

1. The graph below (Figure 1) shows the number of tuberculosis deaths in the United States from 1989 to 1998. The average rate of change in tuberculosis deaths from 1991 to 1996 is

- (A) 100 (B) 500 (C) -500 (D) -100

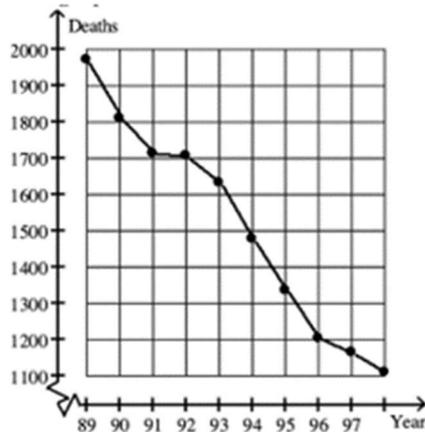


Figure 1

2. Find all values of x where the tangent line to the graph of $f(x) = x^3 - 12x + 2$ is parallel to the line $y = 3$.

- (A) -2, 0, 2 (B) 0, 2
 (C) -4, 0, 4 (D) 2, -2

3. The number of real solutions to the equation $4 \cos x - \sin^2 x + 1 = 0$ in the interval $[0, 2\pi]$ is

- (A) 0 (B) 1 (C) 2 (D) 3 (or infinitely many)

4. If $f(1) = 10$ and $f'(x) \geq 2$ for $1 \leq x \leq 4$, how small can $f(4)$ possibly be?

- (A) 16 (B) 10 (C) 4 (D) 2

5. Figure 2 below provides the graph of a polynomial with degree d , the number of its distinct real roots is denoted by r . Then, which of the following is correct?

- (A) $d \geq 3$ and $r = 3$. (B) $d > 3$ and $r = 3$.
 (C) $d > 3$ and $r > 3$. (D) $d = r = 3$.

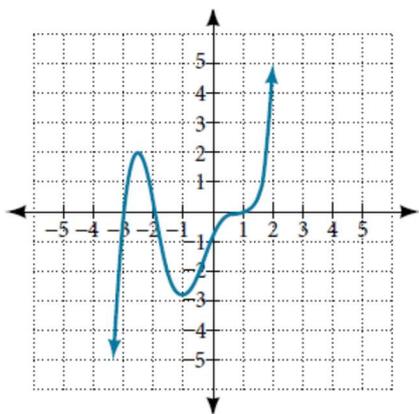


Figure 1

6. Figure 2 represents the graph of a function f (say). Which of the following is correct for this function?

- (A) f is one-to-one and onto on the whole real line
 (B) f is not one-to-one but onto on the whole real line
 (C) f is one-to-one but not onto on the whole real line
 (D) f is neither one-to-one nor onto on the whole real line

7. Consider two functions $f(x) = \frac{x+4}{x^2-12x+32}$ and $g(x) = \frac{4}{(x+3)^2+6}$.

- (A) The numbers of discontinuity points of f and g are both 0.
 (B) The numbers of discontinuity points of f and g are 2 and 0, respectively.
 (C) The numbers of discontinuity points of f and g are 0 and 2, respectively.
 (D) The numbers of discontinuity points of f and g are both infinitely many.

8. Consider the three sets $U = \{1,2,3,4,5\}$, $A = \{1,2,3\}$ and $B = \{2,3,4\}$. Which of the following statements is NOT correct regarding these sets?

- (A) A and B are both subsets of U
- (B) Power set of U has 32 elements
- (C) $A^c \cap B$ has exactly two elements
- (D) A and B are not disjoint

9. Which of the following statements is correct for the following data:

7.2, 1.2, 1.8, 2.8, 18, -1.9, -0.1, -1.5, 13.0, 3.2, -1.1, 7.0, 0.5, 3.9, 2.1, 4.1, 6.5

- (A) The median and the interquartile range for this data are 2.8 and 6, respectively.
- (B) The median and the first quartile for this data are 2.8 and 6, respectively.
- (C) The median and third quartile for this data are 4.1 and 7.2 respectively.
- (D) There is no outlier in this data according to the boxplot.

10. A particular Covid-19 vaccine produces a fever higher than 102 Fahrenheit (can be referred to as a side-effect) in each vaccine with probability of 0.01. A clinic vaccinates 10 people each day. In a given day, what is the probability that exactly 8 people will develop the side-effect?

- (A) 441045×10^{-10}
- (B) 88209×10^{-10}
- (C) 441045×10^{-8}
- (D) 88209×10^{-8}

11. Let $A = \{1, 2\}$ and $B = \{1, 2, \dots, 10\}$. Of all possible maps from A to B , one is chosen at random. What is the probability that the chosen function is strictly increasing?

- (A) 9/50
- (B) 9/20
- (C) 9/10
- (D) 9/100

12. In a certain city for a particular bus route, each bus ticket contains four numbers U, V, W, and X. Each of these numbers is equally likely to be any of the six digits 0, 1, 2, 3, 4, and 5. The four numbers are chosen independently. A bus rider is said to be lucky if $U + V = W + X$ i.e. if the sum of any two numbers is equal to the sum of remaining two numbers on the ticket. The probability that a rider would be lucky is

- (A) $96/625$ (B) $72/625$
(C) $24/625$ (D) $48/625$

13. Suppose we have a dataset $\{x_1, x_2, \dots, x_n\}$. We construct another dataset $\{y_1, y_2, \dots, y_n\}$ by using the transformation $y_i = ax_i + b$, where both a and b are two negative real numbers. Which of the following measures will be the same for both datasets?

