Conceptual question 7.1

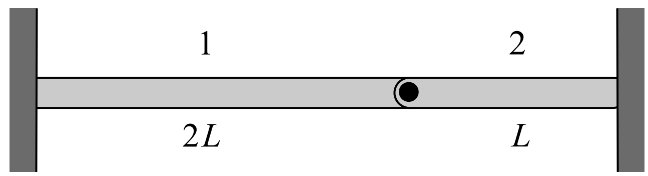
A structure is made up of elements 1 and 2, with each element having an elastic modulus of E, cross-sectional area A and thermal expansion coefficient α. Each element experiences a temperature increase of ΔT. Let F_1 and F_2 represent the axial load carried by elements 1 and 2, respectively. Circle the correct answer below:

a) $|F_1| = |F_2| = 0$

b) $|F_1| > |F_2|$

c) $|F_1| = |F_2| \neq 0$

d) $|F_1| < |F_2|$



Conceptual question 7.2

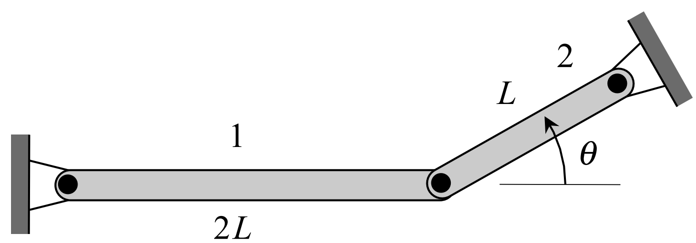
A structure is made up of elements 1 and 2, with each element having an elastic modulus of E, cross-sectional area A and thermal expansion coefficient α. Each element experiences a temperature increase of ΔT. Let F_1 and F_2 represent the axial load carried by elements 1 and 2, respectively. Circle the correct answer below:

a) $|F_1| = |F_2| = 0$

b) $|F_1| > |F_2|$

c) $|F_1| = |F_2| \neq 0$

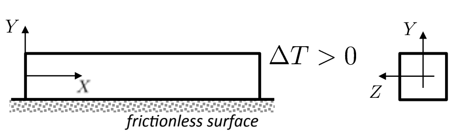
d) $|F_1| < |F_2|$



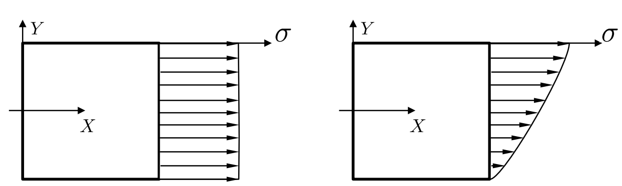
Conceptual question 7.3

For each loading configuration shown below, indicate the correct stress distribution over a cross section perpendicular to the x-axis.

(c) A prismatic bar resting on frictionless surface is subjected to a positive change in temperature ΔT.

(c) 

Answer: ________

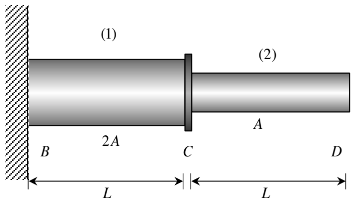


(3) Stress free (all stress components are zero)

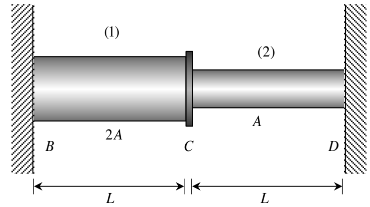
(1) (2)

