Prepared by @MathwithXasan

2024 Math Hardest Questions Part 2

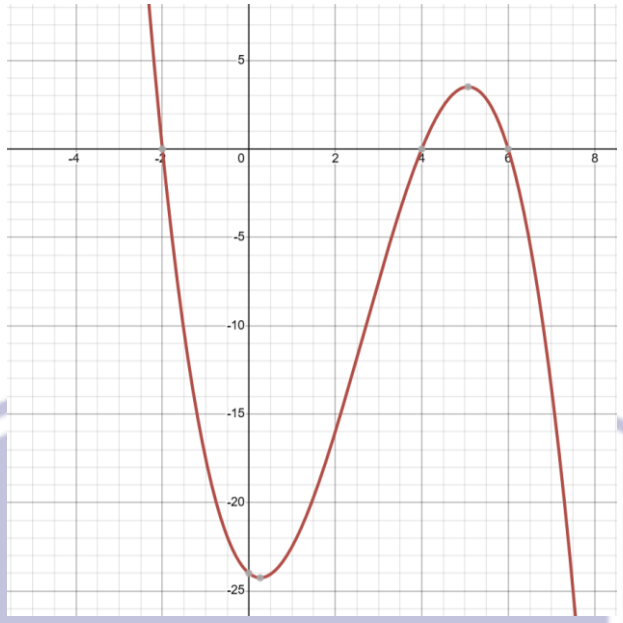
Question 1

A circle is defined by $x^2 - 4x + y^2 + 8y = 5$. There are two parallel lines that are tangent to the circle. The first line is tangent to the circle at point (-1, 0), and second line is tangent at point (a, b), where a and b are integers. What is the slope-intercept form of the second line? (Write down your answer)

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Question 2



The graph of the function f, defined by $f(x) = a(x + b)(x + c)(x + d)$, is shown in the xy-plane, where a, b, c, and d are constants. If each of the roots of the function is increased by 2 to create a new function g, which of the following represents the equation of g?

A) $g(x) = \frac{1}{2}(x + 4)(x - 2)(x - 4)$

B) $g(x) = -\frac{1}{2}(x - 2)(x + 4)(x - 4)$

C) $g(x) = -\frac{1}{2}(x - 8)(x - 6)(x)$

D) $g(x) = \frac{1}{2}(x)(x - 8)(x - 6)$

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Question 3

A right square pyramid has a total surface area of 12800 square units, and the diagonal of the base is $64\sqrt{2}$. If the right square pyramid is cut by a plane through its diagonal of the base to its apex, what is the surface area of one piece. (Rounded to the nearest tenth)

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Question 4

$$F(x) = \frac{9}{5}(x - 273.15) + 32$$

The function F gives the temperature, in degrees Fahrenheit, that corresponds to a temperature of x kelvins. If a temperature increased by 18.90 degrees Fahrenheit, by how much did the temperature increase, in kelvins?

A) 34.02
B) 46.08
C) 10.50
D) 12.80

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Question 5

A new company organized 3-days workshop to advertise its new products. The company invited 12,800 people to attend the workshop, but only 53.125% of invited people attended the first day. Of the people who attended the first day, 42% attended the second day, and on the third day, there were 66% of the people who did not attend the first day and half of the people who attended the second day. If the number of people who attended on the third day is p% of the people who attended on the second day, what is the value of p, rounded to the nearest hundredth?

