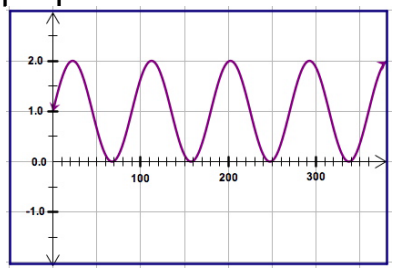
Card Games – Trigonometric Functions

This document includes a collection of card games.

1. **Periodic Functions Cards**: Cards depicting various transformations of y = sinx are provided. Identify the key properties (amplitude, period, maximum & minimum values) of each graph and match graphs that share common key properties.



2. **Key Properties of the Sine Function Cards**: Explore the key properties of y = sin x by matching cards depicting the name of each key property with a visual image, value or brief description, and definition. Variations of this game include Memory Match and Go Fish.

3. **Relations Cards**: Classify various graphs and contextual situations as either linear, quadratic, periodic or other. Determine whether or not each relation is a function.

Periodic Functions Cards

The card set contains 16 “Graph” cards
The answer key (last page) references the graph card numbers.
The cards can be used in a variety of ways.

Suggestion 1
Pick one of the graph cards. Determine the key properties of the graph.

Suggestion 2
Pick one of the graph cards. Find all cards that have a curve with the same period.

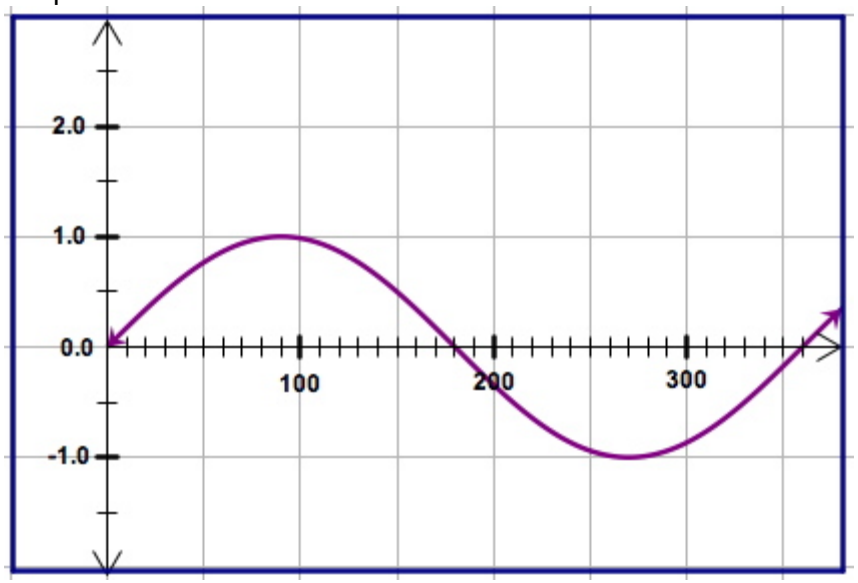
Suggestion 3
Pick one of the graph cards. Find all cards that have a curve with the same maximum value (or minimum value).

Suggestion 4
Pick one of the graph cards. Find all the cards that have a curve with the same amplitude.

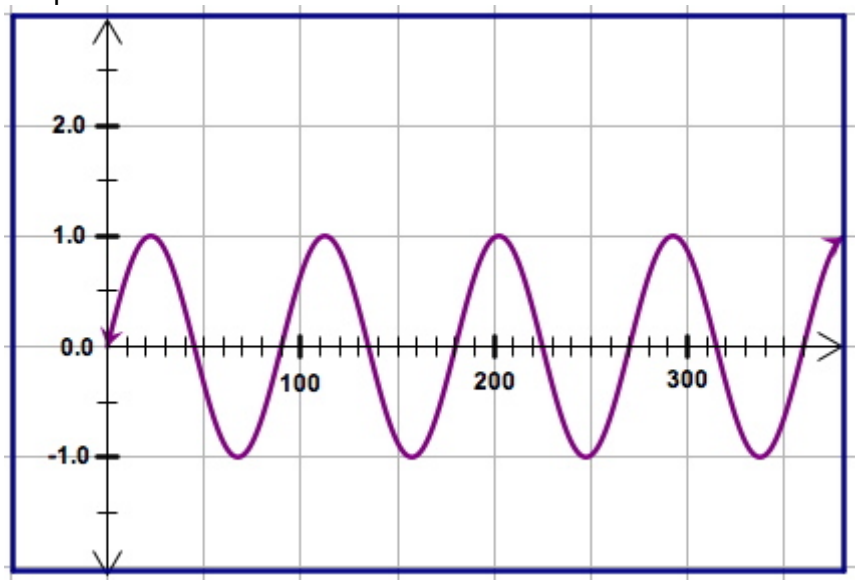
Suggestion 5
Pick one of the graph cards. Sketch a curve with the same amplitude and period but different maximum and minimum values.

Suggestion 6
Create additional cards for the set.

