Math
Spring Operational 2015

Algebra 2
End of Year Released Items

M40479

1. Which of the following is equivalent to $(i+3)+i(2i-4)$?

   - A. $-5i+1$
   - B. $-i+3$
   - C. $i-3$
   - D. $-3i+1$

M40310

2. Let $f(x)=2x^2-x+1$ and let $g(x)=x-4$. Which statements are true?

   Select **all** that apply.

   - [ ] A. One root of $f(x)$ is -4.
   - [ ] B. One root of $f(x)$ is 29.
   - [ ] C. If $f(x)$ is divided by $g(x)$, the remainder is 29.
   - [ ] D. $g(x)$ is a factor of $f(x)$.
   - [ ] E. $g(x)$ is not a factor of $f(x)$.

M41534

3. Solve $\sqrt{a}=a-6$. What is the extraneous solution?

   Enter your answer in the box.

   [ ]

4. Consider the equation $p^2 - 5p - 6 - x(p-6)^2 = 0$, where p is a real constant.

Part A

If $p = 6$, then the equation has

- A. no real solutions.
- B. exactly one real solution.
- C. exactly two real solutions.
- D. infinitely many real solutions.

Part B

If $p \neq 6$, then $x =$

- A. $\frac{p-2}{p-6}$
- B. $\frac{p-1}{p-6}$
- C. $\frac{p+1}{p-6}$
- D. $\frac{p+2}{p-6}$

M40964

5. A solution for each equation is given.

Drag and drop the letter of each equation into the appropriate box for its solution.

A B

A $-4x + 20 - a = 4(-x + 5) + a$

B $4x - 20 + 2a = 4(x - 5) + a + 1$

$a = 1$ $a = 0$ $a = -1$

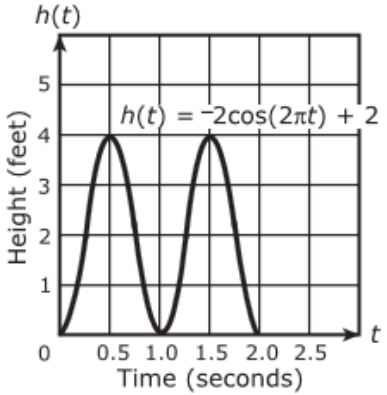
VF803044

6. Four sequences are shown. The general term for each sequence is defined for a_n, where n is a positive integer. For each sequence, drag the definition that generates the sequence into the appropriate box.

$a_n = -3 - 2.5(n - 1)$	$a_n = -3(-2)^{n-1}$
$a_n = 81(\frac{1}{3})^{n-1}$	$a_n = 81 - 3(n - 1)$

$-3, 6, -12, 24, \ldots$	
$81, 78, 75, 72, \ldots$	
$-3, -5.5, -8, -10.5, \ldots$	
$81, 27, 9, 3, \ldots$	

7. Lara is jumping rope for exercise. The function $h(t) = -2\cos(2\pi t) + 2$ gives the height of the midpoint of the rope, in feet, after t seconds. The graph of the function is given for the time interval $0 \leq t \leq 2$.



Select **all** the intervals over which there is a negative average rate of change in the height of the midpoint of the rope.

Select **all** that apply.

- ☐ A. $0 < t < 0.5$
- ☐ B. $0 < t < 1$
- ☐ C. $0.5 < t < 1$
- ☐ D. $1 < t < 2$
- ☐ E. $1.5 < t < 2$

M40261

8. A bank pays depositors a 2% interest rate compounded semiannually. Let P represent an initial deposit and let t represent the number of years that the deposit is in the bank. The expression $P\left(1+\frac{0.02}{2}\right)^{2t}$ can be used to determine the account balance after t years. Which expression accurately reflects the annual interest rate?

- A. $P(1.01)^t$
- B. $P(1.21)^t$
- C. $P(1.0201)^t$
- D. $P(1.0404)^t$

M41089

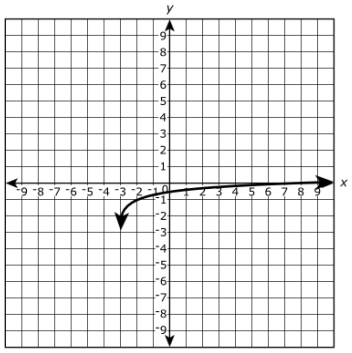
9. Solve the system of equations below for x, y, and z.

$$\begin{cases} 4x-2y+3z=9 \\ x-2y=-3 \\ 2x+3y=1 \end{cases}$$

Enter your answers in the boxes.

