



1 Which expression is equivalent to $(x + 3)^3 - 9x(x + 3)$?

- A $x^3 + 27$
- B $x^3 - 27$
- C $x^3 - 9x^2 - 27x + 27$
- D $x^3 - 9x^2 + 27x + 27$

$- 9x^2 - 27x$

$$\begin{aligned}
 &1(x)^3(3)^0 = x^3 \\
 &3(x)^2(3)^1 = 9x^2 \\
 &3(x)(3)^2 = 27x \\
 &1(x)^0(3)^3 = 27
 \end{aligned}$$

$x^3 + 27$

2 Suppose $p(x) = x^3 - 2x^2 + 13x + k$. The remainder of the division of $p(x)$ by $(x + 1)$ is -8 . What is the remainder of the division of $p(x)$ by $(x - 1)$?

- A -8
- B 8
- C 16
- D 20

$ \begin{array}{r rrrr} -1 & 1 & -2 & 13 & k \\ + & & -1 & 3 & -16 \\ \hline & 1 & -3 & 16 & \boxed{-8} \end{array} $	$ \begin{array}{r rrrr} +1 & 1 & -2 & 13 & 8 \\ + & & 1 & -1 & 12 \\ \hline & 1 & -1 & 12 & \boxed{20} \end{array} $
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$K + -16 = -8$
 $K = 8$

3 What is the **approximate** solution to the equation $3^{x-1} = 4^{2x+5}$?

- A 3.875
- B 1.262
- C -2.354
- D -4.797

* graph on calc
 * find intersection



4 Samantha invested \$10,000 in each of two different financial plans in 2013. The predicted value of each plan is modeled below.

- Plan M: a rate of 7.5%, compounded continuously.
- Plan N: The value is determined by the function $y = 5x^3 - 50x^2 + 4x + 10,000$, where x is the number of years after 2013.

Handwritten notes:
 $A(t) = A_0(e)^{rt}$
 $A(t) = 10000 \cdot e^{.075t}$

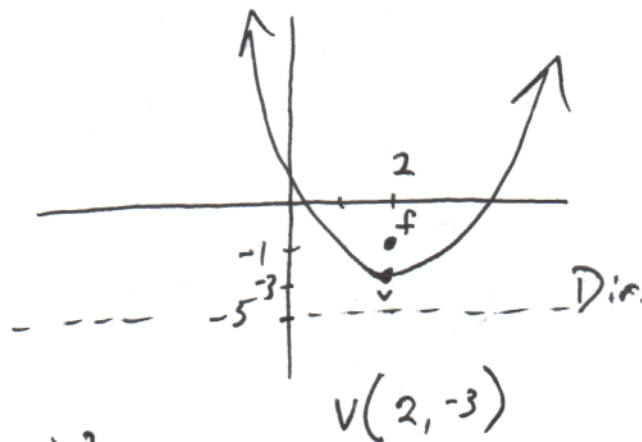
Plan N has a greater predicted value than Plan M during which years?

- A from 2014 to 2041
- B from 2028 to 2055
- C from 2042 to 2073
- D Plan N never has a greater value than Plan M.



5 Which is an equation of a parabola that has a directrix of $y = -5$ and a focus at $(2, -1)$?

- A $y = \frac{1}{2}(x + 2)^2 + 2$
- B $y = \frac{1}{8}(x + 2)^2 + 3$
- C $y = \frac{1}{8}(x - 2)^2 - 3$
- D $y = \frac{1}{2}(x - 2)^2 - 2$



Handwritten work for question 5:

