

**Arkansas Council of Teachers of Mathematics**  
**Regional Algebra I Contest**  
**March 3, 2012**

For questions 1 through 25, mark your answer choice on the answer sheet provided. Make sure that any erasures are cleanly erased and that no stray marks are on the answer grid. After completing items 1 through 25, answer each of the tie-breaker items in sequential order (do #1 first, followed by #2, and then #3 last). Be sure that your name is printed on each of the tiebreaker pages.

1. Evaluate the following expression if  $r = -5, s = 2, t = 7, v = 1, w = 8$

$$(r + w)^2 - \frac{vt}{s + r}$$

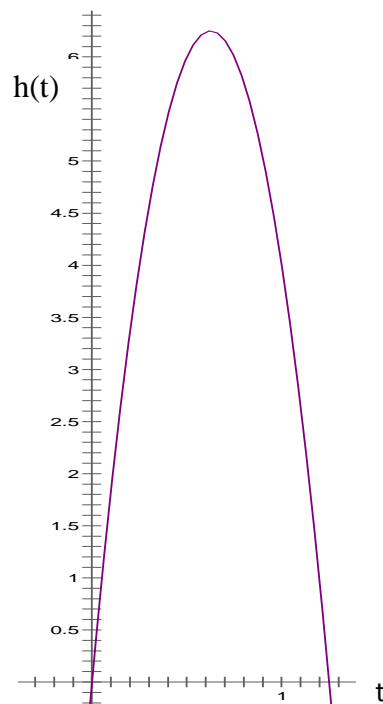
- a)  $\frac{2}{3}$   
 b)  $\frac{16}{3}$   
 c)  $\frac{20}{7}$   
 d)  $\frac{34}{3}$   
 e) None of the above.
2. At *Candy Kitchen* a  $2\frac{1}{4}$  pound bag of roasted nuts normally costs \$6.00. The store is currently offering a 15% seasonal discount on all of its products. At this rate, what is the cost of a bag of nuts weighing 9 ounces rounded to the nearest cent?

- a) \$ 0.15  
 b) \$ 0.24  
 c) \$ 1.28  
 d) \$ 1.50  
 e) \$12.75

3. The function  $h = -16t^2 + 20t$  represents the relationship between the height of an object  $h$ , and the time in the air  $t$ . Shown to the right is the graph of  $h = -16t^2 + 20t$  for  $0 \leq t \leq 1.4$ . Identify any local extrema and zero(s) to two decimal places. What does the  $t$ -coordinate of the zero(s) represent?

- a) Max: (6,1)  
 Zero: (.63, 6.25)  
 $t$ -coordinate represents: When the object hits the ground.  
 b) Max: (1, 6)  
 Zero: (0,0) & (1.25,0)  
 $t$ -coordinate represents: When the object hits the ground.

(See next page for choices c, d, and e)



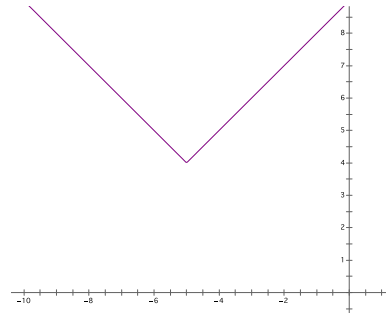
- c) Max: (.63, 6.25)  
Zero: (1.5,0) & (0,0)  
t-coordinate represents: The times at which the object hits the ground.
- d) Max: (.63, 6.25)  
Zero: (0,0) & (1.25,0)  
t-coordinate represents: The time for the initial position of the object and the time when the object hits the ground after being thrown.
- e) None of the above

4. Given the sequence -2, 1, 4, 7, ... what is the sum of the second and seventh terms?

- a) 10  
b) 13  
c) 14  
d) 17  
e) 51

5. If the graph is reflected over the x-axis, which is the equation of the reflected function?

- a)  $y = -|x + 5| + 4$   
b)  $y = |x - 5| + 4$   
c)  $y = -(|x + 5| + 4)$   
d)  $y = -|x - 5| - 4$   
e)  $y = |x + 5| + 4$



6. Which of the following represents an equation in which the sum of three consecutive even numbers equal 24?

- a)  $y + y + 1 + y + 2 = 24$   
b) If  $y = 2x$  then  $2x + (2x + 2) + (2x + 4) = 24$   
c)  $y + y + 2 + y + 4 = 24$   
d) Both b and c.  
e) All of the above.

