. Nos. 46-50) *Data on the candidates, who took an examination in Social Sciences, Mathematics and Science are given below*

Passed in all Subjects	167
Failed in all Subjects	60
Failed in Social Sciences	175
Failed in Mathematics	199
Failed in Science	191
Passed in Social Sciences only	62
Passed in Mathematics only	48
Passed in Science only	52

Answer the following questions based on above data.

46. How many passed in Mathematics and atleast in one more subject?
(a) 94 (b) 170 (c) 203 (d) 210

47. How many passed atleast in one subject?
(a) 167 (b) 304 (c) 390 (d) 450

48. How many failed in Social Sciences only?
(a) 15 (b) 21 (c) 30 (d) 42

49. How many failed in two subjects only?
(a) 56 (b) 61 (c) 144 (d) 162

50. How many failed in one subject only?
(a) 56 (b) 61
(c) 144 (d) 152

51. If a particle is projected with a velocity u at an angle $\alpha = 45°$, then
(a) the range is minimum
(b) the range is maximum
(c) the range is maximum and equals $\frac{u^2}{2g}$
(d) the time to the highest point is $\frac{u}{g\sqrt{2}}$

52. The time of flight of a particle, which is projected with velocity u in a direction making an angle α, is given by
(a) $2\,ug \sin\alpha$ (b) $2\,ug \cos\alpha$
(c) $\frac{2\,u \sin\alpha}{g}$ (d) $\frac{2\,u \cos\alpha}{g}$

53. Masses of 5 kg and 3 kg rest on two inclined planes each of 30° and are connected by a string passing over the common vertex. After 2 s the mass of 5 kg is removed. How far up the plane will the 3 kg mass continue to move?
(a) $\frac{2}{3}$ m (b) $\frac{3}{5}$ m (c) $\frac{4}{7}$ m (d) $\frac{5}{8}$ m

54. A mass m is acted upon by a constant force P lbwt under which in t seconds it moves a distance of x feet and acquires a velocity v ft/s. Then, x is equal to

(a) $\frac{gP}{2mt^2}$
(b) $\frac{mg}{2v^2P}$
(c) $\frac{gt^2}{2Pm}$
(d) $\frac{mv^2}{2gP}$

55. A point moves with uniform acceleration and v_1, v_2, v_3, denote the average velocities in three successive intervals of time t_1, t_2, t_3, then

(a) $\frac{v_1 - v_2}{v_2 - v_3} = \frac{t_1 + t_2}{t_2 + t_3}$
(b) $\frac{v_1 + v_2}{v_2 + v_3} = \frac{t_1 + t_2}{t_2 + t_3}$
(c) $\frac{v_1 + v_2}{v_2 + v_3} = \frac{t_1 - t_2}{t_2 - t_3}$
(d) $\frac{v_1 - v_2}{v_2 - v_3} = \frac{t_1 - t_2}{t_2 - t_3}$

56. If a body is falling freely under gravity, then the acceleration

(a) is zero
(b) is uniform
(c) varies as the square of the distance travelled
(d) varies as the inverse of the distance travelled

57. Acceleration of a moving point is

(a) a negative quantity
(b) a vector quantity
(c) a single number
(d) a positive number

58. To a man walking at 2 km/h the rain appears to fall vertically when he increases his speed to 4 km/h it appears to meet him at an angle of 45°. Then the actual velocity of rain is

(a) $\sqrt{2}$ km/h
(b) $\sqrt{3}$ km/h
(c) $2\sqrt{2}$ km/h
(d) $2\sqrt{3}$ km/h

59. If the resultant of two forces P and Q acting at a point at an angle α is $(2m+1)\sqrt{P^2+Q^2}$ and when they act at an angle $\left[\frac{\pi}{2}-a\right]$, the resultant becomes $(2m-1)\sqrt{P^2+Q^2}$, then

(a) $\tan\alpha = \frac{1}{m+1}$
(b) $\tan\alpha = \frac{1}{m-1}$
(c) $\tan\alpha = \frac{m+1}{m-1}$
(d) $\tan\alpha = \frac{m-1}{m+1}$

60. Two unlike parallel forces P and Q $(P > Q)$, xm apart act at two points of a rigid body. If the direction of P be reversed, then the resultant is displaced through the distance

(a) $2PQ\ xm$
(b) $(P^2 - Q^2)\ xm$
(c) $\frac{2PQ}{P^2 - Q^2}\ xm$
(d) $\frac{2PQ}{P^2 + Q^2}\ xm$

61. P, Q and R are the points on the sides BC, CA, AB of ΔABC such that $BP : PC = CQ : QA = AR : RB = m : n$. If Δ denote the area of the ΔABC, then the forces **AP, BQ, CR** reduce to a couple whose moment is

(a) $2\,\frac{n-m}{m+n}\,\Delta$
(b) $2\,\frac{m+n}{m-n}\,\Delta$
(c) $2(m^2 - n^2)\,\Delta$
(d) $2(m^2 + n^2)\,\Delta$

62. A beam whose centre of gravity divides it into two portions, a and b, is placed inside a smooth sphere. If θ be its inclination to the horizon in the position of equilibrium and 2α be the angle subtended by the beam at the centre of the sphere, then

(a) $\tan\theta = (b-a)(b+a)\tan\alpha$
(b) $\tan\theta = \frac{b-a}{b+a}\tan\alpha$
(c) $\tan\theta = \frac{b+a}{b-a}\tan\alpha$
(d) $\tan\theta = \frac{1}{(b-a)(b+a)}\tan\alpha$

63. Two like parallel forces P and Q act on a rigid body at A and B respectively. If P and Q be interchanged in position, then the point of application of the resultant will be displaced through a distance (along AB)

(a) $\frac{P+Q}{P-Q}AB$
(b) $\frac{P-Q}{P+Q}AB$
(c) $(P-Q)\,AB$
(d) $(P+Q)\,AB$

64. Which one of the following is not a force?

(a) Tension
(b) Attraction
(c) Weight
(d) Acceleration

65. $ABCDE$ is a pentagon. Forces acting on a particle are represented in magnitude and direction by **AB, BC, CD, 2DE, AD** and **AE**. Their resultant is given by

(a) AE
(b) 2AE
(c) 3AE
(d) 4AE

66. The resultant of two forces P, Q acting at a certain angle is X; and that of P, R acting at the same angle is also X. Then, the value of P is

(a) $\sqrt{Q^2+RX}$
(b) $\sqrt{R^2+QX}$
(c) $\sqrt{X^2+QR}$
(d) $\sqrt{QR(Q+R)}$

67. The linear programming problem

Maximize $z = 4x + y$

subject to

$$3x + 5y \le 15,$$
$$5x + y \le 15,$$
$$-x + y \le 2,$$
$$4x + 5y \le 20,$$
$$x, y \ge 0, \text{ has}$$

(a) no solution
(b) one solution
(c) infinite solution
(d) finite solutions

68. In simplex method, when the number of non-zero variables is equal to the number of constraints, the set of values is said to form a

(a) feasible solution
(b) basic solution
(c) iso-cost solution
(d) optimal solution

69. The difference of coefficient of variance of X and Y for the data

	Series X	**Series Y**
Average	25	22
SD	4	5

is

(a) 1.00
(b) 0.84
(c) 6.72
(d) 0.31

70. The value of the correlation coefficient between two variables lies between

(a) 0 and ∞ (b) $-\infty$ and $+\infty$
(c) 0 and 1 (d) -1 and 1

71. For a normal distribution, we have

(a) mean = median (b) median = mode
(c) mode = mean (d) mean = median = mode

72. The standard deviation for Poisson distribution with parameter m is

(a) m (b) $\sqrt{m}$
(c) $\frac{1}{m}$ (d) $\frac{1}{\sqrt{m}}$

73. In case of binomial distribution, probability of r successes is given by

(a) ${}^nC_r\, q^{n-r}\, p^r$ (b) ${}^nC_r p^{n-r}\, q^r$
(c) ${}^nC_r p^{n-r}$ (d) ${}^nC_r q^{n-r}$

74. Which one of the following statements is true for a given distribution?

(a) Mean deviation > Standard deviation
(b) Mean deviation < Standard deviation
(c) Mean deviation = Standard deviation
(d) Mean deviation and Standard deviation are not related

75. For a frequency distribution, standard deviation is computed by using the formula

(a) $\sigma = \frac{\Sigma f\,(x-\overline{x})}{\Sigma f}$ (b) $\sigma = \frac{\sqrt{\Sigma f\,(x-\overline{x})^2}}{\Sigma f}$
(c) $\sigma = \sqrt{\frac{\Sigma f(x-\overline{x})^2}{\Sigma f}}$ (d) $\sigma = \sqrt{\frac{\Sigma f(x-\overline{x})}{\Sigma f}}$

76. The average of n numbers $x_1, x_2, x_3, \ldots, x_n$ is A. If x_n is replaced by $(n+1)x_n$, then the new average is

(a) $\frac{(n-1)\,A + nx_n}{n}$ (b) $\frac{nA + (n+1)\,x_n}{n}$
(c) $\frac{(n+1)\,A + n\,x_n}{n}$ (d) $A + x_n$

77. Three coins are thrown together. The probability of getting two or more heads is

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) $\frac{2}{3}$ (d) $\frac{3}{8}$

78. In a $\Delta\, ABC$, cosec A (sin B cos C + cos B sin$C$) equals

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

79. The value of tan 9° − tan 27° − tan 63° + tan 81° is

(a) 1 (b) 2
(c) 3 (d) 4

80. If $\sin\alpha = -\frac{3}{5}\left(\pi < \alpha < \frac{3}{2}\pi\right)$, then the value of $\cos\frac{1}{2}\alpha$ is

(a) $-\frac{1}{\sqrt{10}}$ (b) $\frac{1}{\sqrt{10}}$
(c) $\frac{3}{\sqrt{10}}$ (d) $\frac{7}{\sqrt{10}}$

81. From the top of a lighthouse 60 m high with its base at the sea-level, the angle of depression of a boat is 15°. The distance of the boat from the foot of the lighthouse is

(a) $\left(\frac{\sqrt{3}-1}{\sqrt{3}+1}\right)$ 60 m (b) $\left(\frac{\sqrt{3}+1}{\sqrt{3}-1}\right)$ 60 m
(c) $\frac{\sqrt{3}+1}{\sqrt{3}-1}$ m (d) $\frac{\sqrt{3}-1}{\sqrt{3}+1}$ m

82. The general solution of the trigonometrical equation $\sin x + \cos x = 1$ is given by

(a) $x = 2n\pi,\ n = 0, \pm 1, \pm 2, \ldots$
(b) $x = 2n\pi + \frac{\pi}{2},\ n = 0, \pm 1, \pm 2, \ldots$
(c) $x = n\pi + (-1)^n\, \frac{\pi}{4} - \frac{\pi}{4},\ n = 0, \pm 1, \pm 2, \ldots$
(d) $x = n\pi + (-1)^n\, \frac{\pi}{4},\ n = 0, \pm 1, \pm 2, \ldots$

83. The value of $\frac{1-\tan^2 15°}{1+\tan^2 15°}$ is

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

84. If $\sin\alpha = \sin\beta$, then the angle α and β are related by

(a) $\alpha = 2n\pi + (-1)^n\,\beta$ (b) $\alpha = n\pi \pm \alpha$
(c) $\beta = n\pi + (-1)^n\,\alpha$ (d) $\beta = (2n+1)\,\pi + \alpha$

85. The value of cos 10° − sin 10° is

(a) positive (b) negative
(c) 0 (d) 1

86. The vector $2\,\mathbf{i} + \mathbf{j} - \mathbf{k}$ is perpendicular to $\mathbf{i} - 4\,\mathbf{j} + \lambda\mathbf{k}$, if λ is equal to

