# A Book on the fortextbook Option

## The Instructors Edition

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# Contents

# Introduction: Instructor Solution Manual

This document contains the solutions to all problems from the historic textbook *A Book on the fortextbook Option*, by Dr. D. P. Story, *et al*.

In addition to any commented text in the source file of this document, a description of how to create a solution manual may be found in **Chapter 3**, page 35, of *A Book on the fortextbook Option*. You can learn much from reading the source file of this document as well.

You can write introductory text to the **Student Edition** and the **Instructor Edition** in the same source file by using the switch(es) `\ifisinstred` and `\ifisstudented`. If it is not compiled for the instructor edition, then it is compiled for the student edition, so normally, both of these are not needed.

The file itself was compiled using the options

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\textbookOpts{instred,lsols}
```

found in the preamble of this document.

# Chapter 1

# The New eqexam

### 1.1 Setting the page layout

**1. (a)** We have, $3x + 5 = 1 \implies 3x = -4 \implies \boxed{x = -\frac{4}{3}}$

**(b)** We have

$$\begin{aligned} \frac{1}{2}(x+5) &= \frac{1}{3}(2x-1) \\ 3(x+5) &= 2(2x-1) \\ 3x+15 &= 4x-2 \\ x &= 17 \end{aligned}$$

The solution is $\boxed{x = 17}$

**(c)** We first note that $x \neq 2$. We now solve the equation.

$$\begin{aligned} \frac{x}{x-2} + 3 &= \frac{2}{x-2} \\ x + 3(x-2) &= 2 \\ 4x - 6 &= 2 \\ x &= 2 \end{aligned}$$

Since the solution, $x = 2$ is not in the domain of the equation, we conclude that the equation has $\boxed{\text{no solution}}$, or the solution set is $\boxed{S = \emptyset}$

**(d)** We multiply both sides by 21.

$$\begin{aligned} \frac{x+1}{3} + \frac{x+2}{7} &= 2 \\ 7(x+1) + 3(x+2) &= 42 \\ 10x + 13 &= 42 \\ 10x &= 29 \\ x &= \frac{29}{10} \end{aligned}$$

The solution is $\boxed{x = 29/10}$

**2. (a)** $(3 - 4\imath) - (-3 - 7\imath) = 3 - 4\imath + 3 + 7\imath) = 6 + (7 - 4)\imath = \boxed{6 + 3\imath}$

**(b)** $(2 + 3\imath)^2 = 4 + 12\imath + 9\imath^2 = 4 + 12\imath - 9 = \boxed{-5 + 12\imath}$

**(c)** We multiply the numerator and denominator by the complex conjugate of the denominator.

$$\begin{aligned}\frac{2-3\imath}{4+3\imath} &= \frac{2-3\imath}{4+3\imath}\cdot\frac{4-3\imath}{4-3\imath}\\ &= \frac{(2-3\imath)(4-3\imath)}{25}\\ &= \frac{8-6\imath-12\imath-9}{25}\\ &= \frac{-1-18\imath}{25}\end{aligned}$$

**3.** We use standard methods.

$$\begin{aligned}x^2-3x+1 &= 0\\ x^2-3x &= -1\\ x^2-3x+\frac{9}{4} &= -1+\frac{9}{4}\\ (x-\frac{3}{2})^2 &= \frac{5}{4}\\ x-\frac{3}{2} &= \pm\frac{\sqrt{5}}{2}\\ x &= \frac{3}{2}\pm\frac{\sqrt{5}}{2}\end{aligned}$$

The solutions are $\boxed{x = \frac{3}{2}-\frac{\sqrt{5}}{2}, \frac{3}{2}+\frac{\sqrt{5}}{2}}$

**4.** We apply the quadratic formula:

$$\begin{aligned}x &= \frac{4\pm\sqrt{16-4(1)(8)}}{2}\\ &= \frac{4\pm\sqrt{16-32}}{2}\\ &= \frac{4\pm\sqrt{-16}}{2}\\ &= \frac{4\pm 4\imath}{2}\\ &= 2\pm 2\imath\end{aligned}$$

The solutions are $\boxed{x = 2-2\imath,\ 2+2\imath}$.

