

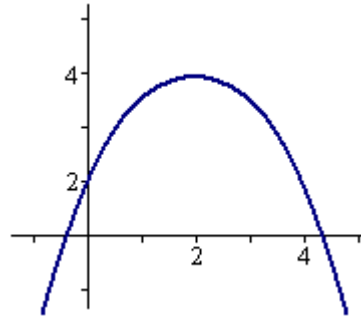
**State Mathematics Finals: Algebra I**  
May 6, 2004

1. Solve the following for  $x$ :  $3x - c = 12$ .

- a)  $4 + c$       b)  $9 + c$       c)  $\frac{12 - c}{3}$       d)  $4 + \frac{c}{3}$       e)  $9 + \frac{c}{3}$

2. Which function corresponds to the graph on the right.

- a)  $f(x) = (x - 2)^2 + 4$   
b)  $f(x) = 4 - (x - 2)^2$   
c)  $f(x) = 2 - x^2$   
d)  $f(x) = \frac{1}{2}(x - 2)^2$   
e)  $f(x) = 4 - \frac{1}{2}(x - 2)^2$



3. Simplify  $\frac{B(A - B) - A(A + B)}{A(A - B) + B(A + B)}$

- a)  $A^2 - B^2$       b) 1      c) -1      d)  $\frac{A - B}{A + B}$       e)  $\frac{A^2 - B^2}{A^2 + B^2}$

4. The product of two natural numbers equals 30 more than their sum. Find the value of the larger number.

- a) 14      b) 2      c) 15      d) 32      e) 12

5. Find the sum of the following:  $\frac{1}{2}\left(1 - \frac{1}{3}\right) + \frac{1}{2}\left(\frac{1}{3} - \frac{1}{5}\right) + \frac{1}{2}\left(\frac{1}{5} - \frac{1}{7}\right) + \dots + \frac{1}{2}\left(\frac{1}{51} - \frac{1}{53}\right)$

- a)  $\frac{26}{53}$       b)  $\frac{52}{53}$       c)  $\frac{52}{103}$       d)  $\frac{1}{2}$       e) none of these

6. Find real numbers  $k$  and  $p$  such that  $x^2 - 7^2 + (x - 7)^2 - 2p(x - 7) = k(x - 7)^2$
- a)  $k = 7, p = 2$                       b)  $k = 2, p = 7$                       c)  $k = 1, p = 3$   
d)  $k = 2, p = 14$                       e)  $k = 2, p = 2$
7. Two cars leave the same point traveling in opposite directions for 3 miles each. Then they both turn 90 degrees left and each travels for an additional 7 miles. How far apart in miles are the cars?
- a) 20 miles      b)  $2\sqrt{58}$  miles      c)  $\sqrt{58}$  miles      d) 6 miles      e) none of these
8. Find the next number in the following whole number sequence: 0, 1, 3, 7, 15, ...
- a) 23              b) 27              c) 31              d) 33              e) 63
9. Tina keeps the numbers 36, 100, and 225, but rejects numbers 25, 49, and 169. Given that she uses the same criteria for making choices, which number(s) should she keep from the following list: 64, 81, 196?
- a) 64              b) 81              c) 196              d) all of these      e) none of these
10. The graph of  $4x^2 + 4y^2 - 16y = 9$  crosses the  $y$ -axis twice. What is the distance between the two intersections.
- a) 12.5              b) 5              c) 4.5              d) 3              e) none of these
11. An unfair coin has a probability of 0.6 of turning up heads. If this coin is flipped 3 times, what is the probability of getting exactly 2 heads?
- a) 0.125              b) 0.144              c) 0.375              d) 0.432              e) none of these
12. If  $\sqrt{x} = \sqrt[3]{2}$ , then  $x^3$  is equal to what?
- a)  $\sqrt{2}$               b) 2              c)  $\sqrt[3]{4}$               d) 4              e)  $3\sqrt[3]{2}$

