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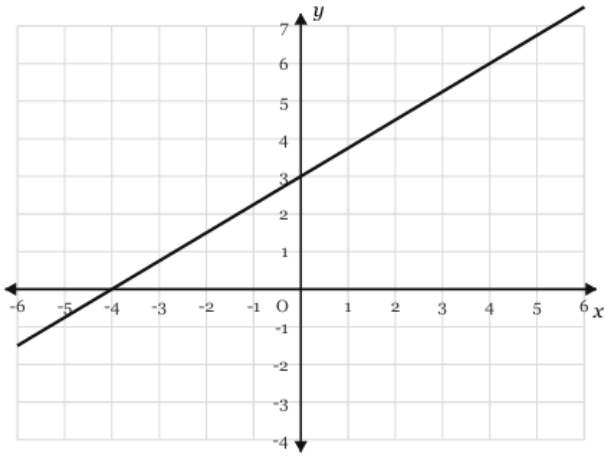
SECTION 1

Algebra

14 challenging questions

01 **Linear equations in two variables**

The line shown can be represented by the equation $ax + by = 48$, where a and b are constants. Which of the following is true about a and b?



A. $a < 0$ and $b < 0$

B. $a < 0$ and $b > 0$

C. $a > 0$ and $b < 0$

D. $a > 0$ and $b > 0$

02 **Linear functions**

For groups of 40 or more passengers, a ferry charges $\$34$ per passenger for the first 40 passengers and $\$21$ for each additional passenger. Which function f gives the total charge, in dollars, for a group with n passengers, where $n \geq 40$?

A. $f(n) = 21n + 34$

B. $f(n) = 21n + 520$

C. $f(n) = 21n + 1{,}360$

D. $f(n) = 55n - 840$

03 **Linear equations in two variables**

Line j is defined by $8x + 3y = 40$. Line k is parallel to line j in the xy-plane. An equation of line k is $56x + ry = 18$, where r is a constant. If line k passes through the point $(0, b)$, what is the value of b?

Student-produced response: _____

04 **Linear functions**

Based on a model, on day 1 of a 10-day trial, a reservoir held an estimated depth of 186 centimeters of water, and each day after day 1 of the trial, the estimated depth decreased by 7 centimeters. Which equation represents this model, where d is the estimated depth, in centimeters, on day x of the trial and $1 \leq x \leq 10$?

A. $d = -7x + 172$

B. $d = -7x + 179$

C. $d = -7x + 186$

D. $d = -7x + 193$

05 **Linear functions**

The function f is defined by $f(x) = 4x - 23$. If $f(a + 2) = 3a$, what is the value of a?

Student-produced response: _____

06 **Linear functions**

A plumber charges $\$210$ for the first 3 hours of work plus an hourly fee for each additional hour. The total cost for 7 hours of work is $\$390$. Which function f gives the total cost, in dollars, for x hours of work, where $x \geq 3$?

A. $f(x) = 45x + 75$

B. $f(x) = 45x + 210$

C. $f(x) = 55.71x$

D. $f(x) = 70x$

07 **Systems of two linear equations in two variables**

$$3x + 7y = 5$$
$$12x + 28y = 20$$

For each real number r, which of the following points lies on the graph of each equation in the xy-plane for the given system?

A. $\left(r, \frac{3r}{7} + \frac{5}{7}\right)$

B. $\left(r, -\frac{7r}{3} + \frac{5}{3}\right)$

C. $\left(\frac{r}{4} + \frac{5}{4}, -\frac{r}{4} + 20\right)$

D. $\left(-\frac{7r}{3} + \frac{5}{3}, r\right)$

08 **Linear functions**

The table shows three values of x and their corresponding values of y, where a and b are constants. There is a linear relationship between x and y. In the xy-plane, the y-intercept of the line representing this relationship is $(0, -9)$. What is the value of $a + b$?

x	y
-8	39
a	15
5	b

A. -43
B. -39
C. 25
D. 35

09 **Systems of two linear equations in two variables**

$$\frac{-12x - 35 + m}{3} = k(x + 8)$$

In the given equation, k and m are constants. The equation has infinitely many solutions. What is the value of m?

A. -131
B. -61
C. 3
D. 131

10 **Systems of two linear equations in two variables**

$$40(x + n) = 40y - 40n$$

One of the equations in a system of two linear equations is given, where n is a positive constant. The system has no solution. Which equation could be the second equation in this system?

A. $3x - 3y = -6n$
B. $3x - 3y = -3n$
C. $3x + 3y = -6n$
D. $3x + 3y = -3n$

11 **Linear equations in two variables**

$$0.15x + 0.40y = 0.35(x + y)$$

The equation gives a volume x, in liters, of a 15% acid solution that could be mixed with a volume y, in liters, of a 40% acid solution to produce a 35% acid solution. According to this equation, what volume, in liters, of the 40% acid solution could be mixed with 60.0 liters of the 15% acid solution to produce a 35% acid solution? (Assume the volume of the mixture is the sum of the two volumes.)

Student-produced response: _____

12 **Linear equations in one variable**

If $\frac{x-8}{3} = \frac{x-8}{7}$, the value of $x-8$ is between which of the following pairs of values?

A. -11 and -5

B. -3 and 3

C. 5 and 11

D. 21 and 25

13 **Systems of two linear equations in two variables**

$$6x - 15y + 4 = 22 - 5y$$
$$-18x + 35y = -7p + 3x$$

In the given system of equations, p is a constant. If the system has infinitely many solutions, what is the value of p?

Student-produced response: _____

14 **Systems of two linear equations in two variables**

$\frac{2}{9}x + \frac{5}{6}y = \frac{4}{3} - \frac{5}{6}y$ and $\frac{4}{7}x + \frac{5}{2} = ky + \frac{4}{5}$. In the given system of equations, k is a constant. If the system has no solution, what is the value of k?

Student-produced response: _____

SECTION 2

Advanced Math

32 challenging questions

15 **Nonlinear functions**

The function g is a quadratic function. In the xy -plane, the graph of $y = g(x)$ has a vertex at $(2, 5)$ and passes through the points $(3, 12)$ and $(-1, 68)$. What is the value of $g(-3) - g(0)$?

A. 147

B. 152

C. 175

D. 180

16 **Equivalent expressions**

Which expression is NOT a factor of $30{,}000x^4 - 3{,}888$?

A. 48

B. $5x + 3$

C. $5x^2 - 3$

D. $25x^2 + 9$

17 **Nonlinear equations in one variable and systems of equations in two variables**

In the given equation $-12x^2 + bx - 75 = 0$, b is a positive integer. The equation has no real solution. What is the largest possible value of b?

Student-produced response: _____

18 **Nonlinear functions**

An exponential function f gives the estimated fraction of a laser's initial power remaining after passing through a d-millimeter-thick filter made of acrylic. The model has $f(0) = 1$ and $f(2.5) = 0.40$. Which equation defines f?

