

Algebra I Exam
2009 University of Houston Math Contest

Name: _____

School: _____

Please read the questions carefully and give a clear indication of your answer on each question.

There is no penalty for guessing.

Judges will use written comments and/or calculations to settle ties.

Good luck.

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**University of Houston
High School Contest – Spring 2009
Algebra I Test**

Exam Time : 1 hour

No calculator allowed.

Write the letter (a, b, c, d or e) corresponding to your answer in the table below.

There is no penalty for guessing.

In the event of a tie, students' work will be used to determine the winner – so show your work clearly on your test or scratch paper.

Problem	Answer	Problem	Answer
1		14	
2		15	
3		16	
4		17	
5		18	
6		19	
7		20	
8		21	
9		22	
10		23	
11		24	
12		25	
13			

1. Which of the following, if any, is/are true.

I. $10y - x^2 = -1$ is not a function.

II. If the slope of line L_1 is $m_1 = -7$ and L_1 is perpendicular to line L_2 then $m_2 = \frac{1}{7}$.

III. The range of the function $g(x) = \frac{-5}{3}x - \frac{1}{2}$ is the set: $\left\{ y \mid y \leq -\frac{1}{2} \right\}$.

IV. The set $\{(-1, 2), (2, -4), (5, 6), (-1, 7), (-4, 4)\}$ is a relation that does not define a function.

V. Let $h(x) = x^2 + 1$. The function has exactly 2 real zeros.

- a. I, III, V
- b. II, IV
- c. None are true
- d. I, III
- e. II, IV, V

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2. You take an average of x hours to process a work form, whereas your team member Coreen's average is 1 hour longer. Which expression represents the number of work forms that you and Coreen can process in 40 hours?

- a. $80x^2 + 40x$
- b. $40x + 20$
- c. $\frac{80x + 40}{x^2 + x}$
- d. $80x + 40$
- e. $\frac{160x + 80}{x^2 + x}$

3. Let $P(x, y)$ be a point on the graph of $f(x) = x^2 - 5$. Express the distance from P to the origin as a function of x .

- a. $d(x) = \sqrt{x^4 - 9x^2 + 25}$
- b. $d(x) = \sqrt{x^2 - 25}$
- c. $d(x) = \sqrt{x^4 - 2x^3 + 9x^2 + 10x + 25}$
- d. $d(x) = \sqrt{x^4 - 625}$
- e. $d(x) = \sqrt{x^4 + x^2 + 25}$

4. Solve for x .

$$\frac{4^{3x}}{\sqrt[3]{4}} - 8 = 0$$

- a. $x = \frac{7}{18}$
- b. $x = \frac{25}{9}$
- c. $x = \frac{7}{9}$
- d. $x = \frac{11}{18}$
- e. $x = \frac{5}{9}$

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The following problem is for problems 5 and 6.

A company car was purchased for \$25,000. The car will be depreciated linearly over 7 years. The value of the car at 7 years will be \$4,000.

5. Sketch the graph that represents this model. What is the domain?

- a. All real numbers
- b. $[0, 7]$
- c. $[7, 4,000]$
- d. $[0, 25,000]$
- e. $[4,000, 25,000]$

6. Find the value of the car after 3 years.

- a. \$3,000
- b. \$21,000
- c. \$7,000
- d. \$9,000
- e. \$16,000

7. A rectangle with width $2x + 5$ feet has an area of $2x^4 + 15x^3 + 7x^2 - 135x - 225$ square feet. Determine the polynomial that represents the perimeter of the rectangle.

- a. $6x^3 + 10$
- b. $2x^3 + 20x^2 + 2x - 120$
- c. $x^3 + 10x^2 - x - 65$
- d. $2x^3 + 10x^2 - 14x - 80$
- e. $2x^3 + 10x^2 + 22x + 180$

8. Multiply. $(2x^{a-1} - 3y^{b+5})(2x^{2a-3} - 3y^{4-b})$

- a. $4x^{3a-4} - 12x^{3a-4}y^9 + 9y^9$
- b. $4x^{3a-4} + 9y^9$
- c. $4x^{3a-4} - 6x^{a-1}y^{-b+4} - 6x^{2a-3}y^{b+5} + 9y^9$
- d. $4x^{2a^2-5a+3} + 9y^{-b^2-b+20}$
- e. $4x^{3a-4} - 9y^9$

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9. The points $(1, y)$ and $(4, -2)$ are on line L_1 and the points $(2, 8)$ and $(-7, y + 4)$ are on line L_2 . If L_1 is parallel to L_2 , what is the value of y ?

- a. -5
- b. 3
- c. -2
- d. 4
- e. -23

10. Which of the following is/are false?

I. The point $(-3, 5)$ satisfies the equation $13x + 6y + 9 = 0$.

II. The x -intercept of a line is a and the y -intercept of the same line is b . Assume $a \neq 0$

and $b \neq 0$. Then the equation of the line may be written in the form: $\frac{x}{a} + \frac{y}{b} = 1$

III. Given the following system of inequalities:

$$\begin{cases} x + 2y \geq 3 \\ 2x + 4y \leq -2 \end{cases}$$

The solution set is all real numbers.

IV. The ordered pair $(-3, 2)$ is in the solution set for $y < x + 5$.

V. The y -intercept of the line $Dx + Ey + F = 0$, with $D \neq 0$, is $\left(0, \frac{-F}{D}\right)$.

- a. I, II, IV
- b. III, IV, V
- c. III, V
- d. I, II
- e. II, III

11. An aerobics instructor gives a class both in the morning and afternoon for 3 days, off for 1 day, gives a class in the morning only for 2 days, off for 2 days, and then her schedule begins again. If she is on her 1 day off part of the schedule, determine what she will be doing 127 days from today.

