A Book on the **fortextbook** Option
The **fortextbook** Package

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Contents

Chapter 1

The New **eqexam**

The eqexam package was originally designed for the creation of tests (exams), quizzes, or homework assignments for a paper document. Later, it was extended to an interactive feature that could, in theory, be used for online testing. In both cases, the page layout of an eqexam document tries to use the maximum amount of white space a paper setting has to offer.

In recent months, I was determined to change the formatting so that eqexam can be easily be incorporated into a textbook (paper or PDF) or an online tutorial; with this new formatting scheme and the fortextbook option, eqexam can be used for support of problems, sample tests, quizzes, in a textbook. The eqexam package, with fortextbook option, the provides many of the common features associated with a textbook:

- For the *student edition*, answers/short solutions to the *odd numbered problems* appear in the back of the book. The .sol file, which contains all the solutions, can be used as a basis for creating a separate solutions manual to the odd-numbered problems.

- For the *instructor edition*, answers/short solutions to *all* problems can appear in the back of the book. Answers can appear *in-line* or in the *margins*, for easy reference by the instructor. The .sol file, which contains all the solutions, can be used as a basis for creating a separate solutions manual (an instructor solution manual) for all problems.

In the sections that follow, we discuss in detail the features of the new eqexam. This document is not only the test document for the new eqexam, it is also the documentation.

1.1 Setting the page layout

With Version 3.0, you can design your own page layout scheme, perhaps to conform to a book style. The following are some basics on formatting for eqexam.

Very Cool!

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The following two commands appear in eqexam, the first set sets some basic page parameters.

```
\newcommand{\eqeSetExamPageParams}{%
    \setlength{\headheight}{12pt}
    \setlength{\topmargin}{-.5in}
    \setlength{\headsep}{20pt}
    \setlength{\oddsidemargin}{0pt}
    \setlength{\evensidemargin}{0pt}
    \setlength{\marginparsep}{11pt}
    \setlength{\marginparwidth}{35pt}
    \setlength{\footskip}{11pt}
}
```

The second command sets some parameters based on the first the setting of the first command.

```
\newcommand{\eqExamPageLayout}{%
    \setlength\textwidth\paperwidth
    \addtolength{\textwidth}{-2in}
    \addtolength{\textwidth}{-\oddsidemargin}
    \setlength\textheight{\paperheight}
    \addtolength\textheight{-2in}
    \addtolength\textheight{-\headheight}
    \addtolength\textheight{-\headsep}
    \addtolength\textheight{-\topmargin}
    \addtolength\textheight{-\footskip}
}
```

The usecustomdesign option

When the package option usecustomdesign *is not taken,* then the two commands \eqeSetExamPageParams and \eqExamPageLayout are executed immediately after the above definitions. These are the original parameters used by eqexam, designed to yield a maximum text body in which to typeset an exam. The margins are set at 1 inch, the \topmargin is raised up, all to maximize space.

For this document, the book class supplied the format.

Now, if the package option usecustomdesign is specified, the commands \eqeSetExamPageParams and \eqExamPageLayout are *not executed*, the package designer can either do a \renewcommand for these two commands in the preamble with custom values inserted (and execute the commands \eqeSetExamPageParams and \eqExamPageLayout), or the designer may use another package to set the page layout parameters (or take the default of the class being used). In the latter case, neither command \eqeSetExamPageParams nor \eqExamPageLayout should be executed.

The following commands directly effect how the problems are displayed within an eqexam environment.

```
\eqexammargin{00}
```

The command \eqexammargin is a convenient way of specifying the list parameter \labelwidth, as set by the eqequestions environment (see below).

Very Cool!

The command uses `\settowidth` to set the `\eqemargin` length. The length `\eqemargin` may also be set directly with `\setlength`. The `\eqexammargin` command may be executed anytime between exam environments (or even between problems, though this is not an intuitive option). Normally it is executed once for the entire document; but may be executed multiple times to change margins.

Finally, the `eqequestions` environment encloses each of the environments `problem` and `problem*`. This is a list environment defined below.

```
\newenvironment{eqequestions}{%
    \begin{list}{}{%
        \setlength{\labelwidth}{\eqemargin}%
        \setlength{\topsep}{3pt}\setlength{\parsep}{0pt}%
        \setlength{\itemindent}{0pt}%
        \setlength{\itemsep}{3pt}%
        \setlength{\leftmargin}{\labelwidth}%
        \settowidth{\labelsep}{\ }%
    }\item\relax}{\end{list}}
```

This environment is opened at the beginning of a `problem` (`problem*`), and closed at the end of these environments. Normally, the document author does not use this environment directly, but can redefine it by resetting its defining parameters.

The `fortextbook` option, yet to be discussed, has certain features discussed earlier, one such is answers to the problem sets can appear in the margins, as they do in this document. The questions themselves are taken from old tests of mine.

The `eqexam`, for the `fortextbook` option, defines a simple `example` environment, which may be redefined as needed.

Example 1.1. This is example.

Solution: This is the solution to the example. □

Example 1.2. This is example.

Solution: This is the solution to the example. □

Following is our first problem set, it illustrate one of the features of `eqexam`, the display of answers in the margins.

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Problem Set 1.1

Solve each of the following problems, without error. It is important to work the problem first, before daring to look in the back of the book.

1. Solve each of the following equations.

(a) $3x + 5 = 1$

(b) $\dfrac{1}{2}(x + 5) = \dfrac{1}{3}(2x - 1)$

(c) $\dfrac{x + 1}{3} + \dfrac{x + 2}{7} = 2$

(d) $\dfrac{x}{x - 2} + 3 = \dfrac{2}{x - 2}$

2. Evaluate each of the following complex expressions.

(a) $(3 - 4\imath) - (-3 - 7\imath)$

(b) $(2 + 3\imath)^2$

(c) $\dfrac{2 - 3\imath}{4 + 3\imath}$

3. Solve the equation $x^2 - 3x + 1 = 0$ using the *method of completing the square*.

4. Solve the equation $x^2 - 4x + 8 = 0$ using the *quadratic formula*. Simplify your final answer.

5. Solve $\sqrt{x - 1} + 7 = x$

6. Solve $(x + 4)^2 - 2(x + 4) - 3 = 0$

7. Solve each of the inequalities, and leave your answer in interval notation.

(a) $\dfrac{1}{3}x - 2 \geq \dfrac{1}{2}x + 1$

(b) $-1 \leq \dfrac{3 - 5x}{2} \leq 9$

8. Solve each of the following involving absolute values.

(a) $|2 - x| = |2x|$

(b) $|x - 4| \leq 6$

(c) $|2x + 1| > 4$

9. Mr. Gilg invested \$4900, part at a 6% interest rate, the rest at 8%. If the yearly interest on each is the same, how much interest does he receive at the end of the year?

10. Solve the system of linear inequalities $\begin{cases} x + y \leq 2 \\ x - y \geq -1 \end{cases}$ using graphical methods. Present your solution in the form of the empty set, $\emptyset$, or as a set of ordered pairs, for example $\{(1, 2)\}$.

Note that the answers to these problem sets appear in the margin, *and they flow over from the previous page*, as needed. This document is compiled with the `instred` and `marginsans`, resulting in the answers so placed. More on this in the Chapter 2, page 11.

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Problem Set 1.2
1. (a) $\sqrt{61}$
   (b) $(-1, -1/2)$
2. $x = 2, \ 4; \ y = 8$
3. $(x-2)^2 + (y+6)^2 = 39$
4. (a) $-6/5$
   (b) $y = \frac{1}{3}x + 3$
   (c) $y = -\frac{1}{2}x - \frac{3}{2}$
5. (a) $2/5$
   (b) $-3/10$
   (c) $\dfrac{2x}{4x^2 + 1}$
   (d) odd function

1.2 Another Section

We begin another section, for no apparent reason. Let's have another problem section as well.

Example 2.1. This is example.

Solution: This is the solution to the example. □

eqexam has an `exercise` environment it inherits from `exerquiz`; as a result, it is easy to define an `example` environment, based on the `exercise` environment.

Example 2.2. This is example.

Solution: This is the solution to the example. □

Example 2.3. This is example.

Solution: This is the solution to the example. □

Problem Set 1.2

Solve each of the following problems, without error. It is important to work the problem first, before daring to look in the back of the book.

1. Let $P(-4, 2)$ and $Q(2, -3)$ be two points in the plane.
   (a) Find the distance $d(P, Q)$ between P and Q.
   (b) Find the midpoint M between P and Q.
2. Find the x- and y-intercepts of the equation $y = x^2 - 6x + 8$. List intercepts as a comma-delimited list (for example, $x = 1, 2$).
3. Given the equation $x^2 + y^2 - 4x + 12y + 1 = 0$ of a circle. Put this equation into standard form (center-radius form).
4. Answer each of these questions about lines.
   (a) Given the two points $P(-9, 4)$ and $Q(-4, -2)$, find the *slope of the line* passing through these two points.
   (b) Find the equation of the line with slope of $1/3$ and passing through the point $P(-3, 2)$. Present your answer in the *slope-intercept form*.
   (c) Find the equation (in slope-intercept form) of the line that crosses the x-axis at $x = -3$ and is parallel to the $2x + 4y = 3$
5. Calculate each of the following for the function $f(x) = \dfrac{x}{x^2 + 1}$.
   (a) $f(2)$ (b) $f(-3)$ (c) $f(2x)$
   (d) Is this function an *even* or *odd* function, or is it neither?
6. Find the domain of each of the functions, leave your answer in *interval notation*.

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(a) $f(x) = \sqrt{3 - x}$

(b) $g(x) = \dfrac{x}{x^2 - 1}$

Problem Set 1.2 (cont.)

