

TOPIC – 01

1. The greatest value of the function $y = \sin(x) \cdot \sin(2x)$ on $(-\infty, \infty)$ is
 - (a) $\frac{4}{3\sqrt{3}}$
 - (b) 1
 - (c) $\frac{3}{3\sqrt{3}}$
 - (d) $\frac{2}{3\sqrt{3}}$
2. The locus of the point (α, β) such that the line $y = \alpha x + \beta$ becomes a tangent to the hyperbola $9x^2 - 4y^2 = 36$, is
 - (a) an ellipse with length of semi-major axis 3
 - (b) a hyperbola with eccentricity $\frac{\sqrt{5}}{2}$
 - (c) an ellipse with eccentricity $\frac{\sqrt{3}}{2}$
 - (d) a hyperbola with eccentricity $\sqrt{5}$
3. The complex number $\frac{2-i\sqrt{3}}{1+i\sqrt{3}}$ is the root of the quadratic with real coefficients described by
 - (a) $2x^2 + 2x + 9 = 0$
 - (b) $4x^2 + 2x + 9 = 0$
 - (c) $2x^2 + 2x + 7 = 0$
 - (d) $4x^2 + 2x + 7 = 0$
4. The system of linear equations $\begin{pmatrix} 1 & 2 & 4 \\ 2 & 1 & 2 \\ 1 & 2 & \lambda - 4 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 6 \\ 4 \\ \lambda \end{pmatrix}$ has
 - (a) no solution if $\lambda=8$
 - (b) infinitely many solutions if $\lambda \neq 8$
 - (c) Unique solution if $\lambda \neq 6$
 - (d) Infinitely many solutions if $\lambda=6$
5. Let $z = x + iy$ and $z^{1/3} = p - iq$. If $\frac{x}{p} - \frac{y}{q} = \lambda(p^2 - q^2)$, then λ is equal to
 - (a) 2
 - (b) -2
 - (c) -4
 - (d) 4
6. If $y(x) = xe^{-2x}$ is a solution of the differential equation $\frac{d^2y}{dx^2} + p\frac{dy}{dx} + (q+1)y = 0$ then the ordered pair (p, q) is equal to
 - (a) (3, 4)
 - (b) (-4, 5)
 - (c) (4, 3)
 - (d) (2, -1)
7. Let $f(x) = \sin^2(x) + \cos^8(x)$. The function f increases in the interval
 - (a) $(5\pi/4, 3\pi/4)$
 - (b) $(\pi/2, 5\pi/8)$
 - (c) $(0, \pi/4)$
 - (d) $(\pi/4, \pi/2)$
8. If the non-zero solution $y(x)$ of the differential equation $\frac{dy}{dx} = \frac{y^3}{e^{2x+y^2}}$ passes through the points $(0, 1)$ and $(\alpha, \frac{1}{\sqrt{e}})$, then α is equal to
 - (a) $\ln \sqrt{2e}$
 - (b) $\ln(2e)$
 - (c) $-\ln(2e)$
 - (d) $-\ln \sqrt{2e}$
9. Let $\alpha \neq 0, \alpha \in R$. Then the matrix $M = \begin{pmatrix} \alpha & \alpha & \alpha \\ \alpha & \alpha & \alpha \\ \alpha & \alpha & \alpha \end{pmatrix}$
 - (a) has different minimal and characteristic polynomials
 - (b) is not diagonalizable
 - (c) is an idempotent
 - (d) is nilpotent
10. Using the 2-point Gauss quadrature $\int_0^2 \cos^2 x \, dx$ is equal to
 - (a) $\cos^2\left(-\frac{1}{\sqrt{3}} + 1\right) + \sin^2\left(\frac{1}{\sqrt{3}} + 1\right)$
 - (b) $\cos^2\left(\frac{1}{\sqrt{3}} + 1\right) - \cos^2\left(\frac{1}{\sqrt{3}} - 1\right)$
 - (c) $\sin^2\left(-\frac{1}{\sqrt{3}} + 1\right) - \cos^2\left(\frac{1}{\sqrt{3}} + 1\right)$
 - (d) $\cos^2\left(-\frac{1}{\sqrt{3}} + 1\right) + \cos^2\left(\frac{1}{\sqrt{3}} + 1\right)$
11. Let $T: R^2 \rightarrow R^3$ be a linear transformation defined by $T(x) = Mx$, where $M = \begin{pmatrix} 1 & 1 \\ 2 & 1 \\ -1 & -3 \end{pmatrix}$. Then which one of the following vectors can NOT be in the range of T ?
 - (a) $\begin{pmatrix} -1 \\ 0 \\ 5 \end{pmatrix}$
 - (b) $\begin{pmatrix} 0 \\ -1 \\ 2 \end{pmatrix}$
 - (c) $\begin{pmatrix} 2 \\ 3 \\ -4 \end{pmatrix}$
 - (d) $\begin{pmatrix} 1 \\ 2 \\ -1 \end{pmatrix}$
12. The perimeter of the loop of the curve $9y^2 = (x-2)(x-5)^2$ is
 - (a) $2\sqrt{3}$
 - (b) $3\sqrt{3}$
 - (c) 4
 - (d) $4\sqrt{3}$
13. Let $\lambda \in R$, and $f: R^3 \rightarrow R$ be a function defined by $f(x, y, z) = x^3y + y^3z + z^3x - \lambda(xyz)$. If the directional derivative of f at the point $P(1, -1, 1)$ in the direction of the unit vector $\hat{u} = \frac{2}{3}\hat{i} - \frac{2}{3}\hat{j} + \frac{1}{3}\hat{k}$ is -10, then the gradient of f at P is equal to
 - (a) $-10\hat{i} + 12\hat{j} - 6\hat{k}$
 - (b) $6\hat{i} - 4\hat{j} + 10\hat{k}$
 - (c) $-6\hat{i} + 8\hat{j} - 2\hat{k}$
 - (d) $2\hat{i} + 6\hat{k}$
14. If $f(x) = e^{g(x)}$ and $g(x) = \int_2^{x^2} \frac{dt}{\sqrt{1+t^4}}$ then the value of the derivative $f'(2)$ is equal to
 - (a) $\frac{2}{\sqrt{5}}$
 - (b) $\frac{1}{2\sqrt{5}}$
 - (c) $\frac{1}{\sqrt{5}}$
 - (d) $\frac{1}{\sqrt{65}}$
15. If $\int \sin^2 x \cos 3x \, dx = \frac{\sin x}{a} + \frac{\sin 3x}{b} - \frac{\sin 5x}{c}$, then $a + b + c$ is equal to
 - (a) -18
 - (b) 22
 - (c) 30
 - (d) 26

