Name _____

The Algebra 1 Semester B examination will have the following types of questions:
- Selected Response
- Student Produced Response (Grid-in)
- Brief Constructed Response (BCR)
- Extended Constructed Response (ECR)
- Short Answer

A calculator may be used on the exam.

You will be provided with the BCR/ECR scoring rubrics in your exam booklet. Your teacher can provide you with a copy.

The formulas below will be provided in the examination booklet.

Equations of a Line

Standard Form:
$Ax + By = C$
where A and B are not both zero

Slope-Intercept Form:
$y = mx + b$ or $y = b + mx$
where m = slope and b = y-intercept

Point-Slope Form:
$y - y_1 = m(x - x_1)$
where m = slope, (x_1, y_1) = point on line

Slope Formula

Let (x_1, y_1) and (x_2, y_2) be two points in the plane.

slope = $\dfrac{y_2 - y_1}{x_2 - x_1}$ where $x_2 \neq x_1$

Quadratic Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a},$$

where $ax^2 + bx + c = 0$

Exponential Equations

General Exponential Equation:
$y = ab^x$

Exponential Growth Equation:
$y = C(1 + r)^t$

Exponential Decay Equation:
$y = C(1 - r)^t$

1. A catering company provides food for three family reunions on July 4th every year. The matrices below represent the number of hamburgers and hot dogs ordered by three families in 2009 and 2010.

| | **Year 2009** | | | | **Year 2010** | |
	Hamburgers	Hot Dogs			Hamburgers	Hot Dogs
Arnold	50	48		Arnold	60	40
Baker	40	25		Baker	45	30
Carroll	15	20		Carroll	40	40

(Families)

a. Write a matrix that represents the total number of hamburgers and total number of hot dogs that each of the three families ordered for the years 2009 and 2010.

b. How many more hot dogs did the Baker family order in 2010 than in 2009?

c. The catering company predicts that in 2014, each family will order five times as many hamburgers and hotdogs as they ordered in 2010. Based on this prediction, write a matrix that will represent the total number of hamburgers and total number of hot dogs each family will order in 2014.

2. Stephan bowled 160, 180, and 215 in his first three games.

BCR
- What score would Stephan have to bowl in his fourth game for his 4-game average to be 180? Explain how you determined your answer. Use words, symbols, or both in your explanation.

3. Jack plays basketball. After 9 games he is averaging 19 points per game. If x represents the number of points that he scores in his tenth game, which of the following inequalities represents how many points that he must score in his 10th game in order to average at least 20 points per game?

A $x \le 20$
B $x \ge 20$
C $x \le 29$
D $x \ge 29$

4.   The table and box-and-whisker plot below show the number of hours Suchita
**ECR**   worked each week at her summer job.

Number of Hours	Number of Weeks
1	1
7	2
20	2
22	1
24	2
25	1
26	3
	Total : 12

Hours worked by Suchita each week
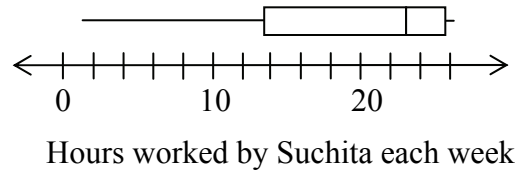
- Jeff looked at the box-and-whiskers plot and concluded the number of weeks Suchita worked 19 hours or less was greater than the number of weeks she worked 23 hours or more. Is Jeff's conclusion correct? Use mathematics to justify your answer.

- Use the frequency table to find each measure of central tendency (mean/median/mode). Which measure best represents Suchita's typical work week? Use mathematics to justify your answer.

