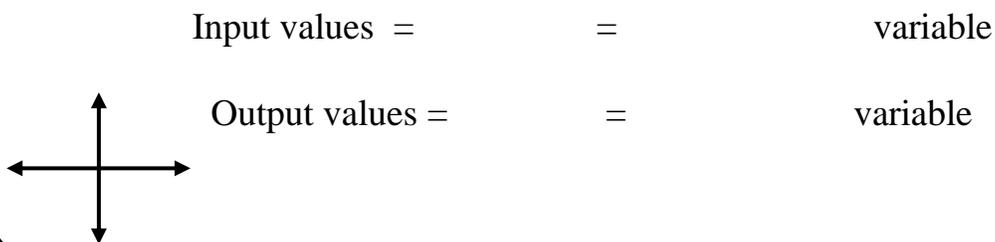


Write your questions  
and thoughts here!**Function**

A **function** is a mathematical relation that maps a set of \_\_\_\_\_ values to a set of \_\_\_\_\_ values such that each input value is mapped to exactly \_\_\_ output value.



Often, it is useful to use other variables that help us recognize the representation. For example, if we throw a football and measure the height, we could use variables where \_\_\_\_\_ is the height of the football and \_\_\_\_\_ is the number of seconds since the football was thrown.

**Function notation** helps us immediately identify which variables are the input and which are the output. For the football example, we would use...

1.  $w(x)$  is a function where  $w$  is the amount of water in a pool measured in gallons, and  $x$  is the length of the pool.
  - a. What does the independent variable represent?
  - b. What does the dependent variable represent?

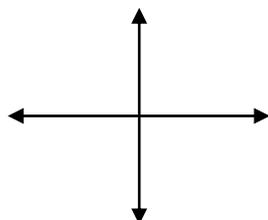
These two variables will **vary in tandem** according to the function rule that is established. That rule can be expressed **V**erbally, **A**nalytically, **N**umerically, or **G**raphically... . Throughout this course, you will use all four of these types of expressions to represent a function.

**Increasing function if...**

Verbally: ...as the input values increase, the output values always

Analytically: ...for all  $a$  and  $b$  in the interval, if

Graphically:

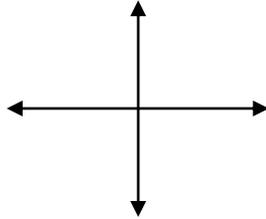


### Decreasing function if...

Verbally: ...as the input values increase, the output values always

Analytically: ...for all  $a$  and  $b$  in the interval, if

Graphically:



2. Example of **numerically**: Let the function  $f$  be increasing or decreasing, but not both. State whether the function is increasing or decreasing on the interval and **justify**.

$x$	4	6	7	10	20
$f(x)$	1	1.01	1.04	1.06	1.29

### Basic elements of a function's graph

- Zero

The graph intersects the  $x$ -axis (independent) when the \_\_\_\_\_ value is zero. We call the INPUT values \_\_\_\_\_.

- $y$ -intercept

The graph intersects the  $y$ -axis (dependent) when the \_\_\_\_\_ value is zero. We call the output value the \_\_\_\_\_.

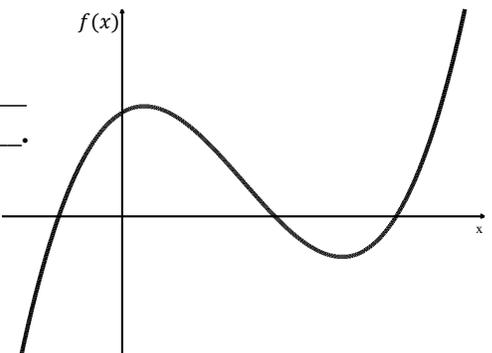
- Concavity

Concave UP

Concave DOWN

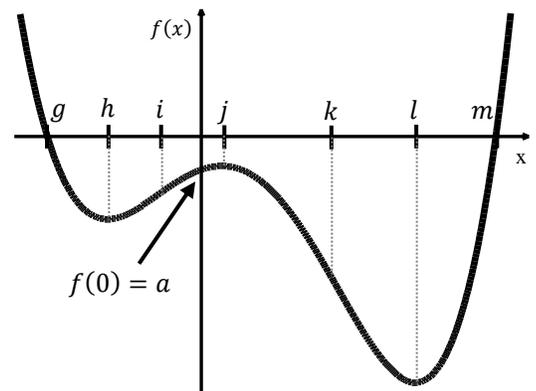
Straight lines don't have concavity.

Point of inflection (point where the concavity changes)



Use the graph of  $f$  below to answer the following questions.

- When is the graph concave up?
- When is the graph concave down?
- Find the zero(s) of the function.
- Find the  $y$ -intercept(s) of the function.
- When is the graph increasing?
- When is the graph decreasing?



# 1.1 Change in Tandem

AP Precalculus

# 1.1 Practice

**For each function, identify what the dependent and independent variables represent.**

1.  $b(s)$  is a function where  $b$  is the number of books in the library and  $s$  is the number of students in the school.