**5.** We isolate the root on the LHS and square.

$$\begin{aligned}\sqrt{x-1}+7 &= x\\ \sqrt{x-1} &= x-7\\ x-1 &= (x-7)^2\\ x-1 &= x^2-14x+49\\ x^2-15x+50 &= 0\\ (x-5)(x-10) &= 0\end{aligned}$$

The results are $x = 5,\ 10$, but $x = 5$ is an extraneous solution, so the solution set is $\boxed{\{10\}}$.

**6.** Let $u = x+4$, so $u^2-2u-3 = 0$. Factoring we get $(u+1)(u-3) = 0$ Thus $x+4 = -1$ or $x+4 = 3$ or $\boxed{x = -5,\ -1}$.

**7. (a)** A simple linear inequality:

$$\begin{aligned} \frac{1}{3}x - 2 \geq \frac{1}{2}x + 1 & \\ &\implies 2x - 12 \geq 3x + 6 \\ &\implies -x \geq 18 \\ &\implies x \leq -18 \end{aligned}$$

The solution set is $\boxed{S = (-\infty, -18\,]}$

**(b)** A compound linear inequality,

$$\begin{aligned} -1 \leq \frac{3-5x}{2} \leq 9 & \\ &\implies -2 \leq 3 - 5x \leq 18 \\ &\implies -5 \leq -5x \leq 15 \\ &\implies 1 \geq x \geq -3 \quad \text{or} \quad -3 \leq x \leq 1 \end{aligned}$$

The solution set is $\boxed{S = [\,-3, 1\,]}$

**8. (a)** We use standard methods,

$$\begin{aligned} |2-x| &= |2x| \\ 2 - x = 2x \quad &\text{or} \quad 2 - x = -2x \\ 3x = 2 \quad &\text{or} \quad x = -2 \\ x = 2/3 \quad &\text{or} \quad x = -2 \end{aligned}$$

The solutions are $\boxed{x = 2/3,\ -2}$

**(b)** We use standard techniques,

$$\begin{aligned} |x - 4| &\leq 6 \\ -6 \leq x - 4 &\leq 6 \\ -2 \leq x &\leq 10 \end{aligned}$$

The solution is $\boxed{S = [\,-2, 10\,]}$

**(c)** We use standard methods again.

$$\begin{aligned} |2x + 1| &> 4 \\ 2x + 1 > 4 \quad &\text{or} \quad 2x + 1 < -4 \\ 2x > 3 \quad &\text{or} \quad 2x < -5 \\ x > 3/2 \quad &\text{or} \quad x < -5/2 \end{aligned}$$

Solution: $\boxed{S = (-\infty, -5/2) \cup (3/2, +\infty)}$

**9.** We first find how much was invested in each account. Let $x$ = amt invested at 6%, so $4900 - x$ was invested at 8%. The problem states that

$$.06x = .08(4900 - x) \implies .06x = 392 - .08x \implies 0.14x = 392 \implies x = 2800.$$

So, Mr. Gilg invested \$2800 at 6% and earned \$168 (\$168 = .06 · \$2800). The interest earned for the other account was the same as the first, so he earned \$168 there too. The total interest earned then by the famous Mr. Gilg is $\boxed{I = \$168 + \$168 = \$336}$

**10.** Note that the coefficients of $y$ are equal but opposite in sign. So we will use the *elimination method* and add the two equations together to get $5x = -5$, so $x = -1$. Substituting this into the first equation, we get $y = 2 - 2(-1) = 4$. The point of intersection of these two lines is $\boxed{(\,-1, 4\,)}$.

