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MEMT 201 HW #9 – Brittle Fracture

1. You have an aluminum alloy plate with an internal crack. The plain strain fracture toughness of this material is 40 MPa-m-1/2. The critical stress for a 4.0 mm internal crack is 300 MPa. For a 6.0 mm crack, will fracture occur at a stress level of 260 MPa?

If $K > K_{IC}$ (40 MPa-$\sqrt{m}$), then fracture occurs.

Find K:

$K = y\sigma\sqrt{(\pi a)}$

Find y:

a := 4 mm / 2 = 0.002 m

$Y = K_{IC} / (\sigma\sqrt{(\pi a)}) := 40 / (300\ \sqrt{(\pi * 0.002)}) = 1.68$

Plug Y:

A := 6 mm / 2 = 0.003 m

$K := 1.68 * (260) * \sqrt{(\pi * 0.003)} = 42.4$ MPa-$\sqrt{m}$

42.4 MPa-$\sqrt{m}$ = $K > K_{IC}$ = 40 MPa-$\sqrt{m}$, so fracture occurs.

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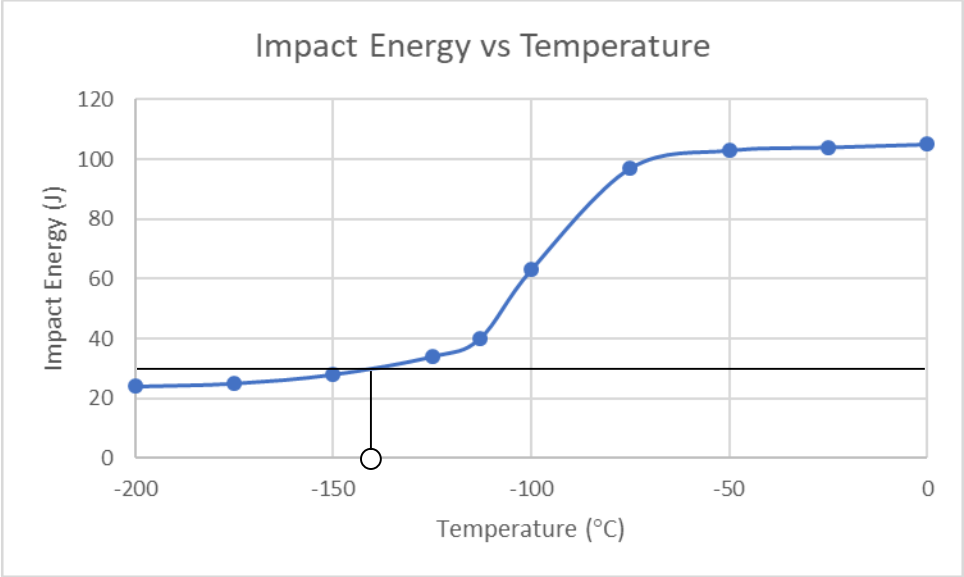
2. You have the following table of Charpy Impact Test data.

Temperature (deg C)	Impact Energy (J)
0	105
-25	104
-50	103
-75	97
-100	63
-113	40
-125	34
-150	28
-175	25
-200	24

a.) Plot the Impact Energy vs. Temperature



b.) Find the DBTT as related to the average of the maximum and the minimum impact fracture energies.

Temperature of highest impact energy, T_{max} := 0 °C
Temperature of lowest impact energy, T_{min} := -200 °C

Average Temperature T := -100 °C

c.) Find the DBTT as related to an impact energy level of 30 J.

According to the graph above:
The temperature corresponding to an impact energy of 30 Joules, T :≈ -140 °C