1 What are the ***approximate*** rectangular coordinates for the point with polar coordinates (5, 30°)?

A (2.5, 2.89)

B (2.5, 4.33)

C (2.89, 4.33)

(D) (4.33, 2.5)

$X = 5\cos(30)$

$Y = 5\sin(30)$

2 A sequence is shown below.

6, 12, 20, 30, 42, 56, . . .

Which is the recursive formula for this sequence?

~~A~~ $t_n = n + 2(t_{n-1} + 1)$ $t_2 = 2 + 2(6+1) = 16$ (not 12)

~~B~~ $t_n = (t_{n-1} + 1)(n - 2)$ $t_2 = (6+1)(2-2) = 0$ (not 12)

~~C~~ $t_n = 2(t_{n-1} + 2) - (n + 2)$ $t_2 = 2(6+2) - (2+2) = 16 - 4 = 12$

(D) $t_n = t_{n-1} + 2(n + 1)$ $t_2 = 6 + 2(2+1) = 6 + 6 = 12$ . . .

I just tested each answer choice using $t_1 = 6$ and $n = 2$, therefore trying to find a formula that gives $t_2 = 12$

Now, check C and D

Answer choice C $t_3 = 2(12+2) - (3+2) = 2(14) - 5 = 23$ (not 20)

✓ Answer choice D $t_3 = 12 + 2(3+1) = 12 + 8 = 20$

3 A quadratic function, f, has zeros P and Q, such that $P + Q = 5$ and $\frac{1}{P} + \frac{1}{Q} = 8$.

Which choice describes f?

(A) $f(x) = 8x^2 - 40x + 5$ $P = .128$ $Q = 4.87$ > Check $\frac{1}{P} + \frac{1}{Q}$

~~B~~ $f(x) = 8x^2 - 40x - 5$ $P = -.122$ $Q = 5.12$

~~C~~ $f(x) = 2x^2 - 10x + 5$ $P = .5635$ $Q = 4.43$

~~D~~ $f(x) = 2x^2 - 10x - 5$ $P = -.45$ $Q = 5.45$

All choices have $P+Q=5$

4 Lucy invested \$6,000 into an account that earns 6% interest compounded continuously. ***Approximately*** how long will it take for Lucy's investment to be valued at \$25,000?

A 52.7 years

B 46.9 years

C 24.5 years

(D) 23.8 years

$Y = 6000e^{.06t}$

$25000 = 6000e^{.06t}$

$4.166 = e^{.06t}$

$\ln 4.166 = .06t$

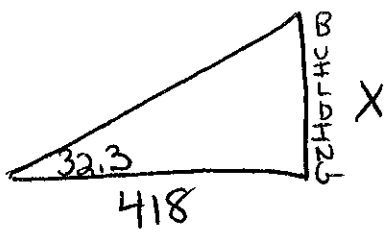
5 A lamppost is located 418 feet from a building. The angle of elevation from the base of the lamppost to the top of the building is 32.3°. ***Approximately*** how tall is the building?

A 223 feet

(B) 264 feet

C 510 feet

D 661 feet



$\tan 32.3 = \frac{X}{418}$

$418 \cdot \tan(32.3) = X$

Go to the next page.

6 Two functions are shown below.

$T(x) = -x$
$P(x) = 10x + 2$

What is the value of $P(T(3)) - T(P(3))$?

A 8

B 4

C 0

D -4

$P(T(3)) = 10(-3)+2$
$= -28$

$T(P(3)) = -(32)$

$-28-(-32)$

Watch your negatives!

7 A piecewise function is shown below.

$$f(x) = \begin{cases} cx + 1, & x \leq 2 \\ cx^2 - 1, & x > 2 \end{cases}$$

For what value of c does $\lim_{x \to 2} f(x)$ exist?

A -2

B -1

C 1

D 4

Must approach same value on the left and right

A) $-2x+1$ $x \leq 2$ -3 on left
$-2x^2-1$ $x>2$ -9 on right

B) $-1x+1$ $x \leq 2$ -1 on left
$-1x^2-1$ $x>2$ -5 on right

C) $x+1$ $x \leq 2$ 3 on left ✓
x^2-1 $x>2$ 3 on right ✓

What are the polar coordinates of (4, 9)? ← Quadrant I

(4, 9) → x y

A $(\sqrt{97}, 66°)$

B $(\sqrt{97}, 114°)$

C $(\sqrt{13}, 66°)$

D $(\sqrt{13}, 114°)$

$x^2+y^2=r^2$ $\quad \tan\theta = \frac{9}{4}$

$4^2+9^2=r^2$

$97=r^2$

$\sqrt{97}=r$

9 A sequence is shown below.

$1, 3, 3^2, 3^3, \ldots$

How many terms of the sequence must be added together for the sum to equal 3,280?