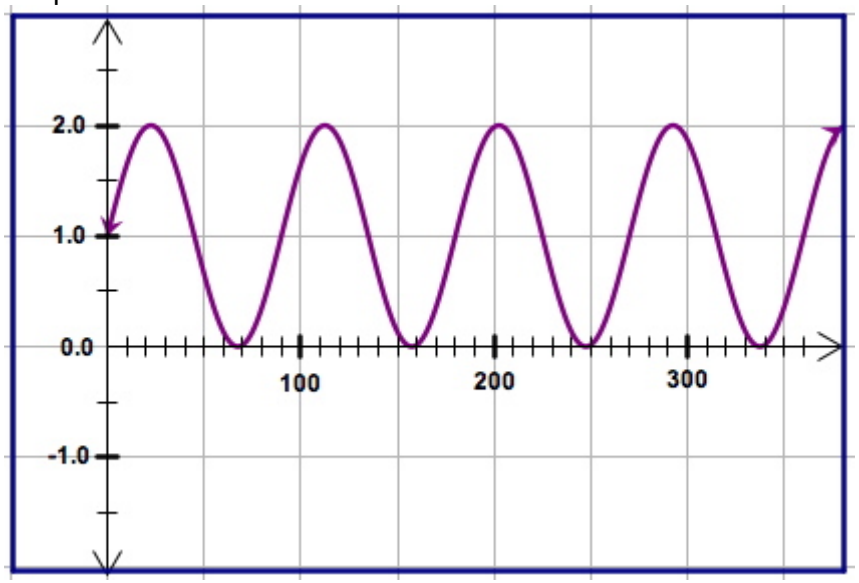
Graph 1



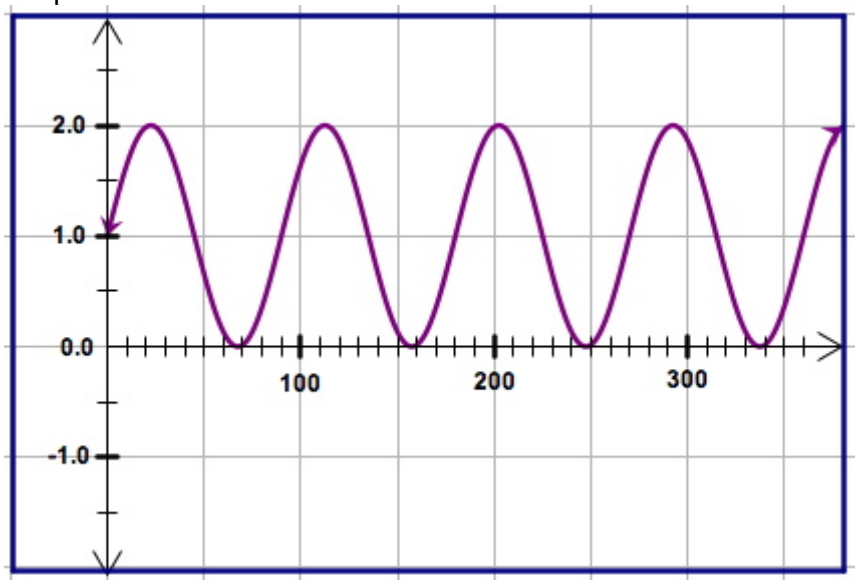
Graph 2



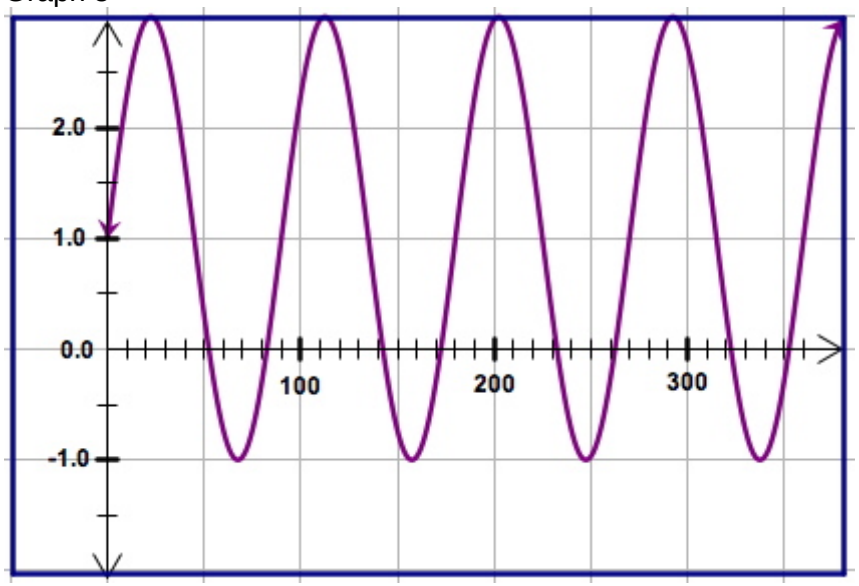
Graph 3



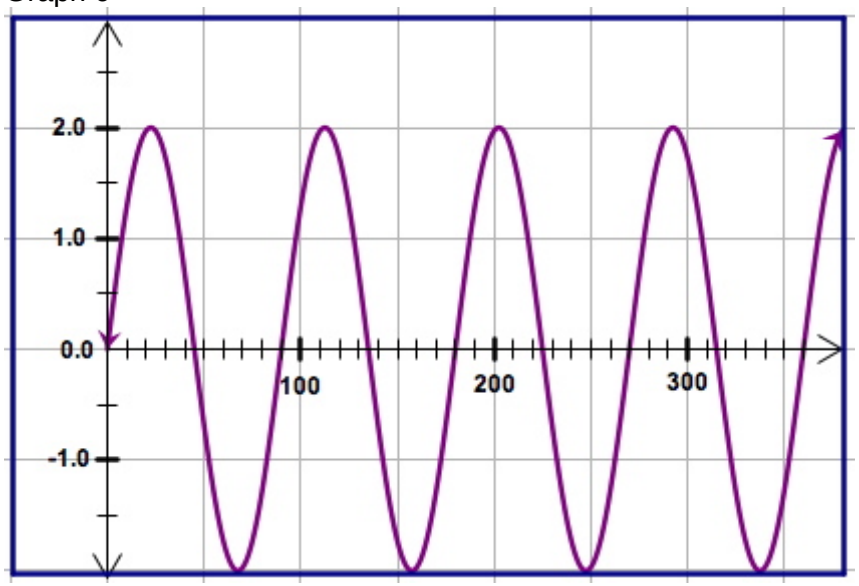
Graph 4



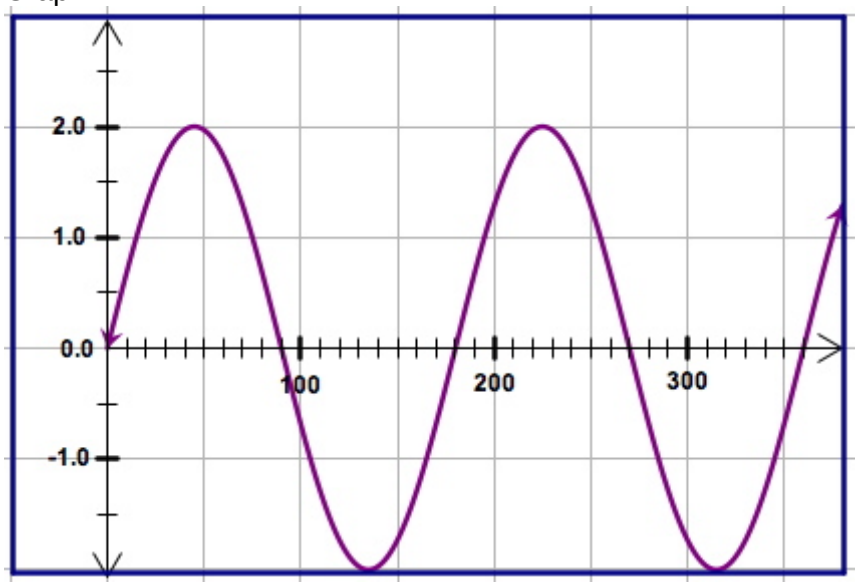
Graph 5



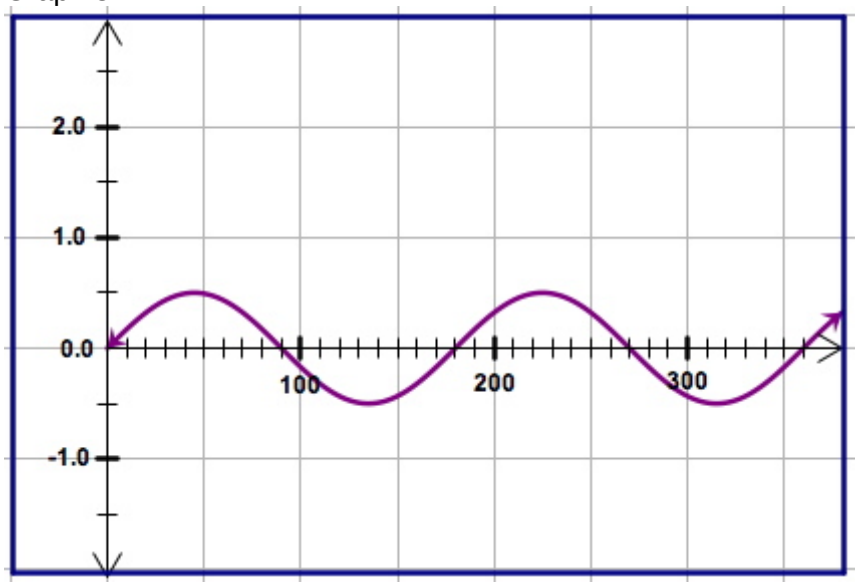
Graph 6



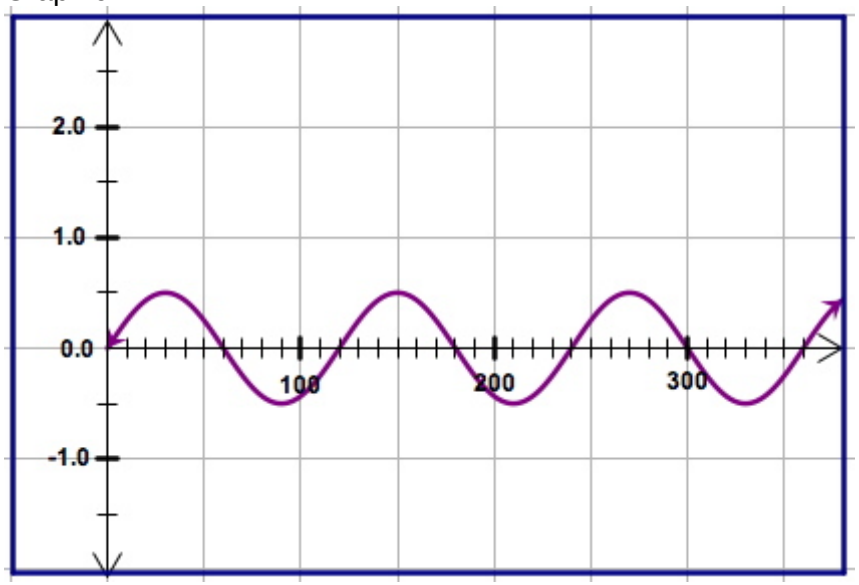
Graph 7



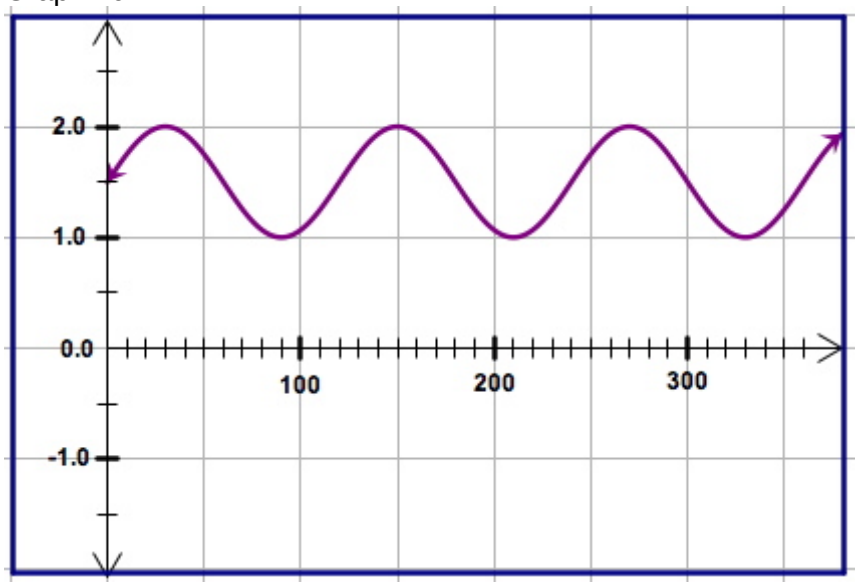
Graph 8



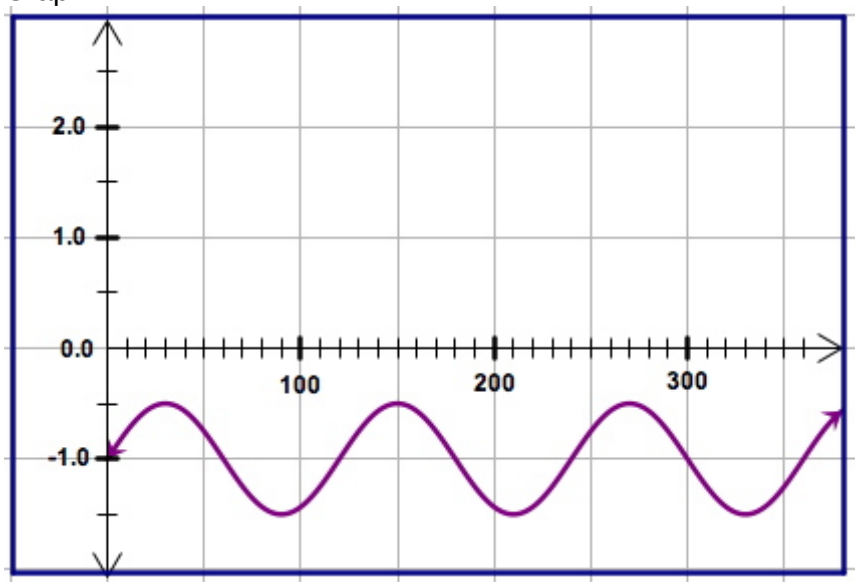
Graph 9



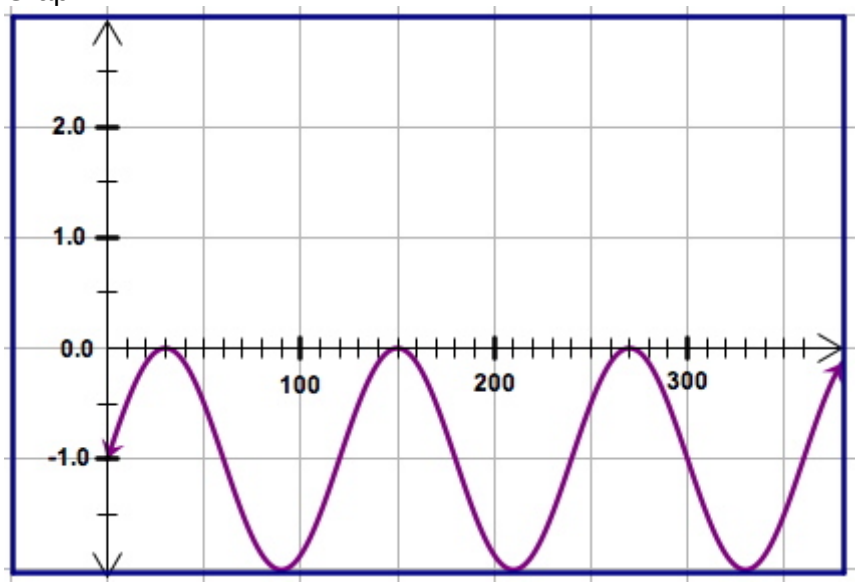
Graph 10



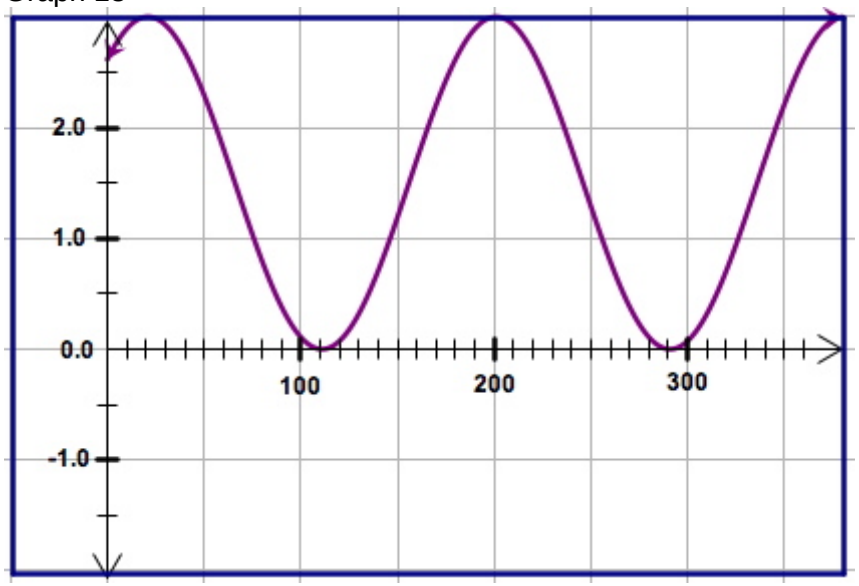
