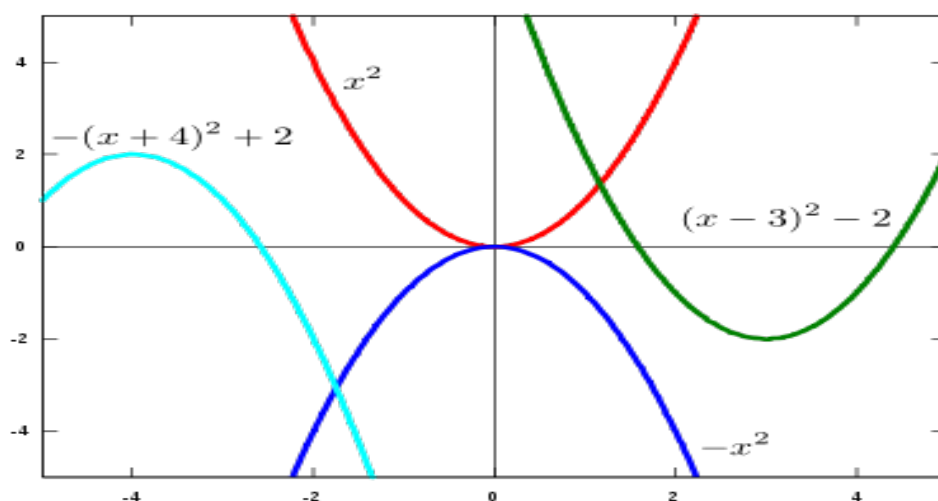


MODELING WITH QUADRATIC RELATIONS

Learning Goals

- name parts of a parabola
- determine if a relation is a parabola in three different ways

What are quadratics?

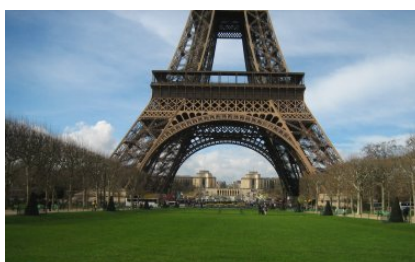


PARABOLAS

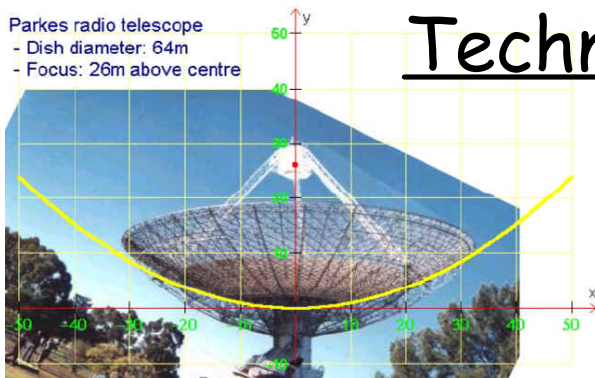
But, they are more than just a "groovy" shape...

Applications of Quadratics:

Architecture



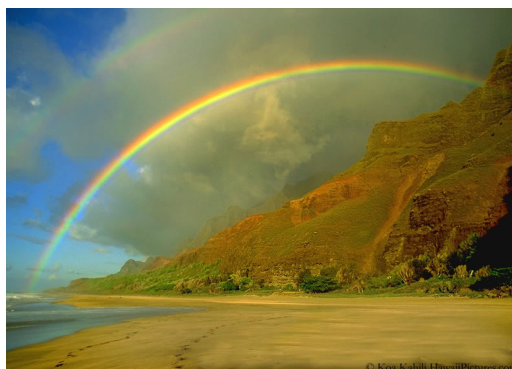
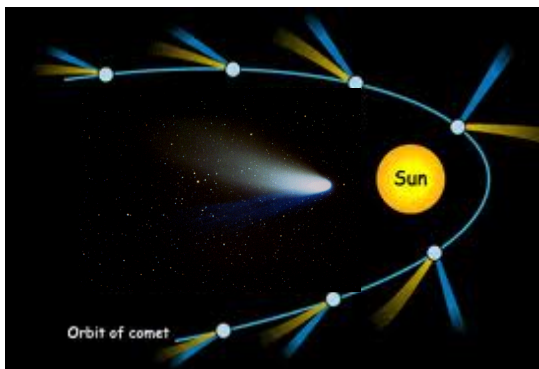
Parkes radio telescope
- Dish diameter: 64m
- Focus: 26m above centre



