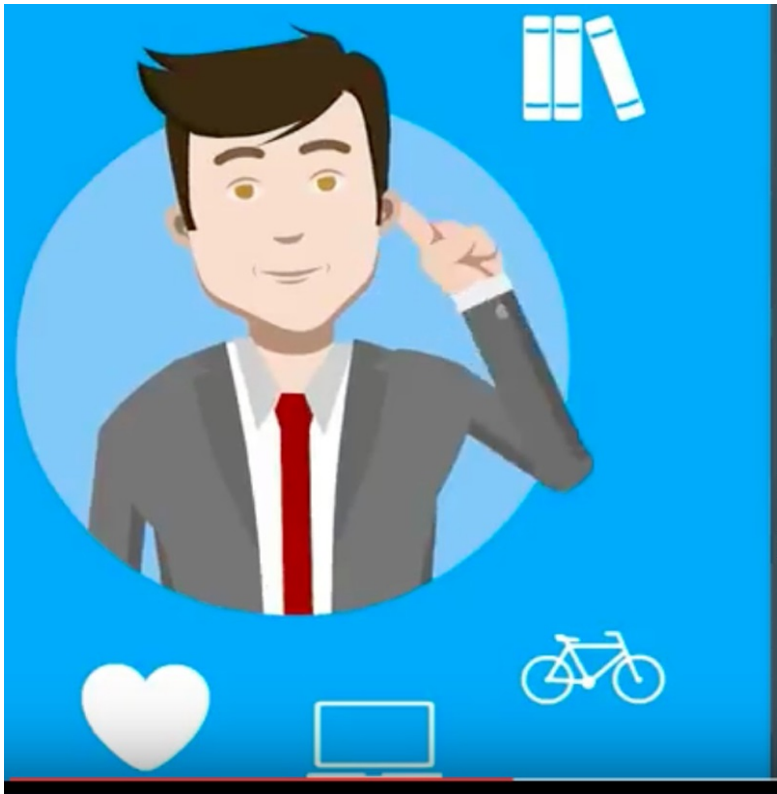

STUDY CHALLENGE
STUDY TIPS

SAT Math

with

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challenge yourself
and solve NOW

Lesson 5

Liner systems

Skill 4: Working with Linear Systems

Lesson 11: Constructing, graphing, and interpreting linear systems

A **system of equations** is just a set of equations that apply simultaneously to a given problem situation. Solving for the system means finding all sets of values for the unknowns that make *all* of the equations true. Systems of equations can be analyzed both algebraically (by exploring the equations) or geometrically (by exploring the graphs).

Two high school teachers took their classes on a field trip to a museum. One class spent \$154 for admission for 20 students and 3 adults, and the other class spent \$188 for admission for 24 students and 4 adults. Which of the following systems of equations could be solved to determine the price of a single student admission, s, and the price of a single adult admission, a, in dollars?

A) $a + s = 51$
$44s + 7a = 342$

B) $20s + 3a = 154$
$24s + 4a = 188$

C) $\frac{20}{s} + \frac{3}{a} = 154$
$\frac{24}{s} + \frac{4}{a} = 188$

D) $20 + 24 = s$
$3 + 4 = a$

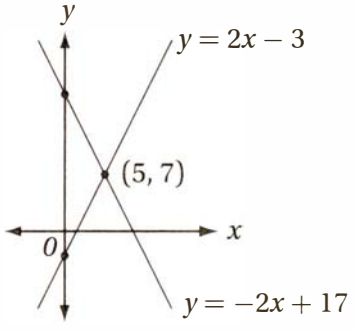
(*Medium*) This problem can be described with a **two-by-two system of equations**, that is, two equations with two unknowns. The two equations come from two facts: one class spent \$154 for admission and the other class spent \$188 for admission. The cost of 20 student admissions and 3 adult admissions is $20s + 3a$, so the first equation is $20s + 3a = 154$. Similarly, the equation for the other class is $24s + 4a = 188$, so the correct answer is (B).

$$y = 2x - 3$$

$$y = -2x + 17$$

If the solutions to the two equations above are graphed in the xy-plane, what is the y-coordinate of the point at which the graphs intersect?

(*Easy*) Since the equations of both lines are given in slope-intercept form, we could graph the two lines in the xy-plane to find their point of intersection.



Therefore, the point (5, 7) gives us the only solution to this system, and so the answer to the original question is 7.

Alternately, (as we will see in Lesson 13) we can just add the corresponding sides of the two equations together to get $2y = 14$, which yields $y = 7$.

The solution of a two-by-two system of equations can be visualized as the **intersection of their graphs in the *xy*-plane**.

If the graphs are parallel lines, or other non-intersecting graphs, then the system **has no solution**. If the graphs intersect multiple times, then the system **has multiple solutions**.

$$y - 4x = 6$$

$$16x = 4y + k$$

For what value of k does the system of equations above have at least one solution?

A) -32

B) -30

C) -24

D) -20

(Medium) This is a two-by-two system of linear equations, and so its solution is the intersection of those two lines. If we convert them to slope-intercept form, we get $y = 4x + 6$ and $y = 4x - k/4$, which reveals that these two lines have the same slope. This means that they are either parallel lines or identical lines. Two lines with the same slope can intersect only if they are the same line, and therefore $-k/4 = 6$ and $k = -24$.

