

**A.REI.D.11: Other Systems 2**

- 1 The path of a rocket is represented by the equation  $y = \sqrt{25 - x^2}$ . The path of a missile designed to intersect the path of the rocket is represented by the equation  $x = \frac{3}{2} \sqrt{y}$ . The value of  $x$  at the point of intersection is 3. What is the corresponding value of  $y$ ?
  - 1) -2
  - 2) 2
  - 3) -4
  - 4) 4
  
- 2 Which value, to the *nearest tenth*, is *not* a solution of  $p(x) = q(x)$  if  $p(x) = x^3 + 3x^2 - 3x - 1$  and  $q(x) = 3x + 8$ ?
  - 1) -3.9
  - 2) -1.1
  - 3) 2.1
  - 4) 4.7
  
- 3 If  $f(x) = 3|x| - 1$  and  $g(x) = 0.03x^3 - x + 1$ , an approximate solution for the equation  $f(x) = g(x)$  is
  - 1) 1.96
  - 2) 11.29
  - 3) (-0.99, 1.96)
  - 4) (11.29, 32.87)
  
- 4 The graphs of the equations  $y = 2^x$  and  $y = -2x + a$  intersect in Quadrant I for which values of  $a$ ?
  - 1)  $0 < a < 1$
  - 2)  $a < 1$
  - 3)  $a \geq 1$
  - 4)  $a > 1$
  
- 5 To the *nearest tenth*, the value of  $x$  that satisfies  $2^x = -2x + 11$  is
  - 1) 2.5
  - 2) 2.6
  - 3) 5.8
  - 4) 5.9
  
- 6 Pedro and Bobby each own an ant farm. Pedro starts with 100 ants and says his farm is growing exponentially at a rate of 15% per month. Bobby starts with 350 ants and says his farm is steadily decreasing by 5 ants per month. Assuming both boys are accurate in describing the population of their ant farms, after how many months will they both have approximately the same number of ants?
  - 1) 7
  - 2) 8
  - 3) 13
  - 4) 36
  
- 7 The flight paths of two Thunderbird jets are plotted on a Cartesian coordinate plane, and the equations of the jets' flight paths are represented by  $y = 2^x + 3$  and  $y = 0.5^x$ . The best approximation of the intersection of the flight paths is
  - 1) (-1.72, 3.3)
  - 2) (0, 1)
  - 3) (-1.50, 2.82)
  - 4) (-2, -1)

- 8 What is the total number of points of intersection of the graphs of the equations  $xy = 12$  and  $y = -x^2 + 3$ ?
- 1) 1
  - 2) 2
  - 3) 3
  - 4) 4

- 9 When  $g(x) = \frac{2}{x+2}$  and  $h(x) = \log(x+1) + 3$  are graphed on the same set of axes, which coordinates best approximate their point of intersection?
- 1)  $(-0.9, 1.8)$
  - 2)  $(-0.9, 1.9)$
  - 3)  $(1.4, 3.3)$
  - 4)  $(1.4, 3.4)$

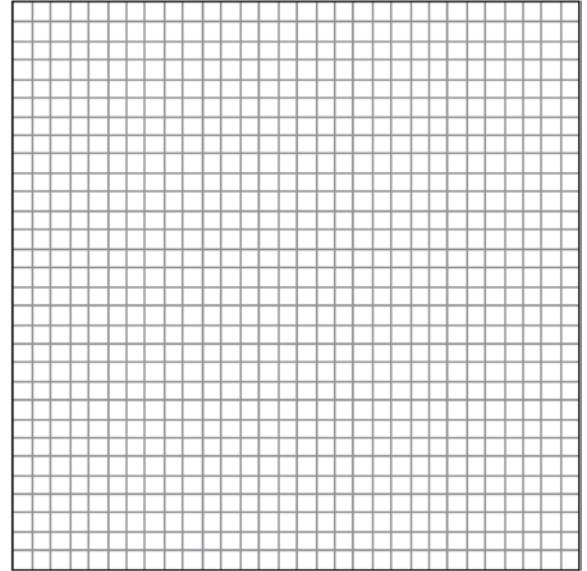
- 10 A landscape architect's designs for a town park call for two parabolic-shaped walkways. When the park is mapped on a Cartesian coordinate plane, the pathways intersect at two points. If the equations of the curves of the walkways are  $y = 11x^2 + 23x + 210$  and  $y = -19x^2 - 7x + 390$ , determine the coordinates of the two points of intersection. [Only an algebraic solution can receive full credit.]

