

1. The year 2002 is a numerical palindrome because it reads the same forwards and backwards. How many four digit numbers are palindromic?
 (A) 90 (B) 900 (C) 1000 (D) 1111 (E) 9000

2. Simplify: $(\sqrt{\sqrt{27} - \sqrt{11}})(\sqrt{\sqrt{27} + \sqrt{11}})$
 (A) 2 (B) $4\sqrt{38}$ (C) 16 (D) 6 (E) 4

3. If $a^2 = 74,701,449$ and $(a + 1)^2 = 74,718,736$, then $a =$
 (A) 8,633 (B) 8,643 (C) 8,742 (D) 8,743 (E) 8,843

4. A shoe store has a sale offering 25% off the retail price. As an employee, Tracy gets a 40% discount off the sale price. If Tracy pays \$9.99 for a pair of shoes, how much money does she save off the retail price?
 (A) \$12.21 (B) \$6.50 (C) \$2.22 (D) \$22.20 (E) \$18.58

5. In which of these is y a function of x ?
 I. $y = 2^\pi + e$ II. $y^4 = x$ III. $y = x^2$ IV. $y = \begin{cases} 1 & \text{if } x \text{ is rational} \\ 0 & \text{if } x \text{ is irrational} \end{cases}$
 (A) III only (B) I, III, and IV (C) II, III, and IV (D) II, III (E) all of the above

6. If $f(x) = 3^{-x}$ and $g(x) = 3x - 1$, then $(f \circ g)(1)$ equals
 (A) -6 (B) -9 (C) $\frac{1}{6}$ (D) $\frac{1}{9}$ (E) $\frac{1}{81}$

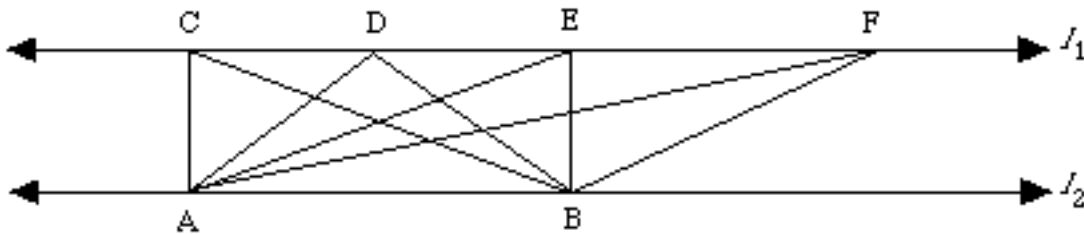
7. What is the coefficient of x^4 in the expansion of $(x^3 + 2x^2 + 3x + 1)(2x^4 - 3x^3 + 2x^2 + x - 2)$?
 (A) 2 (B) -2 (C) -3 (D) 3 (E) -1

8. A drawer contains 6 red, 4 white, and 2 blue socks. If it is dark and you cannot tell the color of the socks removed from the drawer, what is the *minimum* number of socks you must remove to be *certain* of having a red pair?
 (A) 3 (B) 2 (C) 8 (D) 10 (E) 12

9. Let $x = -3\sqrt{3}$ and let $y = 1$. The expression $-\sqrt[3]{\frac{y}{x}}$ is equivalent to
 (A) $\frac{1}{\sqrt{3}}$ (B) $-\frac{1}{\sqrt{3}}$ (C) $\sqrt[3]{3}$ (D) $-\sqrt[3]{3}$ (E) undefined

10. How many numbers are there between 60 and 360 that are divisible by 17?
 (A) 14 (B) 15 (C) 16 (D) 17 (E) 18

11. When the electricity is interrupted, an alarm clock restarts at 12:00 am. Suppose the electricity goes out for an hour in the night. When you get up, the clock reads 4:30 am, but the radio DJ announces the time as 8:45 am. At what time did the electricity go out ?
- (A) 4:15 am (B) 3:45 am (C) 3:30 am (D) 3:15 am (E) 3:00 am
12. For one root of $ax^2 + bx + c = 0$ to be triple the other, the coefficients a, b, c must be related as follows:
- (A) $3b^2 = 16c$ (B) $b^2 = 16c$ (C) $6b^2 = 8c$ (D) $b^2 = 12ac$ (E) $3b^2 = 16ac$
13. Lines l_1 and l_2 are parallel. Which triangle listed below has greatest area?
- (A) $\triangle ABC$ (B) $\triangle ABD$ (C) $\triangle ABE$ (D) $\triangle ABF$ (E) These areas are equal.