Graph 11



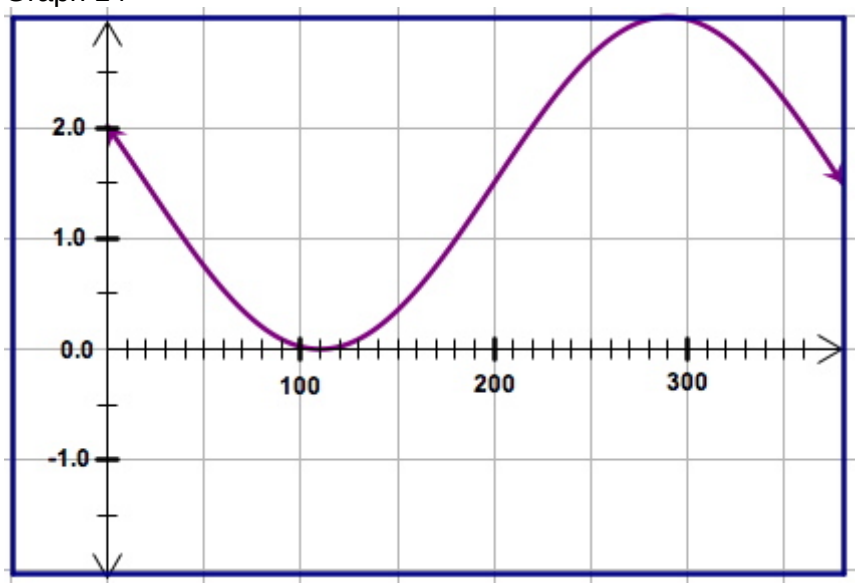
Graph 12



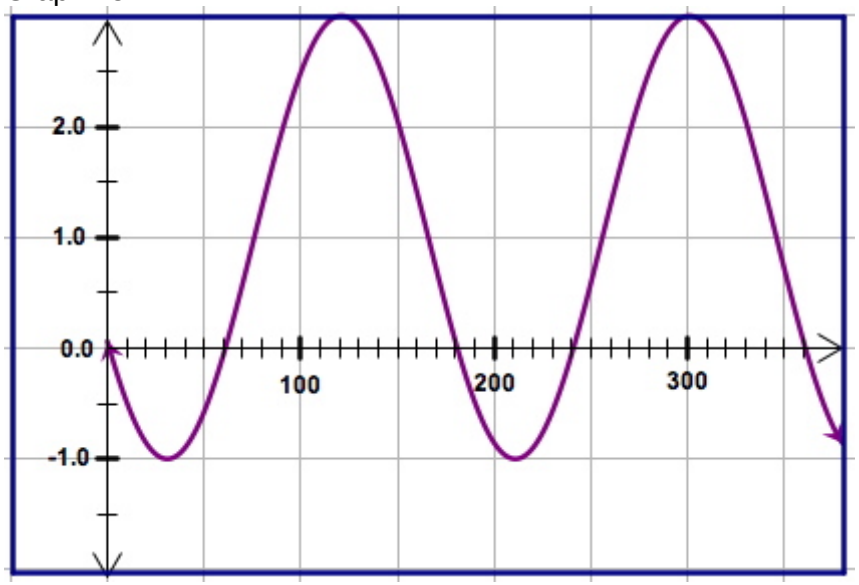
Graph 13



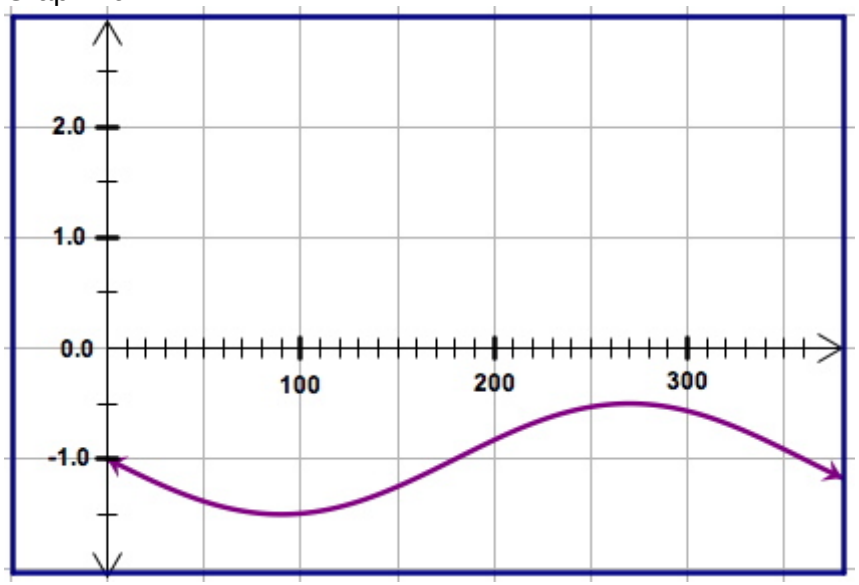
Graph 14



Graph 15



Graph 16



Key Properties

No.	Maximum Value	Minimum Value	Amplitude	Period
1	1.0	-1.0	1.0	360
2	1.0	-1.0	1.0	90
3	2.0	0.0	1.0	90
4	2.0	0.0	1.0	90
5	3.0	-1.0	2.0	90
6	2.0	-2.0	2.0	90
7	2.0	-2.0	2.0	180
8	0.5	-0.5	0.5	180
9	0.5	-0.5	0.5	120
10	2.0	1.0	0.5	120
11	-0.5	-1.5	0.5	120
12	0.0	-2.0	1.0	120
13	3.0	0.0	1.5	180
14	3.0	0.0	1.5	360
15	3.0	-1.0	2.0	180
16	-0.5	-1.5	0.5	360