- 11 Given:  $h(x) = \frac{2}{9}x^3 + \frac{8}{9}x^2 - \frac{16}{13}x + 2$

$$k(x) = -|0.7x| + 5$$

State the solutions to the equation  $h(x) = k(x)$ , rounded to the *nearest hundredth*.

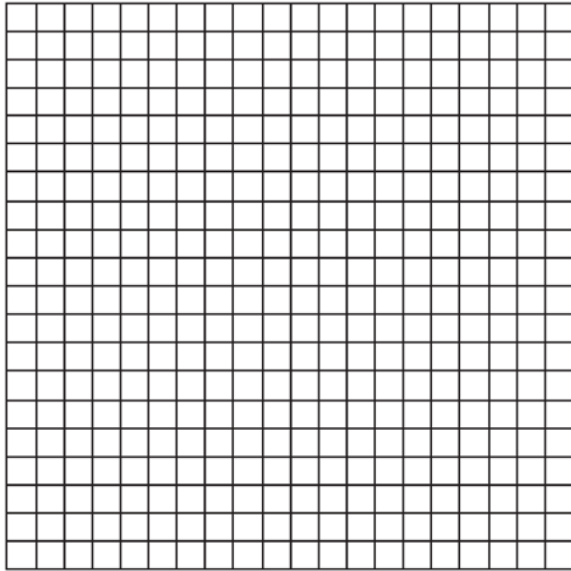
- 12 On the accompanying grid, sketch the graphs of  $y = 2^x$  and  $3y = 7x + 3$  over the interval  $-3 \leq x \leq 4$ . Identify and state the coordinates of all points of intersection.



- 13 On the accompanying grid, solve the following system of equations graphically:

$$y = -x^2 + 2x + 1$$

$$y = 2^x$$



- 14 Determine algebraically the  $x$ -coordinate of all points where the graphs of  $xy = 10$  and  $y = x + 3$  intersect.

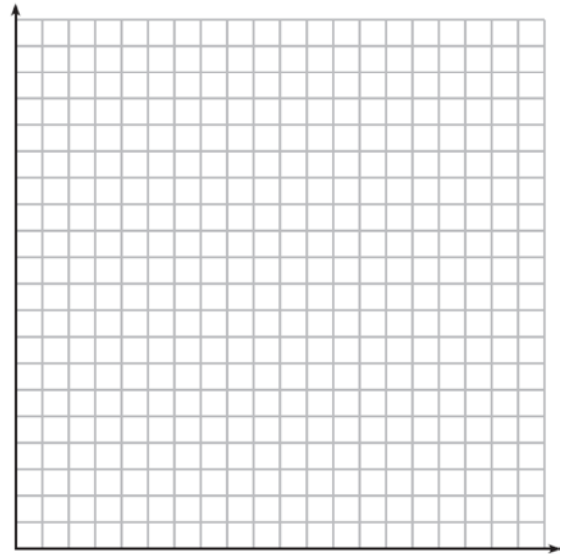
- 15 Solve the system of equations algebraically for  $x$

