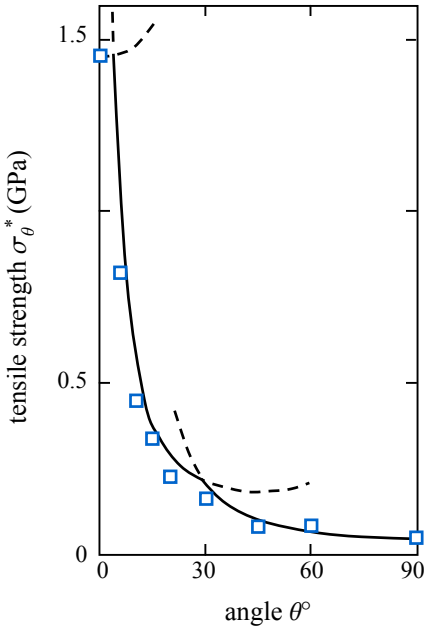
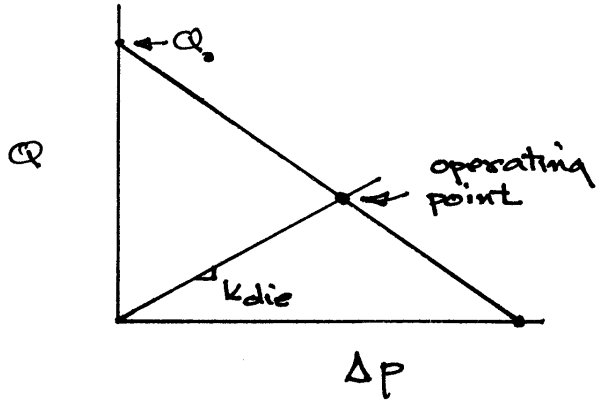
3.064 Quiz 3 – Sample Questions

1. Consider a unidirectionally reinforced fiber-matrix composite:
   a) What elastic constants (relative to the fiber and transverse directions) are needed to describe this material?
   b) Describe how you would compute the elastic modulus in a direction inclined at an angle to the fiber direction.
   c) Explain why the tensile strength seems to *increase* when the stress is applied at a small angle to the fibers as seen in the figure below.



2. Consider the metering zone of a single-screw extruder (neglect temperature variations):
   a) Sketch the flow field and indicate the boundary conditions.
   b) Describe the influence of the die on this field.
   c) Describe how you would go about calculating the volumetric flow output of the extruder, and the power needed to drive it.
   d) Explain the graph:



3. Give three examples of (a) commodity plastics, (b) engineering plastics, (c) elastomers, (d) transparent plastics, (e) thermoset resins for composites. Include chemical formulas if you can.
4. Short answers:
   a) Why is polyethylene a good barrier against water transport but not for CO_2?
   b) Why are some polymers transparent and some opaque or translucent? Why are some yellow?
   c) What is it about polystyrene that makes it a poor choice for children's toys?

d) How does compounding polystyrene with a suitable distribution of rubber particles improve its properties?
e) Why does a short-fiber composite have inferior strengths and stiffnesses compared to continuous-fiber composites?
f) Why might a plot of E vs. K_{Ic} be useful in materials selection?