

PowerPoint to accompany

Introduction to MATLAB for Engineers

Third Edition

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Chapter 11 MuPAD



What can you do with MuPAD?

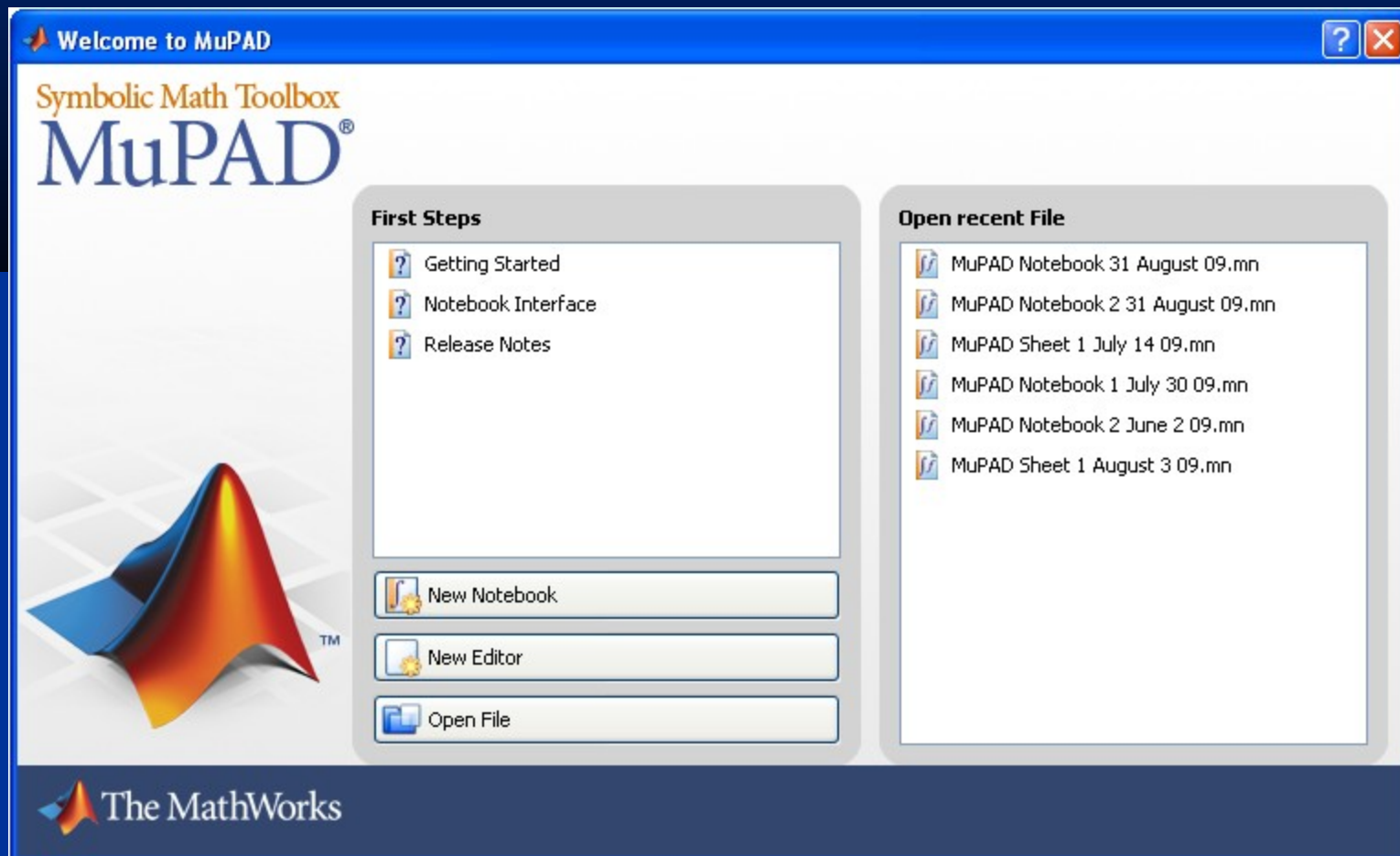
- Create symbolic expressions and manipulate them algebraically.
- Obtain symbolic and numeric solutions to algebraic and transcendental equations.
- Perform symbolic linear algebra operations, including obtaining expressions for determinants, matrix inverses, eigenvectors, and eigenvalues.
- Perform symbolic differentiation and integration.
- Evaluate limits and series symbolically.
- Obtain symbolic solutions to ordinary differential equations.
- Obtain and apply Laplace transforms.
- Solve ordinary differential equations in terms of special functions or series.

To start MuPAD, first start MATLAB, then type `mupadwelcome`.

You will then see the Welcome Screen shown on the next slide.

If you just type `mupad` instead, you will immediately be presented with a blank notebook .

