1. $x^3 + 3x^2 - 4x = x(x^2 + 3x - 4) = x(x+4)(x-1) = 0$, so $x = 0, 1, -4$.

3. $x - \dfrac{24}{x+2} = 3$, so multiply both sides by $x + 2$. It follows that

$$\begin{aligned} x(x+2) - 24 &= 3(x+2) \\ x^2 + 2x - 24 &= 3x + 6 \\ x^2 - x - 30 &= 0 \\ (x-6)(x+5) &= 0 \end{aligned}$$

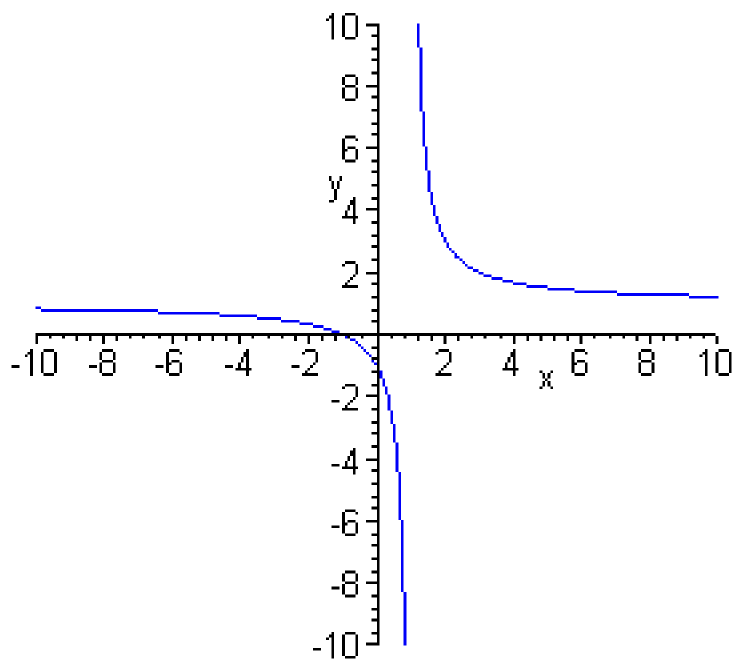
Hence, $x = -5, 6$.

5. $\dfrac{4}{x^2} - \dfrac{3}{x} = 1$, so multiply both sides by x^2. It follows that

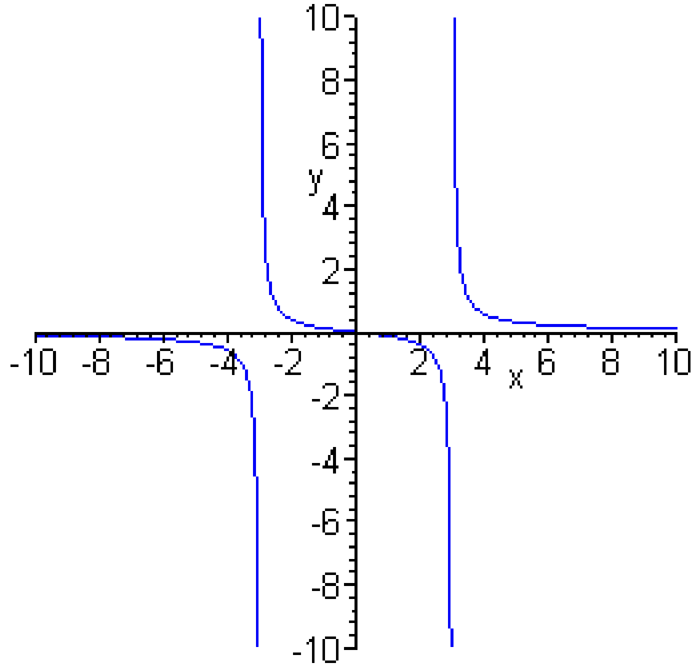
$$\begin{aligned} 4 - 3x &= x^2 \\ x^2 + 3x - 4 &= 0 \\ (x+4)(x-1) &= 0 \end{aligned}$$

Hence, $x = -4, 1$.

