18) The approximate relationship between Kelvin (K) and degrees Celsius (C) is given by this equation: K=273 + C. The freezing point of water is 0 degrees Celsius, and the boiling point of water is 100 degrees Celsius. What are the approximate freezing and boiling points of water in Kelvin?

(F) K = 273+0 = 273

A) Freezing: 0; boiling 100

(B) 273 + 100 = 373

B) Freezing: -273; boiling -173

C) Freezing: 273; boiling 373

D) Freezing: 473; boiling 573

19) What is the value of the smallest side in a right triangle with a hypotenuse of 8 and angles of 30 and 60 degrees?

2x = 8
x = 4

4
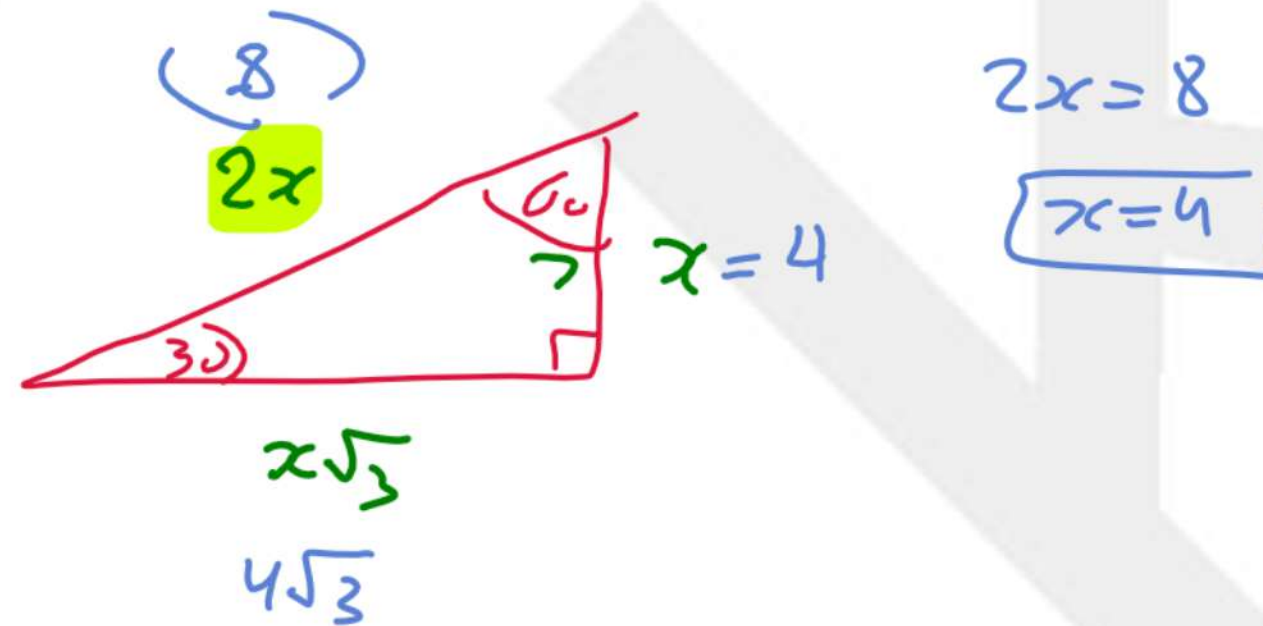
20)

n	Pattern
$1^2 \rightarrow 1$	1
$2^2 \rightarrow 4$	1 + 3
$3^2 \rightarrow 9$	1 + 3 + 5
$4^2 \rightarrow 16$	1 + 3 + 5 + 7
$5^2 \rightarrow 25$	1 + 3 + 5 + 7 + 9

The table above gives the values of a sum of the first n numbers, starting with 1. Which of the following is a correct statement about n?

a) The product of n and its corresponding sum decreases as n increases.

b) The difference between each additional value of n and the previous value of n is increasing exponentially.

c) The sum of the first n odd numbers equals the square of n.

d) The sum of the first n numbers is comprised solely of prime numbers.

Math is Root of Knowledge

(1) Which expression is equivalent to
$6xy(2x^2 + 5y)$?

$12x^3y + 30xy^2$

(A) $8x^3y + 11xy^2$
(B) $12x^2y + 5y$
(C) $12x^2 + 30xy$
(D) $12x^3y + 30xy^2$

(2) Which expression is equivalent to
$$7x^6 - 2x^5 + 9x^4?$$

(A) $x^5(7x - 2)$
(B) $x^4(7x^2 - 2x + 9)$ $7x^6 - 2x^5 + 9x^4$
(C) $9x^4(7x^2 - 2x + 1)$
(D) $2x^6(-2x^5 + 9x^4 + 1)$

(3) The height of a certain vehicle is 61 inches. The vehicle's length is 3 times its height. Which of the following systems of equations represents this situation, where x Is the length of the vehicle, in inches, and y is the height of the vehicle, in inches?

$y = 61$

(A) $y = 3x$, $x = 61$ $x = 3y$
(B) $y = 3x$, $y = 61$
(C) $x = 3y$, $x = 61$
(D) $x = 3y$, $y = 61$

(4) For the linear function f, the graph of $y = f(x)$ in the xy- plane has a slope of -54 andpasses through the point $(0,0)$.
    Which equation defines f?