A. $f(d) = (0.40)^{d/2.5}$

B. $f(d) = 0.40(0.69)^{d/2.5}$

C. $f(d) = 0.40(2.5)^d$

D. $f(d) = 2.5(0.40)^d$

19 **Equivalent expressions**

The expression $\frac{kx-44}{3x^2-17x+10}$ is equivalent to $\frac{p}{x-5}-\frac{2}{3x-2}$, where k and p are constants. What is the value of p?

A. -17

B. -14

C. 22

D. 27

20 **Nonlinear functions**

The table shows three values of x and their corresponding values of $g(x)$, where $g(x)=\frac{f(x)}{x-6}$ and f is a linear function.

x	$g(x)$
-14	4
2	0
16	7

What is the y-intercept of the graph of $y=f(x)$ in the xy-plane?

A. $(0,-10)$

B. $(0,-4)$

C. $(0,2)$

D. $(0,6)$

21 **Equivalent expressions**

$$\frac{1}{3xy}+xyz=\frac{1}{7yz}$$

In the given equation, x, y, and z are positive numbers. Which expression is equivalent to y?

A. $\frac{1}{7xz^2-3x^2z}$

B. $\sqrt{\frac{1}{7xz^2-3x^2z}}$

C. $\frac{3x-7z}{21x^2z^2}$

D. $\sqrt{\frac{3x-7z}{21x^2z^2}}$

22 **Nonlinear functions**

$$y=7\left(\frac{m}{4}\right)^{x+n}-p$$

How many times does the graph of the given equation in the xy-plane cross the x-axis, where m, n, and p are positive constants such that $m>4$ and $p>n$?

A. Zero

B. One

C. Two

D. Three

23 **Equivalent expressions**

The expression $10x^4 + 27x^2 + 5$ can be rewritten as $(5x^2 + a)(2x^2 + b)$, where a and b are positive integers, or as $(5x^2 + c)(2x^2 + d)$, where c and d are positive nonintegers. What is the value of $a + c$?

Student-produced response: _____

24 **Nonlinear equations in one variable and systems of equations in two variables**

$$9x^2 - px + w = -55$$

In the given equation, p and w are integer constants. The equation has exactly one real solution. Which is NOT a possible value of w?

A. -30
B. 40
C. 89
D. 269

25 **Nonlinear equations in one variable and systems of equations in two variables**

$$\frac{7}{4}(x + 6)\left(x + \sqrt{3k} + 6\right)\left(x - \sqrt{3k} + 6\right) = 0$$

In the given equation, k is a positive constant. The product of the solutions to the equation is 36. What is the value of k?

Student-produced response: _____

26 **Nonlinear functions**

The function f is defined by $f(x) = a^x - b$, where a and b are constants. In the xy-plane, the graph of $y = f(x)$ passes through the points $(c, 9)$ and $(2c, 141)$, where c is a constant. Which of the following could be the value of b?

A. 3
B. 12
C. 132
D. 150

27 **Nonlinear functions**

A certain savings certificate offers a promotional interest rate for the first 6 months, then a lower rate afterward. Nadia purchased one with an original balance of $\$500$ and made no other transactions. 6 months after purchase, the balance had increased by 0.8% of the original balance. 9 months after purchase, it had increased by an additional 0.3% of the balance at the end of the first 6 months. Every 3 months after the first 6 months, it increased by an additional 0.3% of the balance 3 months before. Which equation could represent the balance $B(x)$, in dollars, x months after purchase, where $x \geq 6$?

A. $B(x) = 504.00 \cdot 1.003^{x/3-6}$
B. $B(x) = 504.00 \cdot 1.003^{x/3-2}$
C. $B(x) = 504.00 \cdot 1.003^{3x-18}$
D. $B(x) = 504.00 \cdot 1.003^{3x-6}$

28 **Equivalent expressions**

$$21z^{10} + bz^5 + 55$$

In the given expression, b is a positive integer. If $qz^5 + r$ is a factor of the expression, where q and r are positive integers, what is the greatest possible value of b?

Student-produced response: _____

29 **Nonlinear functions**

The function f is defined by $f(x) = 15(4)^x$. If $g(x) = f(x + 3)$, which of the following equations defines the function g?

A. $g(x) = 15(64)^x$

B. $g(x) = 45(4)^x$

C. $g(x) = 45(12)^x$

D. $g(x) = 960(4)^x$

30 **Nonlinear functions**

The function f is defined by $f(x) = -x^3 - ax^2 - bx - c$, where a, b, and c are integer constants. The zeros of the function are -7, -2, and 6. What is the value of $a + b$?

Student-produced response: _____

31 **Nonlinear functions**

A quadratic function models the height, in centimeters, of a decorative water jet above the pool surface t seconds after the water leaves the nozzle. The function estimates the jet reached its maximum height of 291.6 centimeters 6 seconds after leaving the nozzle and then returned to the pool surface 12 seconds after leaving. Based on the function, what was the estimated height, to the nearest centimeter, of the jet 8 seconds after it left the nozzle?

Student-produced response: _____

32 **Nonlinear equations in one variable and systems of equations in two variables**

$$7|x + 4| = k$$

The equation above, where k is a constant, has exactly one solution. Which of the following could be the value of k?

A. -7 only

B. -4 or 4

C. 4 only

D. 0 only

33 **Nonlinear functions**

$$f(x) = (x - a)(x - b)$$

The function f is defined by the given equation, where a and b are integer constants. If $f(15) > 0$, $f(19) < 0$, and $f(23) > 0$, which of the following could be the value of $a + b$?

A. 19
B. 34
C. 38
D. 42

34 **Nonlinear functions**

The function f is defined by the equation $f(x) = 5^x + b$, where b is a constant. In the xy-plane, the graph of $y = f(x)$ contains the points $(0, 29)$ and $(2, p + 12)$, where p is a constant. What is the value of p?

Student-produced response: _____

35 **Nonlinear functions**

$$p(x) = a\left((x + 7)^2 - b\right)\left((x + 7)^2 - c\right)$$

The function p is defined by the equation above, where a, b, and c are constants. In the xy-plane, the graph of $y = p(x)$ passes through the points $(-8, 29)$ and $(0, 411)$. What is the value of $p(-14) + p(-6)$?

Student-produced response: _____

36 **Nonlinear functions**

$$N(m) = 48(Q)^{m/6}$$

The equation above gives the predicted population $N(m)$, in thousands, of a bacteria colony m minutes after the initial measurement, where Q is a constant greater than 1. The predicted population increases by $p\%$ every 240 seconds. What is the value of p in terms of Q?

A. $100(Q^{2/3} + 1)$
B. $100(Q^{2/3} - 1)$
C. $100(Q^{40} + 1)$
D. $100(Q^{40} - 1)$

37 **Nonlinear equations in one variable and systems of equations in two variables**

$$(x - k)^2 = (k - 4a)(x - k)$$

In the given equation, k and a are constants, where $k > 4a$. The sum of the solutions to the equation is $3k + 32$. What is the value of a?

Student-produced response: _____

38 **Nonlinear functions**

A quadratic function models the height, in feet, of a fireworks shell above its launch tube in terms of the time, in seconds, after the shell was fired. According to the model, the shell was fired from a height of 0 feet and reached its maximum height of $2{,}304$ feet 12 seconds after it was fired. Based on the model, what was the height, in feet, of the shell 5 seconds after it was fired?

