# Mathematics 141 Test #2          Name: _____

**Show your work to get credit.** An answer with no work will not get credit.

(1) (25 points) Compute the following (knowing what the notation means is part of the problem).

(a) $\dfrac{dy}{dx}$ where $y = \tan(x^2)$     $\dfrac{dy}{dx} =$ _____

(b) $\dfrac{ds}{dt}$ where $s = 5(t^2 + t + 1)^{50}$.     $\dfrac{ds}{dt} =$ _____

(c) $f''(x)$ where $f(x) = 4x^3 + 7x^2 - 2x + 1$     $f''(x) =$ _____

(d) $\dfrac{d}{dt}\left(t\sin^2(t) + t^2\right)$     _____

(e) $\dfrac{d^2y}{dx^2}$ where $y = \dfrac{4}{x^3}$     $\dfrac{d^2y}{dx^2} =$ _____

(f) $\dfrac{ds}{dt}$ where $s = \sqrt[3]{1 + \tan(t)}$     $\dfrac{ds}{dt} =$ _____

(g) (5 points) $\dfrac{dA}{dr}$ where $A = \dfrac{4}{\sqrt{r^3 + r}}$     $\dfrac{dA}{dr} =$ _____

(2) (5 points) If $u$ and $v$ are related by $u^2 + 4uv + 2v^2 = 10$ find $\dfrac{dv}{du}$ by implicit differentiation.

$$\dfrac{dv}{du} = \text{_____}$$

(3) (5 points) Find the tangent line to $x^2y + 2xy^2 = 10$ at the point $(1, 2)$.

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(4) (10 points) A 20 foot long ladder is leaning against the side of a building, but the base is slipping away from the building at 3 ft/sec. How fast is the top of the latter moving when it is 12 feet from the ground?
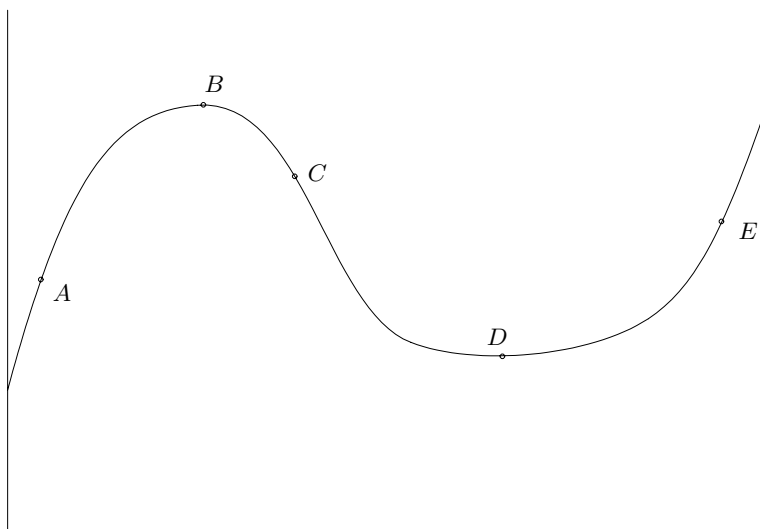
Rate top is moving = _____

(5) (10 points) Draw graphs of functions $f(x)$ with the following properties.
 (a) $f'(x) < 0$ and $f''(x) > 0$.

 (b) $f(2) = 3$, $f'(2) = 0$, and $f''(x) < 0$.

(6) (10 points) In the following figure



(a) At which of the labeled points is $f' > 0$?

(b) Ate which of the labeled points if $f' = 0$
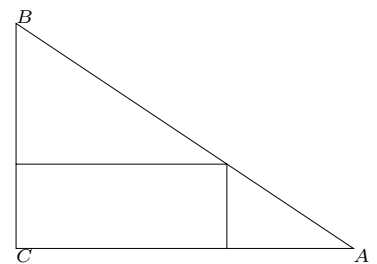
(c) At which of the labeled points is $f'' > 0$

(d) At which of the labeled points is $f'' < 0$

(7) (10 points) Find the maximum and minimum of $y = 3x^2 - x^3$ on the interval $[0, 4]$.

(8) (15 points) Sketch the graph, labeling all the local maximums, local minimums and inflection points of a function $y = f(x)$ on $[1, 4]$ with the following properties:
- $f' > 0$ on the intervals $(1, 2)$ and $(3, 4)$,
- $f' < 0$ on the interval $(2, 3)$,
- $f'' < 0$ on $(1, 2.5)$,
- $f'' > 0$ on $(2.5, 4)$, and
- $f(1) = 3$, $f(2) = 6$, $f(3) = 5$, $f(4) = 9$.

(9) (10 points) The right triangle $\triangle ABC$ has side $AC$ of length 6 and side $BC$ of length 3. What are the lengths of the sides of the rectangle of largest area that can be inscribed in $\triangle ABC$ as in the figure?



(10) 5 free points.