

(To be returned by 12.00 on Friday 15.11.)

1–2. Find the width for the decay  $H \rightarrow WW, ZZ$ ,

$$\Gamma(H \rightarrow ZZ) = \frac{g^2}{128\pi} \frac{m_H^3}{m_W^2} \sqrt{1-x_Z} \left(1 - x_Z + \frac{3}{4}x_Z^2\right),$$

where  $x_Z = 4m_Z^2/m_H^2$  ( $x_Z \leq 1$  for kinematically allowed decays), and

$$\Gamma(H \rightarrow W^+W^-) = \frac{g^2}{64\pi} \frac{m_H^3}{m_W^2} \sqrt{1-x_W} \left(1 - x_W + \frac{3}{4}x_W^2\right),$$

where  $x_W = 4m_W^2/m_H^2$ .

Show that the ratio for transverse and longitudinal decay modes is

$$\frac{\Gamma(H \rightarrow V_T V_T)}{\Gamma(H \rightarrow V_L V_L)} = \frac{\frac{1}{2}x_V^2}{\left(1 - \frac{1}{2}x_V\right)^2}.$$