

1. 10 pts. each Use differentiation rules to find the derivative of each function.

(a)  $s(x) = 4x^{12} - \frac{1}{2}x^4 + 28.$

(b)  $f(x) = \sqrt{x}(x^2 - 1)$

(c)  $g(r) = \frac{r^2}{1 + \sqrt{r}}$

(d)  $h(\theta) = \theta \csc \theta - \cot \theta$

(e)  $y = \sqrt[4]{1 + 2x + x^3}$

(f)  $y = \sin(\tan 2x)$

2. 10 pts. Given that

$$f(x) = \frac{x + 1}{3x - 2},$$

find the second derivative  $f''(x)$ .

3. 10 pts. Let  $f(x) = 2x^3 - 3x^2 - 12x + 4$ . Find all points on the graph of  $f$  at which the tangent line has slope 60.

4. 10 pts. Use implicit differentiation to find  $dy/dx$ , given that

$$\sqrt{x + y^2} = \sin y$$

5. 10 pts. Find an equation of the tangent line to the curve given by

$$\sin y + 5x = y^2$$

at the point  $(\pi^2/5, \pi)$ .

6. 15 pts. Two cars start moving from the same point. One travels south at 70 mi/h and the other travels west at 42 mi/h. At what rate is the distance between the cars increasing three hours later?

7. 15 pts. Gravel is being dumped from a conveyor belt at a rate of 30 ft<sup>3</sup>/min, and its coarseness is such that it forms a pile in the shape of a cone whose base diameter and height are always equal. How fast is the height of the pile increasing when the pile is 12 ft high? (A cone with circular base of radius  $r$  and height  $h$  has volume  $V = \frac{1}{3}\pi r^2 h$ .)