Conceptual question 7.4

Rod I



Rod II



i) Rod I shown above is made up of a material with a Young's modulus of E and thermal expansion coefficient α. The cross-sectional areas of elements (1) and (2) are given by 2A and A, respectively. Both elements are heated in such a way that each has a temperature increase of ΔT. Let σ_1 and σ_2 represent the stress in elements (1) and (2), respectively. Circle the correct description below of these two stresses:

a. $|\sigma_1| > |\sigma_2|$

b. $|\sigma_1| = |\sigma_2|$

c. $|\sigma_1| < |\sigma_2|$

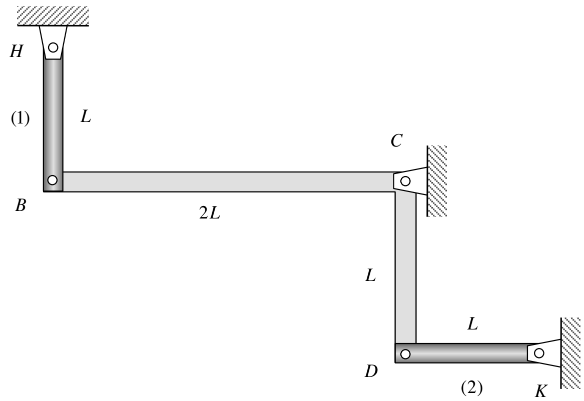
ii) Rod II is exactly the same as Rod I, except its right end is attached to a rigid wall. Again, both elements are heated to the same temperature increase ΔT. Circle the correct description below of the stresses in the two elements:

a. $|\sigma_1| > |\sigma_2|$

b. $|\sigma_1| = |\sigma_2|$

c. $|\sigma_1| < |\sigma_2|$

Conceptual question 7.5



Identical elements (1) and (2) (each having a Young's modulus E, coefficient of thermal expansion α and cross-sectional area A) are connected between ends B and D, respectively, of a rigid, L-shaped bar. The temperature of (1) is *increased* by an amount of $\Delta T > 0$, with the temperature of element (2) being held constant.

Consider the *load* (force) carried by element (1):

a) The load in (1) is *compressive*.

b) The load in (1) is *zero*.

c) The load in (1) is *tensile*.

Consider the *strain* in element (1):

a) The strain in (1) is *compressive*.

b) The strain in (1) is *zero*.

c) The strain in (1) is *tensile*.

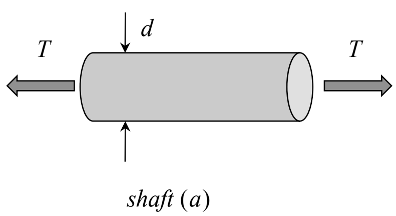
Conceptual question 8.1

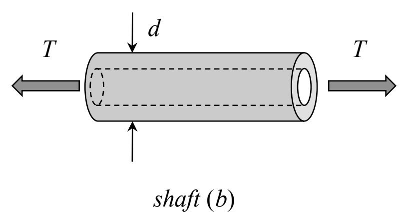
Shaft (a) has a solid cross section with outer radius d. Shaft (b) has a tubular cross section with an outer radius of d. Each shaft has the same length and the same shear modulus G. Let $\tau_{a,max}$ and $\tau_{b,max}$ represent the maximum shear stress in shafts (a) and (b), respectively, due to the torque T applied at the shafts' ends. Circle the correct answer:

a) $|\tau_{a,max}| > |\tau_{b,max}|$

b) $|\tau_{a,max}| = |\tau_{b,max}|$

c) $|\tau_{a,max}| < |\tau_{b,max}|$

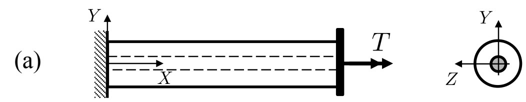




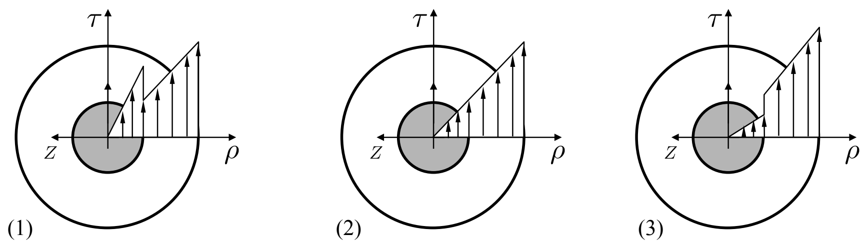
Conceptual question 8.2

For each loading configuration shown below, indicate the correct stress distribution over a cross section perpendicular to the x-axis.

