

Question Paper

Quantitative Methods – I (131) : April 2005

- Answer all questions.
- Marks are indicated against each question.

1. If the sums of **p**, **q** and **r** terms of an arithmetic progression are **a**, **b** and **c** respectively, then find the value [< Answer >](#)

of the expression: $\frac{a}{p}(q-r) + \frac{b}{q}(r-p) + \frac{c}{r}(p-q)$

- (a) $\frac{abc}{pqr}$ (b) $\frac{a+b+c}{p+q+r}$ (c) $ap + bq + cr$ (d) $abc(p+q+r)$ (e) Zero.

(2 marks)

2. [< Answer >](#)

$$\frac{1}{2}x + \frac{1}{3}y - \frac{1}{3}z = -1$$

$$\frac{1}{3}x + \frac{1}{2}y - \frac{1}{6}z = 4$$

$$\frac{1}{6}x - \frac{5}{6}y + \frac{1}{2}z = 3$$

The value of **x** in the above simultaneous equations would be

- (a) 3 (b) 6 (c) 9 (d) 12 (e) 24.

(1 mark)

3. [< Answer >](#)

$$x = \frac{\sqrt[n]{m^{m-1}}}{\sqrt[n]{n^{n+1}}}, \quad y = \frac{\sqrt[n]{n^{1-n}}}{\sqrt[n]{m^{m+3}}} \quad \text{and} \quad z = \frac{\sqrt[n]{m^5}}{\sqrt[n]{n^{1-2n}}}$$

The value of **xyz** is

- (a) $\frac{\sqrt[n]{m}}{\sqrt[n]{n}}$ (b) $\frac{\sqrt[n]{m}}{\sqrt[n]{n}}$ (c) $\frac{\sqrt[n]{n}}{\sqrt[n]{m}}$ (d) $\frac{\sqrt[n]{n}}{\sqrt[n]{m}}$ (e) $\sqrt[n]{m} \times \sqrt[n]{n}$.

(1 mark)

4. The harmonic mean of two numbers is 4. The arithmetic and geometric means of the same numbers are **A**, **G** [< Answer >](#) respectively. The relationship between **A** and **G** is $2A + G^2 = 27$. One of the two numbers is

- (a) 3 (b) 5 (c) 7 (d) 9 (e) 11.

(2 marks)

5. If ${}^{28}C_{2r} : {}^{24}C_{2r-4} = 225 : 11$ the value of **r** is [< Answer >](#)

- (a) 9 (b) 8 (c) 7 (d) 6 (e) 5.

(1 mark)

6. If the letters of the word **MISSISSIPI** are arranged in a row at random, the probability that all **S**'s come together is [< Answer >](#)

(a) $1/7$ (b) $1/10$ (c) $1/3$ (d) $1/30$ (e) $2/15$.

(1 mark)

7. $\log_n \left(1 - \frac{1}{2}\right) + \log_n \left(1 - \frac{1}{3}\right) + \log_n \left(1 - \frac{1}{4}\right) + \dots + \log_n \left(1 - \frac{1}{n}\right) = ?$ [< Answer >](#)

(a) $-1/2$ (b) $1/2$ (c) 1 (d) -1 (e) 2 .

(1 mark)

8. If $x^y = e^{x-y}$ then $\frac{dy}{dx} = ?$ [< Answer >](#)

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

(1 mark)

9. The mean marks obtained by a group of 100 students were found to be 50, while the mean marks obtained by another group of 200 students was 53. Find the mean marks obtained by both the groups of students taken together. [< Answer >](#)

(a) 50 (b) 51 (c) 52 (d) 53 (e) 54.

(1 mark)

10. The arithmetic mean between two numbers exceeds their geometric mean by 2 and the geometric mean exceeds their harmonic mean by $8/5$. The highest of the two numbers is [< Answer >](#)

(a) 12 (b) 16 (c) 20 (d) 24 (e) 32.

(2 marks)

11. If ${}^nC_{r-1} = 36$, ${}^nC_r = 84$ and ${}^nC_{r+1} = 126$. The value of r is [< Answer >](#)

(a) 3 (b) 5 (c) 7 (d) 9 (e) 10.

(2 marks)

12. Which of the following is **false**? [< Answer >](#)

(a) If $b - a > 0$, then $a < b$ (b) If $a < b$ and $b < c$, then $a < c$
 (c) If $a < b$, then $(a + c) < (b + c)$ (d) If $a < b$ and $x < 0$, then $ax < bx$
 (e) If $a < b$ and $x = 0$, then $ax = bx$.

(1 mark)

[< Answer >](#)

13. If $u = \frac{x+y}{x-y}$ then $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = ?$

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

(1 mark)

[< Answer >](#)

14. If $y = (x-b)(x-c)$ then $\frac{dy}{dx}$ at $x = (b+c)$ is

(b and c are constants)

- (a) $(b+c)$ (b) $(b-c)$ (c) $2bc$ (d) $(2b+c)$ (e) $(b-2c)$.

(1 mark)

[< Answer >](#)

15. If $\frac{\log_2 x}{2} = \frac{\log_2 y}{3} = \frac{\log_2 z}{3k}$ and $x^3 y^2 z = 1$ then $k = ?$

- (a) -4 (b) -2 (c) 2 (d) 4 (e) 3 .

(2 marks)

[< Answer >](#)

16. If $f(x) = \sqrt{\frac{(x+1)(x-2)}{(x+3)(x+6)}}$, then $\frac{f'(0)}{f(0)} = ?$

- (a) $1/18$ (b) $1/9$ (c) $1/3$ (d) 1 (e) 0 .

(1 mark)

[< Answer >](#)

17. Which of the following algebraic properties represents the associative property of multiplication?

- (a) $a.b = b.a$ (b) $a.(b+c) = a.b + a.c$ (c) $(a.b).c = a.(b.c)$
(d) $a.1 = a$ (e) $a.0 = 0$.

(1 mark)

[< Answer >](#)

18. $e = 2x^2 - 3x + 4$
 $f = 3x^2 - 2x - 3$

The value of $e \times f$ is

- (a) $6x^4 + 5x^3 + 6x^2 + 9x - 12$ (b) $6x^4 - 5x^3 + 12x^2 + 9x - 12$
(c) $6x^4 - 13x^3 + 12x^2 + x - 12$ (d) $6x^4 + 13x^3 + 6x^2 - 8x - 12$
(e) $6x^4 - 13x^3 - 12x^2 + x - 12$.

(1 mark)

[< Answer >](#)

19. $z = \sqrt[3]{x^{-1} \sqrt{y^3}} \div \sqrt[3]{y^3 \sqrt{x}}$

If $x = 512$ and $y = 729$ then the value of z would be

- (a) $\frac{3}{32}$ (b) $\frac{1}{6}$ (c) $\frac{9}{32}$ (d) $\frac{3}{16}$ (e) $\frac{9}{16}$.

(1 mark)

20. The product of three numbers in geometric progression is 125 and the sum of their products taken in pairs is [< Answer >](#)

$$87\frac{1}{2}$$

. The highest of the three numbers is

- (a) 5 (b) 7 (c) 10 (d) 12 (e) 15.

(1 mark)

21. There are 5 professors and 10 students out of whom a committee of 2 professors and 3 students is to be [< Answer >](#) formed. When a particular professor must be included in this committee, in how many ways can such committee be formed?

- (a) 120 (b) 220 (c) 330 (d) 480 (e) 540.

(1 mark)

22. If $\log_{12} 27 = a$, the value of $\log_6 16$ would be [< Answer >](#)

- (a) $\frac{4(a-3)}{(a+3)}$ (b) $\frac{(3-a)}{4(3+a)}$ (c) $\frac{4(3+a)}{(3-a)}$ (d) $\frac{4(3-a)}{(3+a)}$ (e) $\frac{(3-a)}{(3+a)}$.

(2 marks)

23. In which of the following conditions will a quadratic equation of the form, $ax^2 + bx + c = 0$, have a single [< Answer >](#) root?

- (a) $b^2 = ac$ (b) $b^2 = ac$ (c) $\frac{b^2}{4} = ac$ (d) $\frac{b}{4} = ac$ (e) $\frac{b}{4} = a$.

(1 mark)

24. $\lim_{x \rightarrow \infty} \frac{x^2 - 3x + 2}{3x^2 - 4x} = ?$ [< Answer >](#)

- (a) 0 (b) $\frac{1}{3}$ (c) $\frac{1}{2}$ (d) $\frac{2}{3}$ (e) ∞ .

(1 mark)

25. Differentiation of a^{bx+c} with respect to x is [< Answer >](#)
(a , b and c are constants)

- (a) $(bx+c)a^{bx+c-1}$ (b) $\frac{(bx+c)a^{bx+c-1}}{\log_e a}$
(c) $\frac{ba^{bx+c}}{\log_e a}$ (d) $ba^{bx+c} \times \log_e a$ (e) $(bx+c)a^{bx+c-1} \times \log_e a$.

(1 mark)

26. Sum to n terms of the series 7, 77, 777, 777,....would be

[< Answer >](#)

- (a) $\frac{7(10^{n+1}-10)}{81} - \frac{7n}{9}$ (b) $\frac{7(10^{n+1}-10)}{81} + \frac{7n}{9}$
 (c) $\frac{7(10^{n+1}+10)}{81} - \frac{7n}{9}$ (d) $\frac{7(10^{n+1}+10)}{81} + \frac{7n}{9}$
 (e) $\frac{7(10^{n+1}-10)}{81}$

(2 marks)

[< Answer >](#)

27.

$$\text{Let } f(x) = \begin{cases} 3^{-x} - 1, & \text{for } -1 \leq x < 0 \\ \frac{x}{x^2 - 2}, & \text{for } 0 \leq x < 3 \\ 2^x - 11, & \text{for } 3 \leq x \leq 6 \end{cases}$$

The value of $f(3)$ is

- (a) $-\frac{26}{27}$ (b) $\frac{3}{7}$ (c) -11 (d) -3 (e) 11 .

(1 mark)

[< Answer >](#)

28. The total cost of production in a day, for a firm, is given by the following equation:

$$T(x) = 10500x - 20x^2 + \frac{1}{5}x^3$$

Where $T(x)$ = Total cost of production in a day
 x = Number of units produced in a day

How many units of the product should be produced in a day so that the average cost of the product is minimum?

