

**Mandatory Question**  
**Fusion Spring**  
**2016**

1. Describe from first principles the heating of a fusion plasma by fast ions (e.g. from alpha particles or from neutral beam injection). Under what conditions are thermal ions heated more strongly than electrons at temperatures relevant to fusion.

2. Derive from first principles the equations for MHD equilibrium for a linear, infinite length, screw pinch plasma with finite background poloidal velocity  $\mathbf{u} = \Omega r \hat{\theta}$ , where  $\Omega$  is constant,  $r$  is the plasma radius, and  $\hat{\theta}$ , is the unit vector in the poloidal direction. Explain any assumptions made and describe differences between this case and the usual case when one neglects background flow. How could a poloidal background flow be generated or imposed in a screw pinch plasma?