3. If a and b are any real numbers such that 0 < a < 1 < b, which of the following must be true of the value of ab?

(A) 0 < ab < a

(B) 0 < ab < 1

(C) a < ab < 1

(D) a < ab < b

(E) b < ab

4. If a, b, and c are numbers such that $\frac{a}{b} = 3$ and $\frac{b}{c} = 7$ then $\frac{a+b}{b+c}$ is equal to which of the following?
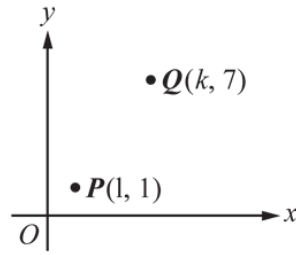
(A) $\frac{7}{2}$

(B) $\frac{7}{8}$

(C) $\frac{3}{7}$

(D) $\frac{1}{7}$

(E) 21

$\bullet Q(k, 7)$

$\bullet P(1, 1)$

5. In the figure above, the slope of the line through points P and Q is $\frac{3}{2}$. What is the value of k?

(A) 4

(B) 5

(C) 6

(D) 7

(E) 8

6. A machine can insert letters in envelopes at the rate of 120 per minute. Another machine can stamp the envelopes at the rate of 3 per second. How many such stamping machines are needed to keep up with 18 inserting machines of this kind?

(A) 12

(B) 16

(C) 20

(D) 22

(E) 24

7. What is the degree measure of the acute angle formed by the hands of a 12-hour clock that reads exactly 1 o'clock?

    A. 15°

    B. 30°

    C. 45°

    D. 60°

    E. 72°

8. What is the probability that a number selected at random from the set {2, 3, 7, 12, 15, 22, 72, 108} will be divisible by both 2 and 3?

    A. $\dfrac{1}{4}$

    B. $\dfrac{3}{8}$

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

    D. $\dfrac{5}{8}$

    E. $\dfrac{3}{8}$

9. A circle has a circumference of 16π feet. What is the radius of the circle, in feet?

     A. $\sqrt{8}$

     B. 4

     C. 8

     D. 16

     E. 32

10.   A rectangle with a perimeter of 30 centimeters is twice as long as it is wide. What is the area of the rectangle in square centimeters?

     A. 15

   B. 50

     C. 200

     D. $3\sqrt{15}$

     E. $6\sqrt{15}$

11. In the standard (x,y) coordinate plane, what are the coordinates of the midpoint of a line segment whose endpoints are (–3,0) and (7,4) ?

    A. (2,2)

    B. (2,4)

    C. (5,2)

    D. (5,4)

    E. (5,5)

12. Points A, B, C, and D are on a line such that B is between A and C, and C is between B and D. The distance from A to B is 6 units. The distance from B to C is twice the distance from A to B, and the distance from C to D is twice the distance from B to C. What is the distance, in units, from the midpoint of BC to the midpoint of CD ?

    A. 18

    B. 14

    C. 12

    D. 9

    E. 6

13. Which of the following statements *must* be true whenever n, a, b, and c are positive integers such that $n < a$, $c > a$, and $b > c$?

    A. $a < n$

    B. $b - n > a - n$

    C. $b < n$

    D. $n + b = a + c$

    E. $2n > a + b$

14. The distribution of John's high school grades by percentage of course credits is given in the circle graph below. What is his grade point average if each A is worth 4 points; each B, 3 points; and each C, 2 points?