A 6

B 7

C 8

D 9

Solve by hand

$S=\frac{1(1-3^n)}{1-3}$

$3280=\frac{1-3^n}{-2}$

$-6560=1-3^n$ $\quad -6560=-3^n$

$6561=3^n$

$\log(6561)=n\cdot\log(3)$

$\frac{\log(6561)}{\log(3)}=n$

$n=8$

(It would probably be quicker to guess and check)

11

$S=\frac{(1-3^7)}{1-3}=1093$ X

$S=\frac{(1-3^8)}{1-3}=3280$ ✓

Go to the next page.

10 The first term of an infinite geometric sequence is 2. The sum of the sequence is 6. What is the common ratio of the sequence?

A $\frac{1}{3}$

B $\frac{2}{3}$

C $\frac{3}{3}$

D $\frac{4}{3}$

$S = \frac{a_1}{1-r}$

$6 = \frac{2}{1-r}$

$6(1-r) = 2$

$6 - 6r = 2$

$-6r = -4$

$r = \frac{4}{6} = \frac{2}{3}$

11 Which is true of the series shown below?

$\pi + \frac{3\pi}{4} + \frac{9\pi}{16} + \frac{27\pi}{64} + \cdots$ $r = \frac{3}{4}$ since $r < 1$ converges

A The series diverges.

B The series converges to $\frac{3\pi}{2}$.

C The series converges to $\frac{4\pi}{3}$.

D The series converges to 4π.

$S = \frac{\pi}{1-(\frac{3}{4})} = \frac{\pi}{\frac{1}{4}} = 4\pi$

Go to the next page

12 Karen recursively generated a sequence of five positive integers by starting with a positive integer, a_1, and then applying the recursive formula $a_n = a_{n-1} + 3n - 1$ to generate a_n for $n = 2, 3, 4$, and 5.

If the value of a_5 was 407, what was the value of Karen's starting term, a_1?

A 366

B 367

C 368

D 369

$407 = a_4 + 3(5) - 1$ $393 = a_3 + 3(4) - 1$

$393 = a_4$ $382 = a_3$

$38 = a_2 + 3(3) - 1$ $374 = a_1 + 3(2) - 1$

$374 = a_2$ $369 = a_1$

13 What is the distance between y-intercepts of the graph of $x + 8 = 2(y + 3)^2$?

A 4

B 6

C 11

D 15

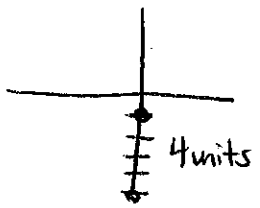
Horizontal Parabola Vertex $(-8, -3)$

y-intercept (where $x = 0$) $8 = 2(y+3)^2$

$4 = (y+3)^2$

$\pm 2 = y + 3$ $y = -3 \pm 2$

$y = -1$ $y = -5$



14 Which is a solution set to $x + \frac{3x}{x-1} = \frac{x+2}{x-1}$?

A $\{-1\}$

B $\{-2\}$

C $\{-2, 1\}$

D $\{2, -1\}$

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

$\frac{x^2+2x}{x-1} = \frac{x+2}{x-1}$

$x^2 + 2x = x + 2$

$x^2 + x - 2 = 0$

$(x+2)(x-1) = 0$

$x = -2$ $x = 1$

$x \neq 1$ (0 in the denominator)

only

Go to the next page

15 What is the range of the inverse of $y = \tan x$?

Original function
Domain: $(-\pi/2, \pi/2)$
↑ asymptotes!
Range: $(-\infty, \infty)$

Inverse:
Domain $(-\infty, \infty)$
Range $(-\pi/2, \pi/2)$

(A) $-\frac{\pi}{2} < y < \frac{\pi}{2}$

B $-\frac{\pi}{2} \leq y \leq \frac{\pi}{2}$

C $0 < y < \pi$

D $0 \leq y \leq \pi$

16 James is standing 10 meters away from Samantha.

- A bird is located in the sky at a point between where James and Samantha are standing.
- James is looking up at the bird at an angle of elevation of 74°.
- Samantha is looking up at the bird at an angle of elevation of 47°.