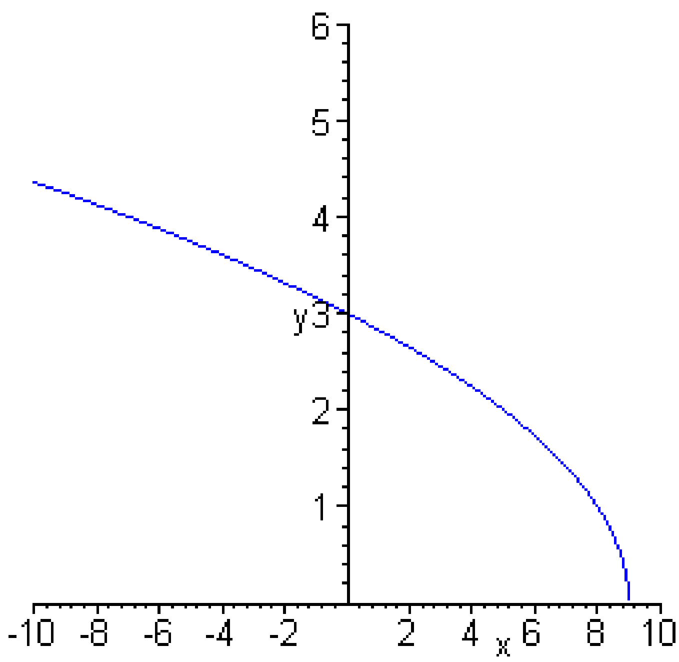
8. For $y = \dfrac{x+1}{x-1}$, the domain is determined by finding where the denominator is zero or $x - 1 = 0$, so the domain is $x \neq 1$.
The x-intercept satisfies $y = 0$, which is when the numerator is zero. So $x + 1 = 0$, which gives the x-intercept $x = -1$.
The y-intercept is where $x = 0$, so $y = \frac{1}{-1}$. Thus, the y-intercept is $y = -1$.
The vertical asymptote occurs where the denominator is zero (boundary of the domain). Thus, $x - 1 = 0$, gives the vertical asymptote of $x = 1$.
The horizontal asymptote is found using large x. Taking the highest powers in the numerator and denominator gives $y = \frac{x}{x} = 1$, so the horizontal asymptote is $y = 1$.
The graph is below:



10. For $y = \dfrac{x}{x^2 - 9}$, the domain is determined by finding where the denominator is zero or $x^2 - 9 = (x+3)(x-3) = 0$, so the domain is $x \neq \pm 3$.
The x-intercept satisfies $y = 0$, which is when the numerator is zero. So $x = 0$, which gives the x-intercept $x = 0$.
The y-intercept is where $x = 0$, so the y-intercept is $y = 0$.
The vertical asymptote occurs where the denominator is zero (boundary of the domain). Thus, $x^2 - 9 = 0$, gives the vertical asymptote of $x = \pm 3$.
The horizontal asymptote is found using large x. Taking the highest powers in the numerator and denominator gives $y = \frac{x}{x^2} = \frac{1}{x}$, so the horizontal asymptote is $y = 0$.
The graph is below:

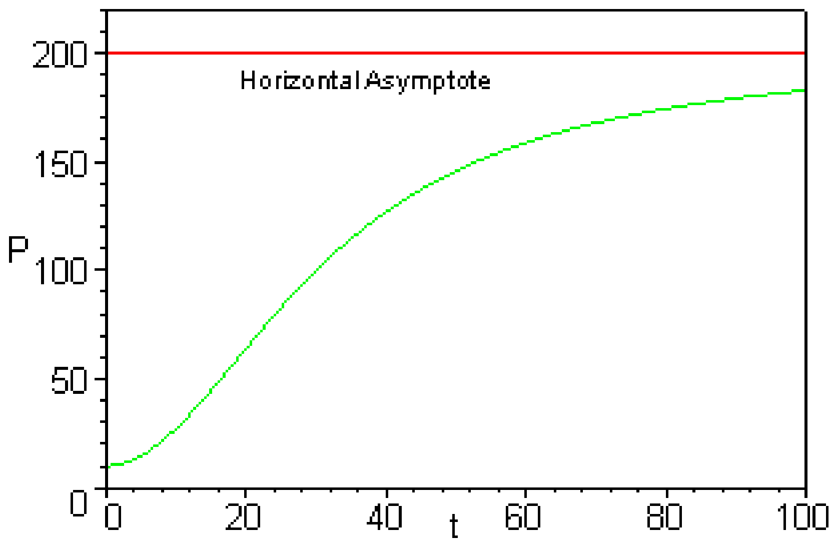


14. For $y = \sqrt{9 - x}$, the domain is determined by finding where the quantity under the radical is non-negative or $9 - x \geq 0$, so the domain is $x \leq 9$.
The x-intercept satisfies $y = 0$, which is when $\sqrt{9 - x} = 0$, which gives the x-intercept $x = 9$.
The y-intercept is where $x = 0$, so $y = \sqrt{9} = 3$.
There are no vertical or horizontal asymptotes.
The graph is below:



17. a. The density of the yeast culture at $t = 0$ satisfies $P(0) = \frac{10+0}{1+0} = 10$. Similarly, $P(10) = \frac{10+0.2(100)}{1+0.001(100)} = \frac{30}{1.1} = 27.27$.

b. The horizontal asymptote is found using large x. Taking the highest powers in the numerator and denominator gives $P(t) = \frac{0.2t^2}{0.001t^2} = \frac{0.2}{0.001} = 200$, so the horizontal asymptote is $P = 200$. The graph is below:



19. a. The domain is determined by finding where the quantity under the radical is non-negative or $9 - y \geq 0$, so the domain is $y \leq 9$. The graph is below.

b. If fish need at least 6 mmHg of dissolved O_2, then $P(y) = 3\sqrt{9-y} = 6$ or $\sqrt{9-y} = 2$, so $9 - y = 2^2 = 4$. Thus, the maximum depth is $y = 5$ meters.