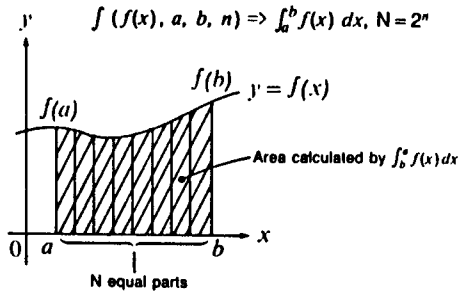
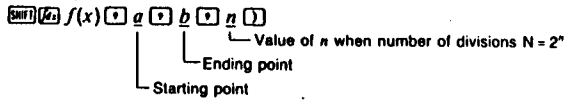


# Section 3 Integration Calculation

Integration calculation can be carried out by entering the integral calculus formula in the following format:



Integration calculation is performed using Simpson's rule to determine function  $f(x)$ . Because of this, partition of the integrated area is necessary, however if the number of divisions is not specified, the unit automatically sets  $N$  according to the formula. To specify the number of divisions for  $N=2^n$ ,  $n$  can be an integer from 1 ~ 9.

## Input of function $f(x)$ and integration calculation

- Press  $\text{SHIFT} \text{ } \int$  to specify integration calculation.
- Input the formula for the function  $f(x)$ , then input integral partitions  $[a, b]$ .  
 \* $f(x)$  can use the  $X$  variable only. Anything other than  $X$  ( $A \sim W, Y, Z$  or array variables) is treated as a constant, and its memory contents are applied.
- Next input  $n$  (number of divisions for  $N=2^n$ ,  $n$  being an integer between 1 and 9) and finish by inputting a parenthesis.  
 \*Input of  $n$  (number of divisions for  $N=2^n$ ) and parenthesis can be omitted. When input is omitted,  $N$  is automatically set.
- Press  $\text{EXE}$  to execute calculation.  
 \*Results are displayed in a few seconds or a number of minutes (mantissa is number of significant digits). Note that following integration data is input in memories  $G \sim L$ :

Memory	G	H	I	J	K	L
Data	$a$	$b$	$2^n$	$\int_a^b f(x) dx$	$f(a)$	$f(b)$

## Examples of operation

**Example 1** Calculate the following:  $\int_1^5 (2x^2 + 3x + 4) dx$

$\text{MODE} \text{ } 4$  (Specify "D")

—

$\text{SHIFT} \text{ } \int \text{ } 2 \text{ } \text{ALPHA} \text{ } X \text{ } \text{SHIFT} \text{ } X^2 \text{ } + \text{ } 3 \text{ } \text{ALPHA} \text{ } X \text{ } + \text{ } 4 \text{ } )$  ( $f(x)$  input)

$f(2X^2+3X+4, _$

$1 \text{ } 5 \text{ } )$  ( $a, b$  input)

$-^2+3X+4, 1, 5, _$

$6 \text{ } )$  ( $n$  input)

$- 3X+4, 1, 5, 6) _$

$\text{EXE}$  (Calculation executed)

$f(2X^2+3X+4, 1 -$   
**134.6666667**

Answer displayed in approximately 15 seconds

$\text{RCL} \text{ } G$

$G =$  **1.**  $a$

$\text{RCL} \text{ } H$

$H =$  **5.**  $b$

$\text{RCL} \text{ } I$

$I =$  **64.**  $N$

$\text{RCL} \text{ } J$

$J =$  **134.6666667**  $\int_a^b f(x) dx$

$\text{RCL} \text{ } K$

$K =$  **9.**  $f(a)$

$\text{RCL} \text{ } L$

$L =$  **69.**  $f(b)$

**Example 2** Calculate the following, omitting specification of the number of divisions:  $\int_1^3 (\log x) dx$

**MODE** **4** (Specify "D")

**SHIFT** **f(x)** **log** **ALPHA** **X** **▷**  
 $f(x)$  input

**1** **▷** **3** **▷** ( $a, b$  input)

**EXE** (Calculation executed)

**RCL** **G**

**RCL** **H**

**RCL** **I**

**RCL** **J**

**RCL** **K**

**RCL** **L**

—

$f(\log X,$

$-\log X, 1, 3)$

$f(\log X, 1, 3) =$   
**0.56277**

**G**— **1.**

**H**— **3.**

**I**— **32.**

**J**— **0.56277**

**K**— **0.**

**L**— **0.477121254**

Answer displayed  
in approximately 8  
seconds

$a$

$b$

$N (n=5)$

$\int_a^b f(x) dx$

$f(a)$

$f(b)$

**• Application of integration calculation**

• Integrals or results of integration calculations can be used in arithmetic calculations.

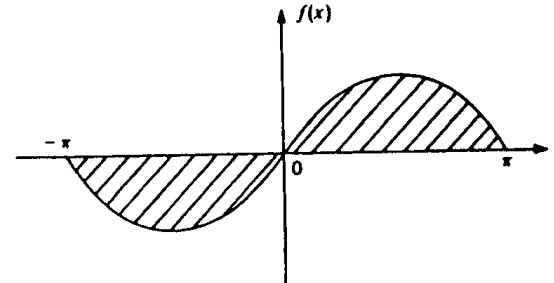
**Example**  $\int_a^b f(x) dx + \int_c^d g(x) dx, 2 \times \int_a^b f(x) dx, \text{ etc.}$

• Results of integration calculation cannot be used in integration calculation formulas.

• When calculating area, Abs (absolute value) should be inserted into formula:

$$\int (\text{Abs } f(x), a, b, n) \Rightarrow \int_a^b |f(x)| dx$$

**Example 3**



Calculate the  $[-\pi, \pi]$  areas of  $f(x) = \sin x$ . Omit input of number of divisions.

**MODE** **5** (Specify "D")

**SHIFT** **f(x)** **SHIFT** **Abs** **sin** **ALPHA** **X** **▷**  
 $f(x)$  input

**(-)** **SHIFT** **π** **▷** **SHIFT** **π** **▷**  
 $(a, b)$  input

**EXE** (Calculation executed)

**RCL** **G**

**RCL** **H**

—

$-\text{Abs sin } X,$

$-\sin X, -\pi, \pi)$

$\int(\text{Abs sin } X, -$   
**4.**

**G**— **-3.141592654**

**H**— **3.141592654**

Answer displayed  
in approximately 20  
seconds

$a$

$b$

RCL I

I = 64. N

RCL J

J = 4.  $\int_a^b f(x)dx$

RCL K

K = 0.  $f(a)$

RCL L

L = 0.  $f(b)$

### ■ Notes on integration calculation

- Press **AC** key during integration calculation (when display is blank) to abort calculation.
- Integration of trigonometric functions carried out in "E" mode (**MODE** **E**).
- This unit utilizes Simpson's rule for integration calculation. As number of significant digits is increased, extended calculation time is required. In some cases, calculation results may be erroneous even after considerable time expires in calculation. In particular, when significant digits are less than 1, an ERROR (Ma ERROR) sometimes occurs. In these cases, use the following methods to shorten calculation time and improve accuracy:

1. If integration value varies widely with slight changes in the integration range, divide integration areas to obtain solutions individually.
2. If some periodic functions or integration values are positive and some are negative, divide according to periods or divide positive and negative values and calculate individually.

## Section 4 Program Calculation

What is a program?

Program correction, addition and deletion

Program searches

Program execution

Convenient program commands

Remaining program capacity

Using the unit as a data bank