6. (a) $(-\infty, 3\,]$
   (b) $(-\infty, -1) \cup (-1, 1) \cup (1, +\infty)$

Very Cool!
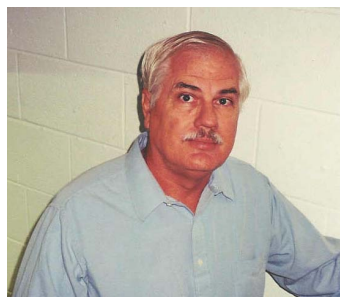
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This is some marginal content that may be entered. Perhaps, a historical sketch of the image above. Whatever annotations are needed. This mechanism is different from the command `\marginpar`. I did use `\marginpar` back on page 6; however the margin should be clear of other marginal content.

Problem Set 2.1

1. (a) -15

   (b) $\dfrac{2x^2 - 5}{4x + 3}$

   (c) $16x + 15$

   (d) $8x^2 - 17$

Chapter 2

The `fortextbook` option

The `fortextbook` option provides a number of features of value to textbook authors: (1) For the instructor edition, answers can be placed in a wide margin, or inline; (2) short or long solutions can be provided (short solutions appear in the back of the book, the long used as part of a solutions manual); (3) the (short) solutions appear at the end of the document, but it is possible to have the solutions appear at the end of each chapter; (4) compiling of the solutions while writing the book can be turned off (this reduces compile time); (5) marginal content is automatically carried over to the next page; and much more.

2.1   A new section

Notice that in addition to the answers to a problem set appearing in the margins, we can also write to the margins, or place other content such as an image or graph. Material will flow over to the following page if there is too much content for the current margin.

Problem Set 2.1

Normally, a problem set would begin a new page, in this document we do not follow that convention.

Solve each of the following problems, without error. It is important to work the problem first, before daring to look in the back of the book.

1. Let $f(x) = 4x + 3$ and $g(x) = 2x^2 - 5$. Compute each of the following, simplify were appropriate.

(a) $(fg)(-2)$

(b) $\left(\dfrac{g}{f}\right)(x)$

(c) $(f \circ f)(x)$

(d) $(f \circ g)(x)$

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Problem Set 2.1 (cont.)

2. $f(x) = \sqrt[4]{x}$,
$g(x) = 3x^2 + 1$

3. $f^{-1}(17) = -2$,
$(f^{-1} \circ f)(-2) = -2$

4. (a) $g^{-1}(x) = \dfrac{1}{1-x}$,
$x \neq 1$

(b) $(-\infty, 1) \cup (1, \infty)$

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

6. $h = 2, k = -3$

7. f has a minimum at
$x = 1/2$

8. 12, 11

9. H.A.: $y = 2$;
V.A.: $x = -3$ (even),
$x = -2$ (odd), $x = 2$,
(odd)

10. (a) $y = \dfrac{16}{x}$

(b) $z = \frac{9}{8}x^2\sqrt{y}$

---

2. Decomposition. Define two functions f and g so that the function $H(x) = \sqrt[4]{3x^2 + 1}$ can be written as a composition of f with g, that is, define functions so that $H(x) = (f \circ g)(x)$.

3. Let f be an invertible function. Suppose $f(-2) = 17$. Calculate the values of $f^{-1}(17)$ and $(f^{-1} \circ f)(-2)$.

4. Define a function $g(x) = 1 - \dfrac{1}{x}$, $x \neq 0$.

(a) Find the inverse of g, and state its domain (in interval notation).

(b) Give the range of the function g in interval notation.

5. Find the equation of the quadratic function $y = f(x)$ that has vertex at $V(2, 0)$ and passing through the point $P(4, 3)$. (Hint: Start the standard form for a quadratic function.)

6. Use the **vertex formula** to find the x-coordinate, h, and the y-coordinate, k, of the quadratic function $f(x) = 2x^2 - 8x + 5$.

7. Using the vertex formula, find and classify the extrema of the function function $f(x) = x^2 - x + 1$.

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

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*.

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

10. Solve each of the variation problems.

(a) Suppose y varies inversely with x, and when $x = 2$, $y = 8$. Write the equation that describes this relationship exactly.

(b) Suppose z varies jointly with the square of x and the square root of y, and when $x = 2$ and $y = 4$, $z = 9$. Write the equation that describes this relationship exactly.

Notice that the answers from the problems on the previous page continues onto this page, and there is an automatically generated heading to guide the reader.

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2.2 Another awesome section

Let's have a short section here.

Problem Set 2.2

Starting a problem set on a new page is a wise strategy for another reason; if the author want to use `\marginpar` through the document (as I have), separating the problems sets, which (may) use the option of placing answers in the margins, from the body of the text, which may use `\marginpar`, keeps the two routines for writing to the margins separate.

Solve each of these problems, being sure not to error.

1. **Simple Evaluations.** Evaluate each of the following.
   (a) $f(x) = 3^{1-x}$, calculate $f(3.2)$
   (b) $f(x) = e^{x/2}$, calculate $f(4.2)$
   (c) $f(x) = -\left(\dfrac{1}{2}\right)^{x+1}$, calculate $f(-3.5)$

2. Solve the exponential equation: $2^{-x+1} = 16$.

3. **Simple Conversion.** Convert $81^{1/2} = 9$ into a logarithmic equation.

4. **Solving (simple).** Solve each equation for x (by converting each logarithmic equation into an exponential form.
   (a) $\log_4(x) = -2$
   (b) $\log_{16}(\sqrt{x-1}) = \dfrac{1}{4}$

5. State the domain of the function $f(x) = \ln(x-4)$, present your answer using interval notation.

6. Perform the indicated operations.
   (a) Evaluate $4^{\log_4(1.4)}$
   (b) Solve for x: $e^{\ln(2x+1)} = 11$

7. Write each expression in *expanded form*.
   (a) $\log_4(16x^8)$
   (b) $\log\left(\sqrt{\dfrac{x}{4}}\right)$
   (c) $\log\dfrac{x(x-1)^4}{(x+1)^3}$

8. Write each expression in *condensed form*.
   (a) $\log_7(12) - \log_7(x)$
   (b) $\dfrac{1}{2}\big(\log(x) + 3\log(y)\big)$

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Problem Set 2.2 (cont.)

9. (a) 2.4919
   (b) 5.7379
   (c) 2.2172
   (d) −3.5110

10. (a) $\dfrac{\ln(7.3)}{2\ln(5)} \approx 0.6176$

    (b) $\dfrac{\ln(3)}{\ln(2) - \ln(3)} \approx$
    -2.7095

11. (a) $\dfrac{1 + 5^{1.1}}{2}$, 3.4365

    (b) $\dfrac{15}{7} \approx 2.1429$

9. Numerically evaluate each of the following logarithms; round your answers to 4 decimal places.

   (a) $\log(310.4)$ (c) $\log_3(11.4)$

   (b) $\ln(310.4)$ (d) $\log_{1/2}(11.4)$

10. **Exponential Equations.** Solve for x in each of the following exponential equation. Represent your answer as an algebraic express, and a numerical approximation.

    (a) $5^{2x} = 7.3$

    (b) $2^x = 3^{x+1}$

11. **Logarithmic Equations.** Solve for x in each of the following exponential equation. Represent your answer as an algebraic express, and a numerical approximation.

    (a) $\log_5(2x - 1) = 1.1$

    (b) $\log_2(x - 1) - \log_2(x - 2) = 3$

2.3 Illustrating the `inlineans` option

The new `eqexam` can optionally display the answers to the problems (for the instructor edition) in-line. Here, `marginans` is manually turned off and `inlineans` is manually turned on. Normally, one would use one or the other for the entire document. We do it here to demonstrate the other option in the same document.

Problem Set 2.3

This is an exercise set. Note that the answers are displayed in blue immediately following the question. This method could potentially create different page breaks between the student edition and the instructor edition. Of course, the answers can be moved by hand (using TEX/LATEX command elsewhere if a different page break is encountered.

1. State the fundamental trigonometric identity for the sine and cosine function! $\sin^2(x) + \cos^2(x) = 1$
2. State the fundamental trigonometric identity relating the secant and the tangent functions. $\tan^2(x) + 1 = \sec^2(x)$
3. State the fundamental trigonometric identity relating the cosecant and the cotangent functions. $1 + \cot^2(x) + 1 = \csc^2(x)$
4. State the double angle formula for the sine function, that is express $\sin(2x)$ in terms of $\sin(x)$ and $\cos(x)$. $\sin(2x) = 2\sin(x)\cos(x)$
5. State the double angle formula, with all its variations, for the cosine function. $\sin(2x) = \cos^2(x) - \sin^2(x) = 2\cos^2(x) - 1 = 1 - 2\sin^2(x)$

Discussion
Margin material inserted by the `\insMidMarg` command flows to the next page. We can leave a `\mark` to give

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Discussion (cont.)

the text that has been split off to the next page a heading. Did it work?

Problem Set 2.4

1. (a) 4.3
   (b) T
   (c) (B) $(0, \infty)$
   (d) $f^{-1}(x) = \log_7(x)$

New Feature
Recently, 2011/05/27, I made a modification how the problems are formatted in the margin. For problems with parts, now, only the problem number for part (a) a appears, see above. This brings up a new problem, however, that I haven't been able to solve in an automated way; what if the margin is split between parts, on the next page, the answer appears without the problem number. We can overcome this manually by inserting `\global\eqeGenProbNumtrue` into the margin stream between parts. This will cause the problem number to appear once.

6. Use the addition formula for the tangent function to derive its double angle. $\tan(2x) = 2\tan(x)/(1 - \tan^2(x))$
7. State the definition of the hyperbolic sine function in terms of the natural exponential function. $\sinh(x) = (e^x - e^{-x})/2$
8. State the definition of the hyperbolic cosine function in terms of the natural exponential function. $\cosh(x) = (e^x + e^{-x})/2$

Some rewording of the questions were necessary here so the answer, which follows the question, does not create an additional line.

