



**Indian Institute of Technology Madras**  
**Zanzibar Campus**

IIT Madras Zanzibar Campus Screening Test (IITMZST)

**MTech Data Science & AI**

2023 Screening Test - Question Paper

## Comprehension and Verbal Aptitude (5 questions, 1 mark each)

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### For Q1-3, Passage 1

Until fairly recently, the Western art world's adaptation of traditional African visual culture was referred to as Primitivism, a term which is now considered outdated due to its problematic connotations. At the turn of the 20th century, the European elite believed Africa and Oceania to be primitive lands rife with mysticism and savagery. At the same time, many appropriated these cultures for their own artistic and social gain, fascinated by an exotic fantasy of the non-Western. But very few had a sophisticated understanding of the cultures and mostly nameless African artists that they were borrowing from.

Europe was both fascinated and shocked by African objects, viewing their spirituality with a mixture of intrigue and contempt. It is important to note that unlike Western art, these objects had been created with function, rather than art in mind. While their function varied depending on region and religion, they played (and in many cases, continue to play) an important role in ceremonies and rituals celebrating religion, social status, and rite of passage.

1. Why is the term "primitivism" outdated now?

- a. It is an archaic term
- b. It perpetuates racist stereotypes\
- c. It refers to Picasso's troubled past
- d. The word has lost its meaning over the years

Correct Option: b

2. What was the significant distinction between Western Art and African Art encountered by Europeans in the late 19<sup>th</sup> century?

- a. Unlike Western art, African art was readily available
- b. Unlike Western art, African art did not have rigid rules
- c. Unlike Western art, African art had functionality in rituals and ceremonies
- d. Unlike Western art, African art did not have value

Correct Option: c



3. The author of the passage is
- a. Critical of Europe's exploitation of African art and artifacts
  - b. Appreciative of Europe's efforts to understand African Art
  - c. Acknowledges the problems of African art
  - d. Angry at Europe and wants them to pay reparations

Correct Option: a

4. Pick the odd one out of the four options \*
- a. Row
  - b. Spat
  - c. Tiff
  - d. Stake

Correct Option: d

5. His \_\_\_\_\_ manners did little to hide the fact that he did not practice what he preached. \*\*
- a. Candid
  - b. Dogmatic
  - c. Stentorian
  - d. Righteous

Correct Option: d



## Analytical Aptitude (5 questions, 1 mark each)

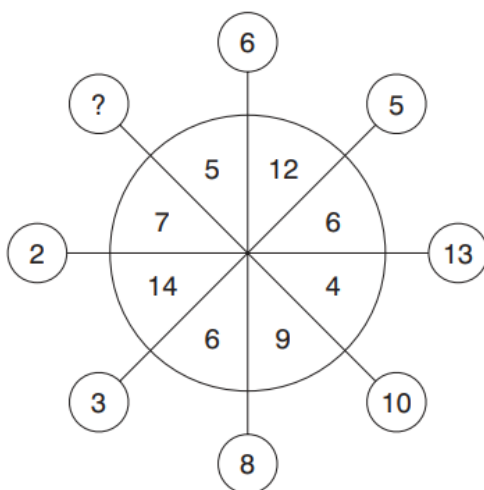
1. Five students A, B, C, D and E participated in a 100m race and finished the race in five different timings (not necessarily in the same order). Three students finished the race behind *D* and three students finished the race ahead of *E*. *C* is neither the first nor the last student to finish the race. If *A* finishes the race after *B*, then who is the last student to finish the race?
- A
  - B
  - D
  - E

Correct Option: a

2. Each of 216 small identical cubes are painted blue on all faces and all these cubes are arranged to form a large cube. Now all the faces of the large cube are painted pink. How many small cubes have only one colour on them?
- 48
  - 64
  - 96
  - 125