Student-produced response: _____

39 **Nonlinear equations in one variable and systems of equations in two variables**

$$-4x(x+11)=48$$

One solution to the given equation can be written as $x=-\dfrac{s+\sqrt{t}}{2}$, where s and t are positive integers. What is the value of $\dfrac{s}{t}$?

A. $\dfrac{73}{11}$

B. $\dfrac{48}{11}$

C. $\dfrac{73}{22}$

D. $\dfrac{11}{73}$

40 **Nonlinear equations in one variable and systems of equations in two variables**

$$\frac{1}{18}x^2+\left(s-\frac{1}{18}t\right)x-st=0$$

In the given equation, s and t are positive constants. The product of the solutions to the given equation is $-3kst$, where k is a constant. What is the value of k?

Student-produced response: _____

41 **Nonlinear equations in one variable and systems of equations in two variables**

$$kx^2-20x=12x-k^2$$

In the given equation, k is an integer constant. If the equation has two distinct real solutions, what is the greatest possible value of k?

Student-produced response: _____

42 **Equivalent expressions**

$$\sqrt{(9y)^5} = 243(\sqrt[5]{y})^k$$

In the given equation, $y > 0$, and k is a constant. What is the value of k?

A. $\frac{1}{2}$

B. $\frac{5}{2}$

C. $\frac{25}{2}$

D. 25

43 **Equivalent expressions**

$$\frac{6x}{5x-2} + \frac{20-5x^2}{(ax-10)(5x-2)} = -4b$$

The equation above is true for all values of x where $x \neq \frac{2}{5}$ and $x \neq \frac{10}{a}$. The numbers a and b are constants. What is the value of ab?

Student-produced response: _____

44 **Equivalent expressions**

Let $n > 0$ and $n \neq 1$. If

$$n^{\frac{5}{2}} = k^{\frac{3}{8}}$$

and

$$n^{2a-4} = k,$$

what is the value of a?

Student-produced response: _____

45 **Equivalent expressions**

If $r = \sqrt[5]{k}$, where $k > 1$, what is the value of a for which $r^{8a-3} = k^2$?

Student-produced response: _____

46 **Nonlinear functions**

A parabola in the xy-plane has its vertex at $(2, 48)$. The equation $y = -ax^2 + bx + c$ represents this parabola, where a, b, and c are positive integer constants. What is the greatest possible value of b?

Student-produced response: _____

SECTION 3

Problem Solving and Data Analysis

8 challenging questions

47 **Percentages**

At the start of a month, two podcasts had an equal number of subscribers. By the end of the month, the number of subscribers to podcast X had increased by 900% of its number of subscribers at the start of the month, and the number of subscribers to podcast Y had increased by 260% of its number of subscribers at the start of the month. The number of subscribers to podcast Y at the end of the month was $p\%$ less than the number of subscribers to podcast X at the end of the month. What is the value of p?

Student-produced response: _____

48 **Ratios, rates, proportional relationships, and units**

The area of an oil film on a water surface is increasing at a rate of 350 square inches per hour. Which of the following is closest to this rate in square centimeters per minute? (Use 1 inch $= 2.54$ centimeters.)

A. 0.90

B. 14.82

C. 37.63

D. $2{,}258.06$

49 **Percentages**

The percent increase in the number of registered users of a mobile app from March to September was 435%. If the app had m registered users in March, which expression represents the number of registered users in September?

A. $0.435m$

B. $4.35m$

C. $5.35m$

D. $43.5m$

50 **Percentages**

For the positive quantities m, q, and r, m is 25% of $m + q + r$, q is 40% of $q + r$, and the value of r is $1{,}485$. What is the value of m?

Student-produced response: _____

51 **Percentages**

0.2044 is 0.07% of the number b. The number b is 20% of the number c. What is the value of c?

Student-produced response: _____

52 **Percentages**

On a plot of land, 60.0% of the square footage is orchard and the remaining square footage is meadow. There are buildings on exactly 18.5% of the square footage of the orchard, and there are buildings on exactly 12.5% of the square footage of the meadow. If there are buildings on exactly $p\%$ of the square footage of the plot of land, what is the value of p?

Student-produced response: _____

53 **Ratios and proportional relationships**

The proposal for a development project was included on a city's election ballots. A local TV station reported that 6 times as many people voted in favor of the proposal as people who voted against it. If 1,770 more people voted in favor of the proposal than those who voted against the proposal, how many people voted against the proposal?

Student-produced response: _____

54 **Percentages**

The mass of object A is 325% of the mass of object B, and the mass of object A is 0.650% of the mass of object C. If the mass of object C is $p\%$ of the mass of object B, what is the value of p?

Student-produced response: _____

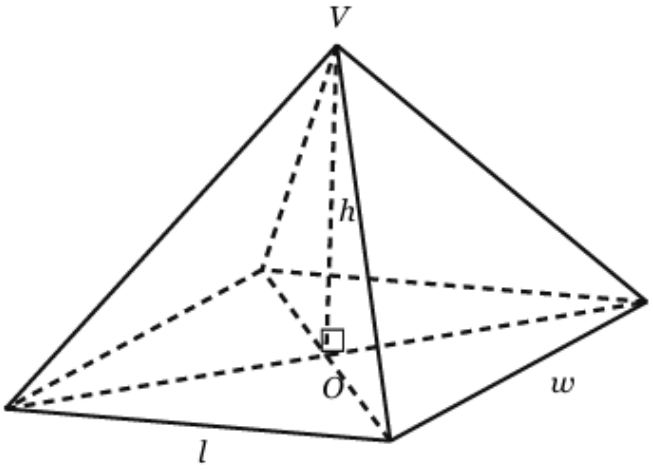
SECTION 4

Geometry and Trigonometry

21 challenging questions

55 **Area and volume**

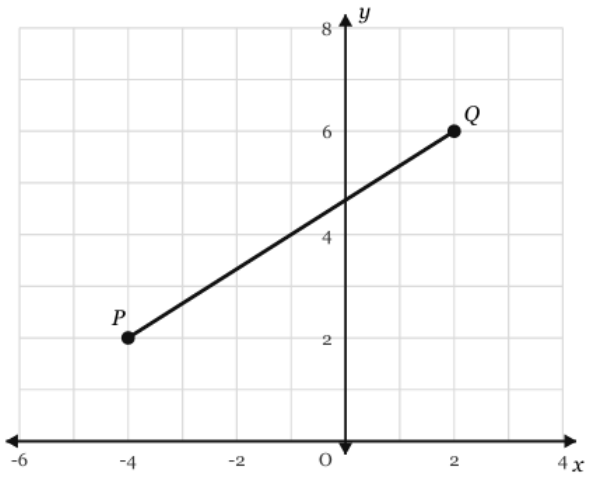
The figure shown is a right rectangular pyramid, where $\ell = 16$ units, $w = 11$ units, and $h = 15$ units. What is the surface area, in square units, of the pyramid?



