1. $p_2 = 2.60714$

2. $p_2 = -0.865684$; If $p_0 = 0$, $f'(p_0) = 0$ and p_1 cannot be computed.

3. (a) -1.25208
   (b) -0.841355

4. (a) 2.45454
   (b) 2.44444
   (c) Part (a) is better.

5. (a) For $p_0 = 2$, we have $p_5 = 2.69065$.
   (b) For $p_0 = -3$, we have $p_3 = -2.87939$.
   (c) For $p_0 = 0$, we have $p_4 = 0.73909$.
   (d) For $p_0 = 0$, we have $p_3 = 0.96434$.

6. (a) For $p_0 = 1$, we have $p_8 = 1.829384$.
   (b) For $p_0 = 1.5$, we have $p_4 = 1.397748$.
   (c) For $p_0 = 2$, we have $p_4 = 2.370687$; and for $p_0 = 4$, we have $p_4 = 3.722113$.
   (d) For $p_0 = 1$, we have $p_4 = 1.412391$; and for $p_0 = 4$, we have $p_5 = 3.057104$.
   (e) For $p_0 = 1$, we have $p_4 = 0.910008$; and for $p_0 = 3$, we have $p_9 = 3.733079$.
   (f) For $p_0 = 0$, we have $p_4 = 0.588533$; for $p_0 = 3$, we have $p_3 = 3.096364$; and for $p_0 = 6$, we have $p_3 = 6.285049$.

7. Using the endpoints of the intervals as p_0 and p_1, we have:

   (a) $p_{11} = 2.69065$
   (b) $p_7 = -2.87939$
   (c) $p_6 = 0.73909$
   (d) $p_5 = 0.96433$

8. Using the endpoints of the intervals as p_0 and p_1, we have:

   (a) $p_7 = 1.829384$
   (b) $p_9 = 1.397749$
   (c) $p_6 = 2.370687; p_7 = 3.722113$
   (d) $p_8 = 1.412391; p_7 = 3.057104$
   (e) $p_6 = 0.910008; p_{10} = 3.733079$
   (f) $p_6 = 0.588533; p_5 = 3.096364; p_5 = 6.285049$

9. Using the endpoints of the intervals as p_0 and p_1, we have:

   (a) $p_{16} = 2.69060$

   (b) $p_6 = -2.87938$

   (c) $p_7 = 0.73908$

   (d) $p_6 = 0.96433$

10. Using the endpoints of the intervals as p_0 and p_1, we have:

   (a) $p_8 = 1.829383$

   (b) $p_9 = 1.397749$

   (c) $p_6 = 2.370687; p_8 = 3.722112$

   (d) $p_{10} = 1.412392; p_{12} = 3.057099$

   (e) $p_7 = 0.910008; p_{29} = 3.733065$

   (f) $p_9 = 0.588533; p_5 = 3.096364; p_5 = 6.285049$

11. (a) Newton's method with $p_0 = 1.5$ gives $p_3 = 1.51213455$.
    The Secant method with $p_0 = 1$ and $p_1 = 2$ gives $p_{10} = 1.51213455$.
    The Method of False Position with $p_0 = 1$ and $p_1 = 2$ gives $p_{17} = 1.51212954$.

    (b) Newton's method with $p_0 = 0.5$ gives $p_5 = 0.976773017$.
    The Secant method with $p_0 = 0$ and $p_1 = 1$ gives $p_5 = 10.976773017$.
    The Method of False Position with $p_0 = 0$ and $p_1 = 1$ gives $p_5 = 0.976772976$.

12. (a) We have

	Initial Approximation	Result	Initial Approximation	Result
Newton's	$p_0 = 1.5$	$p_4 = 1.41239117$	$p_0 = 3.0$	$p_4 = 3.05710355$
Secant	$p_0 = 1, p_1 = 2$	$p_8 = 1.41239117$	$p_0 = 2, p_1 = 4$	$p_{10} = 3.05710355$
False Position	$p_0 = 1, p_1 = 2$	$p_{13} = 1.41239119$	$p_0 = 2, p_1 = 4$	$p_{19} = 3.05710353$

