$6^2/_4$

Rotations consisting of 2 two cycles represent rotations of order 2 about the axis between opposite faces. There are 6 faces hence three axes so three rotations. Since any two opposite faces can be rotated onto any other two opposite faces, all such rotations are conjugate

$(14)(23) = (1243)(1243)$
$(12)(34) = (1324)(1324)$
$(13)(24) = (1234)(1234)$

All possibilities have been covered $\therefore$ every element is a composition of either two or three direct symmetries of order 4.

6/8

It is true that you have covered every possibility but you have dealt with every case rather than dealing with cycle types.

For example:

All 3 cycles are conjugate with each other, so will be of the form $x(132)x^{-1}$ for some $x \in S_4$

But, by part (a)(i)

$$x(132)x^{-1} = \underbrace{x(1234)x}_{\text{A 4 cycle}}\ \underbrace{x^{-1}(1243)x^{-1}}_{\text{Another 4 cycle}}$$

Hence all 3 cycles are a product of 2 four cycles

I've knocked a couple of marks off for "style".