

# Exercise for Colours and Flavours and their consequences Autumn 2019: lecture 1

## 1 Quark mass and mixing angles

Given the  $2 \times 2$  matrices

$$M_U = \begin{pmatrix} 1 & 1+i \\ 1-i & 2 \end{pmatrix} \quad M_D = \begin{pmatrix} 2 & 2+i \\ 2-i & 3 \end{pmatrix} \quad (1)$$

What are the quark masses and what is the mixing angle? Show also explicitly there is no phase.

I picked  $2 \times 2$  and Hermitian matrices to make life not too difficult. Feel free to experiment a little with more matrices.

## 2 Lepton masses and mixings

Prove explicitly that for the case where there are only Majorana neutrino masses for the left-handed neutrinos that there the charged lepton masses, neutrino masses, three mixing angles and three phases for the case of three generations. This was essentially done in the lectures and is also in the notes but it is a good exercise to go through with it.