20%
B's

C's
10%

A's
70%
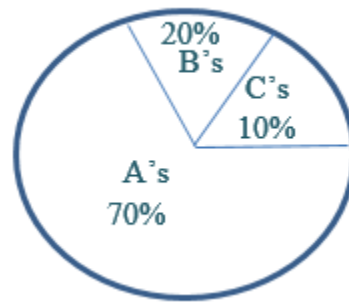
    A. 3.0

    B. 3.4

    C. 3.6

    D. 3.7

    E. Cannot be determined from the given information

15. What is the difference between 1.8 and 1.08?

A. 0.71

B. 0.71

C. 0.719

D. 0.72

E. 0.72

16. Which of the following equations represents the linear relationship between time, t, and velocity, v, shown in the table below?

t	0	1	2
v	120	152	184

A. $v = 32t$

B. $v = 32t + 120$

C. $v = 120t$

D. $v = 120t + 32$

E. $v = 120t + 120$

17. An industrial cleaner is manufactured using only the 3 secret ingredients A, B, and C, which are mixed in the ratio of 2:3:5, respectively, by weight. How many pounds of secret ingredient B are in a 42-pound (net weight) bucket of this cleaner?

    A. 4.2

    B. 12.6

    C. 14.0

    D. 18.0

    E. 21.0

18. If $n = 8$ and $16 \cdot 2^m = 4^{n-8}$, then $m =$?

    a. −4

    b. −2

    c. 0

    d. 1

    e. 8

19. In the figure below, A, B, C, and D are collinear, FC is parallel to ED, BE is perpendicular to ED, and the measures of $\angle FAB$ and $\angle EBA$ are as marked. What is the measure of $\angle FCB$?
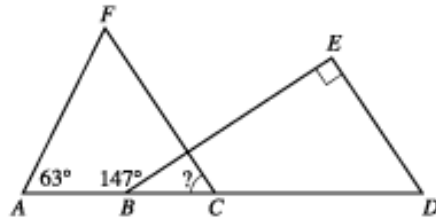
    A. 33°

    B. 57°

    C. 63°

    D. 84°

    E. Cannot be determined from the given information

20. Which of the following is an equation of the circle with its center at (0,0) that passes through (3,4) in the standard (x,y) coordinate plane?

A. $x - y = 1$

B. $x + y = 25$

C. $x^2 + y = 25$

D. $x^2 + y^2 = 5$

E. $x^2 + y^2 = 25$

1. B

Consider statement II, AB + BC = AD - CD. Since B is between A and C, it follows that

AB + BC = AC. Since C is between A and D, it follows that AC + CD = AD.

Therefore, AD – CD = AC. Since both AB + BC, and AD – CD equal AC, they are equal to each other. Statement II is the only statement that is true.

2. E

$3(x – 4) = 3x – 12$ therefore, the equation becomes $3x – 12 = 3x – 12$, which is true for all real numbers.

3. D

If all members of $0 < a < 1 < b$ are multiplied by a, which is positive since $0 < a$, the inequality is $0 < a^2 < a < ab$, so $a < ab$. If all members of $0 < a < 1 < b$ are multiplied by b, which is also positive since $0 < b$ by transitivity, the inequality is $0 < ab < b < b^2$, so $ab < b$. Combining gives $a < ab < b$.

Let $a = \frac{1}{2}$, $b = 2$. These are valid values since $0 < \frac{1}{2} < 1 < 2$. Then $ab = 1$

4. A

From $\frac{a}{b}$ = 3 is implied that $\frac{a+b}{b}$ = 4

From $\frac{b}{c}$ = 7 is implied that $\frac{b}{b+c}$ = $\frac{7}{8}$

If we multiply together, we have $\frac{a+b}{b+c}$ = $4\left(\frac{7}{8}\right)$ = $\frac{7}{2}$

5. B

The slope of a line in a coordinate plane is given by the fraction whose numerator is the change in y between any two points on the line and whose denominator is the change in x between the same points on the line.

The question asks for the value of k, which is the x-coordinate of point Q.

The change in y between points P and Q is 6. The change in x between these points is k - 1. Since the slope is $\frac{3}{2}$, it follows that $\frac{6}{k-1}$ = $\frac{3}{2}$. Solving this equation gives 3k – 3 = 12. Therefore, 3k = 15, and k = 5.