The MuPAD welcome screen. Figure 11.1-1 on page 467

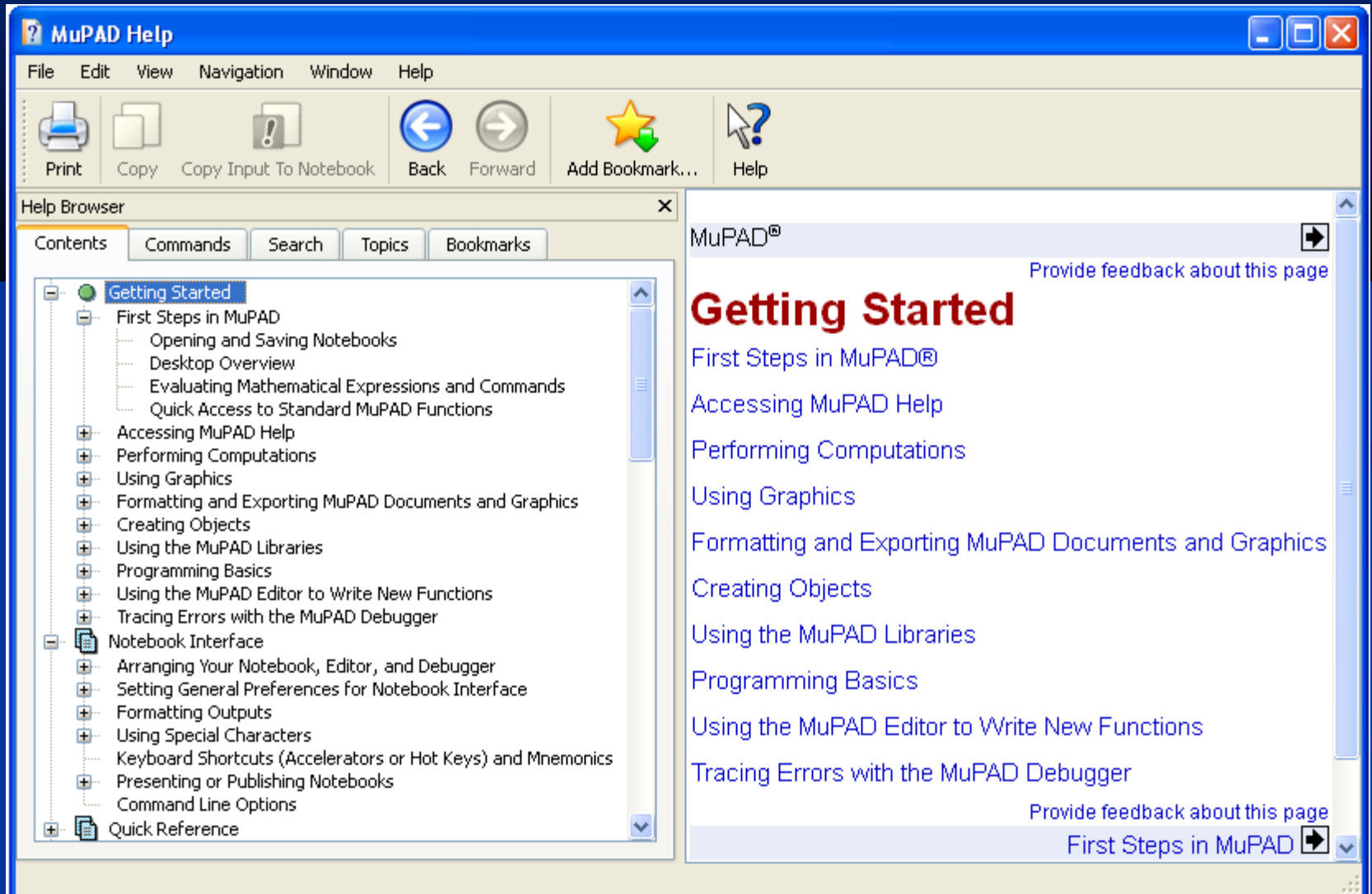


If you then click on Getting Started, you will see what is on the next slide.

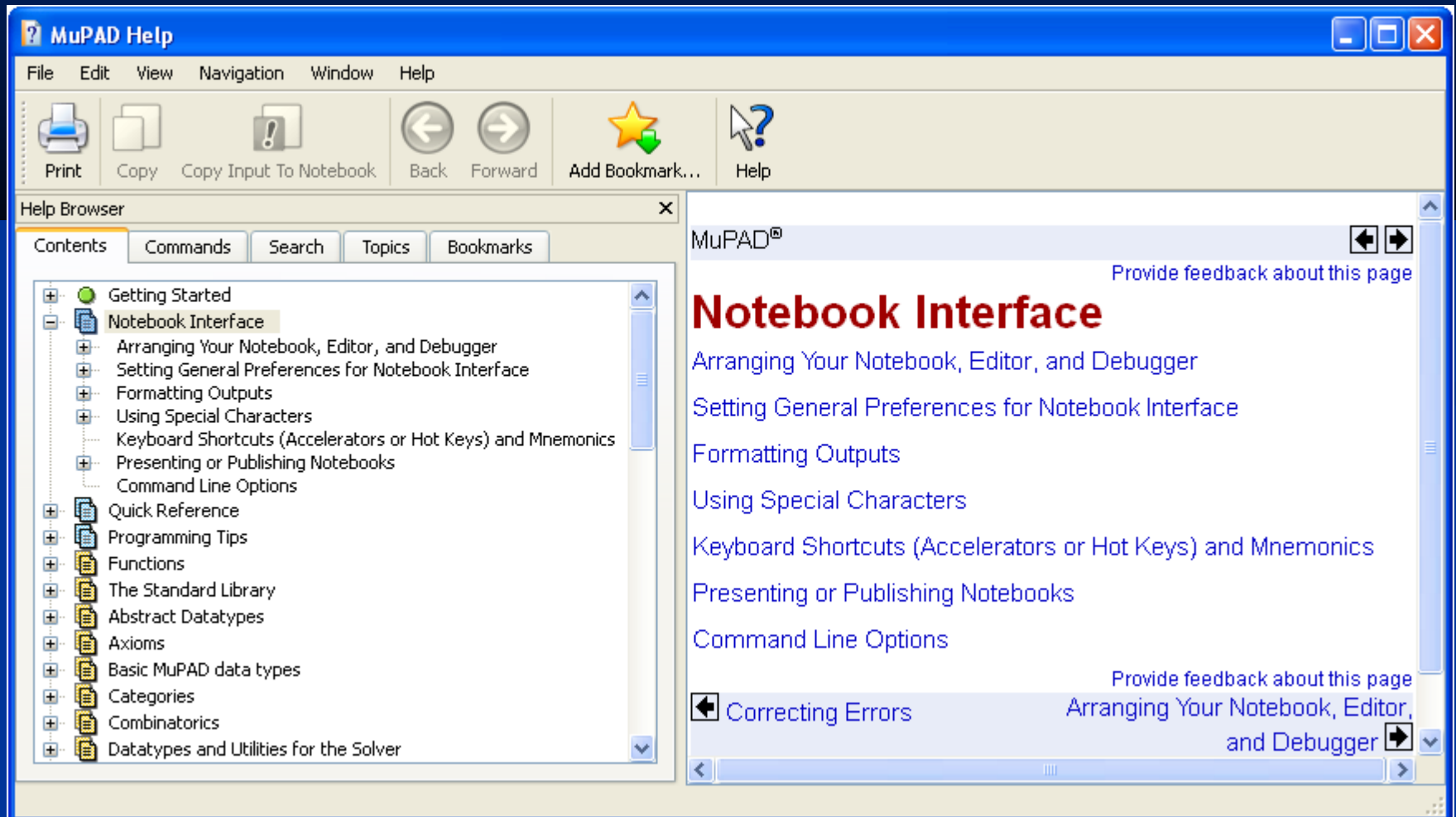
Or you can click on Notebook Interface to bring up the Notebook Interface Help screen shown on slide 11-7.