- (a) 5 (b) 10 (c) 20 (d) 50 (e) 100.

(2 marks)

[< Answer >](#)

29. Mountain States Oil Company refines crude oil into gasoline, jet fuel and heating oil. The company can process a maximum of 10,000 barrels per day at its refinery. The refining process is such that a maximum of 7,000 barrels of gasoline can be produced per day. Furthermore, there is always at least as much jet fuel as gasoline produced. The wholesale prices of gasoline, jet fuel, and heating oil are Rs. 2500, Rs. 2000, and Rs. 1500 per barrel, respectively. The company is interested in maximizing revenue. Let G , J and H respectively denote the number of barrels of gasoline, jet fuel and heating oil produced by the oil company and Z denote the total revenue generated in rupees through the sale of the products.

Which of the following best describes the objective function for the above linear programming problem?

- (a) Maximize $Z = 2500G + 2000J + 1500H$
 (b) Maximize $Z = 2000G + 2500J + 1500H$
 (c) Maximize $Z = 1500G + 2000J + 2500H$
 (d) Maximize $Z = 2500G + 1500J + 2000H$
 (e) Maximize $Z = 2000G + 1000J + 7000H$.

(1 mark)

30. The terms in a series are as given below:

[< Answer >](#)

4, 8, 16, 32, 64,

The ninth term of the series is

- (a) 256 (b) 512 (c) 1024 (d) 2048 (e) 4096.

(1 mark)

31. Rana Fabricators Ltd. (RFL) is manufacturing two products – **A** and **B**. The product **A** requires services of one skilled and one unskilled labourer, whereas, product **B** requires the services of one skilled labourer and two unskilled labourers. Presently, the company employs 45 labourers, of which 20 are skilled and the rest are unskilled. The contributions to the company's profit by product **A** and product **B** are Rs. 600 and Rs. 800 respectively. The company is interested in maximizing its profit. How much profit the company would earn at the optimal point?

[< Answer >](#)

- (a) Rs.11,000 (b) Rs.12,000 (c) Rs.13,000 (d) Rs.14,000 (e) Rs.15,000.

(2 marks)

32. Three balls are drawn successively from a box containing 6 red balls, 4 white balls and 5 blue balls. What is the probability that they are drawn in the order red, white and blue if each of the balls is replaced every time?

[< Answer >](#)

- (a) 2/91 (b) 3/91 (c) 2/75 (d) 4/225 (e) 8/225.

(1 mark)

33. **A**, **B** and **C** are mutually exclusive and collectively exhaustive events, resulting from an experiment. **B** is twice as likely as **A**, and **C** is 2.5 times as likely as **B**.

[< Answer >](#)

Which of the following is **correct**?

- (a) $P(A) = 3\%$, $P(B) = 6\%$, $P(C) = 15\%$
(b) $P(A) = 5\%$, $P(B) = 10\%$, $P(C) = 25\%$
(c) $P(A) = 8\%$, $P(B) = 16\%$, $P(C) = 40\%$
(d) $P(A) = 10\%$, $P(B) = 20\%$, $P(C) = 50\%$
(e) $P(A) = 12.5\%$, $P(B) = 25\%$, $P(C) = 62.5\%$.

(1 mark)

34. Three candidates, **A**, **B** and **C**, are being considered by the board of directors of a company for the post of the CEO. The probability that **A** will be appointed as the CEO is 0.20, the probability that **B** will be appointed is 0.30 and the probability that **C** will be appointed to the post is 0.50. If **A** is appointed as the CEO then the probability of successfully launching a new product is 30%. If **B** is appointed as the CEO then the probability of successfully launching a new product is 50% and if **C** is appointed then the probability of successfully launching a new product is 60%.

[< Answer >](#)

What is the probability that a new product will be successfully launched?

- (a) 6% (b) 15% (c) 30% (d) 51% (e) 60%.

(1 mark)

35. It is required to compute the variance of a population. The observations from the population were grouped into class intervals and, the deviations of the class mid points from an assumed mean were computed. The following details are available: [< Answer >](#)

Deviation of class mid point from assumed mean	Number of observations
-20	5
-10	10
0	20
10	30
20	20
30	15
Total number of observations	100

The width of the class interval is 10. What is the variance of the population?

- (a) 184.75 (b) 1847.5 (c) 18475 (d) 18550 (e) 19450.

(2 marks)

36.

A data set includes some quantities. The sum of reciprocals of the quantities in the data set is $\frac{7}{8}$. The harmonic mean of the data set is $3\frac{3}{7}$. The data set is expanded by including the quantities 5 and 10 into it. [< Answer >](#)

What is the harmonic mean of the expanded data set?

- (a) $\frac{7}{24}$ (b) $10\frac{2}{21}$ (c) $6\frac{2}{3}$ (d) $7\frac{3}{7}$ (e) $4\frac{12}{47}$.

(2 marks)

37. As study was conducted on the daily wages earned by the unskilled labourers in an industrial area. The observations from the survey are given below: [< Answer >](#)

Daily wages (in Rs.)	Number of labourers
25 – 35	15
35 – 45	25
45 – 55	32
55 – 65	28
65 – 75	18
75 – 85	12

The median daily wage earned by the unskilled labourers is

- (a) 35.50 (b) 45.25 (c) 52.66 (d) 60.56 (e) 65.25.

(2 marks)

38. Raj has 40 minutes to complete a government exam. There are 15 multiple-choice questions worth 3 points each. There are also 5 short-answer questions worth 11 points each. It takes about 2 minutes for Raj to answer the each multiple-choice question and about 8 minutes to complete the each short-answer question. Which of the following inequalities is a part of the constraints in the linear programming problem that represents the given situation? [< Answer >](#)

[Note: The number of multiple choice questions and short questions answered are denoted as **m** and **s** respectively.]

- (a) $0 \leq s \leq 15$ (b) $0 \leq m \leq 5$ (c) $2m + 8s \leq 40$ (d) $0 \leq m \leq 11$ (e) $8m + 2s \leq 40$.

(1 mark)

39. In a linear programming problem the feasible region is bounded by the following system of inequalities: [< Answer >](#)

$$2x + y \leq 12$$

$$x + 3y \leq 21$$

$$x, y \geq 0$$

Which of the following points is **not** a part of the feasible region?

- (a) (6, 0) (b) (0, 7) (c) (3, 6) (d) (4, 5) (e) (0, 0).

(1 mark)

40. There are two groups of boxes. The first group contains three boxes each containing five yellow balls and two red balls. The second group contains two boxes each containing one yellow ball and four red balls. A box is selected at random out of the two groups of boxes and a ball is picked at random. If the ball that is picked is a red ball then, what is the probability that the ball is picked from the first group of boxes? [< Answer >](#)

- (a) $\frac{2}{21}$ (b) $\frac{4}{5}$ (c) $\frac{8}{25}$ (d) $\frac{86}{175}$ (e) $\frac{15}{43}$.

(2 marks)

41. Plant **A** of a company employs 5 production and 3 maintenance engineers while plant **B** employs 4 production and 5 maintenance engineers. In a study one of the two plants is randomly selected and then two engineers are selected randomly from that plant. What is the probability that one is a production engineer and the other is a maintenance engineer? [< Answer >](#)

- (a) 0.35 (b) 0.40 (c) 0.45 (d) 0.50 (e) 0.55.

(2 marks)

42. **A** and **B** are mutually exclusive and collectively exhaustive events. Both **A** and **B** are dependent on event **C**. [< Answer >](#)

$$P(\mathbf{A} \text{ and } \mathbf{C}) = 0.48, \quad P(\mathbf{B} \text{ and } \mathbf{C}) = 0.32$$

What is the probability of event **B** happening if event **C** happens?

- (a) 0.32 (b) 0.40 (c) 0.48 (d) 0.60 (e) 0.80.

(1 mark)

43. An NGO has been studying the literacy level among the male and female adults, in a certain village. 3 out of every 5 adults in the village are males. It is observed that 1 out of every 2 adult males, is illiterate and, 4 out of every 5 adult females are illiterates. [< Answer >](#)

If an adult is randomly selected and found to be illiterate then, what is the probability that the adult is a female?

- (a) 32% (b) 25.8% (c) 51.6% (d) 12.9% (e) 62%.

(2 marks)

44. The logarithm of a number

[< Answer >](#)

- (a) Is always expressed with respect to base 10
- (b) Is always expressed with respect to base 1
- (c) Is always expressed with respect to base e
- (d) Is equal to the base which must be raised to a given exponent in order to get the number
- (e) Is equal to the exponent to which a given base must be raised in order to get the number.

(1 mark)

45. If a is a fixed positive real number on the number line and x denotes any real number on the number line then which of the following represents the set of all real numbers x such that $a < x$? [< Answer >](#)

- (a) $(a, +\infty)$ (b) $(-\infty, a)$ (c) $[a, +\infty)$ (d) $(-a, a)$ (e) $(-\infty, +\infty)$.

(1 mark)

46. If $y = x^2 - 3x + 4$, then which of the following statements is **true** for y at the point where the graph of y intersects the Y axis? [< Answer >](#)

- (a) y is increasing at an increasing rate
- (b) y is increasing at a decreasing rate
- (c) y is decreasing at an increasing rate
- (d) y is decreasing at a decreasing rate
- (e) y is decreasing at a constant rate.

(1 mark)

47. Three simultaneous equations involving three variables can be solved if all the three equations [< Answer >](#)

- (a) Can be satisfied by the three variables assuming equal value in all the equations
- (b) Can be satisfied when two out of the three variables assume equal value in all the equations
- (c) Can be satisfied when each of the three variables assumes a different value in each of the three equations
- (d) Can be satisfied when each of the variables are set to zero in all the equations
- (e) Can be satisfied when the three variables respectively assume the same values in the three equations.

(1 mark)

48. Which of the following equations does refer to the distributive property of real numbers? [< Answer >](#)

- (a) $a \times b = b \times a$ (b) $a \times (b + c) = a \times b + a \times c$ (c) $a \times 1 = 1 \times a$
(d) $a \times \frac{1}{a} = 1$ (e) $a \times 0 = 0$.

(1 mark)

49. If a straight line of type $y = mx + c$ in X - Y plane has a negative slope, then [< Answer >](#)

- (a) For a given value of x the value of y will always be negative
- (b) It falls from left to right as the values increase along the X axis
- (c) It always passes through the point of intersection of the X and Y axes
- (d) It is always parallel to the Y axis
- (e) It is always parallel to the X axis.