5.   The box-and-whiskers plots below show the points scored by two basketball
BCR   teams over the course of a season.
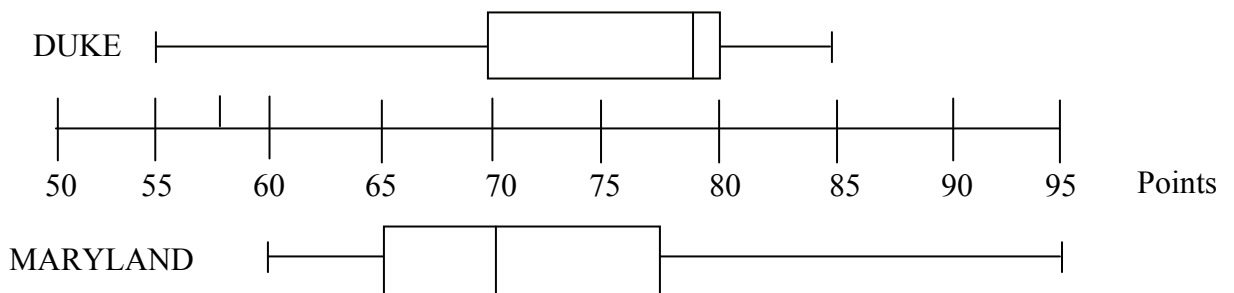
- Derek looked at the plots and stated that he thought that Maryland was the higher scoring team during the season. Is this a valid conclusion? Use mathematics to justify your answer. Give more than one reason.

6.   The tree diagram below shows the ways that Jane can get dressed.
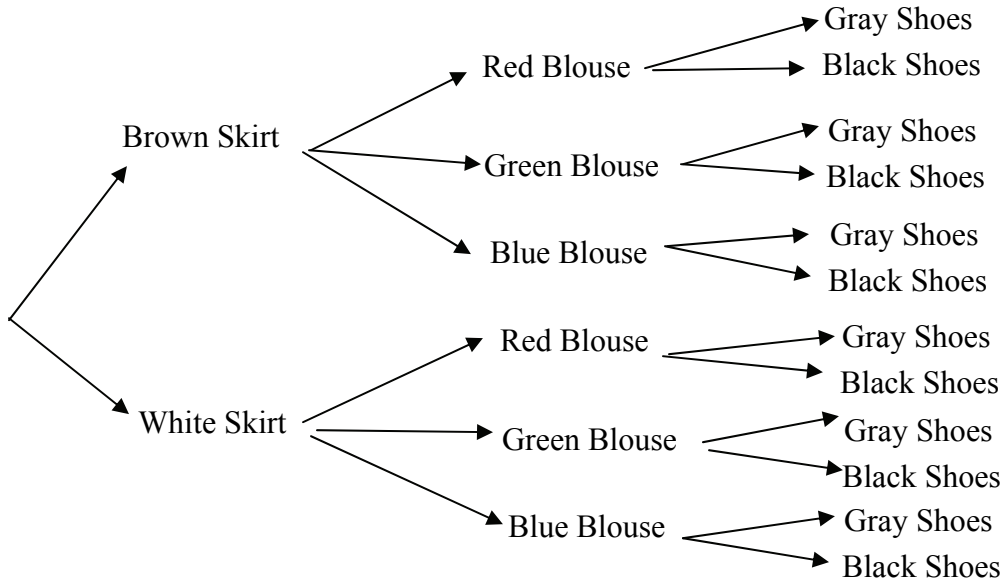
a.   How many different outfits of a skirt, blouse, and shoes can Jane wear?

b.   What is the probability that Jane will wear a white skirt, green blouse, and black shoes?

7.   The Ice-Cream Shoppe states that you can get 240 possible sundaes consisting of one scoop of ice cream, a fruit topping, and either chocolate or caramel syrup. If there are 8 different fruit toppings, how many different flavors of ice cream can you get?

8.   A bubble gum machine has 50 gumballs inside. There are 22 red, 14 blue, 9 green, and 5 white gumballs. A child chooses one gumball at random.

a.   What is the probability that the gumball chosen is white?

b.   What is the probability that the gumball chosen is NOT green?

9.   Bill recorded the color of the traffic light in front of his school when he arrived. The
      table below shows the results.

| Color	Frequency
Red	12
Yellow	3
Green	5

      a.   Based on the results in the table, what is the probability that the light will be
            red when Bill arrives?

      b.   Bill goes to school 180 days in a school year. Based on the results in the table,
            how many days will the light be red when he arrives?

10.   State whether each of the following sampling methods would provide a <u>simple
BCR   random sample</u> of 50 college students? Use the criteria for simple random
      sampling to justify your answer.

      •   Survey the first 50 students to enter the math building in the morning.

      •   Obtain a list of alphabetically assigned student ID numbers, and then select
           every 5th student on the list until there are 50 students.

      •   Place the name of each student in a hat, and then draw 50 names.

