For all questions below, the answer E) NOTA means "None of these answers". Good luck and have fun!

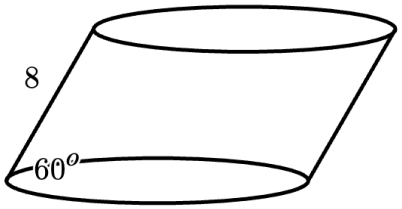
1. Alejandro works at a factory where he earns \$9 per hour. He currently has \$300. What is the least amount of integer hours he must work to be able to afford a \$500 TV?

A: 56 B: 23 C: 22 D: 20 E: NOTA

2. Jackson and Mary both start at point A. Jackson travels 3 miles due East and 2 miles due North to end at point B. Mary travels 1 mile due West and 2 miles due South to end at point C. In miles, what is the distance between B and C?

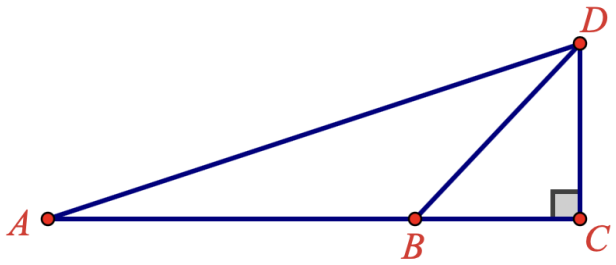
A: $3\sqrt{2}$ B: 5 C: $4\sqrt{2}$ D: $4\sqrt{3}$ E: NOTA

3. Josiah makes a cylinder as shown where the lateral edge of length 8 meets the base at an angle of $60°$. What must be the diameter of the base for the volume of the cylinder to be $48\pi\sqrt{3}$?



A: $2\sqrt{3}$ B: $4\sqrt{3}$ C: 4 D: 8 E: NOTA

4. Scott starts at A and looks up to D at an angle of elevation of $30°$. He walks forward a distance of 20 feet to point B. From B, he looks up again to D at an angle of elevation of $45°$. What is the distance DC?



A: $10(\sqrt{3}+1)$ B: $10(\sqrt{3}-1)$ C: $20(\sqrt{3}-1)$

D: $20(\sqrt{3}+1)$ E: NOTA

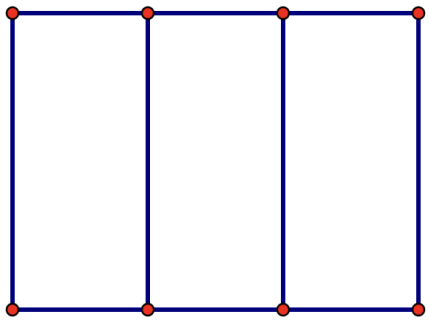
5. Andrea makes a password for her computer by using two digits (0 to 9) followed by two letters (A to Z). How many passwords are possible if she doesn't repeat any character?

A:60,840 B: 58,500 C: 50,625 D: 46,800 E: NOTA

6. Quentin buys a sweater. It is discounted by 20% and then taxed at 5%. The final cost of the sweater is $50.40. What was the original price of the sweater before it was discounted or taxed?

A: $56 B: $58 C: $60 D: $62 E: NOTA

7. Oscar wants to make three pens of equal size for his pigs as shown. He uses a total of 360 feet of fencing to enclose all the pens. What is the maximum area in square feet of *one pen* that Oscar can make?



A: 900 B: 1050 C: 1350 D: 1600 E: NOTA

8. Yvonne is doodling in her notes. She draws ΔABC where $m\angle A, m\angle B, m\angle C$ form an arithmetic progression. If every angle measure is divisible by 5, what is the greatest possible difference between the largest angle measure and the smallest?

A: 120 B: 110 C: 100 D: 10 E: NOTA

9. Ernie's town grows at a rate of 15% each year. Which expression represents the number of years for which the town's population will triple?