and  $y$ :  $\frac{y}{x} = \frac{x-3}{2}$

$$y + 2 = x$$

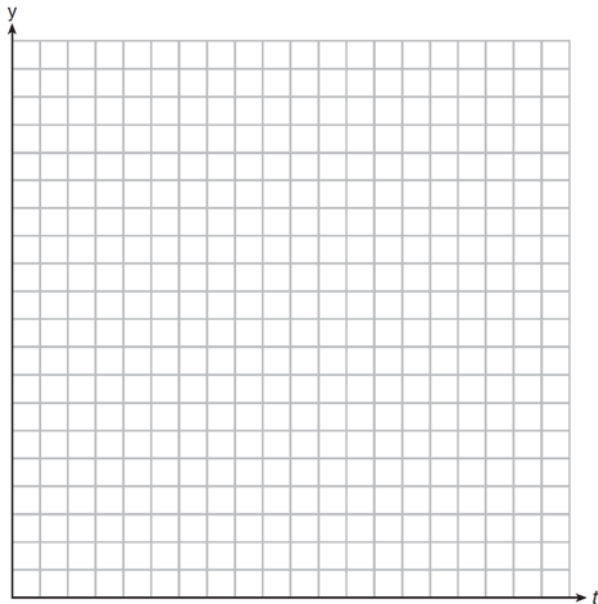
- 16 The value of a certain small passenger car based on its use in years is modeled by

$V(t) = 28482.698(0.684)^t$ , where  $V(t)$  is the value in dollars and  $t$  is the time in years. Zach had to take out a loan to purchase the small passenger car. The function  $Z(t) = 22151.327(0.778)^t$ , where  $Z(t)$  is measured in dollars, and  $t$  is the time in years, models the unpaid amount of Zach's loan over time. Graph  $V(t)$  and  $Z(t)$  over the interval  $0 \leq t \leq 5$ , on the set of axes below.



State when  $V(t) = Z(t)$ , to the *nearest hundredth*, and interpret its meaning in the context of the problem. Zach takes out an insurance policy that requires him to pay a \$3000 deductible in case of a collision. Zach will cancel the collision policy when the value of his car equals his deductible. To the *nearest year*, how long will it take Zach to cancel this policy? Justify your answer.

- 17 Drugs break down in the human body at different rates and therefore must be prescribed by doctors carefully to prevent complications, such as overdosing. The breakdown of a drug is represented by the function  $N(t) = N_0(e)^{-rt}$ , where  $N(t)$  is the amount left in the body,  $N_0$  is the initial dosage,  $r$  is the decay rate, and  $t$  is time in hours. Patient  $A$ ,  $A(t)$ , is given 800 milligrams of a drug with a decay rate of 0.347. Patient  $B$ ,  $B(t)$ , is given 400 milligrams of another drug with a decay rate of 0.231. Write two functions,  $A(t)$  and  $B(t)$ , to represent the breakdown of the respective drug given to each patient. Graph each function on the set of axes below.



To the *nearest hour*,  $t$ , when does the amount of the given drug remaining in patient  $B$  begin to exceed the amount of the given drug remaining in patient  $A$ ? The doctor will allow patient  $A$  to take another 800 milligram dose of the drug once only 15% of the original dose is left in the body. Determine, to the *nearest tenth of an hour*, how long patient  $A$  will have to wait to take another 800 milligram dose of the drug.

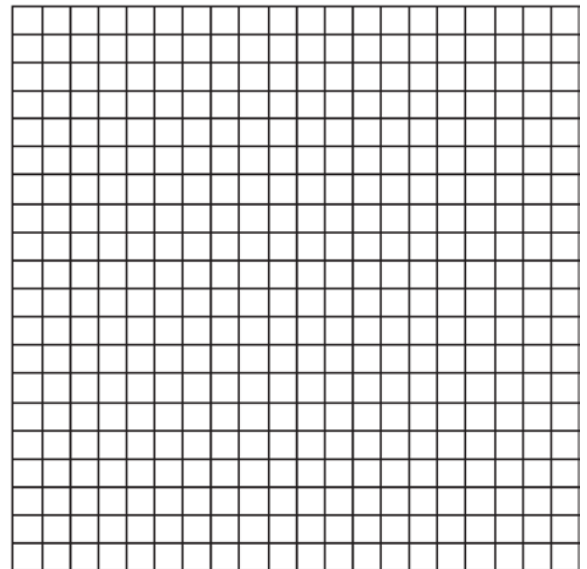
- 18 On a monitor, the graphs of two impulses are recorded on the same screen, where  $0^\circ \leq x < 360^\circ$ . The impulses are given by the following equations:

$$y = 2 \sin^2 x$$

$$y = 1 - \sin x$$

Find all values of  $x$ , in degrees, for which the two impulses meet in the interval  $0^\circ \leq x < 360^\circ$ . [Only an algebraic solution will be accepted.]