11.   Jack and Jill surveyed students in their school to estimate how many students
BCR   listen to classical music. Jack's sample was to survey 50 orchestra students.
      Jill's sample was chosen by selecting students randomly from a list of all students
      in the school.

      •   Will Jack or Jill's sample be more likely to be representative of the
           school's population? Use mathematics to justify your answer.

12.   The table below shows the results of Jill's survey from item 11.

BCR

Number of Students Who Listen to Classical Music	Number of Students Who Do Not Listen To Classical Music
10	40

*   Based on the results of the survey, if a student is chosen at random, what is the probability that a student listens to classical music? Explain how you determined your answer. Use words, symbols, or both in your explanation.

*   Based on the results of the survey, if there are 800 students in her school, predict how many students listen to classical music. Explain how you determined your answer. Use words, symbols, or both in your explanation.

13.   Hairless in Seattle, Inc. is marketing its hair growth cream. The two graphs below are being considered for use in magazine ads.
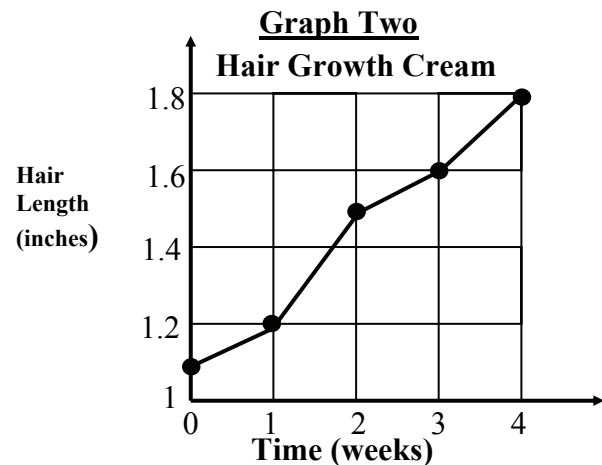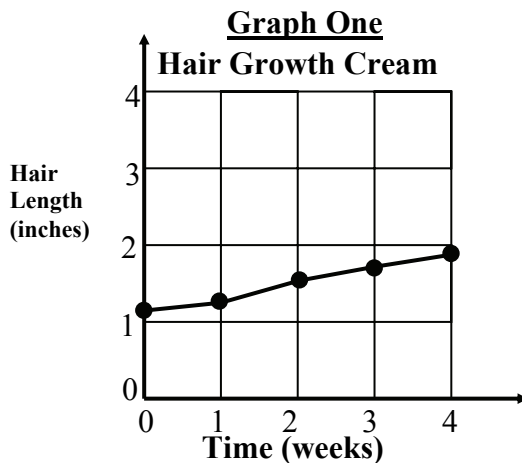
The two graphs represent the same information. Why do the two graphs look different?

14.   On the first 5 weeks of a job, Nancy earned $50, $50, $80, $90, and $300. Which measure of central tendency is best representative of Nancy's weekly income? Explain your answer.

15.   Nathan is conducting a simulation concerning seniors who ride a bus to school. He chooses to use a random number table with digits 0–9, where 0, 1, 2, and 3 represent a senior who rides a bus to school and 4, 5, 6, 7, 8, and 9 represents a senior who does not ride a bus to school. Based on this digit assignment, what is the probability that a senior rides a bus to school?

   A   6%

   B   30%

   C   40%

   D   60%

16.   Describe a model you could use to simulate a probability that 25% of all students go to the movies each week.

17.   Mr. VanDorn states that there is a 30% chance that a student is tardy to his class. Which of the following model(s) can be used to simulate this probability?

   A   A random number table with digits 0–9 where 0, 1, 2, 3, 4, 5, and 6 represent a student that is tardy and 7, 8, and 9 represent a student who is not tardy.

   B   A random number table with digits 0–9 where 0, 1, 2, 3, 4, and 5 represent a student that is tardy and 6, 7, 8, and 9 represent a student who is not tardy.

   C   A random number table with digits 0–9 where 7, 8, and 9 represent a student that is tardy and 0, 1, 2, 3, 4, 5, and 6 represent a student who is not tardy.

   D   A six-sided die where 3 represents a student that is tardy.

For items 18 and 19, rewrite each polynomial in standard form.

18. $3x^2 + x^3 - 4 - 9x$

19. $2 + 3x^2 + 5x^3 + 7x^4$

For items 20 through 25, simplify. Your final answer should have only positive exponents.