A: $\frac{\ln(2)}{\ln(1.15)}$ B: $\frac{\ln(3)}{\ln(0.05)}$ C: $\frac{\ln(1.15)}{\ln(3)}$ D: $\frac{\ln(0.05)}{\ln(3)}$ E: NOTA

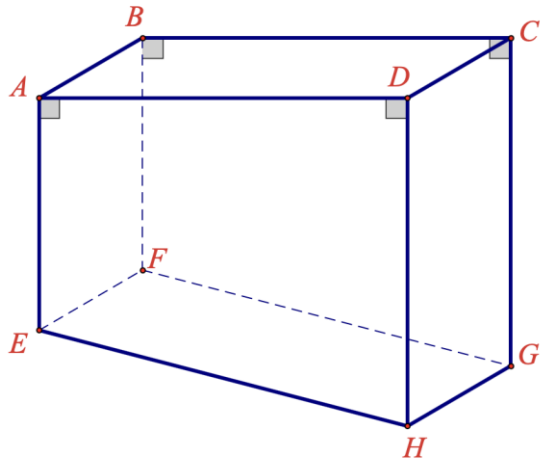
10. Freda and Alex want to travel from their homes and meet at a common location. Freda lives at (1, 2) and drives 5 miles. Alex lives at (4, 6) and drives $2\sqrt{5}$ miles. The location where they meet has integer coordinates. What is the sum of the coordinates of their meeting point?

A: 14 B: 12 C: 10 D: 8 E: NOTA

11. Anthony makes an infinite geometric series whose sum is 24. Juliette squares each term of Anthony's series to make a new series, which sums to 720. What is the common ratio of Anthony's series?

A: $-\frac{2}{3}$ B: $-\frac{1}{9}$ C: $\frac{3}{5}$ D: $\frac{1}{6}$ E: NOTA

12. Zephyr wants to construct a swimming pool in her backyard in the shape of a trapezoidal prism, where ADHE is a base of the prism. Given $AE = 4, DH = 10, AD = 20$, and $AB = 15$. What is the volume of the pool?



A: 1200 B: 1600 C: 2100 D: 4200 E: NOTA

13. Kennedy takes a string and wraps it around a cylinder. The string makes two complete revolutions. The volume and surface area of the cylinder are $16\pi^5$and $8\pi^3 + 16\pi^4$, respectively.

A: $4\pi^2\sqrt{2}$ B: $8\pi^2\sqrt{2}$ C: $8\pi^2$ D: $4\pi^2\sqrt{5}$ E: NOTA

14. Vincent writes the linear equation $y = ax + b$ where a and b are both selected from $\{-4, -3, -2, -1, 0, 1, 2, 3, 4\}$ without replacement. What is the probability that the graph of the equation passes through Quadrant II?

A: $\frac{7}{9}$ B: $\frac{13}{18}$ C: $\frac{3}{4}$ D: $\frac{2}{3}$ E: NOTA

15. Taylor and Harry both wrote functions. Taylor wrote $t(x) = x\sqrt{4 - x^2}$ and Harry wrote $h(x) = 4 - x^2$. How many solutions are there to $t(x) = h(x)$?

A: 0 B: 1 C: 2 D: 3 E: NOTA

16. Ohm's Law states $V = IR$ where V is the voltage, I is the current, and R is the resistance in a circuit. If the resistance is $(2 - 3i)$ and the voltage is $(21 + i)$, what is the current?

A: $3 - 5i$ B: $5 + 3i$ C: $5 - 3i$ D: $3 + 5i$ E: NOTA

17. Alex, Bella, and Chris are hired to paint a long fence. Working alone, Alex can paint the fence in 6 hours, Bella can paint it in 9 hours, and Chris paints it in 12 hours. They all work together for 2 hours then Chris leaves. How much longer, in hours, will it take Alex and Bella to finish the remaining part of the fence?

A: $\frac{1}{2}$ B: 1 C: $\frac{3}{2}$ D: 2 E: NOTA

18. The equation $T = 2\pi\sqrt{\frac{\ell}{g}}$ represents the period T of a pendulum swinging where ℓ is the length of the pendulum and g is the acceleration due to gravity. Which statement is true?

A: If the length is doubled, the period doubles.

B: If the length is quadrupled, the period is halved.

C: If the length is doubled, the period is halved.

D: If the length is quadrupled, the period doubles.

E: NOTA

19. Bethany is thinking of a three-digit number M divisible by 8 and 9. She forms a new three-digit number N by reversing the digits of M and $M - N = 198$. What is the product of the digits of M?

A: 24 B: 36 C: 72 D: 128 E: NOTA

20. José is playing a video game controlling his character in a 2D grid. Each time the player can move up or to the right. The player starts at $A(0, 0)$ and wants to get to $B(4, 6)$. However, there is an obstacle at $C(2, 2)$. How many ways can the character get from A to B without passing through C?

A: 189 B: 144 C: 120 D: 84 E: NOTA

For problems 21 and 22, use the function $y(t) = -16t^2 + 48t + 28$, which denotes the height of an object off the ground (in feet) after $t \geq 0$ seconds.