$$y - k = \frac{1}{4p}(x - h)^2$$

$$y - -3 = \frac{1}{4(2)}(x - 2)^2$$

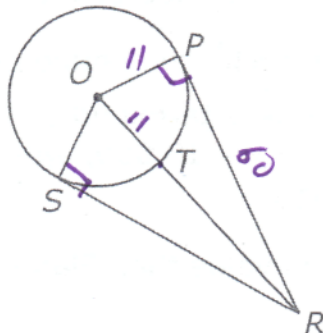
$$y + 3 = \frac{1}{8}(x - 2)^2$$

$$y = \frac{1}{8}(x - 2)^2 - 3$$

Labels: $V(2, -3)$, $p = +2$



6 In the figure below, \overline{PR} and \overline{SR} are tangent to circle O .



$$OR^2 = 11^2 + 60^2$$

$$OR = 61$$

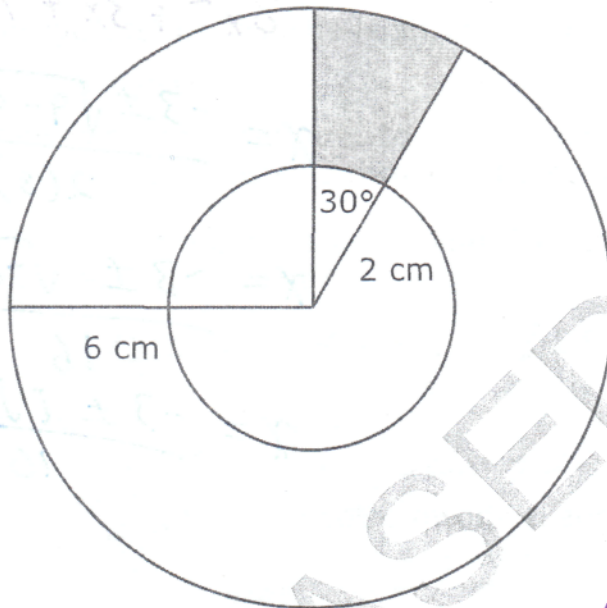
If $OT = 11$ cm and $PR = 60$ cm, what is the length of \overline{OR} ?

- A 61 cm
- B 59 cm
- C 50 cm
- D 48 cm

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- 7 In the figure below, the larger circle has a radius of 6 cm, and the smaller circle has a radius of 2 cm.



What is the **approximate** area of the shaded region?

- A 2.1 cm²
- B 3.4 cm²
- C 4.2 cm²
- D 8.4 cm²

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$$A = \pi r^2$$

$$A_{BIG} = \pi \cdot 6^2$$

$$A_{BIG} = 36\pi$$

$$A_{SMALL} = \pi (2)^2$$

$$A_{SMALL} = 4\pi$$

$$\begin{aligned} \text{Area of outer Ring} &= \text{Big} - \text{Little} \\ &= 36\pi - 4\pi \\ &= 32\pi \\ &\times \frac{1}{12} \end{aligned}$$

$$\underline{\underline{8.378 \text{ cm}^2}}$$

30° = 1/12 of the circle

$$\sqrt{(1-2)^2 + (2-2)^2} = b$$

$$\sqrt{0+0} = b$$



8 Which choice shows the solutions to the equation $8x^2 + 3x = -7$?

A $\frac{-3 \pm i\sqrt{215}}{16}$

B $\frac{3 \pm i\sqrt{215}}{16}$

C $\frac{-3 \pm \sqrt{233}}{16}$

D $\frac{3 \pm \sqrt{233}}{16}$

$$8x^2 + 3x + 7 = 0$$

$$x = \frac{-3 \pm \sqrt{9 - 4(8)(7)}}{2(8)}$$

$$x = \frac{-3 \pm \sqrt{-215}}{16}$$

$$x = \frac{-3 \pm i\sqrt{215}}{16}$$

9 A system of equations is shown below.

$$y = |x - 3|$$

$$y = \frac{1}{2}x$$

What is the distance between the points of intersection of the system?

A $\sqrt{6}$

B $\sqrt{20}$

C $\sqrt{48}$

D $\sqrt{80}$

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$$|x - 3| = \frac{1}{2}x$$

$$x - 3 = \pm \frac{1}{2}x \quad \text{or} \quad x - 3 = -\frac{1}{2}x$$

$$\frac{1}{2}x = 3 \qquad \frac{3}{2}x = 3$$

$$x = 6 \qquad x = 2$$

$$y = \frac{1}{2}(6) \qquad y = \frac{1}{2}(2)$$

$$y = 3 \qquad y = 1$$

$$(6, 3) \qquad (2, 1)$$

$$d = \sqrt{(6-2)^2 + (3-1)^2}$$

$$d = \sqrt{16+4} = \sqrt{20}$$



- 10 Fred drives an average of 15,000 miles per year, and his car gets 20 miles per gallon of gasoline.
- The average cost of gasoline is \$3.25 per gallon.
 - He buys a new car.
 - In his new car, Fred continues to average 15,000 miles per year, and the average cost of gasoline remains the same.

Approximately how many more miles per gallon does the new car get if Fred has a savings of \$650 per year on gasoline?

