1. Estimate the value of $\sqrt{15}$. Using Newton's method, the best choice will be:

(A) $f(x) = \sqrt{x}, \quad x_0 = 16$

(B) $f(x) = \sqrt{x + 15}, \quad x_0 = 0$

(C) $f(x) = \sqrt{x} - 15, \quad x_0 = 4$

(D) $f(x) = x^2 - 15, \quad x_0 = 4$

Estimate the value of $\sqrt{15}$. Using linear approximation, the best choice will be:

(A) $f(x) = \sqrt{x}, \quad x_0 = 16$

(B) $f(x) = \sqrt{x+15}, \quad x_0 = 0$

(C) $f(x) = \sqrt{x} - 15, \quad x_0 = 4$

(D) $f(x) = x^2 - 15, \quad x_0 = 4$

Suppose that $g(x)$ is the inverse function of $f(x)$. The tangent line to $f(x)$ at $x = c$ is $y = a + b(x - c)$ where a, b and c are constants. Which of the following is the equation of a tangent line to $g(x)$?

(A) $y = c + \frac{1}{b}(x - a)$ (B) $y = a + \frac{1}{b}(x - c)$ (C) $y = \frac{1}{a} + \frac{1}{b}\left(x - \frac{1}{c}\right)$

(D) $y = c + b(x - a)$ (E) $y = c - \frac{1}{b}(x - a)$

Which of the following describes the derivative of a function $f(x)$?

(A) It is defined as $\frac{f(x+h)-f(x)}{h}$.

(B) It is the line we see when we zoom into the graph of $f(x)$.

(C) It is the average rate of change of $f(x)$ over the interval $0 < x < h$.

(D) More than one of the above answers are correct.

(E) None of the above are correct.

Use implicit differentiation to calculate the derivative of $\theta(x) = \operatorname{arccot}(x)$. Recall that $\cot(x) = \frac{\cos(x)}{\sin(x)}$.