Key Property	Graphs with the same key property
Maximum Value	1, 2
	3, 4, 6, 7, 10
	5, 13, 14, 15
	8, 9
	11, 16
Minimum Value	1, 2, 5, 15
	3, 4, 13, 14
	6, 7, 12
	8, 9
	11, 16
Amplitude	1, 2, 3, 4, 12
	5, 6, 7, 15
	8, 9, 10, 11, 16
	13, 14
Period	1, 14, 16
	2, 3, 4, 5, 6
	7, 8, 13, 15
	9, 10, 11, 12

Key Properties of the Sine Function cards

The set contains 44 cards, four cards for each key property.

Each key property has a card depicting:

- property name
- visual image
- value or brief description
- definition

The cards can be used in a variety of ways.

Suggestion 1
Pick one of the cards. Find all cards that depict the same key property.

Suggestion 2
Play a version of Memory. Turn all cards face down. Pick two cards. If they depict the same key property, keep them. Otherwise, return them to the table face down. (This could be played solitaire or with others.)

Suggestion 3
Use the cards to play any card game where matching is required.

Go Fish, for example, could be played. Each player is dealt a number of cards (7). In turns, each player asks others for cards with the same key properties as one he/she is holding in his/her own hand. When a player collects all four cards representing a key property, the set is put down in front of them. The player with the most sets in the end wins.

Other card games, or solitaire games requiring matching could be adapted.

Suggestion 4
Use the cards to pick random groupings for the class. Each student draws a random card. Students with cards that match the same key property form a group.

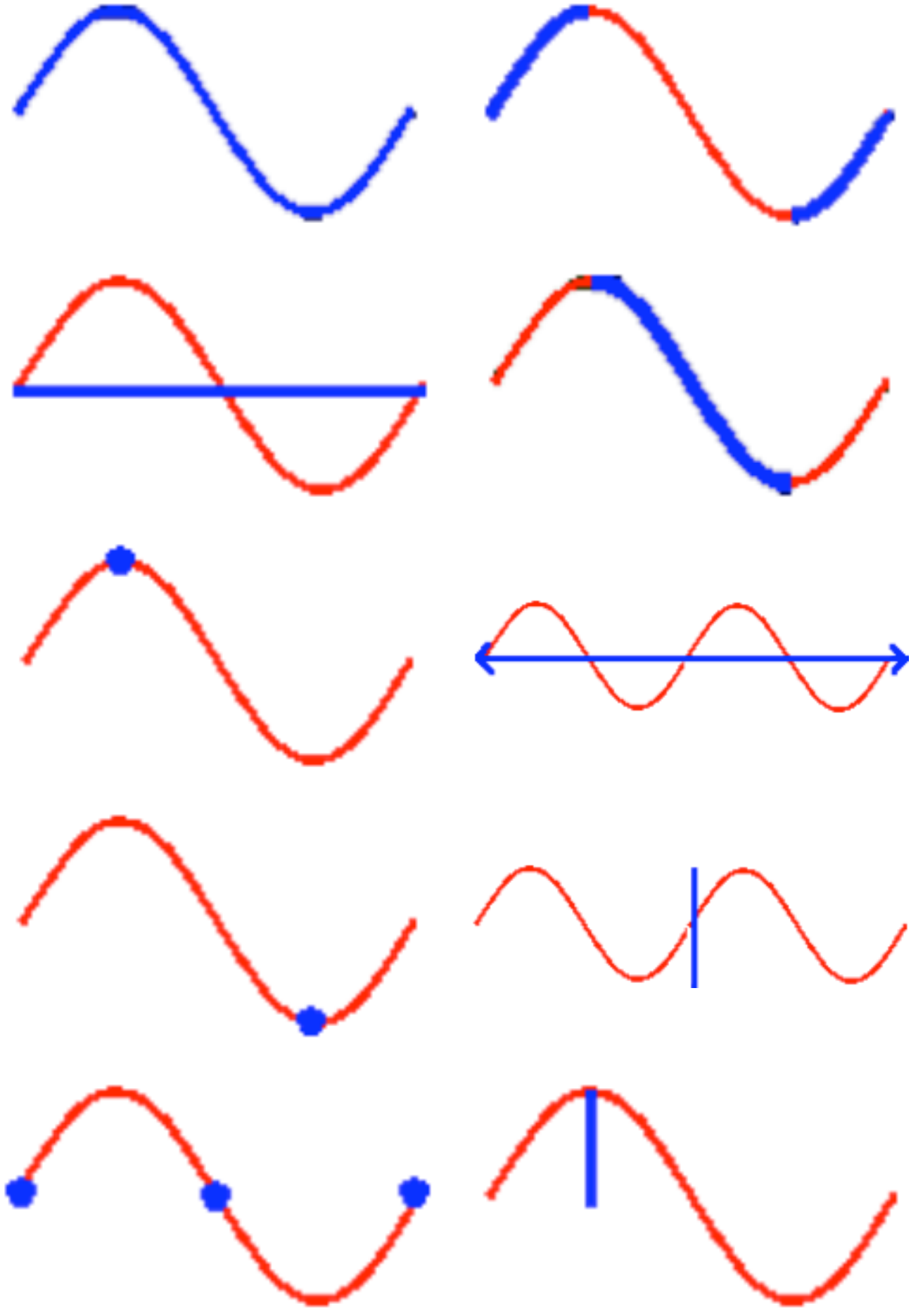
Notes*:*
The PDF of the cards were designed using the same size as Avery Business Cards – style # 05371. A custom back is provided as the final page in this PDF if you wish to run the sheet of cardstock through the printer twice.

The first ten properties are depicted in the four full pages (each property is in the same relative position on each page) – the eleventh property is on the following half page. (The custom back is the final page.)

Key Properties of the Sine Function

cycle	**increasing interval(s)**
period	**decreasing interval(s)**
maximum value	**domain**
minimum value	**range**
zeroes	**amplitude**

Key Properties of the Sine Function



1 wave	0° to 90° , 270° to 360°
360°	90° to 270°
1	$\{x \mid x \in R\}$
-1	$\{y \mid -1 \leq y \leq 1\}$
0°, 180°, 360°	1

the smallest part of the graph, or the smallest shape, that repeats

the portion of the function during which the y-values keep getting higher while moving forward along the x-axis

the length of one cycle

the portion of the function during which the y-values keep getting lower while moving forward along the x-axis