Lesson 12: Solving systems by substitution

Let's go back to the second linear system from Lesson 11. This system can also be solved with a simple application of the Law of Substitution.

$$y = 2x - 3$$

$$y = -2x + 17$$

1. Substitute for y: $2x - 3 = -2x + 17$
2. Add $2x$: $4x - 3 = 17$
3. Add 3: $4x = 20$
4. Divide by 4: $x = 5$
5. Plug into either original equation to find y: $y = 2(5) - 3$ or $-2(5) + 17 = 7$

When one of the equations in a system is already solved for one variable (or when it's relatively easy to solve it for one variable), then substituting for this variable in the other equation often makes it easier to solve the system.

$$3x + y = 3y + 4$$

$$x + 4y = 6$$

Based on the system of equations above what is the value of the product xy?

(*Medium*) This system is not quite as tidy as the previous one, but we can still solve it by using the Law of Substitution.

$$3x + y = 3y + 4$$

$$x + 4y = 6$$

Subtract $4y$ from second equation to isolate x: $x = -4y + 6$

Substitute for x in first equation: $3(-4y + 6) + y = 3y + 4$

Simplify left side: $-11y + 18 = 3y + 4$

Add $11y$ and subtract 4: $14 = 14y$

Divide by 14: $1 = y$

Substitute $y = 1$ to find x: $x = -4(1) + 6 = 2$

Evaluate xy: $xy = (2)(1) = 2$

Lesson 13: Solving systems by linear combination

$$3x + 6y = 18$$
$$3x + 4y = 6$$

Based on the system of equations above, what is the value of y?

(*Easy*) Although this system can be solved by substitution (try it as an exercise), the setup of these equations suggests a much easier method, known as *linear combination*. It's based on a simple idea:

The Law of Combination

If $a = b$ and $c = d$, then $a + c = b + d$, $a - c = b - d$, and $ac = bd$

In other words, you should always feel free to add, subtract, or multiply the corresponding sides of two equations to make a new equation.

If we apply this rule to our system, notice that we can easily eliminate x from the system by just subtracting the equations:

$$\begin{array}{r} 3x + 6y = 18 \\ -\ (3x + 4y = 6) \\ \hline 2y = 12 \end{array}$$

Divide by 2: $y = 6$

$$3x - y = 20$$
$$2x + 4y = 7$$

Based on the system of equations above, what is the value of $x - 5y$?

(*Medium*) This question looks tougher than the previous one, because it's not just asking for x or y. It seems that the question requires us to solve the system for x *and* y and then to plug these values into the expression $x - 5y$ and evaluate. We could do that, but there is a much simpler method. Notice that a simple combination gives us the expression the question is asking for.

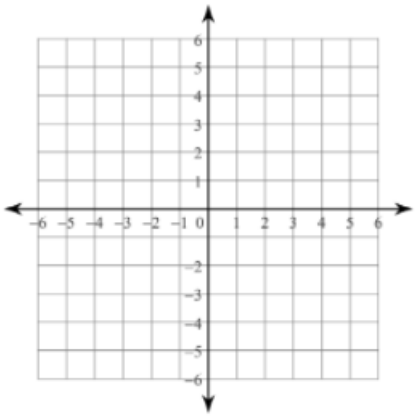
$$\begin{array}{r} 3x - y = 20 \\ -\ (2x + 4y = 7) \\ \hline x - 5y = 13 \end{array}$$

Subtract equations:

Using Linear Combination

When you're given a system of equations on the SAT, **always notice carefully what the question is asking you to evaluate**. Even if it appears to be the value of a complicated expression, often you can find it with a simple combination of the given equations.

1. $8x + y = 13$
$3x + 4y = -6$

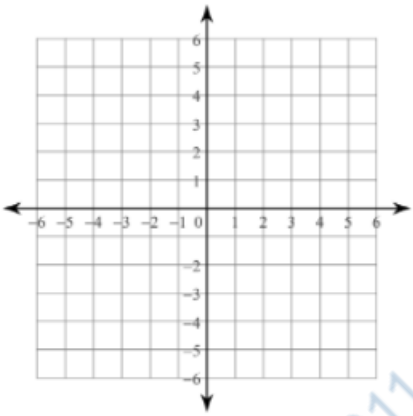


How many solutions?

a) No of solution.
b) 1 solution.
c) Infinity solutions

---

2. $x - 3y = 7$
$-2x + 6y = 4$



How many solutions?

a) No of solution.
b) 1 solution.
c) Infinity solutions

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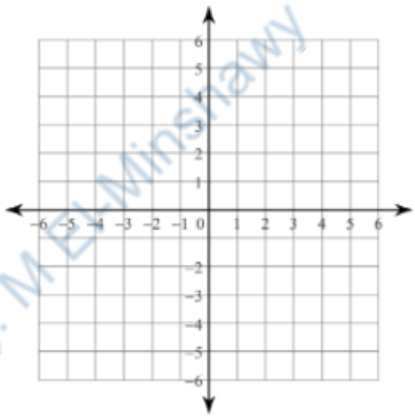
3. $-12x + 6y = -12$
$4x + 2y = -2$



How many solutions?

