

**NAME**

`y0`, `y0f`, `y0l`, `y1`, `y1f`, `y1l`, `yn`, `ynf`, `ynl` – Bessel functions of the second kind

**SYNOPSIS**

```
#include <math.h>

double y0(double x);
double y1(double x);
double yn(int n, double x);

float y0f(float x);
float y1f(float x);
float ynf(int n, float x);

long double y0l(long double x);
long double y1l(long double x);
long double ynl(int n, long double x);
```

Link with `-lm`.

Feature Test Macro Requirements for glibc (see `feature_test_macros(7)`):

```
y0(), y1(), yn():
    _XOPEN_SOURCE
    /* Since glibc 2.19: */ _DEFAULT_SOURCE
    /* Glibc versions <= 2.19: */ _SVID_SOURCE || _BSD_SOURCE
y0f(), y0l(), y1f(), y1l(), ynf(), ynl():
    _XOPEN_SOURCE >= 600
    /* (_ISOC99_SOURCE && _XOPEN_SOURCE)
    /* Since glibc 2.19: */ _DEFAULT_SOURCE
    /* Glibc versions <= 2.19: */ _SVID_SOURCE || _BSD_SOURCE
```

**DESCRIPTION**

The `y0()` and `y1()` functions return Bessel functions of  $x$  of the second kind of orders 0 and 1, respectively. The `yn()` function returns the Bessel function of  $x$  of the second kind of order  $n$ .

The value of  $x$  must be positive.

The `y0f()`, `y1f()`, and `ynf()` functions are versions that take and return *float* values. The `y0l()`, `y1l()`, and `ynl()` functions are versions that take and return *long double* values.

**RETURN VALUE**

On success, these functions return the appropriate Bessel value of the second kind for  $x$ .

If  $x$  is a NaN, a NaN is returned.

If  $x$  is negative, a domain error occurs, and the functions return `-HUGE_VAL`, `-HUGE_VALF`, or `-HUGE_VALL`, respectively. (POSIX.1-2001 also allows a NaN return for this case.)

If  $x$  is 0.0, a pole error occurs, and the functions return `-HUGE_VAL`, `-HUGE_VALF`, or `-HUGE_VALL`, respectively.

If the result underflows, a range error occurs, and the functions return 0.0

If the result overflows, a range error occurs, and the functions return `-HUGE_VAL`, `-HUGE_VALF`, or `-HUGE_VALL`, respectively. (POSIX.1-2001 also allows a 0.0 return for this case.)

**ERRORS**

See `math_error(7)` for information on how to determine whether an error has occurred when calling these functions.

The following errors can occur:

Domain error:  $x$  is negative

`errno` is set to `EDOM`. An invalid floating-point exception (`FE_INVALID`) is raised.

Pole error:  $x$  is 0.0

*errno* is set to **ERANGE** (but see BUGS). No **FE\_DIVBYZERO** exception is returned by **fetestexcept(3)** for this case.

Range error: result underflow

*errno* is set to **ERANGE**. No **FE\_UNDERFLOW** exception is returned by **fetestexcept(3)** for this case.

Range error: result overflow

*errno* is not set for this case. An overflow floating-point exception (**FE\_OVERFLOW**) is raised.

## ATTRIBUTES

For an explanation of the terms used in this section, see **attributes(7)**.

Interface	Attribute	Value
<b>y0()</b> , <b>y0f()</b> , <b>y0l()</b>	Thread safety	MT-Safe
<b>y1()</b> , <b>y1f()</b> , <b>y1l()</b>	Thread safety	MT-Safe
<b>yn()</b> , <b>ynf()</b> , <b>ynl()</b>	Thread safety	MT-Safe

## CONFORMING TO

The functions returning *double* conform to SVr4, 4.3BSD, POSIX.1-2001, POSIX.1-2008. The others are nonstandard functions that also exist on the BSDs.

## BUGS

On a pole error, these functions set *errno* to **EDOM**, instead of **ERANGE** as POSIX.1-2004 requires.

In glibc version 2.3.2 and earlier, these functions do not raise an invalid floating-point exception (**FE\_INVALID**) when a domain error occurs.

## SEE ALSO

**j0(3)**

## COLOPHON

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