(A) $f(x) = -54x$
(B) $f(x) = 36x$
(C) $f(x) = 18x$
(D) $f(x) = x$

(5) The function g is defined by $g(x) = \frac{5}{9}x - \frac{7}{9}$. What is the value of $g(18)$?

(A) $\frac{38}{9}$ $\frac{5}{9}(18) - \frac{7}{9} = \frac{83}{9}$
(B) $\frac{52}{9}$
(C) $\frac{83}{9}$
(D) $\frac{97}{9}$

(6) The function f is defined by $f(x) = x^2 + x - 61$. What is the value of $f(2)$?

$(2)^2 + 2 - 61$

-55

Math is Root of Knowledge

Annotations top left: $y = mx + b$

slope — Average rate Y Per x

y-int — initial starting at $x = 0$

(7) $f(x) = 5x + 7$

The function f gives the estimated height, in feet, of a poplar tree x years after its height was first measured. Which statement is the best interpretation of **7** in this context?

(A) The tree will be measured each year for **7** years.

(B) The tree is estimated to grow to maximum height of **7** feet.

(C) The estimated height of the tree increased by **7** feet each year.

(D) The estimated height of the tree was **7** feet when it was first measured.

(8) In the xy-plane, line k has a slope of **5** and a y intercept of line k ?

(9) $\dfrac{27(k+6)}{3(k+6)}$ $\dfrac{27}{3}$

The given expression is equivalent to c, where c is a constant and $k > 6$. What is the value of c?

9

(10) The table gives the primeters of similar triangles **TUV** and **XYZ**, where $\overline{TU}$ corresponds to $\overline{XY}$. The length of $\overline{TU}$ is **6.**

	Primeters
Triangle TUV	50
Triangle XYZ	150

What is the length of $\overline{XY}$?

Area: $50 \quad 6^2$; $150 \quad x^2$

Volume: $50 \quad 6^3$; $150 \quad x^3$

(A) 2
(B) 6
(C) 18
(D) 56

(11) If

$$9(7 - 8x) + 2 = 8(7 - 8x) + 17$$

What is the value of $7 - 8x$?

Shift Sdz $x = -1$

(A) -15
(B) -1
(C) 1
(D) 15

$7 - 8(-1)$ 15

Math is Root of Knowledge

$$y = a(x-h)^2 + k$$
vertex (h, k)

(17) The town of Fillmore is planning its annual fireworks show.

The equation $y = 16(x - 6.8)^2 + 740$ gives the estimated height y, in feet, of a type of firework X seconds after it is launched into the air. Which of the following is the best interpretation of the vertex of the graph of the equation in the xy-plane?

vertex $(6.8, 740)$
x y
sec   ft

(A) This type of firework reaches an estimated maximum height of **740** feet **16** seconds after it is launched into the air.

(B) This type of firework reaches an estimated maximum height of **740** feet **6.8** seconds after it is launched into the air.

(C) This type of firework reaches an estimated maximum height of **16** feet **740** seconds after it is launched into the air.

(D) This type of firework reaches an estimated maximum height **6.8** feet **740** seconds after it is launched into the air.

(18) The product of a positive number X and the number that is **15** less than X is equal to **286.** What is the value of X?

$x(x-15) = 286$

$x^2 - 15x - 286 = 0$
Mode
5
3

(19) In the figure, $AC = CD$. The measure of angle EBC is $29°$, and the measure of angle ACD is $108°$. What is the value of X?

$\frac{180-108}{2}$

$180-(36+29)$

$180-115$

65

Note: Figure not drawn to scale.

(20) The positive **number a** is **2,800%** of the **number c**, and c is **25%** of the **number b**.

If $a - b = wc$, Where W is a constant, what is the value of W?

$a = 28c$ $a = 2800$

$c = 0.25 b$

$c = 100$

$b = 400$

24

$2800 - 400 = w(100)$

shift
calc
$w = 24$

Math is Root of Knowledge

(21) Line j is defined by $4x + 5y = 55$. Line k is parallel to line j in the xy plane. An equation of line k is $24x + ry = 15$, where r is a constant. If line k passes through the point $(0, b)$, what is the value of b?