(a) 0 (b) -1
(c) -2 (d) -3

87. If $|\mathbf{a}| = |\mathbf{b}|$, then $(\mathbf{a}+\mathbf{b})\cdot(\mathbf{a}-\mathbf{b})$ is

(a) positive (b) negative
(c) unity (d) zero

88. If $\mathbf{A} = 2\mathbf{i} + 2\mathbf{j} - \mathbf{k}$, $\mathbf{B} = 6\mathbf{i} - 3\mathbf{j} + 2\mathbf{k}$, then $\mathbf{A} \times \mathbf{B}$ will be given by

(a) $2\mathrm{i} - 2\mathrm{j} - \mathrm{k}$ (b) $6\mathrm{i} - 3\mathrm{j} + 2\mathrm{k}$
(c) $\mathbf{i} - 10\mathbf{j} - 18\mathbf{k}$ (d) $\mathbf{i} + \mathbf{j} + \mathbf{k}$

89. If the position vectors of three points are $\mathbf{a} - 2\mathbf{b} + 3\mathbf{c}$, $2\mathbf{a} + 3\mathbf{b} - 4\mathbf{c}$, $-7\mathbf{b} + 10\mathbf{c}$, then the three points are

(a) collinear (b) coplanar
(c) non-coplanar (d) None of these

90. If $\mathbf{a} = 4\mathbf{i} + 2\mathbf{j} - 5\mathbf{k}$, $\mathbf{b} = -12\mathbf{i} - 6\mathbf{j} + 15\mathbf{k}$, then the vectors $\mathbf{a}, \mathbf{b}$ are

(a) parallel (b) non-parallel
(c) orthogonal (d) non-coplanar

91. If θ is the angle between vectors $\mathbf{a}$ and $\mathbf{b}$, then $|\mathbf{a} \times \mathbf{b}| = |\mathbf{a} \cdot \mathbf{b}|$ when θ is equal to

(a) 0 (b) 45° (c) 135° (d) 180°

92. If $[\mathbf{abc}]$ is the scalar triple product of three vectors $\mathbf{a}, \mathbf{b}$ and $\mathbf{c}$, then $[\mathbf{abc}]$ is equal to

(a) [bac] (b) [cba] (c) [bca] (d) [acb]

93. If θ be the angle between the vectors $4(\mathbf{i}-\mathbf{k})$ and $\mathbf{i}+\mathbf{j}+\mathbf{k}$, then θ is

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$

(c) $\frac{\pi}{4}$ (d) $\cos^{-1}(1/\sqrt{3})$

94. $\mathbf{a}\cdot\mathbf{b}=0$ implies only

(a) $a=0$

(b) $b=0$

(c) $\theta=90°$

(d) either $a=0$ or $b=0$ or $\theta=90°$

95. Point A is $\mathbf{a}+2\mathbf{b}$, P is $\mathbf{a}$ and P divides AB in the ratio of $2:3$. The position vector of B is

(a) $2a-b$ (b) $b-2a$

(c) $a-3b$ (d) b

96. If the position vectors of A and B are $\mathbf{a}$ and $\mathbf{b}$ respectively, then the position vector of a point P which divides AB in the ratio 1 : 2 is

(a) $\frac{a+b}{3}$ (b) $\frac{b+2a}{3}$

(c) $\frac{a+2b}{3}$ (d) $\frac{b-2a}{3}$

97. If $\mathbf{a}$ and $\mathbf{b}$ are two unit vectors and θ is the angle between them. Then, $\mathbf{a}+\mathbf{b}$ is a unit vector, if

(a) $\theta=\frac{\pi}{3}$ (b) $\theta=\frac{\pi}{4}$

(c) $\theta=\frac{\pi}{2}$ (d) $\theta=\frac{2\pi}{3}$

98. If two vectors $\mathbf{a}$ and $\mathbf{b}$ are parallel and have equal magnitudes, then

(a) they are not equal

(b) they may or may not be equal

(c) they have the same sense of direction

(d) they do not have the same direction

99. Let $ABCD$ be a parallelogram. If $\mathbf{a}, \mathbf{b}, \mathbf{c}$ be the position vectors of A, B, C respectively with reference to the origin O, then the position vector of D with reference to O is

(a) $a+b+c$ (b) $b+c-a$

(c) $c+a-b$ (d) $a+b-c$

100. If $\mathbf{a}$ and $\mathbf{b}$ represent two adjacent sides AB and BC respectively of a parallelogram $ABCD$, then its diagonals AC and DB are equal to

(a) $a+b$ and $a-b$ (b) $a-b$ and $a+b$

(c) $a+2b$ and $a-2b$ (d) $2a+b$ and $2a-b$

101. Let the vectors $\mathbf{a}, \mathbf{b}, \mathbf{c}$ be the position vectors of the vertices P, Q, R of a triangle respectively. Which of the following represents the area of the triangle?

(a) $\frac{1}{2}|a\times b|$ (b) $\frac{1}{2}|b\times c|$

(c) $\frac{1}{2}|c\times a|$ (d) $\frac{1}{2}|a\times b+b\times c+c\times a|$

102. Solution of the differential equation

$$(1+y^2)\,dx+(x-e^{-\tan^{-1}y})\,dy=0 \text{ is}$$

(a) $y\,e^{\tan^{-1}x}=\tan^{-1}x+C$ (b) $x\,e^{\tan^{-1}y}=\tan^{-1}y+C$

(c) $y=\tan^{-1}x\,e^{\tan^{-1}x}+C$ (d) $y=x\,e^{-\tan^{-1}x}+C$

103. The value of $\frac{1}{(D-3)(D-2)}e^{2x}$ is

(a) $x\,e^{2x}$ (b) $2x\,e^{2x}$

(c) $-x\,e^{2x}$ (d) $-2x\,e^{2x}$

104. The particular integral of the differential equation $(D^2-2D+1)\,y=x\,e^x\sin x$ is given by

(a) $e^x\sin(x+1)$ (b) $x\,(e^x\cos x+\sin x)$

(c) $e^x\,(x\cos x+\sin x)$ (d) $-e^x\,(x\sin x+2\cos x)$

105. The degree of the differential equation

$$\left[3+4\left(\frac{dy}{dx}\right)^2+5\left(\frac{d^2y}{dx^2}\right)\right]^{2/3}=\left(\frac{d^3y}{dx^3}\right)^2 \text{ is}$$

(a) 3 (b) 4

(c) 5 (d) 6

106. If l denoted slant height, r_1 and r_2 denote the radii of the frustum of cone, then curved surface of cone is

(a) $\pi\,l\,(r_1+r_2)$ (b) $\frac{1}{2}\pi\,l\,(r_1-r_2)$

(c) $\pi\,r_1\,r_2\,[l+(l^2-r_1\,r_2)]$ (d) $\pi\,r_1\,r_2\,[l+(l^2+r_1\,r_2)]$

107. The volume of a right circular cylinder of height h and radius of base r is

(a) $\frac{1}{3}\pi r^2 h$ (b) $\pi r^2 h$

(c) $\frac{4}{3}\pi r^2 h$ (d) $\frac{1}{2}\pi r^2 h$

108. The value of $\int_0^{\pi/4}\frac{\sin\theta+\cos\theta}{9+16\sin 2\theta}\,d\theta$ is

(a) $\frac{1}{10}\log 2$ (b) $\frac{1}{20}\log 5$

(c) $\frac{1}{20}\log 3$ (d) $\frac{1}{30}\log 7$

109. The value of $\int\frac{x-1}{(x-2)(x-3)}\,dx$ is

(a) $2\log(x-2)+\log(x-3)$

(b) $\log(x-2)-\log(x-3)$

(c) $\log(x-2)-\log(x-3)$

(d) $-\log(x-2)+2\log(x-3)$

110. The value of $\int\frac{e^{\tan^{-1}x}}{1+x^2}\,dx$ is

(a) $e^{\tan^{-1}x}$ (b) $e^{-\tan^{-1}x}$ (c) $\frac{1}{1+x^2}$ (d) $-\frac{1}{1+x^2}$

111. The value of $\int\log x\,dx$ is

(a) $x\,(\log x+1)$ (b) $x\,(\log x-1)$

(c) $\log x\,(x+\log x)$ (d) $x\,(x-\log x)$

112. The function $f(x)=8x^5-15x^4+10x^2$ has no extreme value at

(a) $x=-\frac{1}{2}$ (b) $x=\frac{1}{2}$ (c) $x=1$ (d) $x=-1$

113. The function $f(x)=\sin x\,(1+\cos x)$ has a maximum value when

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

114. The normal to the curve

$$x = a(\cos\theta + \theta\sin\theta),\ y = a(\sin\theta - \theta\cos\theta)$$

at any point θ is such that it

(a) passes through the origin
(b) makes a constant angle with the x-axis
(c) makes a constant angle with the y-axis
(d) is at constant distance from the origin

115. The length of the normal at the point (2, 4) to the parabola $y^2 = 8x$ is

(a) $4\sqrt{2}$ (b) 4
(c) $\sqrt{6}$ (d) $2\sqrt{3}$

116. The equation of tangent to the curve $y^2 = 2x^3 - x^2 + 3$ at the point (1, 4) is

(a) $y = 2x$ (b) $x = 2y - 7$
(c) $y = 4x$ (d) $x = 4y$

117. The straight line $\frac{x}{a} + \frac{y}{b} = 1$ touches the curve $y = b\,e^{-x/a}$ at the point

(a) where it crosses the y-axis
(b) where it crosses the x- axis
(c) (0, 0)
(d) (1, 1)

118. The differential coefficient of x^x is

(a) $x^x \log x$ (b) $x^x\left(\log x + \frac{1}{x}\right)$
(c) $x^x(\log x + 1)$ (d) $x\,x^{x-1}$

119. The derivative of $\sin^{-1}\left(\frac{1-x^2}{1+x^2}\right)$ w.r.t. $\sin^{-1}\left(\frac{2x}{1+x^2}\right)$ is

(a) -1 (b) 0
(c) $\frac{1}{x}$ (d) x

120. If $f(x) = \begin{cases} 0, & \text{if } x = 0 \\ \frac{1}{2} - x + [x], & \text{if } 0 < x < \frac{1}{2} \\ \frac{1}{2}, & \text{if } x = \frac{1}{2} \\ \frac{2}{3} - x, & \text{if } \frac{1}{2} < x < 1 \\ 1, & \text{if } x = 1 \end{cases}$

Then, $f(x)$ is

(a) continuous at $x = \frac{1}{2}$ (b) continuous at $x = 1$
(c) continuous at $x = 0$ (d) discontinuous at $x = 0$

121. The value of $\lim\limits_{x \to -2} \frac{\tan \pi x}{x + 2} + \lim\limits_{x \to \infty}\left(1 + \frac{1}{x^2}\right)^x$ is equal to

(a) $\pi + 1$ (b) $\pi - 1$
(c) π (d) 3

122. Every homogeneous equation of second degree in x and y represent a pair of lines

(a) parallel to x-axis
(b) perpendicular to y-axis
(c) through the origin
(d) parallel to y-axis

123. The difference of the focal distances of any point on the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is

(a) a (b) $2a$
(c) b (d) $2b$

124. If in ellipse the length of latusrectum is equal to half of major axis, then eccentricity of the ellipse is

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

125. An equilateral triangle is inscribed in the parabola $y^2 = 4ax$ whose vertex is at the vertex of the parabola. The length of its side is

(a) $a\sqrt{3}$ (b) $2\,a\sqrt{3}$
(c) $4\,a\sqrt{3}$ (d) $8\,a\sqrt{3}$

126. Two circles $x^2 + y^2 = 5$ and $x^2 + y^2 - 6x + 8 = 0$ are given. Then the equation of the circle through their point of intersection and the point (1, 1) is

(a) $7x^2 + 7y^2 - 18x + 4 = 0$ (b) $x^2 + y^2 - 3x + 1 = 0$
(c) $x^2 + y^2 - 4x + 2 = 0$ (d) $x^2 + y^2 - 5x + 3 = 0$