Student-produced response: _____

56 **Lines, angles, and triangles**

The line segment shown in the xy-plane represents side $\overline{PQ}$ of isosceles triangle PQR, where side $\overline{PR}$ is congruent to side $\overline{QR}$. The perimeter of this triangle is $14\sqrt{13}$ units. What is the length, in units, of side $\overline{PR}$ of this triangle?



A. $2\sqrt{13}$

B. $6\sqrt{13}$

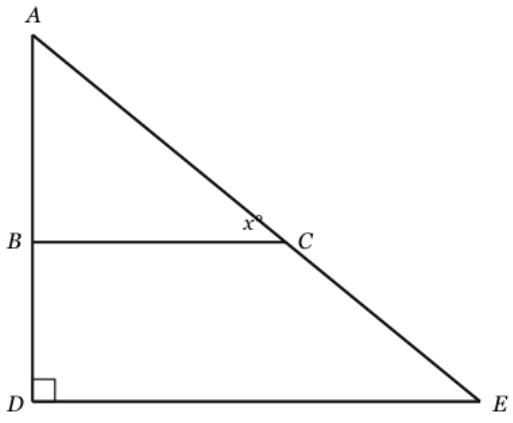
C. $7\sqrt{13}$

D. $12\sqrt{13}$

57 **Right triangles and trigonometry**

In the figure, $\overline{BC}$ is parallel to $\overline{DE}$. If the length of $\overline{DE}$ is 153 and the length of $\overline{AE}$ is 255, what is the value of $\tan x°$?

Note: Figure not drawn to scale.



Note: Figure not drawn to scale.

A. $\frac{255}{153}$

B. $\frac{204}{153}$

C. $\frac{255}{204}$

D. $\frac{153}{204}$

58 **Lines, angles, and triangles**

Triangle DEF is similar to triangle RST such that D, E, F correspond to R, S, T, respectively. The length of each side of triangle DEF is n times the length of its corresponding side in triangle RST, where n is an integer greater than 1. The measure of angle F is 43 degrees, and $EF = 86$. Which of the following must be true?

A. The measure of angle T is $43/n$ degrees.

B. The measure of angle T is $43n$ degrees.

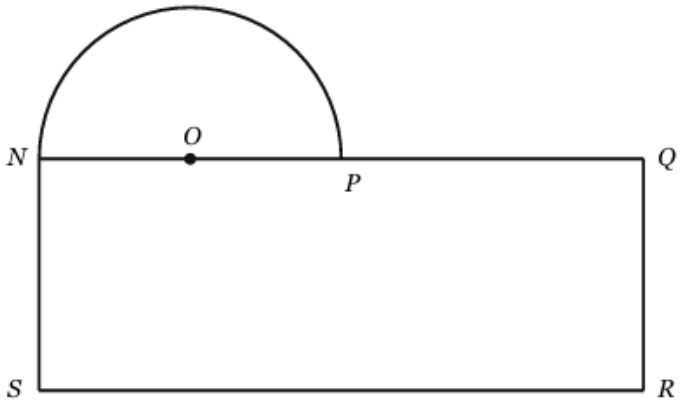
C. $ST = 86/n$

D. $ST = 86n$

59 **Area and volume**

In the given figure, $\overline{NP}$ is the diameter of semicircle O. Angles Q, R, and S are right angles, and point P is the midpoint of $\overline{NQ}$. If $PQ = 44$ feet and $NS = 17$ feet, the area of the figure can be expressed as $a\pi + b$ square feet, where a and b are integers. What is the value of $a + b$?

Note: Figure not drawn to scale.



Note: Figure not drawn to scale.

Student-produced response: _____

60 **Lines, angles, and triangles**

In triangle DEF, the measure of angle D is $62°$ and $\overline{DF} = 24$. In triangle XYZ, the measure of angle X is $62°$ and $\overline{XZ} = 84$. Which additional piece of information is sufficient to prove that triangle DEF is similar to triangle XYZ?

A. $\overline{DE} = 16$ and $\overline{XY} = 48$.

B. $\overline{DE} = 16$ and $\overline{YZ} = 56$.

C. The measures of angle E and angle Z are $39°$ and $79°$, respectively.

D. The measures of angle E and angle Y are $62°$ and $39°$, respectively.

61 **Circles**

A circle in the xy -plane has its center at $(-3, 7)$. Line t is tangent to this circle at the point $(9, 2)$. Which of the following points also lies on line t?

A. $(14, -10)$

B. $(14, 14)$

C. $(21, -3)$

D. $(21, 7)$

62 **Area and volume**

A circle is inscribed in a square such that the circumference of the circle touches the midpoint of each side of the square. The length of the diagonal of the square is 208 units. What is the area, in square units, of the circle?

A. $2{,}704\pi$

B. $5{,}408\pi$

C. $10{,}816\pi$

D. $21{,}632\pi$

63 **Right triangles and trigonometry**

In triangle JKL , the measure of angle J is $(45b)°$, the measure of angle K is $(4a + 18)°$, and the measure of angle L is $(72 - 4a)°$, where a and b are constants. Which of the following must be true?

A. $\cos L° > \sin K°$

B. $\cos L° = \sin K°$

C. $\cos L° < \sin K°$

D. There is not enough information to compare the values of $\cos L°$ and $\sin K°$.

64 **Area and volume**

Trapezoid $ABCD$ is similar to trapezoid $EFGH$, where $\overline{AB}$, $\overline{BC}$, $\overline{CD}$, and $\overline{DA}$ correspond to $\overline{EF}$, $\overline{FG}$, $\overline{GH}$, and $\overline{HE}$, respectively.

	Area (square inches)
Trapezoid $ABCD$	245
Trapezoid $EFGH$	8,820

The length of side $\overline{AB}$ is 34 inches. What is the length, in inches, of side $\overline{EF}$?

Student-produced response: _____

65 **Right triangles and trigonometry**

In triangle ABC, the measure of angle B is $90°$ and $\overline{BD}$ is an altitude of the triangle. The length of $\overline{AB}$ is 17 and the length of $\overline{AC}$ is 23 greater than the length of $\overline{AB}$. What is the value of $\frac{BD}{BC}$?

A. $\frac{17}{40}$

B. $\frac{17}{23}$

C. $\frac{23}{17}$

D. $\frac{23}{40}$

66 **Right triangles and trigonometry**

In triangle XYZ, the measure of angle X is $90°$. Point W lies on segment $\overline{YZ}$, and segment $\overline{WX}$ is perpendicular to segment $\overline{YZ}$. The length of segment $\overline{WX}$ is 564, and the length of segment $\overline{WY}$ is 235. What is the value of $\tan Z$?

A. $\frac{13}{5}$

B. $\frac{12}{5}$

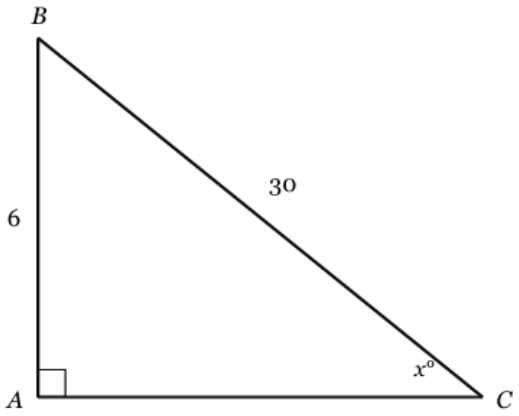
C. $\frac{13}{12}$

D. $\frac{5}{12}$

67 **Right triangles and trigonometry**

$$k \cdot \cos x°$$

The expression above represents the area of triangle ABC shown, which has a right angle at A with $AB = 6$ and hypotenuse $BC = 30$, and $x°$ is the angle at C. What is the value of k?