   (b) We have

	Initial Approximation	Result	Initial Approximation	Result
Newton's	$p_0 = 0.25$	$p_4 = 0.206035120$	$p_0 = 0.75$	$p_4 = 0.681974809$
Secant	$p_0 = 0, p_1 = 0.5$	$p_9 = 0.206035120$	$p_0 = 0.5, p_1 = 1$	$p_8 = 0.681974809$
False Position	$p_0 = 0, p_1 = 0.5$	$p_{12} = 0.206035125$	$p_0 = 0.5, p_1 = 1$	$p_{15} = 0.681974791$

13. For $p_0 = 1$, we have $p_5 = 0.589755$. The point has the coordinates $(0.589755, 0.347811)$.

14. For $p_0 = 2$, we have $p_2 = 1.866760$. The point is $(1.866760, 0.535687)$.

15. The equation of the tangent line is

$$y - f(p_{n-1}) = f'(p_{n-1})(x - p_{n-1}).$$

To complete this problem, set $y = 0$ and solve for $x = p_n$.

16. Newton's method gives $p_{15} = 1.895488$, for $p_0 = \frac{\pi}{2}$; and $p_{19} = 1.895489$, for $p_0 = 5\pi$. The sequence does not converge in 200 iterations for $p_0 = 10\pi$. The results do not indicate the fast convergence usually associated with Newton's method.

17. (a) For $p_0 = -1$ and $p_1 = 0$, we have $p_{17} = -0.04065850$, and for $p_0 = 0$ and $p_1 = 1$, we have $p_9 = 0.9623984$.
    (b) For $p_0 = -1$ and $p_1 = 0$, we have $p_5 = -0.04065929$, and for $p_0 = 0$ and $p_1 = 1$, we have $p_{12} = -0.04065929$.
    (c) For $p_0 = -0.5$, we have $p_5 = -0.04065929$, and for $p_0 = 0.5$, we have $p_{21} = 0.9623989$.

18. (a) The Bisection method yields $p_{10} = 0.4476563$.
    (b) The method of False Position yields $p_{10} = 0.442067$.
    (c) The Secant method yields $p_{10} = -195.8950$.

19. This formula involves the subtraction of nearly equal numbers in both the numerator and denominator if p_{n-1} and p_{n-2} are nearly equal.

20. Newton's method for the various values of p_0 gives the following results.
    (a) $p_8 = -1.379365$
    (b) $p_7 = -1.379365$
    (c) $p_7 = 1.379365$
    (d) $p_7 = -1.379365$
    (e) $p_7 = 1.379365$
    (f) $p_8 = 1.379365$

21. Newton's method for the various values of p_0 gives the following results.

(a) $p_0 = -10, p_{11} = -4.30624527$
(b) $p_0 = -5, p_5 = -4.30624527$
(c) $p_0 = -3, p_5 = 0.824498585$
(d) $p_0 = -1, p_4 = -0.824498585$
(e) $p_0 = 0$, p_1 cannot be computed because $f'(0) = 0$
(f) $p_0 = 1, p_4 = 0.824498585$
(g) $p_0 = 3, p_5 = -0.824498585$
(h) $p_0 = 5, p_5 = 4.30624527$
(i) $p_0 = 10, p_{11} = 4.30624527$

22. The required accuracy is met in 7 iterations of Newton's method.

23. For $f(x) = \ln(x^2 + 1) - e^{0.4x} \cos \pi x$, we have the following roots.

(a) For $p_0 = -0.5$, we have $p_3 = -0.4341431$.
(b) For $p_0 = 0.5$, we have $p_3 = 0.4506567$.
For $p_0 = 1.5$, we have $p_3 = 1.7447381$.
For $p_0 = 2.5$, we have $p_5 = 2.2383198$.
For $p_0 = 3.5$, we have $p_4 = 3.7090412$.
(c) The initial approximation $n - 0.5$ is quite reasonable.
(d) For $p_0 = 24.5$, we have $p_2 = 24.4998870$.