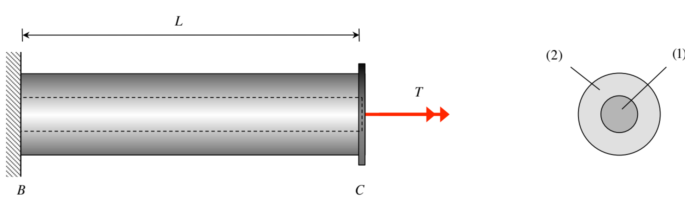
(a) A bimetallic bar with circular cross section comprised of two elastic materials is subjected to a torque T. Material A, depicted using white, is stiffer than material B, depicted using gray. Specifically, the Young's modulus of material A is two times larger than the Young's modulus of material B, and both materials have the same Poisson's ratio.



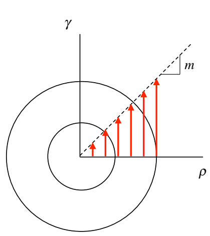
Answer: ________

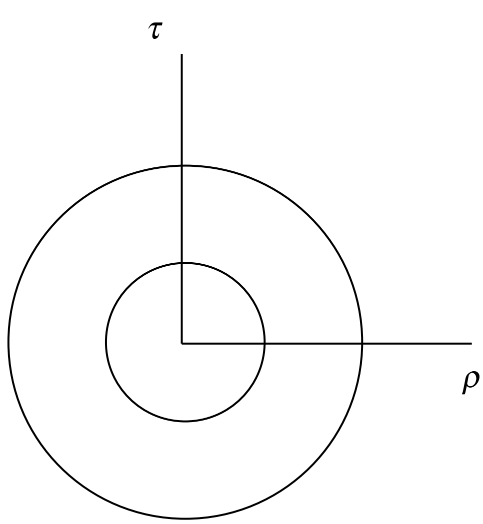


Conceptual question 8.3



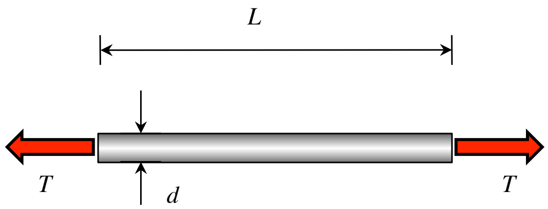
A shaft is made up of a tubular element (2) and core element (1), with the elements have shear moduli of G_2 and G_1, respectively, with $G_2 > G_1$. These elements at attached to a rigid support at B and are attached to a rigid connector C. A torque T is applied to connector C. The resulting shear strain distribution γ on the shaft cross section is shown in the figure below left. In the figure below right, make sketch of the shear stress distribution τ in the shaft cross section. Clearly indicate the slopes of the shear stress curves in terms of the shear strain slope m.



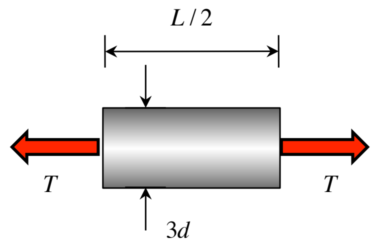


Conceptual question 8.4

Solid shafts 1 and 2 are made from the same material and experience the same applied torque T. The maximum shear stress in Shaft 1 is known to be $13.5 \times 10^6 \, N / m^2$. What is the maximum shear stress in Shaft 2?

