Institute of Actuaries of India

ACET March 2025

Mathematics

1. The minimum value of the function $f(x) = ln(\sqrt{x^2 + 2025}\,)$ is:
   A. Less than 1
   B. Between 1 and 3
   C. Between 3 and 4
   D. More than 4

1 mark

2. If $f(x) = \mathrm{x}^2 + 20|x| + 25$ and $g(x) = |\mathrm{x}^2 + 20x + 25|$, then which of the following is true for all values of x?
   A. $f(x) < g(x)$
   B. $f(x) \leq g(x)$
   C. $f(x) > g(x)$
   D. $f(x) \geq g(x)$

1 mark

3. If $f(x) = 2x^3 + 2x + 5$, then the equation f(x)=1 has:
   A. No real roots
   B. Exactly 1 real root
   C. Exactly 2 real roots
   D. 3 or more real roots

2 marks

4. Let [x] denotes the largest integer not exceeding x and {x} = x – [x]. For example, [π] = 3, {π} = π-3; [3] = 3, {3} = 0. Let $I = \int_0^{2025} [x]\{x\}dx$. Then $\frac{I}{2025} =$ is:
   A. Not an integer
   B. An odd integer
   C. An even integer not divisible by 4
   D. An integer divisible by 4

3 marks

5. If a and b are the roots of $x^2 + 20x + 25 = 0$ and a^2 and b^2 are the roots of a quadratic $P(x) = x^2 + mx + n = 0$, then P(1) equals:
   A. 276
   B. 976
   C. 2116
   D. None of the above

2 marks

6. Evaluate $\lim_{x \to 0} \frac{\tan\left(\frac{x}{20}\right) - \tan\left(\frac{x}{25}\right)}{\sin\left(\frac{x}{2025}\right)}$:
   A. -405
   B. 405
   C. -20.25

D. 20.25

2 marks

7. An geometric progression a_i is such that $a_{20} = 25$ and $a_{25} = 20$. Let k be smallest integer greater than 25 such that a_k is an integer. Then $k + a_k$ equals:
   A. 45
   B. 46
   C. 47
   D. None of the above

2 marks

8. If $\vec{a} = 20\hat{\imath} + 25\hat{\jmath}$, then a unit vector in the direction of $\vec{a}$ will be:
   A. $(\frac{4}{9})\hat{\imath} + (\frac{5}{9})\hat{\jmath}$
   B. $(\frac{4}{\sqrt{41}})\hat{\imath} + (\frac{5}{\sqrt{41}})\hat{\jmath}$
   C. $(\frac{16}{41})\hat{\imath} + (\frac{25}{41})\hat{\jmath}$
   D. $(\frac{4}{41})\hat{\imath} + (\frac{5}{41})\hat{\jmath}$

1 mark

9. Which of the following statements is/are true?
   X: $\vec{a} \times \vec{b} = \vec{b} \times \vec{a}$.
   Y: $\vec{a} \cdot \vec{b} = \vec{b} \cdot \vec{a}$.
   A. Both X and Y
   B. Neither X, nor Y
   C. X but not Y
   D. Y but not X

1 mark

10. Which of the following does not necessarily imply that the determinant of a square matrix M is zero?
    A. All entries of a row / column of M are zero.
    B. A row (or column) of M is a multiple of another row (or column) of M.
    C. M is a skew-symmetric matrix.
    D. A row (or column) of M equals the sum of two other rows (or columns) of M.

1 mark

11. If A, B, C and D are matrices of size 20x20, 25x25, 20x25 and 25x20 respectively, then which of the following expressions are not defined?

