Conditions for Creep

For most metals and ceramics, time is not a consideration when testing is done at room temperature. When loads are removed, elastically deformed samples snap back to their original shapes, and plastically deformed samples remain indefinitely in their deformed shapes. However, if the service temperature of metals is greater than approximately 0.3–0.4 times a metal's melting temperature, expressed in absolute degrees kelvin, then plastic deformation under loading (creep) is observed to continue over time, even though the applied stresses are less than the yield stress. The transition range for most ceramics is slightly higher, at approximately 0.4–0.5 times the melting temperature.

In Unit 2, you will see that glasses and thermoplastic polymers do not discontinuously melt, but rather continuously soften. A glass transition temperature T_g, commonly referred to as the softening point, replaces the melting temperature for these materials. T_g is near room temperature for many plastics, so time-dependent creep is a common problem for these materials.

Without investigating the specific atomic mechanisms of creep, we descriptively say that at higher temperatures, some new plastic strain mechanisms become activated – mechanisms that are frozen out at lower temperatures.