Or you can retrieve a previously created notebook by clicking on its name under Open Recent File.

The Getting Started screen. Figure 11.1-2 on page 467.



The Notebook Interface Help screen. Figure 11.1-3 on page 468.



The Notebook Interface shown on the next slide shows text, input, and output regions, with the code required to simplify an expression, to define a function, and to create a plot.

An example of the Notebook Interface.

The screenshot displays the MuPAD software interface. The title bar reads "MuPAD Example Notebook - MuPAD". The menu bar includes "File", "Edit", "View", "Navigation", "Insert", "Format", "Notebook", "Window", and "Help". The toolbar contains various icons for file operations, navigation, and mathematical symbols. The main workspace contains the following text and code:

This MuPAD notebook shows the three types of regions: text, input, and output regions.
This is a text region. Below is an input region, and below each input region is an output region.

```
expand((x-5)^2+3*x)
```

$$x^2 - 7x + 25$$

The following input region shows that y is defined to be a function or mapping from the independent variable x to exp(3x). The colon silently defines the function.

```
y:=x->exp(3*x):y(x)
```

$$e^{3x}$$

```
plot(y(x),x=-0.3..0.5,GridVisible=TRUE)
```

At the bottom right of the interface, the status bar shows "Mem 18 MB, T 0 s". The bottom right corner of the notebook area has "Text" and "INS" buttons.

On the right side, there is a "Command Bar" with a list of mathematical symbols and functions, including:

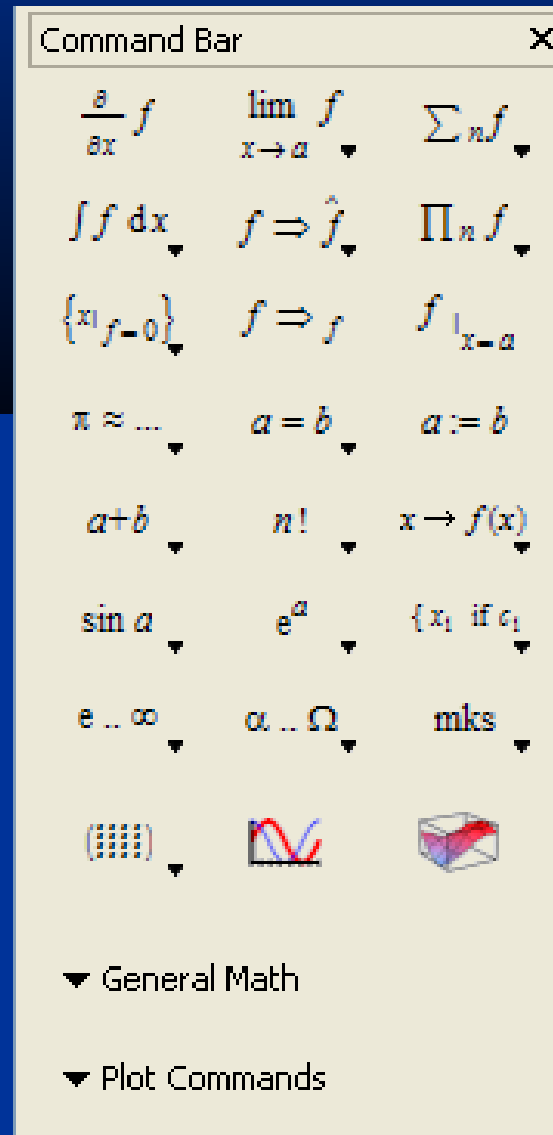
- $\frac{\partial}{\partial x} f$, $\lim_{x \rightarrow a} f$, $\sum_n f$
- $\int f dx$, $f \Rightarrow \hat{f}$, $\prod_n f$
- $\{x|_{f=0}\}$, $f \Rightarrow f$, $f|_{x=a}$
- $\pi \approx \dots$, $a = b$, $a := b$
- $a + b$, $n!$, $x \rightarrow f(x)$
- $\sin a$, e^a , $\{x_i \text{ if } c_i\}$
- $e \dots \infty$, $\alpha \dots \Omega$, mks

Below the Command Bar are sections for "General Math" and "Plot Commands".

The Standard toolbar. Figure 11.1-5 on page 469.



The Command bar. Figure 11.2-2 on page 474.



Entering Commands (page 470).

```
[ cos(PI)  
[ -1
```

The General Math Menu. Page 475.

The General Math Menu

Expand

Simplify

Factor

Combine

Normalize

Rewrite

Evaluate

Solve

Table 11.2–1 Items on the Command bar. Page 475.

Derivatives	Limits	Sums	
Integrals		Rewrite Expressions	Products
Solve Equations		Simplify	
Evaluate with $x = a$			
Numerical Evaluation and Rounding		Equality Tests	
Assignment			
Math Operators		Factorials	Function
Definition			
Trig Functions	Exponentials and Logs	Piecewise	
Definitions			
Reserved Symbols		Greek Letters	Physical
Units			
Matrices and Vectors	2D Plot	3D Plot	

The Simplify Menu. Page 476.

General

Logical

Radical

Relational

Exponential

Logarithm

Sine

Cosine

The Combine Menu. Page 477.

General

Arc Tangent

Exponential

Logarithm

Power

Sine/Cosine

Sine/Cosine Hyp

Square Root

The Rewrite Menu. Page 478.

Differential

Exponential

Factorial

Gamma

Heaviside

Logarithm

Sign

Sine/Cosine

The Solve Menu. Page 481.

Exact

Numeric

Linear System

Polynomial Diophantine Equation

Recurrences

ODE

Table 11.8-1 Special function calls in MuPAD. Page 512.

Name and Symbol	Function Call
Airy, $Ai(x)$	<i>airy Ai(x)</i>
Airy, $Bi(x)$	<i>airy Bi(x)</i>
Chebyshev of first kind, $T(n, x)$	<i>chebyshev1 (n, x)</i>
Gamma, $\Gamma(x)$	<i>gamma(x)</i>
Hermite, $Hn(x)$	<i>hermite (n,x)</i>
Bessel I, $In(x)$	<i>bessell(n,x)</i>
Bessel J, $Jn(x)$	<i>besselJ(n,x)</i>
Bessel K, $Kn(x)$	<i>besselK(n,x)</i>
Bessel Y, $Yn(x)$	<i>besselY (n,x)</i>
Laguerre, $L(n, a, x)$	<i>laguerreL(n,a,x)</i>
Legendre, $Pn(x)$	<i>legendre(n,x)</i>

Table 11.8-2 Evaluation of special functions in MuPAD

Result	Code
Symbolic finite series	orthpoly::
Symbolic infinite series	series
Numeric result	float

The following slides are figures from the examples and the homework problems.