(1 mark)

50. The set of rational numbers

[< Answer >](#)

- (a) Includes positive numbers only
- (b) Includes negative numbers only

(c) Includes those numbers which are of the form $\frac{p}{q}$, where p and q are integers, and $q \neq 0$

- (d) Includes those numbers which cannot be expressed in the form $\frac{p}{q}$, where p and q are integers
- (e) Includes negative integers only.

(1 mark)

51. A series of numbers is said to be in arithmetic progression if

[< Answer >](#)

- (a) The consecutive numbers increase as multiples of a fixed number
- (b) The consecutive numbers decrease as factors of a fixed number
- (c) The consecutive numbers assume positive and negative signs alternately
- (d) The consecutive numbers are multiples of 100
- (e) The consecutive numbers in the series differ by a constant value.

(1 mark)

52. The equation of a straight line is $\frac{y}{3} + \frac{2}{5}x = 2$.

[< Answer >](#)

Which of the following statements is **correct**?

- (a) The intercept on the **Y** axis is 5
- (b) The intercept on the **X** axis is 6
- (c) The intercept on the **Y** axis is 3
- (d) The slope of the straight line is $-6/5$
- (e) The slope of the straight line is $5/6$.

(1 mark)

53. Which of the following is **true**?

[< Answer >](#)

- (a) In a logarithmic function the logarithmic operation is applied on the dependent variable
- (b) In a logarithmic function the base of the logarithm is always 10
- (c) In a logarithmic function the independent variable cannot be negative
- (d) In a logarithmic function the base of the logarithm can be any real number
- (e) In a logarithmic function the independent variable can be zero.

(1 mark)

54. Which of the following is **false** with regard to the derivative of a function?

[< Answer >](#)

- (a) It indicates the rate of change of the function at a given point
- (b) The slope of the tangent to a function at a point is equal to the derivative of the function at the point
- (c) The derivative may be a function of the independent variable
- (d) The derivative of a linear function changes with the value of the independent variable
- (e) If the derivative of a function at a point is negative then it indicates that the function is decreasing at that point.

(1 mark)

55. Which of the following is **true** with regard to the exponential function $y = m \cdot a^x$? [< Answer >](#)

- (a) The exponential curve falls from left to right as the values increase along the **X** axis if $m > 0$ and $0 < a < 1$
- (b) The exponential curve falls from left to right as the values increase along the **X** axis if $m > 0$ and $a > 1$
- (c) The exponential curve is parallel to the **X** axis if $m > 0$ and $0 < a < 1$
- (d) The exponential curve is parallel to the **X** axis if $m > 0$ and $a > 1$
- (e) The graph of the exponential function is a straight line.

(1 mark)

56. A function $f(x)$ is said to be monotonically increasing if [< Answer >](#)

- (a) The first derivative of $f(x)$ is a constant for all values of x
- (b) The first derivative of $f(x)$ is negative for all values of x
- (c) The first derivative of $f(x)$ is positive for all values of x
- (d) The first derivative of $f(x)$ is zero for all values of x
- (e) The first derivative of $f(x)$ is equal to 1 for all values of x .

(1 mark)

57. The derivative of a function, $y = f(x)$, at a point $x = a$ is equal to [< Answer >](#)

- (a) The limit of the function at $x = a$
- (b) The value of the function at $x = a$

(c) $\lim_{x \rightarrow a} \frac{f(x)}{a}$

(d) $\lim_{x \rightarrow a} \frac{f(x)}{f(a)}$

(e) $\lim_{x \rightarrow a} \frac{f(x) - f(a)}{x - a}$

(1 mark)

58. If the first derivative of a function $f(x)$ is zero at $x = a$ then [< Answer >](#)

- (a) $f(x)$ will be maximum at $x = a$
- (b) $f(x)$ will be minimum at $x = a$
- (c) $f(x)$ will be zero at $x = a$
- (d) $f(x)$ will be maximum at $x = a$ if the second derivative is negative at $x = a$
- (e) $f(x)$ will be minimum at $x = a$ if the second derivative is negative at $x = a$.

(1 mark)

59. Which of the following is **true** with regard to the simplex method of solving linear programming problems? [< Answer >](#)

- (a) This method cannot be applied for solving problems involving two decision variables
- (b) At the optimal solution all the decision variables assume zero values
- (c) Slack variables are used to convert 'greater than or equal to' type constraints into equations
- (d) At the optimal solution all the slack variables assume zero values
- (e) The $Z_j - C_j$ value at the bottom of the solution column shows the value of the objective function for any solution.

(1 mark)

60. Which of the following measures can be determined graphically? [< Answer >](#)

- (a) Arithmetic mean (b) Geometric mean
- (c) Harmonic mean (d) Standard deviation (e) Median.

(1 mark)

61. Which of the following averages may be obtained at the point of intersection of the 'more than' ogive and 'less than' ogive? [< Answer >](#)

- (a) Arithmetic Mean (b) Geometric Mean
(c) Harmonic Mean (d) Median (e) Mode.

(1 mark)

62. Which of the following is **true** with regard to the classical approach to probability? [< Answer >](#)

- (a) It assumes that the outcomes are not equally likely
(b) The probability of an event is determined after performing the experiment large number of times
(c) The probability of an event is determined before performing the experiment
(d) It assumes that all possible outcomes of the experiment are not known
(e) The classical approach cannot be used to find out the probability of mutually exclusive events.

(1 mark)

63. If **A**, **B** and **C** are three events such that $P(A)P(B)P(C) > 0$ and $P(B) > P(A)$, which of the following is always **true**? [< Answer >](#)

- (a) $P(\bar{A}) > P(\bar{B})$ (b) $P(\bar{A}) > P(B)$ (c) $P(A) > P(\bar{B})$
(d) $P(\bar{B}) > P(\bar{A})$ (e) $P(B|C) > P(A|C)$

(1 mark)

64. If two events **A** and **B** are independent then, the conditional probability of event **A** given that event **B** has occurred, is equal to [< Answer >](#)

- (a) Joint probability of events **A** and **B**
(b) Conditional probability of event **B** given event **A**
(c) Marginal probability of event **B**
(d) Marginal probability of event **A**
(e) Zero.

(1 mark)

65. A mechanical system is composed of **k** components, all of which must work in order for the system to function. The probability that each component works is **p**. What is the probability that the system will fail to function? [< Answer >](#)

- (a) p^k (b) $(1 - p)^k$ (c) $1 - kp$ (d) $1 - k(1 - p)$ (e) $1 - p^k$.

(1 mark)

66. The events **S** and **T** are independent and are equiprobable such that $P(S \text{ and } T) = p$ where $p > 0$, then $P(S) =$ [< Answer >](#)

- (a) $\sqrt{p}$ (b) p (c) p^2 (d) $2p$ (e) $p/2$.

(1 mark)

67. Which of the following indicates that the distribution curve of the data is negatively skewed? [< Answer >](#)

- (a) Arithmetic Mean < Median < Mode (b) Median < Mode < Arithmetic Mean
(c) Mode < Arithmetic Mean < Median (d) Mode < Median < Arithmetic Mean
(e) Median < Arithmetic Mean < Mode.

(1 mark)

68. Which of the following graphical representations of data can be used to find out the number of observations which are more or less than certain values? [< Answer >](#)

- (a) Frequency polygon (b) Relative frequency polygon
(c) Histogram (d) Ogive (e) Scatter diagram.

(1 mark)

69. The reciprocal of the harmonic mean is equal to [< Answer >](#)

- (a) Arithmetic mean
(b) Sum of all the observations
(c) Sum of the reciprocals of the observations
(d) Average of the reciprocals of the observations
(e) Product of the reciprocals of the observations.

(1 mark)

70. The coefficient of variation cannot be meaningfully used to compare the variability of two or more sets of data, when [< Answer >](#)

- (a) The standard deviations are equal for two or more sets of data
(b) The standard deviation is 1 for one or more sets of data
(c) The mean is zero for one or more sets of data
(d) The mean is 1 for one or more sets of data
(e) The means are equal for two or more sets of data.

(1 mark)

71. According to the Bienayme-Chebyshev rule, at least _____ percent of the observations in a sample are contained within two standard deviations around the mean, regardless of the shape of the distribution. [< Answer >](#)

- (a) 88.89 (b) 93.75 (c) 68.26 (d) 75.0 (e) 50.0.

(1 mark)

72. If every observation in a data set is increased by a constant quantity then the coefficient of variation of the resulting set of values will be [< Answer >](#)

- (a) Less than the coefficient of variation of the original data set
(b) Greater than the coefficient of variation of the original data set
(c) Equal to the coefficient of variation of the original data set
(d) Equal to the coefficient of variation of the original data set plus the square root of the constant quantity
(e) Equal to the coefficient of variation of the original data set multiplied by the square root of the constant quantity.

(1 mark)

73. The appropriate average for a set of ratios using the denominators of the ratio data as weights is [< Answer >](#)

- (a) Simple arithmetic mean (b) Weighted arithmetic mean
(c) Simple harmonic mean (d) Weighted harmonic mean
(e) Geometric mean.

(1 mark)

74. The data below represents the amount of grams of carbohydrates in a serving of breakfast cereal. [< Answer >](#)

11 15 23 29 19 22 21 20 15 25 17

The median carbohydrate amount in the cereal is _____ grams.

- (a) 19 (b) 20 (c) 21 (d) 21.5 (e) 25.

(1 mark)

75. If a constant quantity is subtracted from every observation in a data set then the range of the resulting set of values will be equal to the [< Answer >](#)

- (a) Range of the original data set plus the constant quantity
- (b) Range of the original data set minus the constant quantity
- (c) Range of the original data set
- (d) Range of the original data set multiplied by the constant quantity
- (e) Range of the original data set divided by the constant quantity.

(1 mark)

76. The sum of the observations in a data set containing 10 observations is 120 and the standard deviation of the data set is 3. If 3 is added to every observation in the data set then, what will be the coefficient of variation of the resulting data set? [< Answer >](#)

- (a) 0 (b) 7.5% (c) 20% (d) 25% (e) 50%.

