



UNIVERSITY OF JORDAN
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Electrical Engineering Dept.

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Introduction to MATLAB 7 for Engineers

William J. Palm III

Chapter 8 Numerical Calculus and Differential Equations



8-1

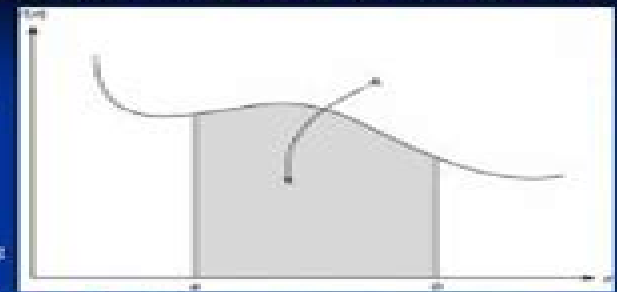
The area A under the curve of $f(x)$ from $x=a$ to $x=b$.
Figure 8.1-1

$$A = \int_a^b f(x) dx$$

Find the following
integral:

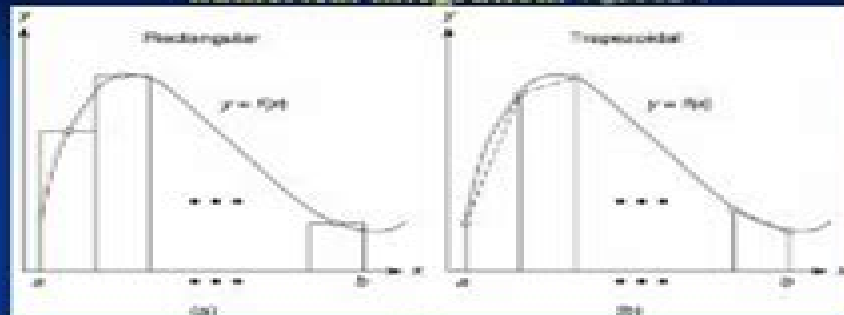
$$A = \int \sin(x^2) dx \quad \text{Fresnel's cosine integral}$$

8-2



8-3

Illustration of (a) Rectangular and (b) Trapezoidal numerical integration. Figure 8.2-1



8-4

Numerical integration functions. Table 8.2-1

Command	Description
<code>quad('fun',a,b,tol)</code>	Uses an adaptive Simpson's rule to compute the integral of the function "fun" with a as the lower integration limit and b as the upper limit. The parameter tol is optional. tol indicates the specified error tolerance.
<code>quadl('fun',a,b,tol)</code>	Uses Lobatto quadrature to compute the integral of the function "fun". The rest of the syntax is identical to quad.
<code>trapz(x,y)</code>	Uses trapezoidal integration to compute the integral of y with respect to x, where the array y contains the function values at the points contained in the array x.

8-5

MATLAB function **quad** implements an adaptive version of Simpson's rule, while the **quadl** function is based on an adaptive Lobatto integration algorithm. To compute the **sine** integral, type:

```
>> A = quad('sin',0,pi)
```

The answer given by MATLAB is 2, which is correct. We use **quadl** the same way; namely,

```
>> A = quadl('sin',0,pi).
```

Integration example: Create the function:

```
function c2 = cosxq(x)
```

```
% cosine x squared function Fresnel's int.
```

```
c2 = cos(x.^2);
```

Now that you **must** use array exponentiation (`.^`).

The **quad** function is called as follows:

```
>> quad('cosxq',0,sqrt(2*pi))
```

The result is 0.6119.

8-6

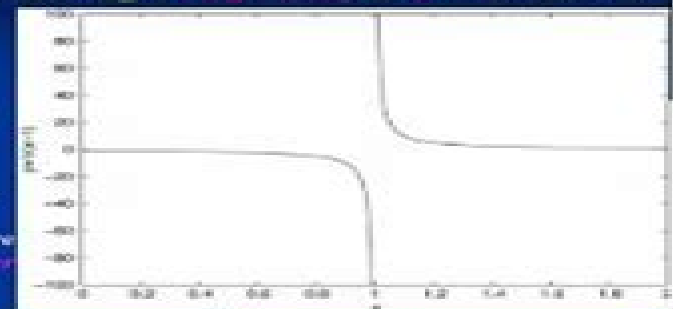
A potential problem with integration.

A function having a **singularity** at $x=1$. Figure 8.1-2

The plot of
 $y = 1/(x-1)$

$$\int_{-1}^1 \frac{1}{x-1} dx = \ln|x-1|$$

Some integrals
have **infinite**
values. These are
called **improper**
integrals.



8-7

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