

TEST NAME: **A-SSE.2**  
TEST ID: **511298**  
GRADE: **09**  
SUBJECT: **Mathematics**  
TEST CATEGORY: **My Classroom**

Student: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

Read the passage - 'Paper Airplane Contest' - and answer the question below:

**Paper Airplane Contest**

Paper Airplane Contest

Jenna read an article in a magazine about a paper airplane contest. The article referenced an internet site about the records for distance and time aloft (time in the air) for paper airplanes. The record for distance, 226 feet 10 inches, was set in California in 2012. The record for time in the air, 29.2 seconds, was set in 2010 in Japan.

The magazine article also gave the requirements for hosting a contest that would have two events. The first event is a competition to find which paper airplane flies the longest distance, and the second event is a competition to find which paper airplane stays in the air the longest amount of time. Jenna asked her teacher if her class could host a paper airplane contest with the two events, and the teacher agreed. Rosa and Alex helped Jenna make posters announcing the contest.

**PAPER AIRPLANE CONTEST**  
Sponsored by Math Department

Enter your best paper airplanes in the contest.  
Enter as an individual or as a team.

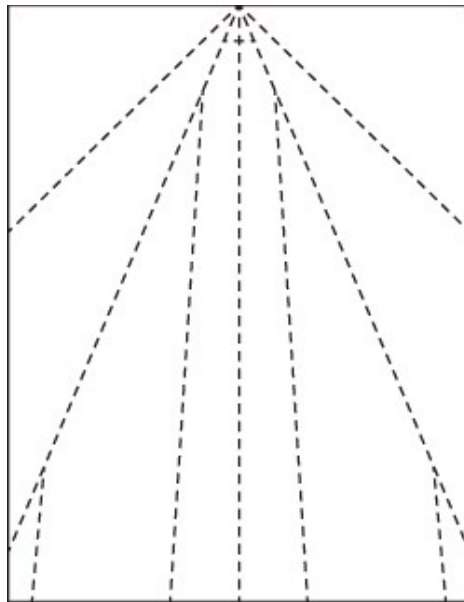
Enter one plane in each category:

- Distance
- Time aloft

Use only the following materials to build your airplane:

- One or two standard-size sheets of copy paper (required)
- One standard paper clip (optional)
- Three inches of tape (optional)
- A dab of glue (optional)
- Three staples (optional)

Rosa found a book with patterns for paper airplanes using a standard 8.5-by-11-inch sheet of paper. The three friends tried several different patterns. One of the patterns Alex chose is shown in this figure.



Jenna, Alex, and Rosa practiced with their paper airplanes and recorded the time and distance for each paper airplane. Each person chose one paper airplane that flew further than the others to compete in the distance competition. This table shows the best distances for the paper airplanes they chose for distance.

**PAPER AIRPLANE PRACTICE DISTANCES**

	<b>Best Distance</b>	<b>Second-Best Distance</b>	<b>Third-Best Distance</b>
<b>Jenna</b>	24 feet	18 feet	16 feet
<b>Alex</b>	19 feet	18 feet	14 feet
<b>Rosa</b>	18 feet	11 feet	9 feet

Each friend also chose a plane that stayed in the air longer than the others for the time aloft competition. This table shows the best times for the paper airplanes they chose for time aloft.

**PAPER AIRPLANE PRACTICE TIMES**

	<b>Best Time</b>	<b>Second-Best Time</b>	<b>Third-Best Time</b>
<b>Jenna</b>	8 seconds	6 seconds	5 seconds
<b>Alex</b>	5 seconds	3 seconds	3 seconds
<b>Rosa</b>	11 seconds	9 seconds	5 seconds

The day of the contest finally arrived, and 12 students had entered the contest. The distance competition was first, and Rosa’s plane won when her paper airplane flew 50% farther than the mean of the three best distances in the table of practice distances. The winner of the time aloft competition was Alex's paper airplane, which stayed in the air 3 seconds longer than the mean of the three best times in the table of practice times.

The students all agreed that the paper airplane contest was a big success.

Alex has some ideas for new patterns for paper airplanes that will fly farther, and Rosa wants a paper airplane that will stay in the air longer for the contest next year.