(1 mark)

77. Which of the following is **false** with regard to linear programming problems? [< Answer >](#)

- (a) The contribution of each unit of the decision variables towards the objective to be achieved is known
- (b) The consumption of resources by each unit of the decision variables is known
- (c) The values of the decision variables in the optimal solution will always be whole numbers
- (d) Linear programming is used either to maximize or to minimize the value of the objective function
- (e) The optimal solution to any linear programming problem is one of the possible feasible solutions.

(1 mark)

78. In which of the following conditions, the graphical solution to a linear programming problem will **not** have multiple optimal solutions? [< Answer >](#)

- (a) One of the edges of the feasible region coincides with the horizontal axis
- (b) One of the edges of the feasible region is parallel to the horizontal axis
- (c) One of the edges of the feasible region coincides with the vertical axis
- (d) One of the edges of the feasible region is parallel to the vertical axis
- (e) None of the edges of the feasible region is parallel to the objective function.

(1 mark)

79. The smallest number that can be divided by each of a group of numbers without leaving a remainder is called [< Answer >](#)

- (a) A factor of the quantities
- (b) The highest common factor of the quantities
- (c) The least common multiple of the quantities
- (d) The average of the quantities
- (e) The sum of all the quantities.

(1 mark)

80. The standard deviation of a data set [< Answer >](#)

- (a) Is expressed in the same unit as the observations in the data set
- (b) Is expressed in the square of the unit of the observations in the data set
- (c) Is expressed in the square root of the unit of the observations in the data set
- (d) Is expressed in a different unit from the unit in which the observations in the data set are expressed
- (e) Is always expressed as a percentage of the mean of the data set.

(1 mark)

81. In which of the following conditions two events, A and B, are said to be mutually exclusive? [< Answer >](#)
 (a) $0 < P(A \text{ or } B) < 1$ (b) $P(A \text{ or } B) = 1$
 (c) $P(A) = P(B) = 1$ (d) $P(A|B) = 0$ and $P(B|A) = 0$ (e) $0 < P(A \text{ and } B) < 1$.
(1 mark)
82. A baker earns 15 paise profit on each glazed doughnut and 40 paise profit on each jelly doughnut. If a customer wants to buy no more than a dozen doughnuts and wants to try at least one of each kind, what is the maximum profit the baker can earn? [< Answer >](#)
 (a) Rs.3.30 (b) Rs.1.80 (c) Rs.4.80 (d) Rs.4.55 (e) Rs.3.90.
(1 mark)
83. Which of the following is **false** with regard to the graphical method of solving linear programming problems? [< Answer >](#)
 (a) The decision variables are represented by the horizontal and vertical axes
 (b) The graphical method can be applied when there are two decision variables
 (c) The optimal solution, if it exists, occurs at one of the corner points of the feasible region
 (d) The optimal solution to the problem always occurs at a point outside the feasible region
 (e) The feasible region is determined by the structural constraints and non-negativity constraints.
(1 mark)
84. Which of the following measures will remain unchanged when every observation in the data set is divided by the same quantity? [< Answer >](#)
 (a) Range (b) Quartile deviation
 (c) Standard deviation (d) Coefficient of variation (e) Mode.
(1 mark)
85. The highest common factor of a group of numbers is [< Answer >](#)
 (a) The smallest number in the group
 (b) A multiple of only the smallest number in the group
 (c) A multiple of only the largest number in the group
 (d) The smallest multiple of only the smallest number in the group
 (e) The highest number that can divide each number in a group of numbers without leaving a remainder.
(1 mark)

Suggested Answers

Quantitative Methods – I (131) : April 2005

1. Answer : (e) [< TOP >](#)

Reason : Let the first term of the A.P. be A and the common difference be D, then

$$S_p = a = (p/2)[2A + (p-1)D]$$

$$\therefore \frac{a}{p} = \left(A - \frac{D}{2}\right) + \frac{p}{2} \cdot D \quad \dots\dots (i)$$

$$\text{Similarly, } \frac{b}{q} = \left(A - \frac{D}{2}\right) + \frac{q}{2} \cdot D \quad \dots\dots (ii)$$

$$\text{And, } \frac{c}{r} = \left(A - \frac{D}{2} \right) + \frac{r}{2} \cdot D \dots\dots (iii)$$

Multiplying equations (i), (ii) and (iii) with (q - r), (r - p) and (p - q) respectively and adding them together, we get,

$$\begin{aligned} & \frac{a}{p}(q-r) + \frac{b}{q}(r-p) + \frac{c}{r}(p-q) \\ &= \left(A - \frac{D}{2} \right) (q-r+r-p+p-q) + \frac{D}{2} [p(q-r) + q(r-p) + r(p-q)] \\ &= 0 \end{aligned}$$

2. Answer : (b)

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Reason :

$$\frac{1}{2}x + \frac{1}{3}y - \frac{1}{3}z = -1 \dots\dots\dots (i)$$

$$\frac{1}{3}x + \frac{1}{2}y - \frac{1}{6}z = 4 \dots\dots\dots (ii)$$

$$\frac{1}{6}x - \frac{5}{6}y + \frac{1}{2}z = 3 \dots\dots\dots (iii)$$

By doing (i) + (ii) + (iii) we get

$$\left(\frac{1}{2} + \frac{1}{3} + \frac{1}{6} \right) x = (-1 + 4 + 3)$$

$$\text{Or, } x = 6$$

3. Answer : (b)

[< TOP >](#)

Reason :

$$\begin{aligned} xyz &= \frac{m^{\frac{m-1}{n}}}{n^{\frac{n+1}{m}}} \times \frac{n^{\frac{1-n}{m}}}{m^{\frac{m+3}{n}}} \times \frac{m^{\frac{5}{n}}}{n^{\frac{1-2n}{m}}} \\ &= \frac{m^{\left(\frac{m-1}{n} - \frac{m+3}{n} + \frac{5}{n} \right)}}{n^{\left(\frac{n+1}{m} - \frac{1-n}{m} + \frac{1-2n}{m} \right)}} \\ &= \frac{m^{\frac{1}{n}}}{n^{\frac{1}{m}}} = \frac{\sqrt[n]{m}}{\sqrt[m]{n}} \end{aligned}$$

4. Answer : (a)

[< TOP >](#)

Reason :

$$H.M = 4, G.M = G, A.M = A$$

$$\text{We know } HM = \frac{GM^2}{AM} = 4$$

$$\text{Or, } GM^2 = 4AM \Rightarrow G^2 = 4A$$

The relationship is

$$2A + G^2 = 27$$

$$\text{Or, } 2A + 4A = 27 \quad \text{Or, } A = \frac{27}{6} = \frac{9}{2}$$

$$\text{So, } G^2 = 4 \times \frac{9}{2} = 18$$

Let the numbers be a, b.

$$(a+b) = 9 \dots (i)$$

$$ab = 18$$

$$\text{Or } b = \frac{18}{a} \text{ Putting this value in equation (i) we get}$$

$$a + \frac{18}{a} = 9$$

$$\text{Or, } a^2 - 9a + 18 = 0 \quad \text{Or, } a^2 - 6a - 3a + 18 = 0$$

$$\text{Or, } a(a - 6) - 3(a - 6) = 0 \quad \text{Or, } (a - 6)(a - 3) = 0$$

So value of (a, b) is (6, 3) or (3, 6).

5. Answer : (c)

[<TOP>](#)

Reason :

$${}^{28}C_{2r} : {}^{24}C_{2r-4} = 225 : 11$$

$$\text{Or, } \frac{{}^{28}C_{2r}}{{}^{24}C_{2r-4}} = \frac{225}{11}$$

$$\text{Or, } 11 \times \frac{28!}{2r!(28-2r)!} = 225 \times \frac{24!}{(2r-4)!(28-2r)!}$$

$$\text{Or, } \frac{11 \times 25 \times 26 \times 27 \times 28}{225} = (2r-3)(2r-2)(2r-1)2r$$

$$\text{Or, } (2r-3)(2r-2)(2r-1)2r = \frac{11 \times 25 \times 26 \times 27 \times 28}{225} = \frac{11 \times 26 \times 27 \times 28}{9}$$

$$= 11 \times 26 \times 3 \times 28 = 11 \times 12 \times 13 \times 14$$

$$= 14(14-1)(14-2)(14-3)$$

$$\text{So, } 2r = 14$$

$$\text{Or, } r = 7$$

6. Answer : (d)

[<TOP>](#)

Reason : The total number of ways the letters of the word MISSISSIPI can be arranged

$$\frac{10!}{n(S) = 4!4!}$$

The number of ways the letters can be arranged when all S's come together is

$$\frac{7!}{n(E) = 4!}$$

$$\text{The required probability} = \frac{n(E)}{n(S)} = \frac{1}{30}$$

7. Answer : (d)

[< TOP >](#)

Reason : The given expression can be rewritten as,

$$\begin{aligned} & \log_n \frac{1}{2} + \log_n \frac{2}{3} + \log_n \frac{3}{4} + \dots + \log_n \frac{n-1}{n} \\ &= \log_n \left(\frac{1}{2} \times \frac{2}{3} \times \frac{3}{4} \times \dots \times \frac{n-1}{n} \right) \\ &= \log_n \left(\frac{1}{n} \right) = \log_n n^{-1} \\ &= -\log_n n = -1 \end{aligned}$$

8. Answer : (b)

[< TOP >](#)

Reason : Given that,

$$x^y = e^{x-y}$$

applying log to the base e on both sides (natural logarithm),

$$y \log_e x = x - y,$$

$$\text{or, } y = \frac{x}{(1 + \log_e x)}$$

$$\text{now, } \frac{dy}{dx} = \frac{(1 + \log_e x) - x \cdot \frac{1}{x}}{(1 + \log_e x)^2}$$

$$\therefore \frac{dy}{dx} = \frac{\log_e x}{(1 + \log_e x)^2}$$

$$\text{(Note: } \log_e p \text{ is symbolically written as } \ln(p) \text{ and } \frac{d}{dp}(\ln p) = \frac{1}{p} \text{)}$$

9. Answer : (c)

[< TOP >](#)

Reason: Total marks obtained by the first group of students = $50 \times 100 = 5000$.

Total marks obtained by the second group of students = $53 \times 200 = 10600$.