14. Suppose the operation $*$ is defined as $a * b = \frac{a + b}{a}$. For integers k and j , simplify the following:
 $[(k + j) * (k \cdot j)] * (-1)$. (The dot, \cdot , is for multiplication.)
- (A) $\frac{k \cdot j}{k + j + k \cdot j}$ (B) $\frac{1}{k + j}$ (C) $\frac{k \cdot j + k}{k \cdot j}$ (D) k (E) $\frac{j(k + 1)}{k + j + k \cdot j}$
15. A lake contains 5,000,000 gallons of water. Suppose the water is to be drained by a pump at a constant daily rate. If $\frac{9}{10}$ of the volume of the lake remains after the first day's pumping, how many gallons are left in the lake after the sixth day?
- (A) 0.5 (B) 5 (C) 50 (D) 2,000,000 (E) 3,000,000
16. If $f(x) = f(x + 1) - x$ and $f(0) = 5$, find $f(3)$.
- (A) 6 (B) 8 (C) 4 (D) 3 (E) 2
17. Find the area of the region determined by the system of inequalities:
- $$\begin{cases} x \geq 0 \\ x - y \leq 0 \\ x + y \leq 4 \end{cases}$$
- (A) 2 (B) 3 (C) 4 (D) 6 (E) 8
18. Two regular 6-sided dice are rolled simultaneously. What is the maximum number of times they could be rolled without the same pair of numbers appearing twice?
- (A) 6 (B) 11 (C) 21 (D) 30 (E) 36

19. In a Toyota Celica, your speed in miles per hour is calculated by the number of revolutions made by the tires assuming you keep the standard size P195 60R15 tires on your car. These tires when mounted have a total diameter of 24 inches. Suppose you hook up your Celica with new wheels and Z-rated P205 55R17 tires which now give you a diameter of 28 inches. With these new tires, how fast are you really going when your speedometer reads 60 miles per hour?

- (A) 60 mph (B) 70 mph (C) 68 mph (D) 62 mph (E) 72 mph

20. The volume of a cube is increased by 24 cubic inches if all edges are increased by 2 inches. The length of an edge of the original cube in inches is:

- (A) $\sqrt[3]{24}$ (B) $\frac{-3 + \sqrt{33}}{3}$ (C) $\frac{6 - \sqrt{132}}{6}$ (D) $\frac{5}{4}$ (E) $\frac{4}{5}$

21. A chessboard consists of 64 small squares arranged in an 8 by 8 square pattern, with the small squares alternately colored white and black. How many squares are there (of any size) with an equal area of black and white?

- (A) 102 (B) 120 (C) 84 (D) 1 (E) 204

22. Let $U = \{n : n \text{ is an integer}\}$ be a universal set containing the following three sets:

$$A = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$$

$$B = \{n : n \text{ is an even integer}\}$$

$$C = \{n : n \text{ is a multiple of 3}\}$$

Which of the following is the complement of the set $(D \cap A)$, where D is the complement of $(B \cup C)$?

(A) $\{1, 5, 7, 11\}$

(B) $\{2, 3, 4, 6, 8, 9, 10, 12\}$

(C) $\{n : n \text{ is an integer}\}$

(D) $\{n : n \text{ is an odd integer}\}$

(E) $\{n : n \text{ is an integer and } n \neq 1, 5, 7, 11\}$

23. The distance around a cylinder is 22 inches regardless of whether the distance is measured around the cylinder laterally (parallel to the bases) or measured by going across a base's diameter, down a lateral length, across the other base's diameter, and up another lateral length. Using the approximation that π is roughly $22/7$, what is the volume of this cylinder?

- (A) 154 cubic inches (B) 109 cubic inches (C) 44 cubic inches
(D) 308 cubic inches (E) 190 cubic inches

24. A cable stretches from the top of a vertical pole to a point on the ground 15 feet away from the base of the pole. If the length of the cable is one foot more than the height of the pole, then how tall is the pole?