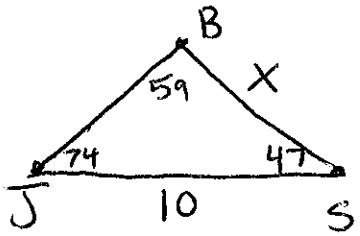
Approximately how far is the bird from Samantha?

A 7.6 meters

B 8.5 meters

(C) 11.2 meters

D 13.1 meters



ASA
Law of Sines

$$\frac{X}{\sin 74} = \frac{10}{\sin 59} \qquad X = 11.2$$

Go to the next page.

17 What is the inverse function of $f(x) = \log_5(2x - 1)$?

A $f^{-1}(x) = 5^x - 1$

(B) $f^{-1}(x) = \frac{5^x + 1}{2}$

C $f^{-1}(x) = \log_2(5x - 1)$

D $f^{-1}(x) = \log_5 \frac{5x + 1}{2}$

$X = \log_5(2y-1)$

$5^x = 2y - 1$

$\frac{5^x + 1}{2} = y$

18 What is the value of the limit shown below?

$$\lim_{n\to\infty}\left(\frac{3^n - 1}{3^n}\right)$$

Calculator, Check x values that get really big!

A $\frac{1}{3}$

B $\frac{2}{3}$

(C) 1

D $+\infty$

Or

$$\lim_{n\to\infty} \frac{3^n}{3^n} - \frac{1}{3^n}$$

take the limit ↑

$1 - 0 = 1$

19 What type of conic section is represented by $r = \frac{8}{16 + 125\sin\theta}$? (Polar)

A circle

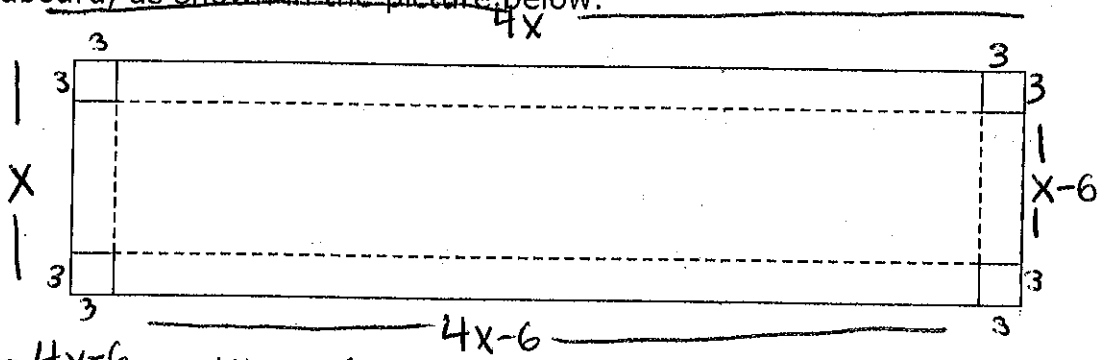
B ellipse

(C) hyperbola

D parabola

Graph it! (Zoom in 😊)

20 James had a rectangular piece of cardboard that was four times as long as it was wide. He wanted to use the cardboard to make a box with no lid. To do this, he first cut a 3-by-3-inch square out of each of the four corners of the piece of cardboard, as shown in the picture below.



length = $4x-6$ width = $x-6$ height = 3

Then James folded the cardboard along the four dotted lines shown in the picture. This created an open box with a volume of 336 cubic inches.

What was the width of the sheet of cardboard that James started with?

