```
> restart;
> L:=(n)->P[n](z)/((z^(n/2*(1-n))));
> L(n+1)*L(n-1)+(z*diff(L(n),z))^2-(z*L(n)*(z*diff(L(n),z)+diff(L
  (n),z,z)));
```

$$L := n \to \frac{P_n(z)}{z^{\frac{1}{2}n(1-n)}}$$

$$\frac{P_{n+1}(z)\,P_{n-1}(z)}{z^{-\frac{1}{2}(n+1)n}\,z^{\frac{1}{2}(n-1)(2-n)}} + z^2\left(\frac{\frac{d}{dz}P_n(z)}{z^{\frac{1}{2}n(1-n)}} - \frac{1}{2}\,\frac{P_n(z)\,n\,(1-n)}{z^{\frac{1}{2}n(1-n)}\,z}\right)^2 \tag{1}$$

$$-\frac{1}{z^{\frac{1}{2}n(1-n)}}\left(z\,P_n(z)\left(z\left(\frac{\frac{d}{dz}P_n(z)}{z^{\frac{1}{2}n(1-n)}} - \frac{1}{2}\,\frac{P_n(z)\,n\,(1-n)}{z^{\frac{1}{2}n(1-n)}\,z}\right) + \frac{\frac{d^2}{dz^2}P_n(z)}{z^{\frac{1}{2}n(1-n)}}\right.\right.$$

$$\left.\left. - \frac{\left(\frac{d}{dz}P_n(z)\right)n\,(1-n)}{z^{\frac{1}{2}n(1-n)}\,z} + \frac{1}{4}\,\frac{P_n(z)\,n^2\,(1-n)^2}{z^{\frac{1}{2}n(1-n)}\,z^2} + \frac{1}{2}\,\frac{P_n(z)\,n\,(1-n)}{z^{\frac{1}{2}n(1-n)}\,z^2}\right)\right)$$

```
> -collect(numer(factor(expand(factor(simplify(%/z^(n^2)))))),
  [diff,n],factor);
```

$$4z^2P_n(z)\left(\frac{d^2}{dz^2}P_n(z)\right) - 4\left(\frac{d}{dz}P_n(z)\right)^2z^3 - 4z\left(n^2z - n^2 - nz - z^2\right. \tag{2}$$

$$\left.+ n\right)P_n(z)\left(\frac{d}{dz}P_n(z)\right) - n\,(z-1)\,(n-1)\left(n^2 - n - 2z - 2\right)P_n(z)^2$$

$$-4\,P_{n+1}(z)\,z^2\,P_{n-1}(z)$$