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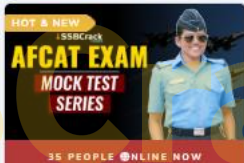★★★★★ 5 (52)
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1. If $z\bar{z} = |z + \bar{z}|$, where $z = x + iy$, $i = \sqrt{-1}$, then the locus of z is a pair of :

   (a) straight lines

   (b) rectangular hyperbolas

   ✓ (c) parabolas

   (d) circles

2. If $1! + 3! + 5! + 7! + ... + 199!$ is divided by 24, what is the remainder ?

   (a) 3

   (b) 6

   ✓ (c) 7

   (d) 9

3. What is the value of $\sqrt{12 + 5i} + \sqrt{12 - 5i}$, where $i = \sqrt{-1}$?

   (a) 24

   (b) 25

   ✓ (c) $5\sqrt{2}$

   (d) $5(\sqrt{2} - 1)$

4. If $A = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$, then what is the value of $\det(I + AA')$, where I is the 3×3 identity matrix ?

   (a) 15

   (b) 6

   (c) 0

   ✓ (d) -1

5. If A, B and C are square matrices of order 3 and $\det(BC) = 2 \det(A)$, then what is the value of $\det(2A^{-1}BC)$?

   (a) 16

   (b) 8

   (c) 4

   ✓ (d) 2

6. If the nth term of a sequence is $\dfrac{2n + 5}{7}$, then what is the sum of its first 140 terms ?

   (a) 2840

   (b) 2780

   ✓ (c) 2920

   (d) 5700

7. Let A be a skew-symmetric matrix of order 3. What is the value of
   $$\det(4A^4) - \det(3A^3) + \det(2A^2) - \det(A) + \det(-I)$$
   where I is the identity matrix of order 3 ?

   ✓ (a) -1

   (b) 0

   (c) 1

   (d) 2

DFTK-S-MTH   (3 – A)

If $A = \begin{bmatrix} 0 & 3 & 4 \\ -3 & 0 & 5 \\ -4 & -5 & 0 \end{bmatrix}$, then which one of the following statements is correct ?

(a) A^2 is symmetric matrix with $\det(A^2) = 0$. ✓

(b) A^2 is symmetric matrix with $\det(A^2) \neq 0$.

(c) A^2 is skew-symmetric matrix with $\det(A^2) = 0$.

(d) A^2 is skew-symmetric matrix with $\det(A^2) \neq 0$.

9. If $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$, then which of the following statements are correct ?

1. A^n will always be singular for any positive integer n.

2. A^n will always be a diagonal matrix for any positive integer n.

3. A^n will always be a symmetric matrix for any positive integer n.

Select the correct answer using the code given below :

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only ✓

(d) 1, 2 and 3

10. If $(a + b)$, $2b$, $(b + c)$ are in HP, then which one of the following is correct ?

(a) a, b and c are in AP

(b) $a - b$, $b - c$ and $c - a$ are in AP

(c) a, b and c are in GP ✓

(d) $a - b$, $b - c$ and $c - a$ are in GP

11. Let $t_1, t_2, t_3 \ldots$ be in GP. What is $(t_1 t_3 \cdots t_{21})^{\frac{1}{11}}$ equal to ?

(a) t_{10}

(b) t_{10}^2 ✓

(c) t_{11}

(d) t_{11}^2

12. Which one of the following is a square root of $-\sqrt{-1}$?

(a) $1 + i$

(b) $\frac{1-i}{\sqrt{2}}$

(c) $\frac{1+i}{\sqrt{2}}$ ✓

(d) $\frac{1}{\sqrt{2}}i$

13. What is the maximum number of points of intersection of 10 circles ?

(a) 45

(b) 60 ✓

(c) 90

(d) 120

14. A set S contains $(2n + 1)$ elements. There are 4096 subsets of S which contain at most n elements. What is n equal to ?

(a) 5

(b) 6

(c) 7 ✓

(d) 8

DFTK-S-MTH (5 – A)

If
$$\begin{vmatrix} x^2 + 3x & x-1 & x+3 \\ x+1 & -2x & x-4 \\ x-3 & x+4 & 3x \end{vmatrix}$$
$$= ax^4 + bx^3 + cx^2 + dx + e,$$

then what is the value of e ?

✓ (a) −1

(b) 0

(c) 1

(d) 2

16. If all elements of a third order determinant are equal to 1 or −1, then the value of the determinant is :

✓ (a) 0 only

(b) an even number but not necessarily 0

(c) an odd number

(d) 0, 1 or −1

17. If $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 3 & 0 \\ 1 & 0 & 1 \end{bmatrix}$, then what is the value of det[adj(adjA)] ?

(a) 5

✓ (b) 25

(c) 125

(d) 625

18. If $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then what is $23A^3 - 19A^2 - 4A$ equal to ?

✓ (a) Null matrix of order 3

(b) Identity matrix of order 3

(c) $\begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$

(d) $\begin{bmatrix} 7 & 0 & 0 \\ 0 & 7 & 0 \\ 0 & 0 & 7 \end{bmatrix}$

19. The value of the determinant of a matrix A of order 3 is 3. If C is the matrix of cofactors of the matrix A, then what is the value of determinant of C^2 ?