Now that the `inlineans` option is demonstrated, let's turn it off and turn `marginans` back on.

2.4 Once more, once!

This section is to illustrate fill-in, true/false, and multiple choice. For the instructor edition, the answers appear inline (and in the margins, if `marginans` is in effect).

Problem Set 2.4

1. **Short Responses.** Answer each of the following, none of the problems shown below requires any calculations. Respond to True/False questions with T (for True) or F (for False).

   (a) The function $f(x) = (4.3)^x$ is an exponential function with a base of $a = \underline{\quad 4.3 \quad}$.

   (b) $\underline{\quad T \quad}$ (T or F) One of the properties of logarithms is $\log_a(x) - \log_a(y) = \log_a(x/y)$.

   (c) Let $f(x) = \log_a(x)$, then the domain of this function, in interval notation, is

   (A) $(1, \infty)$ (✔) $(0, \infty)$

   (C) $(-\infty, \infty)$ (D) $(-\infty, 0) \cup (0, \infty)$

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

I should remind the reader that the (short) solutions to the problems are at the end of the book, as usual, see solutions in Appendix A, page 43.

2.5 Technical Details

In this section we get into the technical details of the `fortextbook` option.

Very Cool!

2.5.1   The `fortextbook` options

Begin by takin the `fortextbook` option in the `eqexam` option list. The preamble for this document says,

```
\usepackage[
    fortextbook,usecustomdesign,
    ftbsolns, % vspacewithsolns,
%    nosolutions,
    forcolorpaper,noseparationrule,usexkv
]{eqexam}
```

As of this writing, the above are the recommended options for the `fortextbook` option. Obviously, we take the `fortextbook` option, and others...

- Use the `fortextbook` option and the `usecustomdesign` which signals `eqexam` not to interfere with the page layout.

- `ftbsolns` (an alias for the original option `vspacewithsolns`) puts the solutions at the end of the document, fills in the multiple choice and fill in the blank questions. **Note:** The `solution` environment has an optional parameter (vertical skip). This option will cause `eqexam` to leave that space; this is undesirable for the `fortextbook` option, so never specify a value a value for the optional parameter. To avoid errors, use `\begin{solution}[]` or `\begin{solution}\relax`. It is safe to use `\begin{solution}` only if there is nothing to expand; LATEX will expand tokens looking for a left bracket (`[`).

- The `nosolutions` option, commented out here may be used to prevent the inputting of the solutions at the end of the document. The method `eqexam` uses is IO intensive, using this option while writing the book will speed up compile time. If you uncomment `nosolutions`, you must comment out `ftbsolns`.

- `forcolorpaper` allows for a book in color.

- `noseparationrule` turns off a rule that appears at the end of each `exam` environment, not appropriate for a book

- `usexkv` is not exactly required. With this option, additional features of the `\fillin` command are read in.

The fortextbook package

The `eqexam` package comes with a small style file, `fortextbook.sty` that is a simple wrapper package that incorporates all the above discussed option. Using this package file, we can say,

```
\usepackage{fortextbook}
```

Any additional eqexam option you want to use are passed from the fortextbook package to the `eqexam` package. Should you want to use the nosolutions option, as discussed above, to reduce the IO while writing the text of the book, you can specify `\NoSolutions` in the preamble.

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eqexam allows for two sets of solutions, long and short. More on this later.

Options `fortextbook`. There are several `fortextbook` options that are set through the command `\textbookOpts` placed in the preamble:

- `\textbookOpts{studented}` is the option for the *student edition*. When compiled with `studented`, no answers appear in the margins on in-line. Only the *odd-numbered short solutions* appear at the end of the book. The option `studented` is the *default*; if no option is given, the student edition is compiled.[1]

- `\textbookOpts{instred}` is the option for the *instructor edition*. Without further options, the answers neither appear in-line nor in the margins. The short solutions to *all problems* appear in the back of the book.

  There are two options relevant to the `instred` option:

  - `marginsans`: If this Boolean key appears, the answers appear in the margins, just as they to in this document. This document has

        \textbookOpts{instred,marginans}

    preamble.
  - `inlineans`: If this Boolean key appears, the answers appear in-line, as they did section 2.3, page 14

- `marginsonleft`: eqexam has a Boolean switch, `\ifmarginsonleft`, its default value is `false`; when `false`, the marginal stack alternates between left (for even numbered pages) and right (for odd numbered pages). If this key is used, it sets the Boolean to `true`, in which case the marginal stack appear on the left on all pages.

- `showssols`: If this key is specified, only the short solutions will appear in the back of the book. This is the default.

- `showlsols`: If this key is specified, the long solutions appear in the back of the book. This option is useful for building the `.sol` file populated with the long solutions to each problem. The file may then be renamed, and compiled separately to form the basis of a solution manual for the student or the instructor.

2.5.2 The `probset` Environment

Each problem set is enclosed in an `probset` environment; `probset` is a renaming of the `exam` environment, which has been defined in the eqexam package for many years.

    \newenvironment{probset}[2][\probSet{\thesection}]{%
        \exam[#2]{\autoExamName}\insProbHead{#1}}{\endexam}

`probset` is the `exam` environment with the parameters changed a little. The first optional parameter is the title heading of the problem set that will appear in the margins if the book is compiled with the `instred` and `marginans` options, the default is `\probSet{\thesection}`,

---

[1]This is a footnote.

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Demo Problem Set

1. $-7/2$

```
\newcommand{\probSet}[1]{Problem Set #1}
```

`\probset` may be redefined. The second required parameter is the title heading that appear in the solutions pages at the end of the book.

After you write a question, you need to supply an *answer*, a *short solution* and a *long solution*—assuming you have the energy to do so. The **Demo Problem Set** illustrates this.

Demo Problem Set

Below is a brief example of a short problem set.

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

```
1   \begin{probset}[Demo Problem Set]
2       {Demo Problem Set\annotPage}
3   \begin{problem}
4   Solve the equation $ 2x + 5 = -2 $ for $x$. \ANS{$-7/2$}
5   \begin{solution}[]
6   \begin{ssol}
7   $ 2x + 5 = -2 \implies 2x = -7 \implies x = -7/2 $
8   \end{ssol}
9   \begin{lsol}
10  Solve the equation $ 2x + 5 = -2 $ for $x$. Indeed,
11  \begin{alignat*}{2}
12      2x + 5 &= -2     \qt{given}\\
13          2x &= -7     \qt{subtract $5$ both sides}\\
14           x &= \boxed{-\frac{7}{2}}
15                       \qt{divide by $3$ both sides}
16  \end{alignat*}
17  \end{lsol}
18  \end{solution}
19  \end{problem}
20  \end{probset}
```

Comments:

- In lines (1) and (2), we start the `probset` environment, giving titles to the margin heading and the solutions heading. The command `\annotPage` expands to `\annotThePage{\thepage}`. The default definition of which is

    ```
    \newcommand\annotThePage[1]{\space(page~#1)}
    ```

  This command may be used, redefined, or not used at all. If you are building a solution manual, you can define

    ```
    \renewcommand\annotThePage[1]{}
    ```

  so there is no page numbers in the solution manual that refers back to a specific page in the textbook.

Very Cool!

The **\ANS** command is used to give an answer. Its behavior depends on the options used.

- We start the problem (environment) in line (3), pose the question in line (4). At the end of the question, also on line (4), is the answer the the problem, `\ANS{$-7/2$}`. The `\ANS` command is required for all problems were you want an answer to appear in the instructor edition.

  When `inlineans` is used, `\ANS{$-7/2$}` simply expands to its argument `$-7/2$`, it appear at the place where `\ANS` is placed. In the end times, you can manually move it around to avoid a page break, like

  `\raisebox{-3pt}{\smash{\ANS{$-7/2$}}}`

  or something like that.

  When `marginans` is in effect, the `\ANS` command make a contribution to the marginal material, and make no appearance in-line.

  There is also a star version `\ANS*`. There is no change in the behavior for the `marginans` option, but for `inlineans` it suppresses the expansion of the inline answer. This was used in this document in **Problem Set 2.4** on page 15. Those questions were fill-in, multiple choice, and true/false types; the answers appear naturally in the spaces provided.

The `solution` is a wrapper environment for the short and long solutions

- Line (5) says `\begin{solution}[]`. As mentioned earlier, there is an optional parameter, and LATEX will start looking for it. In the case of this example, if the empty `[]` brackets were not here, we would get a compile error because LATEX would expand the `\begin{ssol}` looking for a left bracket.

  For lines (5)–(18) we have the solution environment. It can contain two other solution environments, the `ssol` environment, for short solutions to appear in the back of the text, and the `lsol` environment, for long solutions that are to appear in a stand-alone solutions manual (for instructor or student).

The `ssol` and `lsol` environments are comment environments.

- The `ssol` and `lsol` environments are comment environments. We can include them or exclude them. That's what the option `showssol` and `showlsol` do. It is arranged that both do not normally included together, but they can.

Let's review, with details.

1. `\insProbHead[⟨mark_text⟩]{⟨head_text⟩}` sets the header text to the answers to the problem sets that appear in the margins. The optional argument is used for setting mark text if the text flows over to the next page. If this argument is not specified,

   ⟨head_text⟩`\space\tbcontinued`

   is used. This header does not appear unless the document is compiled under the `instred` and `marginans` assumptions. The insertion of this command is automatic when the `probset` environment is used.

2. `\insMargHead[⟨mark_text⟩]{⟨head_text⟩}` places header text in the margins. The optional argument is used for setting the mark text if the

Very Cool!

text overflows over to the next page. If this argument is not specified, ⟨*head_text*⟩ is used. This header appears even for the student edition.

