

1. Compute the following derivatives: (*do not simplify*)

(a)  $\frac{d}{dx} (7x^6 - 5x^{-3} + \frac{1}{\sqrt{x}})$

(b)  $\frac{d}{dt} (t^3 - 3)(t^{\frac{3}{2}} - 2t^{-5})$

(c)  $\frac{d}{dx} \frac{3x^2 - 1}{2x + 3}$

(d)  $\frac{d}{ds} (\sin(3s) + s)^5$

(e)  $\frac{d}{dx} \int_2^{2x} (t^2 + 1) dt$

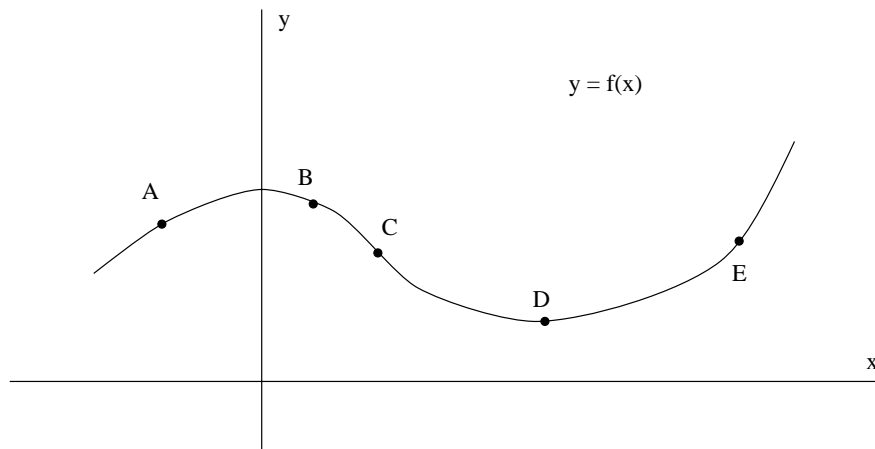
2. Compute the following integrals:

(a)  $\int_2^3 \frac{\frac{3}{t^2} + \frac{1}{t^2} + 1}{t^3} dx$

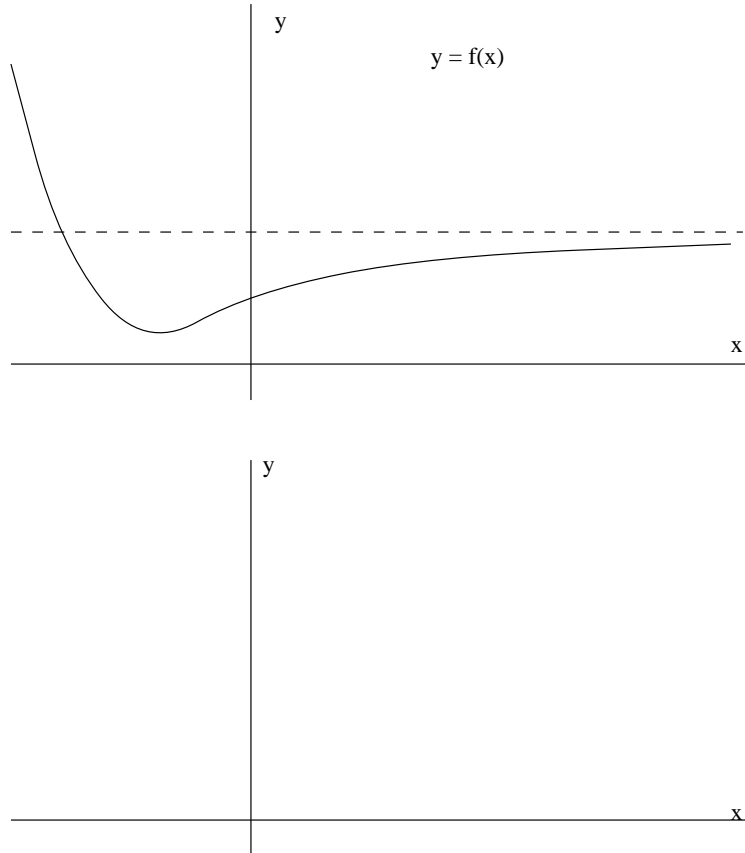
(b)  $\int \frac{1}{\sqrt{x}(1 + \sqrt{x})^3} dx$

(c)  $\int_0^{\frac{\pi}{2}} \sin 2x \cos 2x dx$

3. At which of the five indicated points on the graph sketched below do  $y'$  and  $y''$  have the same sign? Explain your answer.



4. Below is the graph of  $f(x)$ . Sketch the graph of  $f'(x)$ .



5. A rocket that is launched vertically is tracked by a radar station located on the ground 4 miles from the launch site. What is the vertical speed of the rocket at the instant its distance from the radar station is 5 miles and this distance is increasing at the rate of 3600 mi/hr?

6. Find the point or points on the graph of  $y = x^2 + 2$  closest to the point  $(0,4)$ .

7. Use implicit differentiation to find  $y'$  for the function  $y = y(x)$  satisfying the equation  $x^3 + 3x^2y + y^2 =$

9. Find the equation of the tangent line to the graph of this equation at the point  $(1,2)$ .

8. Find the area above the graph of  $y = x^2 - 4x$  and below that of  $y = x$ .

9. Use Riemann sums to obtain an estimate for  $\int_1^3 x^2 dx$ . Divide the interval  $[1,3]$  into 4 equal subintervals  $[x_{i-1}, x_i]$ . Use  $x_i^* = x_i$  the right hand endpoint of the  $i$ -th subinterval  $[x_{i-1}, x_i]$ .

10. Consider  $f(x) = \frac{x}{x^2 - 1}$ ,  $f'(x) = -\frac{x^2 + 1}{(x^2 - 1)^2}$ ,  $f''(x) = \frac{2x(x^2 + 3)}{(x^2 - 1)^3}$ . Find:

(a) the maxima and the minima,

(b) the vertical and horizontal asymptotes,

(c) the intervals where the function is concave upward, those where it is concave downward and the inflections points, and

(d) sketch the graph of  $f$ .