1. Read "Paper Airplane Contest" and answer the questions.

The flight path of Alex's paper airplane is modeled by the quadratic equation  $y = -\frac{x^2}{2} + 5x + \frac{11}{2}$ , where  $y$  is the height, in feet, after  $x$  seconds.

Part A. What is the shape of the graph of  $y = -\frac{x^2}{2} + 5x + \frac{11}{2}$ ? Identify the  $y$ -intercept and any  $x$ -intercepts.

Part B. Use an appropriate factoring technique to rewrite the equation in vertex form.

Part C. Do we know the maximum height of the path of Alex's airplane? Do we know how far away the plane is, horizontally, at the point of maximum height? Explain your answer.

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Read the passage - 'Kevin's Used Car' - and answer the question below:

#### Kevin's Used Car

##### Kevin's Used Car

Kevin is planning to buy a used car. He searches online to find used cars that he can afford. Kevin has \$1,500 in savings and plans to borrow no more than \$6,000.

Next, Kevin investigates different loans that he could use to help him buy the car. In order to figure out how much money he needs to borrow, he needs to know the price of the car he plans to buy, as well as the cost of the title, the registration fees, and the taxes, all of which vary from one state or city to another. He will also need to decide the amount of money he will spend from his savings.

Kevin's local bank offers him a 4-year loan at 4.75% annual percentage rate (APR) with a \$90 application fee. He searches for a better auto loan rate online. Whatever rate Kevin can find, his monthly car payment,  $M$ , will be computed by the formula,

$$M = P \times \frac{\left(\frac{r}{12}\right)\left(1 + \frac{r}{12}\right)^n}{\left(1 + \frac{r}{12}\right)^n - 1}$$

where  $P$  is the amount of money he will borrow,  $r$  is the APR for the loan (expressed as a decimal rather than as a percent), and  $n$  is the number of months for the loan. (In this case,  $\left(\frac{r}{12}\right)$  is a close approximation of the loan's monthly interest rate.)

Kevin is uncomfortable paying for the car for the next four years, so he plans to make additional payments to pay the loan off faster. He hopes that this accelerated schedule will lower the total amount of interest he pays on the car loan by decreasing the outstanding principal (that is, the amount of the loan he still has to pay back). However, some car loans do not allow "prepayments." That is, if Kevin overpays a loan payment, the additional money will go toward his next payment.

2. Read "Kevin's Used Car" and answer the question.

Which expression is equivalent to  $P \cdot \frac{\left(\frac{r}{12}\right)\left(1 + \frac{r}{12}\right)^n}{\left(1 + \frac{r}{12}\right)^n - 1}$ ?

A.  $\frac{-Pr}{12}$

B.  $\frac{\frac{Pr}{12}\left(\frac{1+r}{12}\right)^n}{\left(\frac{1+r}{12}\right)^n - 1}$

C.  $\frac{\frac{Pr}{12}\left(\frac{12+r}{12}\right)^n}{\left(\frac{12+r}{12}\right)^n - 1}$

D.  $\frac{\left(\frac{12Pr + Pr^2}{12}\right)^n}{\left(\frac{12+r}{12}\right)^n - 1}$

Read the passage - 'Kevin's Used Car' - and answer the question below:

3. Read "Kevin's Used Car" and answer the questions.

**Part A**

Rewrite  $\left(1 + \frac{r}{12}\right)^{48} - 1$  as the difference of two squares. Show your work.

**Part B**

What value goes in the position of the missing exponent? Show your work.

$$\left(1 + \frac{r}{12}\right)^n = \left(1 + \frac{r}{12}\right)\left(1 + \frac{r}{12}\right)^\square$$

**Part C**

Assume Kevin takes out a 4-year loan with monthly payments. Let  $r$  represent his annual interest rate. After three months, by what factor is his current debt reduced?