- 19 A pair of figure skaters graphed part of their routine on a grid. The male skater's path is represented by the equation  $m(x) = 3 \sin \frac{1}{2} x$ , and the female skater's path is represented by the equation  $f(x) = -2 \cos x$ . On the accompanying grid, sketch both paths and state how many times the paths of the skaters intersect between  $x = 0$  and  $x = 4\pi$ .



### A.REI.D.11: Other Systems 2 Answer Section

1 ANS: 4

$$x = \frac{3}{2}\sqrt{y}$$

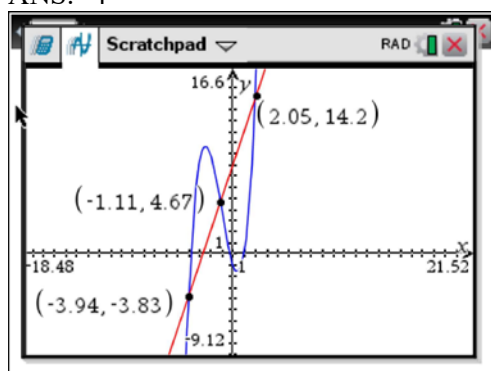
$$y = \sqrt{25 - x^2} = \sqrt{25 - 3^2} = 4. \quad 3 = \frac{3}{2}\sqrt{y}$$

$$2 = \sqrt{y}$$

$$y = 4$$

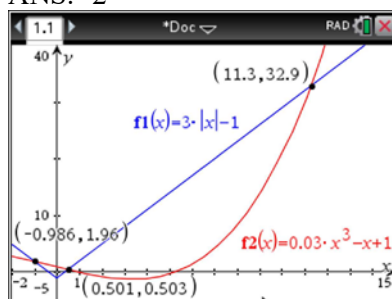
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2 ANS: 4



REF: 061622aii

3 ANS: 2



REF: 061705aii

4 ANS: 4

The function  $y = -2x + \alpha$  passes through Quadrant I only if  $\alpha > 0$ . The function  $y = 2^x$  intersects the  $y$ -axis at  $x = 1$ , and continues through Quadrant I with a positive slope. If  $\alpha = 1$ , the graphs of the equations intersect at  $(0, 1)$ , which is not in Quadrant I. Therefore,  $\alpha > 1$ .

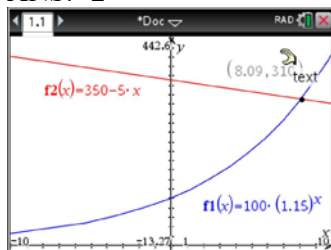
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5 ANS: 2



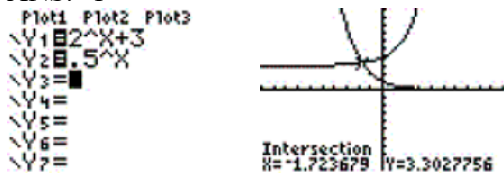
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6 ANS: 2



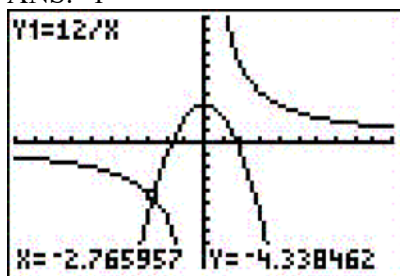
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7 ANS: 1