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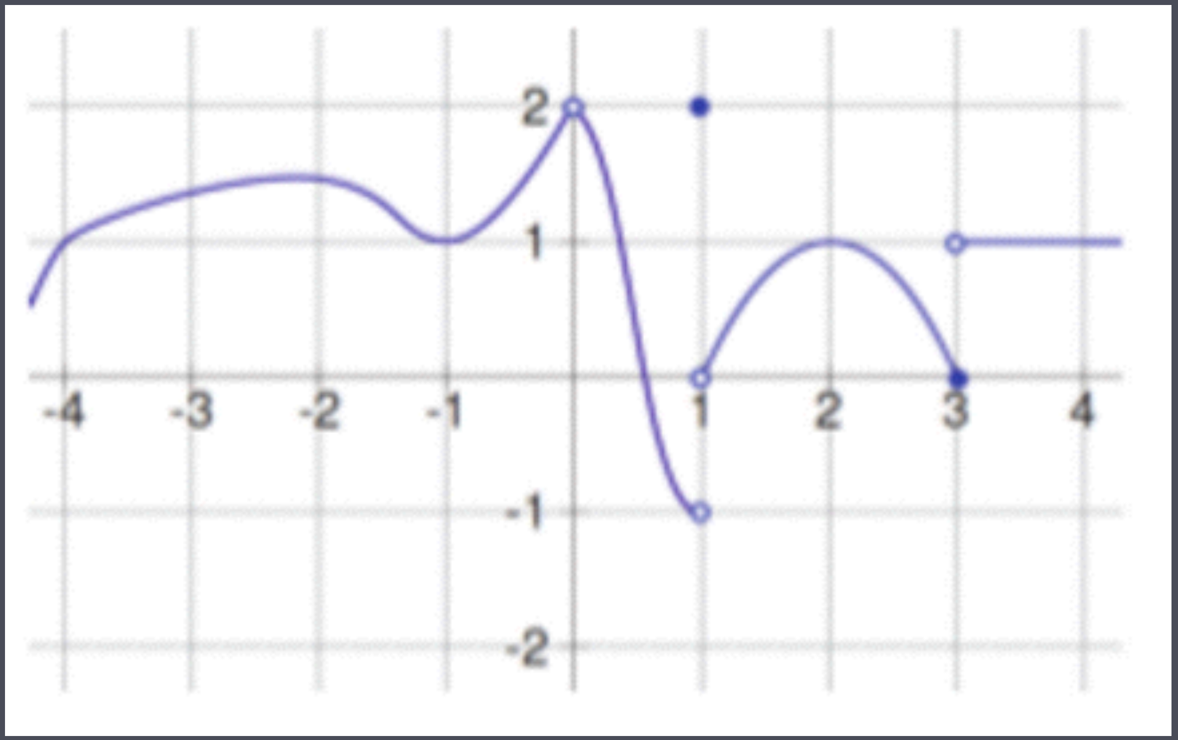
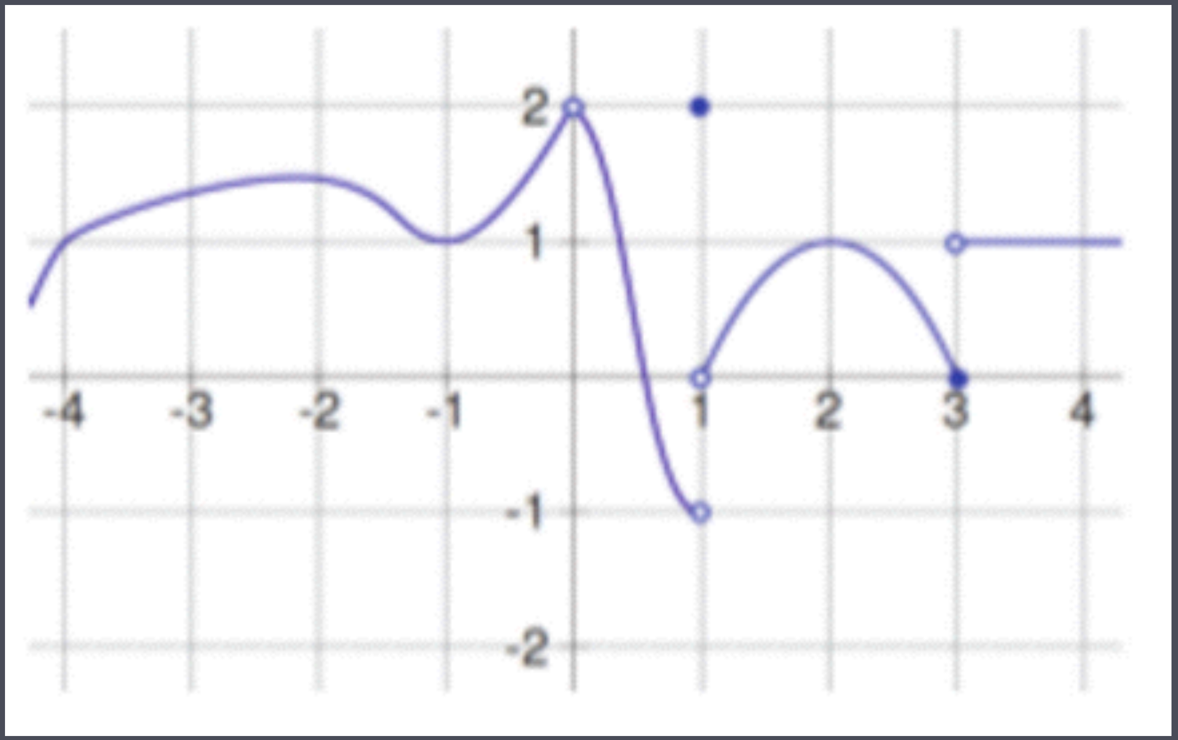
If y = x^(1/m) where m is an integer, find y' using implicit differentiation.



