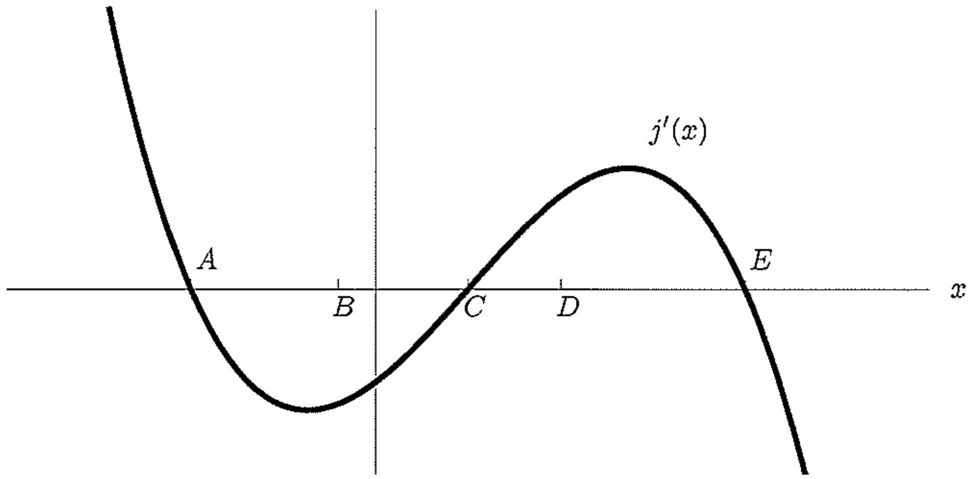
1. (12 points) Consider the graph of $j'(x)$ given here. Note that this is not the graph of $j(x)$.



For each of (a)-(f) below, list **all** x-values labeled on the graph which satisfy the given statement in the blank provided. If the statement is not true at any of the labeled x-values, write "NP". You do not need to show your work. No partial credit will be given on each part of this problem.

(a) The function $j(x)$ has a local minimum at $x =$______________.

(b) The function $j(x)$ has a local maximum at $x =$______________.

(c) The function $j(x)$ is concave up at $x =$______________.

(d) The function $j(x)$ is concave down at $x =$______________.

(e) The function $j'(x)$ has a critical point at $x =$______________.

(f) The function $j'(x)$ is greatest at

2. (1 point) Determine the equation of the tangent line to $f(x) = e^{\frac{1}{3}x^3+\frac{3}{2}x^2-10x}$ at $x = 0$.

3. (1 point) If $x^2 + xy + y^3 = 1$, find the value of y' at the point (1,0).

4. Determine the derivative of the following functions.

(a) (1 point) $g(x) = \dfrac{3^x \cos(x)}{x^3 + 5x + 1}$

(b) (1 point) $h(x) = \sec\left(e^{x^2}\right)$

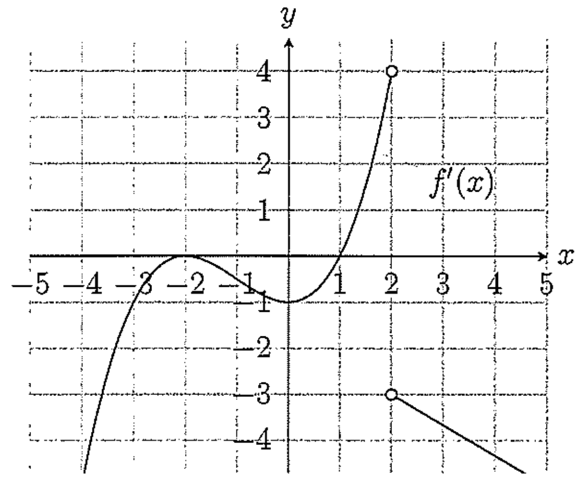
(c) (1 point) $y = x \sin^{-1} x + \sqrt{1 - x^2}$

(d) (1 point) $y = \sqrt{\dfrac{1-x}{1+x}}$

(e) (1 point) $y = 5^x \log_5 x$

5. (1 point) Use logarithmic differentiation to find the derivative of the function $f(x) = x^{\ln x}$

7. Suppose f is a continuous function on $(-\infty, \infty)$. The graph of the *derivative* f' of f is given below.

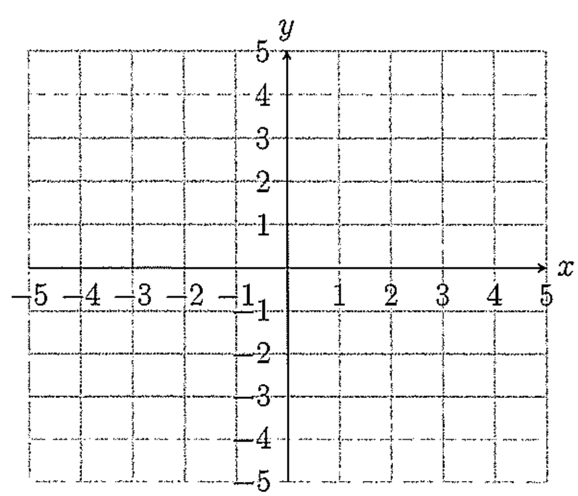


(a) (1 point) On what intervals is f increasing or decreasing?

