[x fval]=fzero(function, x0) assigns the value of the function at x to the variable fval.

x=fzero(function, x0, optimset('display','iter')) displays the output of each iteration during the process of finding the solution.

- When the function can be written in the form of a polynomial, the solution, or the roots, can be found with the roots command, as explained in Chapter 8 (Section 8.1.2).
- The fzero command can also be used to find the value of x where the function has a specific value. This is done by translating the function up or down. For example, in the function of Sample Problem 9-1 the first value of x where the function is equal to 0.1 can be determined by solving the equation $xe^{-x} - 0.3 = 0$. This is shown below:

```
>> x=fzero('x*exp(-x)-0.3',0.5)
x =
    0.4894
```

9.2 Finding a Minimum or a Maximum of a Function

In many applications there is a need to determine the local minimum or maximum of a function of the form $y = f(x)$. In calculus the value of x that corresponds to a local minimum or maximum is determined by finding the zero of the derivative of the function. The value of y is determined by substituting the x into the function. In MATLAB the value of x where a one-variable function $f(x)$ within the interval $x_1 \le x \le x_2$ has a minimum can be determined with the fminbnd command which has the form:

```
x = fminbnd(function,x1,x2)
```

The value of x where the function has a minimum. The function. The interval of x.

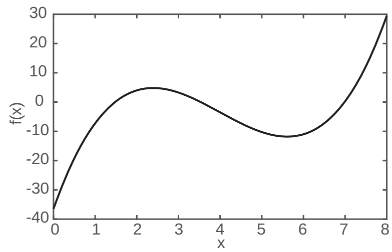
- The function can be entered as a string expression, or as a function handle, in the same way as with the fzero command. See Section 9.1 for details.
- The value of the function at the minimum can be added to the output by using the option

  [x fval]=fminbnd(function,x1,x2)

  where the value of the function at x is assigned to the variable fval.
- Within a given interval, the minimum of a function can either be at one of the end points of the interval or at a point within the interval where the slope of the function is zero (local minimum). When the fminbnd command is executed, MATLAB looks for a local minimum. If a local minimum is found, its value is

compared to the value of the function at the end points of the interval. MATLAB returns the point with the actual minimum value for the interval.

For example, consider the function $f(x) = x^3 - 12x^2 + 40.25x - 36.5$, which is plotted in the interval $0 \le x \le 8$ in the figure on the right. It can be observed that there is a local minimum between 5 and 6, and that the absolute minimum is at $x = 0$. Using the `fminbnd` command with the interval $3 \le x \le 8$ to find the location of the local minimum and the value of the function at this point gives:




```
>> [x fval]=fminbnd('x^3-12*x^2+40.25*x-36.5',3,8)
x =
    5.6073
fval =
  -11.8043
```

The local minimum is at $x = 5.6073$. The value of the function at this point is –11.8043.

Notice that the `fminbnd` command gives the local minimum. If the interval is changed to $0 \le x \le 8$, `fminbnd` gives:

```
>> [x fval]=fminbnd('x^3-12*x^2+40.25*x-36.5',0,8)
x =
     0
fval =
  -36.5000
```

The minimum is at $x = 0$. The value of the function at this point is –36.5.

For this interval the `fminbnd` command gives the absolute minimum which is at the end point $x = 0$.

- The `fminbnd` command can also be used to find the maximum of a function. This is done by multiplying the function by –1 and finding the minimum. For example, the maximum of the function $f(x) = xe^{-x} - 0.2$ (from Sample Problem 9-1) in the interval $0 \le x \le 8$ can be determined by finding the minimum of the function $f(x) = -xe^{-x} + 0.2$ as shown below:

```
>> [x fval]=fminbnd('-x*exp(-x)+0.2',0,8)
x =
    1.0000
fval =
   -0.1679
```

The maximum is at $x = 1.0$. The value of the function at this point is 0.1679.