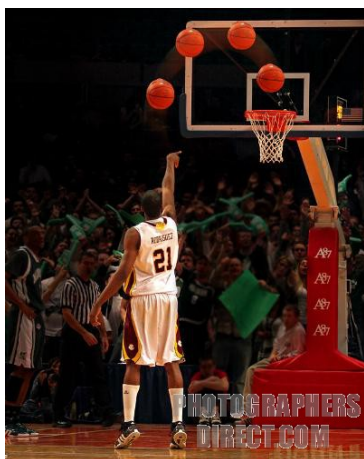
Technology



Nature



Projectile Motion

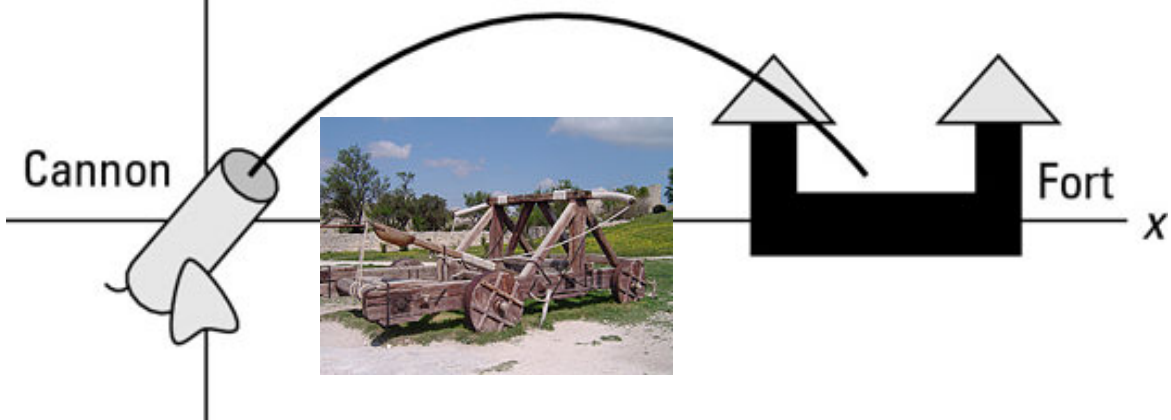


SPORTS

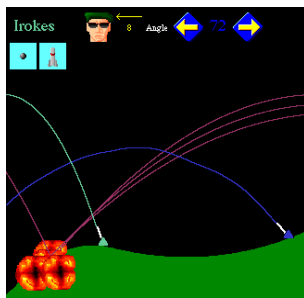
Projectile Motion

WEAPONS

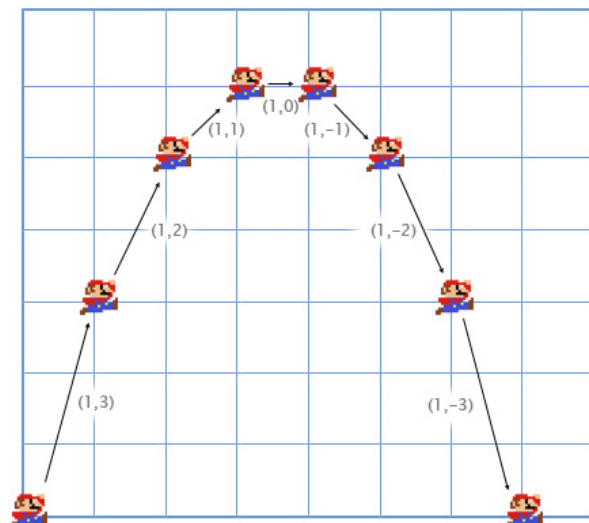
$$y = -\frac{1}{4}x^2 + x$$



Projectile Motion

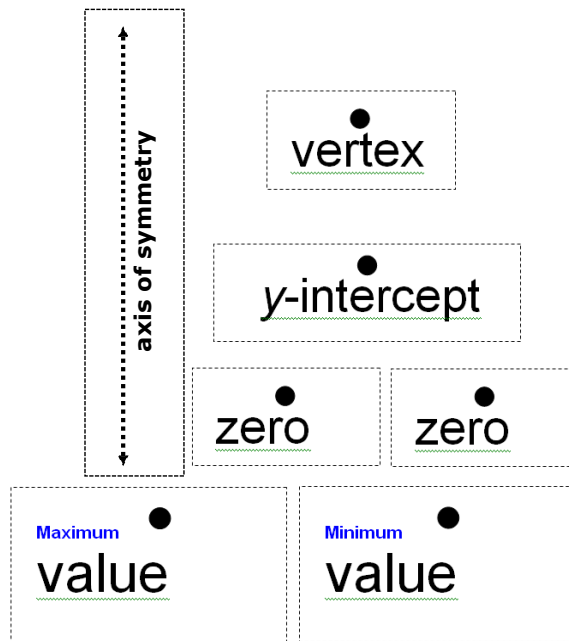


VIDEO GAMES



Identification Activity

1. Draw a set of axes on your graph paper.
2. Hang your piece of string to create a parabola, and glue it to the paper.
3. Cut up the labels and paste them in the correct locations on your parabola.



Quadratic Functions

Finite differences: is the differences that you can find between consecutive values of the dependent variable.

First difference: are the values you get when you do the finite differences only once. If they are all equal, the relation is linear.

Second difference: are the values you get when you do the finite differences twice. If they are all equal, the relation is quadratic. If they are not equal, it is not quadratic nor linear.

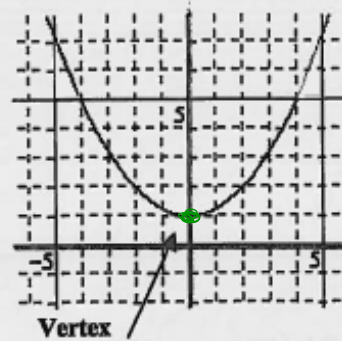