a) No of solution.
b) 1 solution.
c) Infinity solutions

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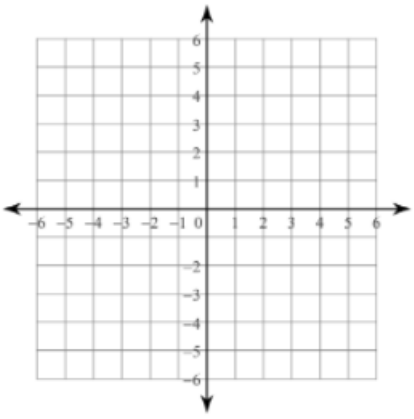
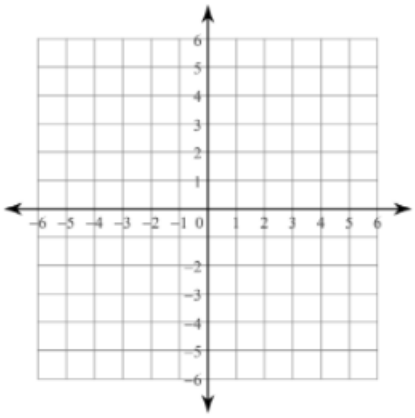
4. $3x + 6y = 12$
$-4x - 7y = -12$



How many solutions?

a) No of solution.
b) 1 solution.
c) Infinity solutions

5. $12x-6y=18$
$4x-2y=6$



How many solutions?

a) No of solution.
b) 1 solution.
c) Infinity solutions

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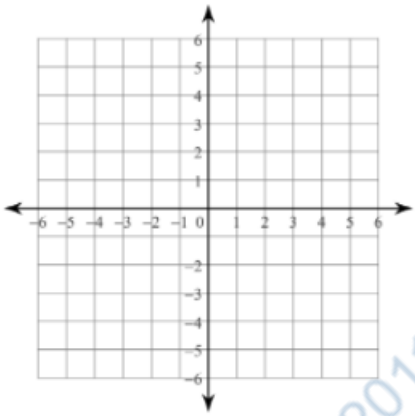
6. $-5x+10y=1$
$x-2y=-8$

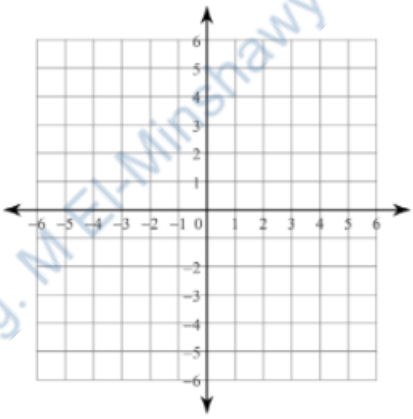


How many solutions?

a) No of solution.
b) 1 solution.
c) Infinity solutions

---

7. $7x+6y=0$
$2x+3y=0$

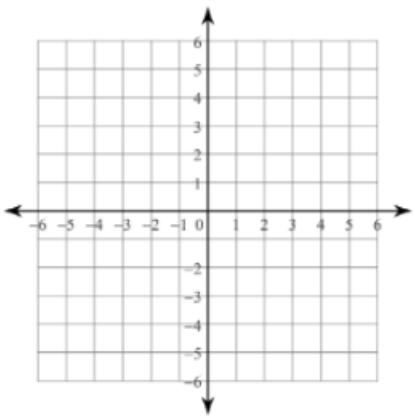


How many solutions?

a) No of solution.
b) 1 solution.
c) Infinity solutions

---

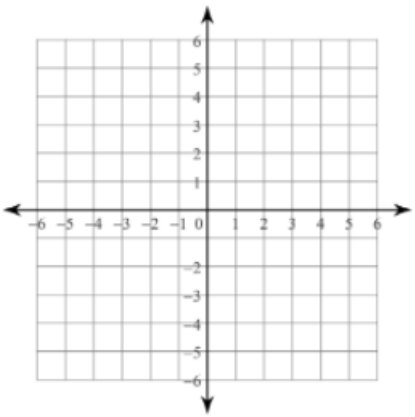
8. $-8x+24y=12$
$10x-30y=-15$



How many solutions?

a) No of solution.
b) 1 solution.
c) Infinity solutions

9. $-2x+3y=24$
$3x-8y=-57$

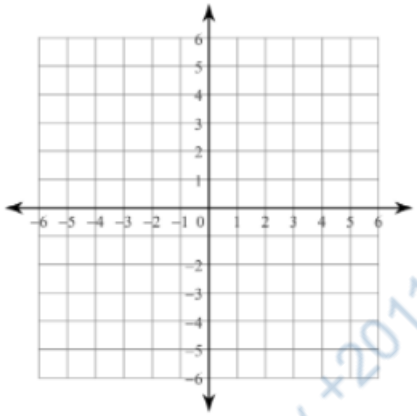


How many solutions?

a) No of solution.
b) 1 solution.
c) Infinity solutions

---

10. $6x+4y=-20$
$7x+3y=-35$



How many solutions?

a) No of solution.
b) 1 solution.
c) Infinity solutions

Exercise Set 5 (No Calculator)

1

If $3x + 2y = 72$, and $y = 3x$, what is the value of x?

2

If $2a - 7b = 10$ and $2a + 7b = 2$, what is the value of $4a^2 - 49b^2$?

3

If the lines $y = -4x - 3$ and $y = -3x - b$ intersect at the point $(-1, c)$, what is the value of b?

4

If the lines $4x + 5y = 13$ and $4y + kx = 2$ are parallel, what is the value of k?

5

If the lines $4x + 5y = 13$ and $6y - kx = 6$ are perpendicular, what is the value of k?

6

$$\frac{2a}{b} = \frac{1}{3}$$

$$\frac{c}{b} + 1 = \frac{5}{3}$$

Based on the system of equations above, what is the value of $\frac{a}{c}$?

