HW 3 Problem 2

In[7]:=
```
Symbolize[ m_t ]; Symbolize[ m_b ];
Symbolize[ m_z ]; Symbolize[ θ_w ];
Symbolize[ m_w ];
Symbolize[ G_f ];
Symbolize[ α_mz ];
m_t = 172.8 GeV // UnitConvert;
m_b = 4.18 GeV // UnitConvert;
m_z = 91.188 GeV // UnitConvert;
G_f = 0.00001166 /GeV^2 // UnitConvert;
α_mz = 1 / 127.951 // UnitConvert;
```

a)

In[13]:=
```
soln = NSolve[ ( Sin[2 θ_w] == Sqrt[ 4 π α_mz / (Sqrt[2] G_f m_z^2) ] ), θ_w ] // Quiet;
StringForm["θ_w = ``", θ_w /. soln[[1]]]
StringForm[ "`` = ``", Sin[θ_w]^2 // TraditionalForm, Sin[θ_w]^2 /. soln[[1]] ]
θ_w = θ_w /. soln[[1]];
```

Out[14]=
$$\theta_W = 0.5045265403000181`$$

Out[15]=
$$\sin^2(\theta_W) = 0.23366881784571636`$$

B)

In[17]:=
$$T = \frac{3}{16\,\pi\,(\text{Sin}[\theta_W]\,\text{Cos}[\theta_W]\,m_Z)^2}\left(m_t^2 + m_b^2 - \frac{2\,m_t^2\,m_b^2}{m_t^2 - m_b^2}\,\text{Log}\left[\frac{m_t^2}{m_b^2}\right]\right);$$

$$m_W = m_Z\sqrt{\text{Cos}[\theta_W]^2 + \frac{\alpha_{m_z}\,\text{Cos}[\theta_W]^2}{\text{Cos}[\theta_W]^2 - \text{Sin}[\theta_W]^2}\left(\text{Cos}[\theta_W]^2\,T\right)}\;;$$

```
StringForm["m_W = ``", UnitConvert[m_W, "Gigaelectronvolts"]]
```

Out[19]=

$$m_W = 80.3573\ \text{GeV}$$