6. A

First, you convert 1 minute to 60 seconds so that the ratios are both in envelopes per second. One inserting machine inserts letters at the rate of 120 per 60 seconds, or 2 per second. Therefore, 18 machines would insert 36 letters per second.
Let x be the number of stamping machines needed to keep up with 18 inserting machines. Then, since one machine stamps 3 envelopes per second, x machines stamp 3x envelopes per second. You can write the equation 3x = 36 or x = 12.

7. B

One complete rotation of a clock hand is 360°, and there are 12 hourly markings on a clock. When the hands read exactly 1 o'clock, the degree measure of the angle formed by the clock hands is $\frac{1}{12}$ of a complete rotation, or $\frac{1}{12}(360°) = 30°$

8. B

Since 12, 72, and 108 are the only numbers in the list divisible by both 2 and 3, the probability that the number selected at random is divisible by both 2 and 3 is $\frac{3}{8}$

9. C

The formula for the circumference of a circle with radius r is $2\pi r$. So $2\pi r = 16$, or $r = 8$.

10. B

If w = width, then $2w$ = length. Therefore, the perimeter is $2(w + 2w) = 30$, and $w = 5$. Since the width is 5, the length is $2(5) = 10$. Then the area is $5(10) = 50$.

11. A

To find the midpoint, you need to take the average of each of the coordinates:

$(\frac{-3+7}{2}, \frac{0+4}{2}) = (2, 2)$

$BC = 2AB = 2(6) = 12$ and $CD = 2BC = 2(12) = 24$. The distance between the midpoints of BC and CD is $\frac{1}{2}BC + \frac{1}{2}CD = \frac{1}{2}(12) + \frac{1}{2}(24) = 18$.

Since $b > a$, subtracting n from each side, $b - n > a - n$, will not change the relationship between b and a.

$4(0.7) + 3(0.2) + 2(0.1) = 3.6$.

Take 1.08 and repeat the pattern several times, then subtract that from 1.8.

$1.8 - 1.08080808 \approx 0.7191919$. Realizing that the pattern should repeat, you can conclude that 0.719 is the correct answer.

16. B

A linear relationship means the associated graph is a line. So, you can think of the ordered pairs (t,v) as points on the line. Since $(0,120)$, $(1,152)$, and $(2,184)$ are points on the line, the slope of the line is $\frac{152-120}{1-0} = 32$. Therefore, $v = 32t + b$, where b is the y-intercept of the line. Since $(0,120)$ is a point on the line, $120 = 32(0) + b$, or $b = 120$. Thus, an equation for the line is $v = 32t + 120$.

17. B

If you let $3x$ be amount of secret ingredient B, you can set up the equation:
$2x + 3x + 5x = 42$. Since $10x = 42$, $x = 4.2$, and B $= 3x = 12.6$

18. A

When $n = 8$, $4^{n-8} = 4^{8-8} = 4^0 = 1$, and $16 \cdot 2^m = 2^4 \cdot 2^m = 2^{4+m}$. So, $2^{4+m} = 1$, and any number to the zeroth power is 1, so $4 + m = 0$, or $m = -4$.

19. B

Since FC and ED are two parallel line segments cut by transversal BE, $\angle E$ and $\angle BGC$ are corresponding angles. So, the measure of $\angle BGC$ is 90°. Since $\angle ABG$ and $\angle GBC$ are supplementary angles, the measure of $\angle GBC = 180° - 147° = 33°$. Looking at $\triangle BGC$, the sum of the measures of angles $\angle GCB$, $\angle BGC$, and $\angle GBC$ is 180°.

The measure of $\angle GCB + 90° + 33° = 180°$, or $180° - 90° - 33° = 57°$

20. E

The radius of the circle is the distance between $(0,0)$ and $(3,4)$, which is $(3-0)^2 + (4-0)^2 = 5$. An equation of a circle where (h,k) is the center and r is the radius is $(x - h)^2 + (y - k)^2 = r^2$. Therefore, $(x - 0)^2 + (y - 0)^2 = 5^2$ or $x^2 + y^2 = 25$