

**Week 3** Flat, Projective, and Completely Reducible modules  
Jacobson II: 3.2, 3.5, 3.10

1. Jacobson II 3.10.2
2. Jacobson II 3.10.6. Show further that  $\mathbf{Q}$  is not a projective  $\mathbf{Z}$ -module.
3. Show that a  $\mathbf{Z}$ -module is flat if and only if it has no torsion elements. (Hint: If such a module is not flat show that there is a finitely generated submodule which is not flat and use the structure theorem for finitely generated modules over principal ideal domains.)
4. Jacobson II 3.2.1
5. Jacobson II 3.5.1
6. Jacobson II 3.5.3
7. Jacobson II 3.5.4
8. Jacobson II 3.5.6
9. Jacobson II 3.5.7