a) Using basic mechanisms, estimate the energy requirement to machine a low carbon steel. Give the answer in MJ per kg removed. What specific material property is involved? Clearly state all assumptions. Within reasonable parameters of production, how does this value change with the rate of production? What things usually limit the rate of production (metal removal rate) in machining? List at least five reasons. What additional energy requirements for machining would be added if you were to look at this problem from the machine tool level (e.g. monitor the electrical power input) instead of at the mechanism level?

b) Using basic mechanisms estimate the energy required to sand cast aluminum. Give the answer in MJ/kg cast. What controls the rate of sand casting? For a given set of functional requirements for a part, how would you speed up the sand casting process? Give at least three suggestions. For a primary energy sources point of view, what additional energy requirements need to be added for the casting problem.

Show all work and state all assumptions