- a. Giving a class in the morning only.
- b. Not enough information is given to determine the answer.
- c. Off on the 1 day part of the schedule.
- d. Giving a class both in the morning and afternoon.
- e. Off on the 2 days part of the schedule.

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12. A company makes surge protectors. The supply equation is $S = 5000 + 200x$ and the demand equation is $D = 9500 - 100x$, where x represents the price (in dollars) of a surge protector. The price at which supply and demand are equal is called the equilibrium price. What will be the demand at the equilibrium price?

- a. 5,000
- b. 15
- c. 14,000
- d. 45
- e. 8,000

13. One factor of $x^2 + 16x - 4 + 64 - y^2 + 4y$ is.

- a. $x + y + 6$
- b. $x - y$
- c. y^2
- d. $y + 4$
- e. x^2

14. Simplify. $\frac{\sqrt{x}}{\sqrt{x} - \sqrt{x-3}}$

- a. $\frac{x + \sqrt{x^2 - 3}}{3}$
- b. $\frac{x + \sqrt{x^2 - 3x}}{3}$
- c. $\frac{x^2 - 2x}{3}$
- d. $\frac{-x - \sqrt{x^2 - 3x}}{3}$
- e. $\frac{-x^2 - 2x}{3}$

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15. Simplify. $\frac{\frac{x}{1 - \frac{x}{2 + 2x}} - 2x}{\frac{2x}{5x - 2} - 3}$

- a. $\frac{(2 + x)(5x - 2)}{2x(13x - 6)}$
- b. $\frac{(x^2 + 2x - 4)(5x - 2)}{2(-13x + 6)}$
- c. $\frac{2x(5x - 2)}{(2 + x)(13x - 6)}$
- d. $\frac{(2x - 4)(5x - 2)}{2(-13x + 6)}$
- e. $\frac{(2x - 4)(5x - 2)}{(2 + x)(13x - 6)}$

16. One of the following expressions has a value different from the other expressions. What is this different value?

- I. $(-1)^{-12}$
- II. $-\left(\frac{10}{23}\right)^0$
- III. $-2^{-1} - 2^{-1}$
- IV. $-1^{-1} \cdot 1^{-1}$
- V. $-(1)^{\frac{1}{4}}$

- a. -2
- b. -1
- c. 0
- d. 1
- e. 2

17. Katerina has math test scores of 95, 87 and 86. She has one more test to take. All exams are equally weighted. Determine what scores on the last test will allow her to get an A in the course. (An “A” is 90% or above.)

- a. It is not possible for Katerina to get an A in the course.
- b. $x \geq 90$
- c. $x \geq 80$
- d. $x \geq 92$
- e. $x \geq 97$

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
18. The equation $2x - 3x^{1/2} + 1 = 0$ has two solutions. The sum of the solutions is:

- a. 1
- b. $\frac{1}{2}$
- c. $\frac{5}{4}$
- d. 4
- e. $\frac{3}{2}$

19. Araceli goes to the bank to get \$10 worth of change. She requests twice as many quarters as half-dollars, twice as many dimes as quarters, three times as many nickels as dimes, and no pennies or dollars. What is the total number of dimes and nickels?

- a. 80
- b. 30
- c. 10
- d. 2
- e. 5

20. A pair of fair dice is cast. If the absolute value of the difference in the face values of the two dice is determined, what is the probability that the absolute value of the difference is odd?

		SECOND DIE					
							
FIRST DIE		(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)	(1, 6)
		(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)	(2, 6)
		(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)	(3, 6)
		(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)	(4, 6)
		(5, 1)	(5, 2)	(5, 3)	(5, 4)	(5, 5)	(5, 6)
		(6, 1)	(6, 2)	(6, 3)	(6, 4)	(6, 5)	(6, 6)

- a. $\frac{2}{9}$
- b. $\frac{1}{3}$
- c. $\frac{1}{2}$
- d. $\frac{1}{9}$
- e. $\frac{1}{6}$

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21. Given the sequence 20, 24, 28, 32, 36, . . . find the 60th term.

- a. 216
- b. 64
- c. 256
- d. 60
- e. 80

22. Bob has a rectangular area he wishes to enclose with 120 feet of fencing. One side of the area is along the straight portion of a river, so no fencing is needed there. Determine an equation that describes the area enclosed.

- a. $A(x) = \frac{x^2 + 60x}{x}$
- b. $A(x) = -2x^2 + x$
- c. $A(x) = \frac{2x^2 + 120x}{x}$
- d. $A(x) = -x^2 + 60x$
- e. $A(x) = -2x^2 + 120x$

23. A survey of 400 people was taken. 223 indicated that they own a jet ski, 172 indicated that they own a sailboat, and 87 indicated that they do not own a jet ski or a sailboat. How many people surveyed own a jet ski and a sailboat?.

- a. Not enough information is given.
- b. 51
- c. 5
- d. 82
- e. 313

24. Solve $x^2 + ax + b = 0$ for x in terms of a and b .

- a. $x = -a - b$
- b. $x = -\frac{a^2}{4} \pm \frac{\sqrt{-4b + a^2}}{2}$
- c. $x = \frac{2a - 2i\sqrt{b}}{2}$
- d. $x = \frac{a^2 - 2a - 4b}{4}$
- e. $x = -\frac{a}{2} \pm \frac{\sqrt{-4b + a^2}}{2}$

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25. Four sets of brothers and sisters are to be seated in a row of eight seats. In how many ways can they be seated if each pair of brother and sister is seated together?

- a. 384
- b. 16
- c. 8
- d. 40,320
- e. 4