16. Let $V = M_2(R)$ denotes the vector space of 2×2 matrices with real entries over the real field. Let $T: V \rightarrow V$ be defined by $T(P) = P^t$ for any $P \in V$, where P^t is the transpose of P . If E is the matrix representation of T with respect to the standard basis of V then $\det(E)$ is equal to
 (a) 2 (b) -2
 (c) -1 (d) 1
17. The set of all $\lambda \in R$ such that the sequence $\{a_n\}$, where $a_n = \sqrt{\lambda^2 n^2 + n + 1} - n$, $n \in N$, is convergent
 (a) is equal to R
 (b) is an empty set
 (c) is a singleton
 (d) contains exactly two elements -1 and 1
18. The area of the plane region bounded by the curves $x + 2y^2 = 0$ and $x + 3y^2 = 1$ above x -axis is equal to
 (a) $2/3$ (b) $1/3$
 (c) $4/3$ (d) $5/3$
19. The equation of common tangent to the curve $y^2 = 8x$ and $xy = -1$ is
 (a) $y = 2x + 1$ (b) $3y = 9x + 2$
 (c) $y = x + 2$ (d) $2y = x + 8$
20. The area (in square units) of the quadrilateral formed by the tangent lines drawn to the ellipse $\frac{x^2}{25} + \frac{y^2}{9} = 1$ at the ends of its two latus rectums is
 (a) $\frac{75}{2}$ (b) 75
 (c) $\frac{125}{4}$ (d) $\frac{125}{2}$
21. The equation $2x^2 + y^2 - 12x - 4y + 16 = 0$ represents
 (a) an ellipse with eccentricity $\frac{1}{\sqrt{2}}$
 (b) a hyperbola with center $(3, 2)$
 (c) an ellipse with center $(2, 3)$
 (d) a hyperbola with eccentricity $\sqrt{2}$
22. Let $T: R^3 \rightarrow R^3$ be a linear transformation defined by $T(x, y, z) = (x - y, y - z, z - x)$. If $\text{rank}(T) = \rho$ and nullity $(T) = \tau$, then the ordered pair (ρ, τ) is equal to
 (a) $(0, 3)$ (b) $(3, 0)$ (c) $(1, 2)$ (d) $(2, 1)$
23. $\lim_{x \rightarrow 0} \frac{(e^x - 1 - x)^2 \cos x}{x(\sin x - x)}$ is equal to
 (a) $2/3$ (b) $-3/2$ (c) -3 (d) $3/2$
24. If the Newton-Raphson method is applied to find a real root of $f(x) = 2x^2 + x - 2 = 0$ with initial approximation $x_0 = 1$. Then the second approximation x_2 is
 (a) $\frac{82}{105}$ (b) $\frac{24}{105}$ (c) $\frac{84}{105}$ (d) $\frac{56}{105}$
25. Let the function $f(x, y)$ possesses continuous first order partial derivatives and $\nabla f(20, -100) = \begin{pmatrix} 5 \\ -2 \end{pmatrix}$. If $g(x, y) = f(xy^2, 2x^2y)$, then $\nabla g(5, -2)$ is equal to
 (a) $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ (b) $\begin{pmatrix} -60 \\ -100 \end{pmatrix}$ (c) $\begin{pmatrix} 100 \\ -200 \end{pmatrix}$ (d) $\begin{pmatrix} -100 \\ 200 \end{pmatrix}$

