1. Two ordinary dice are rolled. What is the probability that the resulting sum is an even number?

   (A) $17/36$ **(B)** $1/2$ **(C)** $5/9$ **(D)** $7/12$ **(E)** NOTA

2. Let $\mathcal{U} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. Suppose an element of $\mathcal{U}$ is randomly selected. What is the probability that it belongs to $\{3, 4\} \cup \{4, 5, 6, 7\} \cup \{6, 7, 8\}$.

   (A) 0.4 **(B)** 0.5 **(C)** 0.6 **(D)** 0.7 **(E)** NOTA

3. A card is randomly selected from an ordinary deck of 52 playing cards. What is the probability that it is a red face (Jack, Queen or King) card?

   (A) $3/52$ **(B)** $3/26$ **(C)** $3/13$ **(D)** $1/2$ **(E)** NOTA

4. Suppose A, B, and C are events such that $P(A) = 1/3, P(B) = 7/12, P(C) = 1/3, P(A \cup B) = 3/4, P(B \cup C) = 2/3$, and $P(A \cup C) = 7/12$. Which one of the following pairs of events are disjoint (ie, mutually exclusive)?

   (A) A, B **(B)** A, C **(C)** B, C **(D)** $A \cup B, C$ **(E)** NOTA

5. Suppose A, B, and C are events such that $P(A) = 1/3, P(B) = 1/2, P(C) = 1/4, P(A \cap B) = 1/6, P(B \cap C) = 1/6$, and $P(A \cap C) = 1/10$. Which one of the following pairs of events are independent?

   (A) A, B **(B)** A, C **(C)** B, C **(D)** $A \cap B, C$ **(E)** NOTA

6. Three non-zero digits a, b, and c are selected, one at a time, with repetition allowed. What is the probability that $a > b > c$?

   (A) $28/243$ **(B)** $10/81$ **(C)** $11/81$ **(D)** $4/27$ **(E)** NOTA

7. An urn has red, white, and blue marbles, including at least one of each. Suppose three marbles are randomly selected without replacement. Let A, B, and C denote the following events:
   A: none of the three marbles is white.
   B: none of the three marbles is red.
   C: none of the three marbles is blue.
   Suppose that $P(A) = 0$ and $P(B) = P(C) > 0$. What is the fewest marbles that could be in the urn?

   (A) 3 **(B)** 4 **(C)** 5 **(D)** 6 **(E)** NOTA

8. Steve has 2 quarters, 3 nickels, and 3 pennies. If Steve selects 3 coins at random, what is the probability that the total value is exactly 35 cents?

   (A) $3/28$ **(B)** $1/7$ **(C)** $1/8$ **(D)** $5/28$ **(E)** NOTA

9. An urn has red, white, and blue marbles. Suppose four marbles are randomly selected without replacement. Let A, B, and C denote the following events:
   A: none of the four marbles is white.
   B: none of the four marbles is red.
   C: none of the four marbles is blue.
   Suppose that $P(A) > P(B) > P(C) > 0$. What is the fewest marbles that could be in the urn?

   (A) 7   **(B)** 8   **(C)** 9   **(D)** 10   **(E)** NOTA

10. A box of coins contains four coins altogether, two coins with heads on both sides, one standard coin with heads on one side and tails on the other, and one coin with tails on both sides. A coin is randomly selected and flipped twice. What is the probability that the second flip results in heads given that the first flip results in heads?

    (A) 0.7   **(B)** 0.75   **(C)** 0.8   **(D)** 0.9   **(E)** NOTA

11. Two numbers m and b are randomly selected from the unit interval $[0, 1]$. What is the probability that the line $y = mx + b$ intersects the set S defined by
    $$S = \{(x, y) : 1 \leq x \leq 2 \text{ and } 1 \leq y \leq 2\}?$$

    (A) 0.25   **(B)** 0.5   **(C)** 0.7   **(D)** 0.75   **(E)** NOTA

12. Six integers $a, b, c, d, e,$ and f are randomly selected. What is the probability that some pair of them differ by a multiple of 5?

    (A) $1/2$ **(B)** $2/3$ **(C)** $3/5$ **(D)** 1   **(E)** NOTA

13. How many of the four-digit positive integers can be written using exactly three distinct digits? For example, three such integers are 2382, 4471, and 2500.

    (A) 2880   **(B)** 3888   **(C)** 4000   **(D)** 4320   **(E)** NOTA

14. A digit is randomly selected from the set of digits comprising the decimal representation of $1/81$. What is the probability that the digit is 9?

    (A) $1/10$ **(B)** $1/9$ **(C)** $1/5$ **(D)** $2/9$ **(E)** NOTA

15. Three integers $a, b,$ and c are randomly selected. What is the probability that some pair of them differ by a multiple of 5?

    (A) $12/25$ **(B)** $1/2$ **(C)** $13/25$ **(D)** 1 **(E)** NOTA

16. A bag of 20 marbles has five red, five green, five blue, and five yellow marbles. Four marbles are randomly selected (without replacement). What is the probability that two or more marbles are the same color?

    (A) $800/969$ **(B)** $4219/4845$ **(C)** $864/969$ **(D)** $844/969$ **(E)** NOTA

17. How many scoring sequences are possible if the Fortyniners won their soccer game by a score of 5 to 4 and they were never behind in the game?