127. The equation

$\sqrt{(x^2 + 4y^2 - 4xy + 4)} + x - 2y = 1$ represents a

(a) straight line (b) circle
(c) parabola (d) pair of lines

128. The coordinates of the orthocentre of the triangle formed by the lines $2x^2 - 2y^2 + 3xy + 3x + y + 1 = 0$ and $3x + 2y + 1 = 0$ are

(a) $\left(\frac{4}{5}, \frac{3}{5}\right)$ (b) $\left(\frac{-3}{5}, \frac{-1}{5}\right)$ (c) $\left(\frac{1}{5}, \frac{4}{5}\right)$ (d) $\left(\frac{2}{5}, \frac{1}{5}\right)$

129. A straight line passes through the point $P(2, \sqrt{3})$ and makes an angle of 60° with the x-axis. The length of the intercept on it between the point P and the line $x + \sqrt{3}\,y = 12$

(a) 1.5 (b) 2.5
(c) 3.5 (d) 4.5

130. If $f = \{(1, 1), (2, 3), (0 - 1), (-1, -3)\}$ be a function described by the formula $f(x) = ax + b$ for some integers a, b, then the value of a, b is

(a) $a = -1,\ b = 3$ (b) $a = 3,\ b = 1$
(c) $a = -1,\ b = 2$ (d) $a = 2,\ b = -1$

131. If $A = \{1, 2, 3\}, B = \{4, 5, 6\}$, which of the following are relations from A to B?

(a) $\{(1, 5), (2, 6), (3, 4), (3, 6)\}$
(b) $\{(1, 6), (3, 4), (5, 2)\}$
(c) $\{(4, 2), (4, 3), (5, 1)\}$
(d) $B \times A$

132. The number of subsets of an n elementric set is

(a) $2n$ (b) n (c) 2^n (d) $\frac{1}{2}2^n$

133. If $A = \{a, b, d, l\}, B = \{c, d, f, m\}$ and $C = \{a, l, m, o\}$, then $C \cap (A \cup B)$ is given by

(a) $\{a, d, l, m\}$ (b) $\{b, c, f, o\}$
(c) $\{a, l, m\}$ (d) $\{a, b, c, d, f, l, m, o\}$

134. The value of $7\log\frac{16}{15}+5\log\frac{25}{24}+3\log\frac{81}{80}$ is equal to

(a) 0 (b) log 2
(c) log 3 (d) log 5

135. If in a GP sum of n terms is 255, the last term is 128 and the common ratio is 2, then the value of n is equal to

(a) 2 (b) 4
(c) 8 (d) 16

136. If the ratio of the sum of m terms and n terms of an AP be $m^2 : n^2$, then the ratio of its mth and nth terms will be

(a) $\frac{m-n}{m+n}$ (b) $\frac{2m-1}{2n-1}$
(c) $\frac{2m+1}{2n+1}$ (d) $\frac{m+n}{m-n}$

137. If $x=\frac{1}{2}(\sqrt{3}+1)$, then the value of expression $4x^3+2x^2-8x+7$, is equal to

(a) 10 (b) 5
(c) 0 (d) −2

138. If $A=\begin{vmatrix}1 & -2 & -3\\ 2 & 1 & -2\\ 3 & 2 & 1\end{vmatrix}$, then A is

(a) symmetric matrix
(b) a skew-symmetric matrix
(c) a singular matrix
(d) non-singular matrix

139. If $A=\begin{bmatrix}1 & 1 & 1\\ 3 & 3 & 3\end{bmatrix}, B=\begin{bmatrix}-2 & 3\\ 1 & -5\\ 4 & 1\end{bmatrix}$, then AB is equal to

(a) $\begin{bmatrix}-3 & -1\\ -9 & -3\end{bmatrix}$ (b) $\begin{bmatrix}3 & -1\\ 9 & -3\end{bmatrix}$
(c) $\begin{bmatrix}-3 & 1\\ 9 & 3\end{bmatrix}$ (d) $\begin{bmatrix}3 & 1\\ -9 & 3\end{bmatrix}$

140. If $\begin{vmatrix}x & x^2 & 1+x^3\\ y & y^2 & 1+y^3\\ z & z^2 & 1+z^3\end{vmatrix}=0$, where x, y, z are unequal and non-zero real numbers, then xyz is equal to

(a) 1 (b) 2
(c) −1 (d) −2

141. In the binomial expansion of $(a-b)^n, n\geq 5$, the sum of the 5th and 6th terms is zero. Then, $\frac{a}{b}$ equals

(a) $\frac{n-4}{5}$ (b) $\frac{n-5}{6}$
(c) $\frac{5}{n-4}$ (d) $\frac{6}{n-5}$

142. If the coefficient of x^7 in the expansion of $\left(px^2+\frac{1}{qx}\right)^{11}$ is equal to the coefficient of x^{-7} in the expansion of $\left(px-\frac{1}{qx^2}\right)^{11}$, then

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

143. There are n numbered seats around a round table. Total number of ways in which n_1 $(n_1<n)$ persons can sit around the round table, is equal to

(a) ${}^nC_{n_1}$ (b) ${}^nP_{n_1}$
(c) ${}^nC_{n_1-1}$ (d) ${}^nP_{n_1-1}$

144. The number of subsets of a set containing n distinct object is

(a) ${}^nC_1+{}^nC_2+{}^nC_3+{}^nC_4+\ldots+{}^nC_n$
(b) 2^n-1
(c) 2^n+1
(d) ${}^nC_0+{}^nC_1+{}^nC_2+\ldots+{}^nC_n$

145. If $1, \omega, \omega^2, \ldots, \omega^{n-1}$ are n th roots of unity, then $(1-\omega)(1-\omega^2)\ldots(1-\omega^{n-1})$ is equal to

(a) n^2 (b) 0
(c) 1 (d) n

146. The value of $\sum_{p=1}^{6} 2\left(\sin\frac{2p\pi}{7}-i\cos\frac{2p\pi}{7}\right)$ is

(a) 1 (b) 2
(c) $2i$ (d) $-2i$

147. The coefficient of x^{15} the product $(x-1)(2x-1)(2^2x-1)(2^3x-1)\ldots(2^{15}x-1)$ is equal to

(a) $2^{120}-2^{108}$ (b) $2^{105}-2^{121}$
(c) $2^{120}-2^{105}$ (d) $2^{120}-2^{104}$

148. The nth term of the series $2\frac{1}{2}+1\frac{7}{13}+1\frac{1}{9}+\frac{20}{23}+\ldots$ is

(a) $\frac{20}{5n+3}$ (b) $\frac{2}{5n-3}$
(c) $20(5n+3)$ (d) $\frac{20}{5n^2+3}$

149. The number of quadratic equations which remain unchanged by squaring their roots, is

(a) zero (b) four (c) two (d) infinite

150. The harmonic mean of the roots of the equation $(5+\sqrt{2})x^2-(4+\sqrt{5})x+8+2\sqrt{5}=0$ is

(a) 2 (b) 4
(c) 6 (d) 8

Answers *with* Solutions

1. (d) Given, Boolean expression

Let $E = (A + C)(AB' + AC)(A'C' + B')$

$= (A + C)A(B' + C)(A'C' + B')$ "by distributive law"

$= (A + C)A(B' + C)(B' + A'C')$ "by commutative law"

$= (A + C)A(B' + C \cdot A'C')$ "by distributive law"

$= (A + C)A\{B' + (CC')A'\}$ "by associative law"

$= (A + C)A\{B' + O \cdot A'\}$ "by complement law"

$= (A + C)A\{B' + O\}$ "by boundness law"

$= (A + C)AB'$ "by identity law"

$= (AA + CA)B'$ "by distributive law"

$= (A + CA)B'$ "by idempotent law"

$= A(1 + C)B'$ "by distributive law"

$= A \cdot 1 \cdot B'$ "by boundness law"

$= AB'$ "by identity law"

2. (b) Since, binary operation on A is a function from $A \times A$ to A_1, therefore the total number of binary operations on A is the total number of functions from $A \times A$ to A which is n^{n^2}

3. (a) Boolean expression,

Let $E = X + X'Y$

$= (X + X') \cdot (X + Y)$ "by distributive law"

$= 1 \cdot (X + Y)$ "by complement law"

$= X + Y$ "by identity law"

4. (a) ASCII codes uses 7 bits to represent a character.

5. (c) C is a high level language with some low level features. Also, called middle level language.

6. (b) Ten data items are to be read in a problem. The control structure needed is only sequential like as array.

7. (a) The base of the binary number system is 2 because binary system have only two numbers 0 and 1.

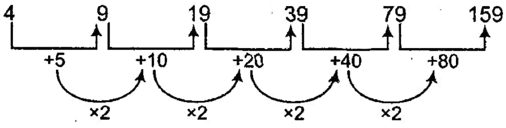
8. (c) The modern digital computer uses binary system.

9. (b) Main memory unit of a computer stores a small amount of data and instructions.

10. (c) The heart and the nerve centre of a computer is its CPU *i.e.*, Central Processing Unit.

11. (b) **12.** (c) **13.** (c) **14.** (a) **15.** (c) **16.** (b)
17. (c) **18.** (c) **19.** (c) **20.** (b)

21. (b) The pattern of series is



22. (a) a $\underline{\text{a}}$ b b c $\underline{\text{c}}$/ a a b $\underline{\text{b}}$ c c/ a $\underline{\text{a}}$ b b c c

$\Rightarrow$ a c b a

23. (d) The pattern of series is

$$\begin{array}{l} D \xrightarrow{+2} F \xrightarrow{+2} H \xrightarrow{+2} J \xrightarrow{+2} \boxed{L} \\ K \xrightarrow{-1} J \xrightarrow{-1} I \xrightarrow{-1} H \xrightarrow{-1} \boxed{G} \\ M \xrightarrow{+3} P \xrightarrow{+3} S \xrightarrow{+3} V \xrightarrow{+3} \boxed{Y} \end{array}$$

24. (c) The pattern of series is

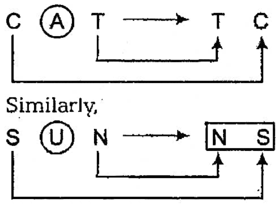
$$9 \xrightarrow{+6} 15 \xrightarrow{+7} 22 \xrightarrow{+8} 30 \xrightarrow{+9} \overset{39}{\boxed{40}} \xrightarrow{+10} 49 \xrightarrow{+11} 60$$

Hence, 39 will come in place of 40.

25. (b) The pattern of series is

$$3 \xrightarrow{\times2+2} 8 \xrightarrow{\times3+3} 27 \xrightarrow{\times4+4} 112 \xrightarrow{\times5+5} 565 \xrightarrow{\times6+6} \boxed{3396}$$

26. (d) As,



27. (a) $M\ \textcircled{T}\ \boxed{P} \longrightarrow \boxed{I}$ am $\textcircled{\text{happy}}$

$C\ \textcircled{T}\ \boxed{R} \longrightarrow$ That black $\textcircled{\text{happy}}$

$N\ \boxed{P}\ S \longrightarrow \boxed{I}$ very happily

Hence, am $\rightarrow$ M

28. (b) As, 2 15 13 2 1 25
B O M B A Y
$\Rightarrow$ 2 + 15 + 13 + 2 + 1 + 25 = 58

Similarly,
20 18 15 13 2 1 25
T R O M B A Y
$\Rightarrow$ 20 + 18 + 15 + 13 + 2 + 1 + 25 = 94

29. (a) As,

$$\begin{array}{cccccccccccccc} M & A & S & T & E & R & \text{and} & S & E & R & V & A & N & T \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 4 & 1 & 2 & 5 & 3 & 6 & & 2 & 3 & 6 & 7 & 1 & 8 & 5 \end{array}$$

Similarly,

$$\begin{array}{cccccccc} R & E & V & E & R & E & N & T \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 6 & 3 & 7 & 3 & 6 & 3 & 8 & 5 \end{array}$$

30. (c) As,

$$\begin{array}{cccccccc} P & E & R & I & L & O & U & S \\ \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} \\ R & G & T & K & N & Q & W & U \end{array}$$

Similarly,

$$\begin{array}{ccccccc} O & L & Y & M & P & I & C \\ \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} & \downarrow{\scriptstyle +2} \\ Q & N & A & O & R & K & E \end{array}$$

31. (c) (6 + 2 + 1) = 9 non-graduate self-employed females are with bank loan facility.