- (A) Mean (B) Median
(C) Variance (D) None of the above

14. Fertilizer that supplies both nitrogen and sulphur is

- (A) Ammonium chloride
(B) Ammonium nitrate
(C) Ammonium sulphate
(D) Calcium ammonium nitrate

15. The highest contributor of greenhouse gases is

- (A) CO_2 (B) CH_4 (C) NO_2 (D) CO

16. Percentage of nitrogen in Urea is

- (A) 16 (B) 26 (C) 36 (D) 46

17. Which soil covers maximum area in India?

- (A) Black cotton soil (B) Alluvial soil
(C) Arid and desert soil (D) Lateritic soil

18. In the sequence 1, 6, 15, 28,, the 15th term is

- (A) 145 (B) 430 (C) 435 (D) 445

19. Which sector among the following accounts for the highest contribution to GDP in India?

- (A) Agriculture and allied sectors
- (B) Services sector
- (C) Industry
- (D) None of the above

20. Agriculture census in India is conducted on

- (A) decadal basis.
- (B) quinquennial basis.
- (C) annual basis.
- (D) biannual basis.

Directions for Question 21 to 24:

Amit, Bhuban, Chintu, Dravid each like exactly one of the sports cricket, football, chess and badminton. Each sport is preferred by exactly one of them. They live in four different cities Bengaluru, Chennai, Delhi and Kolkata, not necessarily in the same order.

The following information is known:

1. Neither Dravid nor the person from Chennai likes Cricket.
2. Amit is from Bengaluru.
3. Bhuban likes either Football or Chess.
4. Amit likes either Chess or Badminton.
5. The person who likes Badminton is from Kolkata.

21. The person who lives in Delhi likes

- (A) Cricket
- (B) Chess
- (C) Badminton
- (D) Football

22. Amit likes

- (A) Badminton
- (B) Chess
- (C) Cricket
- (D) Football

23. Who lives in Chennai?

- (A) Bhuban
- (B) Chintu
- (C) Dravid
- (D) None of these

24. Which of the following statements is true?

- (A) Bhuban is from Delhi
- (B) Chintu likes Football
- (C) Dravid is from Kolkata
- (D) None of these

25. You take the three given statements (a), (b) and (c) to be true even if they seem to be at variance with commonly known facts. From these three statements, we derive the conclusions I, II, III and IV.

- Statements: (a) All bananas are mangoes.
(b) Some mangoes are oranges.
(c) All oranges are pineapples.

- Conclusions: I. Some oranges are bananas.
II. Some pineapples are mangoes.
III. Some pineapples are bananas.
IV. Some mangoes are bananas.

Which of the following is true?

- (A) Only I follows. (B) Only II and III follow.
(C) Only II and IV follow. (D) None of these

Questions 26 – 30 pertain to the following passage.

John Burdon Sanderson Haldane, who was born on November 5, 1892, is remembered today mainly for developing a quantitative theory of evolution. He was also a superb popularizer of science, a strong believer in rationality and a Marxist. Exuberantly boyish in many ways, he was also kind and gentle.

When Haldane was born, his father, John Scott Haldane, was well on his way to being recognized as an authority on physiology. The young Haldane's first steps in science were taken as an infant "guinea pig" in his father's experiments. Haldane was a precocious child who could read by age three and write by five. Precocity was combined with a remarkable memory (even in later years, it is said, Haldane had no need to look up a scientific reference when writing his papers), intellectual brilliance and a strongly pugnacious nature. A fight was never far off when Haldane was around -- a quality he retained all his life.

After preparatory school, where he earned a reputation of teaching mathematics to his teacher, Haldane went on to Eton, where he was extremely unhappy. This may be a reason for his strong anti-establishment attitude in later life. Oxford followed and he enjoyed his sojourn there, studying Mathematics, European Classics and Philosophy.

His love of what we would call the Arts was enduring and he embellished his writings with quotations from Greek and Latin, Christian theology and even the Hindu scriptures. A string of academic appointments in some of Britain's most prestigious educational institutions followed, including a fellowship at Oxford (1919-1922) and the Weldon Professorship of Biometry at University College, London (1937-1957).

Haldane and his wife migrated to India in 1957 and stayed there for seven years until his death in December 1964. The Anglo-French invasion of Suez provided a convenient and dramatic stimulus for the Haldanes to leave England, branding it "a criminal state." Also, Haldane had developed a genuine interest in India and the prospects for doing useful scientific work here. His readings in Hindu, Buddhist, Jain and Islamic philosophy bolstered this interest. His friendship with P C Mahalanobis led him to join the Indian Statistical Institute (ISI) in Calcutta and he went on to become an Indian citizen.

26. Which word in the passage is opposite in meaning to *delinquent*?

- | | |
|----------------|----------------|
| (A) remarkable | (B) genuine |
| (C) superb | (D) precocious |

27. Which word in the passage is closest in meaning to *aggressive*?

- | | |
|--------------|----------------|
| (A) criminal | (B) pugnacious |
| (C) dramatic | (D) boyish |

28. According to the passage, which one of the following qualities was NOT possessed by Haldane:

- | | |
|-------------------------|---------------------------|
| (A) Brilliant intellect | (B) Religious intolerance |
| (C) Belligerence | (D) Memory prowess |

29. Based on the information provided by the passage, which of the following is NOT one of the reasons why Haldane migrated to India.

- (A) His disgust with England for participating in the invasion of Suez.
- (B) His interest in Indian philosophy.
- (C) His desire to conduct scientific research in India.
- (D) His scholarly accomplishments.

30. Fill in the blank in the sentence below with the most appropriate word from the passage out of the four words listed below:

His health, however, was unequal to the strain, and after a short _____ in Algiers he settled in London and adopted the profession of literature.

- (A) invasion
- (B) attitude
- (C) sojourn
- (D) reputation