1. An electric motor delivers 10 hp to a pump through a solid circular shaft that is rotating at 875 rpm. If the shaft has an allowable shear stress of τ_{allow} = 20 ksi, what is the minimum required diameter of the shaft?

   (25 %)

2. A composite beam having the dimensions shown in Figure 2 is constructed by gluing a thin aluminum plate to the top side of a square wood beam. Take E_{alum} = 70 Gpa,　E_{wood} = 12 Gpa.

   Determine the maximum flexural stress in the aluminum and in the wood when a pure bending moment M = 3 kN*m is applied in the manner indicate in Figure 2.
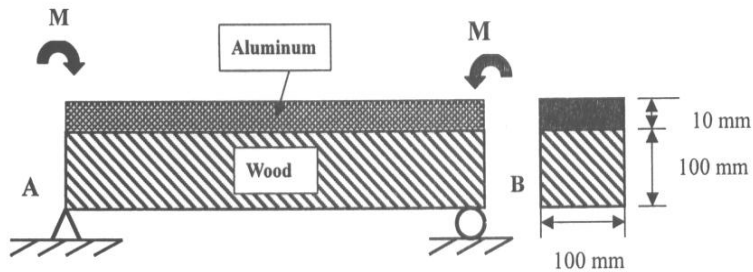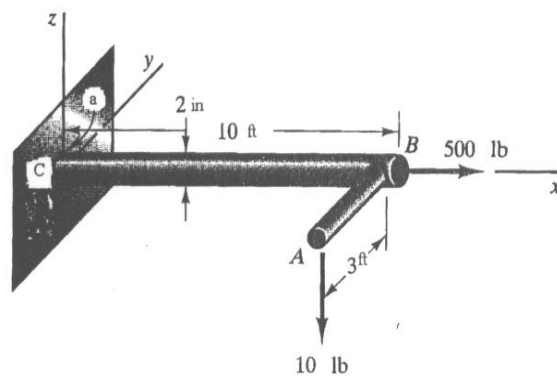
   (25 %)

Figure 2

3. A rod *AB* is welded onto a solid cylindrical cantilever beam *CB* in the following figure. What is the maximum principal stress at point *a* in the cantilever beam? Neglect the weights of *CB* and *AB* (*Note:* Point *a* is on the top of the cantilever beam; $I_y = \pi r^4/4$, $I_p = \pi r^4/2$ for circle).

(25%)

4. Find the position where the slop is largest (see figure). Where is $d^3 w/d x^3$ largest? What is its value? Take $E = 1 \times 10^{11}$ Pa. (*Note: w* is the deflection in the z-direction, cross section = 25mm×50mm) (25%)