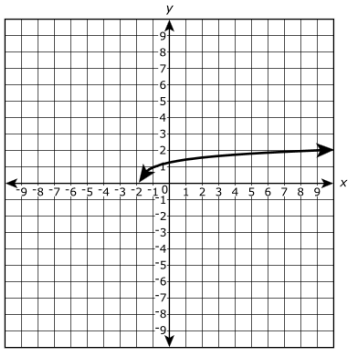
$x=$ ☐ $y=$ ☐ $z=$ ☐

10. The given graph represents the function $f(x)$. Let g be defined as $g(x) = f(x-1) + 2$.

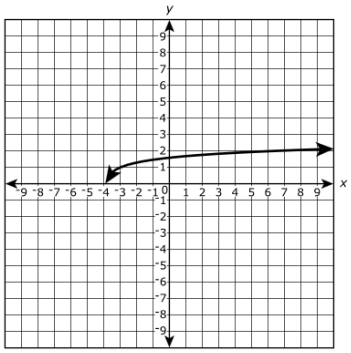


What is the graph of $g(x)$?

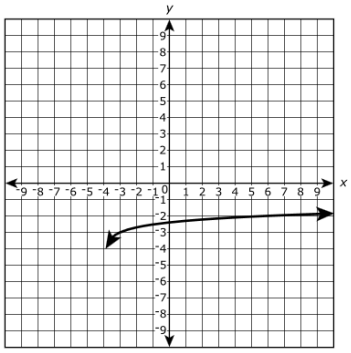
A.



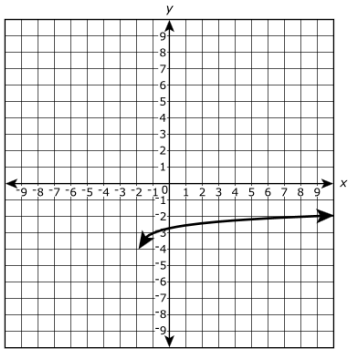
B.



C.



D.



VH001699

11. For $m > 0$, the expression $\frac{2(\sqrt{m})^3}{\sqrt[4]{m}}$ can be rewritten in the form $2m^a$, where a is a fraction.

What is the value of a?

Enter your answer in the boxes.

$\square$

$\frac{\square}{\square}$

VH002816

12. An expression is given.

$$\frac{(3x)}{(3x)^{\frac{3}{2}}}$$

If $x > 0$, which of the expressions listed is equivalent to the expression given?

Select **all** that apply.

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

VF888317

13. Two functions are shown.

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

Fill in **each** coefficient to complete the definition of $2f(1-x) - 3g(x)$.

Enter your answers in the boxes.

$2f(1-x) - 3g(x) =$ ☐ $x^2 +$ ☐ $x +$ ☐

2247-M41256

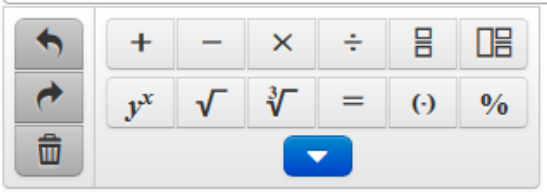
14. Joanna uses the function $p = f(n) = 30n - 450$ to calculate the profit, p, in dollars that she makes from selling n cakes in her store.

- Write a formula for a function to calculate the number of cakes Joanna needs to sell for a given profit.
- Calculate the minimum number of cakes that Joanna must sell to make a profit of at least $500.00.

Enter your answers in the spaces provided. Enter **only** your answers.