Figure 11.3-1 for Example 11.3-1 on page 484.
Intersection points of two circles.

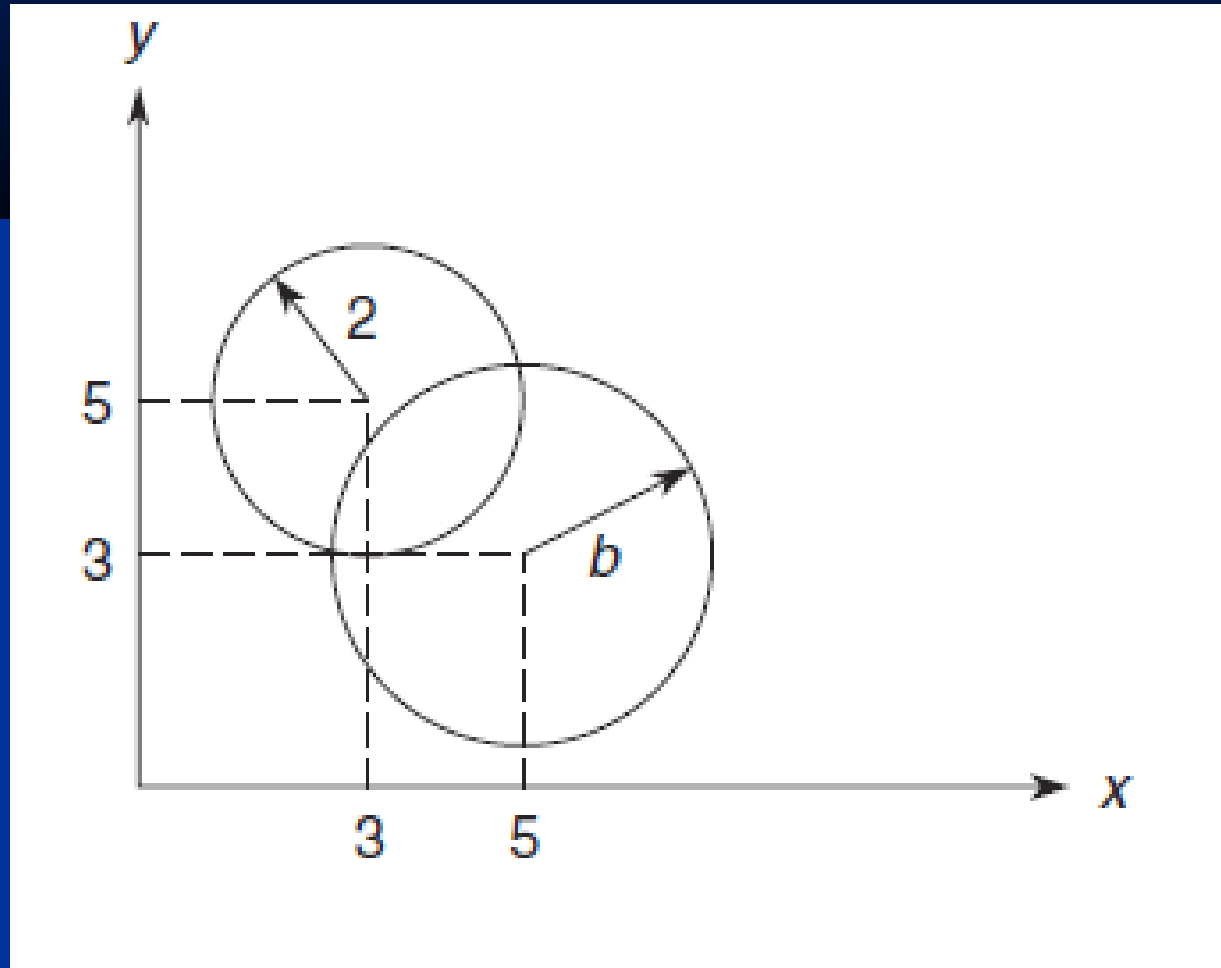


Figure 11.3-2 for Example 11.3-2 on page 486. A robot arm having two joints and two links.