the y-value of a highest point on the graph

the set of all possible x-values for which the function is defined

the y-value of a lowest point on the graph

the set of all possible y-values output by the function

the x-values of points on the horizontal axis of the curve

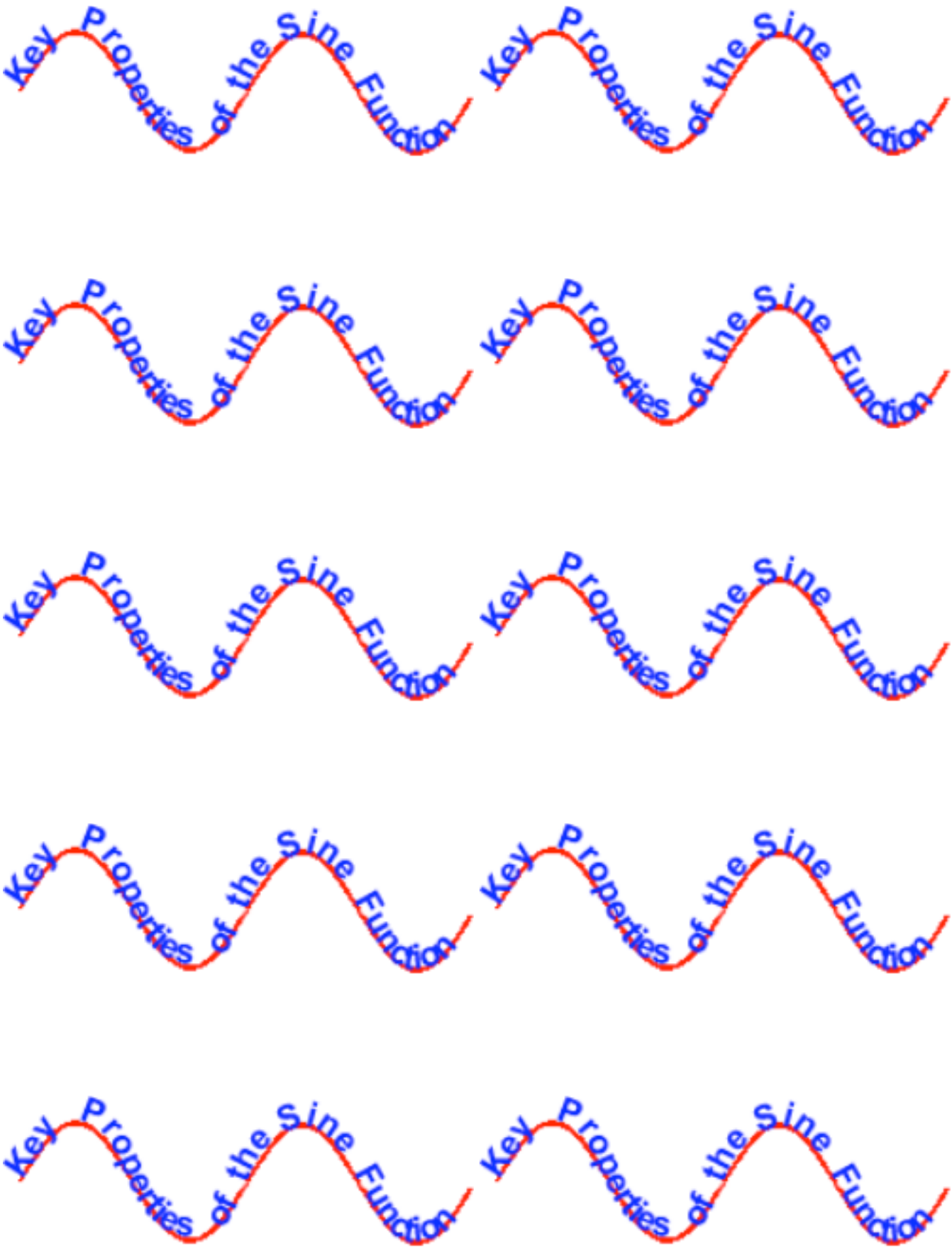
the maximum height from the horizontal axis through the middle of the curve

phase shift

0

the horizontal shift left or right of a function out of standard position

Key Properties of the Sine Function - back of card - use Avery Business Card # 05371



Relations Cards

The card set contains:

- 14 “Graph” cards
- 11 “Context” cards
- 4 “Type of Relation” cards
- 2 “Function” cards

The answer key (last page) references the graph or context card numbers.
The cards can be used in a variety of ways.

Suggestion 1
Pick one of the “Type of Relation” cards (e.g., linear, quadratic, periodic, other) and one of the “Function” cards, then find all the “Graph” cards that match.

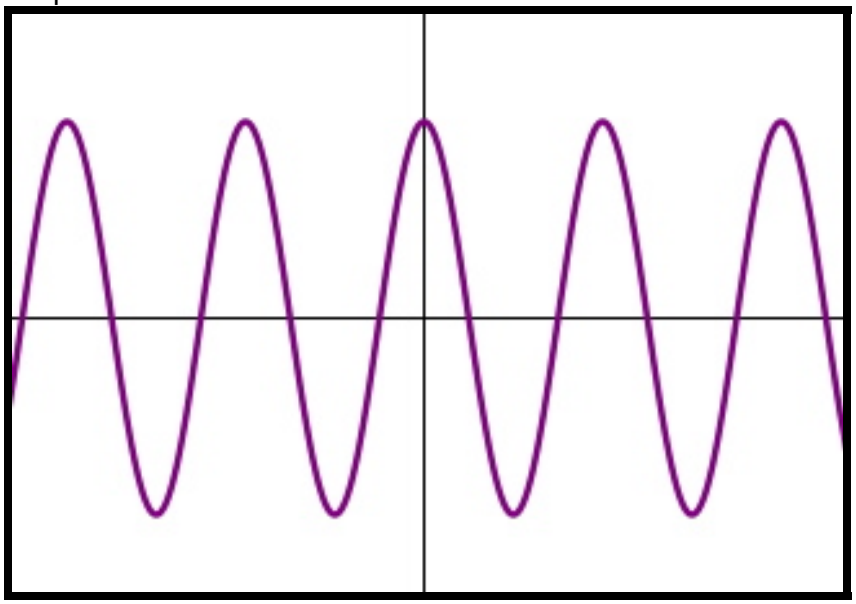
Suggestion 2
Pick one of the “Type of Relation” cards (e.g., linear, quadratic, periodic, other) and one of the “Function” cards, then find all the “Context” cards that match.

Suggestion 3
Pick one of the graph or context cards then select the matching “Type of Relation” card and the matching “Function” card.

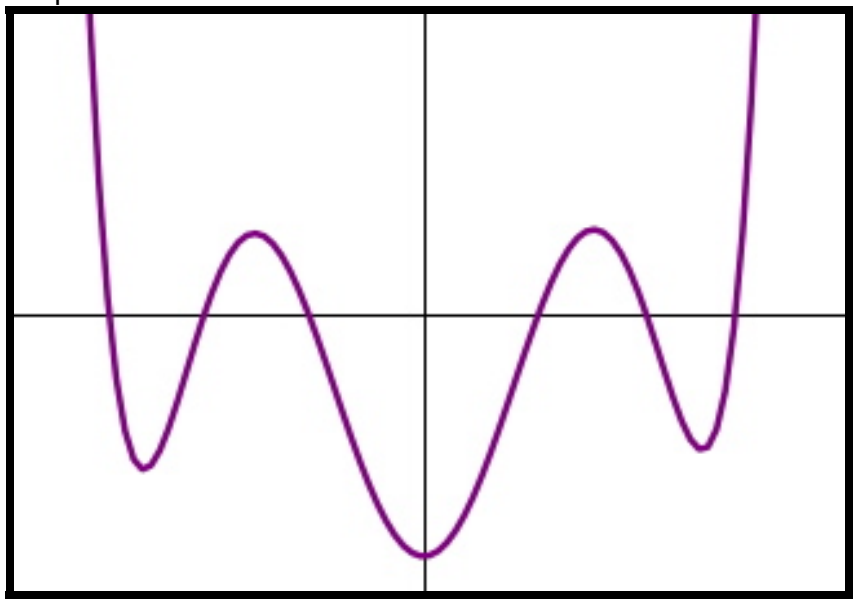
Suggestion 4
Create additional cards for the set.

Suggestion 5
Group the cards in different ways, and state your grouping criteria.

