Solve:

1) Find the intervals on which $w(x) = -2x^2 - 2x - 4$ is increasing or decreasing.

$w'(x) = -4x - 2$

$-4x - 2 = 0$

$x = -\frac{1}{2}$

	$(-\infty, -\frac{1}{2}]$	$[-\frac{1}{2}, \infty)$
f'	$f' > 0$	$f' < 0$

$\boxed{\text{inc.: } (-\infty, -\tfrac{1}{2}] \quad \text{dec.: } [-\tfrac{1}{2}, \infty)}$

2) Find the intervals on which $a(x) = x^2 - 4x + 2$ is increasing or decreasing.

$a'(x) = 2x - 4$

$2x - 4 = 0$

$x = 2$

	$(-\infty, 2]$	$[2, \infty)$
f'	$f' < 0$	$f' > 0$

$\boxed{\text{inc.: } [2, \infty) \quad \text{dec.: } (-\infty, 2]}$

3) Find the intervals on which $a(x) = x^3 + 3x^2 - 9x + 3$ is increasing or decreasing.

$a'(x) = 3x^2 + 6x - 9$

$x^2 + 2x - 3 = 0$

$(x + 3)(x - 1) = 0$

$x = -3, 1$

	$(-\infty, -3]$	$[-3, 1]$	$[1, \infty)$
f'	$f' > 0$	$f' < 0$	$f' > 0$

$\boxed{\text{inc.: } (-\infty, -3] \cup [1, \infty) \quad \text{dec.: } [-3, 1]}$

4) Apply the first derivative test on $c(x) = x^2 - 4x$ to find all local maximum and minimums.

$c'(x) = 2x - 4$

$2x - 4 = 0$

$x = 2$

	$(-\infty, 2]$	$[2, \infty)$
f'	$f' < 0$	$f' > 0$

$\boxed{\text{min.: } (2, -4)}$

5) Apply the first derivative test on $c(x) = 4x^2 - 2x - 2$ to find all local maximum and minimums.

$c'(x) = 8x - 2$

$8x - 2 = 0$

$x = \frac{1}{4}$

	$(-\infty, \frac{1}{4}]$	$[\frac{1}{4}, \infty)$
f'	$f' < 0$	$f' > 0$

$\boxed{\text{min.: } (\tfrac{1}{4}, -\tfrac{9}{4})}$

6) Apply the first derivative test on $h(x) = -x^3 + 9x^2 - 27x + 3$ to find all local maximum and minimums.

$h'(x) = -3x^2 + 18x - 27$

$x^2 - 6x + 9 = 0$

$(x - 3)(x - 3) = 0$

$x = 3$

	$(-\infty, 3]$	$[3, \infty)$
f'	$f' < 0$	$f' < 0$

$\boxed{\text{none}}$

7) Starting at a height of 0 feet, a ball is thrown upwards with an initial velocity of 128 feet/sec. The ball's height after t seconds is $s(t) = -16x^2 + 128x$. Find the time when the ball is at its maximum height.

(when $v(t) = 0$)

$v(t) = -32x + 128$

$-32x + 128 = 0$

$x = \boxed{4 \text{ sec.}}$

8) Starting at a height of 2 feet, a ball is thrown upwards with an initial velocity of 96 feet/sec. The ball's height after t seconds is $s(t) = -16x^2 + 96x + 2$. Find the maximum height of the ball.

$v(t) = -32x + 96$

$-32x + 96 = 0$

$x = 3$ sec.

$s(3) = \boxed{146 \text{ ft.}}$

9) Find the intervals on which $h(x) = x^3 - 6x^2 + 9x - 2$ is concave up or down.

10) Find the intervals on which $k(x) = -5x^3 - x^2 + 4x - 4$ is concave up or down.

*Work on next page.

$h'(x) = 3x^2 - 12x + 9$
$h''(x) = 6x - 12$
$6x - 12 = 0$
$x = 2$

f''	$(-\infty, 2]$	$[2, \infty)$
	$f'' < 0$	$f'' > 0$

$\boxed{\text{C.U.}: [2, \infty) \quad \text{C.D.}: (-\infty, 2]}$

$k'(x) = -15x^2 - 2x + 4$
$k''(x) = -30x - 2$
$-30x - 2 = 0$
$x = -\frac{1}{15}$

f''	$(-\infty, -\frac{1}{15}]$	$[-\frac{1}{15}, \infty)$
	$f'' > 0$	$f'' < 0$

$\boxed{\text{C.U.}: (-\infty, -\frac{1}{15}] \quad \text{C.D.}: [-\frac{1}{15}, \infty)}$

11) **Find the intervals on which $y(x) = x^3 - 12x^2 + 45x - 1$ is concave up or down.**

$y'(x) = 3x^2 - 24x + 45$
$y''(x) = 6x - 24$
$6x - 24 = 0$
$x = 4$

f''	$(-\infty, 4]$	$[4, \infty)$
	$f'' < 0$	$f'' > 0$

$\boxed{\text{C.U.}: [4, \infty) \quad \text{C.D.}: (-\infty, 4]}$

12) **Find all inflection points of $y(x) = 3x^4 - 5x^3 + 4x - 2$**

$y'(x) = 12x^3 - 15x^2 + 4$
$y''(x) = 36x^2 - 30x$
$36x^2 - 30x = 0$
$6x(6x - 5) = 0$
$x = 0, \frac{5}{6}$

f''	$(-\infty, 0]$	$[0, \frac{5}{6}]$	$[\frac{5}{6}, \infty)$
	$f'' > 0$	$f'' < 0$	$f'' > 0$

$\boxed{(0, -2) \ \& \ (\frac{5}{6}, -\frac{49}{432})}$

13) **Find all inflection points of $m(x) = x^4 - 2x^3 - 5x - 3$.**

$m'(x) = 4x^3 - 6x^2 - 5$
$m''(x) = 12x^2 - 12x$
$12x^2 - 12x = 0$
$12x(x - 1) = 0$
$x = 0, 1$

f''	$(-\infty, 0]$	$[0, 1]$	$[1, \infty)$
	$f'' > 0$	$f'' < 0$	$f'' > 0$

$\boxed{(0, -3) + (1, -9)}$

14) **Find all inflection points of $r(x) = 3x^5 - 5x^4 + 3x - 3$.**

$r'(x) = 15x^4 - 20x^3 + 3$
$r''(x) = 60x^3 - 60x^2$
$60x^3 - 60x^2 = 0$
$60x^2(x - 1) = 0$
$x = 0, 1$

f''	$(-\infty, 0]$	$[0, 1]$	$[1, \infty)$
	$f'' < 0$	$f'' < 0$	$f'' > 0$

$\boxed{(1, -2)}$

15) **Apply the second derivative test on $w(x) = x^3 - 3x^2 - 24x + 3$ to find all local maximum and minimums.**

$w'(x) = 3x^2 - 6x - 24$
$w''(x) = 6x - 6$

$x^2 - 2x - 8 = 0$
$(x - 4)(x + 2) = 0$
$x = 4, -2$

16) **Apply the second derivative test on $u(x) = -x^2 + 4x + 4$ to find all local maximum and minimums.**

$u'(x) = -2x + 4$
$u''(x) = -2$

$-2x + 4 = 0$
$x = 2$
$u''(2) = -2$

$w''(4) = 18 \qquad w''(-2) = -18$

$\boxed{\text{min.}: (4, -77)} \qquad \boxed{\text{max.}: (-2, 31)}$

$\boxed{\text{max.}: (2, 8)}$