Correct Option: b

3. What number should replace the question mark, in the figure below?



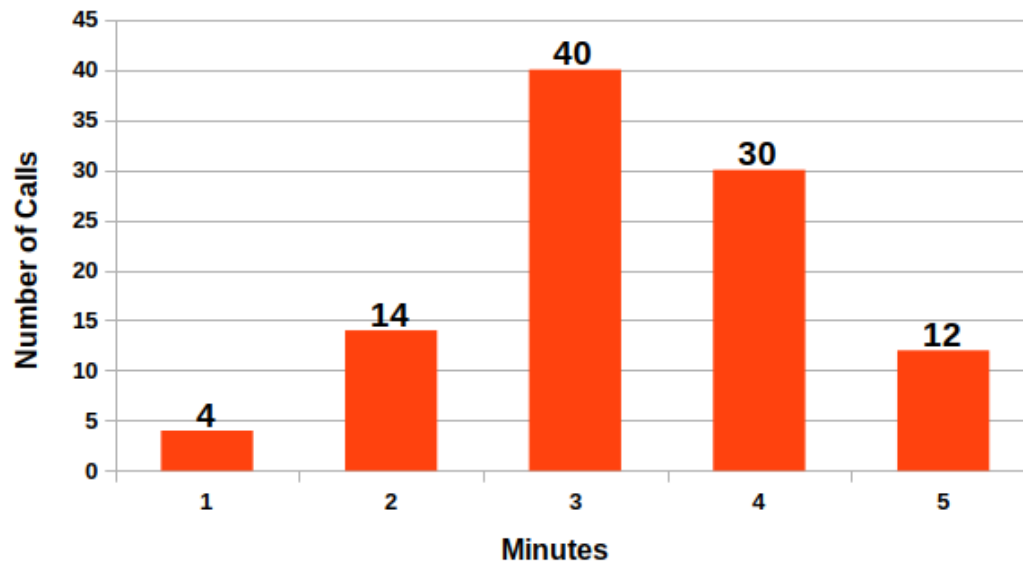
Answer: 11



4. A man can row at a speed of 18 kmph in still water. If it takes him thrice as long to row up as to row down the river, what is the speed of stream?
- 12 km/hr
  - 18 km/hr
  - 9 km/hr
  - 6 km/hr

Correct Option: c

5. A frequency diagram showing the results of a survey of the duration of telephone conversations at the National Child Helpline Call centre over a period of 3 days is given below.



Which procedure would provide the mean length of the calls?

- Total duration of all calls divided by 100
- Total number of calls multiplied by 5
- $4 \times 1 + 14 \times 2 + 40 \times 3 + 30 \times 4 + 12 \times 5$  divided by the number of calls
- Sum of length of all calls multiplied by 100

Correct Option: a



## Technical Aptitude (10 questions of 1 mark and 10 of two marks)

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1. Given a matrix  $\mathbf{A} = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 0 & 3 & 0 \\ 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 2 \end{bmatrix}$ , the sum of the eigenvalues of the matrix  $\mathbf{A}$  is \_\_\_\_.

[NAT 1 mark]

Answer: 7

2. 'Given a matrix  $\mathbf{P} = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 1 & 2 \\ 3 & 3 & 5 \end{bmatrix}$  and a vector  $\mathbf{b} = \begin{bmatrix} 5 \\ 2 \\ 9 \end{bmatrix}$ , the system of equations  $\mathbf{Px} = \mathbf{b}$  has

[MCQ 1 mark]

- a. Unique solution for  $\mathbf{x}$
- b. Many solutions for  $\mathbf{x}$
- c. No solution for  $\mathbf{x}$ .
- d. Exactly two solutions for  $\mathbf{x}$

Correct Option: c

3. The projection of a vector  $\mathbf{b} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$  onto  $\mathbf{a} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$  is

[MCQ 1 mark]

- a.  $= \begin{bmatrix} 1 \\ 0 \end{bmatrix}$
- b.  $= \begin{bmatrix} 1 \\ 1 \end{bmatrix}$
- c.  $= \begin{bmatrix} 0 \\ 1 \end{bmatrix}$
- d.  $= \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

Correct Option: a



4. Given  $T(x) = Ax$ , where  $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ , if  $T(T(x)) = Px$ .

Which of the following represents the matrix  $P$ .