Note: Figure not drawn to scale.

Student-produced response: _____

68 **Right triangles and trigonometry**

In triangle PQR, the measure of angle P is $47°$. The length of $\overline{PQ}$ is 30 units and the length of $\overline{PR}$ is 22 units. What is the area, in square units, of triangle PQR?

A. $330 \sin 47°$

B. $660 \sin 47°$

C. 330

D. 660

69 **Circles**

In the xy-plane, the graph of the given equation is a circle. Which point lies on this circle?

$$(x-4)^2+(y+9)^2=36$$

A. $(4,-9)$

B. $(-9,4)$

C. $(\sqrt{13}-4,\sqrt{23}+9)$

D. $(\sqrt{13}+4,\sqrt{23}-9)$

70 **Right triangles and trigonometry**

In triangle DEF, the sum of the measures of angle D and angle E is 90 degrees. The value of $\sin(D)$ is $\frac{3\sqrt{5}}{9}$. What is the value of $\cos(E)$?

A. $\frac{9}{14\sqrt{3}}$

B. $\frac{3\sqrt{5}}{9}$

C. $\frac{7\sqrt{2}}{12}$

D. $\frac{3\sqrt{5}}{7}$

71 **Area and volume**

The table gives the volume of two similar cylinders, where the surface area of cylinder A is $k\pi$ and of cylinder B is $j\pi$.

Cylinder	Volume	Surface Area
A	$2{,}000\pi$	$k\pi$
B	$128{,}000\pi$	$j\pi$

If the radius of cylinder A is 10 cm, what is the value of $j-k$? (Volume $=\pi r^2 h$; Surface area $=2\pi r^2+2\pi rh$.)

Student-produced response: _____

72 **Area and volume**

The table gives the volume and surface area of two similar rectangular prisms, where k is a constant.

	Volume (cubic inches)	Surface Area (square inches)
Prism A	2,000	1,300
Prism B	250,000	k

What is the value of k?

A. 6,500

B. 32,500

C. 162,500

D. 1,625,000

73 **Right triangles and trigonometry**

An equilateral triangle has a perimeter of $1{,}860$ meters. If the height of the triangle is equal to $x\sqrt{3}$, what is the value of x?

Student-produced response: _____

74 **Area and volume**

A right rectangular pyramid has a square base with an area of 256 square meters. What is the area, in square meters, of one of its triangular faces if the pyramid has a volume of $1{,}280$ cubic meters?

Student-produced response: _____

75 **Area and volume**

The surface area of rectangular prism A is $220\ \text{m}^2$. The surface area of rectangular prism B is $3{,}520\ \text{m}^2$. Rectangular prism A has a volume of $150\ \text{m}^3$. If both rectangular prisms are similar, what is the volume of rectangular prism B?

Student-produced response: _____

Answers & Explanations

Solutions follow the same order as the question section.

Algebra

QUESTION 01 — Linear equations in two variables

Answer: B. $a < 0$ and $b > 0$

The line shown has positive slope and positive y-intercept, crossing the x-axis left of the origin. Writing $ax + by = 48$ as $y = -\frac{a}{b}x + \frac{48}{b}$: positive slope means $-a/b > 0$ and positive intercept means $48/b > 0$, so $b > 0$ and $a < 0$.

QUESTION 02 — Linear functions

Answer: B. $f(n) = 21n + 520$

For $n \geq 40$: $34 \cdot 40 + 21(n - 40) = 1360 + 21n - 840 = 21n + 520$.

QUESTION 03 — Linear equations in two variables

Answer: 6/7

Parallel lines have equal slopes: $-\frac{56}{r} = -\frac{8}{3}$, so $r = 21$. Substituting $(0, b)$ into $56x + 21y = 18$ gives $b = \frac{18}{21} = \frac{6}{7}$.

QUESTION 04 — Linear functions

Answer: D. $d = -7x + 193$

Depth on day x: $d = 186 - 7(x - 1) = -7x + 193$.

QUESTION 05 — Linear functions

Answer: 15

$f(a+2) = 4(a+2) - 23 = 4a - 15 = 3a$, so $a = 15$.

QUESTION 06 — Linear functions

Answer: A. $f(x) = 45x + 75$

Additional hours cost $\frac{390 - 210}{7 - 3} = \$45$ per hour. For $x \geq 3$: $f(x) = 210 + 45(x - 3) = 45x + 75$.

QUESTION 07 — Systems of two linear equations in two variables

Answer: D. $\left(-\frac{7r}{3} + \frac{5}{3},\ r\right)$

The second equation is 4 times the first, so both graph the same line $3x + 7y = 5$. Solving for x in terms of y: $x = \frac{5 - 7y}{3} = -\frac{7}{3}y + \frac{5}{3}$. Setting $y = r$ gives $\left(-\frac{7r}{3} + \frac{5}{3},\ r\right)$.

QUESTION 08 — Linear functions

Answer: A. -43

Using $(0, -9)$ and $(-8, 39)$: slope $= \frac{39 - (-9)}{-8 - 0} = -6$, so $y = -6x - 9$. Then $15 = -6a - 9 \Rightarrow a = -4$, and $b = -6(5) - 9 = -39$. Thus $a + b = -43$.

QUESTION 09 — Systems of two linear equations in two variables

Answer: B. -61

Infinitely many solutions requires identical expressions on both sides. The left side is $-4x + \frac{m - 35}{3}$, so $k = -4$. Then the constant terms must match: $\frac{m - 35}{3} = 8k = -32$, giving $m - 35 = -96$ and $m = -61$.

QUESTION 10 — Systems of two linear equations in two variables

Answer: B. $3x - 3y = -3n$

The given equation simplifies to $y = x + 2n$ (slope 1, intercept $2n$). A system with no solution needs a parallel line with a different intercept. Choice B gives $y = x + n$: same slope but intercept $n \neq 2n$ since $n > 0$. (Choice A would give $y = x + 2n$, the identical line.)

QUESTION 11 — Linear equations in two variables

Answer: 240

Substituting $x = 60$: $9 + 0.40y = 0.35(60 + y) = 21 + 0.35y$, so $0.05y = 12$ and $y = 240$.

QUESTION 12 — Linear equations in one variable

Answer: B. -3 and 3

Let $u = x - 8$. Then $\frac{u}{3} = \frac{u}{7}$ gives $7u = 3u$, so $5u = 0$ and $u = 0$. Since 0 lies between -3 and 3, the answer is $x - 8 = 0 \in (-3, 3)$.

QUESTION 13 — Systems of two linear equations in two variables

Answer: 9

The first equation simplifies to $3x - 5y = 9$. The second simplifies to $-21x + 35y = -7p$, or $3x - 5y = p$. For infinitely many solutions, the two equations must represent the same line, so $p = 9$.