- (A) 20 feet (B) 65 feet (C) 112 feet (D) 210 feet (E) 441 feet

25. Compute $(3 + i)^8 \div (1 + 2i)^8$, where $i = \sqrt{-1}$.

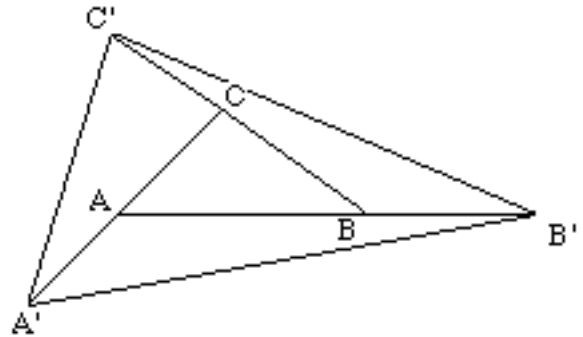
- (A) $82 + 17i$ (B) 16 (C) $-2i$ (D) $1 - i$ (E) 5

26. The city of Savannah decides to dye the water in the Forsyth Park fountain green for next month's St. Patrick's Day. The 2,000 gallons of water in the fountain already contain 1% green dye left over from last year. The city planning committee determines that perfect St. Patrick's Day Green will occur if the concentration of dye is 45%. Which of the following is **closest** to the number of gallons of water which will have to be removed and replaced with pure dye in order to reach perfect St. Patrick's Day Green?

(A) 880 (B) 8800 (C) 900 (D) 90 (E) 1000

27. In the accompanying figure $\overline{AA'} \cong \overline{AC}$, $\overline{BB'} \cong \overline{AB}$, $\overline{CC'} \cong \overline{CB}$.
Then area of $\triangle A'B'C' =$

(A) $4 \cdot \text{area } \triangle ABC$ (B) $6 \cdot \text{area } \triangle ABC$
(C) $7 \cdot \text{area } \triangle ABC$ (D) $8 \cdot \text{area } \triangle ABC$
(E) $10 \cdot \text{area } \triangle ABC$



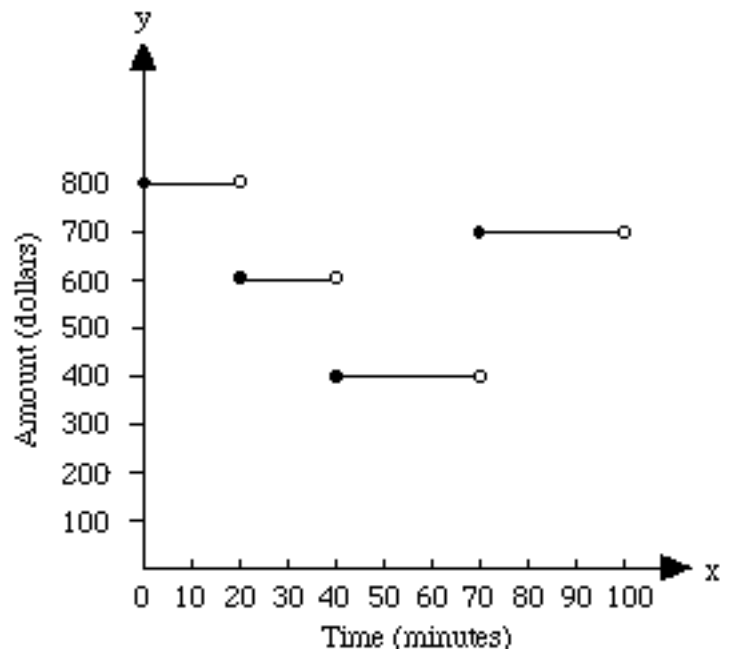
28. Find the shortest distance from a point on the graph of $y = \sqrt{x}$ to the point $(1,0)$.

(A) 1 (B) $\frac{1}{2}$ (C) $\frac{\sqrt{2}}{2}$ (D) $\frac{\sqrt{3}}{2}$ (E) $\sqrt{2}$

29. At a Gymboree class, Judah watches a spherical soap bubble of radius r land on a flat mat and form a hemisphere. Assuming that the volume remains the same, what is the radius of the hemisphere?