Formula: $n = f^{-1}(p) =$ ☐

Minimum number of cakes: ☐



15. There is a unique quadratic function of the form $f(x) = ax^2 + c$ that satisfies each of these conditions:

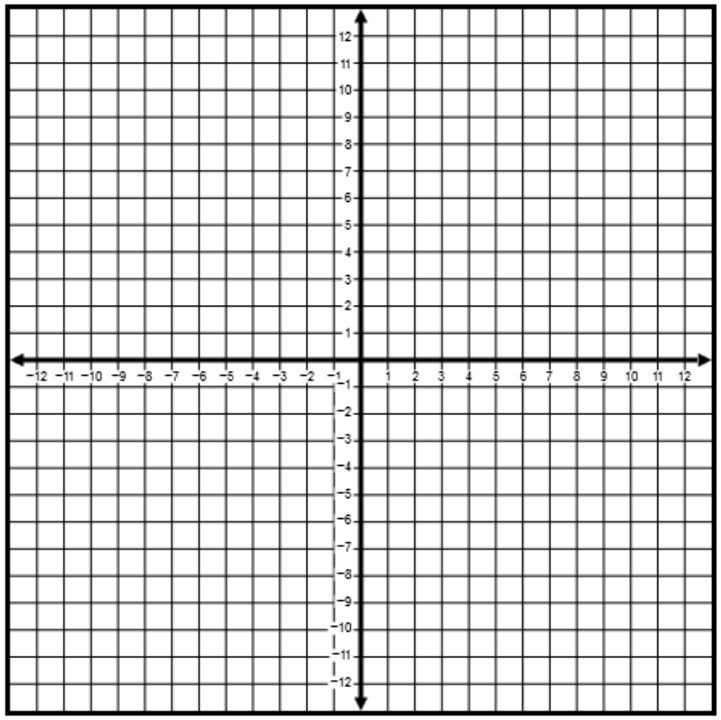
- $f(-2) = f(2) = 0$
- f attains a maximum value of 8

Part A

Create a graph of $f(x)$.

1. Select the quadratic button.
2. Drag the vertex and another point to graph the function.

Quadratic



Part B

Select from the drop-down menus to correctly complete the sentence.

The function f is symmetric about [Choose...] because for all values of x, $f(-x) =$ [Choose..].

Choose...
- the x-axis
- the y-axis
- the origin

Choose..
- -f(-x)
- -f(x)
- f(x)

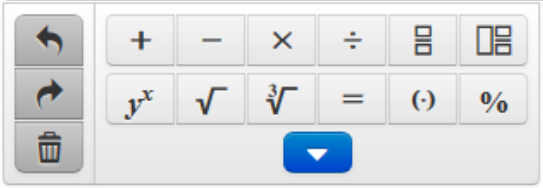
M40507

16. A scientist has a sample of bacteria that initially contains 10 million microbes. He observes the sample and finds that the number of bacterial microbes doubles every 20 minutes. Write an exponential equation that represents M, the total number of bacterial microbes in millions, as a function of t, the number of minutes the sample has been observed. Then, determine how much time, to the nearest minute, will pass until there are 67 million bacterial microbes.

Enter your answers in the boxes. Enter **only** your answers.

$M(t) = \square$

$\square$ **minutes**



M40595

17. Suppose that θ is a second quadrant angle and that $\cos\theta = -\frac{4}{5}$. What is the value of $\sin\theta$ to the nearest tenth?

Enter your answer in the box.

$\square$

18. The organizers of a community fair set up a small Ferris wheel for young children. The table shows the heights of one of the cars above the ground for different rotations of the wheel.

Angle of Rotation (radians)	Height above the Ground (feet)
0	1
$\frac{\pi}{2}$	7
π	13
$\frac{3\pi}{2}$	7
2π	1
$\frac{5\pi}{2}$	7
3π	13
$\frac{7\pi}{2}$	7
4π	1

Part A

The function $h(x) = a\ \sin\left(x - \frac{\pi}{2}\right) + b$, where *a* and *b* are constants, models the height of the Ferris wheel car at a rotation of *x* radians.

What are the values of *a* and *b*?

- A. $a = 1;\ b = 12$
- B. $a = 6;\ b = 7$
- C. $a = 7;\ b = 6$
- D. $a = 12;\ b = 1$

Part B

Consider the graph of $y = h(x)$ in the *xy*-coordinate plane. Which statements are true?

Select **all** that apply.

- A. The amplitude of the graph is 12.
- B. The period of the graph is 2π.
- C. The midline of the graph is at $y = 13$.
- D. The graph is increasing for $4\pi < x < 5\pi$.
- E. The graph is decreasing for $\frac{11\pi}{2} < x < \frac{13\pi}{2}$.
- F. The graph has a maximum at $y = 13$.

19. Students at the local high school were asked about their food preferences. Of the 437 students polled, 306 like hamburgers, 153 like chicken, and 47 like both. One student will be selected at random from the 437 students polled.

Part A

What is the probability that the selected student will like **neither** hamburgers nor chicken? Give your answer as a fraction.

Enter your answer in the boxes.

$\square$

$\frac{\square}{\square}$

Part B

Let H represent the event that the student selected is one who likes hamburgers, and let $P(H)$ represent the probability that event H will occur. Let C represent the event that the student selected is one who likes chicken, and let $P(C)$ represent the probability that event C will occur.