20. $\left(-3x^2y^3\right)^4$

21. $\left(5x^4y^3\right)^2$

22. $\left(2xy^3\right)\left(3x^2y\right)$

23. $\left(-4xy^5\right)\left(2x^3y^4\right)$

24. $\dfrac{36x^6y^7}{4x^3y^5}$

25. $\dfrac{15x^3y^{-2}}{3x^2y^3}$

For items 26 through 29, add or subtract as indicated.

26. $\left(-3x^2+4x-7\right)+\left(2x^2-7x+8\right)$

27. $\left(5m^2-6m+12\right)-\left(-m^2+2m-11\right)$

28. $\left(4x^3-6x+12\right)+\left(5x^2+9x-15\right)$

29. $\left(t^2-3t-9\right)-\left(3t^2-4t+17\right)$

For items 30 through 37, multiply or divide as indicated.

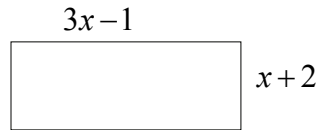30. $(2x-5)(4x+7)$

31. $(3x-2)(x-7)$

32. $(2x-5)^2$

33. $(5x+3)^2$

34. $(x-9)(x+9)$

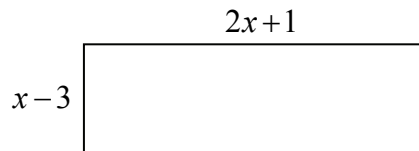35. $(3x+5)(3x-5)$

36. $\dfrac{3x^3-12x^2+9x}{3x}$

37. $\dfrac{64x^3y^2+16x^2y^3+32x^5y^5}{8x^2y^2}$

38.   Look at the rectangle below.

$3x-1$

$x+2$
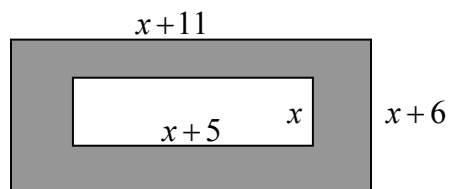
Which expression below could represent the perimeter of the rectangle?

A $8x+2$

B $4x+1$

C $3x^2-2$

D $3x^2+5x-2$

39.   Look at the rectangle below.

$2x+1$

$x-3$

Which expression below could represent the area of the rectangle?

A $2x^2-5x-3$

B $2x^2-7x-3$

C $2x^2-3$

D $2x^2-2$

40.   Look at the figure below.

$x+11$

$x+5$ x $x+6$

Write an expression in terms of x for the area of the shaded region.

41.   Which binomial below is a factor of $x^2 + x - 12$?

   A $(x - 4)$

   B $(x - 3)$

   C $(x + 3)$

   D $(x + 6)$

For items 42 through 49, factor each of the following completely.

42. $6x^3 - 30x^2$

43. $5x^3 y^2 + 15x^2 y^3$

44. $x^2 - 17x + 30$

45. $2x^2 + 9x - 5$

46. $x^2 - 81$

47. $25x^2 - 64$

48. $a^2 - 14a + 49$

49. $x^2 + 20x + 100$

For items 50 through 55, solve.

50. $(2x - 5)(x - 1) = 0$

51. $(x - 6)(3x + 7) = 0$

52. $r^2 + 10r + 9 = 0$

53. $t^2 + 6t - 7 = 0$

54. $x^2 + 7x + 2 = 0$

55. $x^2 - 5x = -1$

56.   Let $f(x) = x^2 - 6x + 5$.

     a.   What is the vertex of the graph?

     b.   What is the equation of the axis of symmetry of the graph?

     c.   What is the *y*-intercept of the graph?

     d.   What are the *x*-intercepts of the graph?

     e.   What are the zeros of the function?

     f.   Write this function in vertex form. You may choose to use your calculator or complete the square.

57.   Look at the graph of the function $g(x)$ below. It is a translation of the graph of the parent function, $f(x) = x^2$.