### 1.2 Another Section

**1. (a)** We use the distance formula:

$$d(P,Q) = \sqrt{(2+4)^2 + (-3-2)^2} = \sqrt{61}$$

**(b)** We use the midpoint formula:

$$M = \left(\frac{-4+2}{2}, \frac{2+(-3)}{2}\right) = \left(-1, -\frac{1}{2}\right)$$

**2.** For the $x$-intercepts, we set $y = 0$: $x^2 - 6x + 8 = 0 \implies (x-2)(x-4) = 0 \implies x = 2,\ 4$

**3.** We complete the square:

$$\begin{aligned} x^2 + y^2 - 4x + 12y = -1 &\implies (x^2 - 4x + 4) + (y^2 + 12y + 36) = -1 + 4 + 36 \\ &\implies \boxed{(x-2)^2 + (y+6)^2 = 39} \end{aligned}$$

**4. (a)** We calculate the slope of a line.

$$m = \frac{-2-4}{-4-(-9)} = -\frac{6}{5}$$

**(b)** Use the point-slope form: $y - 2 = \frac{1}{3}(x+3) \implies y = \frac{1}{3}x + 3$

**(c)** The given line has slope $m = -\frac{1}{2}$ and the target line must pass through $(-3,0)$, so our equation is $y - 0 = -\frac{1}{2}(x+3) \implies y = -\frac{1}{2}x - \frac{3}{2}$

**5. (a)** We have, $f(2) = \dfrac{2}{2^2+1} = \dfrac{2}{5}$

**(b)** We have, $f(-3) = \dfrac{-3}{(-3)^2+1} = \dfrac{-3}{9+1} = -\dfrac{3}{10}$

**(c)** We have, $f(2x) = \dfrac{2x}{(2x)^2+1} = \dfrac{2x}{2x^2+1}$

**(d)** We perform the usual tests.

$$f(-x) = \frac{-x}{(-x)^2+1} = -\frac{x}{x^2+1} = -f(x)$$

The function is odd.

**6. (a)** Because of the square root function, we require $3 - x \geq 0$, or $x \leq 3$. In interval notation, the domain is $(-\infty, 3\,]$

**(b)** The denominator is factored into $(x+1)(x-1)$; as a result, the domain consists of all numbers $x$ except where the denominator is zero. From the factorization, we see that the domain is $\{\, x \mid x \neq -1, x \neq 1\,\}$, or in interval notation, we have $(-\infty, -1) \cup (-1, 1) \cup (1, +\infty)$

# Chapter 2

# The fortextbook option

## 2.1 Building a sound foundation

**1. (a)** We have

$$(fg)(-2) = f(-2)g(-2) = (-5)(3) = -15$$

**(b)** We have

$$\left(\frac{g}{f}\right)(x) = \frac{g(x)}{f(x)} = \frac{2x^2-5}{4x+3}$$

**(c)** Composing, $(f \circ f)(x) = f(f(x)) = f(4x+3) = 4(4x+3)+3 = 16x+15$

**(d)** Composing, $(f \circ g)(x) = f(g(x)) = f(2x^2-5) = 4(2x^2-5)+3 = 8x^2-17$

**2.** It is clear that if $f(x) = \sqrt[4]{x}$ and $g(x) = 3x^2+1$, then $H(x) = (f \circ g)(x)$. Another choice is $f(x) = \sqrt[4]{3x+1}$ and $g(x) = x^2$.

**3.** Let $f$ be an invertible function. Suppose $f(-2) = 17$. Find $f^{-1}(17) = \boxed{-2}$; consequently, we have $(f^{-1} \circ f)(-2) = \boxed{-2}$.

**4. (a)** Removing the functional notation, we have, $y = 1 - \dfrac{1}{x}$. Interchange the roles of $x$ and $y$, and solve for $y$. We have...

$$\begin{aligned} x &= 1 - \frac{1}{y} && \text{interchange } x \text{ and } y \\ \frac{1}{y} &= 1 - x && \text{add } 1/y \text{ and subtract } x\text{, both sides} \\ y &= \frac{1}{1-x} && \text{take reciprocal both sides} \\ g^{-1}(x) &= \frac{1}{1-x} && x \neq 1, \quad \text{use functional notation} \end{aligned}$$

**(b)** $\operatorname{Rng}(g) = (-\infty, 1) \cup (1, \infty)$

**5.** $f(x) = a(x-h)^2 + k$ is the standard form. With the vertex information, we have $f(x) = a(x-2)^2$, we need only find the value of $a$. For that we use the point $P$: $3 = a(4-2)^2 \implies 4a = 3 \implies a = 3/4$. The final form for the function is $f(x) = \frac{3}{4}(x-2)^2$

**6.** We use the vertex formula, $h = -b/(2a) = -(-8)/4 = 2$, and so $h = f(2) = 8 - 16 + 5 = -3$.

**7.** We use the vertex formula, $h = -b/(2a) = -(-1)/2 = 1/2$. A **minimum** occurs since the leading coefficient is positive, which means the parabola opens up, the vertex is a minimum.