3. `\tbMarginHeaderFmt` is the format for the header, the default is black and bold. The ⟨*head_text*⟩ had no formatting, the formatting is provided by `\tbMarginHeaderFmt`.

   ```
   \definecolor{HEADERcolor}{named}{black}
   \newcommand\tbMarginHeaderFmt[1]{%
        \textcolor{\tb@MHC}{\textbf{#1}}}
   ```

   The command `\tb@MHC` expands to the color to be used for the margin headers. The default is the color `HEADERcolor`, defined as black, but may be redefined. The command `\tb@MHC` is a convenience used to change the color.

   ```
   \cngMargHeadColorTo{⟨named_color⟩}
   \resetMargHeadColor
   ```

   The first command is used to change the color of the headers to another color, the second is to reset it back to its default (`HEADERcolor`).

   Use the two above commands to change the margin header color once for problem sets, like so

   ```
   \cngMargHeadColorTo{red}
   \begin{probset}{A Problem Set}
   \resetMargHeadColor
   ...
   \end{probset}
   ```

4. For the headers, `\tbPreMarginHeader` is execute just before the header.

   ```
   \newcommand\tbPreMarginHeader{%
        \par\penalty-200\vskip0pt plus 24pt
        \kern3pt\noindent\strut}
   ```

5. `\tbPostMarginHeader` is executed just after the header

   ```
   \newcommand\tbPostMarginHeader{\par\nobreak\vskip0pt}
   ```

6. `\definecolor{MidMargcolor}{rgb}{0,0,.8}`: The color of content created by `\insMidMarg`.

7. The `ssol` and `lsol` are used to enclose a short (long) solution to a problem. If the solution environment does not contain either of these two environment, then the contents of the solution environment will appear for both options, `showssols` and `showlsols`.

8. `\ANS{⟨ans⟩}` is used to give the answer that will appear in the margins or in-line. Verbatim text cannot appear as an argument of `\ANS`. There is also `\ANS*`, which suppresses the inline answer.

   - `\definecolor{ANScolor}{rgb}{0,0,.8}` is the default color for the in-line answers.
   - `\newcommand{\ANSFmt}[2]{\textcolor{ANScolor}{#2}}`
     The default formatting for the in-line answers. Note that the first parameter passed to `\ANSFmt` is the problem number, in the code, we have

Very Cool!

```
\ifisinlineans\ANSFmt{\theeqquestionnoi}{#1}\fi
```
We include the problem number in case future application requires it be available.

There are a two other variations on \ANS. The first one is for designating ranges of labels; the second one is used for grouping of items

\ANS[⟨*num*⟩] labels a range of parts.

- \ANS has an optional parameter that takes a value of a positive integer; when present, the labeling of the marginal answers (only) is changed to a range of items. For example, \ANS[2] produces (a)–(c), if this optional argument occurs in item (a); it produces (b)–(d), if this optional argument occurs in item (b). See the marginal answer for Problem 1(a) of **Problem Set 2.5**, page 13. The code there is
  ```
  \ANS[2]{$0.089$, $8.166$, $-5.657$, respectively}
  ```

\bGrpANS/\eGrpANS sets up a grouping of items

- \bGrpANS/\eGrpANS sets up a grouping of items. See the margin answer for **Problem Set 2.5**, Problem 1(a), page 8. The code these, in outline form is
  ```
  \bGrpANS{$-4/3$}
  ...
  \ANS{$17$}
  ...
  \eGrpANS{$29/10$}
  ```
  All the answers from the item corresponding to \bGrpANS and through the item \eGrpANS are listed together in the line corresponding to the \bGrpAns item, is that clear?

2.5.3   The Margin Stack

There is a \parbox that is created to hold the marginal content generated by the commands of the fortextbook option. Its width is \tbmarparboxwidth (set using the \marparboxwidth command, see Section 2.5.4, page 24 for a discussion) and its height is \textheight. The formatting for this box is defined by the command \MarParBoxFmt. These latter command can be redefined to suite your needs, see its definition in eqexam.dtx.

There are three levels in the margins:

1. **Top level**: The top level is determined by the expansion of the command \tbTopMargin, which may be redefined between pages. It should have the width of the \parbox that contains all the content of the margin, this width is \tbmarparboxwidth. The content *must* be unbreakable across pages. The expansion of \tbTopMargin will appear *on every page subsequent to its definition.*

   \clearTopMargin is used to clear the top level. Clearing will take effect on the following page.

   \setTopMargin{⟨*content*⟩} is a convenience macro to create top margin content. Redefinitions will appear on the next page from where the definition was made.

Very Cool!

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`\restoreLastTopMargin` restores the previous definition of the top margin. It may be that you want to clear the top margin for a number of pages, then restore the top margin that was defined before you executed `\clearTopMargin`. This command is used in this document.

2. **Middle level**: The middle level is the most interesting. You write to it using `\insMidMarg`. Normally, this is text. If there is too much text, it will be split off and placed in the middle level of the next page. The command `\ANS` also writes to the middle level when the `instred` and `marginans` options are taken.

Margin text that has been inserted using `\insMidMarg` is carried over to the margin on the next page, as needed. This can cause problems if the color of the text has been changed from the default color, `Mid-Margcolor`, to some other color; the carryover text on the next page will be colored `MidMargcolor`. A workaround to this problem is to use the `carryoverFmt` environment, as seen in the margin, partial source code is seen below.

```
1   \insMargHead[Carryover \tbcontinued]{Carryover Problem}
2   \insMidMarg{\begin{carryOverFmt}{\normalcolor}}
3   \insMidMarg{This material has been colored black, which
4   is different from the default color of blue.
5   ...
6   Did it work? \mark{}\par\medskip}
7   \insMidMarg{\end{carryOverFmt}}
8   \insMidMarg{This is still part of the carryover, it is
9   outside the group so the color should be back to the
10  default.}
```

In line (2), we open the `carryOverFmt` environment, and specify as its one required argument, a font declaration, `\color{black}`. If things work out, `eqexam` will insert this carryover font declaration at the top of the next page.

In line (8) we close the `carryOverFmt` environment.

The above code can be combined more stylistically as follows:

```
\insMargHead[Carryover \tbcontinued]{Carryover Problem}
\insMidMarg
{%
    \begin{carryOverFmt}{\normalcolor}
        This material has been colored black, which
        is different from the default color of blue.
        ...
        Did it work?\mark{}
    \end{carryOverFmt}\par\medskip
    This is still part of the carryover, it is outside
    the group so the color should be back to the default.
}
```

The argument for the `carryOverFmt` may be most any declaration, for example, on page 15 we have

```
\begin{carryOverFmt}{\bfseries\small\color{red}}
```

Carryover Problem
This material has been colored black, which is different from the default color of blue. If this paragraph is long enough, it will carry over to the next page. Normally, the text will be the default color, blue, on the next page, but we use

Very Cool!

Carryover (cont.)

the `carryoverFmt` environment to fix this problem. Did it work?

This is still part of the carryover, it is outside the group so the color should be back to the default.

This mid-marginal note is not part of the carryover from the previous page, hopefully it is the default color.

Important. The `carryOverFmt` workaround breaks down if marginal content, emitted from a single page, crosses two page boundaries. Such long marginal content need to be broken up over several pages.

3. **Bottom level**: This is similar to the top level, but on the bottom. The command is named `\tbBotMargin` and follows the same rules as `\tbTopMargin`. Again, the content of `\tbBotMargin` will appear *on every page subsequent to its definition*.

    `\clearBotMargin` clears the bottom level. Clearing will take effect on the following page.

    `\setBotMargin{⟨content⟩}` is a convenience macro to create bottom margin content. Redefinitions will appear on the next page from where the definition was made.

    `\restoreLastBotMargin` restores the previous definition of the bottom margin. It may be that you want to clear the bottom margin for a number of pages, then restore the bottom margin that was defined before you executed `\clearBotMargin`. This command is used in this document.

For this document, the the following declarations were made:

```
\setTopMargin{\parbox[t]{\tbmarparboxwidth}{%
    \edef\logoalign{\ifmarginsonleft l\else
        \ifodd\value{page}r\else l\fi\fi}%
    \makebox[\linewidth][\logoalign]
        {\includegraphics[%
            width={.67\linewidth}]{graphics/AeST_Logo}}%
}}
\setBotMargin{\edef\logoalign{\ifmarginsonleft l\else
    \ifodd\value{page}r\else l\fi\fi}%
    \makebox[\linewidth][\logoalign]
        {\LARGE\textbf{\textcolor{red}{Very Cool!}}}%
}
```

The first command puts a logo at the top of the margin on every page, beginning with page 5 where it was declared. The second command puts some text at the bottom of the margin stack; I used a `\vfill` to force the text to the very bottom of the margin, otherwise it would appear just below the last text of the middle level. **Note:** I've made the bold and color local by putting the text in a group.

The three layers are separated by some glue determined by the length `\tbminskipbtnlayers`, its definition is

```
\setlength{\tbminskipbtnlayers}{6pt}
```

This may be reset using `\setlength`.

At the beginning of the appendix, you will find

```
\clearTopMargin
\clearBotMargin
```

which turns off the top and bottom levels. You can still write to the middle layer, if so moved.

Very Cool!

2.5.4   Setting things up

Now for the hard part, the page layout. We need to define the width of the marginal \parbox that encloses all the marginal material,[2] and make all necessary calculations to locate the position of this marginal box.