Quadratic: is the relationship you have when the second differences are constant. It is a second degree polynomial.

$$y = x^2 + 5$$

Degree: is the highest exponent that appears in any term of the expanded form of a polynomial.

A parabola: is the graph of a quadratic relation in the shape of the letter U.

A vertex: is the point on the graph of a parabola with the greatest y-coordinate (if the graph opens down) or the least y-coordinate (if the graph opens up). It is usually represented by the coordinates (h, k) ,



Optimal value: is the y-coordinate of the vertex when a quadratic relation is used to model a situation.

Maximum: is the greatest y value of the quantity being modeled, when the parabola opens down.

Maximum is $(2, -2)$

Minimum: is the smallest y value of the quantity being modeled, when the parabola opens upwards.

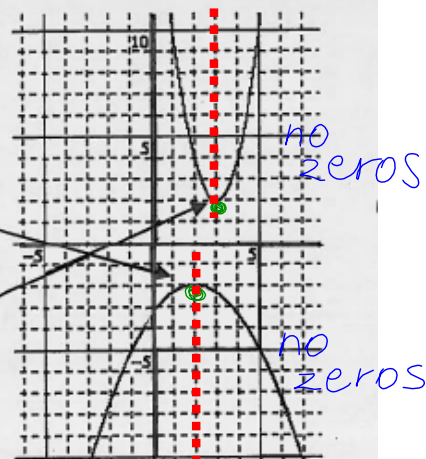
Minimum is $(3, 2)$

Axis of symmetry: is the vertical line that passes through the vertex. It is the perpendicular bisector of the segments joining any two points on the parabola that have the same y-coordinates.