**8.** For a polynomial of degree 12, according to theory, the maximum number of zeros is 12, and the maximum number of turning points is 11.

**9.** List the *horizontal asymptotes* (H.A.) and the *vertical asymptotes* (V.A.) of the rational function below, and label each vertical asymptote as *even* or *odd*.

$$f(x) = \frac{2x^4 - 3x^2}{(x+3)^2(x^2-4)}$$

H.A.: $\boxed{y = 2}$ V.A.: $\boxed{x = -3 \text{ (even)}, x = -2 \text{ (odd)}, x = 2 \text{ (odd)}}$

**10. (a)** We have $y = \dfrac{k}{x}$, but $8 = \dfrac{k}{2} \implies k = 16$. thus, $y = \dfrac{16}{x}$.

**(b)** We have $z = kx^2\sqrt{y}$, but $9 = k2^2\sqrt{4} \implies 9 = 8k \implies k = 9/8$; thus $y = \dfrac{9}{8}x^2\sqrt{y}$.

### 2.2 Another awesome section

**1. (a)** $f(x) = 3^{1-x}$, $f(3.2) = 0.089$

**(b)** $f(x) = e^{x/2}$, $f(4.2) = 8.166$

**(c)** $f(x) = -\left(\dfrac{1}{2}\right)^{x+1}$, $f(-3.5) = -5.657$

**2.** We have $2^{-x+1} = 2^4 \implies -x + 1 = 4 \implies x = -3$

**3.** Convert $81^{1/2} = 9$ into a logarithmic form. It is apparent that, $\log_{81}(9) = 1/2$

**4. (a)** $\log_4(x) = -2 \implies x = 4^{-2} = \boxed{1/16}$

**(b)** $\log_{16}(\sqrt{x-1}) = \dfrac{1}{4} \implies \sqrt{x-1} = 16^{1/4} \implies \sqrt{x-1} = 2 \implies x - 1 = 4 \implies \boxed{x = 5}$

**5.** We require $x - 4 > 0$ or that $x > 4$.

**6. (a)** We use one of the basic log properties: $a^{\log_a(x)} = x$. So here $4^{\log_4(1.4)} = 1.4$.

**(b)** We use the basic identity again, $a^{\log_a(x)} = x$: $e^{\ln(2x+1)} = 11 \implies 2x + 1 = 11 \implies x = 5$

**7. (a)** $\log_4(16x^8) = \boxed{2 + 8\log_4(x)}$

We use the properties of logarithms:

$$\log_4(16x^8) = \log_4(16) + 8\log_4(x) = \log_4(4^2) + 8\log_4(x) = \boxed{2 + 8\log_4(x)}$$

**(b)** We have,

$$\log\left(\sqrt{\frac{x}{4}}\right) = \log\left(\frac{x}{4}\right)^{1/2} = \frac{1}{2}\log\left(\frac{x}{4}\right) = \boxed{\frac{1}{2}(\log(x) - \log(4))}$$

**(c)** We use the properties of logarithms:

$$\log\frac{x(x-1)^4}{(x+1)^3} = \log(x(x-1)^4) - \log(x+1)^3 = \log(x) + \log(x-1)^4 - 3\log(x+1)$$
$$= \boxed{\log(x) + 4\log(x-1) - 3\log(x+1)}$$

**8. (a)** $\log_7(12) - \log_7(x) = \log_7\left(\dfrac{12}{x}\right)$

**(b)** $\dfrac{1}{2}(\log(x) + 3\log(y)) = \dfrac{1}{2}(\log(x) + \log(y^3)) = \dfrac{1}{2}\log(xy^3) = \log(xy^3)^{1/2}$

**9. (a)** $\log(310.4) \approx \boxed{2.4919}$

**(b)** $\ln(310.4) \approx \boxed{5.7379}$

**(c)** $\log_3(11.4) \approx \boxed{2.2172}$

**(d)** $\log_{1/2}(11.4) \approx \boxed{-3.5110}$

