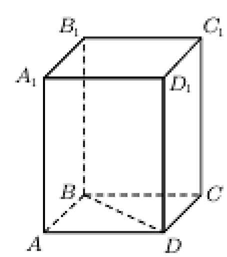
2025 National Unified Examination for Enrollment in Regular Higher Education Institutions (Shanghai Paper) Mathematics

Notes:

1. Before answering the questions, candidates must fill in their name, candidate number, test room number, and seat number on the answer sheet using a black ink pen or signature pen. Use a 2B pencil to fill in the test paper type and candidate number in the corresponding positions on the answer sheet.
2. For multiple-choice questions, after selecting an answer, candidates must use a 2B pencil to darken the corresponding answer option on the answer sheet; if changes are needed, erase it cleanly before filling in another answer. Answers cannot be written on the test paper.
3. Non-multiple-choice questions must be answered using a black ink pen or signature pen, and answers must be written in the designated areas on the answer sheet; if changes are needed, cross out the original answer and then write the new answer. Pencils and correction fluid are not allowed. Answers that do not follow the above requirements will be invalid.

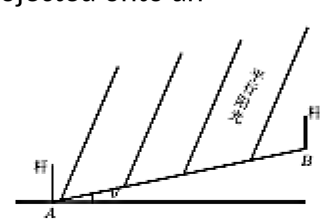
I. Fill in the blanks (This section has a total of 12 questions, questions 1-6 are worth 4 points each, questions 7-12 are worth 5 points each, totaling 54 points. Candidates should write the results directly in the corresponding positions on the answer sheet.)

1. Given the universal set $U = \{x \mid 2 \le x \le 5, x \in R\}$, set $A = \{x \mid 2 < x < 4, x \in R\}$, then $\bar{A}$ =
2. The solution set of the inequality $\frac{x-1}{x-3} < 0$ is ...
3. Given the arithmetic sequence $\{a_n\}$ with the first term $a_1 = -3$ and common difference $d = 2$, the sum of the first 6 terms of the sequence is ...
4. In the expansion of the binomial $(2x - 1)^5$, the coefficient of x^3 is ...
5. The range of the function $y = \cos x$ in $[-\frac{\pi}{2}, \frac{\pi}{4}]$ is ...
6. Given that the distribution of the random variable X is $\begin{pmatrix} 5 & 6 & 7 \\ 0.2 & 0.3 & 0.5 \end{pmatrix}$, then the expected value E[X] =



7. As shown in the figure, in the regular quadrangular prism $ABCD - A_1B_1C_1D_1$, $BD = 4\sqrt{2}$, $DB_1 = 9$, then the volume of the regular quadrangular prism is ...
8. Let $a, b > 0$, $a + \frac{1}{b} = 1$, then the minimum value of $b + \frac{1}{a}$ is ...
9. Four parents and two children go hiking. Six people need to line up, requiring that both the head and tail of the line are parents, then the number of different arrangements is ...
10. Given that the complex number z satisfies $z^2 = (z)^2$, $|z| \le 1$, then the minimum value of $|z - 2 - 3i|$ is ...

11. Student Xiao Shen observed that sometimes in the day, shadows can be completely projected onto an inclined plane. On a certain inclined plane, there are two vertical rods, each 1 meter long, making contact with the inclined plane at points A and B. Under sunlight, which can be considered as parallel light, one rod casts a shadow on the horizontal plane with a length of 0.4 meters; the other rod's shadow is completely on the inclined plane with a length of 0.45 meters. Then the angle at the base of the inclined plane θ = (results should be expressed in radians, accurate to 0.01).



12. Given the function f(x) = $\begin{cases} 1 & x>0 \\ 0 & x=0 \\ -1 & x<0 \end{cases}$ where $\vec{a}$, $\vec{b}$, $\vec{c}$are three different unit vectors in the plane. If f ($\vec{a}$. $\vec{b}$) + f ($\vec{b}$. $\vec{c}$) + f ($\vec{a}$. $\vec{c}$) = 0, then the range of values for $|\vec{a} + \vec{b} + \vec{c}|$ is ...

II. Multiple Choice Questions (This section has 4 questions, with questions 13 and 14 worth 4 points each, and questions 15 and 16 worth 5 points each, totaling 18 points. Each question has only one correct option).

13. Given that events A and B are independent, with the probability of event A occurring as P(A) = ½ , and the probability of event B occurring as P(B) = ½ , then the probability of event A ∩ B occurring, P(A ∩ B), is ...

14. Let a > 0, s ∈ R. Among the following options, the one that can lead to a' > a is ... A. a > 1, and b > 0. B. a > 1, and b < 0. C. 0 < a < 1, and b > 0. D. 0 < a < 1, and b < 0.

15. Given A (0,1), B (1,2), and C on T: $x^2 - y^2 = 1$ ($x \geq 1$, $y \geq 0$), then the area of triangle ABC is:
A. Has a maximum value but no minimum value.
B. Has no maximum value but has a minimum value.
C. Has both maximum and minimum values.
D. Has neither maximum nor minimum values.

16. Let λ = [0, 1], the sequence $a_n = 10n - 9$, the sequence $b_n = 2^n$. Let $c = \lambda a_n + (1 - \lambda)b_n$. If for any ε ∈ [0,1], the line segments of lengths a, b, and c can form a triangle, then the values of n that satisfy the condition are:
A. 1
B. 3
C. 4
D. Infinite.

III. Answer Questions: (This section has 5 questions, with questions 17 to 19 worth 14 points each, and questions 20 and 21 worth 18 points each, totaling 78 points).

17. (1) For the 2024 Tokyo Olympics, China won the gold medal in the men's 4×100 meter medley relay. The following are the championship time records for the men's 4×100 meter medley relay in previous Olympic Games (unit: seconds), arranged in ascending order: 206.78, 207.46, 207.95, 209.34, 209.35, 210.68, 213.73, 214.84, 216.93, 216.93.
(1) Find the range and median of this data set.
(2) Randomly select 3 from these 10 data points, and find the probability that exactly 2 of the data points are above 211 seconds.
(3) If the regression equation for the competition results g concerning the year is y = -0.311z + 6, and the average year is 2006, predict the championship team's score for 2028 (accurate to 0.01 seconds).

SOLUTIONS:

1. $\bar{A} = \{x \in U \mid x \notin A\}$