    A. $ACB + D^T$
    B. A + CD.
    C. CBDA.
    D. $DCB + A^T$.

1 mark

12. The function $f(x) = (x+|x|)^2$ over the set of real numbers is:

    A. Discontinuous at some point
    B. Continuous everywhere, but not differentiable at some point
    C. Differentiable everywhere, but not twice differentiable at some point
    D. Twice differentiable everywhere

2 marks

13. For a positive integer n, the derivative of the function $y = \frac{e^x}{x^n}$ equals 0 when x equals:
    A. n
    B. 2n
    C. n^2
    D. None of the above

1 mark

14. Given that a,b,c,d are in geometric progression, a≠b and a+b+c+d=0, then compute $(c/d)^{2025}$.
    A. -1
    B. 0
    C. 1
    D. None of the above / Cannot be determined

1mark

15. The number of terms in the expansion of $(1 + x^{25})(1 + x)^{20}$ is:
    A. 46
    B. 45
    C. 42
    D. 40

1 mark

16. If n! stands for n factorial (i.e. product of all positive integers from 1 up to and including n), the value of $\sum_{n=1}^{\infty} \frac{n-1}{n!}$ is:
    A. ½
    B. 1
    C. Between ½ and 1
    D. Greater than 1

1 mark

17. In order to evaluate the integral $\int_0^1 f(x)dx$, we are given the functional value of f(x) at three points only, namely, f(0), f(0.5) and f(1). The approximation obtained using Trapezoidal rule with h=0.5 is 20, while that using Simpson's 1/3rd rule is 25. What is the given value of f(0.5)?

    A. 20
    B. 25
    C. 35
    D. None of the above

2 marks

18. Given that a function can be approximated as a quadratic, a student has produced the following approximation table.

X	0	1	2	3	4	5	6
f(x)	-5	-1	7	19	35	55	77

However, due to hasty computation, he has gotten one of the values incorrect. Which is the incorrect value?

    A. f(3)
    B. f(4)
    C. f(5)
    D. f(6)

3 marks

19. If a complex number z is multiplied with its complex conjugate, their product:

    A. Is necessarily a non-negative real number
    B. Is a real number, but can be negative
    C. Is necessarily a non-real number
    D. Can be real or non-real depending on z

1 mark

20. If α is a non-real number such that $1 + \alpha + \alpha^2 + \cdots + \alpha^6 = 0$, then α^{2025} equals:

    A. 1
    B. α
    C. α^2
    D. None of the above

1 mark

Statistics

21. A random variable N is drawn from the set {0, 1, …, 9} such that the probability of j being chosen is directly proportional to j^3. Let m and M be the median and the mode (respectively) of N. Then |M – m| equals:

    A. 0
    B. 1
    C. 2
    D. None of the above

    2 marks

22. The average height of all students in a class is 170 cm. If 5 new students are added, the average increases to 172 cm. If all five new students had the same height, the number of students originally (before the addition of 5 new students) in the class is:

    A. 20
    B. 25
    C. 30
    D. Insufficient information / cannot be determined

    1 mark

23. A secondary school (grades 5 to 10) has two sections for each grade, so 12 classes (6 grades times 2 sections) in all. The school has 3 math teachers who need to be assigned to the 12 classes such that:

    - Each teacher must teach exactly four classes.
    - No teacher can teach both sections of same grade.

    The number of ways of assigning teachers to the classes is N. Then the largest integer not exceeding (N/100) is:

    A. An odd composite number
    B. An odd prime number
    C. An even number not divisible by 4
    D. An even number divisible by 4

    3 marks

24. The median of marks of all boys in a class is 20, while the median of marks of all girls in that class is 25. Then the median marks of all students (boys and girls) in that class will be

    A. 22.5
    B. Indeterminate, but will surely be between 21 and 24 (both inclusive).
    C. Indeterminate, but will surely be between 20 and 25 (both inclusive).
    D. None of the above

    1 mark

25. The probability of a student passing a mathematics exam is p. The probability of that student passing a science exam is q. The conditional probability of the student passing the mathematics exam given that they have passed the science exam is 20%. The conditional probability of the student passing the science exam given that they have passed the mathematics exam is 25%. Then p/q equals.