The simplest case, is really simple; in the preamble place the command

> \marparboxwidth{⟨*parbox_width*⟩}

Execution of this command is required. For this document, we have

> \marparboxwidth{1.75in}

in the preamble. This command does two things: (1) it sets the length \tb-marparboxwidth which it the internal dimension for the marginal \parbox; (2) it executes the command \tbMakeFinalCalcs. The latter command, executes two other commands, \tbSetupForMargins and \tbplaceMargins. The definition are given below.

There is a switch \ifmarginsonleft, if true, the margin annotation only appear on the left side of each page (I have seen textbooks constituted this way); if false, as it is for this document, the margins are on the right for odd numbered pages, and on the left otherwise.

```
1   \newcommand{\tbSetupForMargins}{%
2       \ifmarginsonleft
3           \setlength{\oddsidemargin}
4             {\tbmarparboxwidth+\marginparsep}
5           \setlength{\evensidemargin}{\oddsidemargin}
6           \setlength{\textwidth}
7             {\paperwidth-2in-\oddsidemargin}
8       \else
9           \setlength{\oddsidemargin}{0pt}
10          \setlength{\evensidemargin}{%
11            \tbmarparboxwidth+\marginparsep}
12          \setlength{\textwidth}{%
13            \paperwidth-2in-\oddsidemargin-\evensidemargin}
14      \fi
15  }
```

Note that in lines (3) and (10), we calculate the side margins (\oddside-margin in the first case, \evensidemargin in the second) to be the sum of the lengths

> \tbmarparboxwidth+\marginparsep

The value of \marginparsep must be set already when \marparboxwidth is executed in the preamble.

The other command \tbSetupForMargins attempts to calculate the correct location of the marginal \parbox.

---

[2]Contributed via the commands \setTopMargin, \setBotMargin (for the top and bottom level recurring material), and \insMidMarg, \insProbHead, and \insMargHead (middle level).

Very Cool!

```
1  \newcommand{\tbplaceMargins}{{%
2      \setlength{\@tempdima}{\paperheight-1in-\topmargin
3          -\headheight-\headsep-\textheight}%
4      \xdef\@evenlly{\strip@pt\@tempdima}%
5      \xdef\@oddlly{\@evenlly}
6      \setlength{\@tempdima}{1in}%
7      \xdef\@evenllx{\strip@pt\@tempdima}
8      \ifmarginsonleft\else
9          \setlength{\@tempdima}
10             {1in+\textwidth+\marginparsep}\fi
11      \xdef\@oddllx{\strip@pt\@tempdima}
12  }}
```

For odd numbered pages, the lower-left corner of marginal boxes is placed at coordinates (`\@oddllx,\@oddlly`), and at (`\@evenllx,\@evenlly`) for even numbered pages. The marginal box is placed on the page using the very fine package, eso-pic, by Rolf Niepraschk.

If this does not work for you, well, you're on your own. You can set the value of `\tbmarparboxwidth` directly,

`\setlength\tbmarparboxwidth{1.75in} % for example`

Then calculate `\@oddllx`, `\@oddlly`, `\@evenllx`, `\@evenlly` yourself. Good luck! 𝔇𝔖

2.5.5 Other Details

There are several other commands of interest.

Including solutions

There are two methods of including the solutions: manual inclusion and automatic inclusion.

Manual inclusion This is the default inclusion method, and was used for this book. It is expected that the document author explicitly expands a `\chapter` command followed by `\includeexersolutions` at some point. See the file `ftb_appen_solns.tex` for details.

Automatic inclusion To obtain automatic inclusion of the solutions, place the command `\autoInsSolns` in the preamble of the document. The solutions are automatically included at the end of the document and a section-heading is automatically generated. To introduce the solutions with a `\chapter` heading, use `\InputQzSolnsLevel` and `\InputExrSolnsLevel`; these two commands are defined by exerquiz (2019/12/17).

Very Cool!

Formatting Problem Numbers and Part Letters

Problem sets are use numbers and letters to enumerate questions and questions with parts. The `eqexam` uses two environments to control the presentation of questions and solutions, these two environments are used in three different contexts:

- `eqequestions` environment is used to control the display of the `probset` environment within the body of the textbook;

- `eqequestions` environment is used to control the display of the solutions "in the back of the book."

- `eqeList` environment is used for displaying answers in the margin of the book, when the appropriate options allow it.

To offer the document author a "simple" interface to changing the formatting, the following commands are defined.

Problems in the body of the document. The following commands are defined, and shown below with their default values.

```
1  \prbDecPt{.}
2  \prbNumPrtsep{\ }
3  \prbPrtsep{\ }
4  \setMClabelsep{\ }
5  \prbNumFmt{\textbf{#1}}
6  \partsformat{(\hfil\alph{partno}\hfil)}
7  \setPartsWidth{(d)}
8  \eqexammargin{00}
```

Comments:

1. `\prbDecPt` inserts a decimal point following the problem number. Expanding `\prbDecPt{}` removes the decimal point that follows the problem numbers.

2. `\prbNumPrtsep` inserts a space following the problem number; for example, `\prbNumPrtsep{\quad}` inserts a `\quad` space after the problem number.

3. `\prbPrtsep` inserts a space after the part label; `\prbPrtsep{\quad}` inserts a `\quad` space after the label.

4. `\setMClabelsep` is the separation between label and multiple choice and selection questions. (This command has been around for awhile, and is little used.)

5. `\prbNumFmt` formats the problem number; place the formatting commands as part of the argument, for example,

   `\prbNumFmt{\textsf{#1}}`

   formats the problem number as san-serif. The parameter `#1` is symbolic, and is replaced by the problem number when the document is compiled.

Very Cool!

6. `\partsformat` formats the parts label. Exerquiz/eqexam use the counter `partno` for the part label. We can change the formatting to match the example given in `\prbNumFmt` above by declaring

    `\partsformat{\textsf{(\hfil\alph{partno}\hfil)}}`

7. `\setPartsWidth` sets the amount of horizontal space reserved for the part label; for example `\setPartsWidth{(m)}` defines space wide enough for '(m)'; that is, enough space is allocated to accommodate a width of an 'm' enclosed in parentheses. If you do not want to use the default parentheses, you can define

    `\partsformat{\textbf{\alph{partno}.}}`
    `\setPartsWidth{\textbf{d.}}`

    for example.

8. `\eqexammargin` was discussed earlier (Section 1.1), its argument sets the `\labelwidth` parameter in the definition of the `eqequestions` environment (not used by the document author). There is an optional parameter, used for setting the assumption under which the width is calculated. The default value of the optional parameter is

    `\normalsize\normalfont\bfseries`

    that is, when we calculate the width of '00', the calculation is made under these font settings.

    If you reset any of the above parameters, `\eqexammargin` needs to be executed again with its width argument.

Problems in the solution file. The following commands are defined, and shown below with their default values.

```
1   \solDecPt{.}
2   \solNumPrtsep{\ }
3   \solPrtsep{\ }
4   \solWoPrtsFmt{\textbf{#1}}
5   \solWPrtsFmt{\textbf{#1}}{(\hfil#2\hfil)}
6   \setSolnIndent{00}{(d)}
```

Comments:

1. `\solDecPt` inserts a decimal point following the problem number. Expanding `\solDecPt{}` removes the decimal point that follows the problem numbers.

2. `\solNumPrtsep` inserts a space following the problem number; for example, `\solNumPrtsep{\quad}` inserts a `\quad` space after the problem number.

3. `\solPrtsep` inserts a space after the part label; `\solPrtsep{\quad}` inserts a `\quad` space after the label.

Very Cool!

4. \solWoPrtsFmt sets the formatting for a problem without parts, as it appears in solutions file. The #1 represents the question number.

5. \solWPrtsFmt sets the formatting for a problem with parts. It takes two arguments, the first is the formatting for the problem number; the second is the formatting for the part label. The symbols #1 is the problem number, #2 is the parts letter.

6. \setSolnIndent is used to calculate the proper \labelwidth of the eqe-question environment as it appears in the solution file. It has three arguments

>   \setMarIndents[⟨*font_decls*⟩]{⟨*digits*⟩}{⟨*parts_label*⟩}

The default is

>   \setMarIndents{00}{(d)}

The default optional argument is

>   \normalsize\normalfont\bfseries

\setSolnIndent should be executed after any changes in the above command declarations.

For problems with parts, the solutions that appear in the back of the book (or in a solutions manual) do not use hanging indentation. The default uses like this

> **1.** (a) This is a solution. This is a solution. This is a solution. This is a solution. This is a solution. This is a solution.

Note how the second line wraps around. Some authors, however, may want the solutions with part to look like this instead.

> **1.** (a) This is a solution. This is a solution. This is a solution. This is a solution. This is a solution. This is a solution.

This hanging indentation does not come "natural" to the underlying code base of the eqexam package. The solution I've come up with is as follows:

```
1  \solDecPt{.}
2  \solNumPrtsep{\ }
3  \solPrtsep{\ }
4  \solWoPrtsFmt{\textbf{#1}}
5  \hangSolWPrtsFmt{\textbf{#1}}{(\hfil#2\hfil)}
6  \setSolnIndent{00}{(d)}
```

From the document author's point of view, the only difference between this series of declarations and the example following the paragraph **Problems in the solution file**, page 27, is in line (5). Here, I've replaced,

>   \solWPrtsFmt{\textbf{#1}}{(\hfil#2\hfil)}

by

>   \hangSolWPrtsFmt{\textbf{#1}}{(\hfil#2\hfil)}

Very Cool!

The two arguments of `\hangSolWPrtsFmt` are the same as those of `\solW-PrtsFmt`.

If you are satisfied with default values of the formatting parameters, you can simple enter

```
\hangSolWPrtsFmt{\textbf{#1}}{(\hfil#2\hfil)}
```

in the preamble.