(a) 3

✓ (b) 9

(c) 81

(d) 729

20. If $A_k = \begin{bmatrix} k-1 & k \\ k-2 & k+1 \end{bmatrix}$, then what is $\det(A_1) + \det(A_2) + \det(A_3) + ... + \det(A_{100})$ equal to ?

(a) 100

✓ (b) 1000

(c) 9900

(d) 10000

The Cartesian product A × A has 16 elements among which are (0, 2) and (1, 3). Which of the following statements is/are correct ?

1. It is possible to determine set A.

2. A × A contains the element (3, 2).

Select the correct answer using the code given below :

(a) 1 only

(b) 2 only ✓

(c) Both 1 and 2

(d) Neither 1 nor 2

Let A = {1, 2, 3, ..., 20}. Define a relation R from A to A by R = {(x, y) : 4x − 3y = 1}, where x, y ∈ A. Which of the following statements is/are correct ?

1. The domain of R is {1, 4, 7, 10, 13, 16}.

2. The range of R is {1, 5, 9, 13, 17}.

3. The range of R is equal to codomain of R.

Select the correct answer using the code given below :

(a) 1 only

(b) 2 only

(c) 1 and 2 ✓

(d) 2 and 3

FTK-S-MTH

23. Consider the following statements :

1. The relation f defined by

$$f(x) = \begin{cases} x^3, & 0 \le x \le 2 \\ 4x, & 2 \le x \le 8 \end{cases}$$ is a function.

2. The relation g defined by

$$g(x) = \begin{cases} x^2, & 0 \le x \le 4 \\ 3x, & 4 \le x \le 8 \end{cases}$$ is a function.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2 ✓

(d) Neither 1 nor 2

24. Consider the following statements :

1. $A = (A \cup B) \cup (A - B)$

2. $A \cup (B - A) = (A \cup B)$

3. $B = (A \cup B) - (A - B)$

Which of the statements given above are correct ?

(a) 1 and 2 only

(b) 2 and 3 only ✓

(c) 1 and 3 only

(d) 1, 2 and 3

(9 – A)

25. A function satisfies $f(x - y) = \dfrac{f(x)}{f(y)}$, where $f(y) \neq 0$. If $f(1) = 0.5$, then what is $f(2) + f(3) + f(4) + f(5) + f(6)$ equal to ?

(a) $\dfrac{15}{32}$

(b) $\dfrac{17}{32}$

(c) $\dfrac{29}{64}$ ✗

(d) $\dfrac{31}{64}$ ✓

26. What is $2 \cot\left(\dfrac{1}{2} \cos^{-1} \dfrac{\sqrt{5}}{3}\right)$ equal to ?

(a) -1

(b) 1

(c) $3 + \sqrt{5}$ ✓

(d) $3 - \sqrt{5}$

27. If $\sec^{-1} p - \operatorname{cosec}^{-1} q = 0$, where $p > 0,\ q > 0$; then what is the value of $p^{-2} + q^{-2}$?

(a) 1

(b) 2

(c) $\dfrac{1}{2}$

(d) $\dfrac{1}{2\sqrt{2}}$ ✓

28. What is $1 + \sin^2\left(\cos^{-1}\left(\dfrac{3}{\sqrt{17}}\right)\right)$ equal to ?
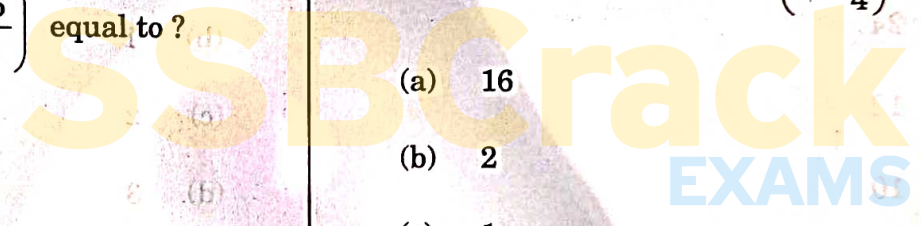
(a) $\dfrac{25}{17}$ ✓

(b) $\dfrac{8}{17}$

(c) $\dfrac{9}{17}$

(d) $\dfrac{47}{17}$

29. If $\tan(\pi \cos\theta) = \cot(\pi \sin\theta),\ 0 < \theta < \dfrac{\pi}{2}$; then what is the value of $8 \sin^2\left(\theta + \dfrac{\pi}{4}\right)$?

(a) 16

(b) 2

(c) 1

(d) $\dfrac{1}{2}$ ✓

30. If $\tan\alpha = \dfrac{1}{7},\ \sin\beta = \dfrac{1}{\sqrt{10}};\ 0 < \alpha,\ \beta < \dfrac{\pi}{2}$, then what is the value of $\cos(\alpha + 2\beta)$?