26. Let $f = R^2 \rightarrow R$ be defined by

$$f(x, y) = \begin{cases} \frac{x^2 - x\sqrt{y}}{x^2 + y} & x \in R, y \geq 0, (x, y) \neq (0, 0) \\ 0 & \text{Otherwise} \end{cases}$$

Otherwise

Then, which one of following is Not correct ?

- (a) $f_y(0, 0) = 0$
 (b) f is not continuous at $(0, 0)$
 (c) $f_x(0, 0)$ does not exist
 (d) $f_x(0, 0) + f_y(0, 0) = 1$
27. If Taylor's theorem applied on the function $f(x) = \int_0^x \frac{\sin t}{t} dt$ then the value of the derivative $f^{(21)}(0)$ is equal to
 (a) $1/(21)21!$ (b) $-1/21!$
 (c) $1/21$ (d) $-1/12$
28. If $f(x) = ax^3 + bx^2 + x + 1$ has a local maxima value 3 at the point of local maxima $x = -2$, then $f(2)$ is equal to
 (a) 19 (b) 24
 (c) 20 (d) 25
29. Let $z = \cos\left(\frac{2\pi}{7}\right) + i \sin\left(\frac{2\pi}{7}\right)$. Then the principal argument of $(1 - z^2)$ is equal to
 (a) $\frac{3\pi}{14}$ (b) $\frac{11\pi}{14}$
 (c) $\frac{5\pi}{7}$ (d) $\frac{4\pi}{7}$
30. Which one of the following is NOT a correct statement ?
 (a) Every non-trivial group has at least two distinct subgroups
 (b) A non-cyclic group can have all of its proper subgroups cyclic
 (c) Every finite cyclic group has even number of generators
 (d) Infinite cyclic group has exactly two generators

TOPIC - 02

Directions: Read the following passage and answer the subsequent questions :

I'd been working with plastic bags, which I cut up and sew back together as my primary material for my artwork for the last 20 years. I turn them into two and three-dimensional pieces and sculptures and installations. After about the first eight years, some of my work started to fissure and break down into smaller little bits of plastic. It's a bad thing that plastic breaks down into smaller little bits, because it's always still plastic. And a lot of it is in the marine environment. I learned about the Pacific garbage patch. I wanted to go out there, pick up the plastic, and cold mold it into bricks to be used as building materials in underdeveloped communities. But soon I realized that I needed to look at the bigger picture

first: we need to attack the source of this waste that is entering the marine environment every day on a global scale. Rather than the marine plastic pile what I should focus on, is the pile of plastic in the

supermarket. I'd go to the supermarket and all of my food is packaged in plastic. I'm concerned about the plastic and the toxins that leach from plastic into us and into our bodies.