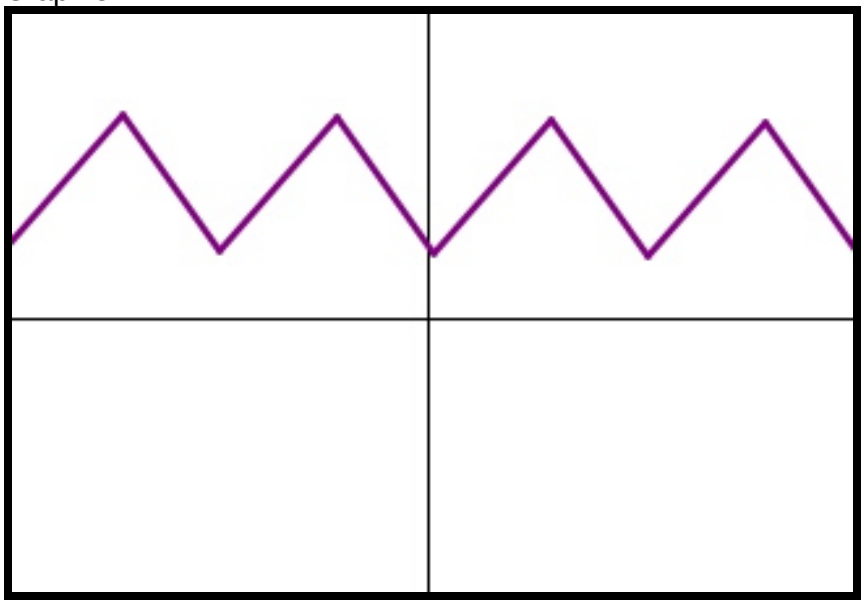
Graph 1



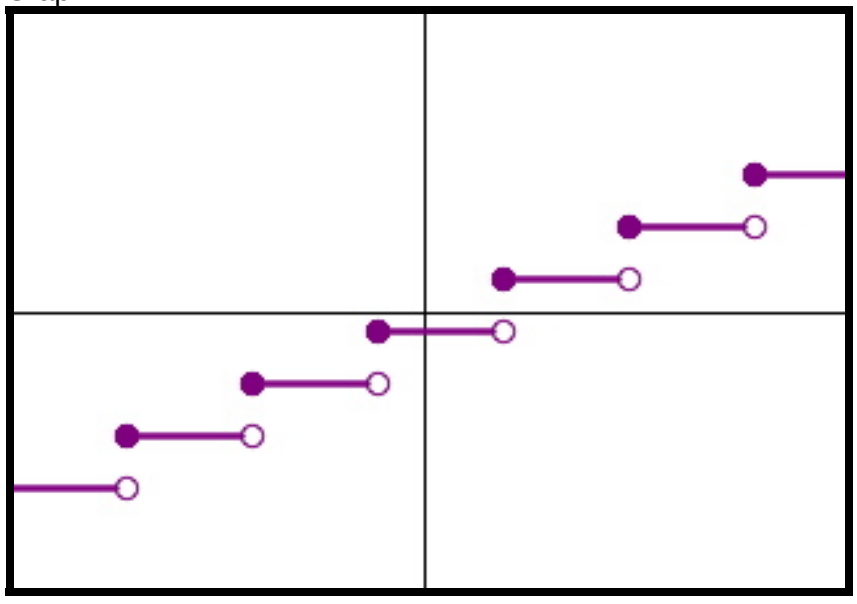
Graph 2



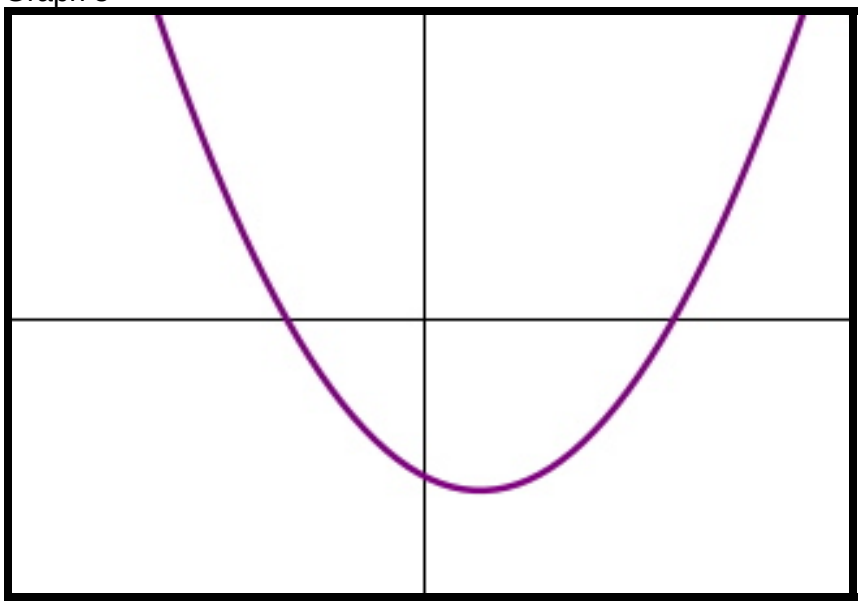
Graph 3



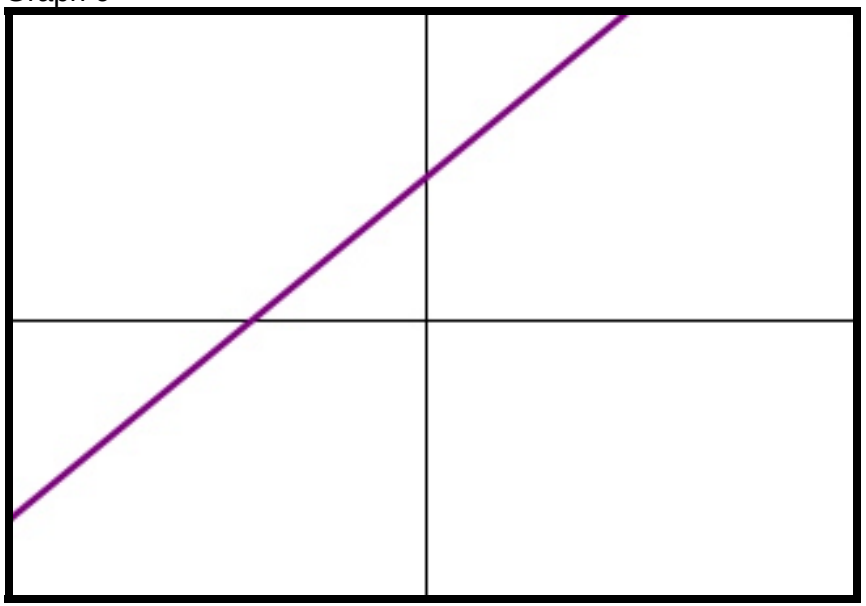
Graph 4



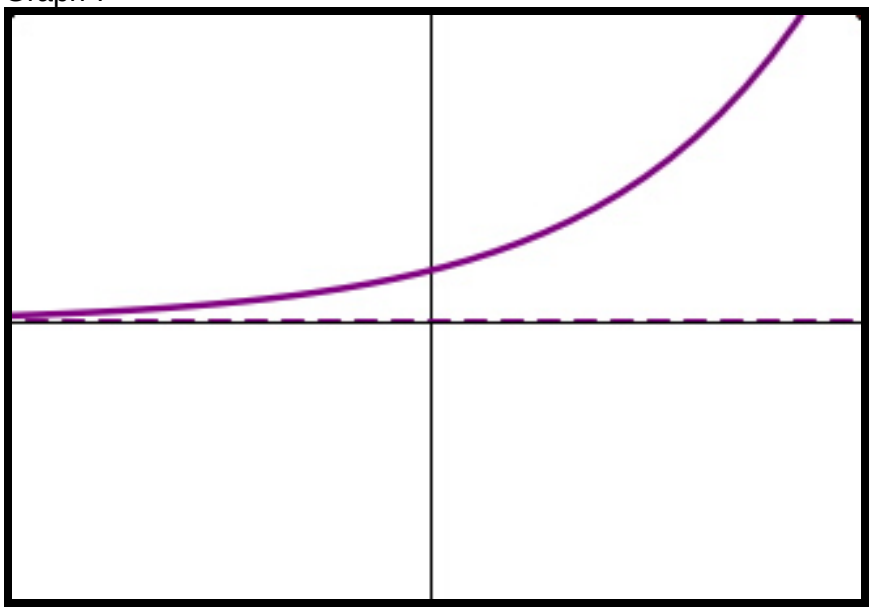
Graph 5



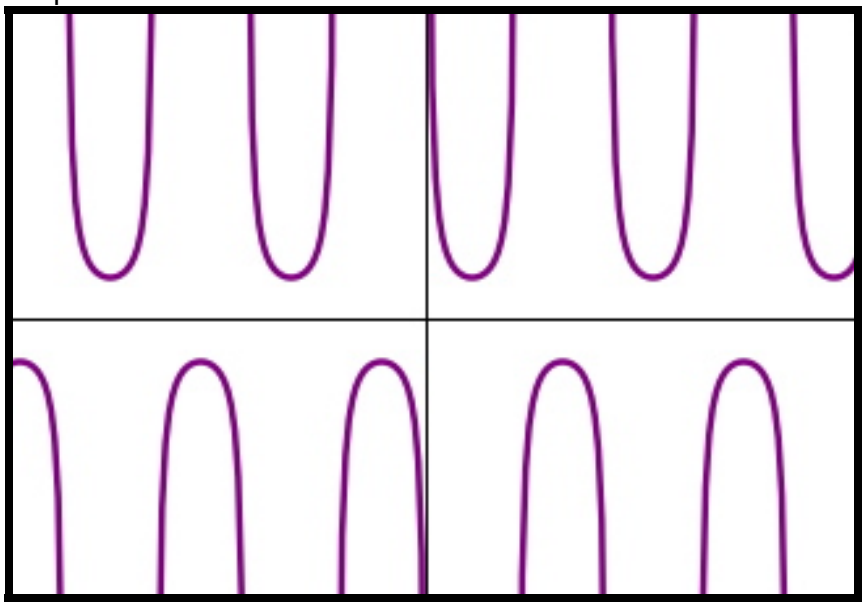
Graph 6



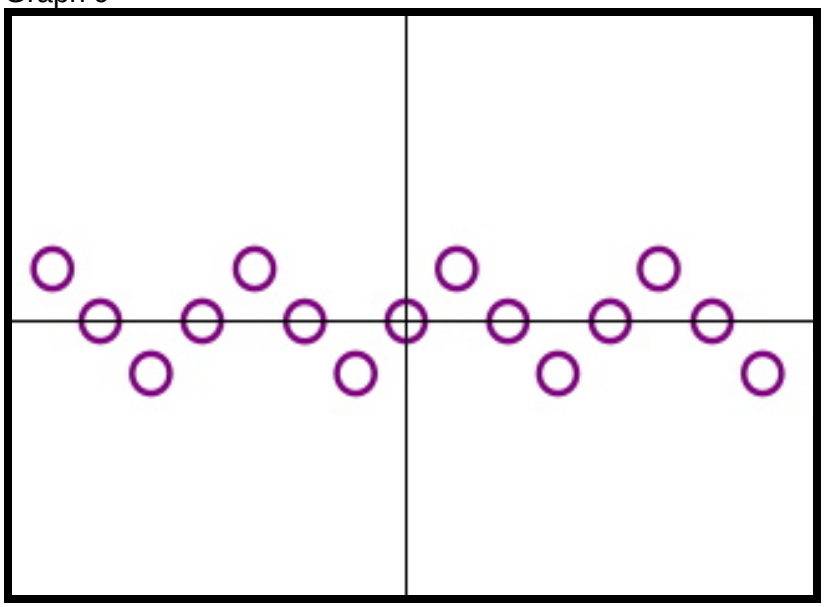