$g(x)$
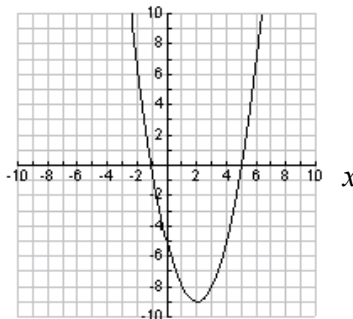
     a.   Describe the translation of the graph from the parent function, $f(x) = x^2$.

     b.   Write an equation for $g(x)$ in vertex form.

     c.   Write an equation for $g(x)$ in standard form.

     d.   What are the zeros of $g(x)$?

     e.   On what interval is $g(x)$ increasing?

     f.   What is the equation of the axis of symmetry of the graph of $g(x)$?

58.   What is the equation of the axis of symmetry for the graph of the parabola
        represented by $y = 2(x+7)^2 - 5$

59.   What is the vertex for the graph of the parabola represented by $y = 4(x+5)^2 - 6$?

        A $(5,-6)$
        B $(-5,6)$
        C $(-5,-6)$
        D $(-5,6)$

60.   Jack kicked a football. The height, $h(t)$ in feet, of the ball after t seconds is given
ECR   by the quadratic function. $h(t) = -16t^2 + 50t$.

        •   Does the ball reach its maximum height at $t = 2$ seconds? Use mathematics to
                justify your answer.

        •   After how many seconds does the ball hit the ground? Explain how you
                determined your answer. Use words, symbols, or both on your explanation.

61.   Look at the exponential function graphed below.
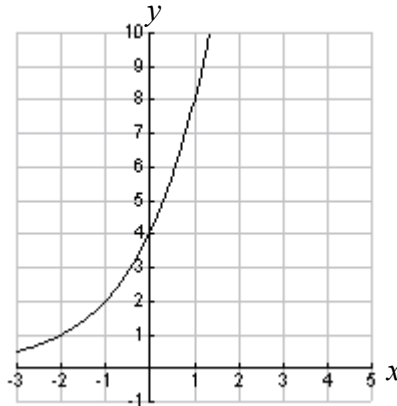
        a.   Complete the values for the function in the table below.

x	−2	−1	0	1	2
$f(x)$					

Item 61 (continued)

     b.   Write the function rule for the graph.

     c.   Is the function increasing or decreasing?

     d.   Is the function continuous?

     e.   What is the domain of the function?

     f.   What is the range of the function?

     g.   What is the equation of the asymptote of the graph?

62.   Look at the two functions below:

$$f(x) = 4(3)^x \qquad\qquad\qquad g(x) = 5(7)^x$$

Which of the following statements are true?

     I $f(x)$ is increasing at a faster rate than $g(x)$.

     II   The y-intercept of $f(x)$ is less than the y-intercept of $g(x)$.

     III   The graphs of both functions have the x-axis as their asymptote.

  A   **I** and **II** only

  B   **I** and **III** only

  C   **II** and **III** only

  D   **I**, **II**, and **III**

63.   Let $f(x) = 5\left(\dfrac{1}{6}\right)^x$. Describe what happens to the values of the function as the values of x increase. Your answer should have two conclusions.

64.   Let $f(x) = 6(5)^x$. Describe what happens to the values of the function as the values of x increase.

65. Sheila had 2048 marbles. She gave marbles to her sister each day. The table
ECR below shows the number of marbles Sheila had left after each day.

# of Days d	0	1	2	3	4
Number of marbles left $N(d)$	2048	1024	512	256	128

- Write a function for the number of marbles remaining after d days.

- How many marbles will she have left after the 6th day?

- After what day will she have 2 marbles left? Explain how you determined your answer. Use words, symbols, or both on your explanation.

- As the value of x increases, what happens to the number of marbles?

For items 66 through 68, classify each function below as linear, exponential, or quadratic. Use mathematics to justify your answers.

66.

x	y
1	2
2	5
3	8
4	11

67.

| x	y
1	2
2	5
3	10
4	17

68.

| x	y
1	2
2	4
3	8
4	16

69. A house was purchased for $200,000. It increases in value by 4% per year.

    a. Write an exponential function that gives the value (V) of the house t years after it was purchased.

    b. What is the value of the house 3 years after it was purchased?