[MCQ 1 mark]

a.  $P = \begin{bmatrix} 2 & 4 \\ 6 & 8 \end{bmatrix}$

b.  $P = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

c.  $P = \begin{bmatrix} 7 & 10 \\ 15 & 22 \end{bmatrix}$

d.  $P = \begin{bmatrix} 4 & 8 \\ 12 & 16 \end{bmatrix}$

Correct Option: c

5. A pharmaceutical company models the efficacy  $E(d)$  of a drug as a function of dosage  $d$  as  $E(d) =$

$$\frac{4}{5}d - \frac{2}{3}(d - 7)^2. \text{ The value of } d \text{ which gives the maximum efficiency is } \underline{\hspace{2cm}}$$

[NAT 1 mark]

Answer: 7.6

6. The inverse Laplace transform of  $F(s) = \frac{s}{s^2+1}$  is

[MCQ 1 mark]

a.  $\sin t$

b.  $\cos t$

c.  $e^t$

d.  $te^t$

Correct Option: b

7. The Taylor series expansion of  $\cos x$  about  $x = 0$  is

[MCQ 1 mark]

a.  $\sum_{n=0}^{\infty} \frac{(-1)^n x^{2n}}{2n!}$

b.  $\sum_{n=0}^{\infty} \frac{x^n}{n!}$

c.  $\sum_{n=0}^{\infty} \frac{(-1)^n x^{2n+1}}{2n!}$

d.  $\sum_{n=0}^{\infty} \frac{x^{2n}}{2n!}$

Correct Option: a



8. In a recreational room of an IIT, the students are playing “throwing a dart” game. Here, the experiment consists in throwing a dart at the dartboard hanging on a wall. Let us consider the dartboard being a disk centred at  $(0, 0)$  and of radius 2. When the dart is thrown at the wall, the position of the dart on the wall defined by  $(x, y)$ -coordinate is an outcome. Then, the event named “you missed the dartboard” occurs when the  $(x, y)$ -coordinates satisfy

[MCQ 1 mark]

- a.  $\{(x, y): x^2 + y^2 = 2\}$
- b.  $\{(x, y): x^2 + y^2 > 4\}$
- c.  $\{(x, y): x^2 + y^2 = 4\}$
- d.  $\{(x, y): x^2 + y^2 > 2\}$

Correct Option: b

9. If  $X$  follows a Bernoulli distribution with parameter  $p = 0.4$ , what is  $P(X = 1)$ ?

[MCQ 1 mark]

- a. 0.6
- b. 0.4
- c. 0.5
- d. 0.2

Correct Option: b

10. In a study assessing drug efficacy, the average improvement in patient symptoms is estimated to be 2.0 units on a symptom scale. A 95% confidence interval for this estimate is [1.8 units, 2.2 units]. Which of the following statements is true?

[MCQ 1 mark]

- a. There’s a 95% probability that the true average improvement in patient symptoms is exactly 2.0 units.
- b. The data suggest that with 95% confidence, the interval from 1.8 units to 2.2 units captures the true average improvement in patient symptoms.
- c. (c) 95% of patients showed an improvement between 1.8 units and 2.2 units.
- d. If the study were repeated many times, the average improvement would be 2.0 units in 95% of the repetitions.

Correct Option: b





11. Given the average number of calls to a call center in 10 minutes is 5. If the calls follow a Poisson distribution, the probability that exactly 7 calls are received in 10 minutes is \_\_\_\_\_ (rounded to 3 decimal places) [NAT 2 marks]

Answer: Range 0.103-0.105

12. Define a function  $f$  as follows: [NAT 2 marks]

$$f(x) = \begin{cases} kx^2 + 15 & \text{if } x \leq 3 \\ kx + 3 & \text{if } x > 3 \end{cases}. \text{ The value of } k \text{ is } f \text{ is continuous at } x = 3 \text{ is } \underline{\hspace{2cm}}$$

