

1. **(8 points)** The horizontal displacement in meters of a particle at time  $t$ , measured in seconds, is given by the formula  $s(t) = t^3 - 8t^2 + 16t$ .

(a) **(2 points)** What is the particle's velocity after 2 seconds?

(b) **(4 points)** At what times is the particle moving to the right?

(c) **(2 points)** What is the particle's acceleration after 5 seconds?

2. **(8 points)** Let  $f(x) = x^5 + x^3$ . Let  $g(x)$  be the inverse function of  $f(x)$ .

(a) **(6 points)** Write a formula for  $g'(x)$  using  $g(x)$ .

(b) **(2 points)** It is known that  $g(2) = 1$ . Find the slope of the tangent line to  $g(x)$  at  $(2, 1)$ .

3. **(8 points)** Calculate  $\frac{d}{dx}(\sqrt{x} \csc(\ln x))$ .

4. **(8 points)** The *conchoid of de Sluze* is a curve satisfying the equation  $(x - 1)(x^2 + y^2) = 4x^2$ .

(a) **(6 points)** Find a formula for  $\frac{dy}{dx}$  on this curve.

(b) **(2 points)** Identify conditions on  $x$  and  $y$  for the tangent lines to the conchoid to be horizontal and vertical (label which is which!).

5. **(8 points)** Find an equation of the tangent line to the curve  $y = 3 \sin(\pi x)$  at  $(\frac{1}{6}, \frac{3}{2})$ .

6. **(8 points)** Differentiate  $\frac{(\arcsin u) \sqrt[5]{u}}{\tan u}$  with respect to  $u$ .