The total marks obtained by the combined group is $5000 + 10600 = 15600$.

$$\text{Therefore the mean of the composite group} = \frac{15600}{300} = 52.$$

10. Answer : (b)

[< TOP >](#)

Reason : Let the numbers be a, b. Let the A.M be A, GM be G and HM be H
 As A.M. exceeds GM by 2. So, $A - G = 2$; Or, $(A - 2)^2 = G^2$ (i)
 As GM exceeds HM by $\frac{8}{5}$. So, $G - H = \frac{8}{5}$ Or, $A - 2 - H = \frac{8}{5}$ Or, $A - H = \frac{18}{5}$

$G^2 = AH = A(A - \frac{18}{5})$ Putting this value of G^2 in equation (i) we get

$$(A - 2)^2 = A(A - \frac{18}{5}) \quad \text{Or, } -4A + 4 = -\frac{18}{5}A$$

$$\text{Or, } 2A = 20 \quad \text{Or, } A = 10. \text{ Or, } (a+b) = 20$$

So, $G = 8$ Or, $\sqrt{ab} = 8$ i.e. $ab = 64$

$$\frac{64}{a} + a = 20$$

$$\text{Or, } a^2 - 20a + 64 = 0.$$

$$\text{Or, } a^2 - 16a - 4a + 64 = 0$$

$$\text{Or, } a(a - 16) - 4(a - 16) = 0$$

$$\text{Or, } (a - 4)(a - 16) = 0$$

So the vale of the numbers would be (4, 16) or (16, 4)
 So the highest value is 16.

11. Answer : (a)

[<TOP>](#)

Reason :

$${}^nC_{r-1} = 36, {}^nC_r = 84 \text{ and } {}^nC_{r+1} = 126$$

$$\text{So, } \frac{{}^nC_r}{{}^nC_{r-1}} = \frac{84}{36} = \frac{7}{3} \quad \text{Or, } 3 \times {}^nC_r = 7 \times {}^nC_{r-1}$$

$$\text{Or, } 3 \times \frac{n!}{r!(n-r)!} = 7 \times \frac{n!}{(r-1)!(n-r+1)!} \quad \text{Or, } 3 \times (n-r+1) = 7 \times r$$

$$\text{Or, } 10r - 3n = 3 \quad \text{.....(i)}$$

$$\text{Again } \frac{{}^nC_{r+1}}{{}^nC_r} = \frac{126}{84}$$

$$\text{Or, } 84 \times \frac{n!}{(r+1)!(n-r-1)!} = 126 \times \frac{n!}{r!(n-r)!} \quad \text{Or, } 84(n-r) = 126(r+1)$$

$$\text{Or, } 84n - 84r = 126r + 126 \quad \text{Or, } 84n - 210r = 126$$

$$\text{Or, } 14n - 35r = 21$$

$$\text{Or, } 2n - 5r = 3 \quad \text{.....(ii)}$$

By $2 \times (i) + 3 \times (ii)$ we get

$$20r - 15r = 9 + 6$$

$$5r = 15 \quad \text{Or, } r = 3$$

12. Answer : (d)

[<TOP>](#)

Reason : If $a < b$ and $x < 0$ then $ax > bx$. All other statements are true.

13. Answer : (c)

[< TOP >](#)

Reason : The given function is

$$u = \frac{x+y}{x-y}$$
$$\frac{\partial u}{\partial x} = \frac{(x-y)(1) - (x+y)(1)}{(x-y)^2} = \frac{-2y}{(x-y)^2}$$
$$\frac{\partial u}{\partial y} = \frac{(x-y) - (x+y)(-1)}{(x-y)^2} = \frac{2x}{(x-y)^2}$$
$$\therefore \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = \frac{-2y}{(x-y)^2} + \frac{2x}{(x-y)^2} = \frac{2}{(x-y)}$$

14. Answer : (a)

[< TOP >](#)

Reason : Given that,

$$y = (x-b)(x-c)$$

$$\text{or, } y = x^2 - (b+c)x + bc$$

Differentiating with respect to x ,

$$\frac{dy}{dx} = 2x - (b+c)$$

$$\text{At } x = (b+c),$$

$$\frac{dy}{dx} = 2(b+c) - (b+c) = (b+c)$$

15. Answer : (a)

[< TOP >](#)

Reason : The given equality can be written as,

$$\frac{\log_2 x}{2} = \frac{\log_2 y}{3} = \frac{\log_2 z}{3k} = p \text{ (say)}$$

$$\text{then, } \log_2 x = 2p$$

$$\Rightarrow x = 2^{2p} \text{ and similarly, } y = 2^{3p} \text{ and } z = 2^{3pk}$$

$$\text{Given that } x^3 y^2 z = 1$$

$$\text{or, } 2^{6p} \cdot 2^{6p} \cdot 2^{3pk} = 2^0$$

$$\text{or, } 2^{12p+3pk} = 2^0$$

$$\text{or, } 12p + 3pk = 0$$

$$\text{or, } 12 + 3k = 0$$

$$\Rightarrow k = -4$$

16. Answer : (e)

[< TOP >](#)

Reason : The given function is,

$$f(x) = \sqrt{\frac{(x+1)(x-2)}{(x+3)(x+6)}}$$

applying log to the base e on both sides, we get

$$\log_e f(x) = \frac{1}{2} [\log_e (1+x) + \log_e (x-2) - \log_e (x+3) - \log_e (x+6)]$$

Differentiating with respect to x ,

$$\frac{f'(x)}{f(x)} = \frac{1}{2} \left[\frac{1}{1+x} + \frac{1}{x-2} - \frac{1}{x+3} - \frac{1}{x+6} \right]$$

$$\therefore \frac{f'(0)}{f(0)} = \frac{1}{2} \left[\frac{1}{1} - \frac{1}{2} - \frac{1}{3} - \frac{1}{6} \right] = 0.$$

17. Answer : (c)

Reason : $(a.b).c = a.(b.c)$ is known as the associative property of multiplication.

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18. Answer : (c)

Reason :

$$\mathbf{e} = 2x^2 - 3x + 4$$

$$\mathbf{f} = 3x^2 - 2x - 3$$

$$\mathbf{e} \times \mathbf{f} = 6x^4 - 9x^3 + 12x^2$$

$$- 4x^3 + 6x^2 - 8x$$

$$- 6x^2 + 9x - 12$$

$$+ 6x^4 - 13x^3 + 12x^2 + x - 12$$

19. Answer : (d)

Reason :

[<TOP>](#)

$$z = \sqrt[3]{x^{-1}} \sqrt{y^3} \div \sqrt[3]{y} \sqrt[3]{x}$$

$$= \frac{(x^{-1})^{\frac{1}{3}} \times (y^2)^{\frac{1}{3}}}{(y)^{\frac{1}{3}} (x^{\frac{1}{3}})^{\frac{1}{3}}} = \frac{x^{-\frac{1}{3}} \times x^{-\frac{1}{9}}}{y^{\frac{1}{3}} \times y^{-\frac{1}{2}}} = \frac{x^{-\frac{4}{9}}}{y^{-\frac{1}{6}}} = x^{-\frac{4}{9}} \cdot y^{\frac{1}{6}}$$

Applying the value of x and y we get

$$(512)^{-\frac{4}{9}} \cdot (729)^{\frac{1}{6}}$$

$$= (2^9)^{-\frac{4}{9}} \cdot (3^6)^{\frac{1}{6}}$$

$$= 2^{-4} \cdot 3^1$$

$$= \frac{3}{2^4} = \frac{3}{16}$$

20. Answer : (c)

[< TOP >](#)

Reason :

Let the numbers be $\frac{m}{r}$, m, mr.

The product of the numbers is $m^3 = 125$; or, $m = 5$.

The sum of the products in pairs is

$$\frac{m}{r} \cdot m + m \cdot mr + mr \cdot \frac{m}{r} = \frac{175}{2}$$

$$25 \left(\frac{1}{r} + r + 1 \right) = \frac{175}{2}$$

$$\text{Or, } 2r^2 + 2r + 2 = 7r$$

$$\text{Or, } 2r^2 - 5r + 2 = 0$$

$$\text{Or, } 2r^2 - 4r - r + 2 = 0$$

$$\text{Or, } 2r(r - 2) - 1(r - 2) = 0$$

$$\text{Or, } (r - 2)(2r - 1) = 0$$

$$\text{So, } r = 2 \text{ or, } \frac{1}{2}$$

So the highest number is $5 \times 2 = 10$

21. Answer : (d)

[< TOP >](#)

Reason : One professor should always be the member of this committee. So, only one

professor is to be selected from remaining 4 professors in ${}^4C_1 = 4$ ways. On the other hand, 3 students can be selected from 10 students in

${}^{10}C_3 = \frac{10 \times 9 \times 8}{1 \times 2 \times 3} = 120$ ways. So, there are $120 \times 4 = 480$ ways this committee can be formed in the given condition.

22. Answer : (d)

[<TOP>](#)

Reason :

$$\begin{aligned}\log_{12} 27 &= a, \\ \text{or, } \frac{\log_x 27}{\log_x (3 \times 4)} &= \frac{3 \log_x 3}{\log_x 3 + \log_x 4} = \frac{3 \log_x 3}{\log_x 3 + 2 \log_x 2} = a \\ \text{or, } \frac{\log_x 3 + 2 \log_x 2}{3 \log_x 3} &= \frac{1}{a} \\ \text{or, } \frac{1}{3} + \frac{2 \log_x 2}{3 \log_x 3} &= \frac{1}{a} \\ \text{or, } \frac{\log_x 2}{\log_x 3} &= \frac{3}{2} \left(\frac{1}{a} - \frac{1}{3} \right) = \frac{3-a}{2a} \dots\dots\dots(i)\end{aligned}$$

$$\begin{aligned}\text{Now, } \log_6 16 &= \frac{\log_x 16}{\log_x 6} = \frac{4 \log_x 2}{\log_x 2 + \log_x 3} = \frac{4 \frac{3-a}{2a} \log_x 3}{\frac{3-a}{2a} \log_x 3 + \log_x 3} = \frac{4(3-a)/2a}{\frac{(3-a)+2a}{2a}} \\ &= \frac{4(3-a)}{(3-a)+2a} = \frac{4(3-a)}{(3+a)}\end{aligned}$$

23. Answer : (c)

[<TOP>](#)

Reason : The roots of the equation $ax^2 + bx + c = 0$ are

$$= \frac{-b \pm \sqrt{b^2 - 4ac}}{2 \cdot a}$$

Now, the above equation will have a single root if and only if $b^2 - 4ac = 0$ or,

$$\frac{b^2}{4} = ac.$$

24. Answer : (b)

[<TOP>](#)

$$\begin{aligned}\text{Reason : } \lim_{x \rightarrow \infty} \frac{x^2 - 3x + 2}{3x^2 - 4x} \\ &= \lim_{x \rightarrow \infty} \frac{\frac{1}{x^2} (x^2 - 3x + 2)}{\frac{1}{x^2} (3x^2 - 4x)} \\ &= \lim_{x \rightarrow \infty} \frac{1 - \frac{3}{x} + \frac{2}{x^2}}{3 - \frac{4}{x}} = \frac{1}{3}\end{aligned}$$

Because as $x \rightarrow \infty$, $\frac{3}{x}$ and $\frac{2}{x^2}$ in the numerator tend to zero, and $\frac{4}{x}$ in the denominator tends to zero.