$\lim_{x\to 1} f(x)$

(A) -1 (B) 0 (C) 2 (D) DNE (E) none of the above

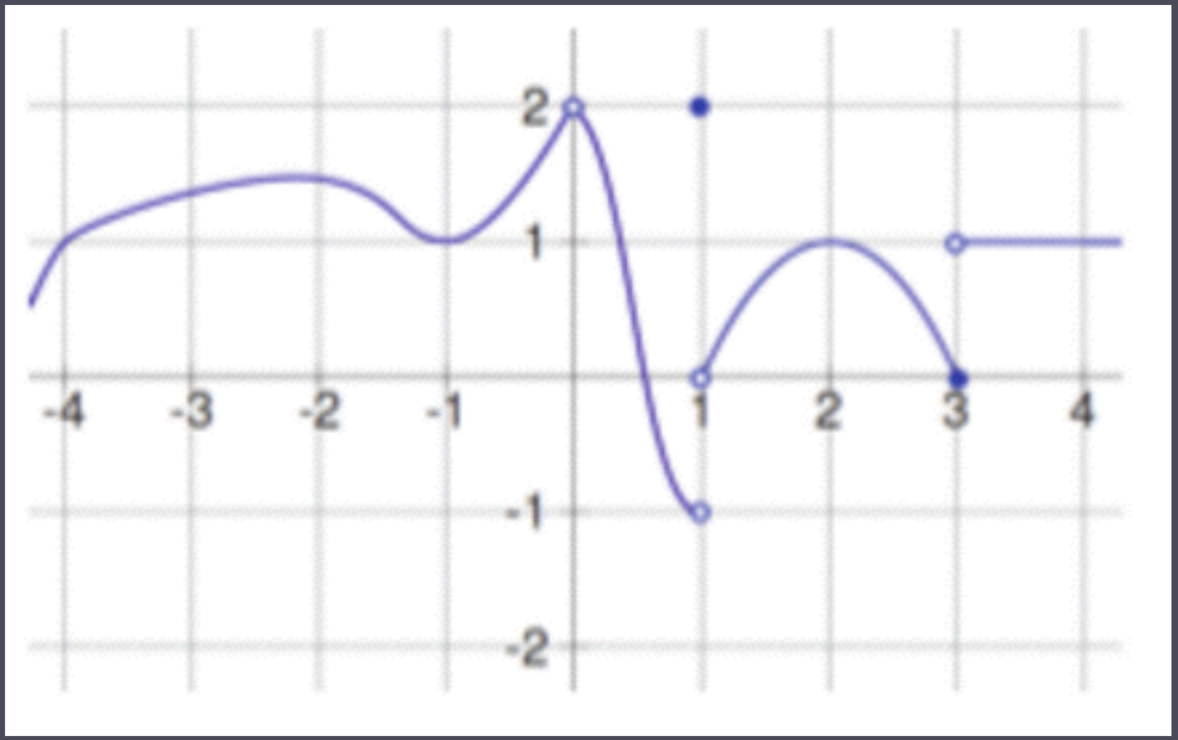


$\lim_{x\to 1} f(x)$

(A) -1 (B) 0 (C) 2 (D) DNE (E) none of the above

$\lim_{x\to 3^-} f(x)$

(A) 0 (B) 1 (C) 3 (D) DNE (E) none of the above



$\lim_{x \to 1} f(x)$

(A) -1 (B) 0 (C) 2 (D) DNE (E) none of the above

$\lim_{x \to 3^-} f(x)$

(A) 0 (B) 1 (C) 3 (D) DNE (E) none of the above

$\lim_{x \to -1} f(x)$

(A) -1 (B) 1 (C) 2 (D) DNE (E) none of the above

Given the differential equation and initial condition

$$\frac{dy}{dt} = y^2(y - a), \quad y(0) = 2a$$

where $a > 0$ is a constant, which of the following is true?

(a) $\lim_{t \to \infty} y(t) = 0$.

(b) $\lim_{t \to \infty} y(t) = \infty$.

(c) $\lim_{t \to \infty} y(t) = a$.

(d) $\lim_{t \to \infty} y(t) = 2a$.

(e) None of the above.

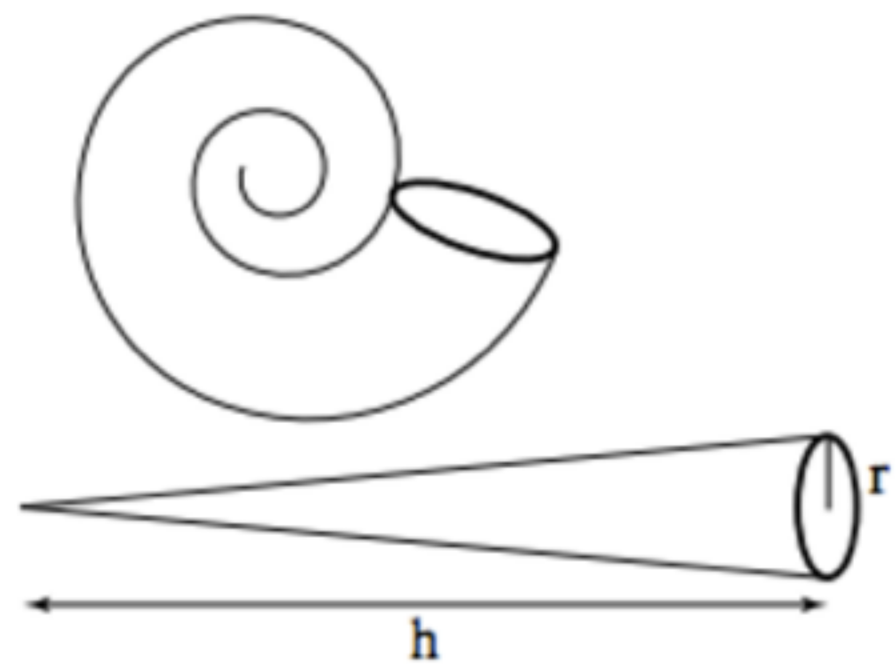
7. [5 pt] A runner on an elliptical track described by the equation $x^2 + \frac{y^2}{4} = 900$ runs at a constant speed v where x and y are measured in metres. Standing at the origin, you must rotate your head at 1/10 radians per second to watch her as she crosses the finish line located on the x axis. How fast is she running?