QUESTION 14 — Systems of two linear equations in two variables

Answer: -30/7

The first equation has slope $-2/15$. The second has slope $4/(7k)$. For parallel lines, $4/(7k) = -2/15$, giving $k = -30/7$; the intercepts differ, so the system has no solution.

Advanced Math

QUESTION 15 — Nonlinear functions

Answer: A. 147

Vertex form $g(x) = a(x - 2)^2 + 5$. Using $(3, 12)$: $12 = a + 5 \Rightarrow a = 7$, so $g(x) = 7(x - 2)^2 + 5$. Then $g(-3) = 7(25) + 5 = 180$ and $g(0) = 7(4) + 5 = 33$, so $g(-3) - g(0) = 147$.

QUESTION 16 — Equivalent expressions

Answer: C. $5x^2 - 3$

$30{,}000x^4 - 3{,}888 = 48(5x - 3)(5x + 3)(25x^2 + 9)$, so $5x^2 - 3$ is not a factor.

QUESTION 17 — Nonlinear equations in one variable and systems of equations in two variables

Answer: 59

No real solution $\Rightarrow$ discriminant < 0: $b^2 - 4(-12)(-75) = b^2 - 3600 < 0 \Rightarrow b < 60$. Largest positive integer $b = 59$.

QUESTION 18 — Nonlinear functions

Answer: A. $f(d) = (0.40)^{d/2.5}$

An exponential function with $f(0) = 1$ has the form $f(d) = b^d$. Since $b^{2.5} = 0.40$, the model is $f(d) = (0.40)^{d/2.5}$.

QUESTION 19 — Equivalent expressions

Answer: D. 27

Since $3x^2 - 17x + 10 = (3x - 2)(x - 5)$, the right numerator is $p(3x - 2) - 2(x - 5) = (3p - 2)x + 10 - 2p$. Matching the constant -44 gives $p = 27$.

QUESTION 20 — Nonlinear functions

Answer: A. $(0, -10)$

Using $f(x) = (x - 6)g(x)$: $f(-14) = -80$, $f(2) = 0$, and $f(16) = 70$. These points lie on $f(x) = 5x - 10$, whose y-intercept is $(0, -10)$.

QUESTION 21 — Equivalent expressions

Answer: D. $\sqrt{\dfrac{3x - 7z}{21x^2z^2}}$

Multiplying both sides by $21xyz$ gives $7z + 21x^2y^2z^2 = 3x$, so $y^2 = \dfrac{3x - 7z}{21x^2z^2}$. Since $y > 0$, $y = \sqrt{\dfrac{3x - 7z}{21x^2z^2}}$.

QUESTION 22 — Nonlinear functions

Answer: B. One

Since $m/4 > 1$, the term $7(m/4)^{x+n}$ is always positive and increases without bound, so y increases from $-p$ (as $x \to -\infty$) to ∞. Because $p > 0$, $-p < 0$, and the strictly increasing continuous graph crosses the x-axis exactly once.

QUESTION 23 — Equivalent expressions

Answer: 13.5

Matching coefficients gives $ab = 5$ and $5b + 2a = 27$, so the positive integer values are $a = 1$ and $b = 5$. Similarly, $cd = 5$ and $5d + 2c = 27$ give the positive noninteger values $c = 12.5$ and $d = 0.4$. Thus $a + c = 1 + 12.5 = 13.5$.

QUESTION 24 — Nonlinear equations in one variable and systems of equations in two variables

Answer: B. 40

Exactly one solution means discriminant zero: $p^2 = 36(w + 55)$. Testing choices: $w = -30 \Rightarrow p^2 = 900$ (\pm30); $w = 89 \Rightarrow p^2 = 5184$ (\pm72); $w = 269 \Rightarrow p^2 = 11664$ (\pm108) all work.
$w = 40 \Rightarrow p^2 = 3420$, not a perfect square, so $w = 40$ is impossible.

QUESTION 25 — Nonlinear equations in one variable and systems of equations in two variables

Answer: 14

The solutions are -6, $-6 - \sqrt{3k}$, and $-6 + \sqrt{3k}$. Their product is $(-6)\left((-6)^2 - 3k\right) = -216 + 18k = 36$, so $18k = 252$ and $k = 14$.

QUESTION 26 — Nonlinear functions

Answer: A. 3

Let $t = a^c$. Then $t - b = 9$ and $t^2 - b = 141$, so $t^2 - t = 132$ and $t = 12$. Thus $b = 3$.

QUESTION 27 — Nonlinear functions

Answer: B. $B(x) = 504.00 \cdot 1.003^{x/3-2}$

After 6 months the balance is $500(1.008) = 504$. Thereafter it grows 0.3% every 3 months, so the number of growth periods by month x is $\dfrac{x-6}{3} = \dfrac{x}{3} - 2$. Hence $B(x) = 504(1.003)^{x/3-2}$.

QUESTION 28 — Equivalent expressions

Answer: 1156

Substituting $u = z^5$: $21u^2 + bu + 55 = (qu + r)(su + t)$ with $qs = 21$, $rt = 55$, $b = qt + rs$.
Testing integer factor pairs $(qs) = (21, 1), (3, 7), (7, 3), (1, 21)$ against $(rt) = (55, 1), (11, 5), (5, 11), (1, 55)$, the maximum $b = 21 \cdot 55 + 1 \cdot 1 = 1156$. Verified by enumeration.

QUESTION 29 — **Nonlinear functions**

Answer: D. $g(x) = 960(4)^x$

$g(x) = 15(4)^{x+3} = 15(4)^3(4)^x = 960(4)^x$, so choice D.

QUESTION 30 — **Nonlinear functions**

Answer: -37

$f(x) = -(x+7)(x+2)(x-6)$. Expanding $(x+7)(x+2)(x-6) = x^3 + 3x^2 - 40x - 84$, so $f(x) = -x^3 - 3x^2 + 40x + 84$. Matching coefficients: $a = 3$ and $-b = 40 \Rightarrow b = -40$. Thus $a + b = -37$.

QUESTION 31 — **Nonlinear functions**

Answer: 259

Vertex form: $h(t) = a(t-6)^2 + 291.6$. Since $h(12) = 0$: $36a + 291.6 = 0$, so $a = -8.1$. Then $h(8) = -8.1(4) + 291.6 = 259.2 \approx 259$.

QUESTION 32 — **Nonlinear equations in one variable and systems of equations in two variables**

Answer: D. 0 only

$7|x+4| = k$ has exactly one solution only when $k = 0$, giving the single solution $x = -4$. For any $k > 0$ there are two solutions, and for $k < 0$ there are none.

QUESTION 33 — **Nonlinear functions**

Answer: C. 38

The sign pattern shows one zero lies between 15 and 19 , and the other between 19 and 23 . Since a, b are integers: $a \in \{16, 17, 18\}$ and $b \in \{20, 21, 22\}$, giving $a + b \in [36, 40]$. Only 38 falls in this range.