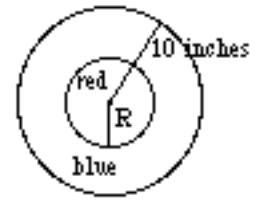
(A) $2r$ (B) $r\sqrt{2}$ (C) $\frac{2\sqrt{3}}{3}r$ (D) $r\sqrt[3]{2}$ (E) r

30. The graph of the function at right depicts the amount of money y in dollars in an automatic teller machine (ATM) after x minutes. If $x = 0$ corresponds to 3:00 pm, which of the following is (are) correct.
- I. A withdrawal of \$600 was made at 3:20 pm.
 - II. A deposit of \$400 was made at 4:00 pm.
 - III. A deposit of \$300 was made at 4:10 pm.
 - IV. The largest single transaction is valued at \$400.
 - V. From 3:00 pm until 4:40 pm the overall monetary difference in the machine was \$100



A. I and II
B. IV only
C. III and V
D. IV and V
E. II, III, and IV

31. If the probability that a randomly thrown dart lands on red is one-fourth of the probability that the dart lands on blue, find the length of the radius, R , in inches.



- (A) $\sqrt{20}$ (B) $\frac{\sqrt{300}}{3}$ (C) $\frac{\sqrt{50}}{2}$ (D) $\pi\sqrt{20}$ (E) 20π
32. Given that $(2 - i)$ is a root of $f(x) = x^3 - 6x^2 + 13x - 10$, what are the other roots?
 (A) $2 + i, -2$ (B) $2 + i, 0$ (C) $2 + i, 2$ (D) $2 + i, -1$ (E) $i, -i, 2$
33. How many *strictly increasing* sequences of six numbers from $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ are there? *Strictly increasing* means that if $n > m$, then $a_n > a_m$.
 (A) 4 (B) 151,200 (C) 5,040 (D) 210 (E) 24
34. All four children in the Jones family have the same birthday. The twins were born two years after their older sister and six years before their younger brother. The standard deviation of their four ages (in years) is:
 (A) 3 (B) 4 (C) 6 (D) 9 (E) 10
35. If $8 = \log_3 r^1 + \log_3 r^{\frac{1}{2}} + \log_3 r^{\frac{1}{4}} + \dots + \log_3 r^{\frac{1}{2^n}} + \dots$ then $r =$
 (A) 3^8 (B) 8 (C) 9 (D) 64 (E) 81
36. A ship sails from Seaport 1 to Seaport 2 along the equator. Upon reaching Seaport 2, the navigator determines that the angle the sun makes with the horizontal is 60° at the same time when the sun is directly overhead at Seaport 1. Approximating the earth as a sphere with radius 4002 miles and assuming that all rays from the sun to the earth are parallel, find the distance the ship sailed.
 (A) 2001 miles (B) $2001\sqrt{2}$ miles (C) $2001\sqrt{3}$ miles
 (D) 1334π miles (E) 667π miles
37. How many distinct arrangements are there using all six letters in “LESSER”?
 (A) $6!$ (B) $\frac{6!}{4}$ (C) $\frac{6!}{2}$ (D) $4!$ (E) none of these
38. ABC is a triangle with $m\angle B = 90^\circ$ and $m\angle A = 30^\circ$. Points P , Q , and R are on \overline{AB} , \overline{BC} and \overline{CA} , respectively, and $\triangle PQR$ is an equilateral triangle. If the length of \overline{BC} is 4, and Q is the midpoint of \overline{BC} , determine the length of \overline{PR} .
 (A) $2\sqrt{2}$ (B) $\frac{5}{2}$ (C) 4 (D) $\sqrt{7}$ (E) $\frac{\sqrt{3}}{2}$
39. The function $y = 2\csc\left(\pi x - \frac{\pi}{2}\right) + 1$ has which of the following as a vertical asymptote?
 (A) $x = \frac{\pi}{2}$ (B) $x = \pi$ (C) $x = \frac{7}{2}$ (D) $y = \frac{1}{2}$ (E) $x = 0$
40. A grocery shopper has a bill of x dollars and y cents, x and y each two-digit numbers. If he gives the clerk y dollars and x cents and receives \$15.84 in change, then
 (A) x cannot exceed 80.
 (B) the sum of the digits of the bill cannot be divisible by 7.
 (C) the amount given to the clerk can equal twice the amount of the bill.
 (D) y can equal $2x$.
 (E) the value of the bill cannot be a multiple of 5 cents.