

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

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1. Find all the critical points of  $f(x) = 5x^2 + 3x + 8$ , if any. Express your answer(s) in simplified form.
2. Find all the critical points of  $f(x) = \frac{1}{3}x^3 - \frac{9}{2}x^2 + 18x + \sin(\ln(2))$ , if any. Express your answer(s) in simplified form.
3. Find all the positive critical points of  $f(x) = 9x^2 + \frac{11}{x}$ , if any. Express your answer(s) in simplified form.
4. Find all the critical points of  $f(x) = (x - 9)^2(2x + 6)$ , if any. Express your answer(s) in simplified form.
5. Find all the critical points of  $f(x) = \frac{x - 1}{x^2 + 35}$ , if any. Express your answer(s) in simplified form.
6. Find all critical points of  $f(x) = (8x - 3)e^{6x}$ , 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 increasing.

	$x < 1$	$1 < x < 3$	$3 < x < 7$	$7 < x$
$f'(x)$	+	+	+	-
$f''(x)$	+	-	-	-

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.

	$x < 1$	$1 < x < 3$	$3 < x < 7$	$7 < x$
$f'(x)$	+	+	+	-
$f''(x)$	+	-	-	-

1.  $-\frac{3}{10}$
2. 6, 3
3.  $\left(\frac{11}{18}\right)^{\frac{1}{3}}$
4. 9, 1
5. -5, 7
6.  $\frac{5}{24}$
7.  $(-\infty, 7)$
8.  $(-\infty, 1)$