$$\frac{4}{24} = \frac{5}{r}$$

$$r = 30$$

$$\boxed{\frac{1}{2}}$$

$$24x + 30y = 15$$

$$24(0) + 30b = 15$$

stylint Solve

$$ax + by = c$$
$$dx + ey = f$$

0 $\qquad \frac{a}{d} = \frac{b}{e}$ //

1 $\qquad \frac{a}{d} \neq \frac{b}{e}$

$\infty \qquad \frac{a}{d} = \frac{b}{e} = \frac{c}{f}$

(22) The dot plot shows the distribution of capacity for a set of capacitors, set A, which a researcher used for a certain experiment. For another experiment, the researcher used a different set of capacitors, set B. Set B has the same number of capacitors as set A, but the capacity of each capacitor of set B is **17 microfarads (μF) greater than** the capacity of **each** respective capacitor in set A. Which of the following is true about the capacities of the capacitors in set B?
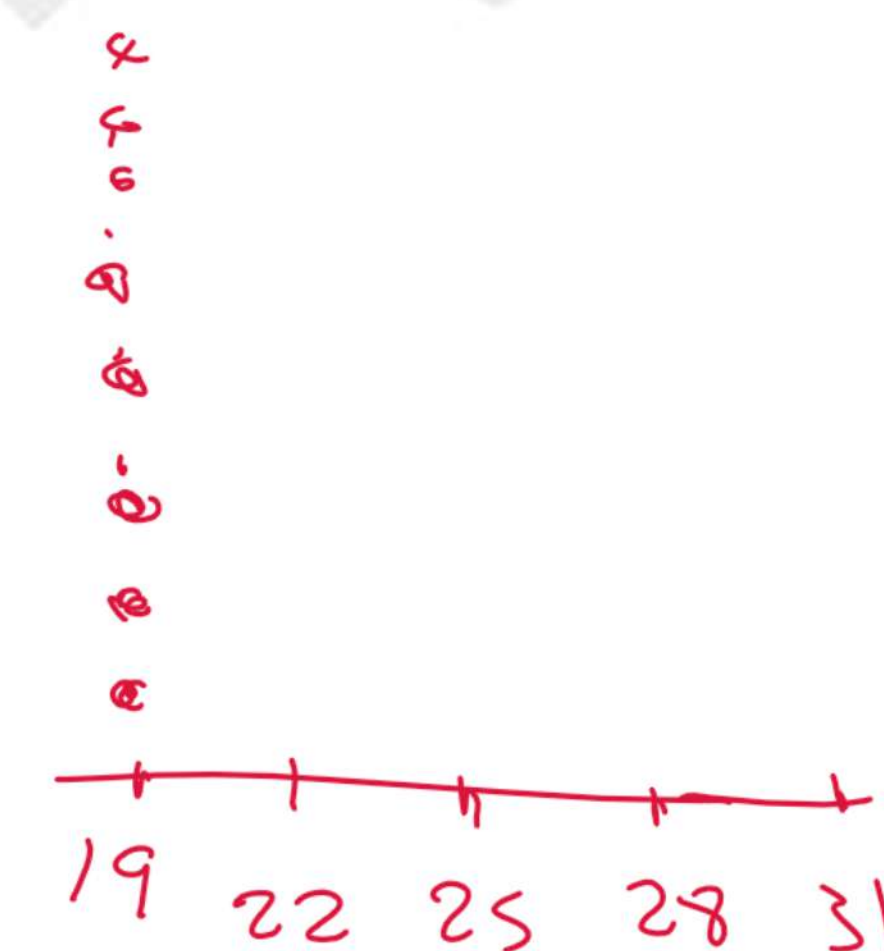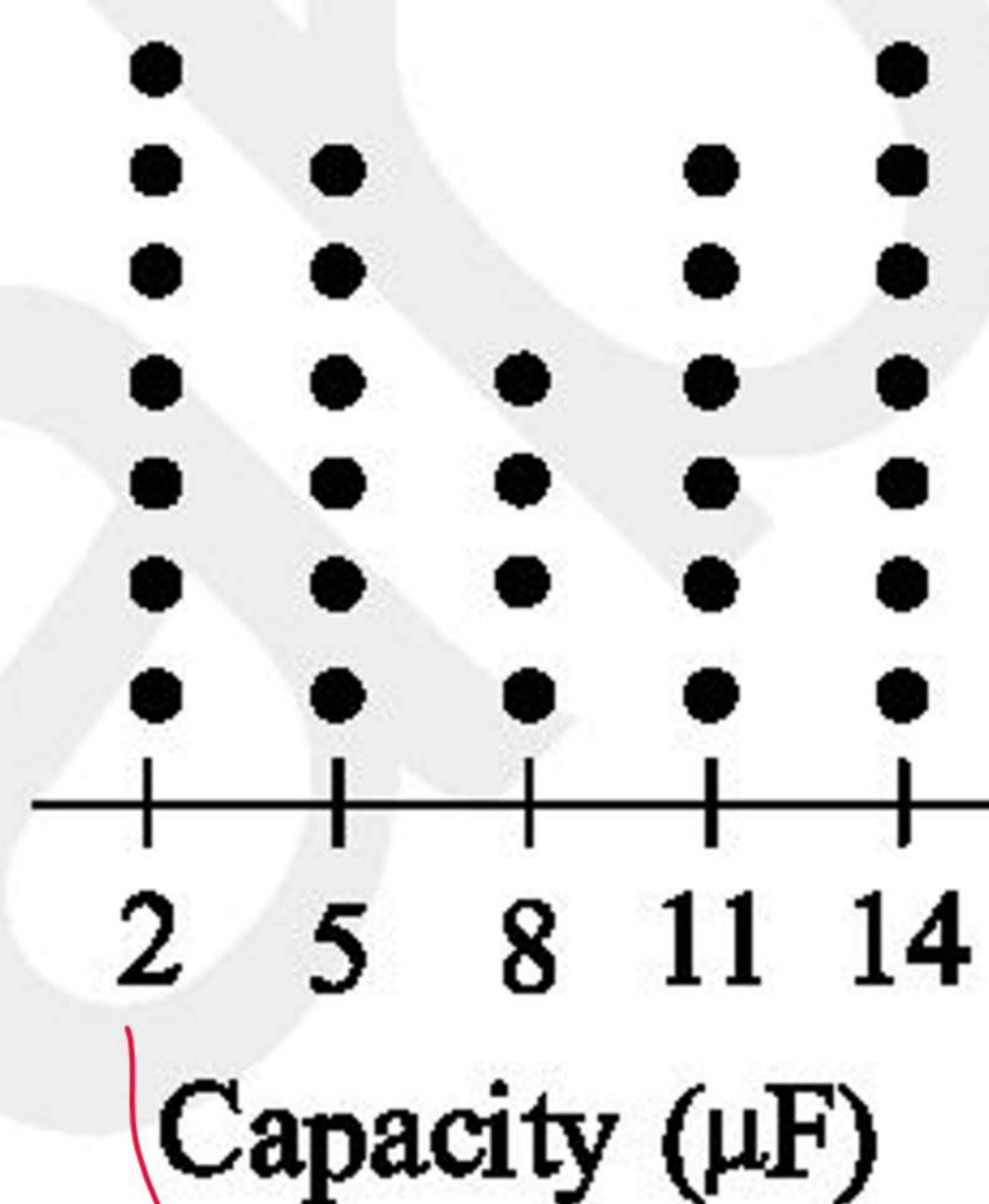

