**Colorado Technical University**

**Course:** MATH116 – Foundations for Calculus

## Unit 8 Part 16 Readings: Conic Sections

Diagram

Description automatically generated**Conic Sections**

A *section* is the surface or outline of that surface formed by

cutting a solid figure with a plane. If the solid figure is a

cone, the resulting curve is called a *conic section*

To draw a circle, you need a string and a focus

To draw an ellipse, you need a string and two foci

To draw a parabola, you need a string, a focus and a line

(the directrix)

To draw a hyperbola, you need a string and two foci

The difference between drawing an ellipse and a hyperbola is

that the ellipse is drawn outside the foci, while the

hyperbola is drawn between the foci

****Not conics, these are **catenaries:**

****

**Circle**: set of points in a plane whose distances from a fixed

point (the center) are constant (denoted "r")

( x  h )2 + ( y  k )2 = r2  Radius: r Center: (h,k)

**Ellipse**: set of points in a plane whose distances from two fixed points (the **foci**) have a

constant sum(denoted "2a")

Center: (h,k)

“a” is the stretch factor for the long axis, “b” for the short one

Because a and b are lengths, they are non-negative

Axis of symmetry: When a ≠ b: x = h y = k

**Horizontal ellipse   Vertical ellipse**

if the graphs are centered at (0,0):

foci at (± c,0) foci at (0,± c)

vertices at (± a,0) vertices at (0,± a)

 to find “c” use: c 2 = a 2 – b 2



**Eccentricity of an ellipse:** how flat it is vs a circle

e = c/a 0 ≤ e ≤ 1

**Parabola**: set of points in a plane that are equidistant

from a fixed point F (the focus) and a fixed line (the **directrix**)

 E/W **x = a(y** – **k)2 + h**

horizontal stretch factor: a

if a > 0, opens right y > k if a < 0, opens left y < k

axis of symmetry: y = k

**vertex: (h, k)**

**focus: (h + , k)**

directrix: x = h –

 N/S **y = a(x** – **h)2 + k**

vertical stretch factor: a

if a > 0, opens up x > h if a < 0, opens down x < h

axis of symmetry: x = h

**vertex: (h, k)**

**focus: (h, k+ )**

directrix: y = k –

 **Reflection property of parabolas**

Parabolas have a property that makes them useful in the

design of reflectors and transmitters

A particle approaching a parabola on any line parallel to the axis

of the parabola is reflected on a line that passes through the focus

This property is used to focus incoming light by a parabolic mirror on

a telescope

Alternatively, signals emanating from the focus are reflected on lines

parallel to the axis, a property used to design radio transmitters

and headlights

**Eccentricity of a parabola:** e = 1

**Hyperbola:** set of points in a plane whose distances from two fixed points are constant

(the foci have a constant difference "2a" or "****2a")

Center: (h,k)

Horizontal axis of symmetry: x = h

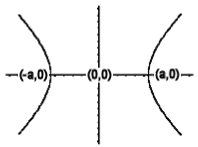
Vertical axis of symmetry: y = k

E/W: N/S:

Vertex: (h – |a|, k) and (h + |a|, k) Vertex: (k – |b|, h) and (k + |b|, h)

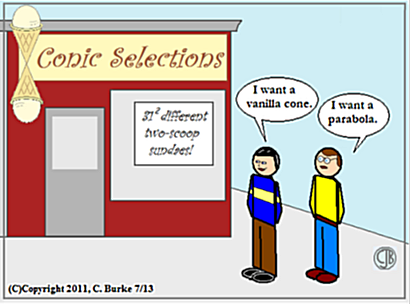
Major (transverse) axis: x Major (transverse) axis: y

**** Asymptotes: y = **±** bx/a Asymptotes: y = **±** ax/b



**Eccentricity of a hyperbola** e = = c/a

e > 1

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