Homework #7
Due: 12/6/16

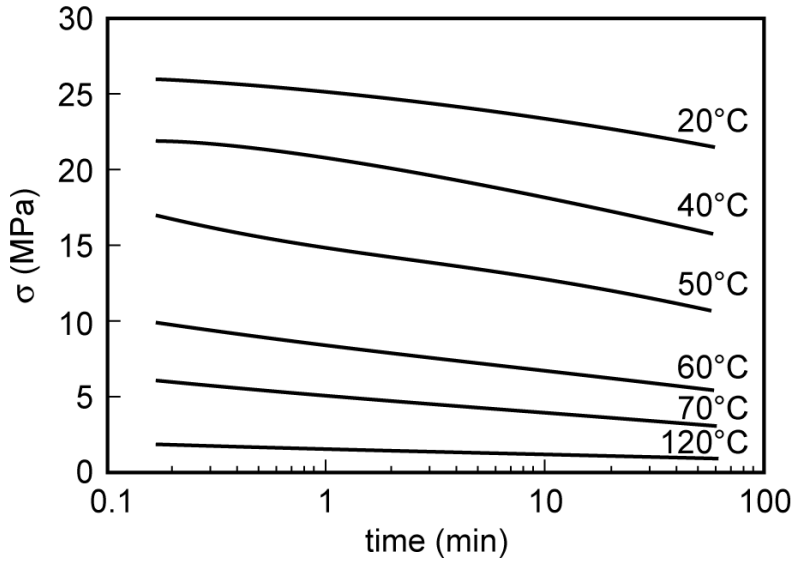
1. (20) Bowman B.5.1. Explain why the strengthening effect of interstitial carbon is different in FCC and BCC iron alloys. In which type should interstitial carbon be more potent, and why?

2. (20) Bowman B.5.2. Sketch and describe what happens to a dislocation loop after it reaches a half-circle. Why might the resistance to growth of the loop actually decrease as it extends beyond the half-circle? Consider the case for both a single half-loop and a continuous length of dislocation meeting two obstacles.

3. (30) Stress relaxation in a polymer results from molecular displacements. Therefore, the effects of temperature on stress relaxation would be similar to that of any thermally activated process, following an Arrhenius-type expression,

$$\frac{1}{\sigma} \propto \exp\left[\frac{-Q}{kT}\right]$$

where all variables have their usual meaning. (a) Describe or show how you would use this relationship to determine the activation energy, Q, for the molecular process responsible for stress relaxation in a polymer. (b) Calculate the activation energy for a liquid crystal polymer composed of polyethylene terephthalate (PET) and polyhydroxybenzoic acid (PHB) that exhibited the stress relaxation behavior shown below for a 0.5% constant strain.



4. (30) For the following creep rupture data, construct a Larson-Miller plot (assuming $C = 20$). Determine the expected life for a sample tested at 650°C with a stress of 240 MPa, and at 870°C with a stress of 35 MPa. Compare these values with actual test results of 32,000 and 9,000 h, respectively.

T (°C)	Stress (MPa)	t_f (h)	T (°C)	Stress (MPa)	t_f (h)
650	480	22	815	140	29
650	480	40	815	140	45
650	480	65	815	140	65
650	450	75	815	120	90
650	380	210	815	120	115
650	345	2700	815	105	260
650	310	3500	815	105	360
705	310	275	815	105	1000
705	310	190	815	105	700
705	240	960	815	85	2500
705	205	2050	870	83	37
760	205	180	870	83	55
760	205	450	870	69	140
760	170	730	870	42	3200
760	140	2150	980	21	440
			1095	10	155