Capacity (μF)

+17

Range: 31-19
= 12

(A) The mean capacity is 8 μF, and the range of capacities is 12 μF.

(B) The mean capacity is 8 μF, and the range of capacities is 29 μF.

(C) The mean capacity is 25 μF, and the range of capacities is 12 μF.

(D) The mean capacity is 25 μF, and the range of capacities is 29 μF.

(1) The bar graph shows the distribution of flower type for the **700 flowers** that a florist has in stock.
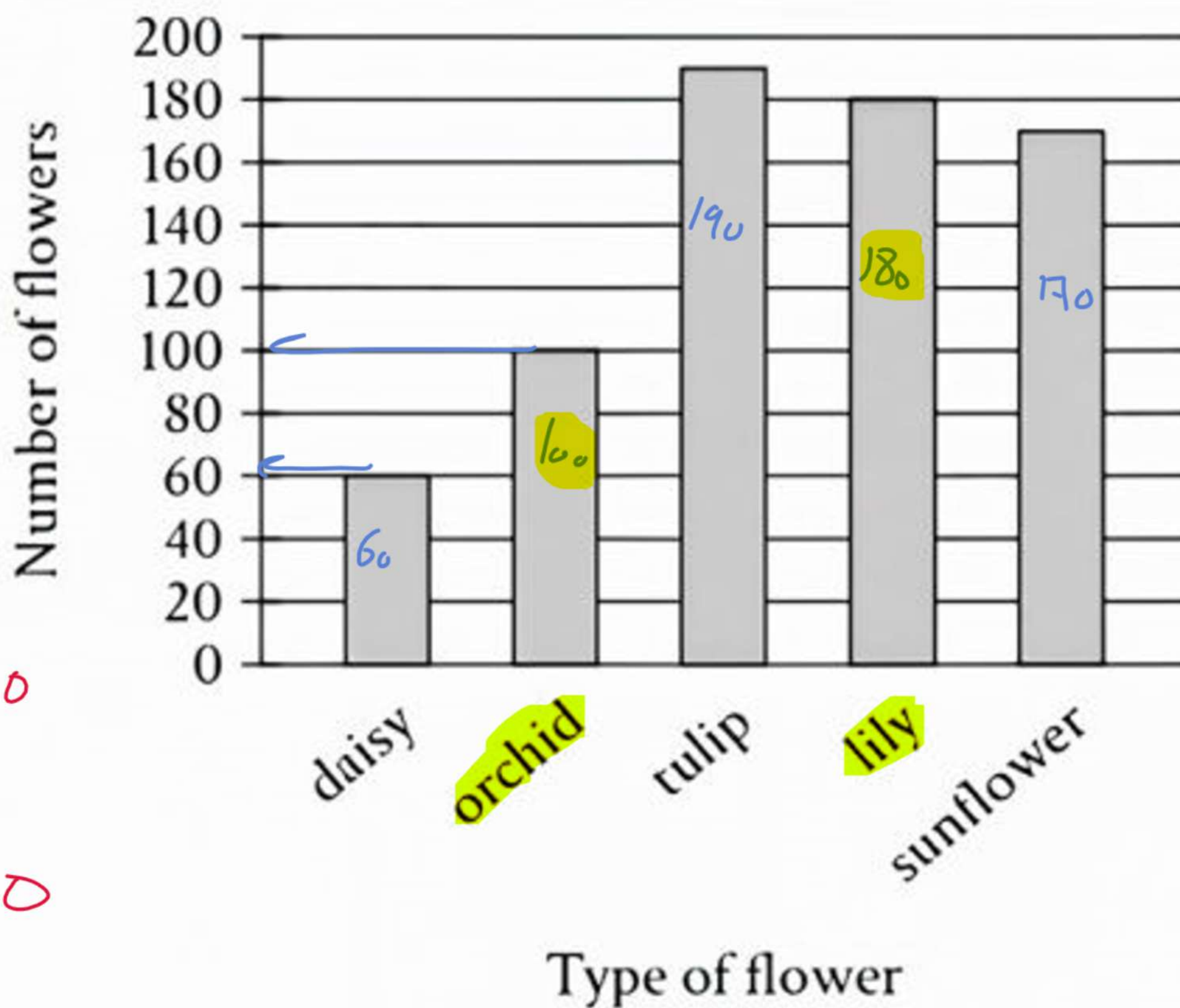
Type of flower

For which two types of flowers is the total number of flowers of the two types exactly $\frac{2}{5}$ of the florist's stock?