7

If $ab = -4$ and $abc = 12$, what is the value of $\frac{c}{ab}$?

8

If a and b are constants and the graphs of the lines $2x - 3y = 8$ and $ax + by = 2$ are perpendicular, then what is the value of $\frac{3a}{b}$?

9

$$5x - y = 11$$

$$2x - 2y = 9$$

Based on the system of equations above, what is the value of $3x + y$?

A) -2

B) 0

C) 2

D) 4

10

Two numbers have a difference of 4 and a sum of -7. What is their product?

A) -33

B) -10.25

C) 8.25

D) 10.25

11

It costs Emma p dollars to make each of her custom bracelets, which she sells for m dollars apiece. She makes a profit of \$60 if she makes and sells 5 of these bracelets, but she only makes a profit of \$10 if she makes 5 bracelets but only sells 4 of them. How much does it cost Emma to make each bracelet?

A) \$36

B) \$38

C) \$48

D) \$50

Exercise Set 5 (Calculator)

12

If $2y = x + 1$ and $4x + 6y = 0$, then $y =$

13

If $6x + 7y = \frac{4}{5}$ and $6x - 7y = \frac{6}{5}$, then $y =$

$$2x - 5y = 20$$

$$10x - 25y = 4k$$

14

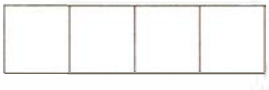
For what value of k does the system of equations above have at least one solution?

15

At the beginning of the week, the ratio of cats to dogs at Glenna's Pet Store was 4 to 5. By the end of the week, the number of cats had doubled, while the number of dogs had increased by 12. If the ratio of cats to dogs at the end of the week was 1 to 1, how many cats did the store have at the beginning of the week?

16

Jenny originally had twice as many friendship bracelets as Emilie. After Jenny gave Emilie 5 of her friendship bracelets, Jenny still had 10 more than Emilie. How many friendship bracelets did Jenny have originally?



17

The average (arithmetic mean) of x and y is 14. If the value of x is doubled and the value of y is tripled, the average (arithmetic mean) of the two numbers remains the same. What is the value of x?

18

$$7m + 10n = 7$$

$$6m + 9n = 1$$

Based on the system of equations above, what is the value of $4m + 4n$?

19

In the xy-plane, perpendicular lines a and b intersect at the point (2, 2). If line a contains the point (7, 1), which of the following points is on line b?

A) (0, 1)

B) (4, 5)

C) (7, 3)

D) (3, 7)

20

Which of the following pairs of equations has no solution in common?

A) $2x - 3y = 1$ and $6x - 9y = 3$

B) $y = 4x$ and $y = -4x$

C) $2x - 3y = 1$ and $6x - 9y = 2$

D) $y = 4x$ and $2y - 8x = 0$

21

In the xy-plane, the line l is perpendicular to the line described by the equation $\frac{1}{x} + \frac{1}{2y} = \frac{1}{y}$. What is the slope of line l?

A) -2

B) $-\frac{1}{2}$

C) $\frac{1}{2}$

D) 2

EXERCISE SET 5 ANSWER KEY

No Calculator

1. **8**

$3x + 2y = 72$

Substitute $y = 3x$: $3x + 2(3x) = 72$

Simplify: $9x = 72$

Divide by 9: $x = 8$

---

2. **20**

$4a^2 - 49b^2$

Factor: $(2a - 7b)(2a + 7b)$

Substitute: $(10)(2) = 20$

---

3. **2**

$y = -4x - 3$

Substitute $x = -1, y = c$: $c = -4(-1) - 3$

Simplify: $c = 1$

Other equation: $y = -3x - b$

Substitute $x = -1, y = 1$: $1 = -3(-1) - b$

Simplify: $1 = 3 - b$

Subtract 3: $-2 = -b$

Divide by -1: $2 = b$

---

4. **3.2 or 16/5** Parallel lines must have equal slopes. The slope of $4x + 5y = 13$ is $-4/5$, and the slope of $4y + kx = 2$ is $-k/4$.

$$\frac{-4}{5} = \frac{-k}{4}$$

Cross-multiply: $-5k = -16$

Divide by -5: $k = 16/5 = 3.2$

---

5. **7.5 or 15/2** Perpendicular line have slopes that are opposite reciprocals. The slope of $4x + 5y = 13$ is $-4/5$, and the slope of $6y - kx = 6$ is $k/6$.

$$\frac{-4}{5} = \frac{-6}{k}$$

Cross-multiply: $-4k = -30$

Divide by -4: $k = 7.5$

---

6. **.25 or ¼**

First equation: $\frac{2a}{b} = \frac{1}{3}$

Divide by 2: $\frac{a}{b} = \frac{1}{6}$

Second equation: $\frac{c}{b} + 1 = \frac{5}{3}$

Subtract 1: $\frac{c}{b} = \frac{2}{3}$

Reciprocate: $\frac{b}{c} = \frac{3}{2}$

Multiply: $\left(\frac{a}{b}\right)\left(\frac{a}{b}\right) = \frac{a}{c} = \left(\frac{1}{6}\right)\left(\frac{3}{2}\right) = \frac{3}{12} = \frac{1}{4}$

---

7. **.75 or ¾**

$abc = 12$

Substitute $ab = -4$: $(-4)c = 12$

Divide by -4: $c = -3$

Expression to evaluate: $\frac{c}{ab}$

Substitute $c = -3$ and $ab = -4$: $\frac{c}{ab} = \frac{-3}{-4} = \frac{3}{4}$

---

8. **4.5 or 9/2** The slope of $2x - 3y = 8$ is $2/3$, and the slope of $ax + by = 2$ is $-a/b$. If the two lines are perpendicular, then the slopes are opposite reciprocals: $\frac{2}{3} = \frac{b}{a}$

