

★ Answer and mark clearly the questions in the provided answer sheets.  
Write down your name and student's ID on the each answer sheet you used.  
\* **Note:** No points will be given if no arguments are provided for an answer.

For your information:

- $\frac{d}{dx}[f(x)g(x)] = f'(x)g(x) + g'(x)f(x)$
- $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$
- $\frac{d}{dx}f(g(x)) = f'(g(x))g'(x)$  and  $\frac{d}{dx}x^r = rx^{r-1}$ , for all  $r$
- $\frac{d}{dx}\sin x = \cos x$  and  $\frac{d}{dx}\cos x = -\sin x$

*Good Luck!*

~~ Yuling ☺

1. (10 points) Let  $f(x) = (x^2 + 1)(2 - x)$ . Find the point(s), if any, on the graph of the function  $f$  where the tangent line is horizontal.
2. (20 points) Find an equation of the tangent line to the given graph at the given point.
  - (1)  $f(x) = x\sqrt{2x^2 + 7}$  ; at  $(3, 15)$
  - (2)  $x^2y^3 - y^2 + xy - 1 = 0$  ; at  $(1, 1)$
3. (30 points) (1) Find  $F'(2)$ , where  $F(x) = g(f(x))$  and  $f(2) = 3$ ,  $f'(2) = -3$ ,  $g(3) = 5$ , and  $g'(3) = 4$ 
  - (2) Find  $\frac{dy}{dx}$ , where  $y = \tan(2x^2)$
  - (3) Find  $\frac{d^2y}{dx^2}$ , where  $y^2 - xy = 8$
4. (10 points) Use a differential to approximate

$$\sqrt{4.02} + \frac{1}{\sqrt{4.02}}.$$

5. (10 points) Let  $f(x) = 2x^3 - 3x^2 - 16x + 3$ , find the points on the graph of  $f$  at which the slope of the tangent line is equal to  $-4$ .
6. (10 points) (a) find the intervals where the function  $f$  is increasing and where it is decreasing, (b) find the relative extrema of  $f$ , (c) find the intervals where the graph of  $f$  is concave upward and where it is concave downward, and (d) find the inflection points, if any, of  $f$ , with

$$f(x) = \frac{x^2}{x - 1},$$

7. (10 points) Find the absolute maximum value and the absolute minimum value, if any, of the function  $f(s) = s\sqrt{1 - s^2}$  on the closed interval  $[-1, 1]$ .