4. Which expression is equivalent to  $r^2 + r - 2$ ?

- A.  $(r + 2)(r + 1)$
- B.  $(r - 2)(r + 1)$
- C.  $(r + 2)(r - 1)$
- D.  $(r - 2)(r - 1)$

5. Which expression is equivalent to  $x^2 - 64$ ?

- A.  $(x - 8)(x - 8)$
- B.  $(x - 8)(x + 8)$
- C.  $(x - 4)(x - 16)$
- D.  $(x - 4)(x + 16)$

6. Which expression is equivalent to  $2x^2 - 72$ ?
- A.  $(2x - 9)(x - 8)$
  - B.  $(2x - 9)(x + 8)$
  - C.  $2(x - 6)(x - 6)$
  - D.  $2(x - 6)(x + 6)$
7. Which expression is equivalent to  $7x^2 - 35x - 42$ ?
- A.  $7(x - 6)(x + 1)$
  - B.  $7(x - 1)(x + 6)$
  - C.  $7(x - 3)(x - 2)$
  - D.  $7(x + 3)(x - 2)$
8. Which expression is equivalent to  $x^2 - 49$ ?
- A.  $(x + 24.5)(x - 24.5)$
  - B.  $(x - 24.5)(x - 24.5)$
  - C.  $(x - 7)(x - 7)$
  - D.  $(x - 7)(x + 7)$
9. Which expression is equivalent to  $100 - 4x^2$ ?
- A.  $4(5 - x)(5 + x)$
  - B.  $4(5 - x)^2$
  - C.  $4(x - 5)^2$
  - D.  $4(x + 5)(x - 5)$

10. Derick said that  $x^8 - x^6$  can be written as the difference of two squares. Which equation proves Derick's statement?
- A.  $x^8 - x^6 = (x^2)^6 - (x^2)^4$
  - B.  $x^8 - x^6 = (x^2)^4 - (x^2)^3$
  - C.  $x^8 - x^6 = (x^6)^2 - (x^4)^2$
  - D.  $x^8 - x^6 = (x^4)^2 - (x^3)^2$
11. Which expression is equivalent to  $6x^2 + 7x - 3$ ?
- A.  $(6x - 1)(x + 3)$
  - B.  $(6x + 1)(x - 3)$
  - C.  $(3x - 1)(2x + 3)$
  - D.  $(3x - 3)(2x + 1)$
12. If  $\frac{1}{x^2 + bx + c}$  can be rewritten as  $\frac{1}{(x + 6)(x - 6)}$ , where  $x \neq 6$  and  $-6$ , what are the values of  $b$  and  $c$ ?
- A.  $b = 0, c = 36$
  - B.  $b = 0, c = -36$
  - C.  $b = 12, c = 36$
  - D.  $b = -12, c = -36$
13. Which expression is a factor of  $2x^2 - 13x + 15$ ?
- A.  $2x + 15$
  - B.  $2x + 5$
  - C.  $x - 5$
  - D.  $x - 3$



14. Which expression is equivalent to  $x^2 + 5x - 24$ ?
- A.  $(x + 8)(x + 3)$
  - B.  $(x - 8)(x + 3)$
  - C.  $(x - 8)(x - 3)$
  - D.  $(x + 8)(x - 3)$
15. Which expression is equivalent to  $x^2 - 16x + 60$ ?
- A.  $(x - 12)(x - 5)$
  - B.  $(x + 20)(x - 3)$
  - C.  $(x - 15)(x - 4)$
  - D.  $(x - 10)(x - 6)$
16. Which expression is equivalent to  $7r^2 - 43rs + 6s^2$ ?
- A.  $(r + 6s)(7r - s)$
  - B.  $(r - s)(7r - 6s)$
  - C.  $(r - 2s)(7r - 3s)$
  - D.  $(r - 6s)(7r - s)$
17. Which expression is equivalent to  $4x^2 + 12xy + 9y^2$ ?
- A.  $(2x + 3y)^2$
  - B.  $(4x + 9y)^2$
  - C.  $(2x)^2 + (3y)^2$
  - D.  $(4x)^2 + (9y)^2$
18. Which expression is equivalent to  $a^2 + 2a - 8$ ?
- A.  $(a + 2)(a - 4)$
  - B.  $(a + 4)(a - 2)$
  - C.  $(a + 1)(a - 8)$
  - D.  $(a - 1)(a + 8)$

19. Which expression is equivalent to  $2x^2 - 18x + 28$ ?

- A.  $(2x - 7)(x - 4)$
- B.  $(2x + 7)(x - 4)$
- C.  $2(x - 7)(x - 2)$
- D.  $2(x + 7)(x - 2)$