(a) $-\dfrac{1}{2}$

(b) $-\dfrac{1}{\sqrt{2}}$

(c) $\dfrac{1}{\sqrt{2}}$

(d) $\dfrac{1}{2}$ ✓

Consider the following for the next two (02) items that follow :

Consider the equation $(1-x)^4 + (5-x)^4 = 82$.

31. What is the number of real roots of the equation ?

(a)   0

(b)   2

(c)   4

(d)   8 ✓

32. What is the sum of all the roots of the equation ?

(a)   24

(b)   12

(c)   10 ✓

(d)   6

Consider the following for the next three (03) items that follow :

Consider equation-I : $z^3 + 2z^2 + 2z + 1 = 0$ and equation-II : $z^{1985} + z^{100} + 1 = 0$.

33. What are the roots of equation-I ?

(a) $1, \omega, \omega^2$

(b) $-1, \omega, \omega^2$

(c) $1, -\omega, \omega^2$ ✓

(d) $-1, -\omega, -\omega^2$

34. Which one of the following is a root of equation-II ?

(a) -1

(b) $-\omega$

(c) $-\omega^2$

(d) ω ✓

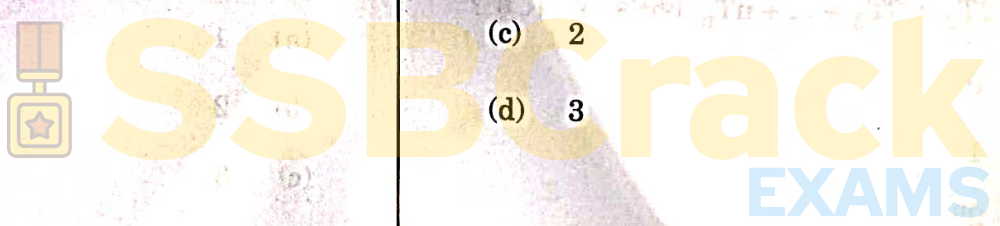**35.** What is the number of common roots of equation-I and equation-II ?

(a)   0 ✓

(b)   1

(c)   2

(d)   3

Consider the following for the next two (02) items that follow :

A quadratic equation is given by $(a+b)x^2 - (a+b+c)x + k = 0$, where a, b, c are real.

36. If $k = \dfrac{c}{2}$, $(c \neq 0)$, then the roots of the equation are :

(a)   Real and equal

(b)   Real and unequal

(c)   Real iff $a > c$ ✓

(d)   Complex but not real

If k = c, then the roots of the equation are :

(a) ✓ $\dfrac{a+c}{a+b}$ and $\dfrac{b}{a+b}$

(b) $\dfrac{a+c}{a+b}$ and $-\dfrac{b}{a+b}$

(c) 1 and $\dfrac{c}{a+b}$

(d) -1 and $-\dfrac{c}{a+b}$

Consider the following for the next three (03) items that follow :

$(1+x)^n = 1 + T_1 x + T_2 x^2 + T_3 x^3 + ... + T_n x^n$.

What is $T_1 + 2T_2 + 3T_3 + ... + nT_n$ equal to ?

(a) ✓ 0

(b) 1

(c) 2^n

(d) $n2^{n-1}$

What is $1 - T_1 + 2T_2 - 3T_3 + ... + (-1)^n nT_n$ equal to ?

(a) 0

(b) ✓ -2^{n-1}

(c) $n2^{n-1}$

(d) 1

What is $T_1 + T_2 + T_3 + ... + T_n$ equal to ?

(a) 2^n

(b) $2^n - 1$

(c) ✓ $2^n - 1$

(d) $2^n + 1$

TK-S-MTH

Consider the following for the next two (02) items that follow :

Let $f(x) = x^2 - 1$ and $gof(x) = x - \sqrt{x} + 1$.

41. Which one of the following is a possible expression for g(x) ?

(a) ✓ $\sqrt{x+1} - \sqrt[4]{x+1}$

(b) ✓ $\sqrt{x+1} - \sqrt[4]{x+1} + 1$

(c) $\sqrt{x+1} + \sqrt[4]{x+1}$

(d) $x + 1 - \sqrt{x+1} + 1$

42. What is g(15) equal to ?

(a) 1

(b) ✓ 2

(c) 3

(d) 4

Consider the following for the next two (02) items that follow :

Let a function f be defined on $\mathbb{R} - \{0\}$ and $2f(x) + f\left(\dfrac{1}{x}\right) = x + 3$.

43. What is f(0·5) equal to ?

(a) $\dfrac{1}{2}$

(b) ✓ $\dfrac{2}{3}$

(c) 1

(d) 2

(15 – A)

If f is differentiable, then what is f'(0.5) equal to ?