1. Why does author want to go to the Pacific?
 - (a) To pick up the plastic and cold mold it into bricks.
 - (b) For sight seeing
 - (c) To see the plastic garbage there
 - (d) To throw more plastic there.
2. What does he mean by "the bigger picture"?
 - (a) Plastic waste that is entering the marine environment regularly
 - (b) Plastic waste cold-molded into bricks to be used as building materials
 - (c) The massive use of plastic packaging for consumer items
 - (d) Toxins leaching from plastic into us and into our bodies
3. How did the writer come to be concerned about plastic waste?
 - (a) Plastic had been the primary material for his artwork for the last 20 years
 - (b) Plastic breaks down into smaller little bits, but it turns into plastic waste
 - (c) His work started to fissure and break down into smaller little bits of plastic
 - (d) He realized that the bits of plastic his work broke into ultimately polluted the marine environment
4. What does the author find in supermarket ?
 - (a) Plastic does not create any problem
 - (b) All of his food is packaged in plastic
 - (c) All the items are packed in paper.
 - (d) Bricks made of plastic

TOPIC – 03

Directions: Read the following passage and answer the subsequent questions :

Recycling – everybody kind of ends their books about being sustainable and greening with the idea of recycling. You put something in a bin and you don't have to think about it again. What is the reality of that? In the United States, less than seven percent of the plastics are recycled, or incinerated, or shipped to China. It is down-cycled and turned

into lesser things -- a plastic bottle can never be a plastic bottle again.

We, a group of people concerned about plastic pollution, have added a fourth R onto the front of the "Reduce, Reuse, Recycle," and that is refuse. Whenever possible, refuse single-use and

disposable plastics. Alternatives exist; I myself am now collecting these cool Pyrex containers and using those instead of plastic containers to store

food in. And I know that I am doing a service to myself and my family. It is a problem that we've created as consumers and we have to solve it –We can solve this by raising awareness of the issue and teaching people to choose alternatives.

1. Mark the statement that is NOT true:
 - (a) In USA seven percent plastic waste is recycled
 - (b) The writer suggests we should refuse to use, as far as possible, single-use and disposable plastics
 - (c) People should prefer to use alternatives wherever possible
 - (d) Down-cycling only converts used plastic into another inferior plastic product
2. What service is writer doing to his family?
 - (a) Refuse single-use and disposable plastics.
 - (b) None of these
 - (c) Using only those food items which are packaged in Pyrex.
 - (d) Using Pyrex containers to store food.
3. Why does the author think recycling is not the right solution?
 - (a) Plastic waste is only down-cycled which again turns into waste in course of time
 - (b) We simply throw our plastic waste into trash bin.
 - (c) We only write about the need to recycle
 - (d) Not much of plastic waste is really recycled

TOPIC – 04

Directions: Read the following passage and answer the subsequent questions :

Milk contains a type of sugar called lactose. When we are babies, our bodies make a special enzyme called lactase that allows us to digest the lactose in our mother's milk. But after we are weaned in early childhood, for many people this stops. Without lactase, we cannot properly digest the lactose in milk. But then evolution kicked in: some people began to keep their lactase enzymes active into adulthood. This "lactase persistence" allowed them to drink milk without side effects. It is the result of mutations in a section of DNA that controls the activity of the lactase gene. But in many

populations, such as those in Africa, in Asia and South America, the trait is uncommon. Even people who are lactase-nonpersistent exploit the option of processing milk into butter, yoghurt, cream or cheese – all of which have reduced amount of lactose.

There is clearly a pattern behind which populations evolved high levels of lactase persistence and

which didn't, says a genetics professor Dallas Swallow of University College London. Those with the trait are pastoralists: people who raise livestock. Hunter-gatherers, who do not keep animals, did not acquire the mutations. Neither did "forest gardeners" who cultivated plants. But milk consumption is going down, says a study. Statistics

tell a different story. While milk consumption has fallen in the US, in Asia demand is growing, where

most people are non-lactase-persistent. Whatever advantages the people there see in milk, they outweigh the potential digestive issues or the need to process the milk.