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Question 6

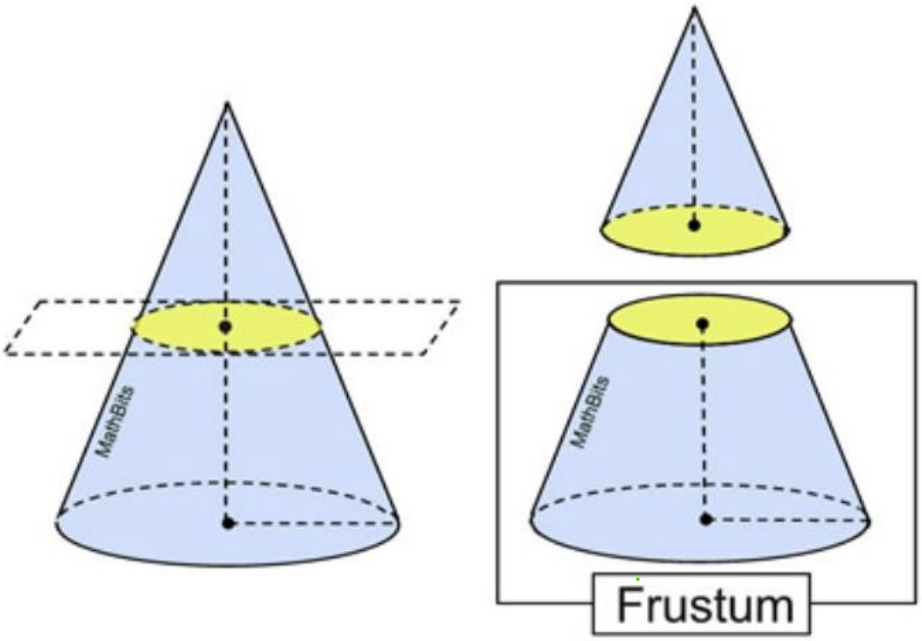


Figure Not Drawn To Scale.

A plane slices a right circular cone parallel to its base. The radius of the cone is 18 cm. and its height is 24 cm. If the cone is separated at the cross section, the bottom portion of the cone is called a **frustum**. The height of the divided cone is one-third of the height of original cone. If the surface area of the frustum is $k\pi$, what is the value of k?
(Use $\pi r(r + l)$ to calculate the surface area of the cone, where l is the slant height.

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Question 7

For the exponential function f, for each increase in the value of x by 8, the value of f(x) increases by a factor of 2. If f(0)=2024, which of the following represents the function f?

A) $f(x) = 2024\left(16^{\frac{1}{8}}\right)^{\frac{2x}{12}}$

B) $f(x) = 2024\left(64^{\frac{2}{7}}\right)^{\frac{3x}{4}}$

C) $f(x) = 2024\left(32^{\frac{1}{12}}\right)^{\frac{3x}{10}}$

D) $f(x) = 2024\left(16^{\frac{1}{3}}\right)^{\frac{9x}{2}}$

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Question 8

Types/Pages	0-60	61-120	121-180	181-240	241-300
Paperback	**X**	8	13	7	16
Hardcover	10	**M**	**N**	20	**K**

The table above shows the number of hardcover and paperback books classified with their number of pages. Find the value of $\frac{X+M+N+K}{Y}$ based on these following statements:

I. If one of the books which have at most 120 pages is selected randomly, the probability of a paperback book that has at most 60 pages is 1/9.

II. There are half as many paperback books as hardcover books. The probability of a book that has at least 121 but at most 180 pages is 9/28, given that the book has more than 60 but less than 241 pages.

III. Given that the book selected has neither 0-60 nor 61-120 pages, the proportion of hardcover book, having at most 240 pages, is **Y** and paperback book, having at least 181 pages is 1/8.

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Question 9

A group of scientists want to conduct an experiment to see whether new vaccine to treat COVID-19 or traditional one is effective. They are divided into 2 groups. First group selects 300 people who have flue from each of these cities Austin, Texas, and Columbus, Ohio, and assigns who take a new vaccine or traditional based on their age. Second group selects randomly 300 people who have flu from each of these cities Austin, Texas, and Columbus, Ohio, and patients divide themselves evenly into two groups, tossing a coin to decide which group is assigned to the new vaccine. Which of the following statements is (are) true to determine the cause-and-effect relationship?

I. For the first group, scientists should randomly select 300 people who have flu, and patients should be given the new vaccine according to their genders.
II. For the second group, scientists should randomly give numbers to patients and those with an even number are assigned to the new vaccine.

A) I only
B) II only
C) Both I and II
D) Neither I nor II

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Question 10

$$f(x) = \left(-\frac{a}{2}\right)x^2 + 12x + 8c$$

In the given quadratic function, a and c are constants. The graph of y=f(x) is a parabola that has a vertex at the point (h, k), where h and k are constants. If the range of the function is no less than 5 and $f(-21) = f(15)$, which of the following must be true?

I. $a \leq -2$
II. $c \geq -1$

A) I only
B) II only
C) Both I and II
D) Neither I nor II

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Question 11

A town’s chamber of commerce printed a map of the business district. The map is 16 inches square, and 1 inch on the map represents an actual distance of 150 feet. A larger version of the same map of the business district is printed with the side length 70% longer than the side length of the previous map. On the larger map, what is the actual distance, in feet square rounded to the nearest tenth, represented by 1 inch square?