Graph 7



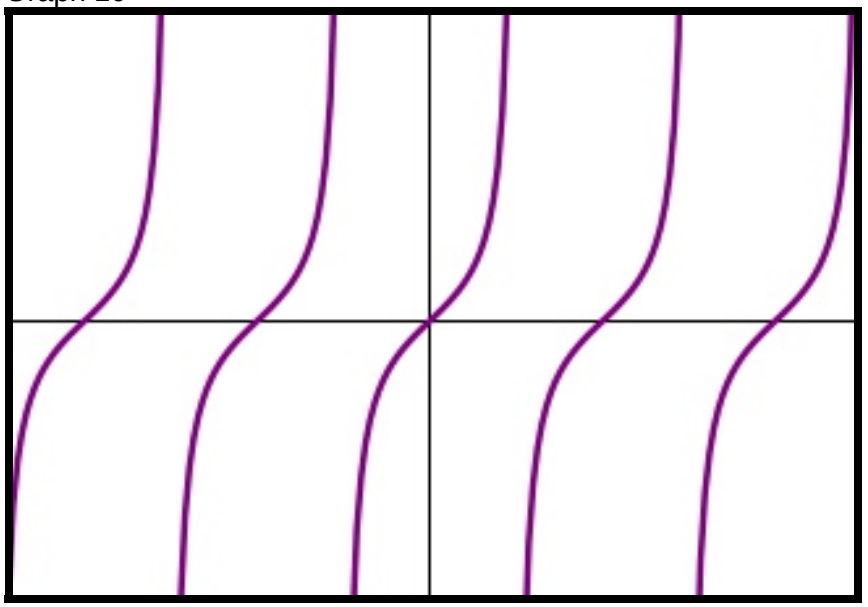
Graph 8



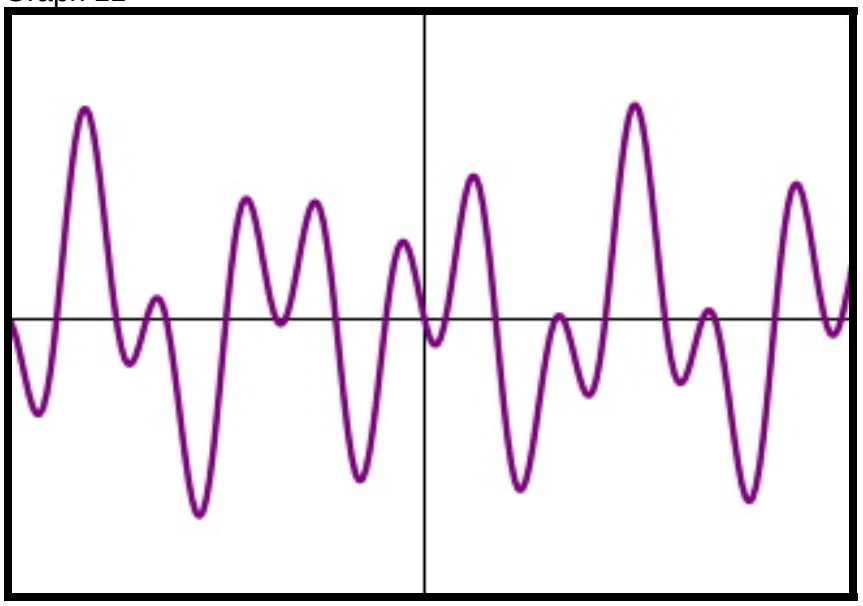
Graph 9



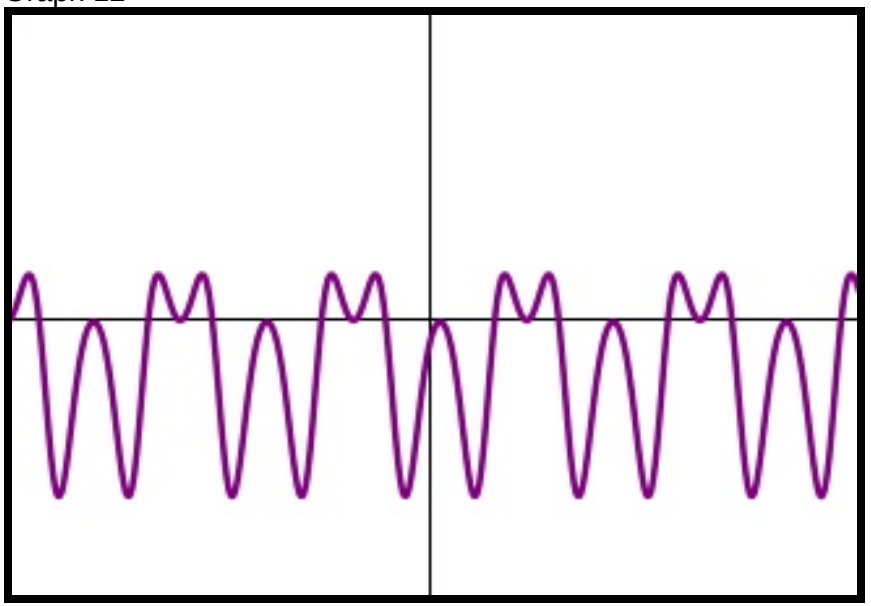
Graph 10



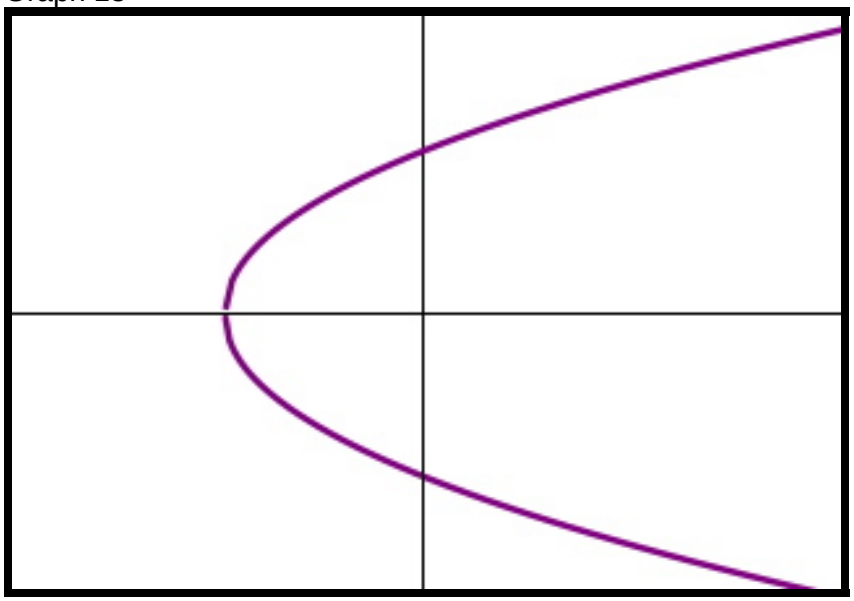
Graph 11



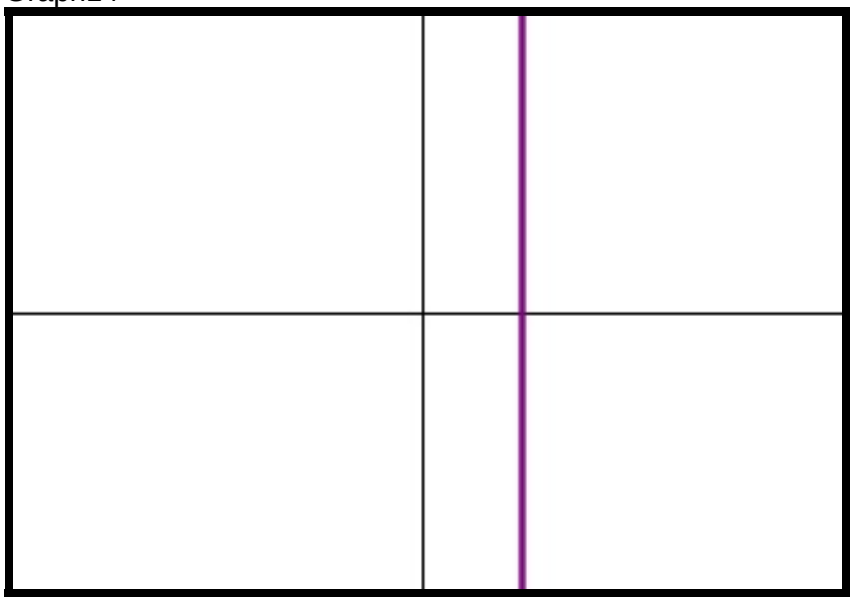
Graph 12



Graph 13



Graph14



Context 1

An escalator runs non-stop.

