

### 3.2 Vertical and Horizontal Asymptotes

Vertical Asymptotes occur due to division by zero.

- Factor the denominator (if necessary).
- Write all vertical asymptotes as equations  $x = k$

Horizontal Asymptotes are a special type of end behaviour.

Tricks for H.A.

- degree of numerator < degree of denominator: H.A.:  $y = 0$
- degree of numerator = degree of denominator: H.A.:  $y = a/b$
- degree of numerator > degree of denominator: no H.A. (see next lesson)

Consider  $y = \frac{x - 1}{x^2 + 3x + 7}$ . As  $x$  gets larger and larger, H.A.  $y = 0$

Consider  $y = \frac{x^2 + 3x + 7}{x - 1}$ . As  $x$  gets larger and larger, no H.A.

Consider  $y = \frac{x + 3}{x - 1}$ . As  $x$  gets larger and larger, ratio of numerator to denominator's leading coefficients.

Generalize the above.

Ex 1 State all horizontal and vertical asymptotes for the following:

(a)  $y = \frac{3x - 1}{3x + 1}$       (b)  $y = \frac{2}{x - 5}$       (c)  $y = \frac{x^3}{x^2 - 1}$       (d)  $y = \frac{3x}{x^2 + 4}$