QUESTION 34 — **Nonlinear functions**

Answer: 41

From $(0, 29)$: $5^0 + b = 1 + b = 29$, so $b = 28$. From $(2, p+12)$: $5^2 + 28 = p + 12$, so $53 = p + 12$ and $p = 41$.

QUESTION 35 Nonlinear functions

Answer: 440

p depends only on $(x+7)^2$. Now $(-14+7)^2 = 49 = (0+7)^2$, so $p(-14) = p(0) = 411$; likewise $(-6+7)^2 = 1 = (-8+7)^2$, so $p(-6) = p(-8) = 29$. Sum $= 411 + 29 = 440$. The given values of a, b, and c are not needed.

QUESTION 36 Nonlinear functions

Answer: B. $100(Q^{2/3} - 1)$

In 240 seconds (4 minutes), the population multiplies by $Q^{4/6} = Q^{2/3}$. An increase of $p\%$ means multiplying by $(1 + \frac{p}{100})$, so $1 + \frac{p}{100} = Q^{2/3}$ and $p = 100(Q^{2/3} - 1)$.

QUESTION 37 Nonlinear equations in one variable and systems of equations in two variables

Answer: -8

Factoring: $(x-k)\left[(x-k) - (k-4a)\right] = 0$, so $x = k$ or $x = 2k - 4a$. Sum $= 3k - 4a = 3k + 32$, giving $-4a = 32$ and $a = -8$.

QUESTION 38 Nonlinear functions

Answer: 1520

$h(t) = a(t-12)^2 + 2304$. From $h(0) = 0$: $144a = -2304$, so $a = -16$. Then $h(5) = -16(49) + 2304 = 1520$.

QUESTION 39 Nonlinear equations in one variable and systems of equations in two variables

Answer: D. $\frac{11}{73}$

Dividing by -4: $x^2 + 11x = -12$, so $x^2 + 11x + 12 = 0$ and $x = \frac{-11 \pm \sqrt{121 - 48}}{2} = \frac{-11 \pm \sqrt{73}}{2}$. Matching $x = -\frac{11 + \sqrt{73}}{2}$ gives $s = 11$, $t = 73$, so $\frac{s}{t} = \frac{11}{73}$.

QUESTION 40 Nonlinear equations in one variable and systems of equations in two variables

Answer: 6

By Vieta's formula, the product of the solutions is $\frac{c}{a} = \frac{-st}{1/18} = -18st$. Setting $-18st = -3kst$ gives $k = 6$.

QUESTION 41 — Nonlinear equations in one variable and systems of equations in two variables

Answer: 6

Rearranging: $kx^2 - 32x + k^2 = 0$. Two distinct real solutions require a positive discriminant: $(-32)^2 - 4(k)(k^2) > 0$, so $1024 - 4k^3 > 0$ and $k^3 < 256$. The greatest integer satisfying this is $k = 6$ (since $6^3 = 216 < 256$ but $7^3 = 343 > 256$).

QUESTION 42 — Equivalent expressions

Answer: C. $\frac{25}{2}$

LHS: $\sqrt{(9y)^5} = (9y)^{5/2} = 9^{5/2}y^{5/2} = 243y^{5/2}$. RHS: $243(y^{1/5})^k = 243y^{k/5}$. Matching exponents: $\frac{k}{5} = \frac{5}{2}$, so $k = \frac{25}{2}$.

QUESTION 43 — Equivalent expressions

Answer: -1.25

Combining the left side over the common denominator $(ax - 10)(5x - 2)$, the numerator $(6a - 5)x^2 - 60x + 20$ must equal $C(ax - 10)(5x - 2)$ so that the left side reduces to the constant C. Matching constant terms: $20 = 20C$, so $C = 1$ (and $1 = -4b \Rightarrow b = -\frac{1}{4}$). Matching x^2: $6a - 5 = 5a \Rightarrow a = 5$ (the x-terms then agree: $-60 = -(2a + 50)$). Thus $ab = 5(-\frac{1}{4}) = -\frac{5}{4}$. Check at $x = 1$: $2 + (-1) = 1 = -4b$ ✓.

QUESTION 44 — Equivalent expressions

Answer: 5.333

From the first equation, $n = k^{\frac{3}{8}\cdot\frac{2}{5}} = k^{3/20}$. Substituting into the second: $\left(k^{3/20}\right)^{2a-4} = k$, so $\frac{3(2a-4)}{20} = 1$. Then $6a - 12 = 20$ and $a = \frac{16}{3} \approx 5.333$.

QUESTION 45 — Equivalent expressions

Answer: 13/8

Since $r = k^{1/5}$, $r^{8a-3} = k^{(8a-3)/5} = k^2$. Thus $8a - 3 = 10$ and $a = 13/8$.

QUESTION 46 — Nonlinear functions

Answer: 44

The vertex x-coordinate is $b/(2a) = 2$, so $b = 4a$. Substituting x=2 into the equation gives $48 = 4a + c$. Since c is a positive integer, $a \leq 11$, so the greatest possible $b = 4(11) = 44$.

Problem Solving and Data Analysis

QUESTION 47 — Percentages

Answer: 64

Let start $= S$. X ends at $S + 9S = 10S$; Y ends at $S + 2.6S = 3.6S$. Y is $p\%$ less than X: $3.6S = 10S(1 - p/100) \Rightarrow 0.36 = 1 - p/100 \Rightarrow p = 64$.

QUESTION 48 — Ratios, rates, proportional relationships, and units

Answer: C. 37.63

$350\ \text{in}^2/\text{hr} \times (2.54\ \text{cm/in})^2 \times (1\ \text{hr}/60\ \text{min}) = 350 \times 6.4516/60 \approx 37.63$.

QUESTION 49 — Percentages

Answer: C. $5.35m$

A 435% increase means September $= m + 4.35m = 5.35m$.

QUESTION 50 — Percentages

Answer: 825

$m = 0.25(m + q + r)$ gives $0.75m = 0.25(q + r)$, so $m = \dfrac{q + r}{3}$. Also $q = 0.4(q + r)$ gives $0.6q = 0.4r$, so $q = \dfrac{2}{3}r = 990$. Then $q + r = 2475$ and $m = 2475/3 = 825$.

QUESTION 51 — Percentages

Answer: 1460

$0.2044 = 0.0007b \Rightarrow b = 292$. Then $292 = 0.2c \Rightarrow c = 1460$.

QUESTION 52 — Percentages

Answer: 16.1

$p = 0.600(18.5) + 0.400(12.5) = 11.1 + 5 = 16.1$.

QUESTION 53 — Ratios and proportional relationships

Answer: 354

Let x be the number of people who voted against the proposal. Then $6x$ voted in favor, so $6x - x = 1{,}770$. Thus $5x = 1{,}770$ and $x = 354$.

QUESTION 54 — Percentages

Answer: 50000

$A = 3.25B$ and $A = 0.00650C$, so $C = 500B = 50{,}000\%$ of B.