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Question 12

$$f(x) = (x - 3)(x + 4)(x + 6)$$

The graph in the xy-plane of the equation above contains the point (a, b). If $-4 \leq a \leq 3$, which of the following is not possible value of b?

A) -73
B) -72
C) 0
D) 1

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Question 13

A researcher surveyed 300 adults selected at random from the town of Freehold, 400 adults selected at random from the town of Howell, and 600 adults selected at random from the town of Lakewood. Each person surveyed was asked whether he or she owns a goat. Some of the results are shown in the partially completed table below.

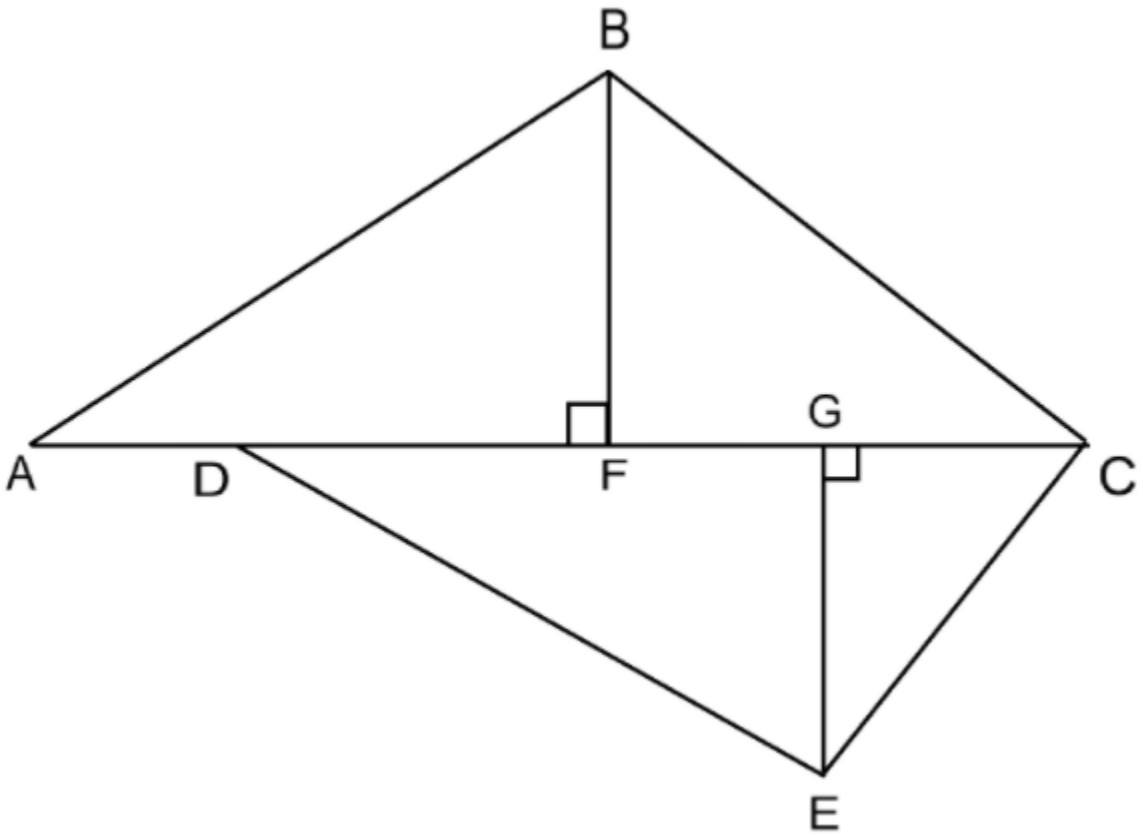
	Owns a goat	Does not own a goat	Total
Freehold	120	180	300
Howell	**X**		400
Lakewood		**Y**	600

The researcher found that an adult surveyed in Howell is twice as likely to own a goat as an adult surveyed in Freehold, and an adult surveyed in Lakewood is 3 times more than not to own a goat an adult surveyed in Howell. What is the value of X + Y.

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Question 14



Note: Figure not drawn to scale.