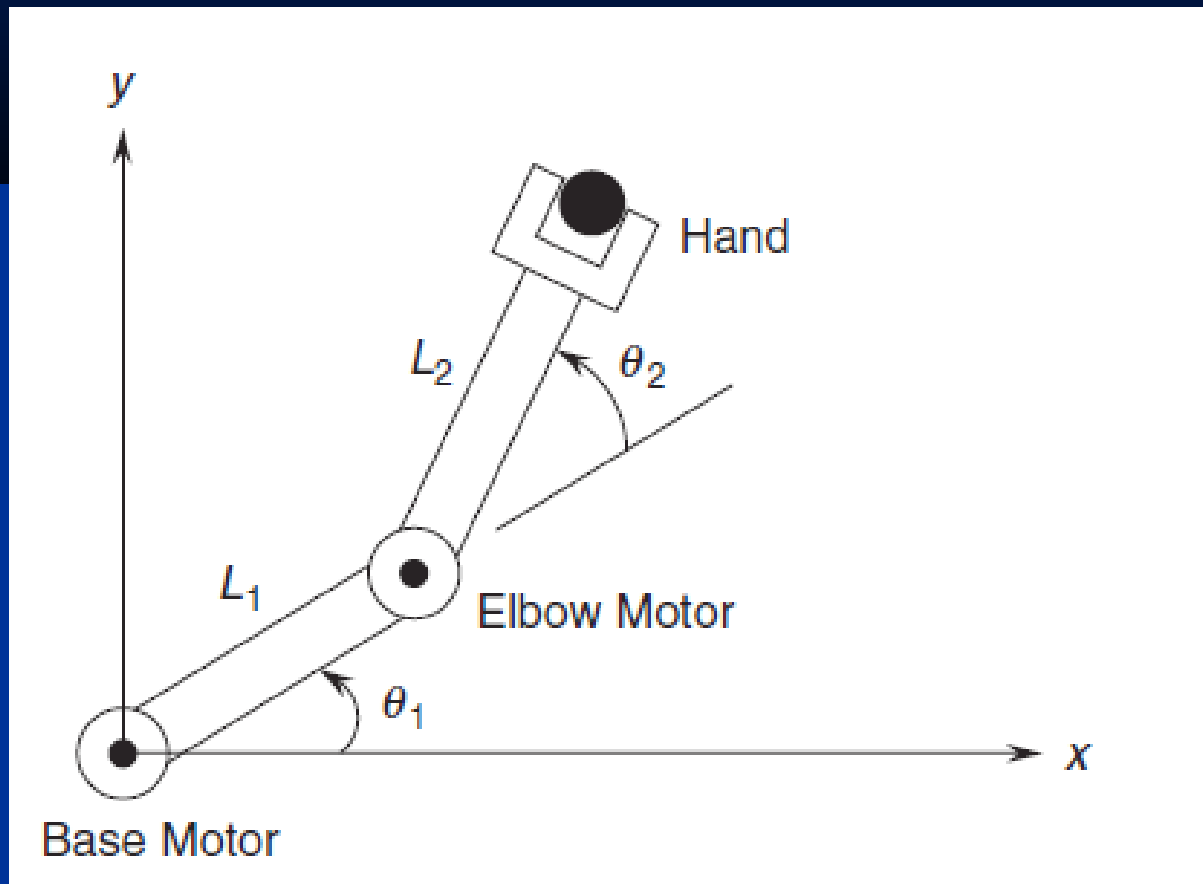


Figure 11.5-1 for Example 11.5-1 on pages 495-497. A baseball trajectory to clear the Green Monster.

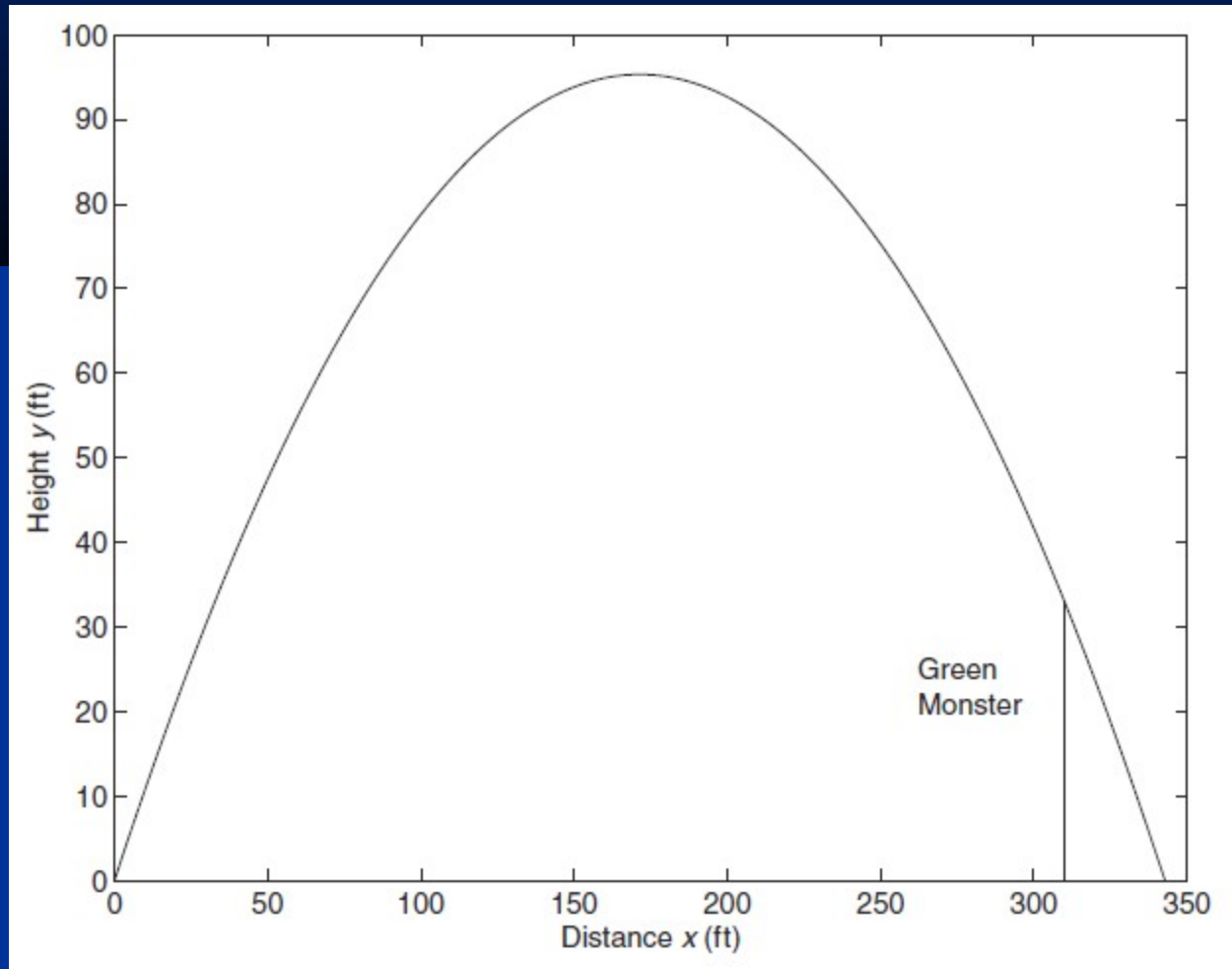


Figure 11.7-1 on page 510. Two mechanical systems, one with and one without an input derivative.