$\frac{2}{5} \times 700$
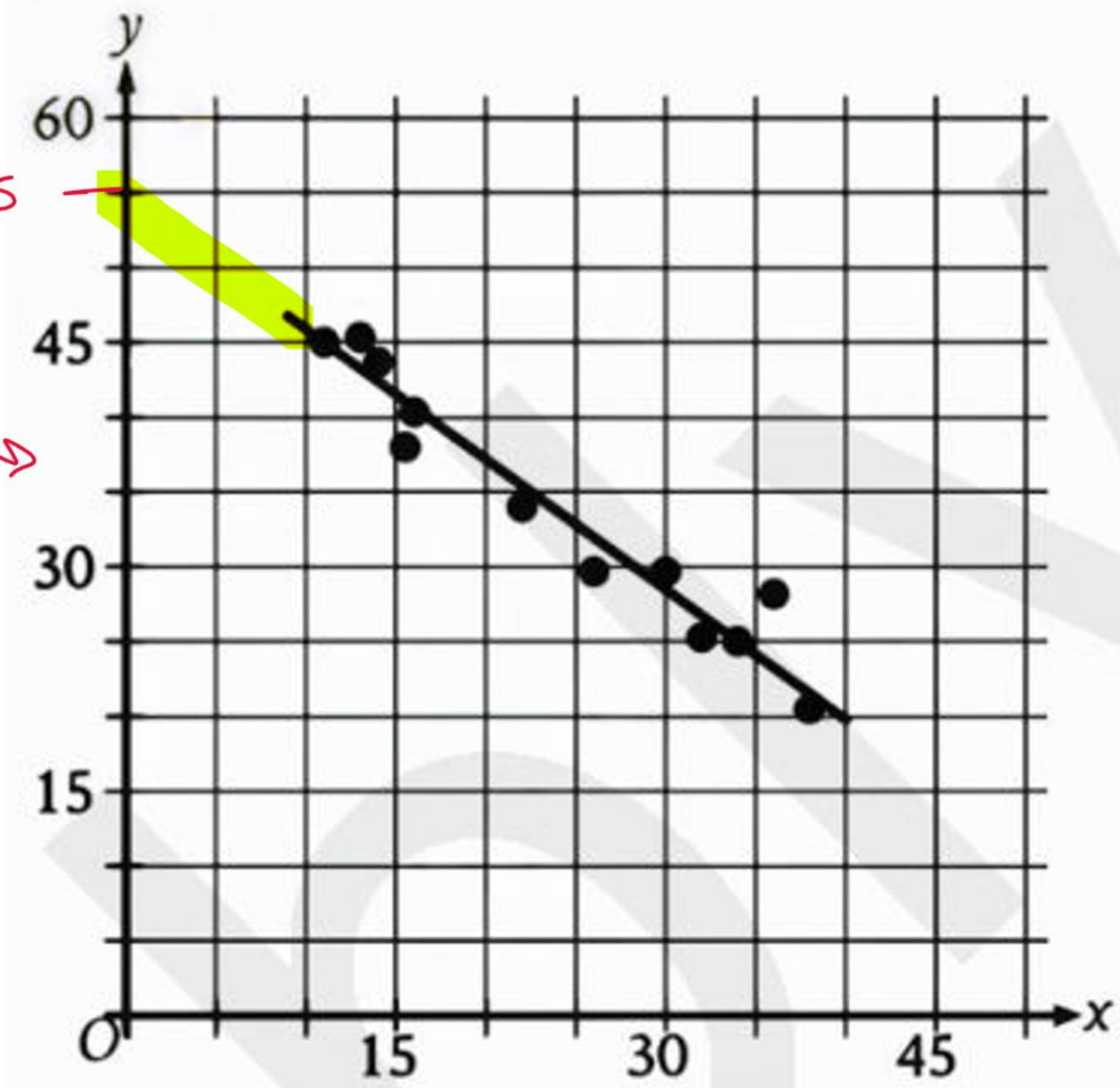
$= 280$

(A) Daisy and orchid.

(B) Orchid and lily.

(C) Orchid and sunflower.

(D) Lily and sunflower.

shift same

(2) If $4(2x + 11) - 2(2x - 5) =$

$-9 + 13x$, what is the value of $12x$?

$x = 7$

$12(7)$

$= 84$

(A) $\frac{7}{12}$

(B) 7

(C) 12

(D) 84

(3)

The scatterplot shows the relationship between two variables, x and y, for data set A. A line of best fit for the data is also shown. Data set B is created by subtracting **11** units from the value of y for each data point from data set A.

Which of the following is closest to the y coordinate of the y intercept of the line of best fit for data set B?

