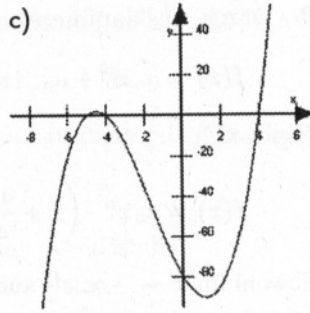
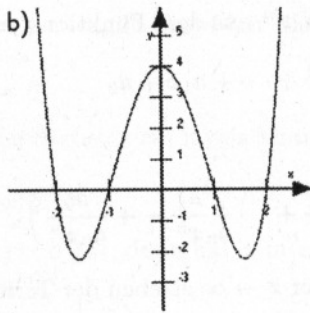
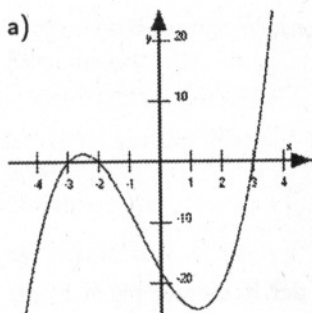


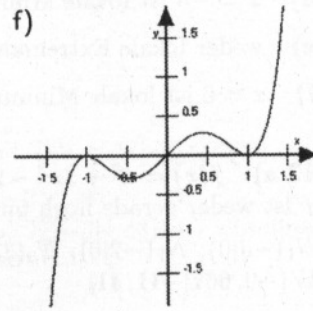
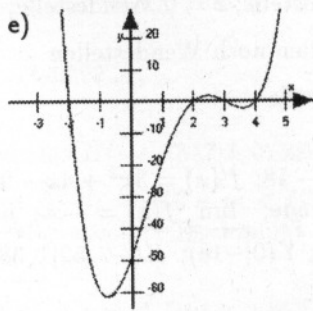
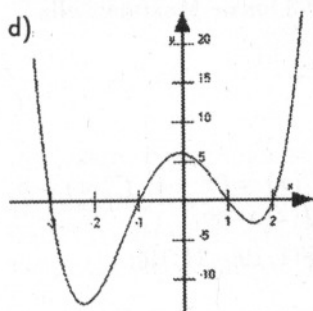
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d) $f(x) = x^4 + x^3 - 7x^2 - x + 6$; $f'(x) = 4x^3 - 14x - 1$; $f''(x) = 12x^2 - 14$; $f'''(x) = 24x$;
 f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = \infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;
 $N_1(-3|0)$; $N_2(-1|0)$; $N_3(1|0)$; $N_4(2|0)$; $Y(0|6)$; $T_1(-2, 25|-12, 95)$; $H(-0, 07|6, 035)$;
 $T_2(1, 57|-2, 88)$; $W_1(-1, 36|-4, 66)$; $W_2(0, 86|1, 16)$

e) $f(x) = x^4 - 7x^3 + 8x^2 + 28x - 48$; $f'(x) = 4x^3 - 21x^2 + 16x + 28$;
 $f''(x) = 12x^2 - 42x + 16$; $f'''(x) = 24x - 42$;
 f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = \infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;
 $N_1(-2|0)$; $N_2(2|0)$; $N_3(3|0)$; $N_4(4|0)$; $Y(0|-48)$; $T_1(-0, 80|-61, 29)$; $H(2, 45|1, 71)$;
 $T_2(3, 60|-2, 15)$; $W_1(0, 44|-34, 85)$; $W_2(3, 065|-0, 33)$

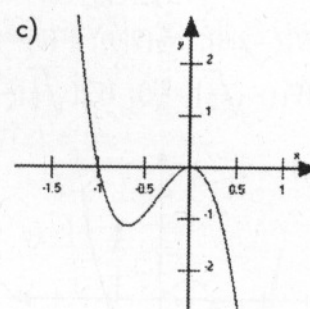
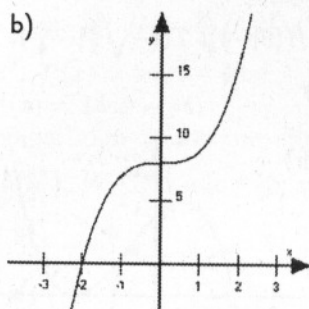
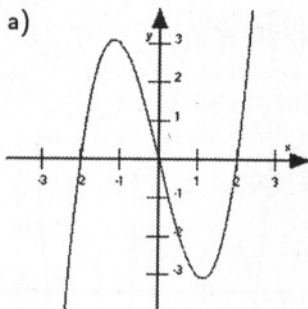
f) $f(x) = x^5 - 2x^3 + x$; $f'(x) = 5x^4 - 6x^2 + 1$; $f''(x) = 20x^3 - 12x$; $f'''(x) = 60x^2 - 12$;
 f ist ungerade; $\lim_{x \rightarrow -\infty} f(x) = -\infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;
 $N_1(0|0)$; $H_1(-1|0)$; $T_1(-0, 45|-0, 29)$; $Y(0|0)$; $H_2(0, 45|0, 29)$; $T_2(1|0)$;
 $W_1(-0, 78|-0, 12)$; $W_2(0|0)$; $W_3(0, 78|0, 12)$