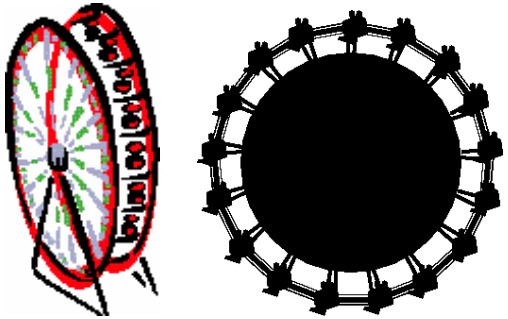
Relationship:

Dependent Variable: distance between one stair tread and the floor at the foot of the elevator

Independent Variable: elapsed time

Context 2

A ferris wheel goes round and round.



Relationship:

Dependent Variable: distance between a person on the ferris wheel and the ground

Independent Variable: time

Context 3

Ocean tides cause the depth of the water in the Bay of Fundy to vary.

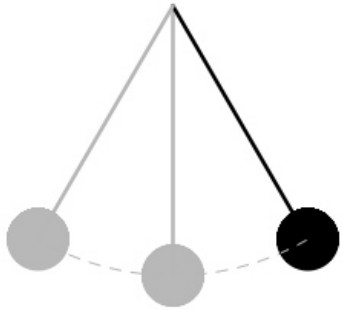
Relationship:

Dependent Variable: depth of water

Independent Variable: time

Context 4

A battery operated pendulum swings back and forth.



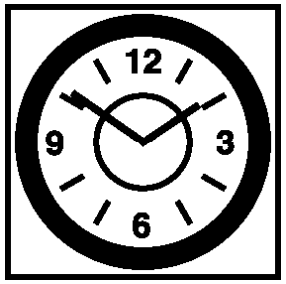
Relationship:

Dependent Variable: distance from the end of the pendulum to its position in the central position

Independent Variable: time

Context 5

The minute hand of a clock goes round and round.



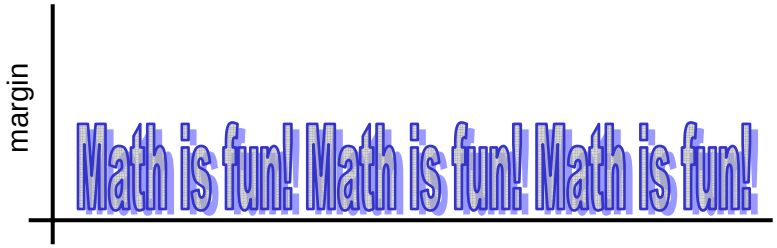
Relationship:

Dependent Variable: distance from the end of the minute hand to its position at 12 o'clock

Independent Variable: time

Context 6

Wendel prints this message over and over.



Relationship:

Dependent Variable: height of the pencil point above the line

Independent Variable: horizontal distance of the pencil point from the margin

Context 7

A kitchen sink, whose shape is a rectangular prism, is filled with water many times per week.

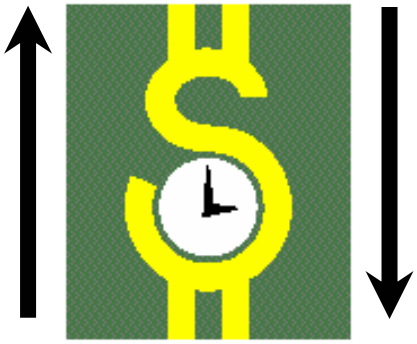
Relationship:

Dependent Variable: volume of water in the sink

Independent Variable: depth of water in the sink

Context 8

Stock prices rise and fall.



Relationship:

Dependent Variable: price of one share of a particular stock

Independent Variable: day of the year

Context 9

An elevator in a 10 story building
makes many several stops during the day.

Relationship:

Dependent Variable: the number of the floor at which the elevator doors open

Independent Variable: the number of stops the elevator has made

Context 10

An employee earns $25 per hour.

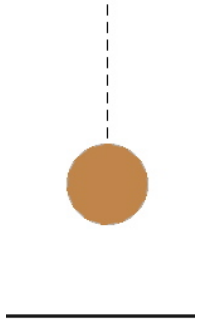
Relationship:

Dependent Variable: income

Independent Variable: number of hours worked

Context 11

A ball is dropped from a height of 5 metres
and bounces again and again until it stops.



Relationship:

Dependent Variable: height of ball

Independent Variable: time

Type of Relation

linear

Type of Relation

quadratic

Type of Relation

periodic

Type of Relation

other

function

not a function

Answer Key – Graphs

No.	Linear	Quadratic	Periodic	Other	Function
1	**No** (the graph is not a line)	**No** (the graph is not a parabola)	**Yes**	**No**	**Yes**
2	**No** (the graph is not a line)	**No** (the graph is not a parabola)	**No** (the graph does not have a horizontal pattern that repeats regularly)	**Yes**	**Yes**
3	**No** (the graph is piece-wise linear)	**No** (the graph is not a parabola)	**Yes**	**No**	**Yes**
4	**No** (the graph is piece-wise linear)	**No** (the graph is not a parabola)	**No** (the graph does not have a horizontal pattern that repeats regularly)	**Yes**	**Yes**
5	**No** (the graph is not a line)	**Yes**	**No** (the graph does not have a horizontal pattern that repeats regularly)	**No**	**Yes**
6	**Yes**	**No** (the graph is not a parabola)	**No** (the graph does not have a horizontal pattern that repeats regularly)	**No**	**Yes**
7	**No** (the graph is not a line)	**No** (the graph is not a parabola)	**No** (the graph does not have a horizontal pattern that repeats regularly)	**Yes**	**Yes**
8	**No** (the graph is not a line)	**No** (the graph is not a parabola)	**Yes**	**No**	**Yes**
9	**No** (the graph is not a line)	**No** (the graph is not a parabola)	**Yes**	**No**	**No** (the graph does not pass the vertical line test)
10	**No** (the graph is not a line)	**No** (the graph is not a parabola)	**Yes**	**No**	**Yes**
11	**No** (the graph is not a line)	**No** (the graph is not a parabola)	**No** (the graph does not have a horizontal pattern that repeats regularly)	**Yes**	**Yes**
12	**No** (the graph is not a line)	**No** (the graph is not a parabola)	**Yes**	**No**	**Yes**
13	**No** (the graph is not a line)	**No** (the graph is the inverse of a quadratic function)	**No** (the graph does not have a horizontal pattern that repeats regularly)	**Yes**	**No** (the graph does not pass the vertical line test)
14	**Yes**	**No** (the graph is not a parabola)	**No** (the graph does not have a horizontal pattern that repeats regularly)	**No**	**No** (the graph does not pass the vertical line test)

Answer Key – Contexts

No.	Linear	Quadratic	Periodic	Other	Function
1	**No**, since the distance cycles through increases and decreases as the escalator moves	**No**, since the distance cycles through increases and decreases as the escalator moves	**Yes**, since there is a pattern that repeats regularly	**No**	**Yes**, since at any moment in time there is only one distance value
2	**No**, since the distance cycles through increases and decreases as the wheel turns	**No**, since the distance cycles through increases and decreases as the wheel turns	**Yes**, since there is a pattern that repeats regularly	**No**	**Yes**, since at any moment in time there is only one distance value
3	**No**, since the depth cycles through increases and decreases as the tide rises and falls	**No**, since the depth cycles through increases and decreases as the tide rises and falls	**Yes**, since there is a pattern that repeats regularly	**No**	**Yes**, since at any moment in time there is only one depth value
4	**No**, since the distance cycles through increases and decreases as the pendulum swings	**No**, since the distance cycles through increases and decreases as the pendulum swings	**Yes**, since there is a pattern that repeats regularly	**No**	**Yes**, since at any moment in time there is only one distance value
5	**No**, since the distance cycles through increases and decreases as the minute hand rotates	**No**, since the distance cycles through increases and decreases as the minute hand rotates	**Yes**, since there is a pattern that repeats regularly	**No**	**Yes**, since at any moment in time there is only one distance value
6	**No**, since the height cycles through increases and decreases	**No**, since the height cycles through increases and decreases	**Yes**, since there is a pattern that repeats regularly	**No**	**No**, since each character has multiple heights above the line for any given distance from the margin
7	**Yes**, since the rate of change of volume with respect to depth of water (for this rectangular prism) is constant	**No**, since it is linear	**No**, since there is no pattern that repeats regularly	**No**	**Yes**, since for any depth value there is only one volume value
8	**No**, since stock prices rise and fall over time	**No**, since stock prices rise and fall over time	**No**, since there is usually no repeating pattern in the rise and fall of stock prices over time	**Yes**	**Yes**, since at any time a stock has only one price
9	**No**, since the number of the floor where the elevator doors open goes up and down from stop to stop	**No**, since the number of the floor where the elevator doors open goes up and down from stop to stop	**No**, since there is usually no repeating pattern in the elevator's stops	**Yes**	**Yes**, since the elevator stops at only one floor at a time
10	**Yes**, since the income rises at a constant rate (i.e., $25 per hour)	**No**, since it is linear	**No**, since the income rises at a constant rate (i.e., there is no repeating pattern)	**No**	**Yes**, since for a specific number of hours there is only one income
11	**No**, since the height rises and falls several times until the ball stops	**No**, since the height rises and falls several times until the ball stops	**No**, since the height to which the ball bounces keeps decreasing until the ball stops	**Yes**	**Yes**, since at any moment in time there is only one ball height