

No calculators will be allowed and no partial credit will be given.

1. Find all the critical points of $f(x) = 2x^2 + 8x + 3$, if any. Express your answer(s) in simplified form.
2. Find all the critical points of $f(x) = \frac{1}{3}x^3 + \frac{9}{2}x^2 + 14x + \sin(\ln(2))$, if any. Express your answer(s) in simplified form.
3. Find all the positive critical points of $f(x) = 2x^2 + \frac{23}{x}$, if any. Express your answer(s) in simplified form.
4. Find all the critical points of $f(x) = (x - 5)^2(4x + 1)$, if any. Express your answer(s) in simplified form.
5. Find all the critical points of $f(x) = \frac{x + 3}{x^2 + 16}$, if any. Express your answer(s) in simplified form.
6. Find all critical points of $f(x) = (2x - 7)e^{6x}$, if any. Express your answer(s) in simplified form.
7. Suppose the twice differentiable function has derivatives with signs as in the chart below. State the interval(s) on which f is decreasing.

	$x < 1$	$1 < x < 5$	$5 < x < 9$	$9 < x$
$f'(x)$	+	-	-	+
$f''(x)$	-	-	+	+

8. Suppose the twice differentiable function has derivatives with signs as in the chart below. State the interval(s) on which f is concave up.

	$x < 1$	$1 < x < 5$	$5 < x < 9$	$9 < x$
$f'(x)$	-	-	+	+
$f''(x)$	-	+	+	-

1. -2

2. $-2, -7$

3. $\left(\frac{23}{4}\right)^{\frac{1}{3}}$

4. $5, 3/2$

5. $-8, 2$

6. $\frac{10}{3}$

7. $(1, 9)$

8. $(1, 9)$