13 a) $f(x) = x^3 - 4x$; $f'(x) = 3x^2 - 4$; $f''(x) = 6x$; $f'''(x) = 6$;
 f ist ungerade; $\lim_{x \rightarrow -\infty} f(x) = -\infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;
 $N_1(-2|0)$; $N_2(0|0)$; $N_3(2|0)$; $Y(0|0)$; $H(-1, 16|3, 08)$; $T(1, 15|-3, 08)$; $W(0|0)$

b) $f(x) = x^3 + 8$; $f'(x) = 3x^2$; $f''(x) = 6x$; $f'''(x) = 6$;
 f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = -\infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;
 $N(-2|0)$; $Y(0|8)$; keine Extrempunkte; $W(0|8)$

- c)** $f(x) = x^4 - 6x^3 - 7x^2$; $f'(x) = 4x^3 - 18x^2 - 14x$; $f''(x) = 12x^2 - 36x - 14$;
 $f'''(x) = 24x - 36$;
 f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = \infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;
 $N_1(-1|0)$; $N_2(7|0)$; $Y(0|0)$; $T_1(-0,68|-1,14)$; $H(0|0)$; $T_2(5,18|-301,8)$;
 $W_1(-0,35|-0,58)$; $W_1(3,35|-178,0)$



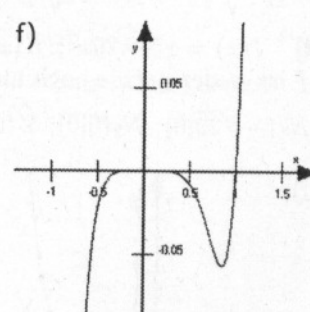
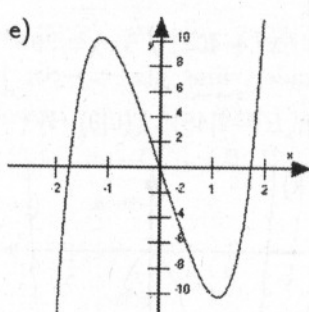
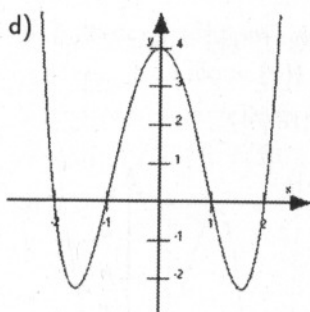
- d)** $f(x) = x^4 - 5x^2 + 4$; $f'(x) = 4x^3 - 10x$; $f''(x) = 12x^2 - 10$; $f'''(x) = 24x$;
 f ist gerade; $\lim_{x \rightarrow -\infty} f(x) = \infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;
 $N_1(-2|0)$; $N_2(-1|0)$; $N_3(1|0)$; $N_4(2|0)$; $Y(0|4)$; $T_1(-1,58|-2,25)$; $H_2(0|4)$;
 $T_2(1,58|-2,25)$; $W_1(-0,91|0,53)$; $W_2(0,91|0,53)$

- e)** $f(x) = x^5 + x^3 - 12x$; $f'(x) = 5x^4 + 3x^2 - 12$; $f''(x) = 20x^3 + 6x$; $f'''(x) = 60x^2 + 6$;
 f ist ungerade; $\lim_{x \rightarrow -\infty} f(x) = -\infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;

- $N_1(-1,73|0)$; $N_2(0|0)$; $N_3(1,73|0)$; $Y(0|0)$; $H(-1,13|10,27)$; $T(1,13|-10,27)$; $W(0|0)$

- f)** $f(x) = x^7 - x^6$; $f'(x) = 7x^6 - 6x^5$; $f''(x) = 42x^5 - 30x^4$; $f'''(x) = 210x^4 - 120x^3$;
 f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = -\infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;

- $N_1(0|0)$; $N_2(1|0)$; $Y(0|0)$; $T(0,86|-0,06)$; keine Wendepunkte



- g)** $f(x) = x^3 - x$; $f'(x) = 3x^2 - 1$; $f''(x) = 6x$; $f'''(x) = 6$;
 f ist ungerade; $\lim_{x \rightarrow -\infty} f(x) = -\infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;

- $N_1(-1|0)$; $N_2(0|0)$; $N_3(1|0)$; $Y(0|0)$; $H(-\frac{1}{3}\sqrt{3}|\frac{2}{9}\sqrt{3})$; $T(\frac{1}{3}\sqrt{3}|-\frac{2}{9}\sqrt{3})$; $W(0|0)$