13. Consider the parabola,  $y = x^2 - 5$ . For which value of “ $c$ ” will the line,  $x - y = c$ , intersect the parabola exactly once?
- a) 0                      b) 5                      c) 5.25                      d)  $3 + \sqrt{5}$                       e)  $\frac{1 + \sqrt{21}}{2}$
14. Which of the expressions below is algebraically equivalent to  $\frac{a}{3 - \sqrt{7}}$ .
- a)  $\frac{a(3 + \sqrt{7})}{2}$       b)  $\frac{a(3 - \sqrt{7})}{2}$       c)  $\frac{a(3 + \sqrt{7})}{16}$       d)  $\frac{a(3 - \sqrt{7})}{16}$       e) none of these
15. Given the lines,  $3x - 5y = 2$  and  $y = mx + 7$ . Find the value of  $m$  such that the lines do not intersect.
- a)  $m = 0.6$                       b)  $m = 3$                       c)  $m = 1.6\bar{6}$                       d)  $m = 15$                       e) none of these
16. Find the  $x$ -coordinate of the vertex of the parabola  $x = y^2 + y + 1$ .
- a)  $-0.5$                       b)  $0.75$                       c)  $1.25$                       d)  $1.75$                       e) none of these
17. Sue drives from city A to city B at 60 mph. She returns to city A at 40 mph. What is her average speed of the entire round trip?
- a) 57.4 mph      b) 50 mph      c) 48 mph      d) 44.8 mph      e) none of these
18. Solve for  $y$ :  $x = 3y - 1$
- a)  $\frac{x}{3} + 1$       b)  $\frac{x - 1}{3}$       c)  $\frac{x + 1}{3}$       d)  $\frac{x - 1}{6}$       e)  $\frac{x}{3}$

19. Which of the following is the positive solution to the equation  $x - \frac{a^2}{x+2} = 0$  where  $a$  is any nonzero real number?
- a)  $\frac{-1+a}{2}$       b)  $a$       c)  $\sqrt{a^2 - 2}$       d)  $a - \sqrt{2}$       e)  $-1 + \sqrt{1+a^2}$
20. If it takes 2 people 6 hours to wash 15 cars, how many cars can 9 people wash in 4 hours, assuming each car takes the same amount of time to wash?
- a) 30      b) 5      c)  $42\frac{2}{9}$       d) 45      e) none of these
21. Let  $a$  be the length of a square's diagonal. Find the perimeter of that square in terms of  $a$ .
- a)  $4\sqrt{2}a$       b)  $2\sqrt{2a}$       c)  $4a$       d)  $\frac{1}{2}a^2$       e)  $2\sqrt{2}a$
22. Suppose you were given 1 penny on the first day, 2 pennies on the second day, 4 pennies on the third day, and so on, for 18 days, and your friend gets \$100 each day for 18 days. Approximately how much more than your friend would you receive? (Hint:  $1 + 2 + 4 + \dots + 2^n = 2^{n+1} - 1$ .)
- a) \$821      b) \$2,621      c) \$3,443      d) \$260,343      e) You would get less.
23. If  $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \dots = c$ , then find the sum of  $\frac{1}{10} + \frac{1}{20} + \frac{1}{40} + \frac{1}{80} + \dots$ .
- a)  $5c$       b)  $c^2$       c)  $c^5$       d)  $\frac{c}{5}$       e) none of these
24. In 1993, Mary was twice Ben's age. In 2000, she was 7 years older than Ben. How old is Ben in 2004?
- a) 18      b) 21      c) 5      d) 14      e) none of these