7. The temperature from a factory furnace varies inversely as the square of the distance from the furnace. The temperature at 2 meters from the furnace is 50 degrees Celsius. Calculate the temperature 3.5 meters from the furnace. Round your answer to 2 decimal places.

- a) 15.33° C                      c) 29.39° C                      e) 61.39° C  
b) 16.33° C                      d) 43.75° C

8. A bag contains tiles with the numbers 1 – 30 on them. You randomly choose a tile from the bag. What is the probability that you choose an odd number or number that is a multiple of 4?

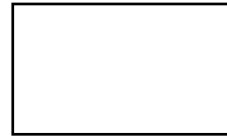
- a)  $\frac{11}{30}$
- b)  $\frac{1}{2}$
- c)  $\frac{2}{3}$
- d)  $\frac{11}{15}$
- e)  $\frac{3}{4}$

9. Which statement is NOT equivalent to  $\sqrt{4y^2 - 4y + 1} = 4$ .

- a)  $(2y - 1)^2 = 4^2$
- b)  $(y - \frac{1}{2})^2 = 4$
- c)  $y^2 - y + \frac{1}{4} = 4$
- d)  $y = \frac{1}{2}$
- e) All statements are equivalent.

10. What is the perimeter of the rectangle?

$$3\sqrt{7}$$



$$2\sqrt{3}$$

- a)  $\sqrt{21}$
- b)  $4\sqrt{3} + 6\sqrt{7}$
- c)  $10\sqrt{21}$
- d)  $10\sqrt{20}$
- e) None of the above

11. What can you determine about the graph of two lines represented by the following?

$$4x + 6y = 18$$

$$2x + 3y = 6$$

- a) The lines are perpendicular
- b) The lines are parallel
- c) The lines are neither parallel nor perpendicular
- d) The equations represent the same line
- e) None of the above

12. A rope of length  $\frac{7}{x-6}$  cm was cut into two pieces. If one piece is  $\frac{2}{x+6}$  cm, express the length of the other piece of rope as a rational expression.

- a)  $\frac{9x+30}{x^2-36}$
- b)  $\frac{5}{x+6}$
- c)  $\frac{9}{x-6}$
- d)  $\frac{5x+54}{x^2-36}$
- e)  $-\frac{5}{12}$

13. A Mars year is longer than an Earth year because Mars takes longer to orbit the sun. The table shows a person's age in both Earth years and Mars years. The data represent which kind of function?

<b>Earth</b>	10	20	30	40	50
<b>Mars</b>	5.3	10.6	15.9	21.2	26.5

- a) Linear function
  - b) Quadratic function
  - c) Exponential function
  - d) Rational function
  - e) None of the above
14. Tom's solution to an equation is shown below.  
Given:  $x^2 - 6x - 12 = 0$

$$\text{Step 1: } \frac{6 \pm \sqrt{(-6)^2 - 4 \cdot 1 \cdot -12}}{2 \cdot 1}$$

$$\text{Step 2: } \frac{6 \pm \sqrt{-36 - -48}}{2}$$

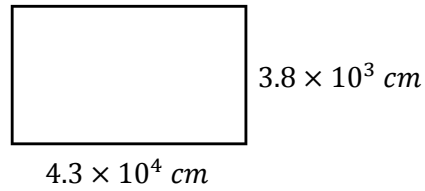
$$\text{Step 3: } \frac{6 \pm \sqrt{12}}{2}$$

$$\text{Step 4: } 3 \pm \sqrt{3}$$

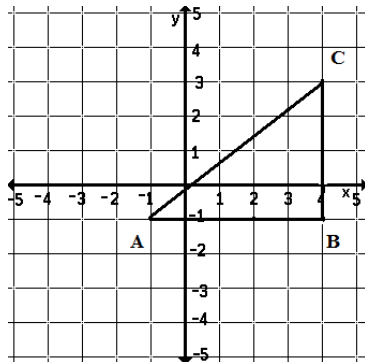
Which statement about Tom's solution is true?

