Chap 1: P67~71

1, 8, 9, 13, 21, 25, 27,28,29, 31(a), 38, 46

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1. From [-7,-5], root = -5.7591, 15 iterations.
   From [-5,-3], root = -3.6689, 15 iterations.

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8. From [-7,-5], root = -5.7591 in 5 iterations (versus 15).
   From [-5,-3], root = -3.6689 in 6 iterations (versus 15).

9* The two solutions are x = -5.7591 and x = -3.6689. The tolerance was set at 1E-5:

Regular falsi gets the first root starting from [-6,-4] in 15 iterations; it gets the second from [-4,-2] in 28 iterations.

Bisection gets the first root starting from [-6,-4] in 17 iterations; it gets the second from [-4,-2] in 17 iterations.

The secant method gets the first root starting from [-6,-4] in 4 iterations; it gets the second from [-4,-2] in 3 iterations.

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13. a. $f'(x) = 4x^2 - x*\exp(x^2/2)$.
    b. From $x_0 = 2$ with error < 1E-05: 1.12656 in 4 iterations.
    c. Near the second root (3.08442), the slope is very large and negative so it is impossible to get that root by Newton's method. Even using a starting value of 3.08442, the method converges to the root at 1.122656.
    d. In part (b), successive accurate digits are: 1, 2, 4, 6.

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21. a. P(-1) = -0.9; P'(-1) = -15.8.
    b. The root is -1.057087399. Successive estimates:
       -1.0569620, 4 digits correct.
       -1.0570874, 8 digits correct.
    c. The root is 1.462723639. Successive estimates from x = 1.5:
       1.4638035, 3 digits correct.
       1.4627295, 6 digits correct.
    d. If only four correct digits of the first root are used to reduce, we get 1.46270 versus 1.46273.

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25. a. We can get the root at x = 2 because the function changes sign there; we cannot get the root at x = 4 because the function does not change sign at that point.
    b. The secant method gets both roots.
    c. We get the root at x = 2 from all three methods.

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27. Quadratic convergence is restored with the proper values for k in Eq.(1.7).

$$x_{n+1} = x_n - k * \frac{f(x_n)}{f'(x_n)} = g_k(x_n). \qquad (1.7)$$

28* The convergence is quadratic. starting from $x_0 = 5$, we get

x_n	5	4.55	4.25	4.0792	4.0113	4.00028	4.00000
digits	0	1	1	1	2	4	8?
Ratio of errors		0.55	0.454	0.317	0.143	0.025	?

Applying Newton to P′(x) to find the triple root results in only linear convergence. Quadratic convergence will be obtained if we apply it to P″(x).

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29. a. The plot shows that f(x) and f′(x) are zero at x = 2 and at x = 4.
    b. A single root.
    c. A single root.
    d. A single root at x = 4 but poles at x = 2.2, 2.701, 3.6899.

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31. a. 0.60583.

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38. a. The g(x) converges to 0.41421 in 7 iterations from $x_0 = 1$.
    b. With acceleration, 5 iterations.
    c. The second root is at -2.41421. g(x) does not get this but if g(x) = 1/x - 2, we get the negative root from any x_0 value except $x_0 = 0$.

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46. a. The plot shows an ellipse and a cosine curve that lies only on or above the x-axis. Intersections at about (-0.96, 0.32) and (1.99, 0.17).
    b. (-0.96442, 0.32478) and (1.9908, 0.16624).
    c. Same as for part (b).
    d. Same as for part (b).
    e. When solving for y is difficult (or for x).