21. What is the maximum height of the object off the ground, in feet?

A: 56 B: 60 C: 64 D: 72 E: NOTA

22. In how many seconds will the object hit the ground?

A: $\frac{3}{2}$ B: $\frac{5}{2}$ C: $\frac{7}{2}$ D: $\frac{11}{2}$ E: NOTA

23. Franklin wrote the polynomial $p(x) = 2x^4 - 5x^3 + 11x^2 - 3x - 5$. What is the product of the *non-real roots* of $p(x)$?

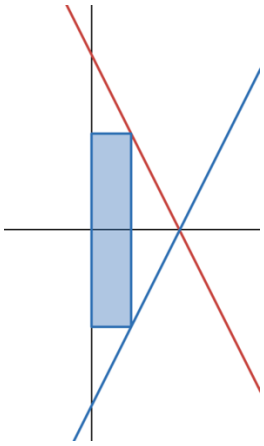
A: -4 B: -5 C: 2 D: 4 E: NOTA

24. The formula $\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}$ represents the total resistance R in a circuit when resistances r_1, r_2, r_3 are wired in parallel. Which of the following expressions represents r_1?

A: $\frac{Rr_2r_3}{r_2r_3 - Rr_3 - Rr_2}$ B: $\frac{Rr_2r_3}{r_2r_3 + Rr_3 + Rr_2}$ C: $\frac{Rr_2r_3}{r_2r_3 - r_3 - r_2}$

D: $\frac{r_2r_3 - r_3 - r_2}{Rr_2r_3}$ E: NOTA

25. Wendy constructs a rectangle as shown. Two vertices are on the y −axis and the other two vertices lie on the lines given by $y = -kx + k$ and $y = kx - k$ for some real $k > 0$. For what value k will the maximum area of the rectangle be 4?



A: 2 B: 4 C: 8 D: 16 E: NOTA

26. Mike is doing a chemistry experiment and uses the equation $P = \frac{kT}{V}$ where P is the pressure, T is the temperature, and V is the volume. If $P = 6$ when $T = 300$ and $V = 4$, find V when $T = 960$ and $P = 12$.

A: 6.4 B: 6.2 C: 4.8 D: 3.2 E: NOTA

27. A business decides to try to incentivize its employees by giving out tokens that can be exchanged for prizes. There are twelve indistinguishable tokens that are distributed among five employees. Let m be the number of ways the tokens can be distributed if there are <u>no restrictions</u> on how many each employee gets. Let n be the number of ways the tokens can be distributed if each employee <u>must get at least one token</u>. Which expression represents $m - n$?

A: $\binom{12}{5} - \binom{7}{5}$ B: $\binom{17}{4} - \binom{12}{4}$ C: $\binom{17}{5} - \binom{12}{5}$

D: $\binom{16}{4} - \binom{11}{4}$ E: NOTA

28. You are on a spaceship and the path of your ship can be representing by the graph of the equation $\frac{(x-8)^2}{100}+\frac{y^2}{36}=1$. The Earth is at the origin and x and y are measured in millions of miles. A navigation system also determines that your location lies on the graph of $\frac{x^2}{4}-\frac{y^2}{\frac{12}{5}}=1$. What is the maximum distance (in millions of miles) that you can be from the Earth?

A: $10\sqrt{2}$ B: 10 C: $5\sqrt{2}$ D: 5 E: NOTA

29. Charlie wants to make a graphical pattern. He starts with the function $f(x)=|x|-2$. He then defines a new function $g_n(x)$ recursively as follows: $g_1(x)=f(x)$ and $g_{n+1}(x)=(f\circ g_n)(x)$ for $n\geq 1$. What is the least value n such that $g_n(x)=-1$ has at least 100 solutions?

A: 100 B: 51 C: 50 D: 49 E: NOTA

30. A company produces four types of electronic devices: smartphones, tablets, laptops, and smartwatches.

- Each smartphone costs \$100 to produce and generates \$200 in revenue.
- Each tablet costs \$150 to produce and generates \$250 in revenue.
- Each laptop costs \$300 to produce and generates \$500 in revenue.
- Each smartwatch costs \$50 to produce and generates \$150 in revenue.

In a given month, the total production cost is \$31,500 and the total revenue is \$61,500. The company produced a total of 280 devices and 100 more smartphones were produced than tablets. How many more smartwatches were produced than laptops?

A: 10 B: 25 C: 30 D: 40 E: NOTA