1. How did some populations come to retain lactase-persistence while very many others did not as they grew up?
 - (a) The need to drink milk to avoid starvation led to evolution of lactase-persistence in people earlier deficient in this enzyme
 - (b) People whose lives centred around livestock came to retain it.
 - (c) It is a genetic characteristic; in many populations, such as those in Africa, in Asia and South America, this trait is uncommon
 - (d) Evolution worked in different ways with people in different areas
2. Why is it that some grownups can drink and digest milk while others cannot digest it?
 - (a) All babies can drink and digest milk but some grownups cannot digest any milk
 - (b) The presence of an enzyme called lactose in milk hinders digestion of milk in some people
 - (c) Some grownups cannot digest milk as a result of mutations in a section of their DNA that controls the activity of the lactase gene
 - (d) An enzyme called lactase allows us to digest mother's milk in our infancy, but in case of some people their bodies stop producing it as they grow up.
3. Mark the statement that is NOT true:
 - (a) People who are non-lactase-persistent can use milk products like cheese as they are lactose-deficient

(b) The enzyme lactase helps us digest milk in our infancy

(c) Lactase-deficient or not, because of its health benefits, people everywhere drink milk

(d) It is interesting to note that milk consumption is going up in non-lactase persistent populations of Asia

TOPIC – 05

1. Average of ten numbers in a list is 25. If one of the numbers in the list is exchanged with another number the average of the new list increases by 5. What is the new number included in the list, if the original number was 15?
 - (a) 65
 - (b) 50
 - (c) 70
 - (d) 60
2. Two's complement of 00000000 is
 - (a) 11111111
 - (b) 10101010
 - (c) 00000000
 - (d) 01010101
3. The code of DOG is ITL, what is the code of ITL?
 - (a) MXP
 - (b) JUM
 - (c) DOG
 - (d) NYQ
4. X works twice as fast as Y. Y alone can finish the work in nine days. X and Y together can finish the work in _____ days.
 - (a) 5
 - (b) 4
 - (c) 3
 - (d) 6
5. How much of acid is in the 10 liter of a 60% solution, of acid and water solution?
 - (a) 10
 - (b) 12
 - (c) 18
 - (d) 6
6. What is the next term in the series? 2, 7, 14, 23, 34, _____
 - (a) 53
 - (b) 47
 - (c) 45
 - (d) 51
7. Study the following C code


```

Main()
{ int i = 4 ;
    int j = 10 ;
    Statements of the program
    If (j > 0)
        { int i = 44 ;
          Statements of the program
        }
}
```

Given

 - I. The local value of *i* is 44
 - II. The global value of *i* is 4

then

 - (a) Only II is true
 - (b) Both I and II are false
 - (c) Both I and II are true
 - (d) Only I is true

8. $\sqrt{\sqrt{1296}} + x^2 = 60\%$ of 70. The value of x is
(a) 6 (b) 7 (c) 5 (d) 8
9. I []
II &
III <=
IV ()
(a) I and II (b) I and IV
(c) II and III (d) II and IV
10. The operator $a \ll b$ shifts binary representation of integer 'a' by 'b' bit _____, in C programming language.
(a) Circularly right (b) Circularly left
(c) Left (d) Right

ANSWER KEY (DU MCA - 2019)

TOPIC – 1

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|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (a) | 2. (d) | 3. (d) | 4. (a) | 5. (d) | 6. (c) | 7. (d) | 8. (d) | 9. (a) | 10. (d) |
| 11. (b) | 12. (d) | 13. (c) | 14. (c) | 15. (b) | 16. (c) | 17. (d) | 18. (a) | 19. (c) | 20. (d) |
| 21. (a) | 22. (d) | 23. (b) | 24. (j) | 25. (c) | 26. (d) | 27. (c) | 28. (a) | 29. (a) | 30. (c) |

TOPIC – 2

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|--------|--------|--------|--------|
| 1. (a) | 2. (c) | 3. (d) | 4. (b) |
|--------|--------|--------|--------|

TOPIC – 3

- | | | |
|--------|--------|--------|
| 1. (a) | 2. (d) | 3. (a) |
|--------|--------|--------|

TOPIC – 4

- | | | |
|--------|--------|--------|
| 1. (b) | 2. (d) | 3. (b) |
|--------|--------|--------|

TOPIC – 5

- | | | | | | | | | | |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| 1. (a) | 2. (c) | 3. (d) | 4. (c) | 5. (d) | 6. (b) | 7. (j) | 8. (a) | 9. (b) | 10. (c) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|