Dep:

Indep:

2.  $p(t)$  is a function where  $t$  is the number of years since kindergarten and  $p$  is the number of Pokemon cards.

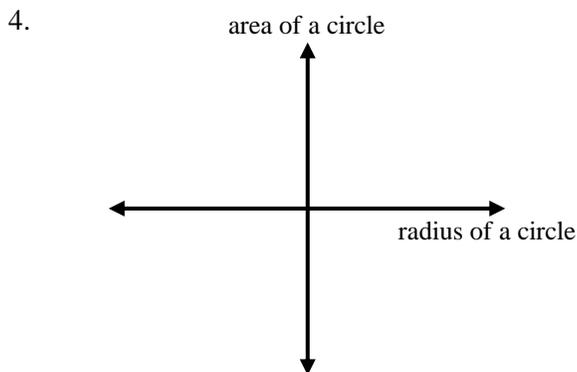
Dep:

Indep:

3.  $c(t)$  is a function where  $c$  is the number of cups of coffee consumed and  $t$  is the number of teachers at the school.

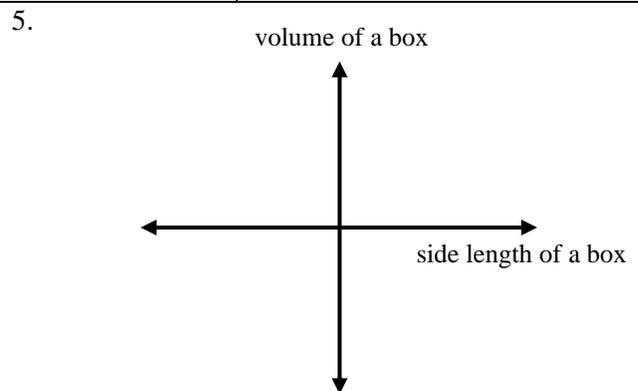
Dep:

Indep:



Dep:

Indep:



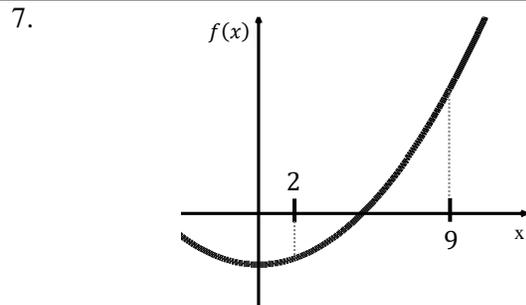
Dep:

Indep:

**Let the function  $f$  be increasing or decreasing, but not both. State whether the function is increasing or decreasing on the given interval and justify your answer.**

6.

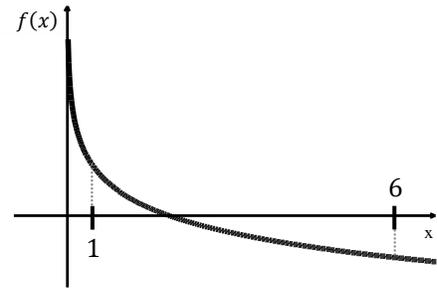
$x$	1	2	3	4	5
$f(x)$	95	90	75	50	10



8.

$x$	12	16	18	25	31
$f(x)$	8	7.99	7.8	7.75	7.7

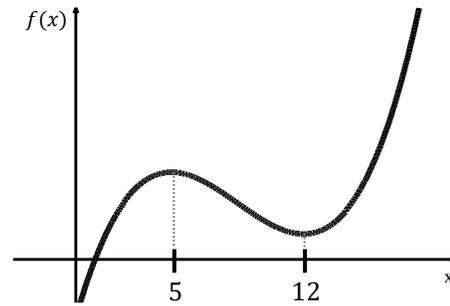
9.



10.

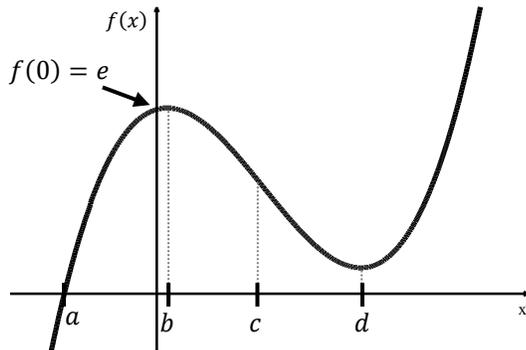
$x$	101	201	301	401	501
$f(x)$	10	11	12	13	14

11.



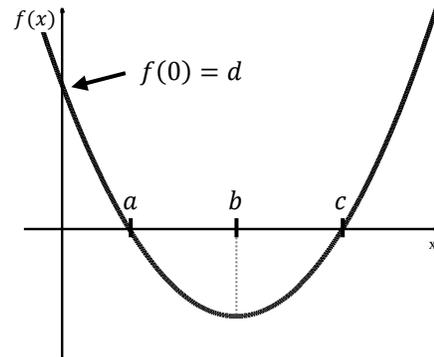
Use the graph of  $f$  to answer the question below.