Correct Answer: -2

13. The correlation coefficient (denoted by  $\rho_{XY}$ ) between two random variables  $X$  and  $Y$  is 0.8. The variances of  $X$  and  $Y$  variables are as follows:  $\sigma_X^2 = 4$   $\sigma_Y^2 = 16$ . Then, the covariance  $\sigma_{XY}$  is \_\_\_\_\_ (rounded off to one decimal place) [NAT 2 marks]

Answer: Range 6-.65

14. For  $\mathbf{P} = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 1 & 2 \\ 3 & 2 & 5 \end{bmatrix}$ , which of the following statement(s) is/are true? [MSQ 2 marks]

- a. The eigenvectors of  $\mathbf{P}$  are orthogonal
- b. The eigenvectors of  $\mathbf{P}$  are not orthogonal
- c. One of the eigenvalues of  $\mathbf{P}$  is zero
- d. One of the eigenvalues of  $\mathbf{P}$  is not zero

Correct Options: a, d

15. Given a matrix  $\mathbf{A} \in \mathbf{R}^{n \times m}$  ( $n \neq m$ ). Denote the pseudoinverse of  $\mathbf{A}$  as  $\mathbf{A}^\dagger$ . Which of the following statement(s) is/are true? [MSQ 2 marks]

- a.  $\mathbf{A}^\dagger = \mathbf{A}$
- b.  $(\mathbf{A}^\dagger)^\dagger = \mathbf{A}$
- c.  $\mathbf{A}^\dagger = (\mathbf{A}^T \mathbf{A})^\dagger \mathbf{A}$
- d.  $(\mathbf{A}^T)^\dagger = (\mathbf{A}^\dagger)^T$

Correct Options: b, d



16. Consider a joint probability density function between random variables X and Y as

$$f(x, y) = \begin{cases} \frac{x+y}{24}, & 0 < x < 3, x < y < x + 2 \\ 0, & \text{otherwise} \end{cases}$$

Then,  $E(Y|X = 2) = \underline{\hspace{2cm}}$ . (rounded off to two decimal places) [NAT 2 marks]

Answer: Range 2.90-3.20

17. Suppose we toss a fair coin until we get exactly two heads. Let  $K$  be the random variable representing the number of tosses required to get these two heads. Which of the following gives the probability that exactly  $k$  tosses are required? [MCQ 2 marks]

- a.  $P(K = k) = 0.5^k$
- b.  $P(K = k) = k \times 0.5^k$
- c.  $P(K = k) = (k - 1) \times 0.5^k$
- d.  $P(K = k) = k \times 0.5^{k-1}$

Correct Option: c

18. Define a function  $f$  in the interval  $[-4, 4]$  as follows: [NAT 2 Marks]

$$f(x) = \begin{cases} 2(x - 2)^2 - 3 & \text{if } -4 \leq x < 0 \\ 6x^3 - 8x + 5 & \text{if } 0 \leq x < 2 \\ x + 3 & \text{if } 2 \leq x \leq 4 \end{cases}$$

Find the number of points where  $f(x)$  is not differentiable in the interval  $(-4, 4)$

Answer: 1

19. Consider the optimisation problem [NAT 2 Marks]

$$\min_{(x,y)} x^2 + y^2$$

such that  $x - y = 1$ .

The value of the optimal cost function is \_\_\_\_

Answer: 0.5



20. Given a matrix  $P = \begin{bmatrix} 2 & 1 \\ 0 & 3 \end{bmatrix}$  and  $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ , the eigenvalues of  $(P + 2I)^{-1}$  are [MCQ 2 marks]

a.  $1/2, 1/3$

b.  $1, 1/3$

c.  $1/4, 1/5$

d.  $1/4, 1/3$

Correct Option: c



**Note:** The last year questions represent only the type of questions that will be asked during the screening test. It is not indicative of the exam pattern or number of questions that will be asked during the screening test.

**For queries related to questions**

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