**PreCalculus 12.1 An Introduction to Limits**

**Limit –** the value of a function as the variable approaches a certain value.

Limit = as *x* approaches *c*, the value of the function gets closer to the Limit.

Example: use the table to find:

|  |  |
| --- | --- |
| *x* |  |
| 2.9 |  |
| 2.99 |  |
| 2.999 |  |
|  |  |
| 3.001 |  |
| 3.01 |  |
| 3.1 |  |

Example: use the table to find:

|  |  |
| --- | --- |
| *x* |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

**Estimating a Limit (we make the table)**

Estimate:

|  |  |
| --- | --- |
| *x* |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

**Using a graph to find a Limit**

Graph:

Use the trace feature to get closer and closer to from the left side () and the right side ().

**Limits that Fail to Exist**

1. approaches a different number from the left side and the right side.
2. increases/decreases without bound as *x* approaches the value of *c*.
3. oscillates between two fixed values as .

Examples:

|  |  |
| --- | --- |
| *x* |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

|  |  |
| --- | --- |
| *x* |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

Graph:

**Basic Limits**

Let *b* and *c* be real numbers and let *n* be a positive integer.

**Properties of Limits**

Let *b* and *c* be real numbers and let *n* be a positive integer, and let *f* and *g* be functions with the following limits.

and

1. Scalar multiple:
2. Sum or difference:
3. Product:
4. Quotient:
5. Power:

**Direct Substitution to find a Limit**

Examples: Find each limit.

**Limits of Polynomial and Rational Functions**

1. If *P* is a polynomial and *c* is a real number.

1. If *r* is a rational function:

Examples: Find each limit.