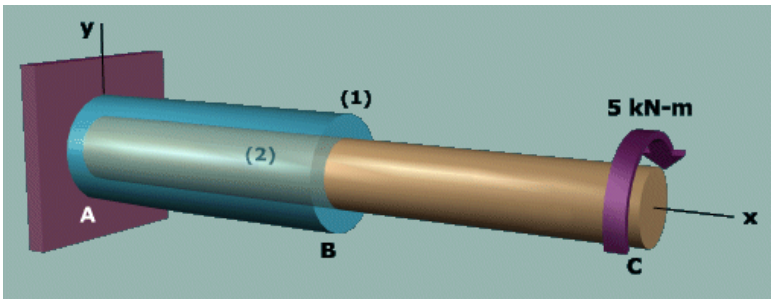
IDE 110 – Summer 2006 Quiz 10 **Name:** _____

A composite torsion member consists of tube (1) bonded to portion AB of solid shaft (2). A 5 kNm torque is applied to end C of the solid shaft. Between A and B, determine how much torque is in the tube T_1 and how much is in the solid shaft T_2.

Properties:

$c_1 = 34$ mm
$L_1 = 1900$ mm
$J_1 = 0.83\ (10^6)$ mm^4
$G_1 = 30$ GPa

$c_2 = 30$ mm
$L_2 = 3200$ mm
$J_2 = 1.27\ (10^6)$ mm^4
$G_2 = 55$ GPa



Show steps clearly. Include units and box the final answer.

$T_{tube} = T_1 \qquad T_{shaft} = T_2$

① $T_1 + T_2 = 5(10^3)\ N \cdot m$

$$\phi_B = \frac{T_1 L_1}{J_1 G_1} = \frac{T_2 L_2}{J_2 G_2} \qquad L_1 = L_2$$

② $$\frac{T_1}{(0.83\times10^{-6})(30\times10^{9})} = \frac{T_2}{(1.27\times10^{-6})(55\times10^{9})}$$

Solve ① & ②

$$\Rightarrow \boxed{\begin{aligned} T_1 &= 1313.98\ N \cdot m \\ T_2 &= 3686.02\ N \cdot m \end{aligned}}$$