24. We have $\lambda \approx 0.100998$ and $N(2) \approx 2{,}187{,}950$.

25. The two numbers are approximately 6.512849 and 13.487151.

26. The minimal annual interest rate is 6.67%.

27. The borrower can afford to pay at most 8.10%.

28. (a) $\frac{1}{3}e, t = 3$ hours
(b) 11 hours and 5 minutes
(c) 21 hours and 14 minutes

29. (a) First define the function by

$f := x- > 3^{3x+1} - 7 \cdot 5^{2x}$

$$f := x \to 3^{(3x+1)} - 7\ 5^{2x}$$

$solve(f(x) = 0, x)$

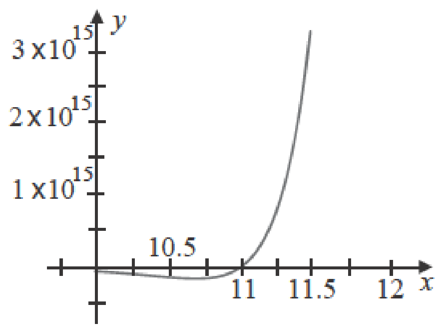
$$-\frac{\ln(3/7)}{\ln(27/25)}$$

$fsolve(f(x) = 0, x)$

$$\text{fsolve}(3^{(3x+1)} - 7\ 5^{(2x)} = 0, x)$$

The procedure *solve* gives the exact solution, and *fsolve* fails because the negative x-axis is an asymptote for the graph of $f(x)$.

(b) Using the Maple command $plot(\{f(x)\}, x = 10.5..11.5)$ produces the following graph.



(c) Define $f'(x)$ using
$fp := x- > (D)(f)(x)$

$$fp := x \to 3\ 3^{(3x+1)} \ln(3) - 14\ 5^{(2x)} \ln(5)$$

$Digits := 18; p0 := 11$

$$\text{Digits} := 18$$

$$p0 := 11$$

for i *from* 1 *to* 5 *do*
$p1 := evalf(p0 - f(p0)/fp(p0))$
$err := abs(p1 - p0)$
$p0 := p1$
od
The results are given in the following table.

i	p_i	$\lvert p_i - p_{i-1} \rvert$
1	11.0097380401552503	.0097380401552503
2	11.0094389359662827	.0002991041889676
3	11.0094386442684488	$.2916978339\ 10^{-6}$
4	11.0094386442681716	$.2772\ 10^{-2}$
5	11.0094386442681716	0

(d) We have $3^{3x+1} = 7 \cdot 5^{2x}$. Taking the natural logarithm of both sides gives

$$(3x+1)\ln 3 = \ln 7 + 2x \ln 5.$$

Thus

$$3x \ln 3 - 2x \ln 5 = \ln 7 - \ln 3, \quad x(3\ln 3 - 2\ln 5) = \ln \frac{7}{3},$$

and

$$x = \frac{\ln 7/3}{\ln 27 - \ln 25} = \frac{\ln 7/3}{\ln 27/25} = -\frac{\ln 3/7}{\ln 27/25}.$$

This agrees with part (a).

30. (a) $solve(2^{x^2} - 3 \cdot 7^{(x+1)}, x)$ fails and $fsolve(2^{x^2} - 3 \cdot 7^{(x+1)}, x)$ returns -1.118747530.

(b) $plot(2^{x^2} - 3 \cdot 7^{(x+1)}, x = -2..4)$ shows there is also a root near $x = 4$.

(c) With $p_0 = 1$, $p_4 = -1.1187475303988963$ is accurate to 10^{-16}; with $p_0 = 4$, $p_6 = 3.9261024524565005$ is accurate to 10^{-16}

(d) The roots are

$$\frac{\ln(7) \pm \sqrt{[\ln(7)]^2 + 4\ln(2)\ln(4)}}{2\ln(2)}.$$

31. We have $P_L = 265816$, $c = -0.75658125$, and $k = 0.045017502$. The 1980 population is $P(30) = 222{,}248{,}320$, and the 2010 population is $P(60) = 252{,}967{,}030$.

32. $P_L = 290228$, $c = 0.6512299$, and $k = 0.03020028$;
The 1980 population is $P(30) = 223,069,210$, and the 2010 population is $P(60) = 260,943,806$.

33. Using $p_0 = 0.5$ and $p_1 = 0.9$, the Secant method gives $p_5 = 0.842$.

34. (a) We have, approximately,

$$A = 17.74, \quad B = 87.21, \quad C = 9.66, \quad \text{and} \quad E = 47.47$$

With these values we have

$$A \sin \alpha \cos \alpha + B \sin^2 \alpha - C \cos \alpha - E \sin \alpha = 0.02.$$

(b) Newton's method gives $\alpha \approx 33.2°$.