Which statement is true?

A. Events H and C are independent because $P(H \text{ and } C) = P(H) \cdot P(C)$.

B. Events H and C are independent because $P(H \text{ and } C) \neq P(H) \cdot P(C)$.

C. Events H and C are **not** independent because $P(H \text{ and } C) = P(H) \cdot P(C)$.

D. Events H and C are **not** independent because $P(H \text{ and } C) \neq P(H) \cdot P(C)$.

20. Mr. and Mrs. Ryan build and sell nesting boxes for small birds. They sell each box for $19.95. So far this month, they have built and sold 74 boxes.

Part A

Let x represent the number of additional boxes they expect to build and sell for the month. Let $n(x)$ represent the amount of money they expect to receive from the entire month's sales. Write an equation for $n(x)$.

Enter your equation in the space provided. Enter **only** your equation.

$n(x) =$ ☐

Part B

Determine the average rate of change, in dollars per nesting box, of $n(x)$ as x varies from 85 to 120.

Enter your answer in the box.

Part C

Mr. and Mrs. Ryan can build no more than 450 boxes in one month. Which statement gives the domain of function n?

A. $0 \leq x < 450$, where x is a whole number

B. $0 \leq x \leq 450$, where x is a whole number

C. $0 < x < 376$ where x is a whole number

D. $0 \leq x \leq 376$, where x is a whole number

Part D

The materials for each nesting box cost a total of $11.75. Write a function $P(s)$ for the profit the Ryans earn when they sell s nesting boxes.

Enter your function in the space provided. Enter **only** your function.

$P(s) =$ ☐

VH002841Y

21. Melissa has a savings account. She deposited $1,000 into the account the first year. For each year after the first, she plans to deposit an amount that is 2 percent greater than the amount deposited the preceding year. If she makes no other deposits, the total amount of the deposited money in year *n* is the sum S_n of a geometric series of *n* terms.

Part A

The formula for S_n can be expressed as $\frac{1{,}000(1-r^n)}{1-r}$. Use the information given about Melissa's account to determine the value of *r*.

Enter your answer in the box.

Part B

Melissa will have deposited approximately how much by year 30?

- A. $30,000
- B. $35,729
- C. $40,568
- D. $87,453

M40370

22. Which expression is equivalent to $162x^4 - 144x^2 + 32$?

Select **all** that apply.

- A. $2(81x^2 - 72x + 16)$
- B. $2(81x^2 + 4)(81x^2 + 4)$
- C. $2(81x^2 - 4)(81x^2 + 4)$
- D. $2(9x^2 - 4)(9x^2 - 4)$
- E. $2(9x^2 + 4)(9x^2 + 4)$
- F. $2(3x + 2)^2(3x - 2)^2$

23. An antique chair was purchased in the year 2013 for $500. At the time of purchase, an appraiser estimated that the value would increase by 10% per year.

Part A

According to the appraiser's estimate about the value of the chair, which statements are true?

Select **all** such statements.

- [ ] A. The value will increase by $50 in the first year.
- [ ] B. After 2 years the value will be $605.
- [ ] C. The value will increase by 30% in the first 3 years.
- [ ] D. The rate of change of the value will decrease over time.
- [ ] E. A linear model provides the best fit of the estimated values.

Part B

Let the appraiser's estimated dollar value of the chair t years after purchase be modeled by the function $f(t) = ab^t$ where a and b are constants. What are the values of a and b ?

- ○ A. $500(0.1)^t$
- ○ B. $500(0.9)^t$
- ○ C. $500(1.1)^t$
- ○ D. $500(10)^t$

Part C

According to the model, what will be the value of the chair 5 years after purchase? Give your answer to the nearest dollar.

Enter your answer in the box.

$ [ ]

Part D

According to the model, what is the average rate of change, in dollars per year, of the estimated value of the chair over the first 5-year period? Give your answer to the nearest dollar.