Reciprocate: $\frac{a}{b} = \frac{3}{2}$

Multiply by 3: $\frac{3a}{b} = \frac{9}{2}$

---

9. **C**

$5x - y = 11$

$2x - 2y = 9$

Subtract equations: $3x + y = 2$

---

10. **C**

$a - b = 4$

$a + b = -7$

Add equations: $2a = -3$

Divide by 2: $a = -1.5$

Substitute $a = -1.5$: $-1.5 + b = -7$

Add 1.5: $b = -7 + 1.5 = -5.5$

Evaluate product: $ab = (-1.5)(-5.5) = 8.25$

---

11. **B** Let c = the cost to make each one of Emma's bracelets.

$5m - 5c = 60$

$4m - 5c = 10$

Subtract: $m = 50$

Substitute $m = 50$: $5(50) - 5c = 60$

Simplify: $250 - 5c = 60$

Subtract 250: $-5c = -190$

Divide by -5: $c = 38$

Calculator

12. **2/7 or .286 or .285**

$2y = x + 1$

Subtract 1: $2y - 1 = x$

Given: $4x + 6y = 0$

Substitute $x = 2y - 1$: $4(2y - 1) + 6y = 0$

Distribute: $8y - 4 + 6y = 0$

Simplify: $14y - 4 = 0$

Add 4: $14y = 4$

Divide by 14: $y = 4/14 = 2/7$

13. **1/6 or .166 or .167**

$$6x + 7y = \frac{4}{5}$$

$$6x - 7y = \frac{6}{5}$$

Add equations: $12x = 2$

Divide by 12: $x = 2/12 = 1/6$

14. **25** The slope of $2x - 5y = 20$ is 2/5. The slope of $10x - 25y = 4k$ is $10/25 = 2/5$. Since the two lines have the same slope, they have no points of intersection unless they are the same line.

$$2x - 5y = 20$$

$$10x - 25y = 4k$$

Multiply first equation by 5: $10x - 25y = 100$

Therefore, $4k = 100$ and so $k = 25$.

15. **16** If the original ratio of cats to dogs is 4 to 5, then we can say there were $4n$ cats and $5n$ dogs to start. At the end of the week, therefore, there were $8n$ cats and $5n + 12$ dogs. If this ratio was 1:1, then $8n = 5n + 12$

Subtract $5n$: $3n = 12$

Divide by 3: $n = 4$

Therefore, there were $4n = 4(4) = 16$ cats at the beginning of the week.

16. **40** Let x = the number of friendship bracelets Emilie had to start. This means that Jenny originally had $2x$ bracelets. After Jenny gave 5 of them to Emilie, Jenny had $2x - 5$ and Emilie had $x + 5$. If Jenny still had 10 more than Emilie, then $2x - 5 = 10 + (x + 5)$

Simplify: $2x - 5 = x + 15$

Subtract x and add 5: $x = 20$

This means that Jenny had $2x = 2(20) = 40$ to start.

17. **56**

$$\frac{x+y}{2} = 14$$

Multiply by 2: $x + y = 28$

If x is doubled and y is tripled, the average remains the same:

$$\frac{2x+3y}{2} = 14$$

Multiply by 2: $2x + 3y = 28$

Previous equation: $x + y = 28$

Multiply by 3: $3x + 3y = 84$

Other equation: $2x + 3y = 28$

Subtract equations: $x = 56$

18. **24**

$$7m + 10n = 7$$

$$6m + 9n = 1$$

Subtract equations: $m + n = 6$

Multiply by 4: $4m + 4n = 24$

19. **D** Line a contains the points (2, 2) and (7, 1); therefore, it has a slope of $\frac{2-1}{2-7} = -\frac{1}{5}$. If line b is perpendicular to line a, then it must have a slope of 5 (the opposite reciprocal of $-1/5$). You might find it helpful to sketch the line with slope 5 through the point (2, 2), and confirm that is passes through the point (3, 7), which is one unit to the right and one 5 units up.

20. **C** In order for two lines in the xy-plane to have no points in common, they must be parallel and nonidentical. The only two such lines among these choices are $2x - 3y = 1$ and $6x - 9y = 2$, which both have a slope of 2/3, but have different y-intercepts of $-1/3$ and $-2/9$.

21. **A**

$$\frac{1}{x} + \frac{1}{2y} = \frac{1}{y}$$

Multiply by $2xy$: $2y + x = 2x$

Subtract x: $2y = x$

Divide by 2: $y = \frac{1}{2}x$

This line has a slope of 1/2, so the perpendicular must have a slope of -2.

Solving systems of linear equations

1. $z+w-3=k$

   $6z-10w=8$

   Consider the system of equations above, where k is a constant. For which value of k are there infinitely many (w, z) solutions?

   A. $-\frac{19}{5}$

   B. 5

   C. 8

   D. None of the above

   Correct answer: D Difficulty level: 2

2. $-5x-4y=2a$

   $4x-5y=2$

   Which of the following choices of *a* will result in a system of linear equations with exactly one solution?