32. (c) 7 + 5 = 12

33. (d) 1 + 2 + 6 + 3 + 9 = 21, non-graduate females are self-employed.

34. (a) Number 4 lies in triangle which is not common to any other figure.

35. (d) 7 + 5 + 8 = 20, female graduates are self-employed.

36. (b) $2^3 = 8, 3^3 = 27, 4^3 = 64, 5^3 = 125,$
$6^3 = 216, 7^3 = 343$

37. (b) As, $5 \times 4 = 20$ and $3 \times 8 = 24$
Similarly, $9 \times 4 = 36$

38. (c) $96 \xrightarrow{\div 2} 48 \xrightarrow{\div 2} 24$

$64 \xrightarrow{\div 2} 32 \xrightarrow{\div 2} \boxed{16}$

39. (a) As, $1 \times 2 + 1 = 3$

and $7 \times 14 + 7 = 105$

Similarly, $9 \times ? + 9 = 117$

$\Rightarrow 9 \times ? = 108$

$\Rightarrow ? = \frac{108}{9} = 12$

40. (a) As, $(5 + 3 + 8)^2 \Rightarrow (16)^2 = 256$

Similarly, $(11 + 7 + 8)^2 \Rightarrow (26)^2 = 676$

$\therefore ? = 8$

41. (d) Number 4 lies in the space, which is common to S and T.

42. (b) Number of persons who do not know all the three languages

$= 1000 - (170 + 105 + 180 + 78 + 200 + 85)$

$= 1000 - 993$

$= 7$

Number of persons who know all the three languages

$= 175$

Hence, required ratio $= \frac{7}{175} = \frac{1}{25}$

43. (a) Number 5 and 7 are common in triangle and square.

44. (d) Number 6

45. (d) 5 and 6.

46. (c) Candidates failed in Science only

$= 191 - (62 + 60 + 48)$

$= 21$

Candidates failed in Social Science only = 15

Therefore, candidates passed in Mathematics and atleast one more subject

$= (21 + 15 + 167)$

$= 203$

47. (c) Candidates passed in atleast one subject

= (Candidates passed in only one subject)
+ (Candidates passed in only two subjects)
+ (Candidates passed in all the subjects)
= (Candidates failed in only two subjects)
+ (Candidates failed in only one subject)
+ (Candidates passed in the subjects)

$= 162 + 61 + 167$

$= 390$

48. (a) Candidates failed in Social Science only

= (Candidates failed in Social Science)−(Candidates failed in all subjects + Candidates passed in Science only + Candidates passed in Mathematics only)

$= 175 - (60 + 52 + 48)$

$= 175 - 160$

$= 15$

49. (d) Candidates failed in two subjects only

= Candidates passed in one subject only

$= 62 + 48 + 52$

$= 162$

50. (b) Candidates failed in one subject only

= (Total number of candidates) − (Candidates passed in all the subjects + Candidates failed in all the subjects + Candidates passed in one subject only)

$= 450 - (167 + 60 + 62 + 48 + 52)$

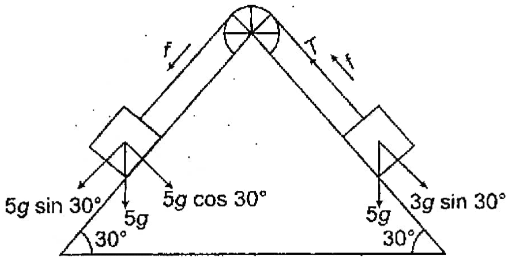
$= 450 - 389 = 61$

51. (b) If a particle is projected with a velocity u at angle $\alpha = 45°$ then the range is maximum.

$\therefore R = \frac{u^2 \sin 2\alpha}{g} = \frac{u^2 \sin 90°}{g} = \frac{u^2}{g}$

52. (c) The time of flight of a particle $= \frac{2u \sin \alpha}{g}$

53. (d) If f is the acceleration of mass of 5 kg down the plane, then the equations of motion are,



$5g \sin 30° - T = 5f$ ...(i)

and $T - 3g \sin 30° = 3f$ ...(ii)

On adding Eqs. (i) and (ii),

as $5g \times \frac{1}{2} - 3g \times \frac{1}{2} = 8f$

$\Rightarrow g = 8f$

$\Rightarrow f = g / 8$

$\therefore$ Velocity after 2 s $\Rightarrow v = u + f \cdot t$

$v = 0 + (g / 8) \cdot 2 = g / 4$

When the particle of 5 kg is removed, then the retardation on the particle of mass 3 kg which moves up the plane is $g \sin 30° = g / 2$. If x is the distance moved up the plane, then

by $v^2 = u^2 - 2fh$

$\Rightarrow 0 = v^2 - 2 (g / 2) x$

$\Rightarrow gx = v^2 = (g / 4)^2$ $(\because g = 10 \text{ m/s}^2)$

$\Rightarrow x = g / 16 = \frac{10}{16} = \frac{5}{8}$ m

54. (d) $\because$ Power, $P = F \cdot v$

$\therefore \frac{\frac{1}{2} mv^2}{t} = Pg \cdot \frac{x}{t}$

$\Rightarrow x = \frac{mv^2}{2 gP}$

55. (a) Suppose, u be the initial velocity.

Velocity after time t_1,

$v_{11} = u + at_1$

Velocity after time $t_1 + t_2$,

$v_{22} = u + a (t_1 + t_2)$

Velocity after time $t_1 + t_2 + t_3$,

$v_{33} = u + a (t_1 + t_2 + t_3)$

$\therefore v_1 = \frac{u + v_{11}}{2} = \frac{u + u + at_1}{2} = u + \frac{1}{2} at_1$

$v_2 = \frac{v_{11} + v_{22}}{2} = u + at_1 + \frac{1}{2} at_2$

$v_3 = \frac{v_{22} + v_{33}}{2} = u + at_1 + at_2 + \frac{1}{2} at_3$

So, $v_1 - v_2 = -\frac{1}{2} a (t_1 + t_2)$

$v_2 - v_3 = -\frac{1}{2} a (t_2 + t_3)$ $\therefore \frac{v_1 - v_2}{v_2 - v_3} = \frac{t_1 + t_2}{t_2 + t_3}$

56. (b) If a body is falling freely under gravity, then the acceleration is uniform.

57. (b) Acceleration of a moving point is a vector quantity.

58. (c) $V_{rg} = \frac{4 - 2}{\sin 45°}$

$= \frac{4 - 2}{1 / \sqrt{2}} = 2\sqrt{2}$ km/h

59. (d) According to the given condition,

$$R^2 = P^2 + Q^2 + 2PQ\cos\theta$$

$\therefore\ (2m+1)^2 (P^2 + Q^2) = P^2 + Q^2 + 2PQ\cos\alpha$

$$\Rightarrow \quad 4m^2 + 4m = 2PQ\cos\alpha \qquad \text{...(i)}$$

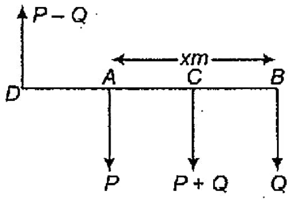
and $(2m-1)^2 (P^2 + Q^2) = P^2 + Q^2 + 2PQ\cos\left(\frac{\pi}{2} - \alpha\right)$

$$\Rightarrow \quad 4m^2 - 4m = 2PQ\sin\alpha \qquad \text{...(ii)}$$

On dividing Eq. (ii) by Eq. (i), we get

$$\tan\alpha = \frac{4m^2 - 4m}{4m^2 + 4m} = \frac{m-1}{m+1}$$

60. (c) We have,



$$AC = \left(\frac{AB}{P+Q}\right)Q$$

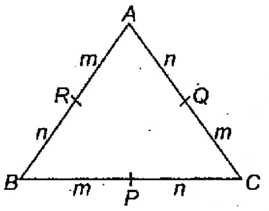
and $$AD = \left(\frac{AB}{P-Q}\right)Q$$

$\therefore$ $$CD = AC + AD$$

$$= Q\left(\frac{AB}{P+Q}\right) + Q\left(\frac{AB}{P-Q}\right)$$

$\therefore$ $$CD = \left(\frac{2PQ}{P^2 - Q^2}\right)AB = \frac{2PQ}{P^2 - Q^2}xm$$

61. (a) $\therefore m(\text{AC}) + n(\text{AB}) = (m+n)\,\text{AP}$ ...(i)



$n(\text{BC}) + m(\text{BA}) = (m+n)\,\text{BQ}$ ...(ii)

$m(\text{CB}) + n(\text{CA}) = (m+n)\,\text{CR}$ ...(iii)

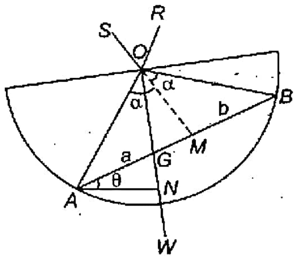
On adding Eqs. (i), (ii) and (iii), we get

$(m+n)(\text{AP} + \text{BQ} + \text{CR}) = (n-m)(\text{BC} + \text{CA} + \text{AB})$

$$\text{AP} + \text{BQ} + \text{CR} = \left(\frac{n-m}{n+m}\right)(2 \times \text{area of } \Delta ABC)$$

$$\Rightarrow \text{AP} + \text{BQ} + \text{CR} = 2\left(\frac{n-m}{n+m}\right)\Delta$$

62. (b) Applying m-n theorem in $\Delta\, ABO$, we get



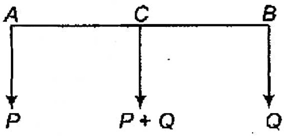
$$(AG + GB)\cot\angle OGB = GB\cot\angle OAB - AG\cot\angle OBG$$

$$\therefore\ (a+b)\cot(90 - \theta) = b\cot\left(\frac{\pi}{2} - \alpha\right) - a\cot\left(\frac{\pi}{2} - \alpha\right)$$

$$\Rightarrow \quad (a+b)\tan\theta = b\tan\alpha - a\tan\alpha$$

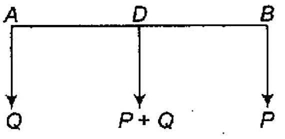
$$\Rightarrow \quad \tan\theta = \frac{b-a}{b+a}\tan\alpha$$

63. (b) *Case* I Support resultant act at C,



then, $$AC = \left(\frac{AB}{P+Q}\right)Q \qquad \text{...(i)}$$

Case II When P and Q inter changed, suppose the resultant acts at D, then



$$AD = \left(\frac{AB}{P+Q}\right)P \qquad \text{...(ii)}$$

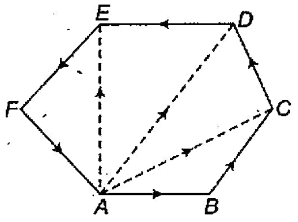
$\therefore$ From Eqs. (i) and (ii), we get

$$CD = AD - AC = \left(\frac{AB}{P+Q}\right)P - \left(\frac{AB}{P+Q}\right)Q$$

$$= \left(\frac{P-Q}{P+Q}\right)AB$$

64. (d) Acceleration is not a force.