(a) $\dfrac{1}{4}$

(b) $\dfrac{2}{3}$

(c) 2

(✓) 4

Consider the following for the next two (02) items that follow :

A function is defined by

$$f(x) = \begin{vmatrix} x+1 & 2 & 3 \\ 2 & x+4 & 6 \\ 3 & 6 & x+9 \end{vmatrix}.$$

. The function is decreasing on :

(a) $\left[-\dfrac{28}{3}, 0\right]$

(b) $\left[0, \dfrac{28}{3}\right]$

(✓) $\left[0, \dfrac{50}{3}\right]$

(d) $\left[0, \dfrac{56}{3}\right]$

. The function attains local minimum value at :

(a) $x = -\dfrac{28}{3}$

(✓) $x = -1$

(c) $x = 0$

(d) $x = \dfrac{28}{3}$

Consider the following for the next two (02) items that follow :

Given that $4x^2 + y^2 = 9$.

47. What is the maximum value of y ?

(a) $\dfrac{3}{2}$

(b̶) 3

(✓) 4

(d) 6

48. What is the maximum value of xy ?

(a) $\dfrac{9}{4}$

(b) $\dfrac{3}{2}$

(c) $\dfrac{4}{9}$

(✓) $\dfrac{2}{3}$

Consider the following for the next two (02) items that follow :

A function is defined by $f(x) = \pi + \sin^2 x$.

49. What is the range of the function ?

(✓) $[0, 1]$

(b) $[\pi, \pi + 1]$

(c) $[\pi - 1, \pi + 1]$

(d) $[\pi - 1, \pi - 1]$

50. What is the period of the function ?

(a) 2π

(✓) π

(c) $\dfrac{\pi}{2}$

(d) The function is non-periodic

FTK-S-MTH   (17 – A)

Consider the following for the next two (02) items that follow :

A parabola passes through (1, 2) and satisfies the differential equation $\frac{dy}{dx} = \frac{2y}{x}$, x > 0, y > 0.

51. What is the directrix of the parabola ?

(a) ✓ $y = -\frac{1}{8}$

(b) $y = \frac{1}{8}$

(c) ✓ $x = -\frac{1}{8}$

(d) $x = \frac{1}{8}$

52. What is the length of latus rectum of the parabola ?

(a) 1

(b) $\frac{1}{2}$

(c) ✓ $\frac{1}{4}$

(d) $\frac{1}{8}$

Consider the following for the next two (02) items that follow :

Let $f(x) = \frac{a^{x-1} + b^{x-1}}{2}$ and $g(x) = x - 1$.

53. What is $\lim\limits_{x \to 1} \frac{f(x) - 1}{g(x)}$ equal to ?

(a) $\frac{ln(ab)}{4}$

(b) $\frac{ln(ab)}{2}$

(c) ✓ $ln(ab)$

(d) $2\, ln(ab)$

DFTK-S-MTH

54. What is $\lim\limits_{x \to 1} f(x)^{\frac{1}{g(x)}}$ equal to ?

(a) $\sqrt{ab}$

(b) ✓ ab

(c) $2ab$

(d) $\frac{\sqrt{ab}}{2}$

Consider the following for the next two (02) items that follow :

Let $f(x) = \sqrt{2 - x} + \sqrt{2 + x}$.

55. What is the domain of the function ?

(a) ✓ $(-2, 2)$

(b) $[-2, 2]$

(c) $R - (-2, 2)$

(d) $R - [-2, 2]$

56. What is the greatest value of the function ?

(a) ✓ $\sqrt{3}$

(b) $\sqrt{6}$

(c) $\sqrt{8}$

(d) 4

Consider the following for the next two (02) items that follow :

Let $f(x) = |x|$ and $g(x) = [x] - 1$, where [.] is the greatest integer function.

Let $h(x) = \frac{f(g(x))}{g(f(x))}$.

57. What is $\lim\limits_{x \to 0+} h(x)$ equal to ?

(a) -2

(b) ✓ -1

(c) 0

(d) 1

(19 – A)

58. What is $\lim\limits_{x\to 0-} h(x)$ equal to ?

(a) -2

(b) -1

✓ (c) 0

(d) 2

Consider the following for the next two (02) items that follow :

Let $f(x) = \begin{cases} \dfrac{x-3}{|x-3|} + a; & x < 3 \\ a - b; & x = 3 \\ \dfrac{x-3}{|x-3|} + b; & x > 3 \end{cases}$

$f(x)$ be continuous at $x = 3$.