Geometry and Trigonometry

QUESTION 55 — Area and volume

Answer: 618.6

The base area is $16 \times 11 = 176$. The two faces with base 16 have slant height $\sqrt{15^2 + 5.5^2} = \sqrt{255.25}$ and combined area $16\sqrt{255.25}$. The other two faces have slant height $\sqrt{15^2 + 8^2} = 17$ and combined area $11 \times 17 = 187$. The total surface area is $176 + 16\sqrt{255.25} + 187 \approx 618.625$.

QUESTION 56 — Lines, angles, and triangles

Answer: B. $6\sqrt{13}$

From the graph, $P = (-4, 2)$ and $Q = (2, 6)$, so $PQ = \sqrt{6^2 + 4^2} = 2\sqrt{13}$. Since $PR = QR$ and $PR + QR + PQ = 14\sqrt{13}$, each congruent side is $(14\sqrt{13} - 2\sqrt{13})/2 = 6\sqrt{13}$.

QUESTION 57 — Right triangles and trigonometry

Answer: B. $\dfrac{204}{153}$

Since $AE = 255$ and $DE = 153$ with $\overline{AD} \perp \overline{DE}$ implied by the figure, $AD = \sqrt{255^2 - 153^2} = \sqrt{(255 - 153)(255 + 153)} = \sqrt{102 \cdot 408} = 204$. Angle x corresponds to angle E, so $\tan x° = AD/DE = 204/153$.

QUESTION 58 — Lines, angles, and triangles

Answer: C. $ST = 86/n$

EF corresponds to ST, and DEF is n times RST, so $EF = n\,ST$ and $ST = 86/n$.

QUESTION 59 — Area and volume

Answer: 1738

P is the midpoint of $\overline{NQ}$, so $NP = PQ = 44$ and the rectangle $NQRP$ is $88 \times 17 = 1496$. The semicircle has radius $44/2 = 22$, giving area $\frac{1}{2}\pi(22^2) = 242\pi$. Total area $= 242\pi + 1496$, so $a + b = 242 + 1496 = 1738$.

QUESTION 60 — Lines, angles, and triangles

Answer: C. The measures of angle E and angle Z are $39°$ and $79°$, respectively.

Choice C gives $E = 39°$, so $F = 180 - 62 - 39 = 79°$; with $Z = 79°$, $Y = 39°$. Both triangles then have angles $62°$, $39°$, $79°$, proving similarity by AA. Choice A fails because $\frac{XY}{DE} = 3 \neq \frac{XZ}{DF} = 3.5$, so the sides around the congruent angles are not proportional.

QUESTION 61 — Circles

Answer: B. $(14, 14)$

The radius to $(9, 2)$ has direction $(12, -5)$, so the tangent line is perpendicular with direction $(5, 12)$, i.e. slope $\frac{12}{5}$. From $(9, 2)$, moving $(+5, +12)$ reaches $(14, 14)$.

QUESTION 62 — Area and volume

Answer: B. $5{,}408\pi$

The square's side satisfies $s\sqrt{2} = 208$, so $s = 104\sqrt{2}$ and the inscribed circle has radius $s/2 = 52\sqrt{2}$. Area $= \pi(52\sqrt{2})^2 = 5408\pi$.

QUESTION 63 — Right triangles and trigonometry

Answer: B. $\cos L° = \sin K°$

Angle sum: $45b + (4a + 18) + (72 - 4a) = 180$, so $45b + 90 = 180$ and angle $J = 90°$. Hence $K + L = 90$, so $K = 90 - L$ and $\sin K = \sin(90 - L) = \cos L$.

QUESTION 64 — Area and volume

Answer: 204

Areas scale as the square of the linear ratio: $k^2 = 8820/245 = 36$, so $k = 6$. Thus $EF = 6(34) = 204$.

QUESTION 65 — Right triangles and trigonometry

Answer: A. $\frac{17}{40}$

$AC = 17 + 23 = 40$, so $BC = \sqrt{40^2 - 17^2} = \sqrt{1311}$. By the altitude-to-hypotenuse theorem, $BD = \frac{AB \cdot BC}{AC}$, hence $\frac{BD}{BC} = \frac{AB}{AC} = \frac{17}{40}$.

QUESTION 66 — Right triangles and trigonometry

Answer: D. $\frac{5}{12}$

In right triangle XWZ (right angle at W), $\tan Z = \frac{WX}{WZ}$. By the altitude theorem on right triangle XYZ, $WX^2 = WY \cdot WZ$, so $WZ = \frac{564^2}{235}$. Then $\tan Z = \frac{564}{564^2/235} = \frac{235}{564} = \frac{5}{12}$ (dividing both by 47).

Equivalently, $\tan Z = \frac{WY}{WX} = \frac{235}{564} = \frac{5}{12}$ directly from similar triangles.

QUESTION 67 — Right triangles and trigonometry

Answer: 90

Area $= \frac{1}{2} \cdot AB \cdot AC = \frac{1}{2}(6)\sqrt{30^2 - 6^2} = 3\sqrt{864}$. Also $\cos x^\circ = AC/BC = \sqrt{864}/30$. Setting $k \cdot \frac{\sqrt{864}}{30} = 3\sqrt{864}$ gives $k = 90$.

QUESTION 68 — Right triangles and trigonometry

Answer: A. $330 \sin 47^\circ$

Area $= \frac{1}{2} \cdot PQ \cdot PR \cdot \sin P = \frac{1}{2}(30)(22)\sin 47^\circ = 330 \sin 47^\circ$.

QUESTION 69 — Circles

Answer: D. $(\sqrt{13} + 4, \sqrt{23} - 9)$

For choice D, $x - 4 = \sqrt{13}$ and $y + 9 = \sqrt{23}$, so the left side is $13 + 23 = 36$.

QUESTION 70 — Right triangles and trigonometry

Answer: B. $\frac{3\sqrt{5}}{9}$

Because $D + E = 90°$, $\cos E = \sin D = \frac{3\sqrt{5}}{9}$.

QUESTION 71 — Area and volume

Answer: 9000

Cylinder volume ratio is $128000/2000 = 64$, so the linear ratio is 4 and surface-area ratio is 16. For A, $2000\pi = \pi(10)^2 h$ gives $h = 20$, so $k = 2(10)^2 + 2(10)(20) = 600$. Thus $j = 9600$ and $j - k = 9000.$

QUESTION 72 — Area and volume

Answer: B. $32{,}500$

The volume ratio is $250000/2000 = 125$, so the linear ratio is 5. Surface area scales by $5^2 = 25$, giving $k = 1300(25) = 32500$.

QUESTION 73 — Right triangles and trigonometry

Answer: 310

Each side is $1860/3 = 620$. The height of an equilateral triangle is $s\sqrt{3}/2 = 310\sqrt{3}$, so $x = 310$.

QUESTION 74 — Area and volume

Answer: 136

The base side is $\sqrt{256} = 16$. From $\frac{1}{3}(256)h = 1280$, the pyramid height is 15. The triangular face slant height is $\sqrt{15^2 + 8^2} = 17$, so its area is $\frac{1}{2}(16)(17) = 136$.

QUESTION 75 — Area and volume

Answer: 9600

The surface-area ratio is $3520/220 = 16$, so the linear ratio is 4. Volumes scale by $4^3 = 64$, giving $150(64) = 9600$.