   A. *a* can be any number

   B. *a* can be any number except 0.8

   C. *a* can be any number except −0.8

   D. *a* = 0.8

   Correct answer: A Difficulty level: 2

3. $\frac{1}{2}\left(x+\frac{2}{3}\right)-1=2\left(y+\frac{1}{3}\right)-\frac{1}{3} \qquad (x-2)-4\left(y+\frac{1}{2}\right)=-2$

   Consider the system of equations above. Which of the following statements about this system is true?

   A. There is only one (x, y) solution and x+y is positive.

   B. There is only one (x, y) solution and x+y is negative.

   C. There are infinitely many (x, y) solutions.

   D. There are no (x, y) solutions.

   Correct answer: C Difficulty level: 2

4. $\frac{2}{3}(x+1)-\frac{4}{5}y=\frac{1}{3} \qquad \frac{2}{5}x+\frac{1}{3}(2y+1)=\frac{1}{5}$

   Consider the system of equations above. Which of the following statements is true?

   A. There is only one solution (x, y) and x+y is positive.

   B. There is only one solution (x, y) and x+y is negative.

   C. There are infinitely many solutions.

   D. There are no solutions.

Correct answer: B Difficulty level: 2

5. $1.70p-0.34q=0$
   $0.17(q+1)-0.85(p-1)=0$
   Consider the system of equations above. How many (p, q) solutions does this system have?
   A. 0
   B. 1
   C. Infinitely many
   D. None of the above

   Correct answer: A Difficulty level: 2

6. $3s+2t-3=c$
   $-7s-5t=4$
   Consider the system of equations above, where c is a constant. For which value of c is there exactly one (s, t) solution where $s=-1$?
   A. -4.8
   B. $4\frac{4}{7}$
   C. 18
   D. None of the above

   Correct answer: A Difficulty level: 2

7. $0.7a-0.8b=-0.1$
   $a-1.4=-6(b-0.1)$
   Consider the system of equations above. If (a, b) is the solution to the system, then what is the value of the sum of a and b?
   A. -0.5
   B. -0.1
   C. 0.1
   D. 0.5

   Correct answer: D Difficulty level: 2

8. $6(1-a)=3(a-b)+1$
   $4(b-2)=3a$
   Consider the system of equations above. If (a, b) is the solution to the system, then what is the value of $a-b$?
   A. $-\frac{1,276}{243}$
   B. $\frac{29}{9}$

C. $\frac{44}{27}$

D. $\frac{1,276}{243}$

Correct answer: D Difficulty level: 2

9. $7p=9(p+q)+11$
$9q+3=-4(7q+p)$
Consider the system of equations above. If (p, q) is the solution to the system, then what is the value of p+q?

Correct answer: -9 Difficulty level: 2

10. $-0.2x+by=7.2$
$5.6x-0.8y=4$
Consider the system of equations above. For what value of b will the system have exactly one solution(x,y) with x=2? Round the answer to the nearest tenth.

Correct answer: 0.8 Difficulty level: 3

11. $-4a-5b-4=-21$
$-2b+5a-11=-9$
Consider the system of equations above. What is the value of $-2a-b$?

A. -5

B. $-\frac{1}{3}$

C. $\frac{1}{3}$

D. 5

Correct answer: A Difficulty level: 3

12. $2x-1=y$
$3x-1=y$
Consider the system of equations above. Which of the following statements about this system is true?

A. There is only one (x, y) solution and y is positive.
B. There is only one (x, y) solution and y is negative.
C. There are infinitely many (x, y) solutions.
D. There are no (x, y) solutions.

Correct answer: B Difficulty level: 3

13. $a\left(\frac{y}{2}-\frac{3}{2}x+1\right)=\frac{4}{3}y-\frac{1}{2}x+\frac{5}{6}$ $\frac{5}{6}y-\left(\frac{5}{6}x+\frac{5}{2}\right)=0$

Consider the system of equations above, where a is a constant. For which value of a is (x, y)=(4, 1) a solution?

A. $-\frac{34}{27}$

B. $-\frac{1}{27}$

C. $\frac{34}{9}$

D. None of the above

Correct answer: D Difficulty level: 3

14. 44(j+2k) =12

22k=−11j+16

Consider the system of equations above. How many solutions (j,k) does this system have?

A. 0

B. Exactly 1

C. Exactly 2

D. Infinitely many

Correct answer: A Difficulty level: 3

15. 1.5a−4.5b=3(a+b)

5.5b=5(b−a)+2.5a

Consider the system of equations above. If (a, b) is the solution to the system, then what is the value of b−a?

Correct answer: 0 Difficulty level: 3

16. 5x−2y=6

10x−4y=c

Which of the following choices of c will result in a system of linear equations with no solutions?

A. c=12

B. c can be any number other than −12

C. c can be any number other than 12

D. c can be any number

Correct answer: C Difficulty level: 3

17. −x=−6y−7

x−6y=k

Consider the system of equations above. Which of the following choices of k will result in a system of equations with infinitely many solutions?

A. Any number

B. Any number except 7

C. 7

D. -7

Correct answer: C Difficulty level: 3

18. $\frac{6}{5}p + kq = \frac{4}{5} \qquad q = \frac{3}{5}p - \frac{2}{5}$

Consider the system of equations above, where k is a constant. For which value of k is there no (p, q) solutions?

A. -2

B. 0

C. 2

D. None of the above

Correct answer: D Difficulty level: 4

19. $-11y=6(z+1)-13y$

$4y-24=c(z-1)$

For what value of c does the above system of linear equations in the variables y and z have infinitely many solutions?