**10. (a)** We use standard techniques, take logs of both sides, and solve for $x$.

$$5^{2x} = 7.3 \implies \ln 5^{2x} = \ln 7.3 \implies 2x \ln 5 = \ln 7.3 \implies \boxed{x = \frac{\ln 7.3}{2\ln 5} \approx 0.6176}$$

**(b)** We use standard techniques, take logs of both sides, and solve for $x$.

$$2^x = 3^{x+1} \implies \ln 2^x = \ln 3^{x+1} \implies x\ln 2 = (x+1)\ln 3 \implies x\ln 2 = x\ln 3 + \ln 3$$

$$\implies x(\ln 2 - \ln 3) = \ln 3 \implies \boxed{x = \frac{\ln(3)}{\ln(2) - \ln(3)} \approx -2.7095}$$

**11. (a)** $\log_5(2x-1) = 1.1 \implies 2x - 1 = 5^{1.1} \implies \boxed{x = \dfrac{1+5^{1.1}}{2} \approx 3.4365}$

**(b)** We have,

$$\log_2(x-1) - \log_2(x-2) = 3 \implies \log_2 \frac{x-1}{x-2} = 3 \implies \frac{x-1}{x-2} = 2^3$$

$$\implies x - 1 = 8(x-2) \implies x - 1 = 8x - 16 \implies 15 = 7x \implies \boxed{x = \frac{15}{7} \approx 2.1429}$$

**2.3 One more time!**

1. Recall the point $(\cos(x), \sin(x))$ lies on the unit circle, hence, the point satisfies the equation $\sin^2(x) + \cos^2(x) = 1$.
2. If we divide both sides of $\sin^2(x) + \cos^2(x) = 1$ by $\cos^2(x)$, we obtain the identity $\tan^2(x) + 1 = \sec^2(x)$.
3. If we divide both sides of $\sin^2(x) + \cos^2(x) = 1$ by $\sin^2(x)$, we obtain the identity $1 + \cot^2(x) + 1 = \csc^2(x)$.
4. Take the addition formula for the sine function,

$$\sin(x+y) = \sin(x)\cos(y) + \cos(x)\sin(y)$$

and put $x = y$ to obtain the required equation: $\sin(2x) = 2\sin(x)\cos(x)$.

5. Take the addition formula for the cosine function,

$$\cos(x+y) = \sin(x)\sin(y) - \cos(x)\cos(y)$$

and put $x = y$ to obtain the basic equation, $\cos(2x) = \cos^2(x) - \sin^2(x)$. Now substitute $\sin^2(x) = 1 - \cos^2(x)$ into this equation to obtain $\cos(2x) = 2\cos^2(x) - 1$; substitute $\cos^2(x) = 1 - \sin^2(x)$ into the first equation, we obtain the last variation, $\cos(2x) = 1 - 2\sin^2(x)$

6. The addition formula for tangent is

$$\tan(x+y) = \frac{\tan(x) + \tan(y)}{1 - \tan(x)\tan(y)}$$

Now, setting $y = x$, we obtain, $\tan(2x) = \dfrac{2\tan(x)}{1 - \tan^2(x)}$

7. $\sinh(x) = (e^x - e^{-x})/2$
8. $\cosh(x) = (e^x + e^{-x})/2$

**2.4 Once more, once!**

**1. (a)** The function $f(x) = (4.3)^x$ is an exponential function with a base of $a =$ __4.3__ .

**(b)** __T__ (T or F) One of the properties of logarithms is $\log_a(x) - \log_a(y) = \log_a(x/y)$