20. How can the following expression be rewritten so it is equal to  $a^2 + b^2$ , where  $a$  and  $b$  are binomials?

$$5x^2 + 14xy + 26y^2$$

- A.  $(x^2 + 2xy + y^2) + (4x^2 + 4xy + y^2)$
- B.  $(x^2 + 4xy + y^2) + (4x^2 + 10xy + 25y^2)$
- C.  $(x^2 + 10xy + 25y^2) + (4x^2 + 4xy + y^2)$
- D.  $(2x^2 + 7xy + 12y^2) + (3x^2 + 7xy + 14y^2)$

21. Use the given equation to solve part A and part B.

$$f(x) = x^4 + 64$$

Part A. If  $f(x)$  is expressed as  $[p(x)]^2 - [q(x)]^2$ , find  $p(x)$  and  $q(x)$ .

Part B. What are the values of  $c$  and  $d$  if  $f(x) = (c + 8)(d + 8)$ ?

Use words, numbers, and/or pictures to show your work.

22. What are the factors of the expression  $e^{4x} + 4e^{2x} + 4 - y^2$ ?

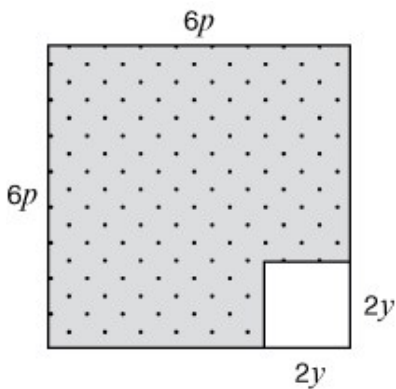
23. Which expression is equivalent to  $121 - m^2$ ?

- A.  $(-1)(m + 11)(m + 11)$
- B.  $(m + 11)(m - 11)$
- C.  $(11 - m)(11 - m)$
- D.  $(11 + m)(11 - m)$

24. Which expression is equivalent to  $x^2 - y^2$ ?

- A.  $(x - y)(x - y)$
- B.  $(x + y)(x - y)$
- C.  $(x + y)(x + y)$
- D.  $2(x - y)$

25. The floor plan of a daycare center is shown below. The arts-and-crafts area in the lower right corner is NOT carpeted. The rest of the center is carpeted.



Part A. Write an expression, in factored form, for the area of the floor that is carpeted.

Part B. What would be the area of the carpeted floor, in factored form, if the arts-and-crafts area was increased to a square with an area of  $9y^2$  units?

Use words, numbers, and/or pictures to show your work.

26. Which expression is equivalent to the expression  $(x+y)^2 - (x-y)^2$ ?
- A. 0
  - B.  $2x^2$
  - C.  $2y^2$
  - D.  $4xy$
27. If the expression  $e^{4x} + 4e^{2x} + 4$  was rewritten in the form  $(a + b)^2$ , what would be the values of  $a$  and  $b$ ?
- A.  $a = e^{2x}, b = 2$
  - B.  $a = e^{4x}, b = 4$
  - C.  $a = e^{x^2}, b = 2$
  - D.  $a = e^{4x^2}, b = 4$
28. Which expression is equivalent to  $14x^2 - 29x - 15$ ?
- A.  $(2x + 5)(7x - 3)$
  - B.  $(2x - 5)(7x + 3)$
  - C.  $(14x + 5)(x - 3)$
  - D.  $(14x - 5)(x + 3)$
29. Which expression is equivalent to  $-10x^2 - 35x + 75$ ?
- A.  $-5(2x - 5)(x + 3)$
  - B.  $-5(2x - 3)(x + 5)$
  - C.  $5(2x - 5)(x + 3)$
  - D.  $5(2x - 3)(x + 5)$