59. What is the value of a ?

✓ (a) -1

(b) 1

(c) 2

(d) 3

60. What is the value of b ?

(a) -1

(b) 1

(c) 2

✓ (d) 3

DFTK-S-MTH

Consider the following for the next two (02) items that follow :

Let $I = \displaystyle\int_{-2\pi}^{2\pi} \dfrac{\sin^4 x + \cos^4 x}{1 + 3^x} dx$

61. What is $\displaystyle\int_0^\pi (\sin^4 x + \cos^4 x)\, dx$ equal to ?

(a) $\dfrac{3\pi}{8}$

✓ (b) $\dfrac{3\pi}{4}$

(c) $\dfrac{3\pi}{2}$

(d) 3π

62. What is I equal to ?

✓ (a) 0

(b) $\dfrac{3\pi}{4}$

(c) $\dfrac{3\pi}{2}$

(d) 3π

Consider the following for the next two (02) items that follow :

Let $f(x) = \begin{cases} ax(x+1) + b, & x < 1 \\ x - 1, & 1 \le x \le 2 \end{cases}$

63. If the function $f(x)$ is differentiable at $x = 1$, then what is the value of $(a + b)$?

(a) $-\dfrac{1}{3}$

(b) -1

✓ (c) 0

(d) 1

(21 – A)

What is $\lim\limits_{x\to 0} f(x)$ equal to ?

(a) $-\dfrac{1}{3}$

(b) $-\dfrac{2}{3}$

✓ (c) 0

(d) 1

5. If $f(x) = |\ln|x||$ where $0 < x < 1$, then what is $f'(0.5)$ equal to ?

(a) -2

✓ (b) -1

(c) 0

(d) 2

6. If $f'(x) = \cos(\ln x)$ and $y = f\left(\dfrac{2x-3}{x}\right)$, then what is $\dfrac{dy}{dx}$ equal to ?

(a) $\cos\left(\ln\left(\dfrac{2x-3}{x}\right)\right)$

(b) $-\dfrac{3}{x^2}\sin\left(\ln\left(\dfrac{2x-3}{x}\right)\right)$

(c) $\dfrac{3}{x^2}\cos\left(\ln\left(\dfrac{2x-3}{x}\right)\right)$

✓ (d) $-\dfrac{3}{x^2}\cos\left(\ln\left(\dfrac{2x-3}{x}\right)\right)$

67. What is $\displaystyle\int_0^{8\pi} |\sin x|\,dx$ equal to ?

(a) 2

(b) 4

(c) 8

✓ (d) 16

DFTK-S-MTH

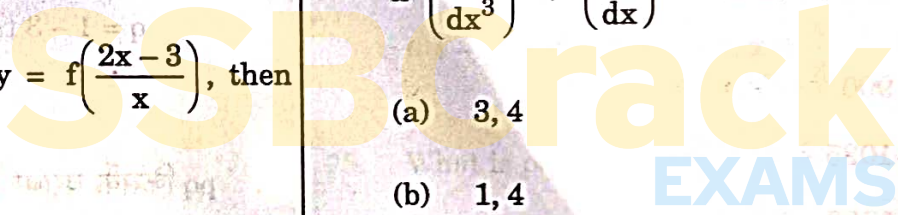68. What is the area between the curve $f(x) = x|x|$ and x-axis for $x \in [-1, 1]$?

(a) $\dfrac{2}{3}$

(b) $\dfrac{1}{2}$

(c) $\dfrac{1}{4}$

✓ (d) $\dfrac{1}{3}$

69. What are the order and the degree respectively of the differential equation $x^2\left(\dfrac{d^3y}{dx^3}\right)^2 + \left(\dfrac{dy}{dx}\right)^4 + \sin x = 0$?

(a) $3, 4$

(b) $1, 4$

(c) $2, 2$

✓ (d) $3, 2$

70. What is the differential equation of all parabolas of the type $y^2 = 4a(x-b)$?

✓ (a) $\dfrac{d^2y}{dx^2} + \left(\dfrac{dy}{dx}\right)^2 = 0$

(b) $\dfrac{d^2y}{dx^2} + x^2\left(\dfrac{dy}{dx}\right)^2 = 0$

(c) $y^2\dfrac{d^2y}{dx^2} + \left(\dfrac{dy}{dx}\right)^2 = 0$

(d) $y\dfrac{d^2y}{dx^2} + \left(\dfrac{dy}{dx}\right)^2 = 0$

(23 - A)

et $a_1, a_2, a_3 \ldots$ be in AP such that

$_1 + a_5 + a_{10} + a_{15} + a_{20} + a_{25} + a_{30} + a_{34} = 300$.

1. What is

$a_1 + a_5 - a_{10} - a_{15} - a_{20} - a_{25} + a_{30} + a_{34}$

equal to ?

(a)   0 ✓

(b)   25

(c)   125

(d)   250

72. What is $\displaystyle\sum_{n=1}^{34} a_n$ equal to ?

(a)   900

(b)   1025 ✓

(c)   1200

(d)   1275

Consider the following for the next two (02) items that follow :

Let $p = \cos\left(\dfrac{\pi}{5}\right)\cos\left(\dfrac{2\pi}{5}\right)$ and $q = \cos\left(\dfrac{4\pi}{5}\right)\cos\left(\dfrac{8\pi}{5}\right)$.