(A) 62.75

(B) 53.75

(C) 42.75

(D) 31.75

SAS
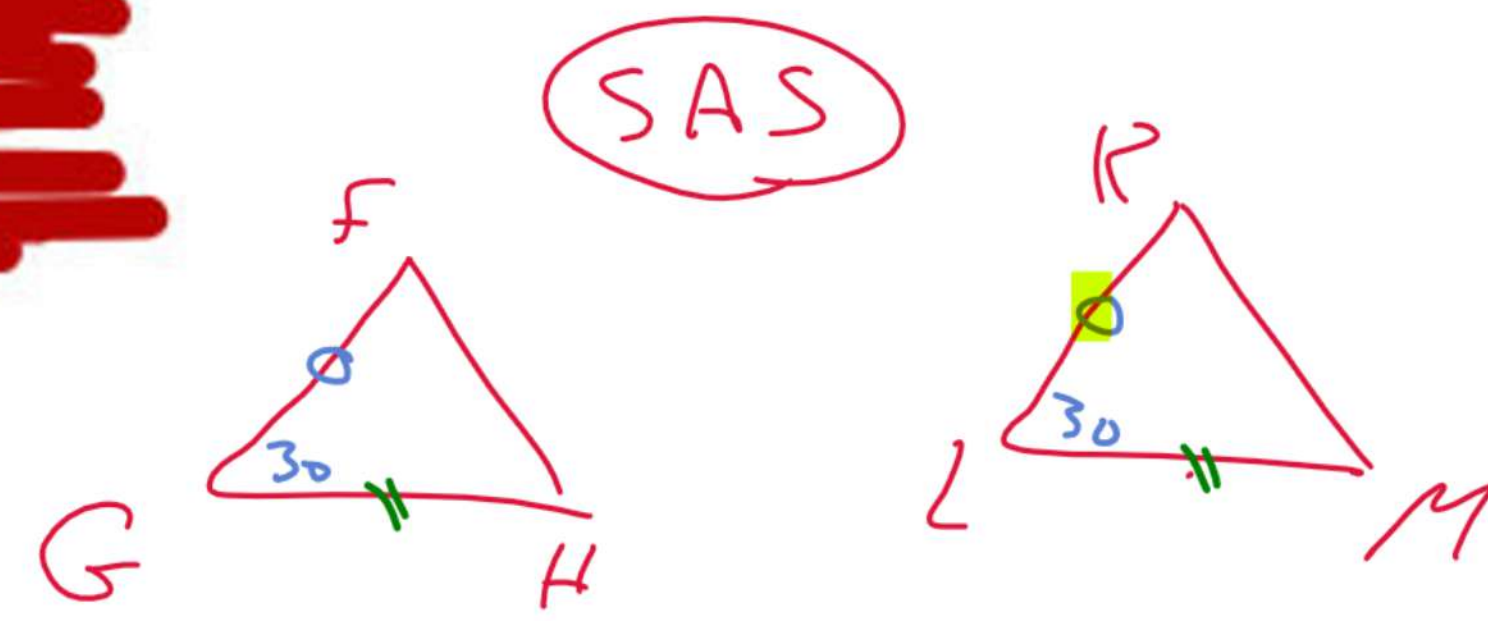
(4) An object has a mass of **308** grams and volume of **28** cubic centimeters. What is the density, in grams per cubic centimeter, of the object?

(A) 11
(B) 280
(C) 336
(D) 8,624

$d = \dfrac{m}{v} = \dfrac{308}{28} = 11$

(5) In the xy-plane, which of the following does NOT contain any points that are part of the solution set to $3x - 7y > 21$?

(A) The region where $x < 0$ and $y > 0$
(B) The region where $x < 0$ and $y < 0$
(C) The region where $x > 0$ and $y > 0$
(D) The X-axis

$x - ve$ $y + ve$
$x < 0$ $y > 0$

S S S
S A S
A S A

(6) In triangle FGH and triangle KLM, the measures of angles G and L are each 30°. The lengths of GH and LM are each 34 centimeters, and $\dfrac{GH}{GF} = \dfrac{LM}{LK}$. Which additional piece of information would be necessary to prove that triangle FGH is congruent to triangle KLM?

(A) The lengths of FG and KM are each **17** centimeters.
(B) The measures of angles H and M are each **60°**.
(C) The measures of angles F and K are each **90°**.
(D) No additional information is necessary.

(7)
$$y = 3x + 9$$
$$3y = 8x - 6$$

The solution to the given system of equations is (x, y). What is the value of $x - y$?