65. (c) (AB + BC) + CD + 2DE + AD + AE



= (AC + CD) + 2DE + AD + AE

= 2(AD + DE) + AE

= 2AE + AE

= 3AE

66. (c) According to the given condition

$$X^2 = P^2 + Q^2 + 2PQ\cos\alpha \qquad \text{...(i)}$$

and $$X^2 = P^2 + R^2 + 2PR\cos\alpha \qquad \text{...(ii)}$$

On subtracting, we get

$$Q^2 = R^2 + 2P\cos\alpha\,(R - Q) - (R + Q)$$

$$= 2P\cos\alpha$$

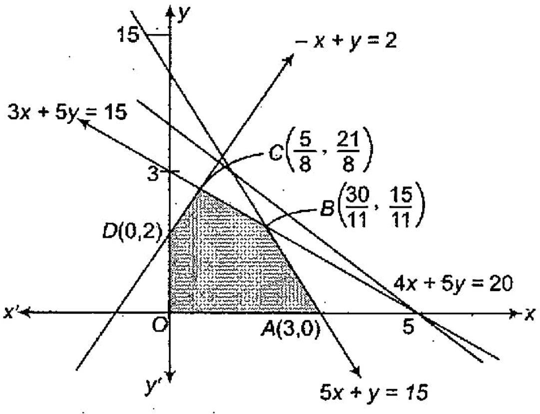
From Eq. (i),

$$X^2 = P^2 + Q^2 - Q(R+Q)$$

$$X^2 = P^2 - QR$$

$$\Rightarrow \quad P = \sqrt{X^2 + QR}$$

67. (b) Given,



Constraints are

$$3x+5y \le 15,\ 5x+y \le 15,$$
$$-x+y \le 2,$$
$$4x+5y \le 20,$$
$$x, y \ge 0$$

and $\qquad z = 4x + y$

At point O (0,0)

$$z = 0 + 0 = 0$$

At point $B\left(\frac{30}{11},\frac{15}{11}\right)$,

$$z = \frac{4 \times 30}{11} + \frac{15}{11} = \frac{135}{11} = 12.27$$

At point $C\left(\frac{5}{8},\frac{21}{8}\right)$

$$z = \frac{4 \times 5}{8} + \frac{21}{8} = \frac{41}{8} = 5.125$$

At point D (0, 2),

$$z = 4 \times 0 + 2 = 2$$

Hence, maximize. of z at point $B\left(\frac{30}{11},\frac{15}{11}\right)$

Hence, it has one solution.

68. (a) In simplex method, when the number of non-zero variables is equal to the number of constraints the set of values is said to be feasible solution.

69. (c) Coefficient of variance of $X = \frac{6}{x} \times 100$

$$= \frac{4}{25} \times 100 = 16$$

Coefficient of variance of $Y = \frac{5}{22} \times 100 = 22.72$

$\therefore$ Required difference $= 22.72 - 16 = 6.72$

70. (d) The correlation coefficient between two variables lies between −1 and 1.

71. (d) For normal distribution,
Mean = Median = Mode
Also, known symmetrical distribution.

72. (a) In a Poisson distribution
Mean = Variance = m

73. (a) The probability of r success $= {}^nC_r\, p^r\, q^{n-r}$

74. (b) We know, $\text{SD} = \frac{5}{4}\,\text{MD}$

$\therefore \qquad \text{SD} > \text{MD}$

75. (c) For frequency distribution,

Standard deviation, $\sigma = \sqrt{\frac{\Sigma f\,(x-\bar{x})^2}{\Sigma f}}$

76. (d) Given, $A = \frac{x_1 + x_2 + \ldots + x_n}{n}$ $\qquad$ ...(i)

$\therefore$ New average $= \frac{x_1 + x_2 + \ldots + (n+1)\,x_n}{n}$

$$= \frac{x_1 + x_2 + \ldots + x_n}{n} + x_n$$

$$= A + x_n \qquad \text{[from Eq. (i)]}$$

77. (b) Probability of getting head in single coin, $\qquad p = \frac{1}{2}, q = \frac{1}{2}$

$\therefore$ Required probability

$$= {}^3C_2\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^1 + {}^3C_3\left(\frac{1}{2}\right)^3$$
$$= \frac{3}{8} + \frac{1}{8}$$
$$= \frac{4}{8} = \frac{1}{2}$$

78. (c) $\operatorname{cosec} A\,(\sin B \cos C + \cos B \sin C)$

$$= \frac{\sin(B+C)}{\sin A} = \frac{\sin(\pi - A)}{\sin A} \qquad (\because A + B + C = \pi)$$
$$= \frac{\sin A}{\sin A} = 1$$

79. (d) $\tan 9° - \tan 27° - \tan 63° + \tan 81°$

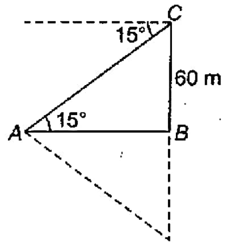
$$= \tan 9° - \tan 27° - \cot 27° + \cot 9°$$
$$= (\tan 9° + \cot 9°) - (\tan 27° + \cot 27°)$$
$$= \frac{\cos(9° - 9°)}{\sin 9° \cos 9°} - \frac{\cos(27° - 27°)}{\sin 27° \cos 27°}$$
$$= \frac{2\cos 0°}{\sin 18°} - \frac{2\cos 0°}{\sin 54°}$$
$$= 2\left\{\frac{\sin 54° - \sin 18°}{\sin 18° \sin 54°}\right\} = 2 \cdot \frac{2 \cdot \cos 36° \cdot \sin 18°}{\sin 18° \cdot \sin 54°}$$
$$= 4\,\frac{\cos(90° - 54°)}{\sin 54°}$$
$$= 4$$

80. (a) Given, $\sin\alpha = -\frac{3}{5}\left(\pi < \alpha < \frac{3\pi}{2}\right)$

$$\cos\alpha = \frac{-4}{5}$$

$$\Rightarrow \qquad \cos\frac{\alpha}{2} = -\sqrt{\frac{1+\cos\alpha}{2}} = -\sqrt{\frac{1-\frac{4}{5}}{2}} = -\sqrt{\frac{1}{10}}$$

81. (b) In $\Delta\, ABC$,



$$\cot 15° = \frac{AB}{60}$$

$$\Rightarrow \quad AB = 60° \times \cot(60° - 45°)$$
$$= 60 \times \left[\frac{\cot 60° \cot 45° + 1}{-\cot 60° + \cot 45°}\right] = 60 \times \left[\frac{\sqrt{3}+1}{\sqrt{3}-1}\right] \text{m}$$

82. (c) Given, $\sin x + \cos x = 1$

$$\therefore \qquad \frac{1}{\sqrt{2}}\sin x + \frac{1}{\sqrt{2}}\cos x = \frac{1}{\sqrt{2}}$$

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

$\Rightarrow \quad x+\frac{\pi}{4}=n\pi+(-1)^n\frac{\pi}{4}$

$\Rightarrow \quad x=n\pi+(-1)^n\frac{\pi}{4}-\frac{\pi}{4},\ n=0,\pm 1,\pm 2,\ldots$

83. (b) We know,

$$\cos 2\theta=\frac{1-\tan^2\theta}{1+\tan^2\theta}$$

Put $\theta=15°$

$\therefore \quad \cos 30°=\frac{1-\tan^2 15°}{1+\tan^2 15°}=\frac{1-\tan^2 15°}{1+\tan^2 15°}=\frac{\sqrt{3}}{2}$

84. (c) $\sin\beta=\sin\alpha$

$\therefore \quad \beta=n\pi+(-1)^n\alpha$

85. (a) We know, for $x\in\left(0,\frac{\pi}{4}\right)$, $\cos x>\sin x$

$\therefore \quad \cos 10°>\sin 10°$

$\Rightarrow \quad \cos 10°-\sin 10°>0$

86. (c) Let $\mathbf{a}=2\mathbf{i}+\mathbf{j}-\mathbf{k}$ and $\mathbf{b}=\mathbf{i}-4\mathbf{j}+\lambda\mathbf{k}$

Since, a is perpendicular to b.

$\therefore \quad \mathbf{a}\cdot\mathbf{b}=0$

$\Rightarrow \quad (2\mathbf{i}+\mathbf{j}-\mathbf{k})\cdot(\mathbf{i}-4\mathbf{j}+\lambda\mathbf{k})=0$

$\Rightarrow \quad 2-4-\lambda=0\Rightarrow\lambda=-2$

87. (d) $(\mathbf{a}+\mathbf{b})\cdot(\mathbf{a}-\mathbf{b})=\mathbf{a}^2-\mathbf{a}\cdot\mathbf{b}+\mathbf{b}\cdot\mathbf{a}-\mathbf{b}^2$

$=|\mathbf{a}|^2-|\mathbf{b}|^2$

$=0 \quad [\because |\mathbf{a}|=|\mathbf{b}|\text{(given)}]$

88. (c) $\therefore A\times B=\begin{vmatrix}\mathbf{i}&\mathbf{j}&\mathbf{k}\\2&2&-1\\6&-3&2\end{vmatrix}$

$=\mathbf{i}(4-3)-\mathbf{j}(4+6)+\mathbf{k}(-6-12)$

$=\mathbf{i}-10\mathbf{j}-18\mathbf{k}$

89. (b) Given position vectors are $\mathbf{a}-2\mathbf{b}+3\mathbf{c}$,

$2\mathbf{a}+3\mathbf{b}-4\mathbf{c},-7\mathbf{b}+10\mathbf{c},$

Now, $\begin{vmatrix}1&-2&3\\2&3&-4\\0&-7&10\end{vmatrix}=1(30-28)+2(20)+3(-14)$

$=2+40-42=0$

Hence, given vectors are coplanar.

90. (a) Given vectors are $\mathbf{a}=4\mathbf{i}+2\mathbf{j}-5\mathbf{k}$

and $\mathbf{b}=-12\mathbf{i}-6\mathbf{j}+15\mathbf{k}$

$\therefore \quad \mathbf{a}=\frac{-3}{-3}\times(4\mathbf{i}+2\mathbf{j}-5\mathbf{k})$

$=-\frac{1}{3}(-12\mathbf{i}-6\mathbf{j}+15\mathbf{k})$

$=-\frac{1}{3}\mathbf{b}\Rightarrow \mathbf{a}=\sqrt{5}$

Hence, given vectors are parallel.

91. (b) Given, $|\mathbf{a}\times\mathbf{b}|=|\mathbf{a}\cdot\mathbf{b}|$

$||\mathbf{a}||\mathbf{b}|\sin\theta\,\mathbf{n}|=||\mathbf{a}||\mathbf{b}|\cos\theta|$

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

$\Rightarrow \quad \theta=\frac{\pi}{4}$

92. (c) Scalar triple product is in cyclic order.

$\therefore \quad [\mathbf{a}\,\mathbf{b}\,\mathbf{c}]=[\mathbf{b}\,\mathbf{c}\,\mathbf{a}]$

93. (a) Let $\mathbf{a}=4(\mathbf{i}-\mathbf{k})$ and $b=(\mathbf{i}+\mathbf{j}+\mathbf{k})$

$\mathbf{a}.\mathbf{b}=4(\mathbf{i}-\mathbf{k})(\mathbf{i}+\mathbf{j}+\mathbf{k})$

$=4(1-1)=0$

$\Rightarrow \quad \theta=90°$

94. (d) Given, $\mathbf{a}\cdot\mathbf{b}=0$

$\Rightarrow$ Either $\mathbf{a}=0$ or $\mathbf{b}=0$ or $\theta=90°$

95. (c) Let position vector of P be $\mathbf{x}$.

$\mathbf{a}=\frac{3(\mathbf{a}+2\mathbf{b})+2\mathbf{x}}{3+2}$, By internal section formula

$\Rightarrow \quad 2\mathbf{x}=2\mathbf{a}-6\mathbf{b}$

$\Rightarrow \quad \mathbf{x}=\mathbf{a}-3\mathbf{b}$

96. (b) $\therefore$ Position vector of $\mathbf{p}=\frac{2\mathbf{a}+\mathbf{b}}{3}$, By internal section formula.