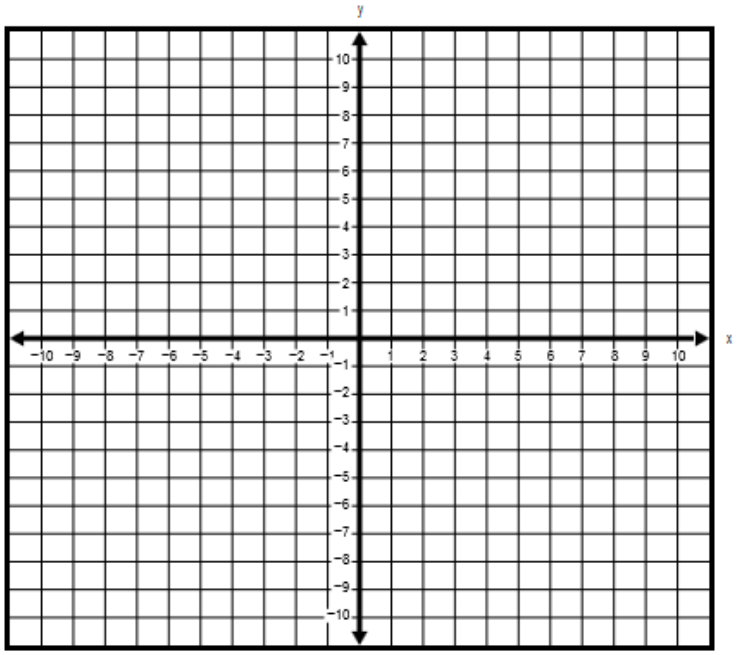
Enter your answer in the box.

$ [ ] per year

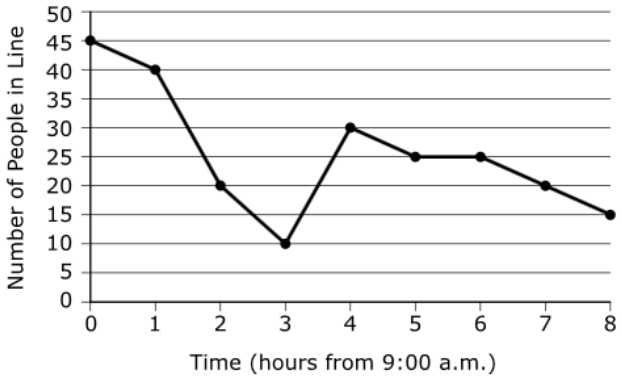
24. Create the approximate graph of the quadratic function with x-intercepts at $(-5, 0)$ and $(3, 0)$ and a y-intercept at $(0, -7.5)$.

1. Select a button to choose the graph type.
2. Drag the two points to the correct position.

Quadratic



25. A ticket window at a theater opened at 9:00 a.m. and closed at 5:00 p.m. At the beginning of each hour, the number of people in line was recorded. The graph shows the number of people in line as a function of the time, where $t = 0$ represents 9:00 a.m. and $t = 8$ represents 5:00 p.m.



Part A

Based on the graph, how many hours after the ticket window opened did the number of people in line reach a minimum before increasing?

Enter your answer in the box.

Part B

The number of people in line at time t can be modeled by the cubic function $f(t) = -0.40t^3 + 5.44t^2 - 21.93t + 48.18$. Based on the model, how many hours after the ticket window opened did the number of people in line reach a minimum before increasing?

Give your answer to the nearest tenth of an hour.

Enter your answer in the box.

Part C

At 11:00 a.m., approximately what was the difference between the number of people in line as recorded on the graph and the number of people in line as predicted by the model $f(t)$?

- A. -5
- B. -3
- C. 0
- D. 5

Part D

Based on the model $f(t)$, for what values of t is the number of people in line predicted to be increasing?

Select **all** intervals that apply.

- A. $0 < t < 1$
- B. $1 < t < 2$
- C. $2 < t < 3$
- D. $3 < t < 4$
- E. $4 < t < 5$
- F. $5 < t < 6$
- G. $6 < t < 7$

26. A quiz in math class consisted of 5 true or false questions. Only 4 out of 30 students in Mr. Denario's class got all 5 questions correct. Mr. Denario used a simulation of flipping a coin to represent the results of his class quiz. He used heads to represent a correct answer and tails to represent an incorrect answer. He flipped 5 coins to represent the 5 problems on the quiz and recorded the number of heads in each group of 5 coins. He repeated the simulation 100 times and recorded the results in this table.

Total Number of Heads	Number of Samples (out of 100 samples)
0	2
1	25
2	22
3	34
4	13
5	4

Which conclusion is supported by the data for the class and the simulation?

A. The simulation model is consistent with the class data because in both the observed class results and the simulation model the result of all heads on all 5 problems correct was 4.

B. The simulation model is consistent with the class data because each coin flipped and each question on the test had only two outcomes and an equal chance of getting either outcome.

C. The simulation model is not consistent with the class data because there are 30 students in the class and there were 100 samples in the coin simulation.