Correct answer: 12 Difficulty level: 4

20. $2\left(x-\frac{1}{3}\right)-\frac{3}{2}\left(y-\frac{1}{6}\right)=0 \qquad 3\left(y-\frac{1}{2}\right)+\frac{8}{3}\left(x-\frac{1}{6}\right)=0$

Consider the system of equations above. If (x, y) is the solution to the system, then what is the value of the sum of x and y?

A. $\frac{5}{6}$

B. $\frac{25}{36}$

C. $\frac{2}{3}$

D. None of the above

Correct answer: B Difficulty level: 4

21. $-5.1x+3y=1.2$

$3.2x-8y=b$

Which of the following choices of b will result in a system of linear equations with exactly

one solution?

A. b can be any number

B. b can be any number except 1.2

C. b can be any number except −1.2

D. b=1.2

Correct answer: A Difficulty level: 4

22. 0.6=1.5(a+c(b+0.8))

−0.2=−2.5(b−0.4(1.2−1.5a))

Consider the system of equations above, where c is a constant. For which value of ccc are there no (a, b) solutions?

A. 0

B. $\frac{5}{17}$

C. $\frac{5}{3}$

D. None of the above

Correct answer: C Difficulty level: 4

23. a(p−q) =1

p = 2q−1

Consider the system of equations above, where a is a constant. For which value of a is (p, q)=(1, 1) a solution?

A. 0

B. 1

C. 2

D. None of the above

Correct answer: D Difficulty level: 4

24. $a\left(y-\frac{1}{3}\right)+\frac{x}{2}=0 \qquad 3y-x-1=0$

Consider the system of equations above, where a is a constant. For which value of a are there infinitely many (x, y) solutions?

A. $-\frac{3}{2}$

B. $\frac{5}{6}$

C. 3

D. None of the above

Correct answer: A Difficulty level: 4

25. ay=2x+1

y=2x+2

Consider the system of equations above, where a is a constant. For what value of a are there no (x, y) solutions?

Correct answer: 1 Difficulty level: 4

26. 5.2s+0.1r=0

0.7(r+0.2)+3.2=−3s

Consider the system of equations above. If (r, s) is the solution to the system, then what is the value of r+s? Round the answer to the nearest tenth.

Correct answer: -5.1 Difficulty level: 4

27. −6.4x=4y+2.1

ky+3.2x=5.8

For what value of k does the above system of linear equations in the variables x and y have no solutions?

Correct answer: 2 Difficulty level: 4

28. $\frac{3}{2}x - 3y = \frac{1}{4}$ $2x - \frac{13}{3}y = \frac{1}{9}$

Consider the system of equations above. If (x, y) is the solution to the system, then what is the value of the product of x and y?

A. -1

B. 1

C. $\frac{13}{6}$

D. None of the above

Correct answer: B Difficulty level: 4

Systems of linear equations word problems

1. The owner of a landscaping company is developing a proposal to maintain the grounds of a building. It is estimated that 75 gardening hours and 25 foreman hours will be required. The total budget for these hours is $1600. The hourly wage for a foreman is 30% more than a gardener plus an additional $1.65 per hour. Which of the following systems of equations can be used to determine the hourly wages of a gardener, g, and a foreman, f, so the total wages are $1600?

   A. $25g+75f=1600$
      $f=1.3g+1.65$
   B. $25f+75g=1600$
      $f=1.3g+1.65$
   C. $25g+75f=1600$
      $g=1.3f+1.65$
   D. $25f+75g=1600$
      $g=1.3f+1.65$

   Correct answer: B Difficulty level: 2

2. Devin is a landscaper who needs to prepare different types of grass seed for his customers' yards. Bluegrass seed costs $2.00 per pound while drought-resistant seed costs $3.00 per pound. If for a particular day the two types of grass seed totaled $68.00 and together weighed 25 pounds, how many pounds of bluegrass seed did Devin prepare?

   A. 4 pounds of bluegrass seed and 21 pounds of drought-resistant seed
   B. 7 pounds of bluegrass seed and 18 pounds of drought-resistant seed
   C. 18 pounds of bluegrass seed and 7 pounds of drought-resistant seed
   D. 21 pounds of bluegrass seed and 4 pounds of drought-resistant seed

   Correct answer: B Difficulty level: 2

3. Ricardo had two types of homework assignments for his college math class. The amount of mmm mini assignments he had was one fewer than twice the amount of l long assignments he had. If he had a total of 46 mini and long assignments, which of the following systems of equations can be used to find out how any mini and long assignments he had?

   A. $m=2l-1$
      $m+l=46$
   B. $m=2l-1$
      $m=l+46$
   C. $l=2m-1$
      $m+l=46$
   D. $l=2m-1$
      $m=l+46$

   Correct answer: A Difficulty level: 2

4. One Saturday, a butcher sells meat at a local farmer's market and makes a total number of dollars from selling a specific number of pounds of beef at \$6.00\$6.00$6.00 per pound as well as \$7.00\$7.00$7.00 from selling pork. On Sunday, she makes the same amount of money from selling an equivalent bbb pounds of beef at \$4.00\$4.00$4.00 per pound as well as \$5.00\$5.00$5.00 from selling pork. Which system of equations can be used to find out how many bbb pounds of beef she made for a total of ddd dollars?