A 10.5 inches

(B) 9.5 inches

C 8.5 inches

D 7.5 inches

$V = 3(4x-6)(x-6) = 3(4x^2-30x+36)$

$= 12x^2-90x+108$

$336 = 12x^2-90x+108$

$0 = 12x^2-90x-228$ $\quad x = 9.5$

21 Which expression is equivalent to $(\sec\theta)\left(\frac{\sin\theta}{\tan\theta}\right)$?

A $\cos^2\theta - \sin^2\theta$

B $\sin^2\theta - \cos^2\theta$

C $\cot^2\theta - \csc^2\theta$

(D) $\csc^2\theta - \cot^2\theta$

$\left(\frac{1}{\cos\theta}\right)\left(\frac{\sin\theta}{\left(\frac{\sin\theta}{\cos\theta}\right)}\right)$

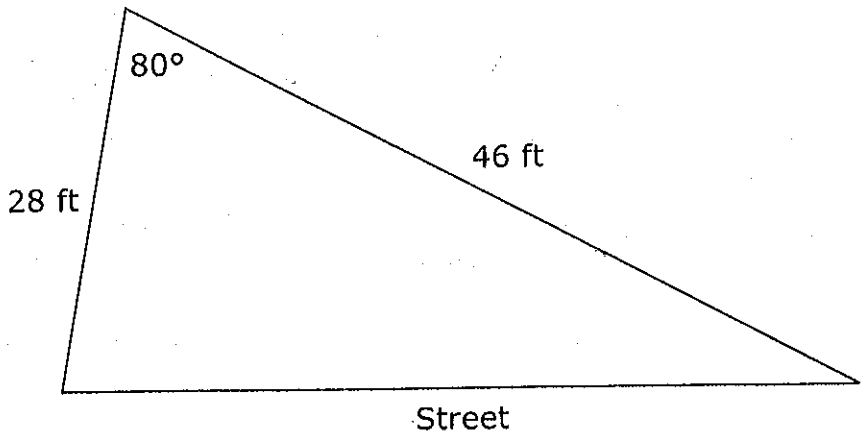
$\left(\frac{1}{\cos\theta}\right)\left(\frac{\cos\theta\sin\theta}{\sin\theta}\right) = 1$

Remember $\sin^2\theta+\cos^2\theta = 1$

and $1+\cot^2\theta = \csc^2\theta$

$\checkmark 1 = \csc^2\theta - \cot^2\theta$

22 Suppose that for each foot of land along the street, the annual tax is $25 per foot. The diagram below shows a plot of land.



About how much is the annual tax for the plot?

SAS Law of Cosines

(A) $1,238

B $1,293

C $1,321

D $1,411

$x^2 = 28^2 + 46^2 - 2(28)(46)\cos(80)$

$X = 49.5$ feet

$\times 25$ per foot

$\$1238.11$

23 The function $C(x) = \frac{2.50x + 1.00}{x}$ models the cost per item for a company to produce x items after the first item is made. What is the inverse function of $C(x)$?

(A) $C^{-1}(x) = \frac{1.00}{x - 2.50}$

B $C^{-1}(x) = \frac{x - 2.50}{1.00}$

C $C^{-1}(x) = \frac{x - 1.00}{2.50}$

D $C^{-1}(x) = \frac{2.50}{x - 1.00}$

$X = \frac{2.5y + 1}{y}$

$yx = 2.5y + 1$

$yx - 2.5y = 1$

$y(x - 2.5) = 1$

$y = \frac{1}{x - 2.5}$

24 A computer rental company charges $50 to rent a computer for one week. The table below shows the daily late fees the company charges if a computer is returned late.

Days Late	Daily Late Fee
days 1 through 10	$5
days 11 through 20	$8
days 21 through 30	$10

What would be the total cost of renting a computer for one week and returning it 15 days late?

$\$50+10(5)+5(8)$

A $120

B $125

C $140

D $170

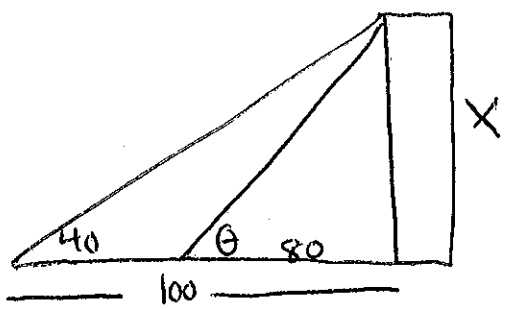
25 From a point 100 feet from the base of a building, Angie looks up at a 40° angle to the top of a building. She walks 20 feet closer to the building. At ***approximately*** what angle must Angie now look up to see the top of the building?

A 32°

B 46°

C 60°

D 77°



$\tan 40 = \frac{X}{100}$

$X = 83.91$ (building)

$\tan\theta = \frac{83.91}{80}$

$\theta = 46.37°$

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

Go to the next page.