73. What is the value of $p + q$?

(a) $-\dfrac{1}{2}$

(b) $-\dfrac{1}{4}$

(c)   0 ✓

(d) $\dfrac{1}{2}$

DFTK-S-MTH

74. What is the value of pq ?

(a) $-\dfrac{1}{16}$

(b) $-\dfrac{1}{4}$ ✓

(c) $\dfrac{1}{4}$

(d) $\dfrac{1}{16}$

Consider the following for the next two (02) items that follow :

Let $p = \dfrac{1}{3} - \dfrac{\tan 3x}{\tan x}$ and

$q = 1 - 3\tan^2 x,\ 0 < x < \pi,\ x \neq \dfrac{\pi}{2}$.

75. What is pq equal to ?

(a)   1

(b)   2 ✓

(c) $\dfrac{8}{3}$

(d) $-\dfrac{8}{3}$

76. For how many values of x does $\dfrac{1}{p}$ become zero ?

(a)   No value

(b)   Only one value

(c)   Only two values

(d)   Only three values ✓

(25 – A)

Consider the following for the next two (02) items that follow:

Let $\sin x + \sin y = \sqrt{3}(\cos y - \cos x)$; $x + y = \dfrac{\pi}{2}$, $0 < x, y < \dfrac{\pi}{2}$.

77. What is a value of $\sin 3x + \sin 3y$?

- (a) -1
- (b) 0
- (c) 1
- (d) ✓ 3

78. What is a value of $\cos^3 x + \cos^3 y$?

- (a) ✓ $\dfrac{3\sqrt{3}}{8}$
- (b) $\dfrac{3\sqrt{6}}{8}$
- (c) $\dfrac{3\sqrt{6}}{4}$
- (d) 1

Consider the following for the next two (02) items that follow:

The angles A, B and C of a triangle ABC are in the ratio 3 : 5 : 4.

79. What is the value of $a + b + \sqrt{2}\,c$ equal to ?

- (a) 3a
- (b) 2b
- (c) ✓ 3b
- (d) 2c

80. What is the ratio of $a^2 : b^2 : c^2$?

- (a) ✓ $2 : 2 + \sqrt{3} : 3$
- (b) $2 : 2 - \sqrt{3} : 2$
- (c) $2 : 2 + \sqrt{3} : 2$
- (d) ✓ $2 : 2 - \sqrt{3} : 3$

DFTK-S-MTH

81. What is the equation of directrix of parabola $y^2 = 4bx$, where $b < 0$ and $b^2 + b - 2 = 0$?

- (a) $x + 1 = 0$
- (b) ✓ $x - 2 = 0$
- (c) $x - 1 = 0$
- (d) $x + 2 = 0$

82. The points $(-a, -b)$, $(0, 0)$, (a, b) and (a^2, ab) are :

- (a) lying on the same circle
- (b) ✓ vertices of a square
- (c) vertices of a parallelogram that is not a square
- (d) collinear

83. Given that $16p^2 + 49q^2 - 4r^2 - 56pq = 0$. Which one of the following is a point on a pair of straight lines $(px + qy + r)(px + qy - r) = 0$?

- (a) $\left(2, \dfrac{7}{2}\right)$
- (b) ✓ $\left(2, -\dfrac{7}{2}\right)$
- (c) $(4, -7)$
- (d) $(4, 7)$

84. If $3x + y - 5 = 0$ is the equation of a chord of the circle $x^2 + y^2 - 25 = 0$, then what are the coordinates of the mid-point of the chord ?

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

(27 – A)

85. Consider the following in respect of the equation $\dfrac{x^2}{24-k} + \dfrac{y^2}{k-16} = 2$.

1. The equation represents an ellipse if $k = 19$.

2. The equation represents a hyperbola if $k = 12$.

3. The equation represents a circle if $k = 20$.

How many of the statements given above are correct ?

(a) Only one

(b) Only two ✓

(c) All three

(d) None

86. Consider the following statements in respect of hyperbola $\dfrac{x^2}{\cos^2\theta} - \dfrac{y^2}{\sin^2\theta} = 1$:

1. The two foci are independent of θ.

2. The eccentricity is $\sec\theta$.

3. The distance between the two foci is 2 units.

How many of the statements given above are correct ?

(a) Only one

(b) Only two

(c) All three ✓

(d) None

87. Consider the following in respect of the circle $4x^2 + 4y^2 - 4ax - 4ay + a^2 = 0$:

1. The circle touches both the axes.

2. The diameter of the circle is 2a.

3. The centre of the circle lies on the line $x + y = a$.

How many of the statements given above are correct ?

(a) Only one

(b) Only two ✓

(c) All three

(d) None

88. For what values of k is the line $(k-3)\,x - (5-k^2)\,y + k^2 - 7k + 6 = 0$ parallel to the line $x + y = 1$?

(a) $-1, 1$ ✓

(b) $-1, 2$

(c) $1, -2$

(d) $2, -2$

89. The line $x + y = 4$ cuts the line joining $P(-1, 1)$ and $Q(5, 7)$ at R. What is PR : RQ equal to ?

(a) $1 : 1$

(b) $1 : 2$

(c) $2 : 1$

(d) $1 : 3$ ✓

90. What is the sum of the intercepts of the line whose perpendicular distance from origin is 4 units and the angle which the normal makes with positive direction of x-axis is 15° ?