The following commands format the headings of the problem sets and the chapter headings.

```
\renewcommand{\preExamSolnHead}{\medbreak\noindent}
\renewcommand{\examSolnHeadFmt}[1]{\textbf{#1}}
\renewcommand{\postExamSolnHead}{\smallbreak}
\renewcommand{\preChapSolnHead}{\bigbreak\noindent}
\renewcommand{\chapHeadSolnFmt}[1]{{\large\textbf{#1}}}
\renewcommand{\postChapSolnHead}{\medbreak}
\newcommand{\ftbFmtChapter}[1]{%
     \chaptername\space#1.\space\ignorespaces}
```

The first three have the word "exam" in them; these commands were originally defined for the `exam` environment, and mustered into use for the `probset` environment.

The results of these commands may be seen in Appendix A, which begins on page 43. For example, the first chapter, first section typesets as,

Chapter 1. The New eqexam

1.1 Setting the page layout (page 8)

Answers in the margin. The answers that appear in the margin (under the assumptions of `instred` and `marginans`) use the `eqeList` environment, which the document author normally does not directly manipulate. The following commands are defined, and shown below with their default values.

```
1   \mrgDecPt{.}
2   \mrgNumPrtsep{\ }
3   \mrgPrtsep{\ }
4   \mrgDigitFmt{#1}
5   \mrgPartFmt{(\hfil#1\hfil)}
6   \setMarIndents{00}{(d)}
```

Comments:

1. `\mrgDecPt` inserts a decimal point following the problem number. Expanding `\mrgDecPt{}` removes the decimal point that follows the problem numbers.

2. `\mrgNumPrtsep` inserts a space following the problem number; for example, `\mrgNumPrtsep{\quad}` inserts a `\quad` space after the problem number.

Very Cool!

3. `\mrgPrtsep` inserts a space after the part label; `\mrgPrtsep{\quad}` inserts a `\quad` space after the label.

4. `\mrgDigitFmt` sets the formatting for a problem number as it appears in the margins. The `#1` represents the question number.

5. `\mrgPartFmt` sets the formatting for the parts label. The symbol `#1` is the parts letter.

6. `\setMarIndents` is used to calculate the proper `\labelwidth` of the `eqeList` environment as it appears in the margins. It has three arguments

   `\setMarIndent[⟨font_decls⟩]{⟨digits⟩}{⟨parts_label⟩}`

   The default is

   `\setMarIndents{00}{(d)}`

   The default optional argument is

   `\normalsize\normalfont\bfseries`

   `\setSolnIndent` should be executed after any changes in the above command declarations.

Creating a blank page

- `\insertpageifcarryover`: When compiling with the options `instred` and `marginans`, the answers that appear in the margin may carryover to the next page. Normally this not a problem unless the answers carry over to title page of a new chapter. In this case, you want a new page inserted to hold the marginal content that has been carried over. The command `\insertpageifcarryover` inserted just before a chapter (or section) and after a problem set, determines if there is carry over to the next page, if there is, it creates a new page to hold this carryover content. The document author may want to fill or partially fill this generated page with other content (and remove the `\insertpageifcarryover` command). If there is overflow to the next page, a message in the log is reported:

  ```
  \PackageInfo{eqexam}{Carryover of marginal content
  in margin from page \thepage.\MessageBreak
  Creating a blank page}
  ```

  The command has an optional parameter that can be used to insert content into the newly created page, the default value of this optional parameter is `\null`.

Full-width pages and headers

There may be occasions where you want to remove the generous margins, and use the full width of the page. This is useful for special pages, or for the pages that hold the answers in the appendix in the back of the book.

Very Cool!

- `\setFullWidthHeader` extends the running headers to full-width. The running header for this document extends from the 1-inch left margin to the 1-inch right margin. May be re-defined as appropriate, or have another package handle headers and footers.

  This command is in effect throughout this document.

- `\setFullWidthLayout`: Some pages require a change in page layout. For sections that contain solutions to the problems, the page layout may be wide, and solutions are in two columns, as they are here in this document. Use `\setFullWidthLayout` to set the page layout to a wide layout.

- `\restorePageLayout` restores the page layout to its original page parameters, at least the ones changed by `\setFullWidthLayout`. See the usage of these two commands in this document.

- The `fullwidthtext` environment is used to enclose text on "full-width" pages.

Exercises at the end of each chapter

- `\exercisesAtEndOfChapter` is a feature developed several years ago when he was working on his book.[3] When this command is executed in the preamble, it is possible for the solutions to appear at the end of each chapter.

  I wrote that "it is possible" in the previous paragraph, for this to actually come about you must place some code between chapters. Below is some verbatim code taken from this document.

- `\initChapAfterSolns` is used to initiate a full-width page, and `\restoreFromChapAfterSolns` restores the page layout parameters to their original values.

- `\chaptersolutions` inputs the solutions to the problem sets of the current chapter.

```
1   \begin{afterChapSolns}
2   % if carry over, generate a blank page
3   \insertpageifcarryover
4   \initChapAfterSolns
5   \section{Solutions to Chapter Exercises}
6   \begin{fullwidthtext}
7   Below you will find the solutions to the questions.
8   \end{fullwidthtext}
9   \par\bigskip
10  \begin{multicols}{2}\forceNoColor
11  \chaptersolutions
12  \end{multicols}
13  \restoreFromChapAfterSolns
14  \end{afterChapSolns}
```

---

[3] *Curious Curves* by Richard B Darst, Judith Palagallo, and Thomas E Price. See `http://www.worldscibooks.com/mathematics/7544.html`

Very Cool!

A comment environment, `afterChapSolns`, is defined. If `\exercis-esAtEndOfChapter` is executed, the environment `afterChapSolns` is *included*, otherwise, it is *excluded*. You can set the source file for either scheme, as is this document.

Miscellaneous commands

There are a large number miscellaneous commands of some interest.

- `\writeToSolnFile` can be used to write to the solutions file. It take one argument.

  ```
  \ifisstudented
      \writeToSolnFile{\protect\tballowAllNums}
  \fi
  ```

  This code writes `\tballowAllNums` to the solutions file. In this case, it is done just before the chapter quiz; we want all solutions to appear. After the quiz, this document has

  ```
  \ifisstudented
  \writeToSolnFile{\protect\tbfilterOutEvenNums}
  \fi
  ```

  to return to showing only the odd-numbered solutions for the quiz.

- `\tballowAllNums` and `\tbfilterOutEvenNums`, when appearing in the solutions file, redefines things to allow all solutions, or just the odd numbered ones.

- The commands `\preExamSolnHead`, `\examSolnHeadFmt`, and `\postEx-amSolnHead` set the spacing before and after a problem set in the solutions section, and the formatting of the heading.

- `\preChapSolnHead`, `\chapHeadSolnFmt`, and `\postChapSolnHead` do the same thing, but for chapter headings that appear in the solutions section.

- `\wrtChapSolnHead` writes the chapter head to the solution file using the above formatting. It takes one argument,

  ```
  \wrtChapSolnHead{The New \eqexam}
  ```

  the chapter title.

  When `\wrtChapSolnHead` expands (at the end of the book in the solutions section, or in a solutions manual), the chapter number is formatted by the command `\ftbFmtChapter`. The default definition of which is

  ```
  \newcommand{\ftbFmtChapter}[1]{%
      \chaptername\space#1.\space\ignorespaces}
  ```

  This command may be redefined in the source document, or in the solutions manual, as appropriate.

- `\probSet` is a convenience macro for setting problem set titles. Its definition is

  ```
  \newcommand{\probSet}[1]{Problem Set #1}
  ```

Very Cool!

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Review Exercises
Section 2.2

1. (a) $x = 17$

  (b) $x = -\dfrac{4}{3}$

2. $x = \dfrac{3}{2} - \dfrac{\sqrt{5}}{2}, \dfrac{3}{2} + \dfrac{\sqrt{5}}{2}$

3. (a) $S = (-\infty, -18\,]$

  (b) $S = [\,-2, 10\,]$

4. $y = -\frac{1}{2}x - \frac{3}{2}$

Section 2.3

5. (a) $f^{-1}(x) = \dfrac{3 - x}{5}$

  (b) $f^{-1}(x) = \sqrt[3]{\dfrac{x - 2}{6}}$

Very Cool!

- `\promoteNewPage` is a simplified version of a command has been defined in `eqexam` for several years. It takes one optional argument. without the argument, it generates a page break if the amount of space left on the page is less than

    `\@fvsizeskip\textheight`

  where `\@fvsizeskip` is determined by the command `\setDefaultfv-sizeskip`. In the preamble of this document we have

    `\setDefaultfvsizeskip{.1}`

  with this as the default, `\promoteNewPage` will generate a new page if there is less than `.1\textheight`. The optional argument allows you to specify the amount of space left to create a page break. For example, if you say

    `\promoteNewPage[.5in]`

  a page break will occur if there is less than .5 inch of space left on the page (at the point where TEX expands the command).

2.6   Review Exercises for Chapter 2

Review exercises of a chapter are similar to section problem sets: For the student edition, odd-numbered problems have solutions in the back of the book; for the instructor edition, all problems have solution.

Section 2.2

1. Solve each of the following equations.

  (a) $\dfrac{1}{2}(x + 5) = \dfrac{1}{3}(2x - 1)$ (b) $6x + 5 = 3x + 1$

2. Solve the equation $x^2 - 3x + 1 = 0$ using the either the *quadratic formula* or the *method of completing the square.*

3. Solve each of the inequalities, and leave your answer in interval notation. Insert the solution set, in the form of interval notation, in the box provided.

  (a) $\dfrac{1}{3}x - 2 \geq \dfrac{1}{2}x + 1$ (b) $|x - 4| \leq 6$

4. Find the equation (in slope-intercept form) of the line that crosses the x-axis at $x = -3$ and is parallel to the $2x + 4y = 3$.