A. 1.25
B. 0.8
C. None of the above
D. Cannot be determined

1 mark

26. The number of ways in which the letters of the word "ACTUARY" can be rearranged is:

A. 2520
B. 5040
C. 6^7
D. None of the above

1 mark

27. A fair, six-sided dice is rolled to yield a random variable X. Then the ratio of the interquartile range of X to the range of X is:

A. 0.5
B. 0.4
C. 0.6
D. None of the above

1 mark

28. X follows an exponential distribution with mean 2. Given that X is greater than 2, the probability that X is greater than 4 is:

A. 0.368
B. 0.5
C. 0.135
D. None of the above

2 marks

29. If X follows a normal distribution with mean m and variance σ^2 and given real constants a and b, then aX+b follows a normal distribution with mean am+b and variance:

A. $a\sigma^2+b$
B. $(a\sigma+b)^2$
C. $a\sigma^2$
D. $a^2\sigma^2$

1 mark

30. When is the binomial distribution symmetric?

A. Always
B. Only for a specific value(s) of parameter n
C. Only for a specific value(s) of parameter p
D. Never

1 mark

31. A *discrete* random variable X taking integer values has the cumulative distribution function given by:

$$F(x) = \Pr(X \leq x) = \begin{cases} 0 \; if \; x \leq 0 \\ \frac{x^2}{36} \; if \; 0 < x \leq 6 \\ 1 \; if \; x > 6 \end{cases}$$

Then the absolute difference between the mean and the median of X is.

A. Less than ½
B. More than ½ but less than 1
C. Exactly ½
D. 1 or more

2 marks

32. The following stem-and-leaf plot depicts scores of students (out of 100) on a test.

Stem	Leaves
2	2,5
3	1,6,9
4	1,1,7,8,9,9
5	2,3,5,7
6	1,6,7,7,7
7	1,3,4,8
8	4,5,9
9	0,2

The modal score:

A. Is unique
B. Has two possible values
C. Has three possible values
D. Does not exist

1 mark

33. Two random variables x and y have the following regression equations: 3x+2y-26=0 and 6x+y-31=0. Then the correlation coefficient between x and y is:

A. 0.5
B. 0.25
C. 0
D. None of the above

3 marks

34. If X denotes the outcome of the roll of a fair, six-faced die, then the covariance of X and X^2 will be:

A. 245/12
B. 91/6
C. 35/12
D. None of the above

2 marks

35. If X is a continuous random variable such that its probability density function is f(x) = k*max{0, 2.5-|x-22.5|} for a positive real constant k, then k equals:

A. 0.2
B. 5

C. 6.25
D. None of the above

2 marks

36. A student tosses a fair coin 5 times. If the number of heads (out of 5 tosses) is n, the student then tosses a fair, six-faced die n^2 times and adds up the numbers rolled. The expected value of the sum of the numbers rolled is:

A. 8.75
B. 26.25
C. 96.25
D. None of the above

2 marks

37. If Y follows a continuous uniform distribution over [0,s] for some positive real s such that mean(Y) = variance(Y), then s equals:

A. 1
B. 2
C. 6
D. None of the above

1 mark

38. If A and B are independent events, then which of the following statements are true?
Statement X: A and B^c are independent events.
Statement Y: A^c and B^c are independent events.

A. Both X and Y
B. Only X
C. Only Y
D. Neither X nor Y

1 mark

39. If X follows a Poisson distribution with mean m, and a is a non-negative integer such that Pr(X=a) = Pr(X=a+1), then m equals:

A. a
B. a+0.5
C. a+1
D. None of the above / indeterminate

1 mark

40. Lines m and n are parallel to each other with a few points marked on each of them. Exactly 20 points on line m and 25 points on line n are marked. Then the total number of line segments that can be drawn such that both their end points marked and on different lines is:

A. 45
B. 500
C. 250
D. None of the above

1 mark

Data Interpretation

The following table shows the annual number of laptops sold by different outlets during the observation period (2021 to 2025 – both inclusive). Questions 41 to 44 are based on this information.

