2 RG&TC-Code

In[75]:=

In[84]:=
```
xCoord = {x, y};
g = {
   {x * y, 0},
   {0, x^2}
  };
RGtensors[g, xCoord]
```

In[79]:=

In[87]:=
```
GUdd // MatrixForm
```

Out[87]//MatrixForm=

$$\begin{pmatrix} \begin{pmatrix} \frac{1}{2x} \\ \frac{1}{2y} \end{pmatrix} & \begin{pmatrix} \frac{1}{2y} \\ -\frac{1}{y} \end{pmatrix} \\ \begin{pmatrix} -\frac{1}{2x} \\ \frac{1}{x} \end{pmatrix} & \begin{pmatrix} \frac{1}{x} \\ 0 \end{pmatrix} \end{pmatrix}$$

In[90]:=
```
D[Log[x * y], y]
```

Out[90]=

$$\frac{1}{y}$$

In[92]:=
```
RUddd // MatrixForm
```

Out[92]//MatrixForm=

$$\begin{pmatrix} \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix} & \begin{pmatrix} 0 & \frac{x+2y}{4xy^2} \\ -\frac{x+2y}{4xy^2} & 0 \end{pmatrix} \\ \begin{pmatrix} 0 & -\frac{x+2y}{4x^2y} \\ \frac{x+2y}{4x^2y} & 0 \end{pmatrix} & \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix} \end{pmatrix}$$

In[94]:=
```
Rdd // MatrixForm
```

Out[94]//MatrixForm=

$$\begin{pmatrix} \frac{x+2y}{4x^2y} & 0 \\ 0 & \frac{x+2y}{4xy^2} \end{pmatrix}$$

In[97]:=
```
D[1 / (2 x), x]
```

Out[97]=
$$-\frac{1}{2\,x^2}$$

In[98]:=
```
(x + 2 y) / (4 x y^2) // FullSimplify
```

Out[98]=
$$\frac{x+2\,y}{4\,x\,y^2}$$

In[99]:=
```
R
```

Out[99]=
$$\frac{x+2\,y}{2\,x^3\,y^2}$$

In[101]:=
```
Integrate[Integrate[-(r - Rs) / (2 * r^3), t], t]
```

Out[101]=
$$-\frac{t^2}{4\,r^2}+\frac{Rs\,t^2}{4\,r^3}$$

In[102]:=
```
3^3 * 4
```

Out[102]=
```
108
```

Cosmology from my workshop week 3 I derived this where distance dl is in mpc

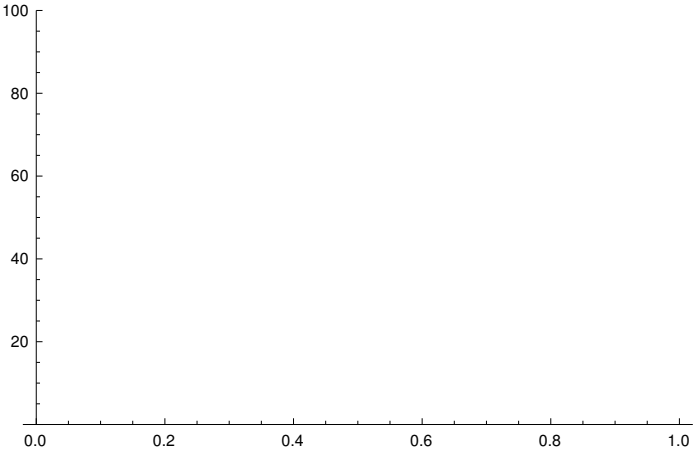
In[103]:=
```
Ωm = 0.27;
ΩΛ = 1 - Ωm;
H0 = 70 / (3 * 10^5);
f[z_] = (Ωm (1 + z)^3 + ΩΛ)^(1/2);
dl[z_] = (1 + z) / H0 Integrate[f[z]^-1, z];
```

In[120]:=
```
dl[z]
```

Out[120]=
```
5016.05 (1 + z) (1. + z) Hypergeometric2F1[0.333333, 0.5, 1.33333, -0.369863 (1. + z)^3]
```

In[122]:=
```
Plot[dl[z], {z, 0, 1}, PlotRange → {0, 100}]
```

Out[122]=



In[123]:=
```
9 * 5.3^4
```

Out[123]=
```
7101.43
```