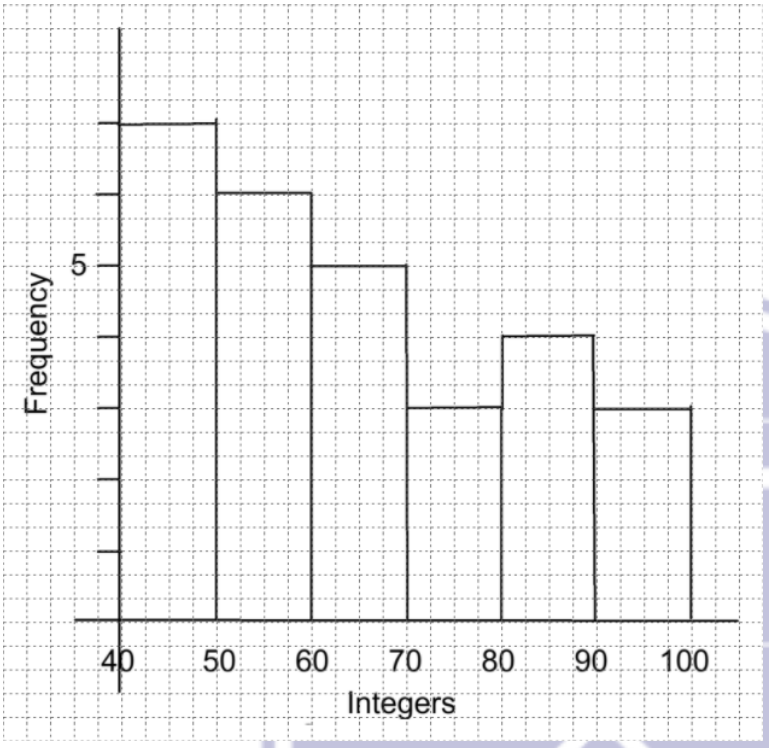
In the figure above, AB = 16, AC = 20, AD = 3 and CE = 8. What is the length of FG? (Write your answer in fractional form)

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Question 15



Integers	Frequency
40-49	2
50-59	3
60-69	5
70-79	5
80-89	7
90-99	8

Data set X **Data set Y**

The histogram above represents the Data set X, and the table above represents the Data set Y. In the histogram and table, the first interval includes the whole numbers greater than or equal to 40, but less than 50. Second interval includes the whole numbers greater than or equal to 50, but less than 60, and so on. If the greatest possible difference between the range of data set X and mean of data set Y is m, and the smallest possible difference between the median of data set X and the mode of data set Y is n, what is the sum of m and n?

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Question 16

The composition of metal alloy consists of 4 different metals: iron, silver, gold and bronze. The mass of iron is at least 65% less than the mass of bronze, and total mass of the gold and bronze is no less than 400% of the mass of iron. If the mass of bronze is 20% more than the mass of silver which has a mass of 150 grams, what is minimum mass of the gold?

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Question 17

For a certain position, an employer offers an hourly wage of $24.00 at the start of employment. For the next two years after the start of employment, the hourly wage is increased by 15% of the hourly wage at the end of the previous year. For the next five years, at the end of every 3-month interval, the hourly wage is increased by 7% of the hourly wage at the end of the previous 3-month interval. Which of the following functions models the percent change in the value of hourly wage between at the end of the second and seventh year?

A) $f(x) = (31.74 \cdot (1.07)^{28} - 31.74) \cdot 100$
B) $f(x) = (31.74 \cdot (1.07)^{20} - 31.74) \cdot 100$
C) $f(x) = ((1.07)^{28} - 1) \cdot 100$
D) $f(x) = ((1.07)^{20} - 1) \cdot 100$

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Question 18



The graph of 3 functions is shown above. Find the value of $a + b + c$, where a, b and c are positive integer constants.