30. Which expression is equivalent to  $2x^2 - 18x - 20$ ?
- A.  $2(x - 20)(x + 1)$
  - B.  $2(x - 5)(x + 4)$
  - C.  $2(x - 1)(x + 10)$
  - D.  $2(x - 10)(x + 1)$
31. Which expression is equivalent to the expression  $(x^2 - y^2)^2$ ?
- A.  $(x^2 + y^2)(x + y)(x - y)$
  - B.  $(x + y)^2(x - y)^2$
  - C.  $2(x + y)(x - y)$
  - D.  $x^4 - y^4$
32. Which expression is equivalent to  $(x + 4)^4 - (x - 1)^4$ ?
- A.  $3(2x + 5)(2x^2 + 10x + 17)$
  - B.  $5(2x + 5)(2x^2 + 10x + 17)$
  - C.  $3(2x + 3)(2x^2 + 6x + 17)$
  - D.  $5(2x + 3)(2x^2 + 6x + 17)$
33. Which expression is equivalent to  $12x^2 + 16x - 35$ ?
- A.  $(6x + 7)(2x - 5)$
  - B.  $(3x + 7)(4x - 5)$
  - C.  $(2x + 5)(6x - 7)$
  - D.  $(4x - 5)(3x - 7)$

34. Which expression is equivalent to  $4t^2 - 16$ ?
- A.  $4(t - 4)(t - 4)$
  - B.  $4(t + 4)(t - 4)$
  - C.  $4(t + 2)(t - 2)$
  - D.  $4(t - 2)(t - 2)$
35. For all  $x \neq 2$ , which expression is equivalent to  $\frac{x^4 - 16}{x - 2}$ ?
- A.  $x^3 + 8$
  - B.  $(x - 2)^3$
  - C.  $\frac{(x^2 - 4)^2}{(x - 2)}$
  - D.  $(x + 2)(x^2 + 4)$
36. Which expression is equivalent to  $4x^2 - 121$ ?
- A.  $(2x - 11)(2x - 11)$
  - B.  $(2x - 11)(2x + 11)$
  - C.  $(4x - 11)(x - 11)$
  - D.  $(4x - 11)(x + 11)$
37. What are the values of  $a$ ,  $b$ , and  $c$  in the equation  $4(x - 2)^2 - 7 = ax^2 + bx + c$ ?
- A.  $a = 4; b = -4; c = -3$
  - B.  $a = 4; b = 4; c = -3$
  - C.  $a = 4; b = 16; c = 9$
  - D.  $a = 4; b = -16; c = 9$

38. Which expression is equivalent to  $6x^2 - 29x + 28$ ?
- A.  $(6x - 7)(x + 4)$
  - B.  $(6x - 7)(x - 4)$
  - C.  $(2x - 7)(3x + 4)$
  - D.  $(2x - 7)(3x - 4)$
39. Which expression is equivalent to  $4(x - 2)^2 + 16(x - 2)$ ?
- A.  $4(x^2 + 12)$
  - B.  $4(x^2 - 4)$
  - C.  $4(x^2 + 8x - 4)$
  - D.  $4(x^2 + 4x - 12)$
40. How can the expression  $48x^4 - 1875y^4$  be written as the product of four factors?
41. Which expression is equivalent to  $8x^2 + 26x - 7$ ?
- A.  $(8x - 1)(x + 7)$
  - B.  $(4x + 7)(2x - 1)$
  - C.  $(8x + 7)(x - 1)$
  - D.  $(4x - 1)(2x + 7)$
42. Part A. Use the completing the square method to rewrite an expression equivalent to  $a^{2b} + 6a^b + 8$ .

Part B. Use the difference of squares method to write the expression you found in Part A in an equivalent form. Explain another way you could have gotten to this expression without using completing the square and difference of squares.

Use words, numbers, and/or pictures to show your work.

43. Which expression is equivalent to  $y^3 + 4y^2 - 21y$ ?
- A.  $(y^2 - 3)(y + 7)$
  - B.  $(y^2 + 3)(y - 7)$
  - C.  $y(y - 3)(y + 7)$
  - D.  $y(y + 3)(y - 7)$
44. Which expression is equivalent to  $x^2 - 4y^2$ ?
- A.  $(x + 2y)(x - 2y)$
  - B.  $(x - 2y)(x - 2y)$
  - C.  $(x + y)(x - 4y)$
  - D.  $(x + 4y)(x - y)$
45. Which of the following expressions is equivalent to  $25b^{16} - 64c^2$ ?
- A.  $(5b^4 - 8c)(5b^4 - 8c)$
  - B.  $(5b^4 + 8c)(5b^4 - 8c)$
  - C.  $(5b^8 - 8c)(5b^8 - 8c)$
  - D.  $(5b^8 + 8c)(5b^8 - 8c)$
46. Which expression is equivalent to  $(x^4 - 1)^2$ ?
- A.  $(x^4 - 2x^2 + 1)(x^4 + 2x^2 + 1)$
  - B.  $(x^2 - 2x + 1)(x^2 + 2x + 1)$
  - C.  $x^6 - 1$
  - D.  $x^8 - 1$
47. If  $x^2 + y^2 + 2xy - 9$  is factored as  $(a + b)(a - b)$ , what are the values of  $a$  and  $b$ ?