Years / Outlet	U	V	W	X	Y	Z
2021	183	123	277	167	178	237
2022	178	272	269	95	379	198
2023	133	161	226	176	239	277
2024	264	107	237	225	282	237
2025	278	272	213	284	293	196

41. The outlet having the highest compounded annual growth rate (CAGR) in sales over the observation period is:

    A. U
    B. V
    C. X
    D. Y

    1 mark

42. The steepest year-on-year growth observed in the annual median sales (across outlets) was:

    A. 29.4% from 2021 to 2022
    B. 19.4% from 2021 to 2022
    C. 17.9% from 2023 to 2024
    D. None of the above

    1 mark

43. The outlet with the highest sales in the observation period had its worst year (in terms of sales) in:

    A. 2021
    B. 2022
    C. 2024
    D. 2025

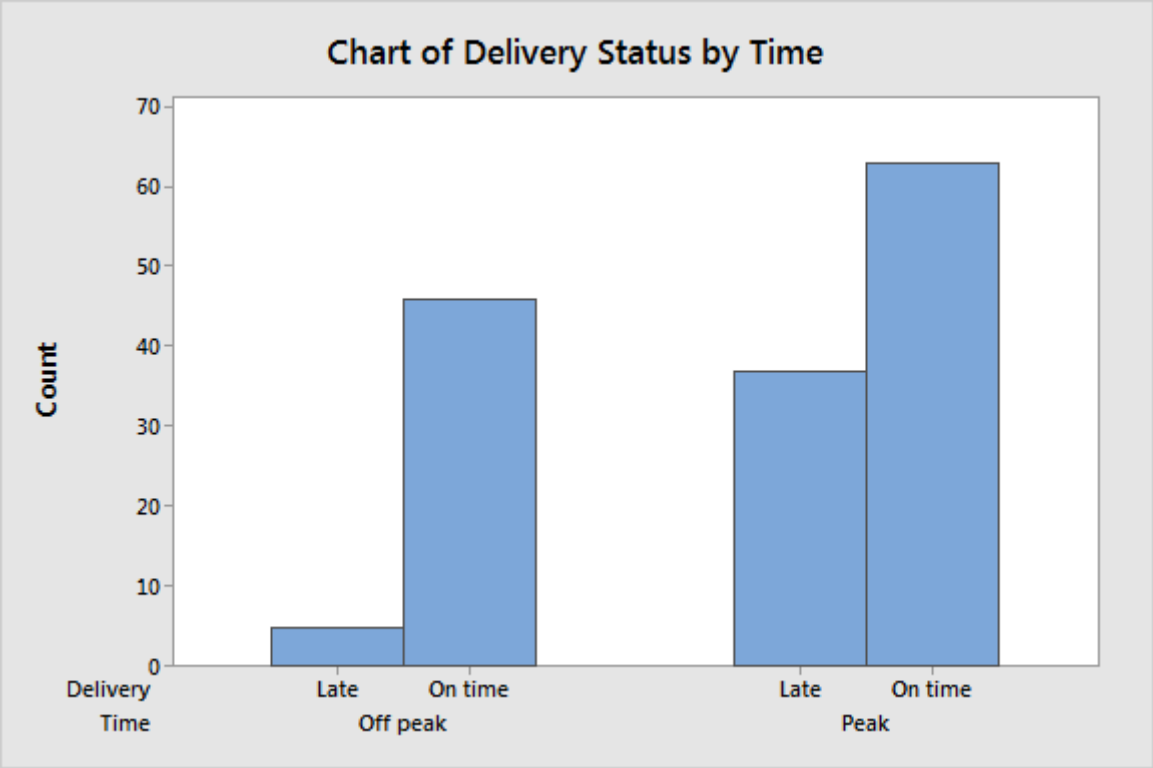
    1 mark

44. The market share of an outlet in a single year is defined as sales by that outlet as a proportion of total sales of all outlets during that year. During the observation period, the lowest market share of an outlet in a single year was:

    A. ~8% (attained by outlet V)
    B. ~7% (attained by outlet V)
    C. ~8% (attained by outlet X)
    D. ~7% (attained by outlet X)

    2 marks

The chart below contains the results of on-time performance of a delivery service provider, separated for peak and off-peak hours. Questions 45 to 47 are based on this information.



