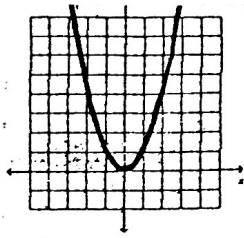
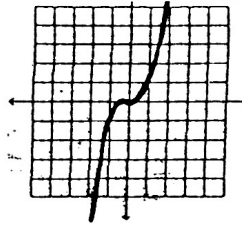


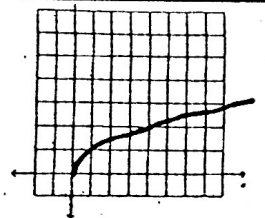
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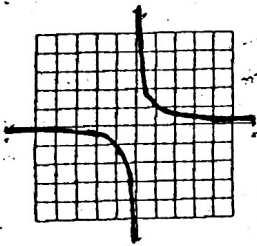
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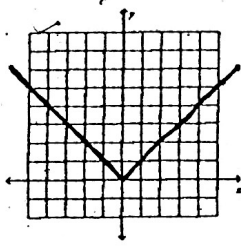
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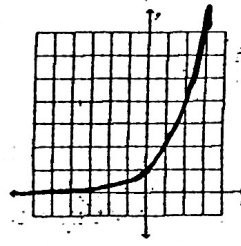
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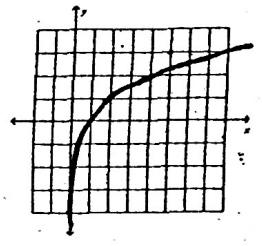
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$y = x^{\frac{a}{n}}$	$\frac{\text{even}}{\text{odd}}$	$\frac{\text{odd}}{\text{odd}}$	$\frac{\text{odd}}{\text{even}}$
$0 < \frac{a}{n} < 1$			
$\frac{a}{n} > 1$			
$\frac{a}{n} < 0$			

$$\log_b x = y \text{ iff } b^y = x$$

$$\log_b 1 = 0 \quad \log_b b = 1$$

$$\log_b b^x = x \quad b^{\log_b x} = x$$

$$\log_e x = \ln x$$

$$\ln x = y \text{ iff } e^y = x$$

$$\ln 1 = 0 \quad \ln e = 1$$

$$\ln e^x = x \quad e^{\ln x} = x$$

$$\log_b xy = \log_b x + \log_b y$$

$$\log_b \frac{x}{y} = \log_b x - \log_b y$$

$$\log_b x^p = p \log_b x$$

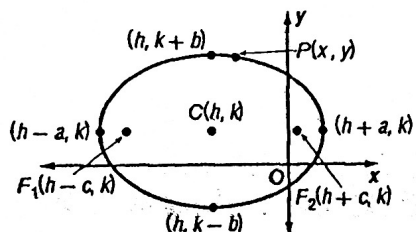
$$\log_b x = \frac{\log x}{\log b} = \frac{\ln x}{\ln b}$$

$$y = a f(b(x-h)) + k$$

CH → ←, CV ↓, EV ↑, EH ← →

↑ ↓

	Transformations	Changes
$a > 1$		
$0 < a < 1$		
$a < 0$		
$b > 1$		
$0 < b < 1$		
$b < 0$		
$k > 0$		
$k < 0$		
$(x-h)$		
$(x+h)$		
$c > 2$		
$1 < c < 2$		
$0 < c < 1$		



$$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$$

$$\frac{(x-h)^2}{b^2} + \frac{(y-k)^2}{a^2} = 1$$

Orientation: horizontal major axis

Center:  $(h, k)$

Foci:  $(h \pm c, k)$

Vertices:  $(h \pm a, k)$

Co-vertices:  $(h, k \pm b)$

Major axis:  $y = k$

Minor axis:  $x = h$

$a, b, c$  relationship:  $c^2 = a^2 - b^2$  or  $c = \sqrt{a^2 - b^2}$

Orientation: vertical major axis

Center:  $(h, k)$

Foci:  $(h, k \pm c)$

Vertices:  $(h, k \pm a)$

Co-vertices:  $(h \pm b, k)$

Major axis:  $x = h$

Minor axis:  $y = k$

$a, b, c$  relationship:  $c^2 = a^2 - b^2$  or  $c = \sqrt{a^2 - b^2}$

Circle

$$(x-h)^2 + (y-k)^2 = r^2 ; \text{ where } C(h, k) \text{ } r = \text{radius}$$

Eccentricity

$$e = \frac{c}{a}$$

Discriminant

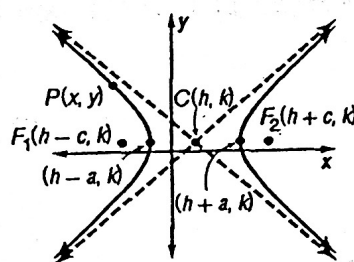
$$Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$$

Circle if:  $B^2 - 4AC < 0$ ;  $B = 0$  and  $A = C$

Ellipse if:  $B^2 - 4AC < 0$ ; either  $B \neq 0$  or  $A \neq C$

Parabola if:  $B^2 - 4AC = 0$

Hyperbola if:  $B^2 - 4AC > 0$



$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$

$$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$$

Orientation: horizontal transverse axis

Center:  $(h, k)$

Vertices:  $(h \pm a, k)$

Foci:  $(h \pm c, k)$

Transverse axis:  $y = k$

Conjugate axis:  $x = h$

Asymptotes:  $y - k = \pm \frac{b}{a}(x - h)$

$a, b, c$  relationship:  $c^2 = a^2 + b^2$  or  $c = \sqrt{a^2 + b^2}$

Orientation: vertical transverse axis

Center:  $(h, k)$

Vertices:  $(h, k \pm a)$

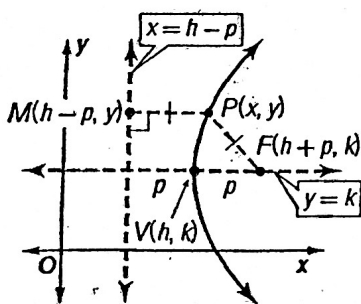
Foci:  $(h, k \pm c)$

Transverse axis:  $x = h$

Conjugate axis:  $y = k$

Asymptotes:  $y - k = \pm \frac{a}{b}(x - h)$

$a, b, c$  relationship:  $c^2 = a^2 + b^2$  or  $c = \sqrt{a^2 + b^2}$



$$y = \frac{1}{4p}(x-h)^2 + k$$

$$x = \frac{1}{4p}(y-k)^2 + h$$

$$(x-h)^2 = 4p(y-k)$$

$$(y-k)^2 = 4p(x-h)$$

Orientation: opens vertically

Vertex:  $(h, k)$

Focus:  $(h, k + p)$

Axis of Symmetry  $a: x = h$

Directrix  $d: y = k - p$

$p > 0$  up

$p < 0$  down

Orientation: opens horizontally

Vertex:  $(h, k)$

Focus:  $(h + p, k)$

Axis of Symmetry  $a: y = k$

Directrix  $d: x = h - p$

$p > 0$  right

$p < 0$  left

### LINES

Slope of line through  $P_1(x_1, y_1)$  and  $P_2(x_2, y_2)$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Point-slope equation of line through  $P_1(x_1, y_1)$  with slope  $m$

$$y - y_1 = m(x - x_1)$$

Slope-intercept equation of line with slope  $m$  and  $y$ -intercept  $b$

$$y = mx + b$$

### DISTANCE AND MIDPOINT FORMULAS

Distance between  $P_1(x_1, y_1)$  and  $P_2(x_2, y_2)$ :

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Midpoint of  $P_1P_2$ :  $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$