    (A) 36 **(B)** 38 **(C)** 40 **(D)** 42 **(E)** NOTA

18. In the game *Candy*, a random cost in the range 1 cent to 1 dollar inclusive is selected. The contestant wins if he has in his pocket coins that will pay exactly the selected cost (with no change required). Steve has 2 pennies, 3 dimes and a quarter. For example, if the selected cost was 32 cents, Steve would win because he could buy the Candy bar, but if the cost was 34 cents, he would lose. What is the probability that Steve wins the game?

    (A) 0.23 **(B)** 0.28 **(C)** 0.29 **(D)** 0.30 **(E)** NOTA

19. In a carnival game, a contestant tosses a 1-inch diameter circular disk onto a large grid of two inch by two inch squares. The contestant wins if the disk falls entirely inside one of the squares. Given that the disk lands in the grid (that is, the center of the disk lies in one of the squares), what is the probability that the contestant wins?

    (A) $1/4$ **(B)** $1/3$ **(C)** $1/2$ **(D)** $1/\pi$ **(E)** NOTA

20. A point P is randomly selected from the square with vertices $(1, 1), (-1, 1),$ $(1, -1), (-1, -1)$. What is the probability that P is closer to $(0, 0)$ than it is to $(1, 1)$?

    (A) $1/8$ **(B)** $3/8$ **(C)** $5/8$ **(D)** $7/8$ **(E)** NOTA
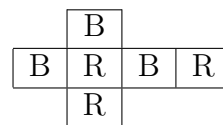
21. Each face of three cubes is colored either B(lue) or R(ed). One of the three cubes, whose planar representations (i.e., *nets*) are given below is randomly selected and rolled. What is the probability that the color 'red' is rolled?

	B		
B	B	R	R
	B		

CUBE 1

	R		
R	R	B	B
	B		

CUBE 2

	B		
B	R	B	R
	R		
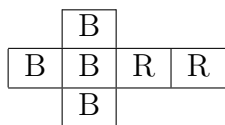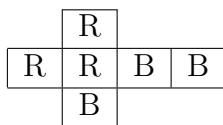
CUBE 3

(A) 4/9   **(B)** 1/2   **(C)** 5/9   **(D)** 2/3   **(E)** NOTA

22. A point P is randomly selected from the rectangle with vertices $A = (0, 0), B = (2, 0), C = (2, 1)$, and $D = (0, 1)$. What is the probability that the angle APB is obtuse?

    (A) $\dfrac{\pi}{4}$ **(B)** $\dfrac{4 - \pi}{2}$ **(C)** $1 - \dfrac{\pi}{4}$ **(D)** $\dfrac{\pi}{2} - 1$ **(E)** NOTA

23. A deck of n cards consists only of red and green cards. When two cards are selected simultaneously and without replacement, the probability that they are both green is twice the probability that they are both red. What is the smallest possible value of n?

    (A) 6   **(B)** 7   **(C)** 8   **(D)** 9   **(E)** NOTA

24. The faces of a cube are colored red and blue, one at a time, with equal probability. What is the probability that the resulting cube has a vertex P such that all three faces containing P are colored red?

    (A) 1/4   **(B)** 5/16   **(C)** 27/64   **(D)** 1/2   **(E)** NOTA

25. How many distinguishable cubes can be built using a supply of blue and red faces?

    (A) 6   **(B)** 7   **(C)** 10   **(D)** 12   **(E)** NOTA

26. Three sets of Mu Alpha Theta students, M, A, and T satisfy the following properties: $|MAT| = |MA\overline{T}| = |M\overline{A}T| = |\overline{M}AT| = |M\overline{A}\,\overline{T}|$ and $|M| = 20$, $|A| = 17$, and $|T| = 19$. What is $|M \cup A \cup T|$? Recall that UV refers to $U \cap V$.

    (A) 23   **(B)** 25   **(C)** 27   **(D)** 31   **(E)** NOTA

27. A square whose edges are a subset of the gridlines in the figure shown is randomly selected. The smallest squares in the grid are unit squares. What is the probability that the selected square has area at least 4?

    (A) 1/4   **(B)** 1/3   **(C)** 1/2   **(D)** 5/17   **(E)** NOTA
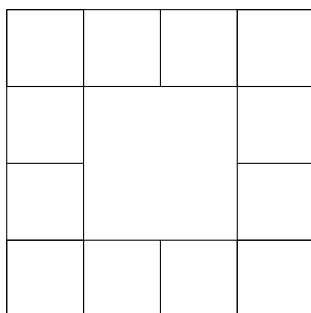
28. Three points are randomly selected on the circumference of a circle. What is the probability that the triangle having these points as vertices contains the center of the circle?

    (A) 1/4   **(B)** 1/3   **(C)** 1/2   **(D)** 2/3   **(E)** NOTA

29. A coin is biased so that the probability of landing heads exactly twice when flipped three times is 2/9. Assuming that the probability that the coin lands heads is rational, what is the probability that all three flips land heads?

    (A) 1/27   **(B)** 1/9   **(C)** 1/3   **(D)** 1/2   **(E)** NOTA

30. An urn consists entirely of blue and red marbles. When two marbles are randomly selected (without replacement), the probability that they are different colors is 10/21. Given that the number of blue marbles is an integer multiple of the number of red marbles, which of the following could be the number of marbles in the urn?

    (A) 7   **(B)** 14   **(C)** 15   **(D)** 16   **(E)** NOTA

Tiebreakers

1 Row zero of Pascals triangle consists of a single entry, row one has two entries, etc. How many of the entries in rows 0 through 1023 of Pascal's triangle are odd numbers?

2 For how many of the first 100 is positive integers n does the decimal representation of $n!$ ends with an even number of zeros?