Teaching Advanced Placement and beyond in an Urban high school

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About Central High School

Nebraska MATH
A partnership to improve mathematics achievement

- founded in 1859
- current attendance is just over 2500 with 65% of students coming from outside the home attendance area
- serves ethnically and economically diverse populations. About 35% of the students are White, 33% African American and 30% Latino with the other 2% being Asian and Native American.
- offers 14 AP courses as well as multiple courses beyond AP that are dual enrolled, and will be adding IB next year

Mathematics Courses

To meet the needs of all students, Central High offers

- both Academic and Honors Courses ranging from Consumer Mathematics to Calculus 3
- Algebra, Geometry and Advanced Algebra to the majority of students
- three AP courses; AB Calculus, BC Calculus and Statistics
- five dual enrolled courses; AB Calculus, BC Calculus, Statistics, Calculus 3 and Differential Equations

Common Core Standards for Mathematical Practice

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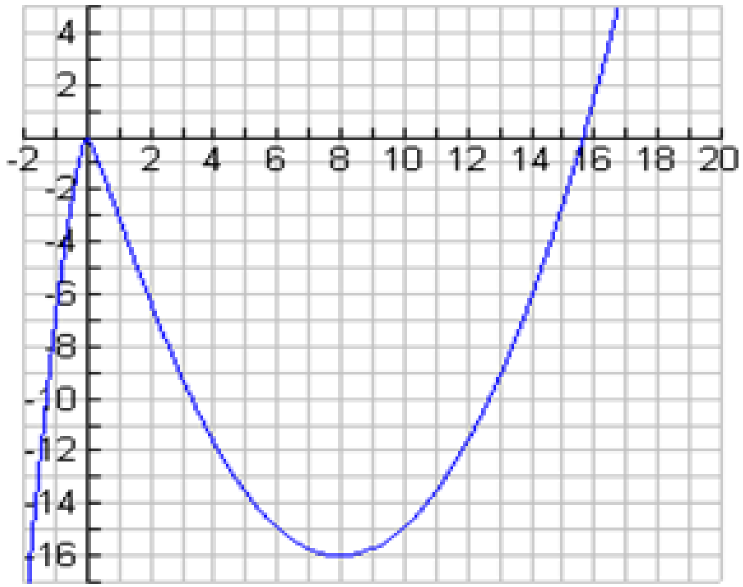
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Example 1

You are given the graph of $f'(x)$, determine the following:

1. Over what interval(s) is $f(x)$ increasing?
2. Over what interval(s) is $f(x)$ decreasing?
3. Identify the x-value of any local extrema
4. Over what interval(s) is $f(x)$ concave up?
5. Over what interval(s) is $f(x)$ concave down?
6. Identify the x-value of any points of inflection.



Example 2

The function $z = f(x,y,r) = \frac{1+(1-x)y}{1+r} - 1$ describes the net gain or loss of money invested, where x = annual marginal tax rate, y = annual effective yield on an investment and r = annual inflation rate.

a. Calculate $f(0.25, 0.06, 0.1)$, $f_x(x, 0.04, 0.05)$, $f_y(0.25, y, 0.05)$, and $f_r(0.25, 0.04, r)$.

b. Describe in your own words the meaning of each of the answer from part (a). Make sure to use the terminology given in the problem.

Example 3

Let f be a function that satisfies $f(1+h)-f(1)=3h+4h^2-5h^3$ for all real numbers h. Find $f'(1)$

Example 4

If $v = \langle 3,-2,2 \rangle$, then find the vector $u = \langle a,b,c \rangle$ such that $u \times v = \langle -2,5,8 \rangle$.

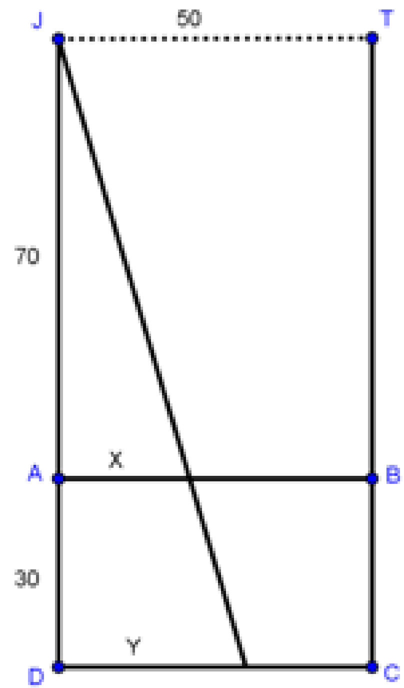
Example 5

A tightrope is stretched 30 feet above the ground between the Jay and the Tee buildings, which are 50 feet apart. A tightrope walker, walking at a constant rate of 2 feet per second from point A to point B, is illuminated by a spotlight 70 feet above point A, as shown in the diagram.

a. How fast is the shadow of the tightrope walker's feet moving along the ground when she is midway between the buildings? (indicate units of measure)

b. How far from point A is the tightrope walker when the shadow of her feet reaches the base of the Tee building? (Indicate units of measure)

c. How fast is the shadow of the tightrope walker's feet moving up the wall of the Tee building when she is 10 feet from point B? (Indicate units of measure)



Example 6

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Two mountain peaks are modeled by the functions $f(x,y) = 4500 - x^2 - y^2$ and $f(x,y) = 6200 - (x-80)^2 - (y-80)^2$ where the height is measured in feet. A climber has made his base camp at the peak of the lower mountain and has a goal of hiking to the summit of the high mountain by noon. When he climbs up hill, he travels at an average rate of 30 feet per minute, but when he climbs downhill, he can climb twice as fast. If he takes the shortest path in terms of distance and he plans on resting every 2 hours for 15 minutes, when does he need to leave his camp?

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