$x = -33$
$y = -90$

(A) -123
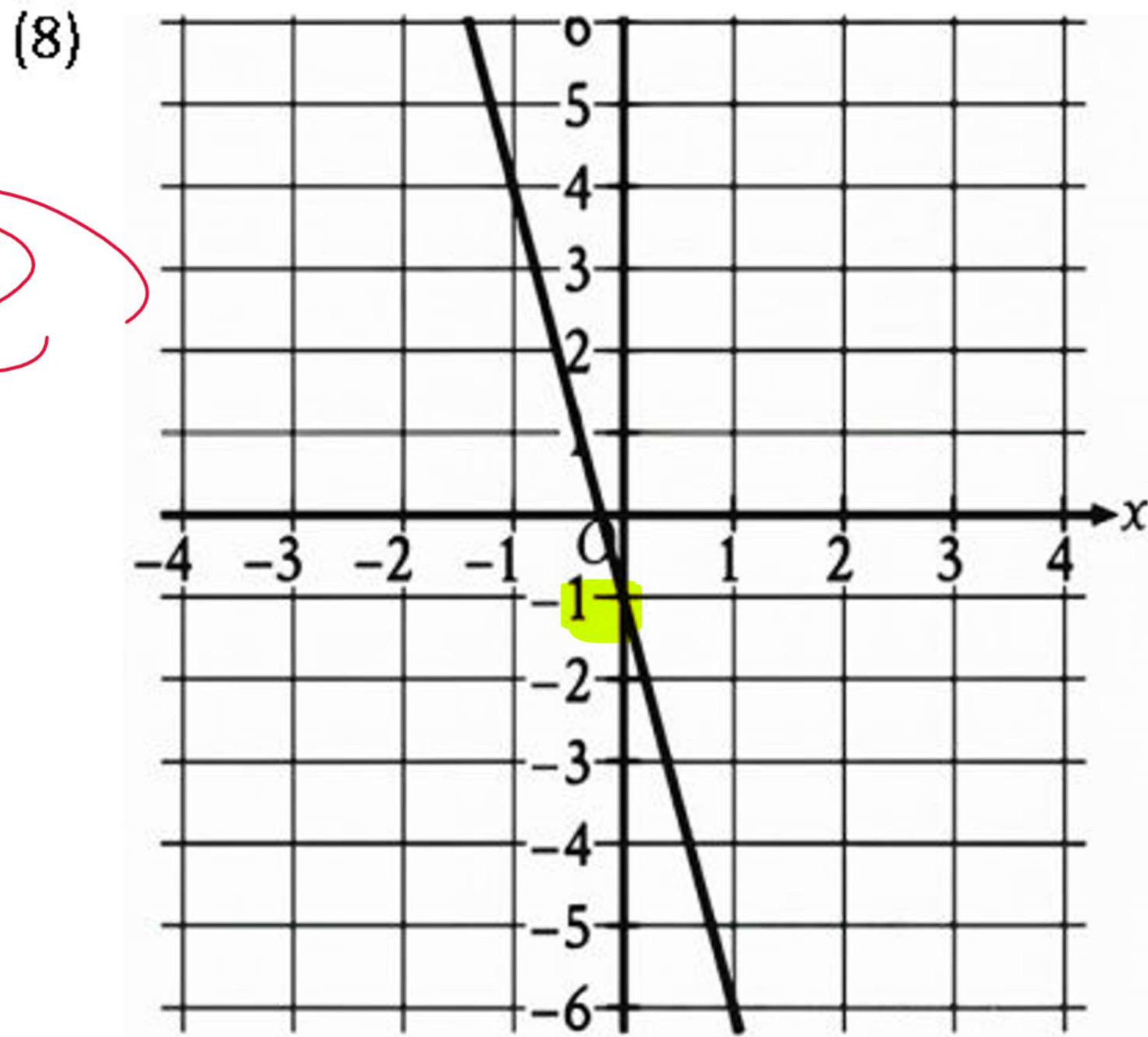(B) -33
(C) 3
(D) 57

$-33 - (-90)$

Math is Root of Knowledge

(8)

Which equation defines the linear function f ?