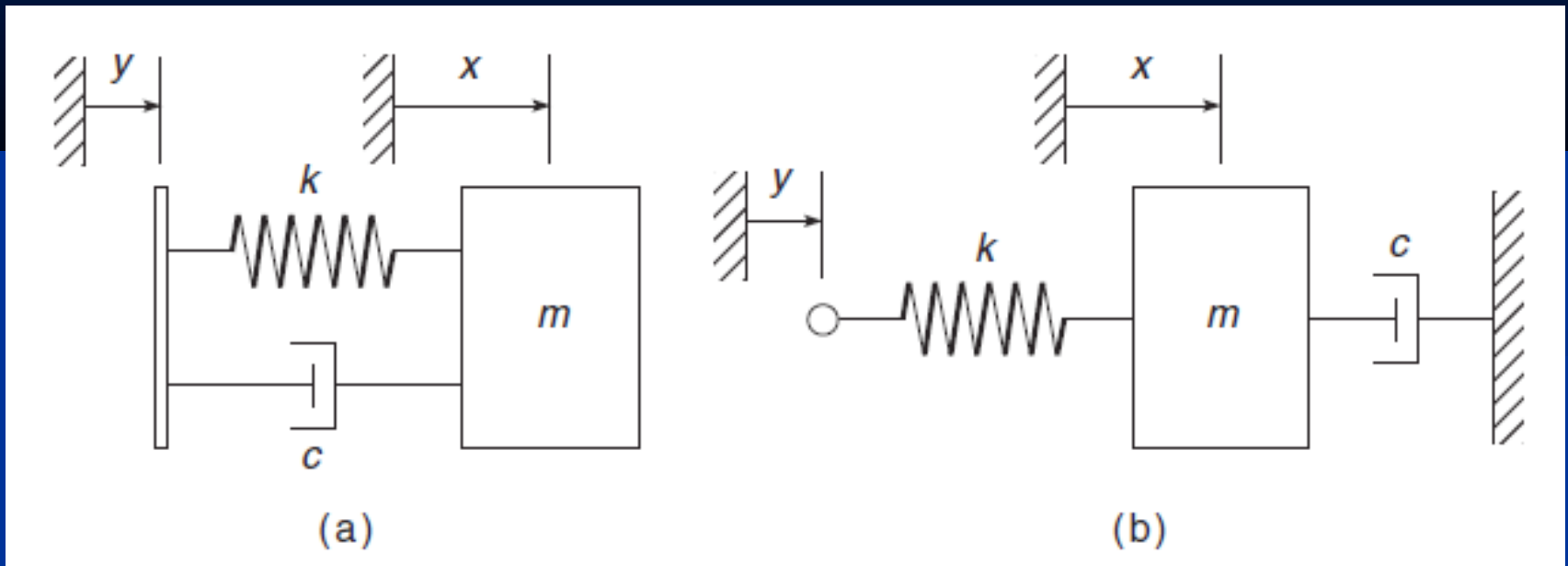


Figure 11.7-2 on page 511.

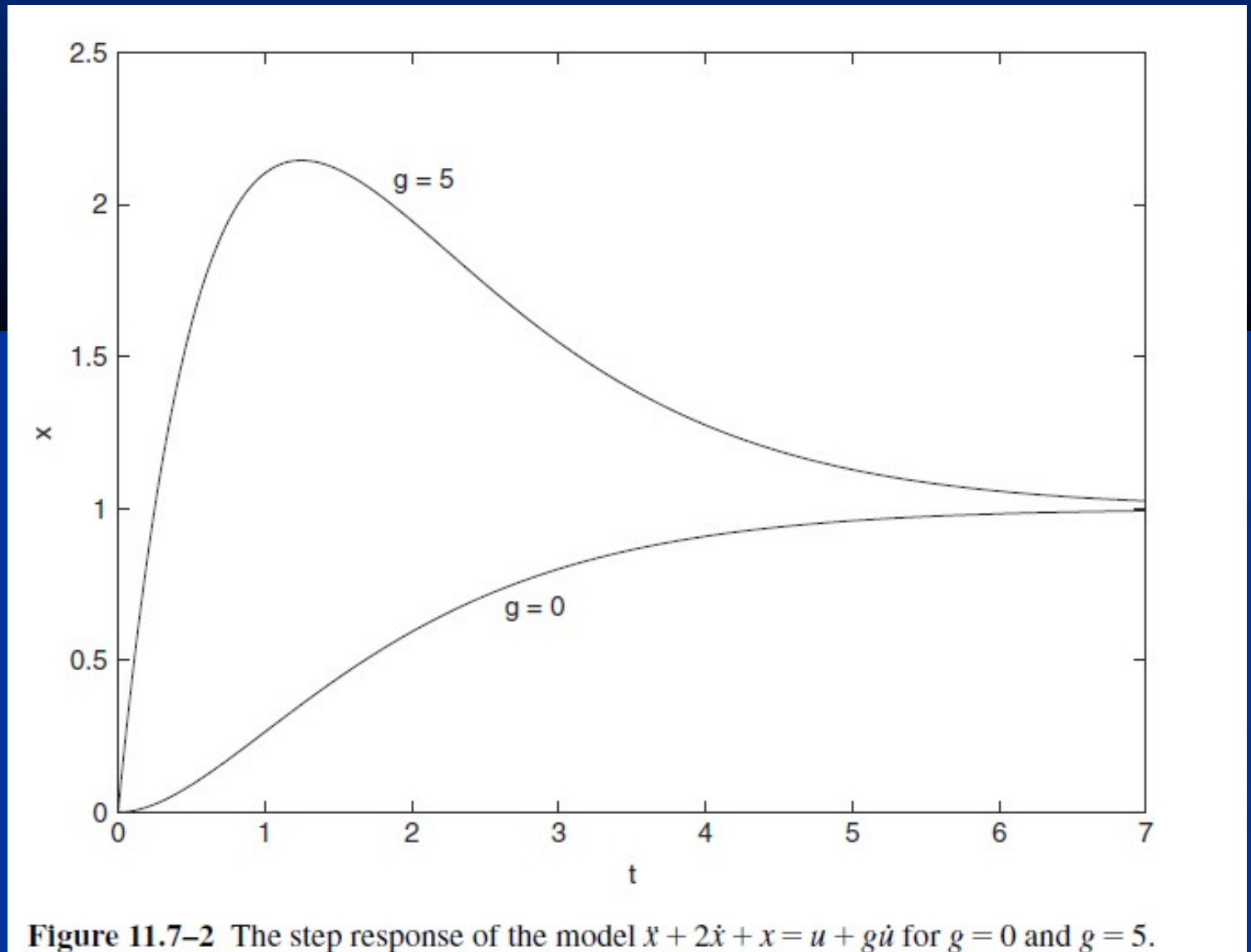


Figure P12 for Problem 12 on pages 516-517.

