

Problem 1 (Peskin 15.2)

```
In[ ]:= << Units`
        << Notation`
```

```
In[ ]:= Symbolize[ $\Gamma_1$ ]; Symbolize[ $\Gamma_h$ ];
```

a)

```
In[ ]:= StringForm[" $G_F^\theta = \text{``}$ ", UnitConvert[ $G_F^\theta$ , "GeV^(-2)"] // ScientificForm]
```

```
Out[ ]:=
```

$$G_F^\theta = 1.16638 \times 10^{-5} \text{ GeV}^2$$

```
In[ ]:=  $\Gamma_1 = \text{UnitConvert}\left[\left(\left(G_F^\theta\right)^2 \left(\tau_{\text{PARTICLE}}\left[\text{mass}\right] c^2\right)^5\right) / \left(192 \pi^3\right), \text{"GeV"}\right];$ 
        StringForm[" $\Gamma_1 = \text{``}$ ",  $\Gamma_1$ ]
```

```
Out[ ]:=
```

$$\Gamma_1 = 4.0476 \times 10^{-13} \text{ GeV}$$

b)

```
In[ ]:=  $\alpha_s = 0.31;$ 
         $\Gamma_h = 3 \Gamma_1 \left(1 + \frac{\alpha_s}{\pi}\right);$ 
        StringForm[" $\Gamma_h = \text{``}$ ",  $\Gamma_h$ ]
```

```
Out[ ]:=
```

$$\Gamma_h = 1.33409 \times 10^{-12} \text{ GeV}$$

c)

```

In[ ]:=  $\Gamma_{\text{total}} = 2 \Gamma_1 + \Gamma_h;$ 

$$\text{BR} = \frac{2 \Gamma_1}{\Gamma_{\text{total}}};$$



$$\tau = \text{UnitConvert}\left[\frac{\hbar}{\Gamma_{\text{total}}}, "s"\right];$$

StringForm[" $\Gamma_{\text{total}} = ``$ ",  $\Gamma_{\text{total}}$ ]
StringForm["BR( $\tau \rightarrow \nu_\tau l^- \bar{\nu}_l$ ) = ``", BR]
StringForm[" $\tau = ``$ ",  $\tau$ ]

Out[ ]=

$$\Gamma_{\text{total}} = 2.1436 \times 10^{-12} \text{ GeV}$$


Out[ ]=
BR( $\tau \rightarrow \nu_\tau l^- \bar{\nu}_l$ ) = 0.3776414940934138`

Out[ ]=

$$\tau = 3.07058 \times 10^{-13} \text{ s}$$


```