- a) Tom's solution is correct.
- b) Tom made a mistake in Step 1.
- c) Tom made a mistake in Step 2.
- d) Tom made a mistake in Step 4.
- e) Tom made a mistake in Step 1 and 4.

15. John wants to put a new window in his living room. The window will have wood edging. Using John's measurements, how much wood edging material should he purchase?



- a)  $16.34 \times 10^7 \text{ cm}$   
b)  $9.36 \times 10^4 \text{ cm}$   
c)  $163.4 \times 10^6 \text{ cm}$   
d)  $16.34 \times 10^1 \text{ cm}$   
e) None of the above.
16. Determine the domain of the set of ordered pairs.  
 $S = \{(4, 3), (5, 2), (2, 5), (3, 4), (1, 2)\}$
- a) Domain =  $\{1, 2, 3, 4, 5\}$   
b) Domain =  $\{2, 3, 4, 5\}$   
c) Domain =  $\{2, 3, 4\}$   
d) None of the above since the relation is not a function  
e) Both B and C
17. Given the graph, find the length of AC.



- a)  $\sqrt{14}$   
b) 3  
c) 5  
d)  $\sqrt{41}$   
e) 41

18. On Tuesday, a store sold 12 compact discs, 5 cassettes, and 9 videos. On Wednesday, the store sold 19 compact discs, 3 cassettes, 9 videos, and 35 concert tickets. Which matrix shows the number of items sold, organized by day and product?

- a)  $\begin{bmatrix} 12 & 9 & 5 \\ 19 & 3 & 9 \end{bmatrix}$
- b)  $\begin{bmatrix} 12 & 5 & 9 \\ 19 & 3 & 35 \end{bmatrix}$
- c)  $\begin{bmatrix} 19 & 9 & 3 \\ 12 & 5 & 9 \end{bmatrix}$
- d)  $\begin{bmatrix} 12 & 5 & 9 & 0 \\ 19 & 3 & 9 & 35 \end{bmatrix}$
- e)  $\begin{bmatrix} 12 & 9 & 19 & 9 \\ 5 & 0 & 3 & 35 \end{bmatrix}$

19. The length and width of a 6-inch by 8-inch photograph are reduced by the same amount to make a new photograph whose area is half that of the original. By how many inches will the dimensions of the photograph have to be reduced?

- a) 12 in.
  - b) 4 in.
  - c) 6 in.
  - d) 2 in.
  - e) -4 in.
20. An airport taxi service can take passengers to three different locations as described in the table below. The costs are summarized in the table below. Which relationship describes the correct relationship between the cost  $c$ , and the distance  $d$  of the taxi ride?

**Airport Taxi Cost**

Location	Distance (miles)	Cost
Business District	3	\$10
Tourist District	4	\$12
City Center	6	\$16

- a)  $c = 3d - 2$
- b)  $c = 3d + 1$
- c)  $c = 2d - 4$
- d)  $c = 2d + 4$
- e)  $d = 2c + 4$

21. This table shows the number of tickets remaining in the first six rows of a theater for an upcoming concert.

**Concert Tickets Remaining**

Row	Number of Tickets
A	3
B	2
C	4
D	4
E	6
F	5

On the day of the concert, the number of remaining tickets in Row A decreases by 1, while the number of remaining tickets in Row F decreases by 3. What is the effect of these changes on the mode of the data?

- a) The mode decreases by 2.
  - b) The mode decreases by 1.
  - c) The mode increases by 2.
  - d) The mode increases by 1.
  - e) The mode stays the same.
22. Write the slope-intercept form of an equation for a line that passes through  $(-1, 0)$  and is perpendicular to the graph of  $3x - 5y = 20$ .