Let $f(x) = \sin(x) + ax^2$. Which of the following conditions describes all values of a for which f HAS inflection points?

(a) $|a| > 1/2$ (b) $a > 1/2$ (c) $a \geq 1/2$ (d) $|a| < 1/2$ (e) $|a| \leq 1/2$

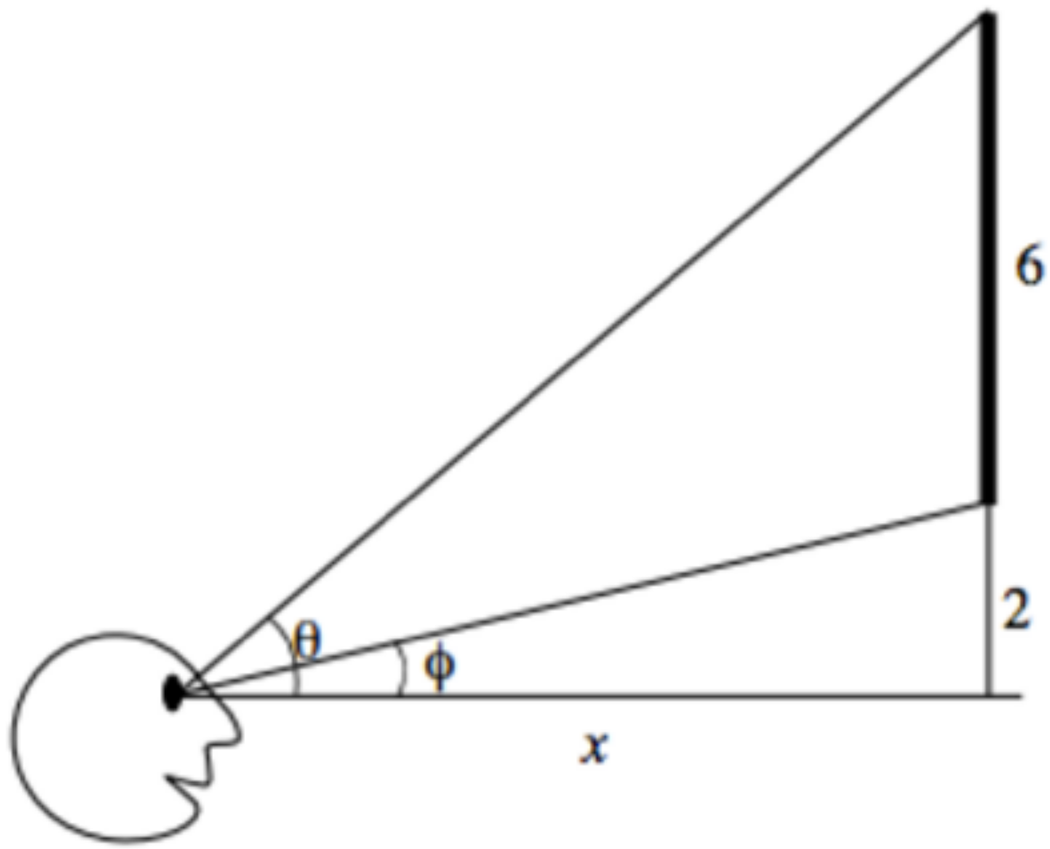
[6 pts.] A mollusc grows inside a shell (top) and produces new shell material at its opening (thick curve). The volume of the shell can be approximated as that of a cone of base radius r and height h. Given that the height of the cone grows at a constant rate of 0.1 cm/year, at what rate will the volume of the cone be changing when $h = 10$ and $r = 1$ cm? Leave your answer in terms of π.

[See formula list on the last page of the exam.]



[**7 pt**] At the outdoor summer movie at Stanley Park, the bottom of the screen is 2 meters above your eye level, and the screen is 6 meters tall. At what distance x from the base of the screen is the visual angle occupied by the screen as large as possible?

HINT: There are several possible approaches to this problem but one approach is to define θ as the angle to the top of the screen and ϕ as the angle to the bottom of the screen and maximize their difference.



(2 points) Consider the the function in the graph shown below. Draw a qualitatively accurate sketch of its derivative on top of it.