25. Answer : (d)

[< TOP >](#)

Reason :

$$\text{Let } a^{bx+c} = p \text{ Or, } bx+c = \log_a p = \frac{\log_e p}{\log_e a}$$

Now differentiating both sides with respect to x

$$\frac{d(bx+c)}{dx} = \frac{1}{\log_e a} \times \frac{d \log_e p}{dx} = \frac{1}{\log_e a} \times \frac{d \log_e p}{dp} \times \frac{dp}{dx}$$

$$\text{Or, } b = \frac{1}{\log_e a} \times \frac{1}{p} \times \frac{dp}{dx}$$

$$\text{Or, } \frac{dp}{dx} = bp \times \log_e a$$

Now by putting $p = a^{bx+c}$

$$\text{Or, } \frac{da^{bx+c}}{dx} = ba^{bx+c} \times \log_e a$$

(Note: Since $\log_e p$ is symbolically written as $\ln p$ and $\frac{d}{dp}(\ln p) = \frac{1}{p}$)

26. Answer : (a)

[< TOP >](#)

Reason : $S_n = 7 + 77 + 777 + \dots$ to n terms

$$= 7(1 + 11 + 111 + \dots \text{ to n terms})$$

$$= 7/9(9 + 99 + 999 + \dots \text{ to n terms})$$

$$= 7/9[(10-1) + (10^2-1) + (10^3-1) + \dots \text{ to n terms}]$$

$$= 7/9[(10 + 10^2 + 10^3 + \dots \text{ to n terms}) - (1 + 1 + 1 + \dots \text{ to n terms})]$$

$$= \frac{7}{9} \left\{ \frac{10(10^n - 1)}{10 - 1} - n \right\}$$

$$= \frac{7}{9} \left\{ \frac{10^{n+1} - 10}{9} - n \right\} = \frac{7}{81}(10^{n+1} - 10) - \frac{7}{9}n.$$

27. Answer : (d)

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Reason :

$$\text{Let } f(x) = \begin{cases} 3^{-x} - 1, & \text{for } -1 \leq x < 0 \\ \frac{x}{x^2 - 2}, & \text{for } 0 \leq x < 3 \\ 2^x - 11, & \text{for } 3 \leq x \leq 6 \end{cases}$$

$$\text{The value of } f(3) = 2^3 - 11 = 8 - 11 = -3$$

28. Answer : (d)

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Reason : Total cost is given by: $T(x) = 10500x - 20x^2 + \frac{1}{5}x^3$

$$\text{Average cost} = \frac{\text{Total cost}}{\text{Number of units}}$$

$$\therefore \text{Average cost, } U(x) = \frac{1}{x} \left[10500x - 20x^2 + \frac{1}{5}x^3 \right]$$

$$\text{or } U(x) = 10500 - 20x + \frac{1}{5}x^2$$

$$U'(x) = -20 + \frac{2}{5}x$$

For maxima or minima $U'(x) = 0$

$$U'(x) = 0 \Rightarrow -20 + \frac{2}{5}x = 0 \text{ or } x = \frac{20 \times 5}{2} = 50$$

$$U''(x) = \frac{2}{5} > 0 \text{ always}$$

$\therefore$ The average cost of the product is minimum when number of units produced is 50.

29. Answer : (e)

[<TOP>](#)

Reason : Objective: Maximizing revenue

Or, Maximize: $2500G + 2000J + 1500H$

Where, G, J and H are the barrels of gasoline, jet fuel and heating oil produced per day.

30. Answer : (c)

[<TOP>](#)

Reason : 4, 8, 16, 32, 64

This is a G.P with:

$$a = 4$$

$$r = 2$$

The 9th term of the series,

$$t_9 = ar^{9-1} = ar^8 = 4 \times 2^8 = 1024.$$

31. Answer : (c)

[<TOP>](#)

Reason : The problem can formulated as follows:

Objective function: Maximize: $600X_1 + 800X_2$

Subject to:

$$X_1 + X_2 \leq 20 \text{ the terminal line would be } X_1 + X_2 = 20 \dots\dots\dots(i)$$

$$X_1 + 2X_2 \leq 25 \text{ the terminal line would be } X_1 + 2X_2 = 25 \dots\dots\dots(ii)$$

$$\text{and } X_1, X_2 \geq 0 \dots\dots\dots(iii)$$

The feasible region is obtained by solving all the three constraints. So the vertices on X and Y-axes are (20, 0) and (0, 12.5). Now the common point between these two lines are the solution of these two equations, i.e. $X_1 = 15$ and $X_2 = 5$.

The corner points of the feasible regions are (0,0), (20, 0), (15, 5) and (0, 12.5).

Evaluating the objective functions at these points we find that we obtain the maximum value at (15, 5). So the company should manufacture 15 units of product **A** and 5 units of product **B**.

$$\text{Profit} = 600 \times 15 + 800 \times 5 = \text{Rs. 13, 000.}$$

32. Answer : (e)

[<TOP>](#)

Reason : If each ball is replaced, then R, W and B are independent events and

$$P\{R \text{ and } W \text{ and } B\} = P\{R\}P\{W\}P\{B\} = (6/15)(4/15)(5/15) = 8/225.$$

33. Answer : (e)

[<TOP>](#)

Reason : $P(A) = x \quad \therefore P(B) = 2x \quad P(C) = 2.5 P(B) = 2.5(2x) = 5x$

Since A, B and C are mutually exclusive and collectively exhaustive,

$$P(A) + P(B) + P(C) = 1$$

$$\therefore x + 2x + 5x = 1$$

$$\text{or } 8x = 1$$

$$\text{or } x = \frac{1}{8} = 0.125 \quad \text{i.e. } 12.5\%$$

$$\therefore P(A) = 12.5\% \quad P(B) = 2 \times 12.5 = 25\% \quad P(C) = 5 \times 12.5 = 62.5\%$$

34. Answer : (d)

[<TOP>](#)

Reason : Let the following notations be used,

A : A is appointed as CEO.

B : B is appointed as CEO.

C : C is appointed as CEO.

N : New product is launched.

$$\text{Given: } P(A) = 0.20$$

$$P(B) = 0.30$$

$$P(C) = 0.50$$

$$P(N/A) = 30\% = 0.30$$

$$P(N/B) = 50\% = 0.50$$

$$P(N/C) = 60\% = 0.60$$

$$\therefore P(N) = P(A \text{ and } N) + P(B \text{ and } N) + P(C \text{ and } N)$$

$$= (0.20 \times 0.30) + (0.30 \times 0.50) + (0.50 \times 0.60) = 0.51 \quad \text{i.e. } 51\%.$$

35. Answer : (a)

[<TOP>](#)

Reason : The variance of the population using assumed mean can be calculated as:

$$\sigma^2 = \left[\frac{\sum fd^2}{N} - \left(\frac{\sum fd}{N} \right)^2 \right] \times i^2$$

Deviations	Deviation $d = \frac{\text{Deviation}}{i}$	Frequency	d^2	fd^2	fd
-20	-2	5	4	20	-10
-10	-1	10	1	10	-10
0	0	20	0	0	0
10	1	30	1	30	30

20	2	20	4	80	40
30	3	15	9	135	45
		100		275	95

$$\begin{aligned}
 \text{Variance of the population} &= \left[\frac{\sum fd^2}{N} - \left(\frac{\sum fd}{N} \right)^2 \right] i^2 \\
 &= \left[\frac{275}{100} - \left(\frac{95}{100} \right)^2 \right] \times (10)^2 \\
 &= 184.75.
 \end{aligned}$$

36. Answer : (e)

[< TOP >](#)

Reason : Harmonic mean of a set of 'n' quantities, $H = \frac{n}{\sum \frac{1}{x_i}}$

$$\text{Given: } \sum \frac{1}{x_i} = \frac{7}{8} \quad H = 3\frac{3}{7} = \frac{24}{7}$$

$$\text{From above, } n = H \cdot \sum \frac{1}{x_i}$$

$$n = \frac{24}{7} \times \frac{7}{8} = 3$$

$$\text{Harmonic mean after the expansion} = \frac{\frac{n+2}{\frac{7}{8} + \frac{1}{5} + \frac{1}{10}}}{\frac{3+2}{\frac{47}{40}}} = \frac{40}{4} = 10$$

37. Answer : (c)

[< TOP >](#)

$$\text{Reason : Median} = \left[\frac{(N+1)/2 - (F+1)}{f_m} \right] W + L_m$$

Class	Frequency (f)	Cumulative frequency
25 – 35	15	15
35 – 45	25	40
45 – 55	32	72
55 – 65	28	100
65 – 75	18	118
75 – 85	12	130
	130	

$$\text{Position of the median} = \frac{N+1}{2} = 65.5\text{th item}$$

From above can be seen that the median class is 45 – 55.

$$\therefore N = 130$$

$$\begin{aligned}
 L_m &= 45 \\
 f_m &= 32 \\
 F &= 40 \\
 W &= 10
 \end{aligned}$$

$$\therefore \text{Median wage} = \left[\frac{\left(\frac{131}{2} \right) - (40+1)}{32} \right] 10 + 45 = \text{Rs. } 52.66 \text{ (approx.)}$$

38. Answer : (c)

[< TOP >](#)

Reason : The constraints in the given linear programming problem is as below:

For short question: $0 \geq s \leq 5$

For multiple choice questions: $0 \geq m \leq 15$

Time constraint: $2m + 8s \leq 40$.