- a)  $y = \frac{3}{5}x - \frac{3}{5}$
- b)  $y = \frac{-5}{3}x + \frac{5}{3}$
- c)  $y = \frac{-5}{3}x - \frac{5}{3}$
- d)  $y = \frac{3}{5}x - \frac{3}{5}$
- e)  $x = \frac{-5}{3}y + \frac{5}{3}$

23. Two numbers are in the ratio 5:6. If 22 is added to the first number and 22 is subtracted from the second number then the ratio of the two numbers becomes 6:5. Find the sum of the two numbers.

- a) 132
- b) 242
- c) 248
- d) 342
- e) 348

24. Given the function  $f(a) = 4a^2 + 5a + 2$ , find  $f(1)$  and  $f(2)$ .

- a) 12 and 13
- b) 11 and 27
- c) 10 and 28
- d) A and C
- e) None of the above

25. Simplify  $\left[\frac{-3b^3}{a^2}\right]^{-1}$

- a)  $\frac{-3a^2}{b^3}$
- b)  $\frac{3b^3}{a^2}$
- c)  $\frac{a^2}{-3b^3}$
- d)  $\frac{a^2}{3b^3}$
- e) All of the above

**Note: Make sure you have answered all 25 questions before you attempt the Tiebreaker problems.**



ACTM Regional Algebra I Exam  
Tie-breaker Questions  
March 3, 2012

Name \_\_\_\_\_  
School/Teacher \_\_\_\_\_

**Tie-breaker #1**

The profit (in dollars) from the sale of  $x$  Dell laptops at a university bookstore is given by:

$$P(x) = 100x - 0.2x^2 - 300, \quad x \geq 0$$

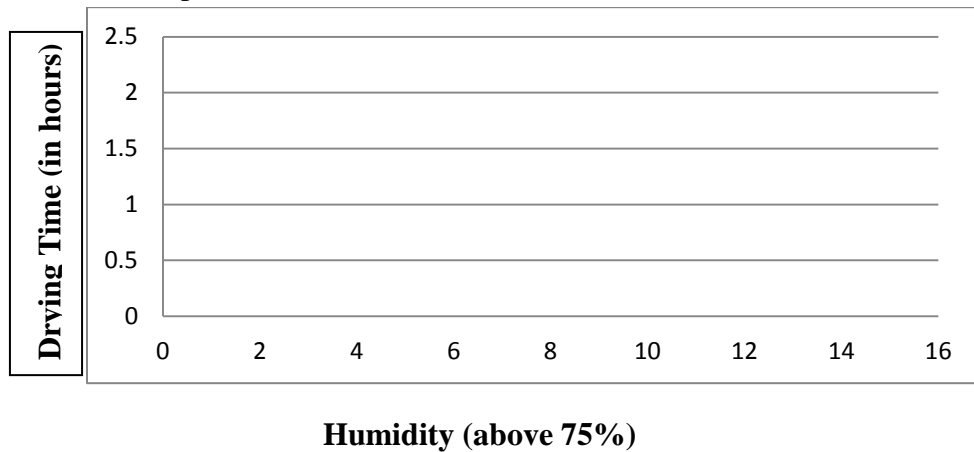
- a) Sketch a graph of the profit function
- b) State the domain of the profit function
- c) State the range of the profit function
- d) Find the number of laptops that must be sold to maximize the profit.
- e) What is the maximum profit (to the nearest dollar)?
- f) Determine the intervals of  $x$  for which the profit function is increasing, decreasing and/or constant.

**Tie-breaker #2**

The table below shows the time that the same amount of the same paint takes to dry at different levels of humidity.