Axis of symmetry for top is $x = 3$

Axis of symmetry for bottom is $x = 2$

Zeros or x-intercepts: are the points where the parabola crosses the x-axis. The vertex is directly above the midpoint of the segment joining the zeros.



What are **three** ways to determine if an equation will produce a straight line?

Table of Values - first differences

Graph - shape

Equation

- $y=mx+b$

← y-intercept
 ↑ slope

What are **three** ways to determine if an equation will produce a parabola?

- 2nd differences
- shape
- has an x^2

Use a **table of values** to determine if this equation produces a straight line or a parabola.

$y=3x^2+1$

x	y
-3	$3(-3)^2+1 = 28$
-2	$3(-2)^2+1 = 13$
-1	4
0	1
1	4
2	13
3	28

1st

-15
 -9
 -3
 3
 9

28-13=15

6
 6
 6
 6

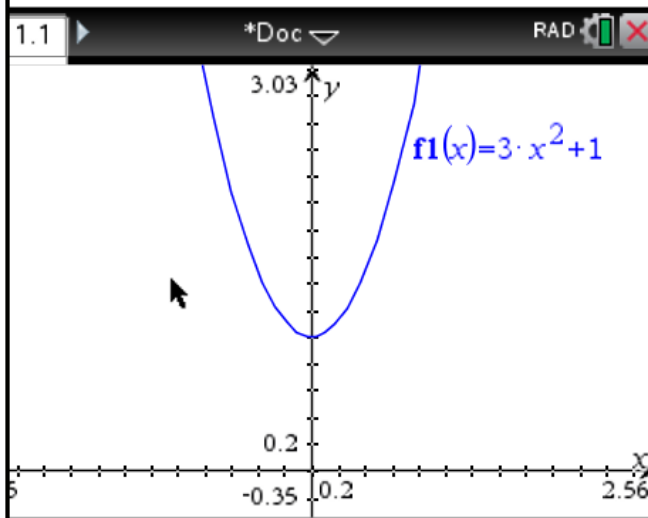
15-9=6

↑ different
 ∴ not straight line

↑ same ∴ parabola

Use your calculator to determine if it is a straight line or a parabola.

$$y=3x^2+1$$



How are these equations **different** or the **same**?
Which ones are **parabolas**?

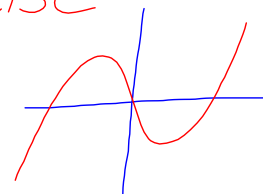
$y=3x+8$ straight line $y=mx+b$

$y=3x^2+5$ parabola

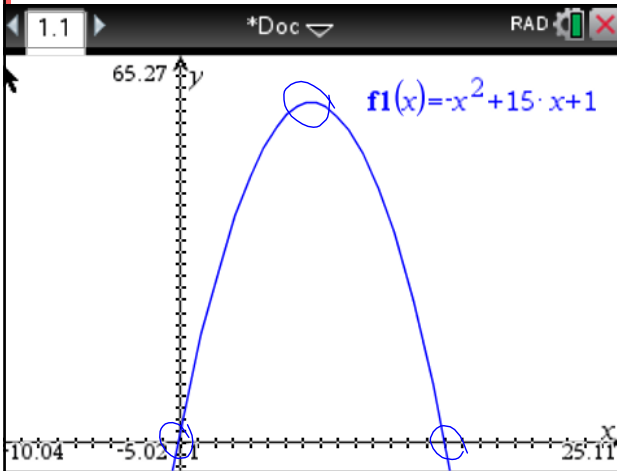
$y=3x^2-7x-1$ parabola

$y=-3x^2+8x+3$ parabola $\rightarrow -3x^2 \rightarrow$ opens down

$y=2x^3-7x-1$ something else



A football is kicked. Its height above the ground is modelled by the equation $h = -t^2 + 25t + 1$ where h is the height in meters and t is time in seconds.



What are the main parts of the parabola and what do they represent with respect to this problem?

Y-int - height of the ball at the time of the kick

zeros - when the ball hit the ground

vertex - maximum height of the ball

Seatwork / Homework

Pg. 174 # 1d, 2d, 3, 4