Hence the correct answer is (c).

39. Answer : (d)

[< TOP >](#)

Reason : The constraints are

$2x + y \leq 12$ and the terminal line of feasibility is $2x + y = 12$ (i)

$x + 3y \leq 21$ and the terminal line of feasibility is $x + 3y = 21$ (ii)

Line (i) crosses x-axis at (6, 0) and line (ii) crosses x-axis at (21, 0). So the point, which is part of feasible region, is (6, 0).

Line (i) crosses y-axis at (0, 12) and line (ii) crosses x-axis at (0, 7). So the point, which is part of feasible region, is (0, 7).

Both lines would intersect each other at (3, 6).

So, the vertices are

(0, 0), (6, 0), (0, 7), and (3, 6).

The point (4, 5) is not in the feasible region because it does not satisfy first constraint.

40. Answer : (e)

[< TOP >](#)

Reason : Group 1 contains 3 boxes and group 2 contains two boxes

$$\therefore P(G1) = \frac{3}{5} \quad P(G2) = \frac{2}{5}$$

Probability of selecting a red ball from group 1 = $P(R|G1) =$

$$\left(\frac{1}{3} \times \frac{2}{7} \right) + \left(\frac{1}{3} \times \frac{2}{7} \right) + \left(\frac{1}{3} \times \frac{2}{7} \right) = \frac{2}{7}$$

Probability of selecting a red ball from group 2 = $P(R|G2)$

$$\left(\frac{1}{2} \times \frac{4}{5} \right) + \left(\frac{1}{2} \times \frac{4}{5} \right) = \frac{4}{5}$$

$$\therefore P(G1 \text{ and } R) = P(G1).P(R|G1) = \frac{3}{5} \times \frac{2}{7} = \frac{6}{35}$$

$$P(G2 \text{ and } R) = P(G2).P(R|G2) = \frac{2}{5} \times \frac{4}{5} = \frac{8}{25}$$

$$\begin{aligned}\therefore P(R) &= P(G1 \text{ and } R) + P(G2 \text{ and } R) = \frac{6}{35} + \frac{8}{25} = \frac{86}{175} \\ \therefore P(G1|R) &= \frac{P(G1 \text{ and } R)}{P(R)} = \frac{6/35}{86/175} = \frac{15}{43}\end{aligned}$$

41. Answer : (e)

[<TOP>](#)

Reason : Let us denote the events as follows:

A_1 : Plant 1 is being selected while A_2 : Plant 2 is being selected

B: Selection of two persons where one is a production engineer and another is a maintenance engineer.

Now, the required probability of selecting one production engineer and one maintenance engineer is possible if either of the following two mutually events happens:

(i) A_1 and B happens, (ii) A_2 and B happens

Now, from the given situation, $P(A_1) = P(A_2) = 0.5$

$P(B | A_1)$ = Probability of selecting one production engineer and one maintenance engineer in a selection of two engineers from the first plant.

$$\text{Therefore, } P(B | A_1) = \frac{{}^5C_1 \times {}^3C_1}{{}^8C_2} = \frac{5 \times 3 \times 2}{8 \times 7} = \frac{15}{28}$$

$$\text{Similarly, } P(B | A_2) = \frac{{}^4C_1 \times {}^5C_1}{{}^9C_2} = \frac{5 \times 4 \times 2}{8 \times 9} = \frac{5}{9}$$

Therefore, the required probability will be $= P(A_1) \times P(B | A_1) + P(A_2) \times P(B | A_2)$

$$= \frac{1}{2} \times \frac{15}{28} + \frac{1}{2} \times \frac{5}{9} = \frac{275}{504} = 0.5456 \approx 0.55 \text{ (approx.)}$$

42. Answer : (b)

[<TOP>](#)

Reason : $P(A \text{ and } C) = 0.48$

$P(B \text{ and } C) = 0.32$

$\therefore P(C) = P(A \text{ and } C) + P(B \text{ and } C) = 0.80$

$P(B \text{ and } C) = P(C) \cdot P(B | C)$

$$\text{Or, } P(B | C) = \frac{P(B \text{ and } C)}{P(C)} = \frac{0.32}{0.80} = 0.40$$

43. Answer : (c)

[<TOP>](#)

Reason : According to Bayes' theorem:

$$\begin{aligned}P(\text{Female} | \text{Illiterate}) &= \frac{P(\text{Female and Illiterate})}{P(\text{Illiterate})} \\ P(\text{Female and Illiterate}) &= P(\text{Female}) \cdot P(\text{Illiterate} | \text{Female}) \\ &= \left(1 - \frac{3}{5}\right) \times \frac{4}{5} = \frac{2}{5} \times \frac{4}{5} = \frac{8}{25} \\ P(\text{Illiterate}) &= P(\text{Female and Illiterate}) + P(\text{Male and Illiterate}) \\ &= \frac{8}{25} + [P(\text{Male}) \cdot P(\text{Illiterate} | \text{Male})]\end{aligned}$$

$$= \frac{8}{25} + \left[\frac{3}{5} \times \frac{1}{2} \right] = \frac{8}{25} + \frac{3}{10} = \frac{31}{50}$$

$$\frac{\frac{8}{25}}{\frac{31}{50}} = \frac{16}{31}$$

$\therefore P(\text{Female} | \text{Illiterate}) = \frac{16}{31} = 0.516$ i.e. 51.6% approximately.

(In the above calculations, 'males' imply adult males and 'females' imply adult females).

44. Answer : (e)

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Reason : The logarithm of a number is equal to the exponent to which a given base must be raised in order to get the number. The logarithm of a number is not expressed with respect to base zero or one. The logarithm of a number may be expressed with respect to base 10 or other positive real number not equal to 1.

45. Answer : (a)

[< TOP >](#)

Reason : $(a, +\infty)$ contains all values of 'x' such that $a < x$.
 $(-\infty, a)$ contains all values of 'x' such that $x < a$.
 $[a, +\infty)$ contains all values of 'x' such that $x \geq a$.
 $(-\infty, a]$ contains all values of 'x' such that $-a < x < a$.
Hence the answer is (a).

46. Answer : (c)

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Reason : At Y-axis the x – co-ordinate is always zero. Here $\frac{dy}{dx} = 2x - 3 = -3$ and $\frac{d^2y}{dx^2} = 2$; For $x = 0$, $\frac{dy}{dx} = -3$ (a negative value) and $\frac{d^2y}{dx^2} = 2$ (a positive value). So, we can say that y is decreasing at an increasing rate.

47. Answer : (e)

[< TOP >](#)

Reason : Three simultaneous equations involving three variables can be solved if the three equations can be satisfied when the three variables respectively assume the same values in each of the three equations.

48. Answer : (b)

[< TOP >](#)

Reason : The commutative property of real numbers says

Addition : $a + b = b + a$

Multiplication : $a.b = b.a$

The associative property of real numbers says

Addition : $(a + b) + c = a + (b + c)$

Multiplication : $(a.b).c = a.(b.c)$

The distributive property of real numbers says

$a.(b+c) = a.b + a.c$

or

$(a+b).c = a.c + b.c$

The identity property of real numbers says

Addition : $a+0 = 0+a = a$

Multiplication : $a.1 = 1.a = a$

The inverse property of real numbers says

Addition : $a + (-a) = (-a) + a = 0$

Multiplication : $a \cdot \frac{1}{a} = \frac{1}{a} \cdot a = 1$

The cancellation property of real numbers says

Addition : If $a + x = a + y$, then $x = y$

Multiplication : If $a \neq 0$, and $ax = ay$, then $x = y$.

The zero factor property of real numbers says

Addition : $a \cdot 0 = 0 \cdot a = 0$

Multiplication: If $a \cdot b = 0$, then $a=0$ or $b=0$ or both.

49. Answer : (b)

[<TOP>](#)

- Reason : (a) A straight line with a negative slope does not necessarily mean that the value of y will always be negative for any given value of x .
- (b) If a straight line has a negative slope then it falls from left to right as the values increase along the X -axis because for increase in the x – values will be accompanied with decrease in the y -values.
- (c) A straight line passes through the origin when the y intercept is zero; a negative slope will not pass through the origin if the y intercept is not zero.
- (d) A straight line is parallel to the Y -axis when the slope is infinite.
- (e) A straight line is parallel to the X -axis when the slope is zero.

50. Answer : (c)

[<TOP>](#)

Reason : The set of rational numbers includes those numbers which are of the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

51. Answer : (e)

[<TOP>](#)

Reason : A series of numbers is said to be in AP, if the consecutive numbers in the series increase or decrease by a constant value, and neither by a fixed factor nor by a fixed multiple. Moreover, the consecutive numbers need not necessarily experience any change in sign, nor be in multiples of 100.

52. Answer : (d)

[<TOP>](#)

Reason : $\frac{y}{3} + \frac{2}{5}x = 2$

$$\Rightarrow 5y + 6x = 30$$
$$\Rightarrow y = \frac{30}{5} - \frac{6x}{5}$$
$$\text{or } y = 6 - \frac{6}{5}x$$

$\therefore$ Intercept on Y axis = 6 and intercept on X axis is 5.

$$\text{Slope} = \frac{-6}{5}$$

53. Answer : (c)

[<TOP>](#)

- Reason : (a) In a logarithmic function the logarithmic operation is applied on the independent variable.
- (b) In a logarithmic function the base of the logarithm may be any number

other than 10.

- (c) In a logarithmic function the independent variable cannot be negative.
- (d) In a logarithmic function the base of the logarithm cannot be zero or negative numbers.

54. Answer : (d)

[<TOP>](#)

- Reason :
- (a) The derivative of a function indicates the rate of change of the function.
 - (b) The slope of the tangent to a function at a point is equal to the derivative of the function at that point.
 - (c) The derivative of a function can be said to be a function of the independent variable if the expression of the derivative contains the independent variable.
 - (d) The derivative of a linear function is the slope of the linear function, which is a constant value for all values of the dependent variable.
 - (e) If the derivative of any function at a point is negative then it indicates that the function is decreasing at that point.

55. Answer : (a)

[<TOP>](#)

Reason : The exponential function falls from left to right as the values increase along the X-axis if $m > 0$ and $0 < a < 1$. Hence (a) is true. (b), (c) (d) and (e) are not true because they are not the characteristics of the exponential function.