**(c)** The correct alternative is , the domain of $f(x) = \log_a(x)$ is $\text{Dom}(f) =$ .

**(d)** The inverse of the function $f(x) = 7^x$ is $f^{-1}(x) =$ $\log_7(x)$____.

**Demo Problem Set**

**1.** Solve the equation $2x + 5 = -2$ for $x$. Indeed,

$$\begin{aligned} 2x + 5 &= -2 && \text{given} \\ 2x &= -7 && \text{subtract 5 both sides} \\ x &= \boxed{-\frac{7}{2}} && \text{divide by 3 both sides} \end{aligned}$$

**2.6 Review Exercises**

**Section 2.2**

**1. (a)** We have

$$\begin{aligned} \frac{1}{2}(x+5) &= \frac{1}{3}(2x-1) \\ 3(x+5) &= 2(2x-1) \\ 3x + 15 &= 4x - 2 \\ x &= 17 \end{aligned}$$

The solution is $\boxed{x = 17}$

**(b)** We have,

$$6x + 5 = 3x + 1 \implies 3x = -4 \implies \boxed{x = -\frac{4}{3}}$$

**2.** We use standard methods.

$$\begin{aligned} x^2 - 3x + 1 &= 0 \\ x^2 - 3x &= -1 \\ x^2 - 3x + \frac{9}{4} &= -1 + \frac{9}{4} \end{aligned} \qquad \begin{aligned} (x - \frac{3}{2})^2 &= \frac{5}{4} \\ x - \frac{3}{2} &= \pm\frac{\sqrt{5}}{2} \\ x &= \frac{3}{2} \pm \frac{\sqrt{5}}{2} \end{aligned}$$

The solutions are $\boxed{x = \frac{3}{2} - \frac{\sqrt{5}}{2}, \frac{3}{2} + \frac{\sqrt{5}}{2}}$

**3. (a)** A simple linear inequality:

$$\begin{aligned} &\frac{1}{3}x - 2 \ge \frac{1}{2}x + 1 \\ &\implies 2x - 12 \ge 3x + 6 \\ &\implies -x \ge 18 \\ &\implies x \le -18 \end{aligned}$$

The solution set is $\boxed{S = (-\infty, -18\,]}$

**(b)** We use standard techniques,

$$\begin{aligned} |x-4| &\le 6 \\ -6 \le x-4 &\le 6 \\ -2 \le x &\le 10 \end{aligned}$$

The solution is $\boxed{S = [\,-2, 10\,]}$

**4.** The given line has slope $m = -\frac{1}{2}$ and the target line must pass through $(-3, 0)$, so our equation is $y - 0 = -\frac{1}{2}(x+3) \implies y = -\frac{1}{2}x - \frac{3}{2}$

**Section 2.3**

**5. (a)** We use standard methods.

$$\begin{aligned} &f(x) = 3 - 5x \implies y = 3 - 5x \\ &\implies x = 3 - 5y \implies 5y = 3 - x \\ &\implies y = \frac{3-x}{5} \implies \boxed{f^{-1}(x) = \frac{3-x}{5}} \end{aligned}$$

**(b)** We use standard methods.

$$\begin{aligned} &f(x) = 6x^3 + 2 \implies y = 6x^3 + 2 \\ &\implies x = 6y^3 + 2 \implies 6y^3 = x - 2 \\ &\implies y = \sqrt[3]{\frac{x-2}{6}} \implies \boxed{f^{-1}(x) = \sqrt[3]{\frac{x-2}{6}}} \end{aligned}$$

**6. (a)** We have...

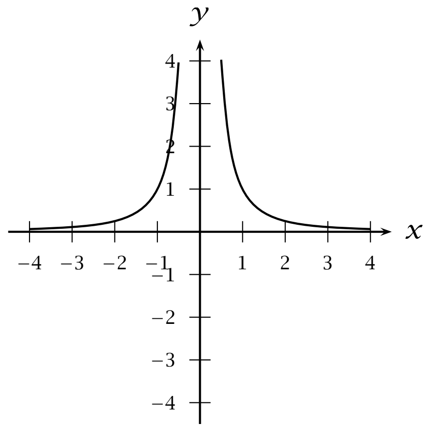
$$\begin{aligned} &9^{2x} = 27 \implies 3^{4x} = 3^3 \\ &\implies 4x = 3 \implies \boxed{x = 3/4} \end{aligned}$$

