1.) Decompose $\dfrac{3x+2}{x^2-x-12}$ into fractions with linear denominators.

$$\frac{3x+2}{(x-4)(x+3)} = \frac{A}{x-4} + \frac{B}{x+3} = \frac{A(x+3)+B(x-4)}{(x-4)(x+3)}$$

$A+B = 3 \qquad A = 3-B$

$3A-4B = 2$

$$\boxed{\frac{2}{x-4} + \frac{1}{x+3}}$$

$3(3-B)-4B = 2$

$9-3B-4B = 2$

$B = 1 \qquad A = 2$

2.) Solve the system of equations: $\begin{cases} x+y=4 \\ x-y=2 \end{cases}$.

$x+y = 4 \qquad x = 4-y$

$x-y = 2$

$(4-y)-y = 2$

$4-2y = 2 \qquad \boxed{\begin{array}{c} y = 1 \\ x = 3 \end{array}}$

3.) Solve the system of equations: $\begin{cases} x^3 - y = 0 \\ x - y = 0 \end{cases}$.

$$y = x$$

$$x^3 - x = 0 \implies x(x^2 - 1) = 0$$

$$x(x-1)(x+1) = 0$$

So, $\boxed{(0,0),\ (1,1),\ (-1,-1)}$

4.) Solve the system of equations: $\begin{cases} -x + y = 4 \\ x^2 + y = 3 \end{cases}$.

$$y = 4 + x$$

$$x^2 + (4+x) = 3$$

$$x^2 + x + 1 = 0$$

$$\frac{-1 \pm \sqrt{1-4}}{2} = \frac{-1 \pm \sqrt{-3}}{2}$$

$\boxed{\text{No real solutions}}$

5.) Solve the system of equations: $\begin{cases} x+y-3z=-1 \\ y-z=0 \\ -x+2y=1 \end{cases}$. (Solution should end up being:

infinitely many solutions).

$$y = z$$

$$x - 2y = -1$$
$$-x + 2y = 1 \qquad \Rightarrow \qquad x = -1 + 2y$$

$$-(-1+2y) + 2y = 1$$

$$1 - 2y + 2y = 1$$

$$\Rightarrow \quad 1 = 1$$

$$\Rightarrow \quad 0 = 0$$

So, infinitely many solutions.
Any triple of the form:

$$\boxed{(a, b, b)} \qquad a, b \text{ are real numbers}$$

6.) Sketch the region containing all points that satisfy the system of inequalities.

$$\begin{cases} 2x + y < 2 \\ x + 3y > 2 \end{cases}$$

$$y < 2 - 2x$$

$$y > -\frac{1}{3}x + \frac{2}{3}$$

$$Y = 2 - 2x$$