Section 2.3

5. Find the inverse function of each of the following.

  (a) $f(x) = 3 - 5x$ (b) $f(x) = 6x^3 + 2$

6. Solve each of these exponential equations by writing them in the form $a^u = a^v$, then equating $u = v$ and solve for x.

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(a) Solve $9^{2x} = 27$

(b) $e^{x+1} = (e^4)^{-x}$

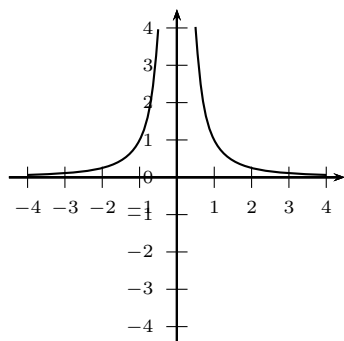**Section 2.3 (cont.)**

6. (a) $x = 3/4$

(b) $x = -1/5$

Very Cool!

2.7 Chapter Quiz

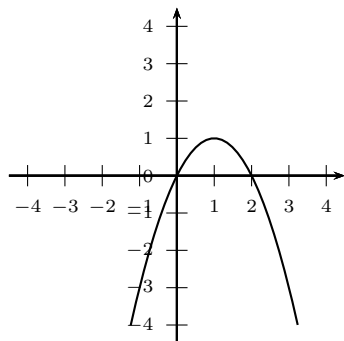For the end of the chapter quizzes, we allow all answers to appear in the back of the book for the student edition.

1. Make a good sketch of each of the functions given below, by discerning that they are simple transformations (vertical/horizontal shifts or reflections) of library functions.

(a) $f(x) = \dfrac{1}{x^2}$ (b) $f(x) = 1 - (x-1)^2$

2. Let $f(x) = 4x + 3$ and $g(x) = 2x^2 - 5$. Compute each of the following, simplify where appropriate.

(a) $\left(\dfrac{g}{f}\right)(x)$ (b) $(f \circ g)(x)$

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. Define a function $g(x) = 3x + 2$. Find the inverse of g, and state its domain (in interval notation).

5. Use the **vertex formula** to find the cartesian coordinates of the vertex of the quadratic function $f(x) = 2x^2 - 8x + 5$. The vertex is located at a ___minimum___ (maximum or minimum).

6. Suppose y varies inversely with x, and when $x = 4$, $y = 8$. Write the equation that describes this relationship exactly.

7. Write each of the expressions in the form indicated.

(a) Write the expression in *expanded form*: $\log \dfrac{x(x-1)^4}{(x+1)^3}$

(b) Write the expression in *condensed form*: $\dfrac{1}{2}\big(\log(x) + 3\log(y)\big)$

8. Exponential Equations. Solve for x in each of the following exponential equation. Represent your answer as an algebraic express, and a numerical value.

(a) $5^{2x} = 7.3$ (b) $\log_5(2x - 1) = 1.1$

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Chapter Quiz

1. (a)

1. (b)

2. (a) $\dfrac{2x^2 - 5}{4x + 3}$

  (b) $8x^2 - 17$

3. 17 and 16, respectively

4. $(x - 2)/3$

5. $V(2, -3)$, a minimum

6. $y = 32/x$

7. (a) $\log x + 4\log(x - 1) - 3\log(x + 1)$

  (b) $\log(xy^3)^{1/2}$

8. (a) $\dfrac{\ln(7.3)}{2\ln(5)} \approx 0.6176$

  (b) $\dfrac{1 + 5^{1.1}}{2} \approx 3.4365$

Very Cool!

Very Cool!

Chapter 3

Writing a Solutions Manual

When you write a textbook using the `fortextbook` option of `eqexam`, each problem has three answers/solutions:

1. The *answer* to the problem, this is the argument of the `\ANS` command; this answer appears either in the margin, or after the statement of the problem.

2. The *short solution*, enclosed in the `ssol` environment; this solution appears in the back of the book, customarily, the odd-numbered ones for the student edition, and all solutions for the instructor edition.

3. The *long solution*, enclosed in the `lsol` environment. The long solutions are used as a basis for writing the solution manual for both the student and the instructor.

When you compile the source document for the textbook using the `ftbsolns` option, an auxiliary file named `\jobname.sol` is created. This SOL file contains both the short and the long solutions to each problem in the textbook. The *short solutions* are automatically input back in at the end of the book to create an appendix with the solutions.[1]

In this chapter, we outline the steps needed to create a stand alone solution manual for the student and for the instructor. The solutions manual for this textbook[2] is named `fortextbook_sman.tex`. The solution manual itself contains additional comments.

3.1 The Minimal Required Content

In this section we discuss the minimal set up necessary to produce a solutions manual.

---

[1]The long solutions can optionally be input in at the end of the document, perhaps for the purpose of verifying that the long solutions compile correctly, or to edit them. This can be done, by the way, by specifying `lsols` as an option in the command `\textbookOpts`

[2]Recall, this document is both documentation and a "textbook."

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Steps for Creating a Solutions Manual.

1. Create a new TEX file in your favorite editor and copy the preamble of your textbook file into this new document. Now insert the usual \begin{document}/\end{document} pair.

   - The preamble for the eqexam package might look like this,

     ```
     1   \usepackage[%
     2       fortextbook,ftbsolns,nomarginwrite,
     3       % usecustomdesign,
     4       forcolorpaper,noseparationrule,usexkv
     5   ]{eqexam}
     ```

     For the solution manual, you probably do not want any marginal notes,[3] the option nomarginwrite, seen in line (1), turns off the routine of eqexam that writes to the margins. For this demo textbook, the usecustomdesign option is commented out, see line (2). This will give the maximum page space to use for displaying the solutions. See Section 1.1, page 5, for the discussion of the usecustomdesign option. Normally however,the solution manual needs a custom layout, and usecustomdesign would be used; in this case, the page layout parameters need to be adjusted to meet the requirements of the design of the solutions manual.

     The simple wrapper package, fortextbook, may be used instead of the eqexam package with all the above listed options. Using the fortextbook simplifies the package specification. The above package declaration becomes,

     ```
     \usepackage[%
         nomarginwrite,nocustomdesign]{fortextbook}
     ```

     Note the nocustomdesign option, it cancels out the customdesign option, which is not accessible when the fortextbook package is used. For a proper book, the solution manual would have its own custom design, and so the nocustomdesign option would not be used here.

   - Insert the following commands into the preamble:

     ```
     1   %\textbookOpts{studented,lsols}
     2   \textbookOpts{instred,lsols}
     ```

     In line (1), which is commented out, are the options for the student edition; if this set of \textbookOpts is used, only the odd-numbered solutions are typeset. Line (2) specifies the option list for the instructor edition of the solution manual; all solutions are typeset.

   - Not all packages used in the textbook source file are necessarily needed for the solutions manual. Some of these package may be commented out if not needed.

   - Be sure to include any special formatting definitions used by the solutions; for example, the following definitions are used in the solution manual for this textbook.

nomarginwrite

studented,lsols
instred,lsols

---

[3]No marginal notes, as implemented by eqexam, we do not refer to notes generated by the \marginpar command.

Very Cool!

```
\setlength\columnseprule{0pt}
\everymath{\displaystyle}
\def\qt#1{&&\qquad\text{#1}}
\def\OR{&&\hspace*{3pt}\text{or}\quad&}
```

`\ftbInputBookAux`

2. Copy the following command into the preamble

> `\ftbInputBookAux{⟨textbook_source_filename⟩}`

Where ⟨*textbook_source_filename*⟩ is the file name (with extension) of the main source file for the textbook. For example, for this textbook, you will find

> `\ftbInputBookAux{fortextbook.ltx}`

just above `\begin{document}`. This command inputs the auxiliary files (AUX) of the textbook, reading the the `\newlabel` commands. Now, cross-references to the main textbook can be made.

Note: Because you are typesetting the long solutions, you must make a decision early in the authoring process to have cross-references within these long solutions to a section in the main book, or not.

`\ftbInputSolnFiles`

3. Place the command `\ftbInputSolnFiles` within the body of the solutions manual at the point where you want the solutions to be input. This command takes an optional parameter

> `\ftbInputSolnFiles[⟨solutions_filename⟩]`

The default argument is ⟨*textbook_source_filename*⟩`.sol`, where the base name is the one passed to the `\ftbInputBookAux` command, expanded in the preamble.

Note: You may want to rename the SOL file so it will not overwritten; this is useful if you plan to hand-edit the file. In this case, you pass the renamed filename as the optional argument.

4. **Compiling your Solution Manual.** First, generate the SOL file for the main book. This is done by compiling the source file (three times) for your textbook with the `ftbsolns` specified. Once the SOL file is created, compile your student (or instructor) solution manual, and stand in awe! 𝔇𝔖

3.2 Additional Refinements

3.2.1 Formatting the Solutions

Formatting the solutions that appear in the solutions manual is controlled by the set of commands described in the paragraph titled **Problems in the solution file**, that appeared on page 27. In the preamble of the demo solutions manual, `fortextbook_sman.ltx`, you will find a sampling of proposed formats.

Very Cool!

3.2.2 Formatting the Headings

The chapter and section headings are formatting by the commands, seen below with their default definitions.

```
\renewcommand{\preExamSolnHead}{\medbreak\noindent}
\renewcommand{\examSolnHeadFmt}[1]{\textbf{#1}}
\renewcommand{\postExamSolnHead}{\smallbreak}
\renewcommand{\preChapSolnHead}{\bigbreak\noindent}
\renewcommand{\chapHeadSolnFmt}[1]{{\large\textbf{#1}}}
\renewcommand{\postChapSolnHead}{\medbreak}
\newcommand{\ftbFmtChapter}[1]{%
    \chaptername\space#1.\space\ignorespaces}
```

These may be redefined as desired.