97. (d) We have,

$(\mathbf{a}+\mathbf{b})^2=|\mathbf{a}+\mathbf{b}|^2=|\mathbf{a}|^2+|\bar{\mathbf{b}}|^2+2\mathbf{a}\cdot\mathbf{b}$

Given, $|\mathbf{a}|=|\mathbf{b}|=|\mathbf{a}+\mathbf{b}|=1$

$\Rightarrow \quad 1=1+1+2(\mathbf{a}\cdot\mathbf{b})$

$\Rightarrow \quad -1=2|\mathbf{a}||\mathbf{b}|\cos\theta$

$\Rightarrow \quad -1/2=1\cdot1\cdot\cos\theta$

$\Rightarrow \quad \cos\theta=\cos 2\pi/3$

$\Rightarrow \quad \theta=\frac{2\pi}{3}$

98. (b) We know, two vectors are equal only if their magnitude are both have same direction.
Hence, if two vectors a and b are parallel and have equal magnitudes, then they may or may not be equal.

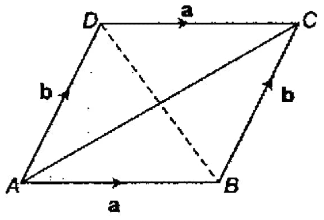
99. (c) Let the position of vector be **D** be x

$\therefore \quad AB=DC$

$\Rightarrow \quad \mathbf{b}-\mathbf{a}=\mathbf{c}-\mathbf{x}$

$\Rightarrow \quad \mathbf{x}=\mathbf{a}+\mathbf{c}-\mathbf{b}$

100. (a) $\therefore AC=\mathbf{a}+\mathbf{b}$



and $\quad DB=\mathbf{a}-\mathbf{b}$

101. (d) $\therefore$ Area of triangle $=\frac{1}{2}|\mathbf{a}\times\mathbf{b}+\mathbf{b}\times\mathbf{c}+\mathbf{c}\times\mathbf{a}|$

102. (b) Given, equation can be rewritten as

$$\frac{dx}{dy}+\frac{x}{1+y^2}=\frac{e^{-\tan^{-1}y}}{1+y^2}$$

$\therefore \quad IF=e^{\int 1/(1+y^2)dy}=e^{\tan^{-1}y}$

$\therefore$ Solution is

$$x\times e^{\tan^{-1}y}=\int\frac{e^{\tan^{-1}y}\times e^{-\tan^{-1}y}}{1+y^2}dy+C$$

$\Rightarrow \quad x\,e^{\tan^{-1}y}=\int\frac{1}{1+y^2}dy=\tan^{-1}y+C$

103. (c) $\therefore PI=\frac{1}{(D-3)(D-2)}e^{2x}$

$$=e^{2x}\frac{1}{(2-3)(D+2-2)}=\frac{e^{2x}}{-1}\cdot\frac{1}{D}=-x\,e^{2x}$$

104. (d) $\therefore \text{PI} = \dfrac{xe^x \sin x}{D^2 - 2D + 1}$

$$= \frac{x e^x \sin x}{(D-1)^2} = e^x \frac{1}{(D+1-1)^2} \cdot x \sin x$$

$$= e^x \frac{1}{D^2} x \sin x$$

$$= \frac{e^x}{D} [- x \cos x + \int \cos x dx]$$

$$= \frac{e^x}{D} [- x \cos x + \sin x]$$

$$= e^x [- (x \sin x - \int \sin x \, dx) - \cos x]$$

$$= e^x [- (x \sin x + \cos x) - \cos x]$$

$$= - e^x (x \sin x + 2 \cos x)$$

105. (d) In a given differential equation, cubing both sides, we get

$$\left[3 + 4\left(\frac{dy}{dx}\right)^2 + 5\left(\frac{d^2y}{dx^2}\right)\right]^2 = \left(\frac{d^3y}{dx^3}\right)^6$$

$\therefore$ Here, highest order is 3 whose degree is 6.

106. (a) Curved surface area of cone $= \pi \, l \, (r_1 + r_2)$

where, $l^2 = h^2 + (r_1 - r_2)^2$, h = height of a cone

107. (a) Volume of right circular cylinder $= \dfrac{1}{3} \pi r^2 h$

108. (c) Let $I = \displaystyle\int_0^{\pi/4} \frac{\sin\theta + \cos\theta}{9 + 16 \sin 2\theta} d\theta$

$$= \int_0^{\pi/4} \frac{\sin\theta + \cos\theta}{9 + 16 \times 2 \sin\theta \cos\theta} d\theta$$

$$= \int_0^{\pi/4} \frac{\sin\theta + \cos\theta}{25 - 16 (\sin\theta - \cos\theta)^2} d\theta$$

Put $\quad \sin\theta - \cos\theta = t$

$\Rightarrow \quad (\cos\theta + \sin\theta) \, d\theta = dt$

$$\therefore \quad I = \int_{-1}^{0} \frac{1}{25 - 16 t^2} dt$$

$$= \frac{1}{16} \int_{-1}^{0} \frac{1}{\left(\frac{5}{4}\right)^2 - t^2} dt$$

$$= \frac{1}{16} \times \frac{1}{2 \times \frac{5}{4}} \left[\frac{\log |\frac{5}{4} + t|}{|\frac{5}{4} - t|}\right]_{-1}^{0}$$

$$= \frac{1}{40} \left[\log \left|\frac{5/4}{5/4}\right| - \log \frac{|(5/4) - 1|}{|(5/4) + 1|}\right]$$

$$= \frac{1}{40} \left[\log 1 - \log \left(\frac{1/4}{9/4}\right)\right]$$

$$= \frac{1}{40} \log 9 = \frac{2 \log 3}{40} = \frac{\log 3}{20}$$

109. (d) Let $I = \displaystyle\int \frac{x-1}{(x-2)(x-3)} dx$

Let $\dfrac{x-1}{(x-2)(x-3)} = \dfrac{A}{(x-2)} + \dfrac{B}{(x-3)}$

$\Rightarrow \quad (x-1) = A(x-3) + B(x-2)$

On equating the coefficient of x and constant, we get

$$1 = A + B \text{ and } -1 = -3A - 2B$$

One solving, we get $A = -1, B = 2$

$$\therefore \quad I = \int -\frac{1}{(x-2)} dx + \int \frac{2}{(x-3)} dx$$

$$= - \log (x-2) + 2 \log (x-3)$$

110. (a) Let $\quad I = \displaystyle\int \frac{e^{\tan^{-1} x}}{1 + x^2} dx$

Put $\quad \tan^{-1} x = t \Rightarrow \dfrac{1}{1+x^2} dx = dt$

$\therefore \quad I = \int e^t dt = e^t$

$$= e^{\tan^{-1} x}$$

111. (b) $\displaystyle\int 1 \log x \, dx = x \log x - \int \frac{x}{x} dx$

$$= x \log x - \int dx$$

$$= x \log x - x = x (\log x - 1)$$

112. (c) $\quad f(x) = 8x^5 - 15x^4 + 10x^2$

$$f'(x) = 40x^4 - 60x^3 + 20x$$

Put $\quad f'(x) = 0$

$\Rightarrow \quad 20x (2x^3 - 3x^2 + 1) = 0$

$\Rightarrow 20x (x-1)(x-1)\left(x + \dfrac{1}{2}\right) = 0$

$\Rightarrow \quad x = 0, 1, -\dfrac{1}{2}$

Now, $f''(x) = 160x^3 - 180x^2 + 20$

At $\quad x = 1$

$$f''(1) = 180 - 180 = 0$$

So, f has no extreme value at $(x = 1)$.

113. (c) Given, $f(x) = \sin x (1 + \cos x)$

$$f'(x) = \sin x (- \sin x) + (1 + \cos x) \cos x$$

$$= - \sin^2 x + \cos x + \cos^2 x$$

$$= - 1 + \cos^2 x + \cos x + \cos^2 x$$

$$= 2\cos^2 x + \cos x - 1$$

For max or min value of $f(x)$

$$f'(x) = 0$$

$\Rightarrow \quad 2\cos^2 x + \cos x - 1 = 0$

$\Rightarrow \quad 2\cos^2 x + 2\cos x - \cos x - 1 = 0$

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

$\Rightarrow (\cos x + 1)(2 \cos x - 1) = 0 \Rightarrow \cos x = -1 \text{ or } + \dfrac{1}{2}$

$\Rightarrow \quad x = \pi \text{ or } \pi/3$

$$f''(x) = 4 \cos x (- \sin x) + (- \sin x)$$

$$= - 2 \sin 2x - \sin x$$

At $x = \pi$,

$$f''(\pi) = - 2 \sin 2\pi - \sin \pi$$

$$= 0 - 0 = 0$$

At $x = \pi/3$

$$f''(\pi/3) = - 2 \sin 2\pi/3 - \sin \pi/3$$

$$= - 2 \cos 30° - \sin 60°$$

$$= - \sqrt{3} - \sqrt{3}/2 = -3\sqrt{3}/2 < 0$$

So, $f(x)$ has a max value at $x = \pi/3$.

114. (d) Given, $y = a (\sin\theta - \theta \cos\theta)$, $x = a (\cos\theta + \theta \sin\theta)$

On differentiating w.r.t. θ, we get

$$\frac{dy}{d\theta} = a [\cos\theta - \cos\theta + \theta \sin\theta] = a \theta \sin\theta$$

and $\quad \dfrac{dx}{d\theta} = a (-\sin\theta + \sin\theta + \theta \cos\theta)$

$$= a\theta \cos\theta$$

$$\therefore \quad \frac{dy}{dx} = \frac{dy/d\theta}{dx/d\theta} = \frac{a\theta \sin\theta}{a\theta \cos\theta}$$

$$= \tan\theta$$

$\therefore$ Slope of normal $= -\dfrac{1}{\tan\theta}$

∴ Equation of normal is

$$y - a(\sin\theta - \theta\cos\theta) = -\frac{\cos\theta}{\sin\theta}[x - a(\cos\theta + \theta\sin\theta)]$$

$$\Rightarrow y\sin\theta - a\sin^2\theta + a\theta\sin\theta\cos\theta = -x\cos\theta + a\cos^2\theta + a\theta\sin\theta\cos\theta$$

$$\Rightarrow x\cos\theta + y\sin\theta = a(\sin^2\theta + \cos^2\theta)$$

$$\Rightarrow x\cos\theta + y\sin\theta = a$$

∴ Distance from origin $= \dfrac{a}{\sqrt{\sin^2\theta + \cos^2\theta}}$

$= a =$ constant

115. (a) Given, $y^2 = 8x$

$$\Rightarrow \quad 2y\frac{dy}{dx} = 8$$

$$\Rightarrow \quad \left(\frac{dy}{dx}\right)_{(2,4)} = \frac{8}{2\times 4} = 1$$

∴ Length of normal $= y\sqrt{1 + \left(\dfrac{dy}{dx}\right)^2}$

$$= 4\sqrt{1 + (1)^2}$$

$$= 4\sqrt{2}$$

116. (b) Given, $y^2 = 2x^3 - x^2 + 3$

On differentiating w.r.t. x, we get

$$2y\frac{dy}{dx} = 6x^2 - 2x$$

$$\Rightarrow \quad \left(\frac{dy}{dx}\right)_{(1,4)} = \frac{6-2}{2\times 4} = \frac{1}{2}$$

∴ Equation of tangent at (1, 4)

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

$$\Rightarrow \quad 2y = x + 7$$

117. (a) Given, curve is

$$y = be^{-x/a}$$

On differentiating w.r.t. x, we get

$$\frac{dy}{dx} = -\frac{b}{a}e^{-x/a}$$

Also, slope of line $\dfrac{x}{a} + \dfrac{y}{b} = 1$ is $-\dfrac{b}{a}$

∴ Since, the line touches the curve.