<b>Humidity Level, <math>h</math> (in % above 75%)</b>	0	2	4	6	8
<b>Drying Time, <math>t</math> (in hours)</b>	1.0	1.1	1.3	1.4	1.5

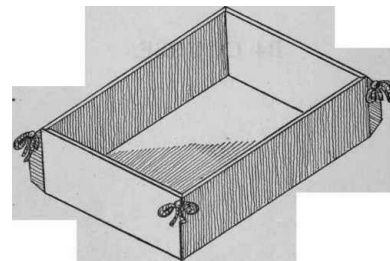
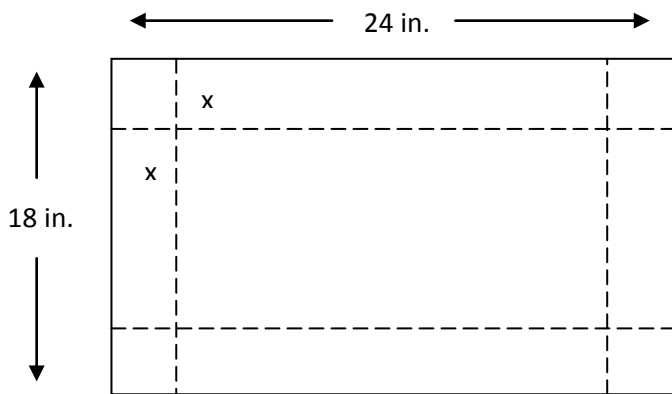
- a) Make a scatter plot of the data and draw a line of fit.



- b) Predict the time (to the nearest hour) that the paint will take to dry in 90% humidity.

**Tie-breaker #3**

A box is to be made out of a piece of cardboard that measures 18 by 24 inches. Squares,  $x$  inches on a side, will be cut from each corner and then the ends and sides will be folded up (see the figure).



- 1) Express the volume as a function of  $x$ . ( $V = lwh$ )
- 2) Complete the table below for  $0 \leq x \leq 9$ .

Size of Square (inches)	Volume of Box (cubic inches)

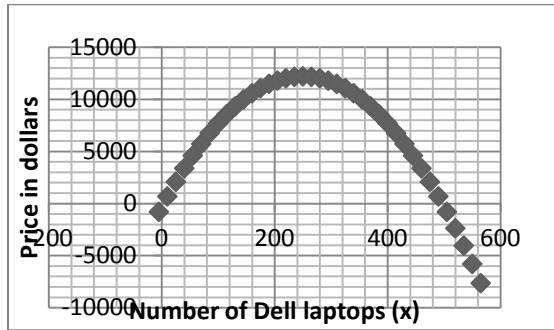
- 3) Find the size of the cutout squares that will make the maximum volume. What is the maximum volume? Round your answers to two decimal places and include appropriate units.

**Answer Key:**

1. D
2. C
3. D
4. D
5. C
6. D
7. B
8. D
9. D
10. B
11. B
12. D
13. A
14. C
15. B
16. A
17. D
18. D
19. D
20. D
21. A
22. C
23. B
24. E
25. C

### Tie-breaker Solution #1

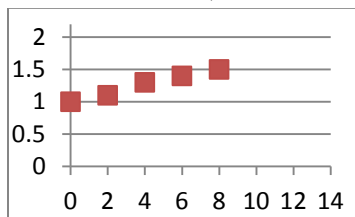
a)



- b) State the domain of the profit function :  $[0, \infty)$
- c) State the range of the profit function:  $(-\infty, 12200]$
- d) Find the number of laptops that must be sold to maximize the profit: 250
- e) What is the maximum profit (to the nearest dollar): \$12,200
- f) Increasing from  $(0, 250)$ , decreasing from  $(250, \infty)$

### Tie-breaker Solution #2

a)



b) 2 hours

### Tie-breaker Solution #3

- 1)  $V = x(18 - 2x)(24 - 2x)$
- 2) Table of values for the sketch

Size of Square (inches)	Vol. of Box (cubic inches)
0	0
1	352
2	560
3	648
4	640
5	560
6	432
7	280
8	128
9	0

- 3) The maximum volume is 654.98 cubic inches when the side of each square is 3.39 inches.