48. Which statement is true about the expression  $54x^3 - 16y^3$ ?
- A. It is the product of 2 and the difference of 2 perfect cubes.
  - B. It is the product of  $2x$  and the difference of 2 perfect squares.
  - C. It is the product of 3 and the difference of 2 perfect cubes.
  - D. It is the product of  $3x$  and the difference of 2 perfect squares.
49. Which expression is a factor of  $a^2 - a - 30$ ?
- A.  $a - 5$
  - B.  $a - 2$
  - C.  $a + 5$
  - D.  $a + 6$
50. Which expression is equivalent to  $4x^2 + x - 3$ ?
- A.  $(4x - 3)(x + 1)$
  - B.  $(4x + 3)(x - 1)$
  - C.  $(2x - 3)(2x + 1)$
  - D.  $(2x + 3)(2x - 1)$
51. Which expression is equivalent to  $12r^2 + r - 35$ ?
- A.  $(2r - 5)(6r + 7)$
  - B.  $(2r + 5)(6r - 7)$
  - C.  $(3r - 5)(4r + 7)$
  - D.  $(3r + 5)(4r - 7)$
52. Which expression is equivalent to  $y^2 - 25$ ?
- A.  $(y - 5)(y - 5)$
  - B.  $(y - 5)(y + 5)$
  - C.  $(y - 25)(y - 1)$
  - D.  $(y - 25)(y + 5)$

53. The expression  $x^4 - 16$  is equivalent to the product of  $(x + 2)$  and  $p(x)$ . Which expression could represent  $p(x)$ ?
- A.  $(x^3 - 2)$
  - B.  $(x^3 + 8)$
  - C.  $(x^2 - 4)(x + 2)$
  - D.  $(x^2 + 4)(x - 2)$
54. Which expression is equivalent to  $15x^2 + 32x - 28$ ?
- A.  $(3x + 4)(5x - 7)$
  - B.  $(3x - 4)(5x + 7)$
  - C.  $(3x + 2)(5x - 14)$
  - D.  $(3x - 2)(5x + 14)$
55. Which expression is equivalent to  $8x^2 + 3x - 5$ ?
- A.  $(4x - 5)(2x + 1)$
  - B.  $(4x + 5)(2x - 1)$
  - C.  $(8x - 5)(x + 1)$
  - D.  $(8x + 5)(x - 1)$
56. Which of these expressions is equivalent to  $2x^3 - 8x^2 - 3x + 12$ ?
- $2x^3 - 8x^2 - 3x + 12$ ?
- A.  $(2x^2 - 3)(x - 4)(2x^2 - 3)(x - 4)$
  - B.  $(2x^2 + 3)(x - 4)(2x^2 + 3)(x - 4)$
  - C.  $2(x^3 - 4x^2 - x + 6)2(x^3 - 4x^2 - x + 6)$
  - D.  $2x(x^2 - 4x - 1 + 6)2x(x^2 - 4x - 1 + 6)$

57. Which expression is equivalent to  $6x^2 + x - 1$ ?

- A.  $(2x - 1)(3x + 1)$
- B.  $(2x + 1)(3x - 1)$
- C.  $(6x + 1)(x - 1)$
- D.  $(6x - 1)(x + 1)$

58. Which expression is equivalent to  $3x^2 + 4x - 15$ ?

- A.  $(3x - 5)(x + 3)$
- B.  $(3x + 5)(x - 3)$
- C.  $(3x - 1)(x + 15)$
- D.  $(3x + 1)(x - 15)$

59. Which expression is equivalent to  $x^2 - 12x + 36$ ?

- A.  $(x + 9)(x - 4)$
- B.  $(x - 9)(x - 4)$
- C.  $(x + 6)(x - 6)$
- D.  $(x - 6)(x - 6)$