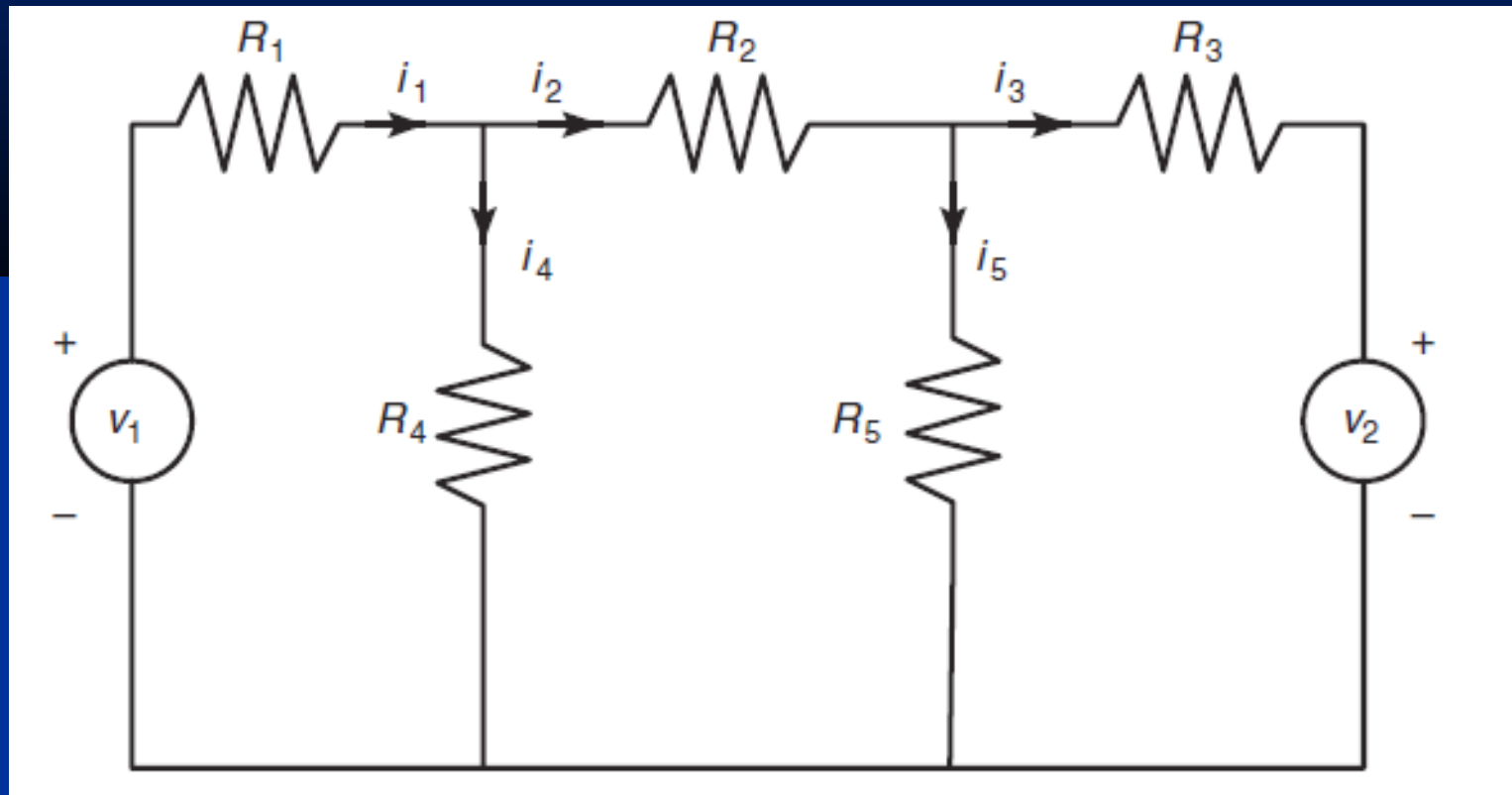


Figure P13 for Problem 13 on pages 517-518.

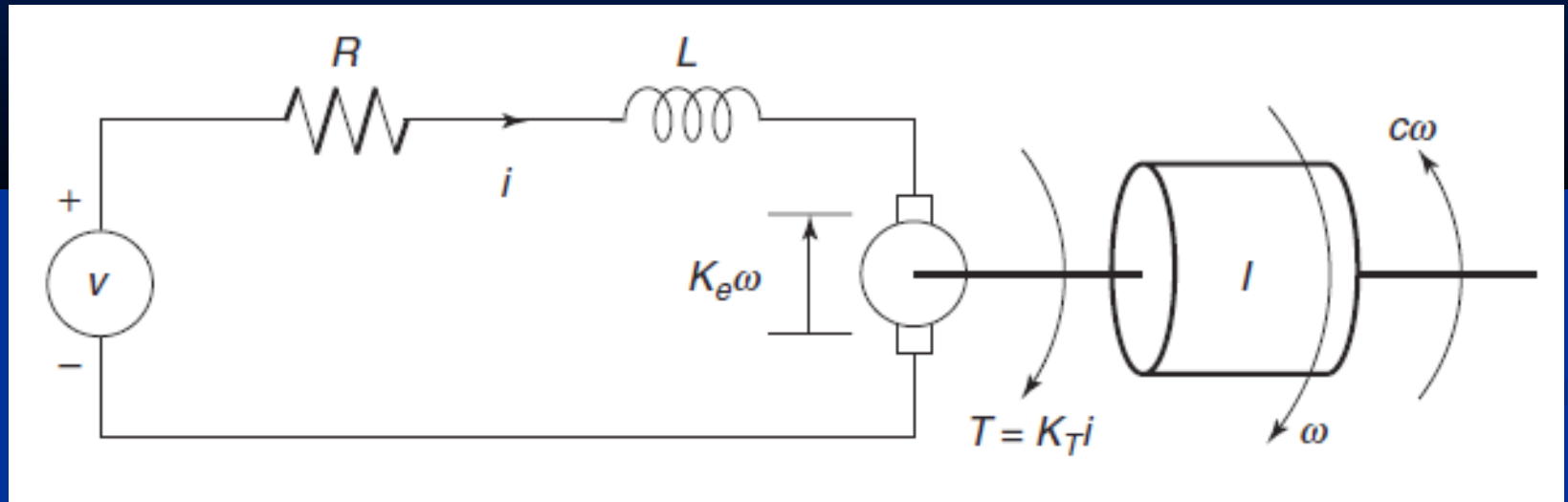


Figure P13 for Problem 13 on page 519.