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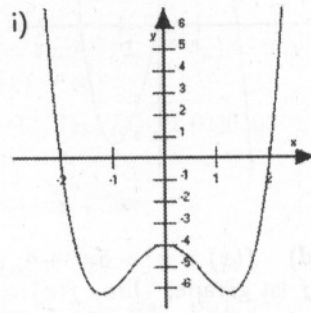
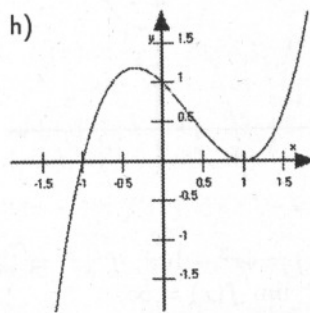
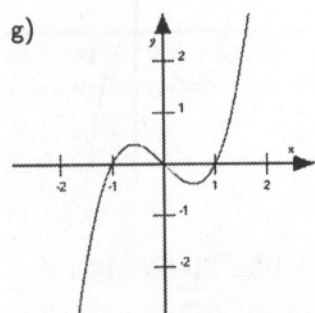
h) $f(x) = x^3 - x^2 - x + 1$; $f'(x) = 3x^2 - 2x - 1$; $f''(x) = 6x - 2$; $f'''(x) = 6$;
 f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = -\infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;

$N_1(-1|0)$; $N_2(1|0)$; $Y(0|1)$; $H(-\frac{1}{3}|\frac{32}{27})$; $T(1|0)$; $W(\frac{1}{3}|\frac{16}{27})$

i) $f(x) = x^4 - 3x^2 - 4$; $f'(x) = 4x^3 - 6x$; $f''(x) = 12x^2 - 6$; $f'''(x) = 24x$;
 f ist gerade; $\lim_{x \rightarrow -\infty} f(x) = \infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;

$N_1(-2|0)$; $N_2(2|0)$; $Y(0|-4)$; $H(0|-4)$; $T_1(-\sqrt{\frac{3}{2}}|-\frac{25}{4})$; $T_2(\sqrt{\frac{3}{2}}|-\frac{25}{4})$;

$W_1(-\sqrt{\frac{1}{2}}|-\frac{21}{4})$; $W_2(\sqrt{\frac{1}{2}}|-\frac{21}{4})$



j) $f(x) = x^3 - 2x^2$; $f'(x) = 3x^2 - 4x$; $f''(x) = 6x - 4$; $f'''(x) = 6$;
 f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = -\infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;

$N_1(0|0)$; $N_2(2|0)$; $Y(0|0)$; $H(0|0)$; $T(\frac{4}{3}|-\frac{32}{27})$; $W(\frac{2}{3}|-\frac{16}{27})$

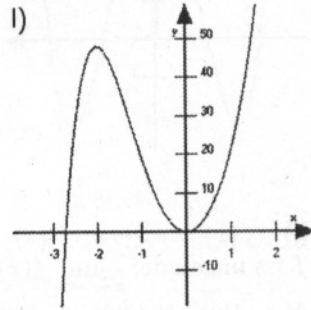
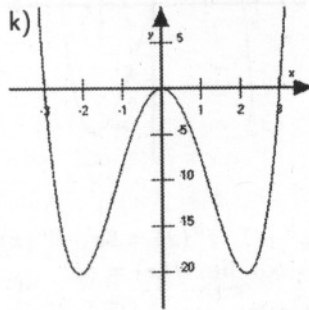
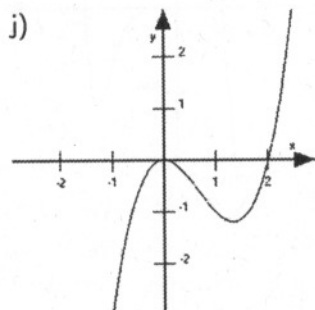
k) $f(x) = x^4 - 9x^2$; $f'(x) = 4x^3 - 18x$; $f''(x) = 12x^2 - 18$; $f'''(x) = 24x$;
 f ist gerade; $\lim_{x \rightarrow -\infty} f(x) = \infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;

$N_1(-3|0)$; $N_2(0|0)$; $N_3(3|0)$; $Y(0|0)$; $H(0|0)$; $T_1(-\frac{3}{2}\sqrt{2}|-\frac{81}{4})$; $T_2(\frac{3}{2}\sqrt{2}|-\frac{81}{4})$;

$W_1(-\sqrt{\frac{3}{2}}|-\frac{45}{4})$; $W_2(\sqrt{\frac{3}{2}}|-\frac{45}{4})$

l) $f(x) = x^5 + 20x^2$; $f'(x) = 5x^4 + 40x$; $f''(x) = 20x^3 + 40$; $f'''(x) = 60x^2$;
 f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = -\infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;