- A 5.8 mpg
 B 7.3 mpg
 C 8.8 mpg
 D 10.3 mpg

$$\frac{15000}{20} = 750 \text{ gal} \cdot 3.25 = \$2437.50 \text{ (old)}$$

$$\frac{15000}{\text{mpg}} = \boxed{550} \text{ gal} \cdot 3.25 = \$1787.50 \text{ (New)}$$

$$\text{MPG} = 27.27$$

- 11 A student wants to determine the most liked professor at her college. Which type of study would be the **most** practical to obtain this information?
- A a simulation
 B an experiment
 C a survey
 D an observation



- 12 A principal wants to survey 150 students to determine which electives to offer during the next school year. There are 1,800 students in the school. Which procedure could the principal use to select a sample using a systematic random sample?
- A Obtain a list of all students. Start with the eighth student, and select every twelfth student until 150 students have been selected.
- B Select the first 150 students who enter the school.
- C Choose the fifth student to come into the cafeteria, and then select every third student who comes into the cafeteria until 150 students have been selected.
- D Place students' names on slips of paper and select 150 slips.
- 13 What value of h is needed to complete the square for the equation $x^2 + 10x - 8 = (x - h)^2 - 33$?

A -25

B -5

C 5

D 25

$$x^2 + 10x + \underline{25} = 8 + \underline{25}$$

$$(x + 5)^2 = 33$$

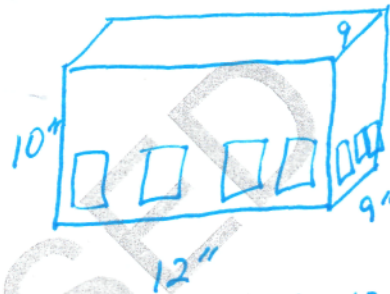
$$(x - -5)^2 = 33$$



- 14 A shipping company is designing boxes to meet specific requirements.
- Each box must be a completely closed rectangular prism with no overlapping material.
 - The boxes must hold 24 cans in two layers of 12 cans each.
 - The cans are 3 inches in diameter and 5 inches in height.

What is the smallest amount of cardboard needed to meet the specifications?

- A 1,080 in.²
- B 840 in.²
- C 636 in.²
- D 540 in.²



$$SA = 120 + 120 + 108 + 108 + 90 + 90 = 636 \text{ in}^2$$

- 15 Which expression is equivalent to $\frac{\cos(\theta)}{1 - \sin(\theta)} - \tan(\theta)$?

- A $\sec(\theta)$
- B $\sin(\theta)$
- C $\cos(\theta)$
- D $\csc(\theta)$

$$\frac{\cos \theta}{1 - \sin \theta} - \frac{\sin \theta}{\cos \theta}$$

$$\frac{\cos \theta \cdot \cos \theta - \sin \theta (1 - \sin \theta)}{\cos \theta (1 - \sin \theta)}$$

$$\frac{\cos^2 \theta - \sin \theta + \sin^2 \theta}{\cos \theta (1 - \sin \theta)} = \frac{1 - \sin \theta}{\cos \theta (1 - \sin \theta)} = \frac{1}{\cos \theta} = \sec \theta$$



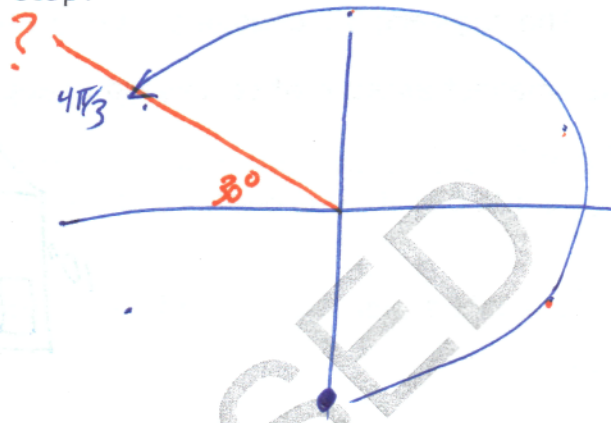
16 William put the tip of his pencil on the outer edge of a graph of the unit circle at the point $(0, -1)$. He moved his pencil tip through an angle of $\frac{4\pi}{3}$ radians in the counterclockwise direction along the edge of the circle. At what angle of the unit circle did William's pencil tip stop?

A $\frac{\pi}{3}$

B $\frac{5\pi}{6}$

C $\frac{7\pi}{6}$

D $\frac{5\pi}{3}$



17 A town has 685 households. The number of people per household is normally distributed with a mean, μ , of 3.67 and a standard deviation, σ , of 0.34.

