

### Results for Problem 3

There were a lot of good solutions to this challenge problem. No class scored a 5 primarily because they often gave a result or a solution without an explanation of how it was created. Each result should be supported.

In this problem, Michael Conklin's class at University High School in Spokane Valley, Washington had a beautiful presentation of part a). Deanna Wasman's "Kewpie Calculus Team" had a nice development that distinguished between the two limits. This is actually better than what I wrote up in my solution, but it created some difficulty with the algebra in simplifying the result.

Denise McCleary's "McCleary's Dearies" from Fairview High School in Boulder, Colorado also found that the formulation

$$\lim_{h \rightarrow 0} \frac{f(x+h) - 2f(x) + f(x-h)}{h^2}$$

worked as well (this earned them a half a point). This solution is based on the symmetric difference definition of derivative,

$$\lim_{h \rightarrow 0} \frac{f(x+h) - f(x-h)}{2h}.$$

The symmetric difference is used when your calculator computes a numerical derivative. Does this explain why your calculator probably tells you that the derivative of  $y = |x|$  is zero at  $x = 0$ ?

There are a number of other computations that work as well.

Everyone did a nice job with part b). You presented your work with clarity and good detail. Several classes saw the connection to Pascal's triangle in part c), but none gave an explanation of why the pattern was the same.

School	Location	Teacher	Score
Boulder Creek High School	Anthem, Arizona	Julie Baldwin	4
Brookville High School	Brookville, Ohio	Sandy Dobberstein	4
Eagle's Landing Academy	McDonough, Georgia	Deborah Brown	4
Fairview High School	Boulder, Colorado	Denise Fuji McCleary	4.5
Hickman High School	Columbia, Missouri	Deanna Wasman	4.5
Salem High School B	Virginia Beach, Virginia	Mary Harrison	3
The Westminster Schools	Atlanta, Georgia	Ellen Vesey	4
University High School	Spokane Valley, WA	Michael Conklin	3

Cummulative Results on the next page.

## Cumulative Results

<b>School</b>	<b>Location</b>	<b>Teacher</b>	<b>Total Score</b>
Boulder Creek High School	Anthem, Arizona	Julie Baldwin	13
Brookville High School	Brookville, Ohio	Sandy Dobberstein	12
Canton Central School	Canton, New York	Meg Clemens	5
Eagle's Landing Academy	McDonough, Georgia	Deborah Brown	8
Fairview High School	Boulder, Colorado	Denise Fuji McCleary	13.5
Hickman High School	Columbia, Missouri	Deanna Wasman	13.5
McIntosh High School	Peachtree City, Georgia	Diane Freeman	5
Pine View School	Osprey, Florida	Ann Hankinson	5
Salem High School A	Virginia Beach, Virginia	Mary Harrison	5
Salem High School B	Virginia Beach, Virginia	Mary Harrison	8
The Westminster Schools	Atlanta, Georgia	Ellen Vesey	12
University High School	Spokane Valley, WA	Michael Conklin	8