$N_1(-\sqrt[3]{20}|0)$; $N_2(0|0)$; $Y(0|0)$; $H(-2|48)$; $T(0|0)$; $W(-\sqrt[3]{2}|18\sqrt[3]{4})$



m) $f(x) = 2x^3 - x^4$; $f'(x) = 6x^2 - 4x^3$; $f''(x) = 12x - 12x^2$; $f'''(x) = 12 - 24x$;
 f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = -\infty$; $\lim_{x \rightarrow \infty} f(x) = -\infty$;

$N_1(0|0)$; $N_2(2|0)$; $Y(0|0)$; $H(\frac{3}{2}|\frac{27}{16})$; $W_1(0|0)$ mit $f'(0) = 0$; $W_2(1|1)$

n) $f(x) = -x^3 + 3x^2 + x - 3$; $f'(x) = -3x^2 + 6x + 1$; $f''(x) = -6x + 6$; $f'''(x) = -6$;
 f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = \infty$; $\lim_{x \rightarrow \infty} f(x) = -\infty$;

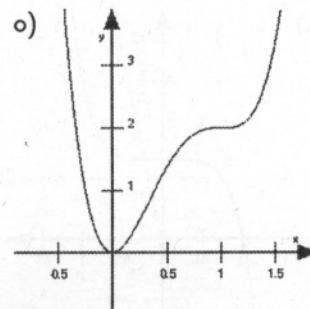
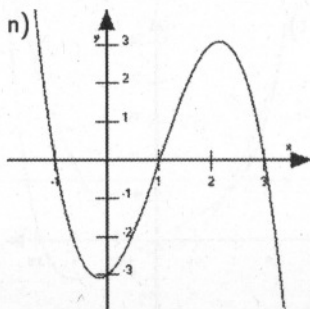
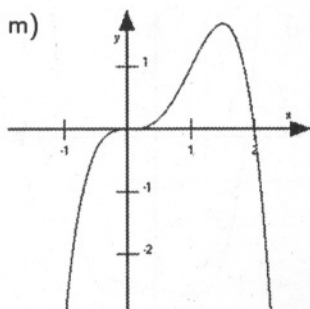
$N_1(-1|0)$; $N_2(1|0)$; $N_3(3|0)$; $Y(0|-3)$; $H(1+\frac{2}{3}\sqrt{3}|\frac{16}{9}\sqrt{3})$; $T(1-\frac{2}{3}\sqrt{3}|-\frac{16}{9}\sqrt{3})$; $W(1|0)$

o) $f(x) = 6x^4 - 16x^3 + 12x^2$; $f'(x) = 24x^3 - 48x^2 + 24x$;

$f''(x) = 72x^2 - 96x + 24$; $f'''(x) = 144x - 96$;

f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = \infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;

$N(0|0)$; $Y(0|0)$; $T(0|0)$; $W_1(\frac{1}{3}|\frac{22}{27})$; $W_2(1|2)$ mit $f'(2) = 0$



p) $f(x) = 0,1x^5 - 1,5x^3$; $f'(x) = 0,5x^4 - 4,5x^2$; $f''(x) = 2x^3 - 9x$; $f'''(x) = 6x^2 - 9$;
 f ist ungerade; $\lim_{x \rightarrow -\infty} f(x) = -\infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;

$N_1(-\sqrt{15}|0)$; $N_2(0|0)$; $N_3(\sqrt{15}|0)$; $Y(0|0)$; $H(-3|\frac{81}{5})$; $T(3|-\frac{81}{5})$;

$W_1(-\frac{3}{2}\sqrt{2}|\frac{567}{80}\sqrt{2})$; $W_2(0|0)$ mit $f'(0) = 0$; $W_3(\frac{3}{2}\sqrt{2}|-\frac{567}{80}\sqrt{2})$

q) $f(x) = x^3 - 7x^2 + 36$; $f'(x) = 3x^2 - 14x$; $f''(x) = 6x - 14$; $f'''(x) = 6$;

f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = -\infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;

$N_1(-2|0)$; $N_2(3|0)$; $N_3(6|0)$; $Y(0|36)$; $H(0|36)$; $T(\frac{14}{3}|-\frac{400}{27})$; $W(\frac{7}{3}|\frac{286}{27})$

r) $f(x) = x^4 - 4x^3 + 27$; $f'(x) = 4x^3 - 12x^2$; $f''(x) = 12x^2 - 24x$; $f'''(x) = 24x - 24$;
 f ist weder gerade noch ungerade; $\lim_{x \rightarrow -\infty} f(x) = \infty$; $\lim_{x \rightarrow \infty} f(x) = \infty$;

$N(3|0)$; $Y(0|27)$; $T(3|0)$; $W_1(0|27)$ mit $f'(0) = 0$; $W_2(2|11)$

