**gfun[listtodiffeq]** - find a linear differential equation for the generating function

**gfun[seriestodiffeq]** - find a linear differential equation satisfied by a series

**Calling Sequence**

```plaintext
listtodiffeq(l, y(x), <[typelist]>)
seriestodiffeq(s, y(x), <[typelist]>)
```

**Parameters**

- `l` - a list
- `s` - a series
- `y, z` - the name of the unknown function and the generic variable
- `[typelist]` - (optional) a list of generating function types

**Description**

- The procedures `listtodiffeq` and `seriestodiffeq` compute a linear differential equation in `y(x)` with polynomial coefficients in `x` satisfied by the generating function `y(x)` of the expressions in `l` or `s`, this generating function being one of the types specified by typelis for example, ordinary (ogf) or exponential (egf). For a full list of available choices see `gftypes`.
- If `typelist` contains more than one element, these types are tried in order.
- If `typelist` is not provided, the default `optionsgf=['ogf','egf']` is used. The output is a list whose second element is the type for which an equation was found, and whose first element is the differential equation satisfied by the generating function.
- In the current implementation, the maximal order is 2 and the maximum degree of the coefficients is 3. This can be changed by modifying the variables `gfun['maxordereqn']` and `gfun['maxdegcoeff']`.
- If sufficiently many terms were given, and no solution was found, it means that the generating function does not satisfy any linear differential equation of order less or equal to `gfun['maxordereqn']` with coefficients of degree less or equal to `gfun['maxdegcoeff']`.

**Examples**

```plaintext
> with(gfun):
l:= [1, 2, 6, 22, 91, 408, 1938, 9614, 49335, 260130, 1402440, 7702632,
42975796, 243035536, 1390594458, 8038677054, 4689282815,
275750636070, 1633292229030, 9737153323590]:
listtodiffeq(l,y(x));
```

\[
\begin{align*}
\left\{ 12 + (-12 + 60 x) y(x) + (-18 x + 108 x^2) \left( \frac{d}{dx} y(x) \right) + (27 x^3 - 4 x^2) \left( \frac{d^2}{dx^2} y(x) \right), \right. \\
y(0) = 1, D(y)(0) = 2, \left. \text{ogf} \right\} 
\end{align*}
\] (2.1)
\[ s := \text{series}(\exp(x)/\sqrt{1-x}, x, 7); \]
\[ s := 1 + \frac{3}{2} x + \frac{11}{8} x^2 + \frac{53}{48} x^3 + \frac{115}{128} x^4 + \frac{2947}{3840} x^5 + \frac{31411}{46080} x^6 + O(x^7) \]  \hspace{1cm} (2.2)

\[ > \text{seriestodiffeq}(s, y(x)); \]
\[ \left[ \begin{array}{l}
y(0) = 1, (-3 + 2 x) y(x) + (2 - 2 x) \left( \frac{d}{dx} y(x) \right) \end{array} \right], \text{ogf} \]  \hspace{1cm} (2.3)

See Also
\texttt{gfun}, \texttt{gfun[parameters]}

```