express the given power series as a series with generic term x^k

$$\sum_{n=0}^{\infty} a_n x^{n+1} \qquad\qquad \sum_{n=1}^{\infty} \frac{a_n}{n+3} x^{n+3}$$

determine all the singular points of the given differential equation

1. $(x+1)y'' - x^2 y' + 3y = 0$

2. $x^2 y'' + 3y' - xy = 0$

3. $(\theta^2 - 2)y'' + 2y' + (\sin\theta)y = 0$

4. $(x^2 + x)y'' + 3y' - 6xy = 0$

find at least the first four nonzero terms in
a power series expansion about x = 0 for a general solution
to the given differential equation.

$$y' + (x+2)y = 0$$

$$y' - y = 0$$

$$z'' - x^2 z = 0$$

$$(x^2 + 1)y'' + y = 0$$