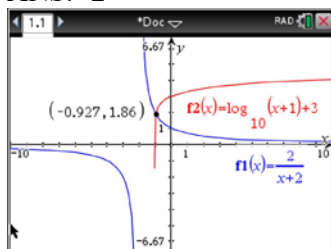
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8 ANS: 1



REF: 010704b

9 ANS: 2



REF: 011712a

10 ANS:

$$11x^2 + 23x + 210 = -19x^2 - 7x + 390$$

$$30x^2 + 30x - 180 = 0$$

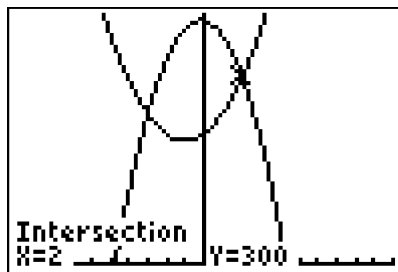
(2,300), (-3,240).

$$x^2 + x - 6 = 0$$

$$y = 11(-3)^2 + 23(-3) + 210 = 240.$$

$$(x+3)(x-2) = 0$$

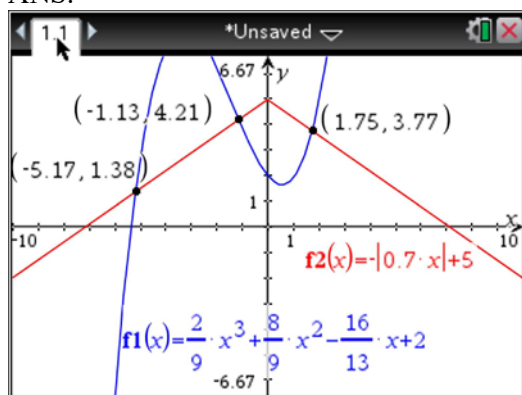
$$x = -3 \quad x = 2$$



$$y = 11(2)^2 + 23(2) + 210 = 300.$$

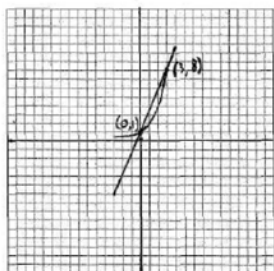
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11 ANS:



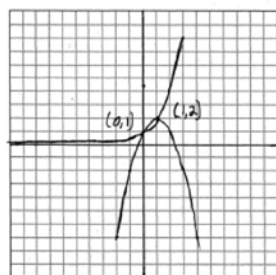
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12 ANS:



REF: 010628b

13 ANS:



REF: 010527b

14 ANS:

$$x(x + 3) = 10$$

$$x^2 + 3x - 10 = 0$$

$$(x + 5)(x - 2) = 0$$

$$x = -5, 2$$

REF: 011431a2

15 ANS:

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

$$x^2 - 3x = 2x - 4 \quad y = 1 - 2 = -1$$

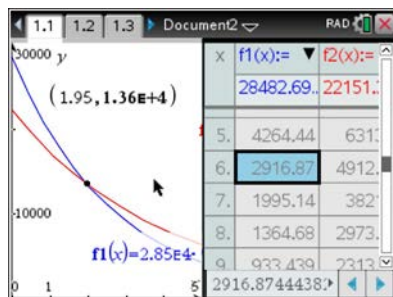
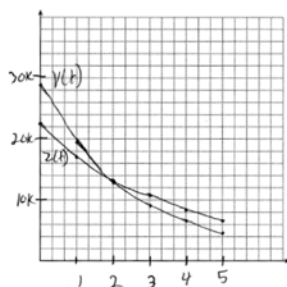
$$x^2 - 5x + 4 = 0$$

$$(x - 4)(x - 1) = 0$$

$$x = 4, 1$$

REF: 011737a2

16 ANS:

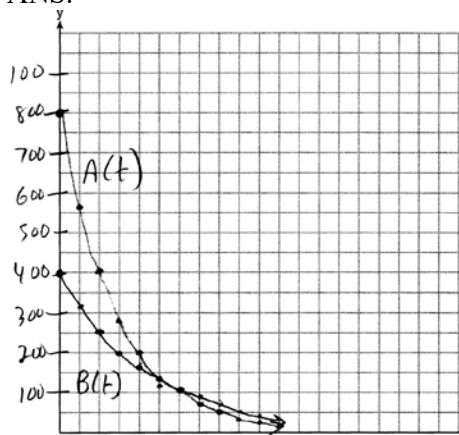


At 1.95 years, the value of the car equals the loan balance. Zach can cancel the policy after 6 years.