It occurred to me that it would be nice to convert the chapter headings into an actual chapter, as declare by the `\chapter` command. To do this, insert the following command in the preamble:

```
\convertChapHeadToChapters
```

This command executes the following series of commands

```
\let\preChapSolnHead\relax
\let\chapHeadSolnFmt\chapter
\let\ftbFmtChapter\@gobble
\let\postChapSolnHead\relax
```

These commands redefine the chapter formatting commands seen above; in particular, we `\let` the command `\preChapSolnHead` to `\chapter`.

3.2.3 Removing Page Numbers from the Section Headings

By default, the section headings in the solution manual include a page number reference. For example, from the demo solutions manual, we have

1.1 Setting the page layout (page 8)

The "page 8" refers to the page 8 in the textbook itself, it is on this page the problem section for section 1.1 starts. Perhaps a convenient reference for the student. If you don't want that reference there, you can put the following definition in the preamble of the solutions manual.

```
\renewcommand{\annotThePage}[1]{}
```

With this definition, the above section heading would now appear as

1.1 Setting the page layout

The command `\annotThePage` takes on argument, the page number; the command may be redefined in some other way.

```
\renewcommand{\annotThePage}[1]{\space(Seite~#1)}
```

Very Cool!

where 'Seite' is German for 'page', I hope. The heading now appears as

1.1 Setting the page layout (Seite 8)

Most satisfying!

Very Cool!

Very Cool!

Appendix A

Solutions to Exercises and Chapter Quizzes

This appendix contains short solutions to all problems in this textbook. More extensive solutions may be found in the *Instructor Solution Manual*.

Ideally, the student should work the problem first before daring to take a peek at the answers. When you work on problems, use good mathematical notation; you will write on an exam, what you practice at home.

Chapter 1. The New `eqexam`

1.1 Setting the page layout (page 8)

1. (a) $x = -\dfrac{4}{3}$
   (b) $x = 17$
   (c) $29/10$
   (d) No solution, or the solution set is $\emptyset$.
2. (a) $6 + 3\imath$
   (b) $-5 + 12\imath$
   (c) $-\dfrac{1}{25} - \dfrac{18}{25}\imath = \dfrac{-1 - 18\imath}{25}$
3. $x = \dfrac{3}{2} - \dfrac{\sqrt{5}}{2},\ \dfrac{3}{2} + \dfrac{\sqrt{5}}{2}$
4. $x = 2 \pm 2\imath$
5. Solution set is $\{\, 10 \,\}$
6. $x = -5,\ -1$
7. (a) $(-\infty, -18]$
   (b) $[-3, 1]$
8. (a) $x = 2/3,\ -2$
   (b) $S = [-2, 10]$
   (c) $S = (-\infty, -5/2) \cup (3/2, +\infty)$
9. $I = \$168 + \$168 = \$336$
10. $\{\, (-1, 4) \,\}$

1.2 Another Section (page 9)

1. (a) $\sqrt{61}$
   (b) $M = \left(-1, -\dfrac{1}{2}\right)$
2. $x = 2,\ 4;\ y = 8$
3. $(x - 2)^2 + (y + 6)^2 = 39$
4. (a) $-6/5$
   (b) $y = \frac{1}{3}x + 3$
   (c) $y = -\frac{1}{2}x - \frac{3}{2}$
5. (a) $2/5$
   (b) $-3/10$
   (c) $\dfrac{2x}{4x^2 + 1}$
   (d) The function is odd.
6. (a) $(-\infty, 3]$
   (b) $(-\infty, -1) \cup (-1, 1) \cup (1, +\infty)$

Chapter 2. The `fortextbook` option

2.1 Building a sound foundation (page 11)

1. (a) -15
   (b) $\dfrac{2x^2 - 5}{4x + 3}$
   (c) $16x + 15$
   (d) $8x^2 - 17$
2. $f(x) = \sqrt[4]{x},\ g(x) = 3x^2 + 1$
3. $f^{-1}(17) = -2,\ (f^{-1} \circ f)(-2) = -2$
4. (a) $g^{-1}(x) = \dfrac{1}{1 - x},\ x \neq 1$
   (b) $\mathrm{Rng}(g) = (-\infty, 1) \cup (1, \infty)$
5. $f(x) = \frac{3}{4}(x - 2)^2$
6. $h = 2, k = -3$
7. f has a minimum at $x = 1/2$
8. The maximum number of zeros is 12, and the maximum number of turning points is 11.
9. H.A.: $y = 2$; V.A.: $x = -3$ (even), $x = -2$ (odd), $x = 2$, (odd).
10. (a) $y = \dfrac{16}{x}$
    (b) $z = \frac{9}{8}x^2\sqrt{y}$

2.2 Another awesome section (page 13)

1. (a) $f(3.2) = 0.089$
   (b) $f(4.2) = 8.166$
   (c) $f(-3.5) = -5.657$
2. $x = -3$
3. $\log_{81}(9) = 1/2$
4. (a) $x = 1/16$
   (b) $x = 5$
5. $\mathrm{Dom}(f) = (4, \infty)$
6. (a) 1.4
   (b) $x = 5$
7. (a) $2 + 8\log_4(x)$
   (b) $\frac{1}{2}\big(\log(x) - \log(4)\big)$
   (c) $\log x + 4\log(x - 1) - 3\log(x + 1)$
8. (a) $\log_7\left(\dfrac{12}{x}\right)$

(b) $\log(xy^3)^{1/2}$

9. (a) 2.4919

    (b) 5.7379

    (c) 2.2172

    (d) -3.5110

10. (a) $x = \dfrac{\ln(7.3)}{2\ln(5)} \approx 0.6176$

    (b) $x = \dfrac{\ln(3)}{\ln(2)-\ln(3)} \approx -2.7095$

11. (a) $\dfrac{1+5^{1.1}}{2} \approx 3.4365$

    (b) $\dfrac{15}{7} \approx 2.1429$

2.3 One more time! (page 14)

1. $\sin^2(x) + \cos^2(x) = 1$

2. $\tan^2(x) + 1 = \sec^2(x)$

3. $1 + \cot^2(x) + 1 = \csc^2(x)$

4. $\sin(2x) = 2\sin(x)\cos(x)$

5. $\cos(2x) = \cos^2(x) - \sin^2(x) = 2\cos^2(x) - 1 = 1 - 2\sin^2(x)$

6. $\tan(2x) = \dfrac{2\tan(x)}{1-\tan^2(x)}$

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

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

2.4 Once more, once! (page 15)

1. (a) The function $f(x) = (4.3)^x$ is an exponential function with a base of $a = \underline{\quad 4.3 \quad}$.

    (b) $\underline{\quad \text{T} \quad}$ (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 (B), the domain of $f(x) = \log_a(x)$ is $\mathrm{Dom}(f) = (0, \infty)$.

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

Demo Problem Set (page 18)

1. $2x + 5 = -2 \implies 2x = -7 \implies x = -7/2$

2.6 Review Exercises (page 33)

Section 2.2

1. (a) $x = 17$

    (b) $x = -\dfrac{4}{3}$

2. $x = \dfrac{3}{2} - \dfrac{\sqrt{5}}{2}, \dfrac{3}{2} + \dfrac{\sqrt{5}}{2}$

3. (a) $S = (-\infty, -18\,]$

    (b) $S = [-2, 10\,]$

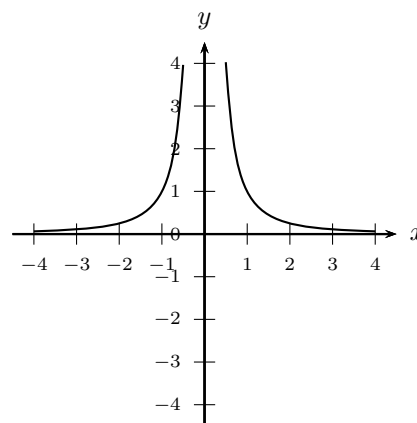**4.** $y = -\frac{1}{2}x - \frac{3}{2}$

Section 2.3

5. (a) $f^{-1}(x) = \dfrac{3-x}{5}$

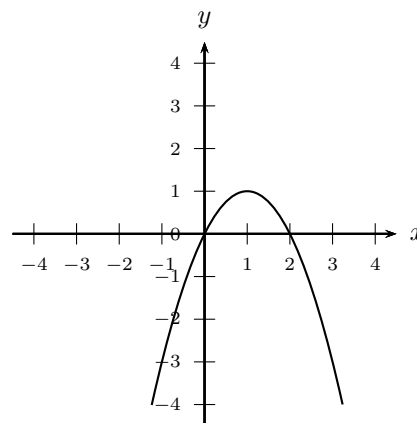   **(b)** $f^{-1}(x) = \sqrt[3]{\dfrac{x-2}{6}}$

6. (a) $x = 3/4$

    (b) $x = -1/5$

Chapter 2. Chapter Quiz (page 35)

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

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

2. (a) $\dfrac{g(x)}{f(x)} = \dfrac{2x^2 - 5}{4x + 3}$

(b) $(f \circ g)(x) = 8x^2 - 17$

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. $g^{-1}(x) = \dfrac{x-2}{3}$, the domain is $(-\infty, \infty)$

5. $V(2, -3)$, a minimum

6. $y = \dfrac{32}{x}$

7. (a) $\log x + 4 \log(x-1) - 3 \log(x+1)$
    (b) $\log(xy^3)^{1/2}$

8. (a) $\dfrac{\ln(7.3)}{2 \ln(5)} \approx 0.6176$
    (b) $\dfrac{1 + 5^{1.1}}{2} \approx 3.4365$