12.



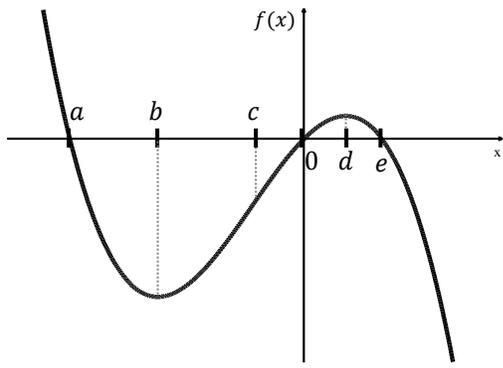
- On what interval(s) is the graph concave up?
- On what interval(s) is the graph concave down?
- On what interval(s) is the graph increasing?
- On what interval(s) is the graph decreasing?
- Find the zeros of the function.
- Find the y-intercept of the function.

13.



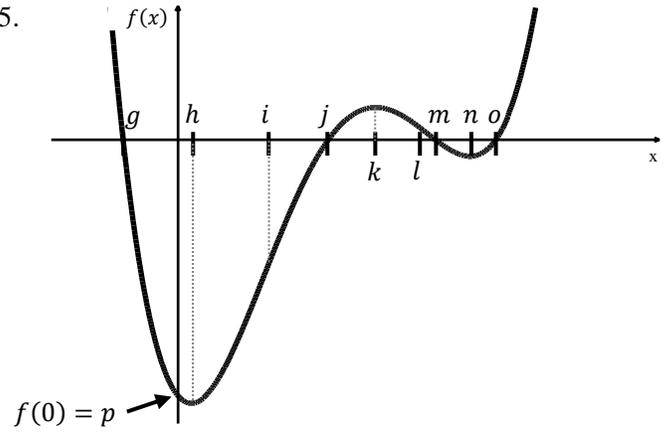
- On what interval(s) is the graph concave up?
- On what interval(s) is the graph concave down?
- On what interval(s) is the graph increasing?
- On what interval(s) is the graph decreasing?
- Find the zeros of the function.
- Find the y-intercept of the function.

14.



- On what interval(s) is the graph concave up?
- On what interval(s) is the graph concave down?
- On what interval(s) is the graph increasing?
- On what interval(s) is the graph decreasing?
- Find the zeros of the function.
- Find the  $y$ -intercept of the function.

15.



- On what interval(s) is the graph concave up?
- On what interval(s) is the graph concave down?
- On what interval(s) is the graph increasing?
- On what interval(s) is the graph decreasing?
- Find the zeros of the function.
- Find the  $y$ -intercept of the function.

## 1.1 Change in Tandem

## 1.1 Test Prep

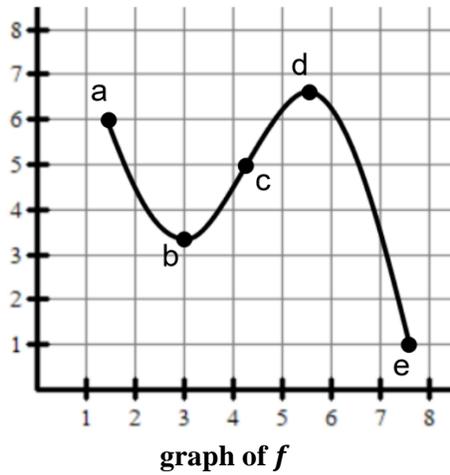
### Multiple Choice

16. Let the function  $f$  be defined as a function that is always decreasing. The table shows values for the function  $f$  at selected values of  $x$ . Which of the following represents all possible values for  $a$  ?

- $-5 < a < 7$
- $-2 < a < 0$
- $0 < a < 3$
- $-2 < a < 4$
- $-15 < a < 12$

$x$	$f(x)$
-5	12
-2	4
0	$a$
3	-2
7	-15

For questions 17-18 use the graph of  $f$ .



17. The figure shows the graph of a function  $f$ . Let  $a$ ,  $b$ ,  $c$ ,  $d$ , and  $e$  represent the  $x$ -coordinates at those points. Of the following, which is a point of inflection?

- (A) point  $a$
- (B) point  $b$
- (C) point  $c$
- (D) point  $d$
- (E) point  $e$

18. The figure shows the graph of a function  $f$ . Let  $a$ ,  $b$ ,  $c$ ,  $d$ , and  $e$  represent the  $x$ -coordinates at those points. Of the following, on which interval is  $f$  decreasing and the graph of  $f$  concave down?

- (A) The interval from  $a$  to  $b$ .
- (B) The interval from  $b$  to  $c$ .
- (C) The interval from  $c$  to  $d$ .
- (D) The interval from  $d$  to  $e$ .
- (E) None of the above.