*Def* A ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** from a set *D* to a set *Y* is a rule that assigns an element to some element .

The only rules are that they need to be 1. Reflexive, 2. Symmetric, and 3. Transitive.

A function is a relation that has more rules imposed upon it.

*Def* A ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** from a set *D* to a set *Y* is a rule that assigns a unique (single) element to each element . The set *D* of all possible input values is called the ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_***. The set containing all output values is called the ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_***. A function is called ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** if its range consists of only real numbers. A function is of a **\_\_\_\_\_\_\_\_\_\_\_\_\_** if its domain consists of only real numbers.

The test for a function is the Vertical Line test. Why does this work?

For one point circle the correct T or F. For the rest of the points state why it is.

***T/F*** *All relations are functions.*

Ex 1 Find the domain and range of each function.

Ex 2 evaluate the function from c and e in the previous example at

*Def* An ***\_\_\_\_\_\_\_\_\_\_\_\_ function*** is any function that is not solved exclusively for y.

*Def* An ***\_\_\_\_\_\_\_\_\_\_\_\_\_ function*** is any function that is solved exclusively for y.

*Def* A ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** *is a function defined piecewise, that is is defined by different expression on various intervals.*

*Ex:*

*Create your own example:*

*Ex3: Create a linear function which has both a positive and negative slope and is not defined on*

Ex 4 Find a formula for each graph.

 

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Transformations of Function (rigid and non-rigid)

A transformation is the process of taking one equation or graph and performing some operation on it. The effect this has is called a transformation. Some of the possible effects can be classified as Rigid and Non-rigid.

Rigid Transformations are transformations where the graph shape remains untouched, only its position is changed. Pin the tail on the donkey is an example of a rigid transformation of the donkeys tail.

Non-rigid transformations are transformations where the actual shape of the graph is warped, stretched, or simply changed (through composition or some algebraic operation).

## Shift, Scaling, and Reflecting Formulas

*Rigid transformations are the following:*

 Shifts the graph of \_\_\_\_\_\_\_\_ units if

 Shifts the graph of \_\_\_\_\_\_\_\_ units if

 Shifts the graph of \_\_\_\_\_\_\_\_\_ units if

 Shifts the graph of \_\_\_\_\_\_\_\_\_ units if

 Reflects the graph of across the \_\_\_-axis

 Reflects the graph of across the \_\_\_-axis

Non-rigid transformations are the following:

**For ,**

 \_\_\_\_\_\_\_\_\_\_\_\_ the graph of \_\_\_\_\_\_\_\_\_\_\_\_\_ by a factor of

 \_\_\_\_\_\_\_\_\_\_\_\_ the graph of \_\_\_\_\_\_\_\_\_\_\_\_\_ by a factor of

 \_\_\_\_\_\_\_\_\_\_\_\_ the graph of \_\_\_\_\_\_\_\_\_\_\_\_\_ by a factor

 \_\_\_\_\_\_\_\_\_\_\_\_ the graph of \_\_\_\_\_\_\_\_\_\_\_\_\_ by a factor of

**For** this becomes the last two rigid transformations listed above

Note: If , factor -1 out and “For ” above applies.

*Transformation of Trig Graphs*

 – Amplitude: vertical stretch or compression; reflection about -axis if negative

 – horizontal stretch or compression; reflection about -axis if negative

 – horizontal shift

 – vertical shift

Ex 5 The accompanying figure shows the graph of shifted to four new positions. Write equations for the new graphs.



 From top most vertex (a) down to lowest vertex (d)

 a)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ c)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 b)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ d)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Standard Equation of Circle with center Standard Equation of Ellipse with center*

Ex 6 Give an equation for the shifted graph. Then sketch the original and shifted graphs together.

1. Down 3, right 2 Eqn: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Up 3, left 4 Eqn: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Down 1, left 1 Eqn: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Up 3, right 1 Eqn: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Classifications and Combinations of Functions

*(Graph them)*

***linear functions***

***power functions*** , where is a constant

***nth root functions***

* ***square root functions***
* ***cube functions***

***polynomial functions***

* ***linear functions***
* ***quadratic functions***
* ***cubic functions***

***rational functions*** where and are polynomial functions and

***algebraic functions*** – any function constructed from polynomials using algebraic operations (such as addition, subtraction, multiplication, division, and taking roots) Note: could be multivariate (and thus polynomial, power, nth root, and rational functions are each a strict subset of algebraic functions)

***trigonometric functions*** – sine, cosine, tangent, and their reciprocals: cosecant, secant, cotangent (see Appendix B for review)

***exponential functions***

***logarithmic functions***

***transcendental functions*** – nonalgebraic function such as the trig, inverse trig, exponential, logarithmic, and hyperbolic functions.

*Defn* A function is called an

***even function*** if (graph of is symmetric about the -axis)

***odd function*** if (graph of is symmetric about the origin)

for every in the function’s domain

Note: is an even function if is even and an odd function if is odd

Ex 2 Decide whether the function is even, odd, or neither.

Note: Even and odd functions follow the same multiplication and division rules for +/- signs.

*Algebra of Functions (Notation)*

, where

*Defn* If and are functions, the ***composite*** function (“ composed with ”) is defined by

.

The domain of consists of all the numbers in the domain of for which is in the domain of . In terms of sets, this is the intersection of Dom f & Dom g;

I.E. Dom Dom Dom .

Ex 1 (# 6) If and , find the following:

Ex 2 (#10) Let and . Express each of the functions as a composite involving one or more of and .