Slope of curve = Slope of line

$$\therefore \quad -\frac{b}{a}e^{-x/a} = -\frac{b}{a}$$

$$\Rightarrow \quad e^{-x/a} = 1$$

$$\Rightarrow \quad -\frac{x}{a} = 0 \Rightarrow x = 0$$

Hence, the line touches the curve, where it crosses the y-axis.

118. (c) Let $y = x^x$

On taking log on both sides, we get

$$\log y = x\log x$$

$$\Rightarrow \quad \frac{1}{y}\frac{dy}{dx} = \frac{x}{x} + \log x$$

$$\Rightarrow \quad \frac{dy}{dx} = x^x(1 + \log x)$$

119. (a) Let $u = \sin^{-1}\left(\dfrac{1-x^2}{1+x^2}\right)$

Put $x = \tan\theta$

$$\therefore \quad u = \sin^{-1}\left(\frac{1-\tan^2\theta}{1+\tan^2\theta}\right)$$

$$= \sin^{-1}(\cos 2\theta) = \frac{\pi}{2} \pm 2\theta$$

$$\Rightarrow \quad u = \frac{\pi}{2} \pm 2\tan^{-1}x$$

$$\therefore \quad \frac{du}{dx} = \frac{\pm 2}{1+x^2}$$

and $\quad v = \sin^{-1}\left(\dfrac{2x}{1+x^2}\right)$

Put $\quad x = \tan\theta,$

$$\therefore \quad v = \sin^{-1}\left(\frac{2\tan\theta}{1+\tan^2\theta}\right) = \sin^{-1}(\sin 2\theta)$$

$$= 2\theta = 2\tan^{-1}x$$

$$\therefore \quad \frac{dv}{dx} = 2\frac{1}{1+x^2}$$

$$\frac{du}{dv} = \frac{du/dx}{dv/dx} = \frac{\pm 2}{(1+x^2)} \times \frac{(1+x)^2}{2}$$

$$\therefore \quad \frac{du}{dv} = \pm 1$$

120. (d) Given, $f(x) = \begin{cases} 0, & \text{if } x = 0 \\ \dfrac{1}{2} - x + [x], & \text{if } 0 < x < \dfrac{1}{2} \\ \dfrac{1}{2}, & \text{if } x = \dfrac{1}{2} \\ \dfrac{2}{3} - x, & \text{if } \dfrac{1}{2} < x < 1 \\ 1, & \text{if } x = 1 \end{cases}$

$$= \begin{cases} 0, & \text{if } x = 0 \\ \dfrac{1}{2} - x, & \text{if } 0 < x < \dfrac{1}{2} \\ \dfrac{1}{2}, & \text{if } x = \dfrac{1}{2} \\ \dfrac{2}{3} - x, & \text{if } \dfrac{1}{2} < x < 1 \\ 1, & \text{if } x = 1 \end{cases}$$

At $x = 0$

We cannot determine the LHL of a function.

Hence, at $x = 0$, $f(x)$ is discontinuous.

121. (a) $\displaystyle\lim_{x\to -2}\frac{\tan\pi x}{x+2} + \lim_{x\to\infty}\left(1 + \frac{1}{x^2}\right)^x$

$$= \lim_{x\to -2}\frac{\tan\pi x}{x+2} + \lim_{x\to\infty}\left(1+\frac{1}{x^2}\right)^x \qquad \left(\frac{0}{0}\text{ form}\right)$$

Use L' Hospital rule,

$$= \lim_{x\to -2}\frac{\pi\sec^2\pi x}{1} + e^{\lim\limits_{x\to\infty}\frac{1}{x}}$$

$$= \pi + 1$$

122. (c) Every homogeneous equation of second degree in x and y represent a pair of line through the origin.

e.g., $ax^2 + 2hxy + by^2$

123. (b) The difference of a focal distance is $2a$.

124. (b) According to the given condition, length of latusrectum

$$= \frac{1}{2} \times \text{major axis}$$

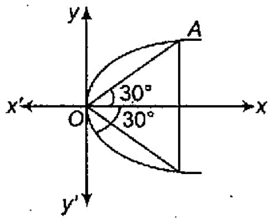
$$\therefore \quad \frac{2b^2}{a} = \frac{1}{2} \times 2a \Rightarrow 2b^2 = a^2$$

$$\therefore \quad e = \sqrt{1 - \frac{b^2}{a^2}} = \sqrt{1 - \frac{b^2}{2b^2}}$$

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

125. (d) Equation of line OA is

$$\sqrt{3}\cdot y - x = 0$$



$\therefore$ Intersection point of

$$\sqrt{3}\,y - x = 0 \text{ and } y^2 = 4ax \text{ is}$$
$$y = 4a\sqrt{3} \text{ and } x = 12a$$
$$\therefore \quad OA = \sqrt{144a^2 + 48a^2} = a\sqrt{192}$$
$$= 8a\sqrt{3}$$

126. (a) Intersection of two circles is

$$x^2 + y^2 - 5 + \lambda(x^2 + y^2 - 6x + 8) = 0 \quad \text{...(i)}$$

Since, it passes through (1, 1)

$$\therefore \quad 1 + 1 - 5 + \lambda(1 + 1 - 6 + 8) = 0$$
$$\Rightarrow \quad -3 + 4\lambda = 0 \Rightarrow \lambda = \frac{3}{4}$$

$\therefore$ From Eq. (i),

$$x^2 + y^2 - 5 + \frac{3}{4}(x^2 + y^2 - 6x + 8) = 0$$
$$\Rightarrow \quad 7x^2 + 7y^2 - 18x + 4 = 0$$

127. (a) Given, $\sqrt{x^2 + 4y^2 - 4xy + 4} = 1 - x + 2y$

On squaring both the sides, we get

$$x^2 + 4y^2 - 4xy + 4 = 1^2 + x^2 + 4y^2 - 2x - 4xy + 4y$$
$$\Rightarrow \quad 4 = 1 + 4y - 2x$$
$$\Rightarrow \quad 4y - 2x = 3$$

Hence, it represents a straight line.

128. (b) Given, line is

$$2x^2 - 2y^2 + 3xy + 3x + y + 1 = 0 \quad \text{...(i)}$$

Here, we see that $a + b = 2 - 2 = 0$.

It means lines are perpendicular.

$\therefore$ Pair of lines and a given line makes a right angle triangle.

We know that, vertex of the right angle triangle is the required orthocentre.

On comparing Eq. (i) by

$$ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$$
$$\therefore \quad a = 2, b = -2, h = \frac{3}{2}, g = \frac{3}{2},$$
$$f = \frac{1}{2}, c = 1$$

$$\therefore \text{ Required vertex} = \left(\frac{bg - fh}{h^2 - ab}, \frac{af - gh}{h^2 - ab}\right)$$
$$= \left(\frac{-2 \times \frac{3}{2} - \frac{1}{2} \times \frac{3}{2}}{\frac{9}{4} + 4}, \frac{2 \times \frac{1}{2} - \frac{3}{2} \times \frac{3}{2}}{\frac{9}{4} + 4}\right)$$
$$= \left(\frac{-3 - \frac{3}{4}}{25/4}, \frac{1 - \frac{9}{4}}{25/4}\right)$$
$$= \left(\frac{-15}{25}, -\frac{5}{25}\right)$$
$$= \left(-\frac{3}{5}, -\frac{1}{5}\right)$$

129. (c) Let equation of line is

$$y = mx + c$$
$$\therefore \quad y = \sqrt{3}\,x + c \qquad (\because \tan 60° = m = \sqrt{3})$$

At point $P(2, \sqrt{3})$

$$\therefore \quad \sqrt{3} = 2\sqrt{3} + c \Rightarrow c = -\sqrt{3}$$
$$\therefore \quad y = \sqrt{3}\,x - \sqrt{3}$$

$\therefore$ Intersection point of $y - \sqrt{3}\,x + \sqrt{3} = 0$ and

$$x + \sqrt{3}\,y - 12 = 0 \text{ is}$$
$$Q\left(\frac{15}{4}, \frac{11\sqrt{3}}{4}\right)$$
$$\therefore \text{ Length of } PQ = \sqrt{\left(2 - \frac{15}{4}\right)^2 + \left(\frac{\sqrt{3} - 11\sqrt{3}}{4}\right)^2}$$
$$= \sqrt{\left(\frac{-7}{4}\right)^2 + \left(\frac{-7\sqrt{3}}{4}\right)^2}$$
$$= \frac{7}{4}\sqrt{1 + 3} = \frac{7}{4} \times 2 = \frac{7}{2} = 3.5$$

130. (d) Given, $f = \{(1, 1), (2, 3), (0, -1), (-1, -3)\}$

and $f(x) = ax + b$

$$\therefore \quad f(1) = a + b$$
$$\Rightarrow \quad a + b = 1 \quad \text{...(i)}$$

and $f(2) = 2a + b$

$$\Rightarrow \quad 2a + b = 3 \quad \text{...(ii)}$$

Solving Eqs. (i) and (ii), we get

$$a = 2, b = -1$$

131. (a) Given, $A = \{1, 2, 3\}$, $B = \{4, 5, 6\}$

$\therefore$ Relation from A to B is

$$R = \{(1, 5), (2, 6), (3, 4), (3, 6)\}$$

132. (c) The total number of subsets are 2^n.

133. (c) Given, $A = \{a, b, d, l\}$, $B = \{c, d, f, m\}$

and $C = \{a, l, m, o\}$

$$\therefore \quad A \cup B = \{a, b, c, d, f, l, m\}$$
$$\therefore C \cap (A \cup B) = \{a, l, m, o\} \cap \{a, b, c, d, f, l, m\}$$
$$= \{a, l, m\}$$

134. (b) $7\log\left(\frac{16}{15}\right) + 5\log\frac{25}{24} + 3\log\frac{81}{80}$

$$= 7[\log 16 - \log 15] + 5(\log 25 - \log 24) + 3(\log 81 - \log 80)$$
$$= 7\log 2^4 - 7(\log 3 + \log 5) + 5\log 5^2 - 5\log 2^3 - 5\log 3 + 3\log 3^4 - 3(\log 2^4 + \log 5)$$
$$= 28\log 2 - 7\log 3 - 7\log 5 + 10\log 5 - 15\log 2 - 5\log 3 + 12\log 3 - 12\log 2 - 3\log 5 = \log 2$$

135. (c) Given, sum of n terms of GP = 255

$$\Rightarrow \quad 255 = \frac{a(r^n - 1)}{r - 1}$$

and also given, $r = 2$, last term $l = 128$

$$\Rightarrow \quad 255 = \frac{a(2^n - 1)}{2 - 1}$$
$$\Rightarrow \quad a(2^n - 1) = 255 \quad \text{...(i)}$$

and $l = ar^{n-1} = 128$

$$\Rightarrow \quad 128 = a \cdot (2)^{n-1} \quad \text{...(ii)}$$

On dividing Eq. (i) by Eq. (ii)

$$\Rightarrow \quad \frac{255}{128} = \frac{a(2^n - 1)}{a\,2^{n-1}}$$
$$\Rightarrow \quad \frac{255}{128} = \frac{2(2^n - 1)}{2^n}$$
$$\Rightarrow \quad \frac{2^n - 1}{2^n} = \frac{255}{256} \Rightarrow 2^n = 256 = 2^8 \Rightarrow n = 8$$