D. The simulation model is not consistent with the class data because the observed class results had 13% of the students with all 5 problems correct, and the simulation model only had 4% of the samples with all 5 heads.

VF649980

27. The weight of a bag of Brand A cookies is labeled as 4 ounces on the bag. However, the actual weights of the bags vary by a small amount. According to the packaging specifications, the weights are approximately normally distributed with a mean of 4.10 ounces and a standard deviation of 0.10 ounce.

Part A

Select the number to complete the sentence.

According to the specifications, approximately Choose.. percent of the bags weigh 4.00 ounces or more.

- 25
- 34
- 50
- 84

Part B

During a quality control check on the bag weights, a bag was found that weighed 3.95 ounces. How many standard deviations below the mean was the bag weight?

Enter your answer in the box.

[ ] standard deviations

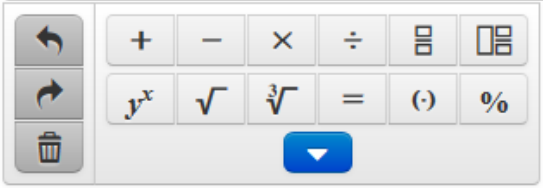
M42696

28. Data were collected on the number of kilowatt-hours (kWh) of electricity customers used each month. The data were fit into a function. The function $f(x) = 650\sin(0.6x - 2.8) + 962$ gives the number of kWh of electricity used during month x. Month 1 corresponds to January.

The electric company charges $0.0715 per kWh up to 500 kWh. Then the company charges $0.1042 per kWh for kWh used above 500. The company also charges $8.00 in fees. How many kWh would a customer use in April, and what would the total cost be?

Enter your answers in the space provided. Enter **only** your answers.

kWh used in April : ☐
Total cost for April : ☐



29. The management of a furniture store chain wanted to determine which color of couch adults in the United States preferred. The management conducted a survey of a random sample of adults in the United States. The number of people who preferred each color is shown in the table.

Color of Couch Preferred

Color	Number of People
black	143
blue	108
brown	210
green	93
red	126
white	204

Part A

What is the population of the study?

- A. the color of couch preferred
- B. all adults in the United States
- C. 884 adults selected at random
- D. the adults surveyed who preferred blue

Part B

What is the estimated proportion of the population that prefers brown couches? Round your answer to the nearest tenth of a percent.

Enter your answer in the box.

[ ] %

M40072

30. Let $f(x) = -x + 3$ and $g(x) = 3|x| - 1$. Where do the graphs of $f(x)$ and $g(x)$ intersect?

Enter your answer in the boxes.

(☐ , ☐) (☐ , ☐)

M42981

31. Which of the equations have only real solutions?

Select **each** equation with real solutions.

- ☐ A. $(x-7)^2 = 0$
- ☐ B. $3x^2 + 7 = 4x$
- ☐ C. $x = \frac{3 \pm \sqrt{-3}}{2}$
- ☐ D. $x = \frac{-18 \pm \sqrt{18^2 - 4(3)(4)}}{2(3)}$
- ☐ E. $(x+2)(x-6) = -18$
- ☐ F. $x^2 + 8x = -8$

32. **Part A**

Write the expression $j^4 - 16 + (j^2 - 4)^2$ without parenthesis and with all like terms combined.

Enter your answer in the space provided.

Part B

Which expressions are equivalent to the expression $j^4 - 16 + (j^2 - 4)^2$?

Select **all** that apply.

- ☐ A. $(j^2 - 4)(j^2 + 4)$
- ☐ B. $2j^2(j + 2)(j - 2)$
- ☐ C. $(j - 2)(j + 2)(j^2 + 4)$
- ☐ D. $(j^2 + 4)(j^2 - 4)(j^2 - 4)^2$
- ☐ E. $(j^2 - 4)(j^2 + 4 + j^2 - 4)$
- ☐ F. $(j^2 + 4)(j^2 - 4) + (j^2 - 4)^2$

33. A company is starting a scholarship fund for its employees. The company will add to the fund on a yearly basis. Each year, it will increase the amount added to the fund the previous year by 10%. The amount in the scholarship fund after 4 years is $2,552.55.

Part A

To the nearest dollar, how much did the company add to the scholarship fund in the first year?

- A. $182
- B. $550
- C. $742
- D. $2,298

Part B

If the company decided to change the amount added the first year to $1,000 and then increase the amount added by 10% each year, what would be the average amount of whole dollars per year added to the fund over the first 10 years?

Enter your answer in the box.