**(b)** We have...

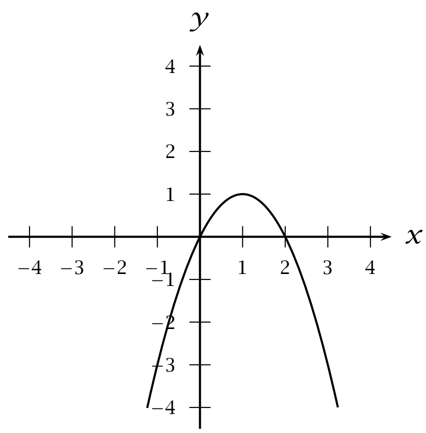
$$\begin{aligned} &x + 1 = -4x \implies 5x = -1 \\ &\implies \boxed{x = -1/5} \end{aligned}$$

**Chapter 2. Chapter Quiz**

**1. (a)** Graph $f(x) = \dfrac{1}{x^2}$.




**1. (b)** Graph $f(x) = 1 - (x - 1)^2$.




**2. (a)** We have

$$\left(\frac{g}{f}\right)(x) = \frac{g(x)}{f(x)} = \frac{2x^2 - 5}{4x + 3}$$

**(b)** Composing,

$$\begin{aligned}(f \circ g)(x) &= f(g(x)) = f(2x^2 - 5)\\ &= 4(2x^2 - 5) + 3\\ &= \boxed{8x^2 - 17}\end{aligned}$$

**3.** For a polynomial of degree 17, according to theory, the maximum number of zeros is __17__, and the maximum number of turning points is __16__.

**4.** Removing the functional notation, we have, $y = 3x + 2$. Interchange the roles of $x$ and $y$, and solve for $y$. We have...

$$\begin{aligned} x &= 3y + 2 && \text{interchange } x \text{ and } y \\ 3y &= x - 2 && \text{subtract 2, both sides} \\ y &= \frac{x-2}{3} && \text{divide by 3} \\ g^{-1}(x) &= \frac{x-2}{3} && \text{use functional notation} \end{aligned}$$

The domain is $(-\infty, \infty)$.

**5.** We use the vertex formula, $h = -b/(2a) = -(-8)/4 = 2$, and so $h = f(2) = 8 - 16 + 5 = -3$. The coordinates of the vertex is then $V(2, -3)$. Because the coefficient of $x^2$ is positive, the parabola opens up, which implies the vertex is a *minimum*.

**6.** We have $y = \dfrac{k}{x}$, but $8 = \dfrac{k}{4} \implies k = 32$. thus, $y = \dfrac{32}{x}$.

**7. (a)** We use the properties of logarithms:

$$\begin{aligned} \log \frac{x(x-1)^4}{(x+1)^3} &= \log(x(x-1)^4) - \log(x+1)^3 = \log(x) + \log(x-1)^4 - 3\log(x+1) \\ &= \boxed{\log(x) + 4\log(x-1) - 3\log(x+1)} \end{aligned}$$

**(b)** We use the properties of logarithms.

$$\frac{1}{2}(\log(x) + 3\log(y)) = \frac{1}{2}(\log(x) + \log(y^3)) = \frac{1}{2}\log(xy^3) = \log(xy^3)^{1/2}$$

**8. (a)** We use standard techniques, take logs of both sides, and solve for $x$.

$$5^{2x} = 7.3 \implies \ln 5^{2x} = \ln 7.3 \implies 2x \ln 5 = \ln 7.3 \implies \boxed{x = \frac{\ln 7.3}{2\ln 5} \approx 0.6176}$$

**(b)** We solve by converting log to exponential.

$$\log_5(2x - 1) = 1.1 \implies 2x - 1 = 5^{1.1} \implies \boxed{x = \frac{1 + 5^{1.1}}{2} \approx 3.4365}$$