56. Answer : (c)

[<TOP>](#)

- Reason :
- (a) If the first derivative of $f(x)$ is a constant for all values of x then it indicates that the function changes at a constant rate.
 - (b) A function $f(x)$ is said to be monotonically decreasing if the first derivative of $f(x)$ is negative for all values of x .
 - (c) A function $f(x)$ is said to be monotonically increasing if the first derivative of $f(x)$ is positive for all values of x .
 - (d) If the first derivative of $f(x)$ is zero for all values of x then it indicates that the function has a constant value.
 - (e) This is not the condition for a monotonically increasing function.

57. Answer : (e)

[<TOP>](#)

Reason : The derivative of a function, $y = f(x)$ at $x = a$ is equal to $\lim_{x \rightarrow a} \frac{f(x) - f(a)}{x - a}$. It indicates the rate at which $f(x)$ is changing with respect to the corresponding change in x .

58. Answer : (d)

[<TOP>](#)

Reason : If the first derivative of a function $f(x)$ is zero at $x = a$ then $f(x)$ will be maximum at $x = a$ if the second derivative is negative at $x = a$. If the first derivative of a function $f(x)$ is zero at $x = a$ then $f(x)$ will be minimum at $x = a$ if the second derivative is positive at $x = a$.

In the given condition it cannot be inferred that $f(x)$ is zero at $x = a$.

59. Answer : (e)

[<TOP>](#)

Reason : The following are **true** with regard to simplex method of solving linear programming problems:

- (a) This method can be applied for solving problems involving two decision variables.
- (b) At the optimal solution all the decision variables assume non-negative values.

- (c) Slack variables are used convert 'less than or equal to' type constraints into equations.
- (d) At the optimal solution all the slack variables assume non-negative values.
- (e) The $Z_j - C_j$ value at the bottom of the solution column shows the value of the objective function for any solution.

60. Answer : (e) [< TOP >](#)

- Reason :
- (a) Arithmetic mean cannot be determined graphically.
 - (b) Geometric mean cannot be determined graphically.
 - (c) Harmonic mean cannot be determined graphically.
 - (d) Standard deviation cannot be determined graphically.
 - (e) Median can be determined graphically.

61. Answer : (d) [< TOP >](#)

Reason : Median may be obtained from the point of intersection of the 'more than ogive' and the 'less than ogive' by dropping a perpendicular on the abscissa. Hence, the option (d) is the correct answer.

62. Answer : (c) [< TOP >](#)

- Reason :
- (a) The classical approach to probability assumes that the outcomes are equally likely.
 - (b) In the relative frequency approach to probability the probability of an event is determined after performing the experiment large number times.
 - (c) In the classical approach to probability the probability of an event is determined before performing the experiment.
 - (d) The classical approach to probability assumes that all possible outcomes of the experiment are known.
 - (e) The classical approach can be used to find out the probability of mutually exclusive events.

63. Answer : (a) [< TOP >](#)

Reason : If $P(B) > P(A)$ then $-P(A) > -P(B)$ i.e. $1 - P(A) > 1 - P(B)$ i.e. $P(\bar{A}) > P(\bar{B})$ Hence, the answer.

64. Answer : (d) [< TOP >](#)

Reason : If two events A and B are independent then, the conditional probability of event A given event B is equal to marginal probability of event A because the occurrence of event B does not influence the occurrence of event A.

65. Answer : (e) [< TOP >](#)

Reason : The probability of the functioning of one component = p and that of the simultaneous functioning of two is p^2 and hence, similarly, the functioning of k components will be p^k . Therefore, the probability of malfunctioning of any one of the k-components is given by $1 - p^k$. Hence the probability that the system will fail = $1 - p^k$.

66. Answer : (a) [< TOP >](#)

Reason : We have $P(S) = P(T) = x$ (say) and $P(ST) = p$ while the events are independent. Therefore, $x^2 = p$ and hence, we get $x = \sqrt{p}$. Hence, the option (a) is correct.

67. Answer : (a) [< TOP >](#)

Reason : In case of a negatively skewed distribution arithmetic mean < median < mode. Hence (a) is the answer. The relationships stated in (b), (c), (d) and (e) are not the features of negatively skewed distributions.

68. Answer : (d)

[<TOP>](#)

Reason : In an ogive, a cumulative frequency distribution is graphically represented. A cumulative frequency represents the number of observations that are greater than or less than certain numbers. Hence the choice.

69. Answer : (d)

[<TOP>](#)

Reason : Harmonic mean = Reciprocal of the average of reciprocals of the observations.

- (a) The reciprocal of the harmonic mean is not equal to the arithmetic mean.
- (b) The reciprocal of the harmonic mean is not equal to the sum of all the observations.
- (c) The reciprocal of the harmonic mean is not equal to the sum of the reciprocals of the observations.
- (d) The reciprocal of the harmonic mean is equal to average of the reciprocals of the observations.
- (e) The reciprocal of the harmonic mean is not equal to the product of the reciprocals of the observations.

70. Answer : (c)

[<TOP>](#)

Reason : Coefficient of variation = (standard deviation / mean) $\times$ 100

- (a) A standard deviation equal to zero implies that there is no deviation in the data set. The same will be reflected by the c.v. provided mean is not equal to zero.
- (b) Even when the standard deviation is 1 the c.v. can be meaningfully used for comparison of variability provided mean is not equal to zero.
- (c) Hence it cannot be meaningfully used for comparison of variability when mean of one or more data sets is zero.
- (d) When the mean is equal to 1, the c.v. can be meaningfully used for comparison of variability.
- (e) When the mean and standard deviation are equal for one or more sets of data, the c.v. can be meaningfully used for comparison of variability.

71. Answer : (d)

[<TOP>](#)

Reason : According to the Bienayme-Chebyshev rule, at least 75 percent of the observations in a sample are contained within two standard deviations around the mean, regardless of the shape of the distribution.

72. Answer : (a)

[<TOP>](#)

Reason : If every observation in a data set is increased by a constant then the coefficient of variation of the resulting set of values will be less than the coefficient of variation of the original data set because the numerator remains the same whereas the denominator increases.

73. Answer : (b)

[<TOP>](#)

Reason : (a) Simple arithmetic mean is the appropriate average when the denominators are same and no weighting is required.
(b) Weighted arithmetic mean is appropriate when the denominators of the ratio data are used as weights.
(c) Simple harmonic mean is used when the numerators of the ratios are same.
(d) Weighted harmonic mean is appropriate when the numerators of the ratio data are used as weights.

(e) Geometric mean is appropriate when the quantities vary over time.

74. Answer : (b)

[< TOP >](#)

Reason : Arranging the data in the ascending order

11,15,15,17,19,20,21,22,23,25,29.

$$\text{Median} = \left(\frac{N+1}{2} \right) \text{th item} = \frac{12}{2} \text{th item} = 6 \text{th item} = 20.$$

75. Answer : (c)

[< TOP >](#)

Reason : If a constant is subtracted from every observation in a data set then the range of the resulting set of values will be equal to the range of the original data set.

76. Answer : (c)

[< TOP >](#)

Reason : Given : $\sum x = 120$ $s = 3$ $n = 10$

$$\therefore \bar{x} = \frac{\sum x}{n} = \frac{120}{10} = 12$$

After 3 is added to every observation, mean of the resulting data set =

$$\bar{x} + 3 = 12 + 3 = 15$$

Standard deviation of the resulting data set will be unchanged, i.e. = 3.

$$\therefore \text{Coefficient of variation of the resulting data set} = \frac{3}{15} \times 100 = 20\%$$

77. Answer : (c)

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Reason : The following are true for any LPP:

- (a) The contribution of each unit of the decision variables towards to the objective to be achieved is known.
- (b) The consumption of resources by each unit of the decision variables is known.
- (c) The values of the decision variables in the optimal solution may be fractional numbers.
- (d) Linear programming is used either to maximize or to minimize the value of the objective function.
- (e) The optimal solution to any linear programming problem is one of the possible feasible solutions.

78. Answer : (e)

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Reason : A graphical solution to a linear programming problem will have multiple optimal solutions if the objective function is parallel to an edge of the feasible region which is in the direction of the optimal movement of the objective function. If none of the edges of the feasible region is parallel to the objective function then, the possibility of multiple optimal solutions does not arise.

79. Answer : (c)

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Reason : The least common multiple of a group of quantities can be divided by each quantity in the group without leaving any remainder. While, each number of the group can be divided by a factor, even by the highest common factor also. But that condition is not satisfied, if each number is divided by the average or the sum of all the quantities.

80. Answer : (a)

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Reason : (a) The standard deviation of a data set is expressed in the same unit as the observations

in the data set.

(b), (c), (d) and (e) are incorrect with regard to the standard deviation.

81. Answer : (d)

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Reason : Since the two events A and B are mutually exclusive, the happening of A precludes the occurrence of B and vice versa.

Hence $P(A | B) = 0$ and $P(B | A) = 0$

82. Answer : (d)

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Reason : A baker earns 15 paise profit per glazed doughnut g , and 40 paise profit per jelly doughnut j . So, the maximum profit is earned when he sells 11 jelly doughnuts and one glazed doughnut. Total profit is Rs. $(11 \times 0.40 + 1 \times 0.15) = \text{Rs. } 4.55$.

83. Answer : (d)

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Reason : (a) In the graphical method of solving LP problems the decision variables are represented by the horizontal and vertical axes.

(b) This method can be applied when there are two decision variables.

(c) If the optimal solution exists then it occurs at one of the corner points.

(d) The optimal solution to the LPP can not occur at a point outside the feasible region because a point outside the feasible region means that the constraints are violated.

(e) The feasible region is determined by the structural constraints as well as the non-negativity constraints.

84. Answer : (d)

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Reason : Coefficient of variation is a relative measure of dispersion. Range, quartile deviation, standard deviation and mode are absolute measures of dispersion. When every observation in the data set is divided by a constant both the standard deviation and the mean of the resulting data set will be divided by the constant. Since coefficient of variation is the ratio standard deviation to the mean, the coefficient of variation of the resulting data set will be same as the original data set. Since the other measures are absolute measures, they will permanently change due to the modification.

85. Answer : (e)

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Reason : The highest common factor is a quantity obtained from the given quantities and which divides each of them without leaving a remainder.

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