136. (b) Given, $\frac{S_m}{S_n} = \frac{m^2}{n^2}$

$$\Rightarrow \quad \frac{\frac{m}{2}[2a + (m-1)d]}{\frac{n}{2}[2a + (n-1)d]} = \frac{m^2}{n^2}$$

$$= \frac{2a + (m-1)d}{2a + (n-1)d} = \frac{m}{n}$$

$$\Rightarrow \quad \frac{a + \frac{(m-1)}{2}d}{a + \frac{1}{2}(n-1)d} = \frac{m}{n}$$

$$\Rightarrow \quad an + \frac{1}{2}(m-1)nd = am + \frac{1}{2}(n-1)md$$

$$\Rightarrow \quad a(n-m) + \frac{d}{2}[mn - n - mn + n] = 0$$

$$\Rightarrow \quad a(n-m) + \frac{d}{2}(m-n) = 0$$

$$\Rightarrow \quad a = \frac{d}{2} \quad \text{or } d = 2a$$

$\therefore$ Required ratio, $\frac{T_m}{T_n} = \frac{a + (m-1)d}{a + (n-1)d}$

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

$$= \frac{1 + 2m - 2}{1 + 2n - 2}$$

$$= \frac{2m-1}{2n-1}$$

137. (a) Given, $x = \frac{\sqrt{3}+1}{2}$

$$\therefore \quad 4x^3 + 2x^2 - 8x + 7 = 4\left(\frac{\sqrt{3}+1}{2}\right)^3 + 2\left(\frac{\sqrt{3}+1}{2}\right)^2 - 8\left(\frac{\sqrt{3}+1}{2}\right) + 7$$

$$= 4\left(\frac{3\sqrt{3} + 1 + 9 + 3\sqrt{3}}{8}\right) + 2\left(\frac{3 + 1 + 2\sqrt{3}}{4}\right) - 8\left(\frac{\sqrt{3}+1}{2}\right) + 7$$

$$= \frac{6\sqrt{3} + 10}{2} + \frac{4 + 2\sqrt{3}}{2} - 4(\sqrt{3} + 1) + 7$$

$$= 3\sqrt{3} + 5 + 2 + \sqrt{3} - 4\sqrt{3} - 4 + 7$$

$$= 10$$

138. (d) Given, $A = \begin{bmatrix} 1 & -2 & -3 \\ 2 & 1 & -2 \\ 3 & 2 & 1 \end{bmatrix}$

$$\therefore \quad |A| = 1(1+4) + 2(2+6) - 3(4-3)$$

$$= 5 + 16 - 3 = +18 \neq 0$$

Hence, given matrix is non-singular, here for skew-symmetric matrix all elements of principle diagonal should be zero.

139. (b) $\therefore \quad AB = \begin{bmatrix} 1 & 1 & 1 \\ 3 & 3 & 3 \end{bmatrix} \begin{bmatrix} -2 & 3 \\ 1 & -5 \\ 4 & 1 \end{bmatrix}$

$$= \begin{bmatrix} -2 + 1 + 4 & 3 - 5 + 1 \\ -6 + 3 + 12 & 9 - 15 + 3 \end{bmatrix}$$

$$= \begin{bmatrix} 3 & -1 \\ 9 & -3 \end{bmatrix}$$

140. (c) Given, $\begin{vmatrix} x & x^2 & 1 + x^3 \\ y & y^2 & 1 + y^3 \\ z & z^2 & 1 + z^3 \end{vmatrix} = 0$

$$\Rightarrow \quad \begin{vmatrix} x & x^2 & 1 \\ y & y^2 & 1 \\ z & z^2 & 1 \end{vmatrix} + \begin{vmatrix} x & x^2 & x^3 \\ y & y^2 & y^3 \\ z & z^2 & z^3 \end{vmatrix} = 0$$

$$\Rightarrow \quad \begin{vmatrix} x & x^2 & 1 \\ y & y^2 & 1 \\ z & z^2 & 1 \end{vmatrix} + xyz\begin{vmatrix} 1 & x & x^2 \\ 1 & y & y^2 \\ 1 & z & z^2 \end{vmatrix} = 0$$

$$\because \quad \begin{vmatrix} x & x^2 & 1 \\ y & y^2 & 1 \\ z & z^2 & 1 \end{vmatrix} = \begin{vmatrix} 1 & x & x^2 \\ 1 & y & y^2 \\ 1 & z & z^2 \end{vmatrix}$$

$$\Rightarrow \quad (1 + xyz)\begin{vmatrix} x & x^2 & 1 \\ y & y^2 & 1 \\ z & z^2 & 1 \end{vmatrix} = 0$$

$$(1 + xyz)\begin{vmatrix} x & x^2 & 1 \\ y - x & y^2 - x^2 & 0 \\ z - x & z^2 - x^2 & 0 \end{vmatrix} = 0$$

$$(1 + xyz)[(y-x)(z-x)(z+x) - (z-x)(y-x)(y+x)] = 0$$

$$(1 + xyz)(y-x)(z-x)(z + x - y - x) = 0$$

$$(1 + xyz)(y-x)(z-x)(z-y) = 0$$

$$\because \quad x \neq y \neq z \Rightarrow xyz + 1 = 0$$

$$\Rightarrow \quad xyz = -1$$

141. (a) Given expansion is $(a-b)^n$.

$$\therefore \quad T_5 + T_6 = 0$$

$$\Rightarrow \quad {}^nC_4(a)^{n-4}(-b)^4 + {}^nC_5(a)^{n-5}(-b)^5 = 0$$

$$\Rightarrow \quad \frac{n(n-1)(n-2)(n-3)}{4 \times 3 \times 2 \times 1}[a^{n-4} \times b^4] - \frac{n(n-1)(n-2)(n-3)(n-4)}{5 \times 4 \times 3 \times 2 \times 1}a^{n-5}b^5 = 0$$

$$\Rightarrow \quad \frac{n(n-1)(n-2)(n-3)}{4!}b^4a^{n-4}\left[1 - \frac{b}{a} \times \frac{n-4}{5}\right] = 0$$

$$\Rightarrow \quad 1 - \frac{(n-4)}{5} \times \frac{b}{a} = 0$$

$$\Rightarrow \quad \frac{a}{b} = \frac{n-4}{5}$$

142. (a) General term of $\left(px^2 + \frac{1}{qx}\right)^{11}$ is

$$T_{r+1} = {}^{11}C_r(px^2)^{11-r}\left(\frac{1}{qx}\right)^r$$

$$= {}^{11}C_r\,p^{11-r}q^{-r}(x^{22-3r})$$

For coefficient of x^7,

Put $\quad 22 - 3r = 7 \Rightarrow 3r = 15$

$\Rightarrow \quad r = 5$

$\therefore \quad T_6 = {}^{11}C_5\,p^{11-5}q^{-5} = {}^{11}C_5\,p^6q^{-5}$

Also, general term of $\left(px - \frac{1}{qx^2}\right)^{11}$ is

$$T_{r+1} = {}^{11}C_r(px)^{11-r}\left(-\frac{1}{qx^2}\right)^r$$

$$= {}^{11}C_r\,p^{11-r}(-q)^{-r}\,x^{11-3r}$$

For coefficient of x^{-7},

Put $\quad 11 - 3r = -7 \Rightarrow 3r = 18$

$\therefore \quad r = 6 \qquad (\because r \text{ is integer})$

$\therefore \quad T_7 = {}^{11}C_6 p^{11-6}(-q)^{-6} = {}^{11}C_6 p^5 q^{-6}$

According to the given condition,

$$T_6 = T_7$$

$$\therefore \quad {}^{11}C_5\, p^6 q^{-5} = {}^{11}C_6 p^5 q^{-6}$$

$$\Rightarrow \quad \frac{p^6}{q^5} = \frac{p^5}{q^6} \qquad (\because {}^{11}C_5 = {}^{11}C_6)$$

$$\Rightarrow \quad pq = 1$$

143. (b) Since, the seated are numbered in a round table.

$\therefore$ The total number of ways $= {}^nP_{n_1}$

144. (d) The total number of subsets of a set containing n distinct objects

$$= {}^nC_0 + {}^nC_1 + {}^nC_2 + \dots + {}^nC_n = 2^n$$

145. (d) Since, $1, \omega, \omega^2, \dots, \omega^{n-1}$ are the nth roots of unity.

$$\therefore \quad x^n - 1 = (x-1)(x-\omega)(x-\omega^2)\dots(x-\omega^{n-1})$$

$$\Rightarrow \quad \frac{x^n - 1}{x-1} = (x-\omega)(x-\omega^2)\dots.(x-\omega^{n-1})$$

$$\Rightarrow \quad 1 + x + x^2 + \dots + x^{n-1} = (x-\omega)(x-\omega^2) \dots.(x-\omega^{n-1})$$

Put $\quad x = 1$

$$\therefore \quad n = (1-\omega)(1-\omega^2)\dots(1-\omega^{n-1})$$

146. (c) Now, $\sin\frac{2\pi p}{7} - i\frac{\cos 2\pi p}{7} = -i\left(\cos\frac{2\pi}{7} + i\frac{\sin 2\pi}{7}\right)^p$

$$= -iz^p, \text{ where } z = \cos\frac{2\pi}{7} + i\sin\frac{2\pi}{7}$$

$$\therefore \quad \sum_{p=1}^{6} 2\left(\sin\frac{2\pi p}{7} - i\cos\frac{2\pi p}{7}\right)$$

$$= -2i(z + z^2 + z^3 + \dots + z^6)$$

$$= -2i\left(\frac{z(1-z^6)}{1-z}\right)$$

$$= -2i\left(\frac{z - z^7}{1-z}\right)$$

$$= 2i\left(\frac{z^7 - z}{1-z}\right) = 2i\frac{(1-z)}{1-z} = 2i$$

$$[\because z^7 = \left(\cos\frac{2\pi}{7} + i\sin\frac{2\pi}{7}\right)^7 = \cos 2\pi + i\sin 2\pi = 1 + i\cdot 0 = 1]$$

147. (b) Given, $E = (x-1)(2x-1)(2^2x-1)(2^3x-1)\dots(2^{15}x-1)$

$\therefore$ Coefficient of x^{15} in E

$$= -1[2^{1+2+\dots.+15} + 2^{0+2+3+\dots+15} + 2^{1+3+4+\dots+15} + \dots. + 2^{1+2+3+\dots.+14}]$$

$$= -[2^{120} + 2^{119} + 2^{118} + \dots + 2^{105}]$$

$$= -2^{105}[1 + 2 + \dots. + 2^{15}]$$

$$= -2^{105}\left(\frac{2^{16}-1}{2-1}\right) = -2^{105}\left(\frac{2^{16}-1}{1}\right) = 2^{105} - 2^{121}$$

148. (a) Given series can be rewritten as

$$S_\infty = \frac{5}{2} + \frac{20}{13} + \frac{10}{9} + \frac{20}{33} + \dots.$$

Taking option (a) is

$$T_n = \frac{20}{5n+3}$$

$$\therefore \quad T_1 = \frac{20}{5+3} = \frac{20}{8} = \frac{5}{2}$$

$$T_2 = \frac{20}{10+3} = \frac{20}{13}$$

$$T_3 = \frac{20}{15+3} = \frac{20}{18} = \frac{10}{9}$$

$$\vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots$$

Hence, option (a) is correct.

149. (c) The number of quadratic equations which remain unchanged by squaring their roots is two.

e.g., if we take roots

$$\alpha = 1, \beta = 1$$

$$\Rightarrow \quad \alpha^2 = 1, \beta^2 = 1$$

and if we take roots

$$\alpha = 0, \beta = 1$$

$$\Rightarrow \quad \alpha^2 = 0, \beta = 1$$

150. (b) Given equation is

$$(5 + \sqrt{2})x^2 - (4 + \sqrt{5})x + 8 + 2\sqrt{5} = 0$$

Let roots be α and β.

$$\therefore \quad \alpha + \beta = \frac{4+\sqrt{5}}{5+\sqrt{2}} \quad \text{and} \quad \alpha\beta = \frac{8+2\sqrt{5}}{5+\sqrt{2}}$$

$$\therefore \quad \text{Harmonic mean of roots} = \frac{2\alpha\beta}{\alpha+\beta} = \frac{2\left(\frac{8+2\sqrt{5}}{5+\sqrt{2}}\right)}{\frac{4+\sqrt{5}}{5+\sqrt{2}}}$$

$$= \frac{4(4+\sqrt{5})}{4+\sqrt{5}} = 4$$