(A) $f(x) = -14x - 9$

(B) $f(x) = -5x - 1$

(C) $f(x) = 5x + 8$

(D) $f(x) = 14x \quad 8$

D

(9) An exponential function f is defined by $f(x) = c^x$, where C is a constant greater than 1. I $f(6) = 9 . f(4)$,f what is the value of C ?
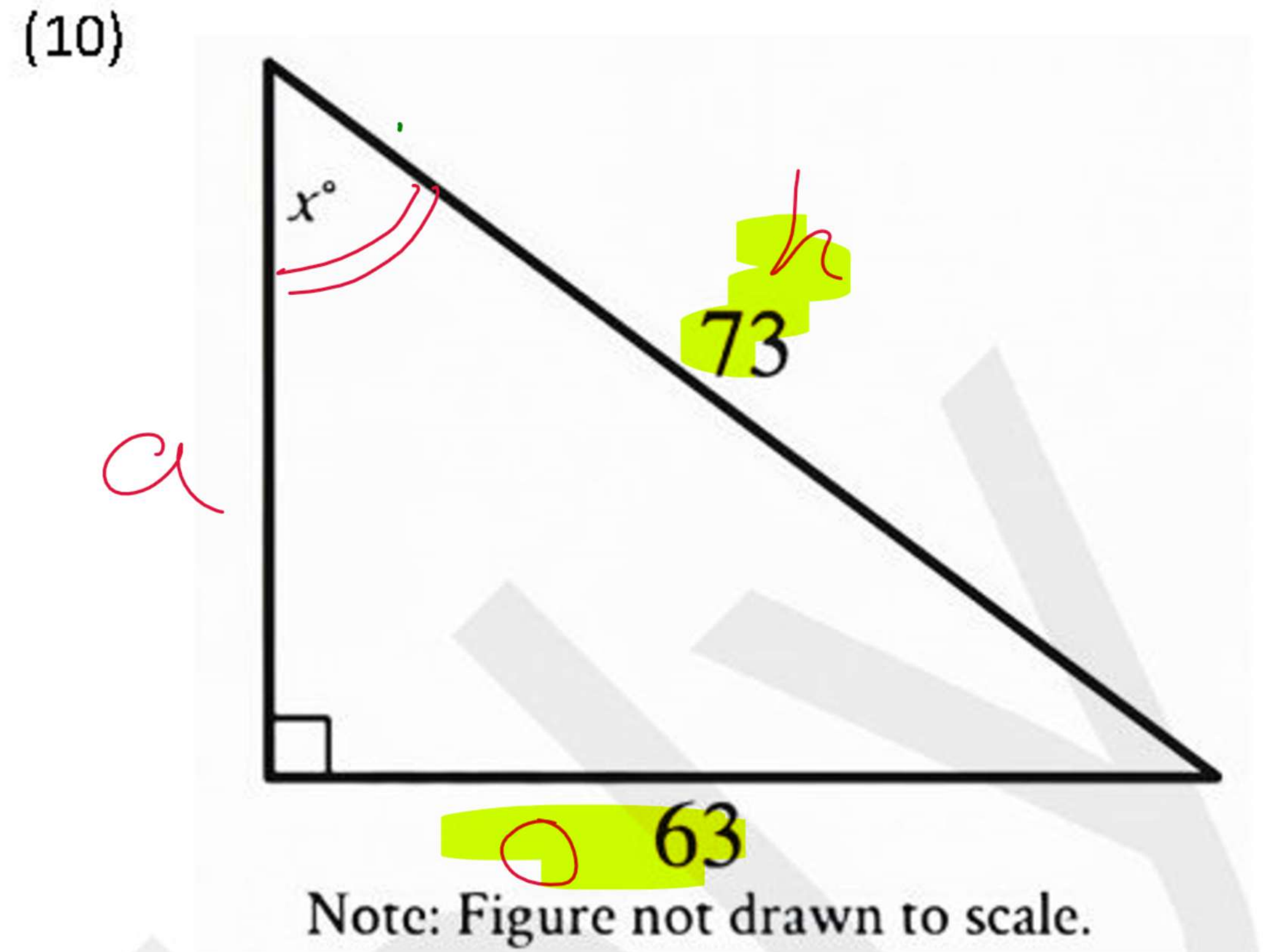
$$3$$

$$c^6 = 9c^4$$

$$\frac{c^6}{c^4} = 9$$

$$c^2 = \pm\sqrt{9}$$

$$C = \pm 3$$

$$D$$

$$x^6 = 9x^4$$

(10)

73

63

Note: Figure not drawn to scale.

In the right triangle shown, what is the value of $\sin X^\circ$?

(A) $\frac{1}{73}$

(B) $\frac{10}{73}$

(C) $\frac{63}{73}$

(D) $\frac{136}{73}$

(11)

Mode
$\frac{5}{1}$

$$-x - wy = -337$$
$$2x - wy = 47$$

$$-q - 19w = -337$$
$$2q - 19w = 47$$

D

In the given system of equations, W is a constant. In the xy-plane, the graphs of these equations intersect at the point $(q, 19)$, where q is a constant.

What is value of W ?

$q = 128$
$w = 11$

$$11$$

(12)

	Site A	Site B	Total
Red maple	35	15	50
Chestnut oak	31	20	51
Total	66	35	101

The table shows the distribution of two types of trees at two different sites. If a tree represented in the table is selected at random, what is the probability of selecting tree from site A, given that the tree is a red maple? (Express your answer as a decimal or fraction, not as a percent)

$$\frac{Part}{Total} = \frac{35}{50}$$

$$\frac{7}{10} \bigg\} \ 0.7$$

(13) A beaker containing a liquid is placed on a table. The function $g(t) = 295 + (361 - 295)(272)^{-0104t}$ gives the approximate temperature, in kelvins, of the liquid t minutes after the beaker was placed on the table. According to this function, what was the approximate temperature, in kelvins, of the liquid when the beaker was placed on the table? $t = 0$

$$295 + (361 - 295)^{-0.04(0)}$$

$$361$$

(14) For the exponential function f, n the value of $f(1)$ is K, where K is a constant. Which of the following equivalent forms of the function f shows the value of K as the coefficient or the base?

$50(1.7)^{41}$
$= 144.5$

(A) $f(x) = 50(1.7)^{x+1}$
(B) $f(x) = 85(1.7)^x$
(C) $f(x) = 144.5(1.7)^{x-1}$ $\quad 1.1 = 0$
(D) $f(x) = 245.65(1.7)^{x} \ 2$

(15) $y = 9\left(\frac{a}{6}\right)^{x+c} - b$

How many times does the graph of the given equation in the xy-plane cross the x-axis, where a, b and c are positive constants such that $a > 6$ and $b > c$?

(A) Zero
(B) One
(C) Two
(D) Three

(16) For a polynomial function f, the graph of $y = f(x)$ in the xy-plane contains the points $(-6, 0)$, $(7, 0)$, $(0, 0)$, and $(4, 0)$. Which of the following must be a factor of $f(x)$?

$(x+6)(x-7)(x-5)(x-4)$

$(x+6)(x-7)x(x-4)$

(A) $x^2 - 2x - 24$
(B) $x^2 - x + 42$
(C) $x^2 - 11x - 28$
(D) $x^2 - 7x$ $\qquad x^2 - 7x$

Math is Root of Knowledge