(a) 8

(b) $4\sqrt{6}$ ✓

(c) $8\sqrt{6}$

(d) 16

(29 – A)

DFTK-S-MTH

91. What is the length of projection of the vector $\hat{i} + 2\hat{j} + 3\hat{k}$ on the vector $2\hat{i} + 3\hat{j} - 2\hat{k}$?

✓ (a) $\dfrac{1}{\sqrt{17}}$

(b) $\dfrac{2}{\sqrt{17}}$

(c) $\dfrac{3}{\sqrt{17}}$

(d) $\dfrac{2}{\sqrt{14}}$

92. If $(\vec{a} \times \vec{b})^2 + (\vec{a} \cdot \vec{b})^2 = 144$ and $|\vec{b}| = 4$, then what is the value of $|\vec{a}|$?

(a)   3

(b)   4

✓ (c)   5

(d)   6

93. If θ is the angle between vectors $\vec{a}$ and $\vec{b}$ such that $\vec{a} \cdot \vec{b} \geq 0$, then which one of the following is correct ?

(a) $0 \leq \theta \leq \pi$

(b) $\dfrac{\pi}{2} \leq \theta \leq \pi$

(c) $0 \leq \theta \leq \dfrac{\pi}{2}$

✓ (d) $0 < \theta < \dfrac{\pi}{2}$

94. The vectors $60\hat{i} + 3\hat{j}$, $40\hat{i} - 8\hat{j}$ and $\beta\hat{i} - 52\hat{j}$ are collinear if :

✓ (a) $\beta = 20$

(b) $\beta = 40$

(c) $\beta = -40$

(d) $\beta = 26$

95. Consider the following in respect of the vectors $\vec{a} = (0, 1, 1)$ and $\vec{b} = (1, 0, 1)$:

1. The number of unit vectors perpendicular to both $\vec{a}$ and $\vec{b}$ is only one.

2. The angle between the vectors is $\dfrac{\pi}{3}$.

Which of the statements given above is/are correct ?

(a)   1 only

(b)   2 only

(c)   Both 1 and 2

✓ (d)   Neither 1 nor 2

96. If L is the line with direction ratios $< 3, -2, 6 >$ and passing through $(1, -1, 1)$, then what are the coordinates of the points on L whose distance from $(1, -1, 1)$ is 2 units ?

✓ (a) $\left(-\dfrac{11}{7}, \dfrac{13}{7}, \dfrac{19}{7}\right)$ and $\left(\dfrac{1}{7}, \dfrac{3}{7}, \dfrac{5}{7}\right)$

(b) $\left(\dfrac{19}{7}, -\dfrac{11}{7}, \dfrac{13}{7}\right)$ and $\left(-\dfrac{1}{7}, \dfrac{3}{7}, -\dfrac{5}{7}\right)$

(c) $\left(\dfrac{13}{7}, \dfrac{11}{7}, \dfrac{19}{7}\right)$ and $\left(-\dfrac{1}{7}, -\dfrac{3}{7}, \dfrac{5}{7}\right)$

(d) $\left(\dfrac{13}{7}, -\dfrac{11}{7}, \dfrac{19}{7}\right)$ and $\left(\dfrac{1}{7}, -\dfrac{3}{7}, -\dfrac{5}{7}\right)$

97. Which one of the planes is parallel to the line $\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-4}{5}$?

   (a) $2x + 2y + z - 1 = 0$

   ✓(b) $2x - y - 2z + 5 = 0$

   (c) $2x + 2y - 2z + 1 = 0$

   (d) $x - 2y + z - 1 = 0$

98. What is the angle between the lines $2x = 3y = -z$ and $6x = -y = -4z$?

   (a) $0°$

   (b) $30°$

   ✓(c) $60°$

   (d) $90°$

99. What is the equation of the sphere concentric with the sphere $x^2 + y^2 + z^2 - 2x - 6y - 8z - 5 = 0$ and which passes through the origin ?

   (a) $x^2 + y^2 + z^2 - 2x - 8z = 0$

   (b) $x^2 + y^2 + z^2 - 2x - 6y = 0$

   (c) $x^2 + y^2 + z^2 - 6y - 8z = 0$

   ✓(d) $x^2 + y^2 + z^2 - 2x - 6y - 8z = 0$

100. A point P lies on the line joining A(1, 2, 3) and B(2, 10, 1). If z-coordinate of P is 7, what is the sum of other two coordinates ?

   (a) -15

   ✓(b) -13

   (c) -11

   (d) -9

101. The sum of deviations of n numbers from 10 and 20 are p and q respectively. If $(p - q)^2 = 10000$, then what is the value of n ?

   (a)   10

   (b)   20

   (c)   50

   (d)   100

102. If $\bar{X} = 20$ is the mean of 10 observations $x_1, x_2, ..., x_{10}$; then what is the value of $\sum\limits_{i=1}^{10} \left(\frac{3x_i - 4}{5} \right)$?