Approximately how many households have between 2.99 and 4.01 people?

A 493 households

B 520 households

C 558 households

D 575 households



Total = 81.5%

$\times 685$

558.275 households



- 18 The graph of the function $f(x) = x^3$ will be shifted down 2 units and to the right 3 units. Which is the function that corresponds to the resulting graph?

A $g(x) = (x + 3)^3 + 2$

B $g(x) = (x + 3)^3 - 2$

C $g(x) = (x - 3)^3 + 2$

D $g(x) = (x - 3)^3 - 2$

- 19 Which is the inverse of $f(x) = 1.5^x + 4$?

A $f^{-1}(x) = \frac{x - 4}{1.5}$

B $f^{-1}(x) = \frac{\log(x) - 4}{1.5}$

C $f^{-1}(x) = \frac{\log(x - 4)}{\log(1.5)}$

D $f^{-1}(x) = \frac{4 - \log(x)}{\log(1.5)}$

$$x = 1.5^y + 4$$

$$x - 4 = 1.5^y$$

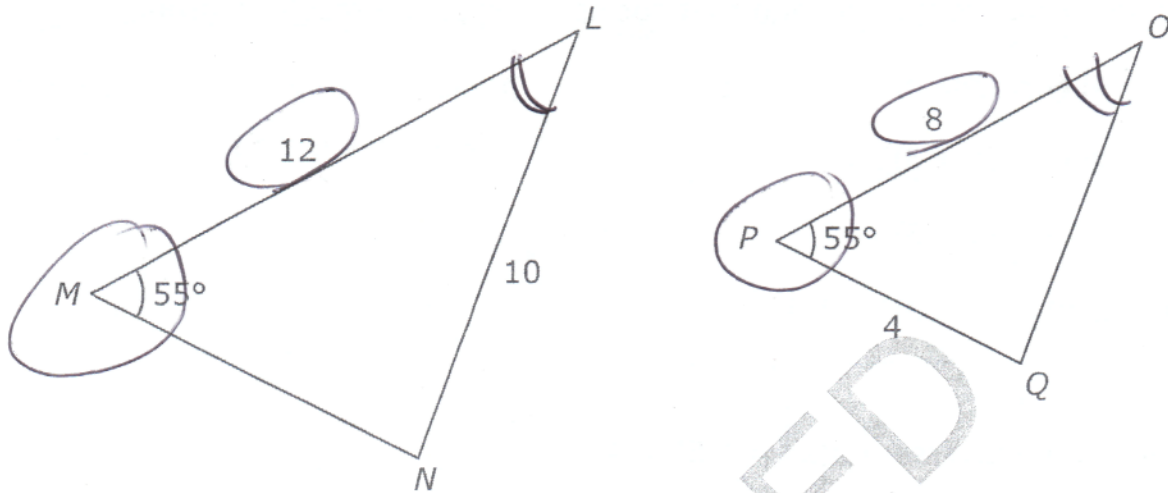
$$\log(x - 4) = y \log(1.5)$$

$$\frac{\log(x - 4)}{\log(1.5)} = \frac{y \log(1.5)}{\log(1.5)}$$

$$y = f^{-1}(x) = \frac{\log(x - 4)}{\log(1.5)}$$



20 Triangles LMN and OPQ are shown below.



What additional information is sufficient to show that $\triangle LMN$ can be transformed and mapped onto $\triangle OPQ$?

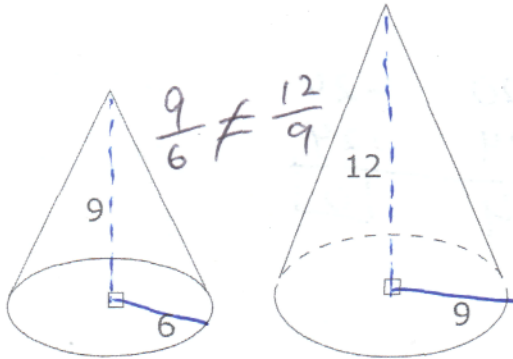
- A $OQ = 6$
- B $MN = 9$
- C $\angle LMN \cong \angle QOP$
- D $\angle NLM \cong \angle QOP$