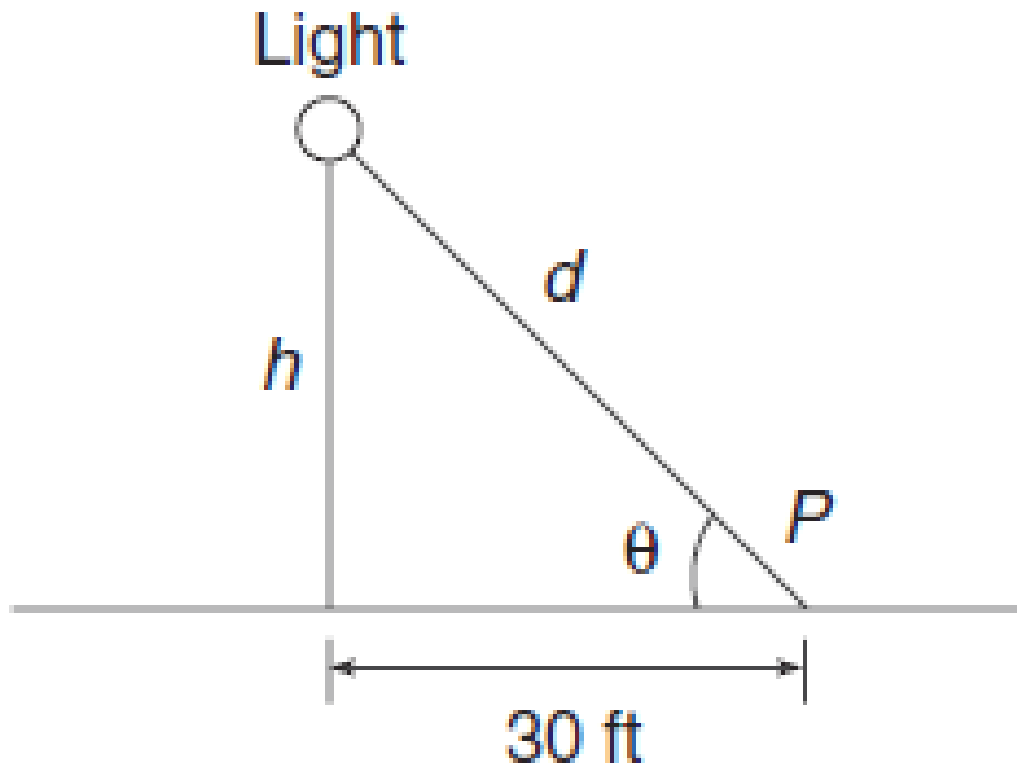


Figure P28 for Problem 28 on page 520.

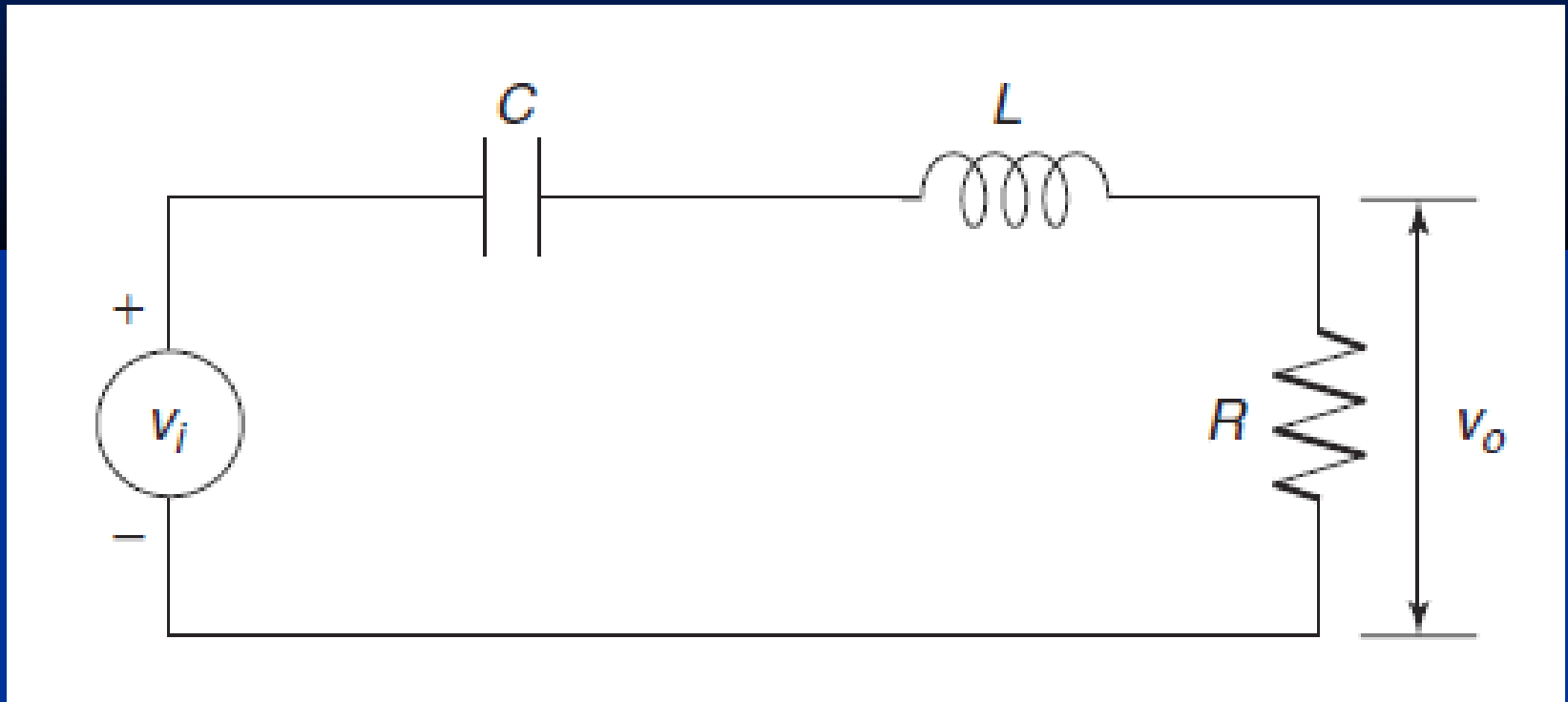


Figure P29 for Problem 29 on pages 520-521.