   (a)   0

   (b)   12

   (c)   112

   ✓(d)   1012

103. If the mean and the sum of squares of 10 observations are 40 and 16160 respectively, then what is the standard deviation ?

   (a)   16

   ✓(b)   6

   (c)   5

   (d)   4

104. Three dice are thrown. What is the probability of getting a sum which is a perfect square ?

   (a) $\frac{17}{108}$

   ✓(b) $\frac{5}{108}$

   (c) $\frac{19}{108}$

   (d) $\frac{23}{108}$

DFTK-S-MTH

105. A, B, C and D are mutually exclusive and exhaustive events.

If $2P(A) = 3P(B) = 4P(C) = 5P(D)$,

then what is $77P(A)$ equal to ?

(a) 12

(b) 15

(c) ✓ 20

(d) 30

106. Two distinct natural numbers from 1 to 9 are picked at random. What is the probability that their product has 1 in its unit place ?

(a) $\dfrac{1}{81}$

(b) $\dfrac{1}{72}$

(c) ✓ $\dfrac{1}{18}$

(d) $\dfrac{1}{36}$

107. Two dice are thrown. What is the probability that difference of numbers on them is 2 or 3 ?

(a) $\dfrac{7}{36}$

(b) $\dfrac{7}{18}$

(c) ✓ $\dfrac{5}{18}$

(d) $\dfrac{11}{36}$

DFTK-S-MTH

108. What is the mean of the numbers 1, 2, 3, ..., 10 with frequencies $^9C_0$, $^9C_1$, $^9C_2$, ..., $^9C_9$, respectively ?

(a) $1 \cdot 1 \times 2^8$

(b) ✓ $1 \cdot 2 \times 7^4$

(c) 5·5

(d) 0·55

109. The probability that a person recovers from a disease is 0·8. What is the probability that exactly 2 persons out of 5 will recover from the disease ?

(a) 0·00512

(b) ✓ 0·02048

(c) 0·2048

(d) 0·0512

110. Suppose that there is a chance for a newly constructed building to collapse, whether the design is faulty or not. The chance that the design is faulty is 10%. The chance that the building collapses is 95% if the design is faulty, otherwise it is 45%. If it is seen that the building has collapsed, then what is the probability that it is due to faulty design ?

(a) 0·10

(b) 0·19

(c) ✓ 0·45

(d) 0·95

111. If r is the coefficient of correlation between x and y, then what is the correlation coefficient between (3x + 4) and (− 3y + 3) ?

(a) − r ✓

(b) r

(c) $\sqrt{3}$ r

(d) − $\sqrt{3}$ r

112. A fair coin is tossed 6 times. What is the probability of getting a result in the 6th toss which is different from those obtained in the first five tosses ?

(a) $\frac{7}{16}$

(b) $\frac{1}{16}$

(c) $\frac{1}{32}$

(d) $\frac{1}{64}$ ✓

113. If H is the Harmonic Mean of three numbers $^{10}C_4$, $^{10}C_5$, and $^{10}C_6$, then what is the value of $\frac{270}{H}$?

(a) 1

(b) $\frac{14}{17}$

(c) $\frac{17}{14}$ ✓

(d) $\frac{1}{31}$

114. In a class, there are n students including the students P and Q. What is the probability that P and Q sit together if seats are assigned randomly ?

(a) $\frac{1}{n}$ ✓

(b) $\frac{2}{n}$

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

(d) $\frac{1}{2n}$

115. In a Binomial distribution B(n, p), n = 6 and 9P(X = 4) = P(X = 2). What is p equal to ?

(a) $\frac{1}{4}$

(b) $\frac{1}{2}$

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

(d) $\frac{4}{5}$ ✓

(37 – A)

DFTK-S-MTH

Three boys P, Q, R and three girls S, T, U are to be arranged in a row for a group photograph.

116. What is the probability that all three boys sit together ?

(a) ✓ $\dfrac{1}{5}$

(b) $\dfrac{1}{4}$

(c) $\dfrac{1}{3}$

(d) $\dfrac{1}{12}$

117. What is the probability that boys and girls sit alternatively ?

(a) $\dfrac{4}{5}$

(b) ✓ $\dfrac{1}{10}$

(c) ✓ $\dfrac{5}{6}$

(d) $\dfrac{1}{7}$

118. What is the probability that no two girls sit together ?

(a) $\dfrac{2}{5}$

(b) ✓ $\dfrac{3}{5}$

(c) $\dfrac{1}{18}$

(d) $\dfrac{1}{5}$

119. What is the probability that P and Q take the two end positions ?

(a) $\dfrac{1}{15}$

(b) $\dfrac{7}{15}$

(c) ✓ $\dfrac{14}{15}$

(d) $\dfrac{11}{45}$

120. What is the probability that Q and U sit together ?

(a) ✓ $\dfrac{2}{3}$

(b) $\dfrac{1}{4}$

(c) $\dfrac{5}{6}$

(d) $\dfrac{1}{3}$

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