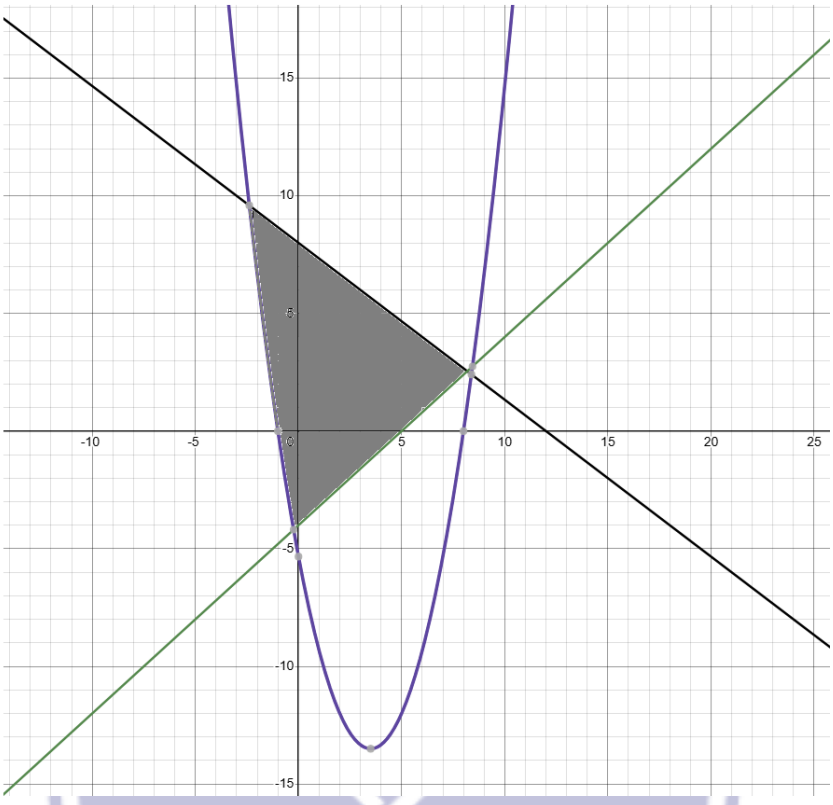
I. $f(x) = -a(0.3)^x + 11$
II. $g(x) = b(1.02)^x - 2$
III. $h(x) = -c(1.3)^x + 24$

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Question 19

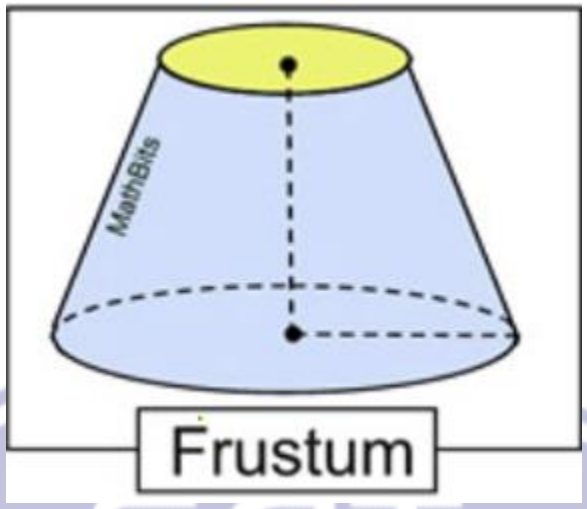


The system inequalities of two linear and one quadratic function is given. If the shaded region is solution to this system, write the system of standard form of both linear and quadratic inequalities ($Ax + By = C \; and \; y = ax^2 + bx + c$).

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Question 20



The figure above, frustum, is inscribed in a cube so that top and bottom faces of the frustum touch to those of the cube, and the bottom face also touches to the four edges of the cube. The slant height of the frustum is 18.45 cm and the radius of the top face is 4.95 cm. The ratio of the bigger radius to the smaller radius is 20 to 11. Find the positive difference between the volumes of the cube and the frustum. (Round your answer to the nearest integer)

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Question 21

Segment of ride	Distance (miles)	Average cycling speed with no cramp delay (mph)
From home to top of hill	1.2	12
From top of hill to valley	4.8	24
From valley to river	2.4	16
From river to the city center	15.3	34

Mr. David rides his bike from his home to the city center every weekend evening. The table above shows the distance, in miles, and his average cycling speed, in miles per hour (mph), when he doesn't have any cramps, for each segment of his ride.

If Mr. David starts his ride at 7:00 p.m., he can ride at his average cycling speed with no cramps for each segment of the ride. If he starts his ride at 7:30 p.m., the ride time increases by 40% in the first segment and by 65% in the third segment due to cramps, but the ride time for each of the other segments of his ride does not change. Based on the table, how many more hours does Mr. David take to arrive at the city center if he starts his ride at 7:30 p.m. than if he starts his ride at 7:00 p.m.?

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Question 22

The amount of money owed on a certain type of loan has two components: the principal balance of the loan and the amount of interest accrued on the loan. For a loan of this type, each payment was $350.00 and there were 60 payments total. Part of each payment was applied to the principal balance of the loan, and the rest was applied to the amount of interest accrued on the loan. The amount of the 1st payment that was applied to the principal balance was $220.93. For each additional payment, the amount that was applied to the principal balance was approximately 0.8% less than the amount that was applied to the principal balance for the previous payment. What is the amount of the 15th payment, in dollars, that was applied to the amount of interest accrued, where $x \leq 60$ (Round your answer to the nearest tenth).

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