REF: 081737a2



17 ANS:



$$A(t) = 800e^{-0.347t}$$

$$800e^{-0.347t} = 400e^{-0.231t} \quad 0.15 = e^{-0.347t}$$

$$B(t) = 400e^{-0.231t}$$

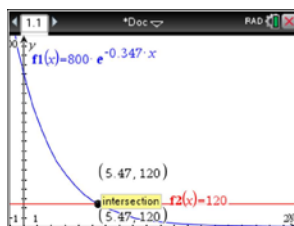
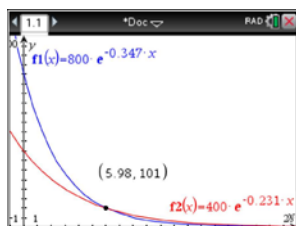
$$\ln 2e^{-0.347t} = \ln e^{-0.231t} \quad \ln 0.15 = \ln e^{-0.347t}$$

$$\ln 2 + \ln e^{-0.347t} = \ln e^{-0.231t} \quad \ln 0.15 = -0.347t \cdot \ln e$$

$$\ln 2 - 0.347t = -0.231t \quad 5.5 \approx t$$

$$\ln 2 = 0.116t$$

$$6 \approx t$$



REF: 061637aii

18 ANS:

30, 150, 270.

$$2 \sin^2 x + \sin x - 1 = 0$$

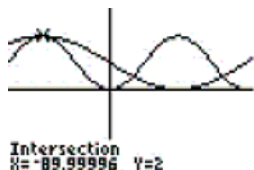
$$2 \sin^2 x = 1 - \sin x \quad (2x - 1)(x + 1) = 0$$

$$2x - 1 = 0 \quad x + 1 = 0 \quad \sin^{-1}\left(\frac{1}{2}\right) = 30^\circ \text{ or } 150^\circ$$

$$x = \frac{1}{2} \quad x = -1 \quad \sin^{-1}(-1) = 270^\circ$$

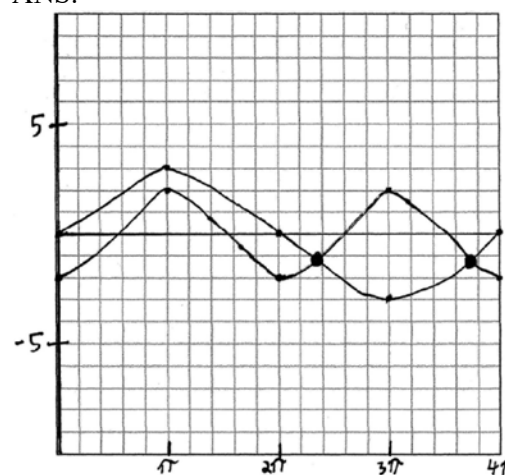
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Plot1 Plot2 Plot3
Y1=2sin(X)^2
Y2=1-sin(X)
Y3=
Y4=
Y5=
Y6=
Y7=
    
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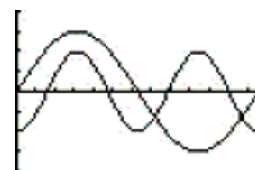
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19 ANS:



Plot1 Plot2 Plot3  
 $\sqrt{1}$   $\sin(.5X)$   
 $\sqrt{2}$   $-2\cos(X)$   
 $\sqrt{3}$  =  
 $\sqrt{4}$  =  
 $\sqrt{5}$  =  
 $\sqrt{6}$  =  
 $\sqrt{7}$  =

two times.



REF: 060329b