70. A pool table was purchased for $2,400. It depreciates (loses value) by 12% per year.

    a. Write an exponential function that gives the value (V) of the pool table t years after it was purchased.

    b. What is the value of the pool table 5 years after it was purchased?
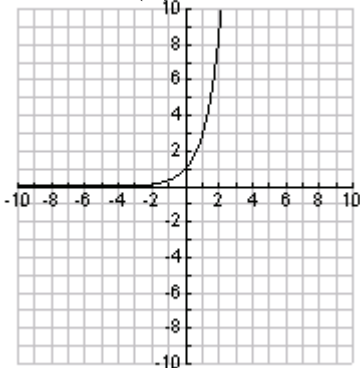
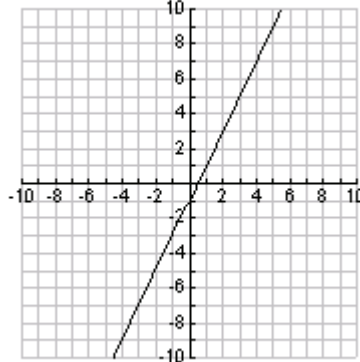Use the following graphs to answer items 71 and 72.

$$f(x) = |x|$$
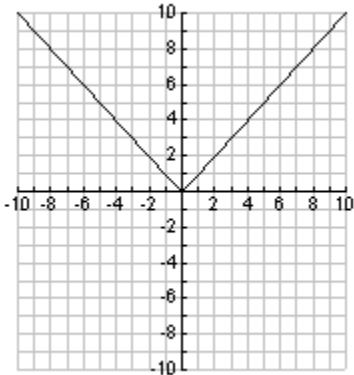
$$g(x) = (x-1)^2 - 2$$
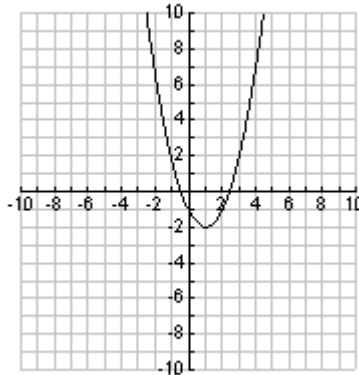
$$h(x) = 3^x$$

$$j(x) = 2x - 1$$

71.   Complete the following:

a. $f(x)$ is a(n) _____ function.

b. $g(x)$ is a(n) _____ function.

c. $h(x)$ is a(n) _____ function.

d. $j(x)$ is a(n) _____ function.

72.   Which of the functions $f(x), g(x), h(x)$, and/or $j(x)$:

a.   have a domain of all real numbers? _____

b.   have a range of all real numbers ? _____

c.   have a vertex? _____

d.   increase on some interval? _____

e.   increase on the entire domain? _____

f.   decrease on some interval? _____

g.   decrease on the entire interval $x < 1$? _____

h.   are continuous? _____

i.   have an axis of symmetry? _____

73.   The curve of best fit on the scatter plot below shows the number of petals on a daisy as a function of time.

Number of Petals on a Daisy
As Time Passes
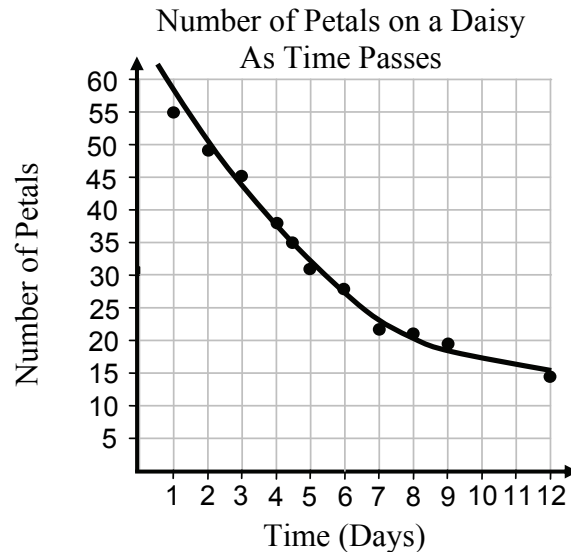
a. According to the curve of best fit, when will the daisy have only 20 petals remaining?

b. According to the curve of best fit, how many petals will be remaining after day one?

74.   The amount of time it takes to complete a job varies inversely with the number of people on the job. If it takes 10 people a total of 15 hours to do a job, how long will it take 6 people to do the job?

75.   The number of slices of pizza that a person gets at a party varies inversely as the number of people. If there are 40 people at a party, each person will get 3 slices of pizza. How many people are at the party if each person gets 4 slices of pizza?