   A. $d=4b+7$
      $d=6b+5$
   B. $d=6b+7$
      $d=4b+5$
   C. $b=4d+7$
      $b=6d+5$
   D. $b=6d+7$ $b=4d+5$

   Correct answer: B Difficulty level: 2

5. A piece of glass with an initial temperature of 99°C is cooled at a rate of 3.5°C per minute. Concurrently, a piece of copper with an initial temperature of 0°C is heated at 2.5°C per minute. Which of the following systems of equations can be used to solve for the temperature, T, in degrees Celsius, and the time, m, in minutes, when the glass and copper reach the same temperatures?

   A. $T=99+3.5m$
      $T=2.5m$
   B. $T=99-3.5m$
      $T=2.5m$
   C. $T=99+2.5m$
      $T=3.5m$
   D. $T=99-2.5m$
      $T=3.5m$

   Correct answer: B Difficulty level: 2

6. A vegetable stand sells p pumpkins for \$5.00 each and s squashes for \$3.00 each. On Monday, the stand sold 6 more squashes than pumpkins and made a total of \$98.00. Which system of equations can be used to determine the number of pumpkins and squashes sold?

   A. $3p+5s=98$
      $s=p+6$
   B. $3p+5s=98$
      $p=s+6$
   C. $5p+3s=98$
      $s=p+6$
   D. $5p+3s=98$
      $p=s+6$

Correct answer: C Difficulty level: 3

7. Mikayla is the communications director for a politician and has recommended that a total of 41 talks are given by the politician before election day. She also recommends a total of 9 more formal speeches, s, than informal talks, t. Which of the following systems of equations can be used to find out how many formal speeches versus informal talks she had?
   A. $t=s+9$
      $s+t=41$
   B. $t=s+9$
      $s=t-41$
   C. $s=t+9$
      $s+t=41$
   D. $s=t+9$
      $s=t-41$

   Correct answer: C Difficulty level: 3

8. Tickets for a concert were $5 for each child and $8 for each adult. At one of the concerts, each adult brought 4 children with them, and 10 children attended without an adult. The total ticket sales were $1730. Which of the following systems of equations can be solved to determine the number of children, c, and adults, a, who attended the concert?
   A. $5c+8a=1730$
      $4a+10=c$
   B. $5c+8a=1730$
      $4a-10=c$
   C. $8c+5a=1730$
      $4a+10=c$
   D. $8c+5a=1730$
      $4a-10=c$

   Correct answer: A Difficulty level: 3

9. Today, the population of Canyon Falls is 22,500 and the population of Swift Creek is 15,200. The population of Canyon Falls is decreasing at the rate of 740 people each year while the population of Swift Creek is increasing at the rate of 1,500 each year. Assuming these rates continue into the future, in how many years from today will the population of Swift Creek equal twice the population of Canyon Falls?
   A. 9 years
   B. 10 years
   C. 11 years
   D. 12 years

   Correct answer: B Difficulty level: 3

10. The owner of a health food store is developing a new product that consists of peanuts and raisins. Raisins cost $2.50 per pound and peanuts cost $3.50 per pound. The owner wants to create 20 pounds of the product that cost $3.03 per pound. Which of the following systems of equations can be used to determine the number of pounds of peanuts, p, and the number of pounds of raisins, r, that should be combined?

A. $\mathrm{p} - \mathrm{r} = 20 \quad \frac{2.50p+3.50r}{20} = 3.03$

B. $\mathrm{p} + \mathrm{r} = 20 \quad \frac{2.50p+3.50r}{20} = 3.03$

C. $\mathrm{p} - \mathrm{r} = 20 \quad 2.50p + 3.50r = 3.03$

D. $\mathrm{p} + \mathrm{r} = 20 \quad 2.50p + 3.50r = 3.03$

Correct answer: B Difficulty level: 3

11. Jerry has a large car which holds 22 gallons of fuel and get 20 miles per gallon. Kate has a smaller car which holds 16.5 gallons of fuel and gets 30 miles per gallon. If both cars have a full tank of fuel now and drive the same distance, in how many miles will the remaining fuel in each tank be the same?

A. 320
B. 325
C. 330
D. 335

Correct answer: C Difficulty level: 4

12. Paulo's economics course requires two papers−−one long and one short−−throughout the semester. The number of pages, l, in the long paper is one more than two times the number of pages, s, in the short paper. If the total number of pages for both papers is 40, how many pages must be in the long paper?

_____ pages

Correct answer: 27 Difficulty level: 4

13. A charity is planning a raffle to raise money. There are 125 regular tickets and 50 premium tickets. The cost of a premium ticket is 25% more than a regular ticket plus an additional $1.50. The raffle organizers expect to sell all of the tickets, and they want to collect $1,950 from the ticket sales. Which of the following systems of equations can be used to determine the price, p, of each premium ticket and the price, r, of each regular ticket?

A. 50p+125r=1950
   p−1.25r=1.50
B. 50p+125r=1950
   p−1.50r=1.25
C. 125p+50r=1950

$p-1.25r=1.50$

D. $125p+50r=1950$
$p-1.50r=1.25$

Correct answer: A Difficulty level: 4

14. The length of a rectangular swimming pool is twice the width. If the perimeter is 120 feet, then what is the width in feet?
_____ feet

Correct answer: 20 Difficulty level: 4

15. For a high school dinner function for teachers and students, the math department bought 6 cases of juice and 1 case of bottled water for a total of $135. The science department bought 4 cases of juice and 2 cases of bottled water for a total of $110. How much did a case of juice cost?
A. $12.50
B. $15.00
C. $20.00
D. $25.00

Correct answer: C Difficulty level: 4