1. 4.3.4

2. 4.3.5

3. 4.4.1

4. Consider the map ϕ defined on page 83. Let **i**, **j**, and **k** be the usual imaginary quaternions and let e_1, e_2 and e_3 be the standard basis vectors for $\mathbb{R}^3$. It is easy to show the following:

$$\phi([\mathbf{i},\mathbf{j}]) = \phi(\mathbf{i}) \times \phi(\mathbf{j}) \tag{1}$$
$$\phi([\mathbf{j},\mathbf{k}]) = \phi(\mathbf{j}) \times \phi(\mathbf{k}) \tag{2}$$
$$\phi([\mathbf{k},\mathbf{i}]) = \phi(\mathbf{k}) \times \phi(\mathbf{i}) \tag{3}$$
$$\tag{4}$$

You should show that the last of these equatins holds, and trust me on the other two.

Then, use bilinearity and just these equations to show that $\phi([u, v]) = \phi(u) \times \phi(v)$ for all imaginary quaternions u and v.