45. The ratio of deliveries during peak hours to that during off-peak hours is approximately:
    A. 3:1
    B. 5:2
    C. 2:1
    D. 3:2

1 mark

46. Let success rate be defined as on-time deliveries as a proportion of total deliveries. The ratio of success rate during peak hours to that during off-peak hours is approximately:
    A. 1:2
    B. 2:3
    C. 4:5
    D. 1:3

1 mark

47. The overall proportion of late deliveries (combining both peak and off-peak periods) is approximately:
    A. 10%
    B. 20%
    C. 30%
    D. 50%

2 marks

The city of Dholakpur has four garment manufacturers, Alpha Ltd, Beta Ltd, Gamma Ltd, and Delta Ltd. The following information is available to you about their financial performance in 2024.

- The sales of Alpha are half that of Beta whereas the profits of Alpha are double that of Beta.

- The expenses of Gamma are Rs. 6 crores less than those of Alpha, whereas those of Beta are three times those of Alpha.
- The profit of Delta is Rs. 2 crores less than that of Gamma.
- The sales of Gamma are Rs. 30 crores or ¼ those of Delta.
- The sales of Alpha are Rs. 50 crores.

Note: Profit = Sales – Expenses; Profit Margin = Profit / Sales. Questions 48 to 51 are dependent on the above information.

48. What are the combined sales (in Rs. crores) of the four manufacturers in 2024?
    A. 300
    B. 225
    C. 187.5
    D. 112.5

1 mark

49. In 2024, the expenses of Delta (in Rs. crores) exceeded that of Beta by:
    A. 86
    B. 66
    C. 26
    D. None of the above / Insufficient information to determine

1 mark

50. In 2024, the median of the profit earned by the four manufacturers (in Rs. crores) is:
    A. 10
    B. 8
    C. 6
    D. None of the above / Insufficient information to determine

2 marks

51. In 2024, the ratio of profit margins of the company with the highest profit margin to that of the least profit margin is:
    A. Between 2 and 6 (both inclusive)
    B. Between 7 and 10 (both inclusive)
    C. Between 13 and 16 (both inclusive)
    D. None of the above / Insufficient information to determine

2 marks

52. Something that is ‘ephemeral’ will:
    A. Be relating to a part of the neuron (nerve cell)
    B. Be relating to the largest bone in the human body
    C. Last for a very long time
    D. Last for a very short time

1 mark

53. Which of the following is incorrect?
    A. An ominous sign
    B. An oxymoron
    C. An one-eyed person
    D. An onslaught

1 mark

54. There is a group of people who don’t already know each other. X is trying to make them feel more comfortable or relaxed with each other. X can be said to be trying to ‘break the _____’.
    A. Silence
    B. Ice
    C. Heat
    D. Discomfort

1 mark

55. Biology : Biologist :: Astrology : ?
    A. Astrologer
    B. Astrologist
    C. Astrologician
    D. Astrologic

1 mark

56. “I don’t know weather he will come to school tomorrow.” Identify the erroneous portion in this sentence.
    A. “I don’t know”
    B. “weather he will”
    C. “come to school tomorrow”
    D. None of the above

1 mark

57. “Today it is ___ cold ___ be having ___ scoops of ice-cream.” Fill in the blanks.
    A. too, to, two
    B. to, too, two
    C. two, too, to
    D. two, to, too

1 mark

58. Which of the words is NOT similar in meaning to the others?
    A. Scream
    B. Yell
    C. Bellow
    D. Canter

1 mark

59. "He attended the meeting to _____ the proceedings." Fill in the blanks.
    A. overlook
    B. overwatch
    C. oversee
    D. glance

1 mark

60. Which of these is NOT a valid inference from the passage below?
"A day after the September 11th terrorist attacks, every member of Congress stood on the steps of the U.S. Capitol and sang 'God Bless America'. Could you imagine that happening today? It's easy to say no, given how nasty politics has become. But if America faced an existential crisis like 9/11 again, I think you'd see the same kind of unity return. There's a long history of enemies putting their differences aside when facing a big, devastating threat. People get serious when shit gets real.
If that sounds like wishful thinking to you, let me propose a reason why: Part of the reason today's world is so petty and angry is because life is currently pretty good for a lot of people. There are no domestic wars. Unemployment is low. Household wealth is at an all-time high. Innovation is astounding.
It's far from perfect, and even an optimist could list hundreds of problems and injustices. A pessimist could do worse. But let me put it this way: As the world improves, our threshold for complaining drops. In the absence of big problems, people shift their worries to smaller ones. In the absence of small problems, they focus on petty or even imaginary ones."

