Concavity and the Second Derivative Test - Key

In problems 1-4, Determine the open intervals on which the graph of the function is concave upward or concave downward.

1. $concave\ down : (-\infty, \infty)$	2. $concave\ down : \left(-\infty, \dfrac{2}{3}\right)$ $concave\ up : \left(\dfrac{2}{3}, \infty\right)$
3. $concave\ down : \left(-\infty, -\sqrt{3}\right)$ $concave\ up : \left(-\sqrt{3}, 0\right)$ $concave\ down : \left(0, \sqrt{3}\right)$ $concave\ up : \left(\sqrt{3}, \infty\right)$	4. $concave\ down : (-\infty, 2)$ $concave\ up : (2, \infty)$

In problems 5-8, Discuss the concavity of the graph of the function and find the points of inflection.

5. $concave\ down : (-\infty, 7)$ $concave\ up : (7, \infty)$ $POI : (7, -566)$	6. $concave\ up : (-\infty, -3)$ $concave\ down : (-3, 1)$ $concave\ up : (1, \infty)$ $POI : (-3, -273), (1, -49)$
7. $concave\ up : (-\infty, \infty)$ $No\ POI$	8. $concave\ down : (-\infty, 2)$ $concave\ up : (2, \infty)$ $POI : (2, 10)$

In problems 9-11, Find all relative extrema of the function. Use the Second-Derivative Test when applicable.

9. relative min : (4,-14)	10. $relative\ \max : (2, 64)$ $relative\ \min : (5, 37)$
11. No relative extrema	

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In problems 12-13, Find all relative extrema and points of inflection.

12.	13.
relative min : (-1,-2) relative max : (1, 2) POI : (0, 0)	$relative\min : (-\sqrt{2}, -2)$ $relative\max : (0,2)$ $relative\min : (\sqrt{2}, -2)$ $POI : \left(\dfrac{-\sqrt{6}}{3}, -0.22 \right), \left(\dfrac{\sqrt{6}}{3}, -0.22 \right)$ *or* $POI : \left(\dfrac{-\sqrt{6}}{3}, \dfrac{-18}{81} \right), \left(\dfrac{\sqrt{6}}{3}, \dfrac{-18}{81} \right)$

14. Find the point of diminishing returns for the function R (revenue) and x is amount spent.

   $(2,18)$

15. Find the point of diminishing returns for the function R (revenue) and x is amount spent

   $(5,-196)$