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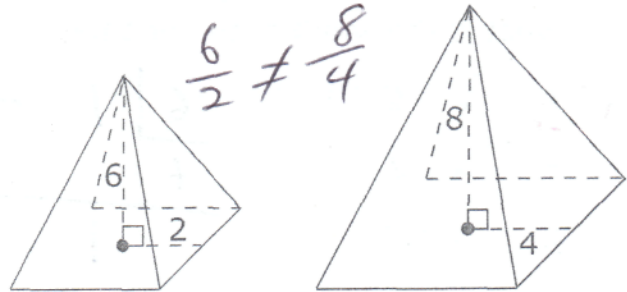


21 Which choice shows a pair of similar figures?

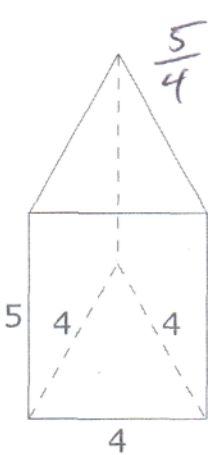
A



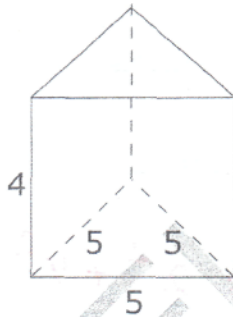
B



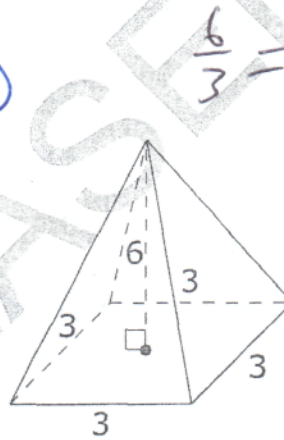
C



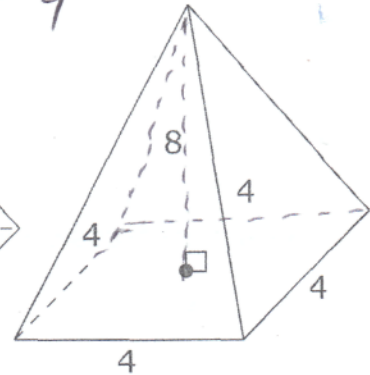
Handwritten notes show $\frac{5}{4} \neq \frac{4}{5}$.



D



Handwritten notes show $\frac{6}{3} = \frac{8}{4}$.



22 What is the **approximate** value of the sum:

$$8 - \frac{8}{7} + \frac{8}{49} - \dots + 8 \cdot \left(-\frac{1}{7}\right)^{2,500} ?$$

(Note: The sum of a series can be calculated using the formula $S_n = \frac{a_1(1-r^n)}{1-r}$, where $r \neq 1$.)

- A 1
- B 7**
- C 8
- D 9

$$S_n = \frac{8(1 - (-\frac{1}{7})^{2500})}{1 - (-\frac{1}{7})} = \frac{8(1-0)}{1\frac{1}{7}} = \frac{8}{\frac{8}{7}}$$



- 23 The volume of a rectangular prism is represented by the expression $(x^3 - 2x^2 - 20x - 24)$. If the length is $(x - 6)$ and the height and width are equal, what is the width of the prism?

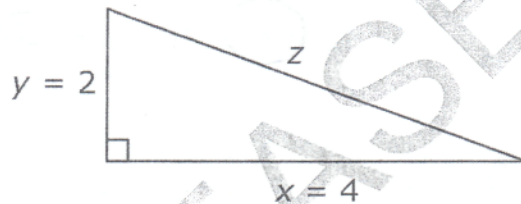
- A $x + 2$
- B $x - 2$
- C $x + 4$
- D $x - 4$

$$\begin{array}{r|rrrr} 6 & 1 & -2 & -20 & -24 \\ + & & 6 & 24 & 24 \\ \hline & 1 & 4 & 4 & 0 \end{array}$$

$$x^2 + 4x + 4$$

$$(x+2)(x+2)$$

- 24 A right triangle is shown below.



Which expression would result in an irrational number?

- A $x^2 + y^2$
- B $\frac{1}{2}xy$
- C $x + y + z$
- D $x^2 - z^2$

$$z^2 = 2^2 + 4^2$$

$$z = \sqrt{20}$$

irrational



25 Which expression is equivalent to $(4 - 3i)^2 + (6 + i)^2$?

- A 30
- B $42 - 12i$
- C 50
- D $62 - 12i$

$$\begin{aligned} &16 - 24i + 9i^2 + 36 + 12i + i^2 \\ &16 - 24i - 9 + 36 + 12i - 1 \\ &42 - 12i \end{aligned}$$

This is the end of the multiple-choice portion of the test.

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