    A. Crises tend to compel people to set aside differences and unite.
    B. While the world today is not perfect, it is much better overall than most historical times.
    C. Over time, humans always complain about increasingly petty problems.
    D. While people today complain too much about relatively minor things, we'd stop doing so if a serious calamity were to happen.

3 marks

61. The following sentences are jumbled up. Choose the correct sequence from the options below.
    I. It's quiet compounding, and it's a wonder to see.
    II. Giant sequoias, advanced organisms, towering mountains – it builds the most jaw-dropping features of the universe.
    III. "Nature is not in a hurry, yet everything is accomplished," said Chinese philosopher Lao Tzu.
    IV. And it does so silently, where growth is almost never visible right now but staggering over long periods of time.

    A. III, I, II, IV
    B. III, II, IV, I
    C. I, III, II, IV
    D. I, II, IV, III

2 marks

62. Consider the following set of sentences:
    I. I look forward to meeting you tomorrow.
    II. Please give me a blank paper.
    III. Please tell me how can I improve my English.

    Of these, the sentences that are erroneous are:

A. I and II
B. I and III
C. II and III
D. I, II and III

2 marks

63. In 2025, India's Republic Day (26th January) falls on a Sunday and Independence Day (15th August) falls on a Friday. When will there be the first future year such that both Republic Day and Independence Day will fall on a weekend (Saturday & Sunday)?
    A. On or before 2035
    B. After 2035, but on or before 2045
    C. After 2045, but on or before 2055
    D. After 2055 / Never

2 marks

64. Starting from sun-rise which is at 06:10 am at some place on some day, the number of times when all the three hands of clock point exactly to one of the 12 numbers over a 24 hour period is:
    A. 24
    B. 25
    C. 360
    D. None of the above

1 mark

65. All sides of an n*n*n cube are painted pink for some positive integer n > 2. The cube is then divided into n^3 unit cubes (i.e. of dimension 1*1*1). Then which of the following is independent of n?
    A. Number of unit cubes with exactly two sides pink.
    B. Number of unit cubes with exactly three sides pink.
    C. Number of unit cubes with exactly one side pink.
    D. None of the above

1 mark

66. Folklore considers sun to be one's father's father and moon to be one's mother's brother. Assuming this literally, which of these are a married couple?
    A. Sun's daughter, moon's father
    B. Sun's son, moon's mother
    C. Sun's daughter, moon's brother
    D. Sun's son, moon's sister

1 mark

67. Five persons (Mrs. & Mr. X, Mrs. & Mr. Y and Mr. Z) are supposed to stand in a straight line for a group photograph subject to the following conditions:
    - No two adjacent individuals can be of the same gender.
    - No two adjacent individuals can be a couple.

    Whose position is completely determined by these constraints?

    A. Mr. Z
    B. Mrs. X & Mrs. Y
    C. All five individuals
    D. None of the above

2 marks

68. If all runners are athletes, all athletes are scientists and no athletes are mathematicians, then which of the following conclusions are true?

Conclusion X: No scientist is a mathematician.
Conclusion Y: No mathematician is a runner.

A. Both X and Y
B. Neither X nor Y
C. Only X
D. Only Y

1 mark

69. Arrange the following words in a meaningful sequence:
P = Treatment, Q = Symptom, R = Diagnosis, S = Cure

A. R,P,Q,S
B. R,Q,P,S
C. Q,R,P,S
D. None of the above

1 mark

70. Find the wrong number in the series: 1, 3, 9, 33, 163, 873, 5913, …

A. 33
B. 163
C. 873
D. 5913

1 mark

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