25. Simplify  $(\sqrt{x} - \sqrt{3})(\sqrt{x} + \sqrt{3}) - (\sqrt{x} - \sqrt{2})^2$
- a)  $-1$       b)  $\sqrt{2x} - 5$       c)  $\sqrt{2x-5}$       d)  $2\sqrt{2x} - 5$       e)  $2x + 2\sqrt{2x} - 5$
26. A bank robber leaves town riding his horse at 16 mph. The sheriff pursues him 15 minutes later at 20 mph. How long does it take the sheriff to overtake and catch the robber?
- a) 60 min.      b) 75 min.      c) 80 min.      d) 180 min.      e) 240 min.
27. Find the point of intersection between the functions,  $f(x) = 11 - 2x$  and  $g(x) = x^2 - 4$  that is farthest from the origin.
- a) (2, 7)      b) (3, 5)      c) (-5, 21)      d)  $(5\frac{1}{2}, 26\frac{1}{4})$       e) (2, -2)
28. If  $x^2 - 8 > -2x$ , then the solution set of  $x$  is:
- a)  $\{x|x < -4\}$       b)  $\{x|x > 2\}$       c)  $\{x|(x < -4) \text{ or } (x > 2)\}$   
d)  $\{x|x > -4\}$       e)  $\{x|-4 < x < 2\}$
29. Solve for  $x$ :  $x^{-2} + (a+b)x^{-1} + ab = 0$
- a)  $x = a, x = b$       b)  $x = -a, x = -b$       c)  $x = 1/a, x = 1/b$   
d)  $x = -1/a, x = -1/b$       e) none of these
30. Which of the following statements about  $f(x+y)$  is always true?
- a)  $f(x+y) = f(x) + f(y)$   
b)  $f(x+y) \neq f(x) + f(y)$   
c)  $f(x+y) \leq f(x) + f(y)$   
d)  $f(x+y) = f(x) + f(y)$  only if  $f(x) = f(y)$   
e) none of these

31. Which of the following is not a rational number?

a)  $\sqrt{1.777\dots}$

b)  $(9.123123123\dots)^{-2}$

c)  $1.5129^{-1/2}$

d)  $(\sqrt{5} - \sqrt{3})^2$

e)  $\frac{(\sqrt{2} + 1)^2}{3 + \sqrt{8}}$

32. Approximately how high was a ball kicked if it had a parabolic path, was 2 meters above the ground at a point 3 meters from the kicker, and landed 42 meters from the kicker?

a) 3.77 meters

b) 7.54 meters

c) 14 meters

d) 15.08 meters

e) 28 meters

33. Solve for  $x$ :  $64^x = 8^3$

a) 2

b) 1.5

c)  $\sqrt{2}$

d)  $\frac{\log_2(3)}{8}$

e) 9

34. Given the base 5 numbering system with digits 0, 1, 2, 3, and 4, what is  $322 + 341 + 401$ ?

a) 2144

b) 2314

c) 3224

d) 2114

e) 1414

35. Duck weed is a fast growing aquatic plant. In 4 days it doubles the amount of surface area it covers. If there was enough duck weed on June 1 to cover  $5 \text{ cm}^2$ , approximately how much of the area was covered on June 30?

a)  $38 \text{ cm}^2$

b)  $641 \text{ cm}^2$

c)  $761 \text{ cm}^2$

b)  $905 \text{ cm}^2$

e)  $960 \text{ cm}^2$

36. If the ratio of the legs of a right triangle is  $4/3$ , and the hypotenuse is 25 cm, what is the area of the triangle?

a)  $625 \sqrt{2} \text{ cm}^2$

b)  $44 \frac{4}{9} \text{ cm}^2$

c)  $25 \sqrt{2} \text{ cm}^2$

d)  $300 \text{ cm}^2$

e)  $150 \text{ cm}^2$

37. Let  $x$  and  $y$  be positive numbers, and define  $x \oplus y$  as  $x \oplus y = \frac{xy}{x+y}$ .

Determine  $2 \oplus (3 \oplus 5)$ .

- a) 3                      b)  $\frac{30}{31}$                       c) 10                      d)  $\frac{15}{4}$                       e)  $\frac{8}{5}$

38. As in question "37" define  $x \oplus y$  as  $x \oplus y = \frac{xy}{x+y}$  where both  $x$  and  $y$  are positive numbers.

Solve the following equation for  $x$ :  $3(x \oplus 1) = (2x \oplus 5)$ .

- a) 2                      b) 1.25                      c)  $\sqrt{15}$                       d) 4                      e) No solution

39. Given the two equations:  $2x + 3y = c$  and  $3x + 4y = 1$ , find the value for  $x$ .

- a)  $3 - 4c$                       b)  $2c - 3$                       c)  $\frac{c+3}{5}$                       d)  $3c - 2$                       e)  $4 - 3c$

40. Arnold started getting an allowance at his tenth birthday. Each month he got three times as many dollars as he was years old. If he saved 25% of his allowance, how much money would he have saved by the day before his 18<sup>th</sup> birthday?

- a) \$972                      b) \$ 1,134                      c) \$1,188                      d) \$3,888                      e) none of these