(b) (1 point) At what values of x does f have a local maximum or minimum?

(c) (1 point) On what intervals is f concave upward or downward?

(d) (1 point) If $f(0) = 0$, sketch a possible graph *of the continuous function* $f(x)$. Be sure to label all local extrema and any inflection point(s).



8. Find the derivatives of each of the following functions. For each part, circle the correct answer.

(a) (1 point) $y = x^2 \sin(x) \tan(x)$

I) $x^2 \cos(x) \sec^2(x) + 2x \sin(x) \tan(x)$

II) $2x \cos(x) \sec^2(x)$

III) $2x \sin(x) \tan(x) + x^2 \sin(x) \sec^2(x)$

IV) $x^2 \sin(x) \sec^2(x) + (2x \sin(x) + x^2 \cos(x)) \tan(x)$

(b) (1 point) $y = \ln(a^3 + x^3)$

I) $\frac{3x^2}{a^3 + x^3}$

II) $3 \ln(a + x) \cdot 3x^2$

III) $\frac{1}{a^3 + x^3}$

IV) $\ln(3x^2)$

(c) (1 point) $y = \arctan(\cos\theta)$

I) $\frac{1}{1 + \cos^2\theta}$

II) $\frac{\cos\theta}{1 + (-\sin\theta)^2}$

III) $\frac{-\sin\theta}{1 + \cos^2\theta}$

IV) $-\sec^2(\cos\theta) \sin\theta$

(d) (1 point) $y = \sqrt{x + \sqrt{x+1}}$

I) $\dfrac{1 + \sqrt{x+1}}{2\sqrt{1 + \sqrt{x+1}}}$

II) $\dfrac{1 + \dfrac{1}{2\sqrt{x+1}}}{2\sqrt{x + \sqrt{x+1}}}$

III) $\frac{1}{2}(x + \sqrt{x+1})^{-1/2} \cdot (1 + \sqrt{x+1})$

IV) $\frac{1}{2}\sqrt{x + \sqrt{x+1}} \cdot \sqrt{x+1}$

(e) (1 point) $y = 2^{x\cos(x)}$

I) $2^{x\cos x} \cdot \ln(2)$

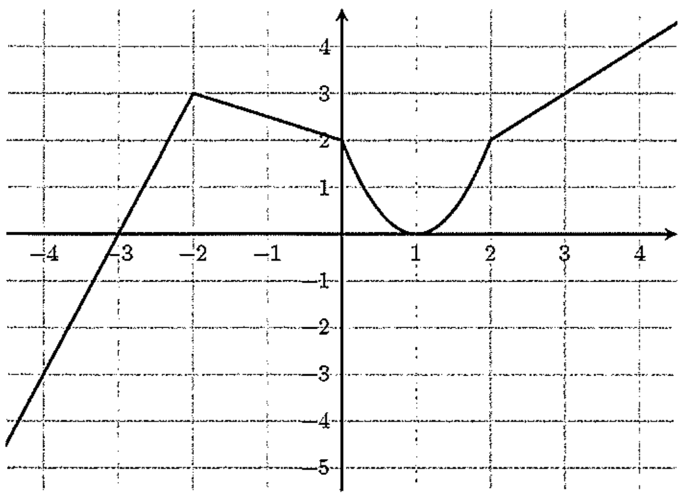
II) $2^{\cos x} \cdot 2^{x} \cdot \ln(2) \cdot (-sinx)$

III) $2^{x\cos x} \cdot \ln(2) \cdot (\cos x - \sin x)$

IV) $2^{\cos x - x\sin x} \cdot \ln(2)$

9. Find the following derivatives using the information given below:

Graph of $f(x)$



	-3	-2	-1	0	1	2	3	4
g(x)	-10	-4	-2.5	-1	3	5	9	14
g'(x)	-4	-2	1	5	2	2	3	6

(a) (1 point) $h'(0)$, where $h(x) = g(g(x))$

(b) (1 point) $q'(1)$, where $q(x) = \dfrac{f(x) + g(x)}{2^x}$

(c) (1 point) $r'(0)$, where $r(x) = \sqrt{\cos(x)g(x)}$

8. [12 points] In the following table, both f and g are differentiable functions of x. In addition, $g(x)$ is an invertible function. Write your answers in the blanks provided. You do not need to show your work.

x	2	3	4	5
$f(x)$	7	6	2	9
$f'(x)$	-2	1	3	2
$g(x)$	1	4	7	11
$g'(x)$	1	2	3	2

a. [3 points] If $h(x) = \frac{g(x)}{f(x)}$, find $h'(4)$.

$h'(4) =$ ____________________

b. [3 points] If $k(x) = f(x)g(x)$, find $k'(2)$.

$k'(2) =$ ____________________

c. [3 points] If $m(x) = g^{-1}(x)$, find $m'(4)$.

$m'(4) =$ ____________________

d. [3 points] If $n(x) = f(g(x))$, find $n'(3)$.

$n'(3) =$ ____________________