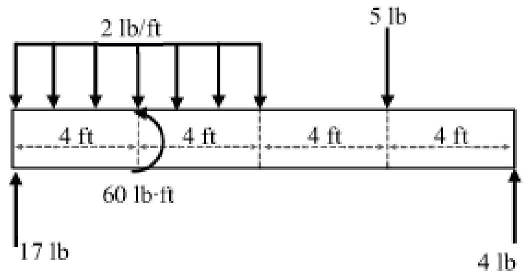


Shaft 1

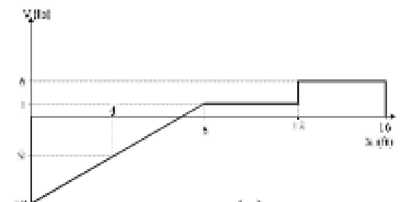


Shaft 2

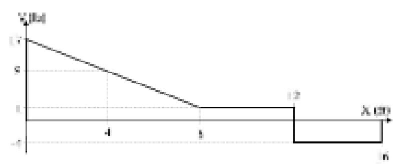
Conceptual question 9.1



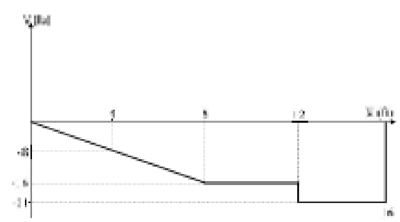
circle the letter of the appropriate shear and moment diagrams shown below. Note that the correct shear and moment diagrams do not necessarily appear next to each other.



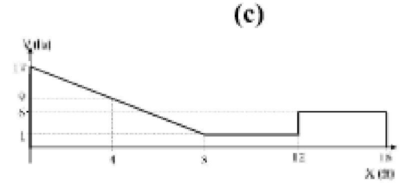
(a)



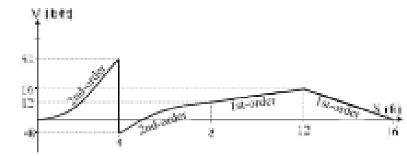
(b)



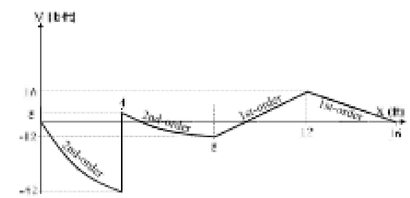
(c)



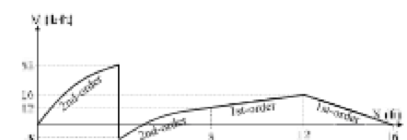
(d)



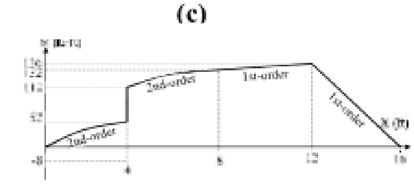
(a)



(b)

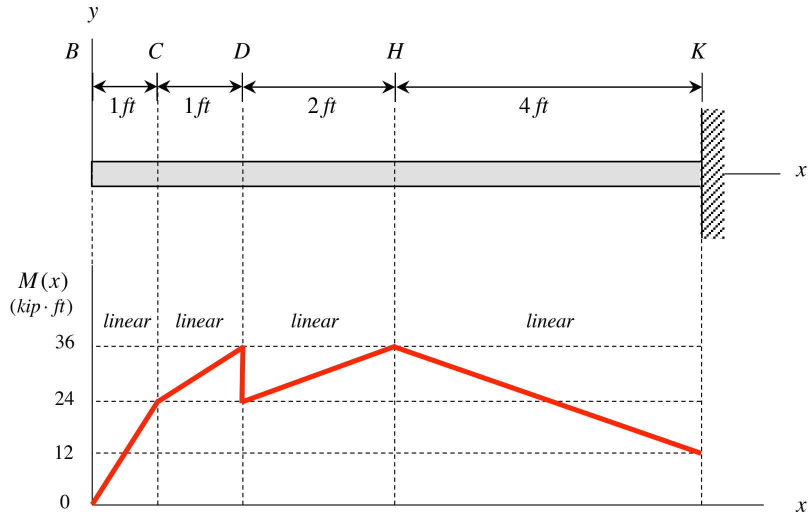


(c)



(d)

Conceptual question 9.2

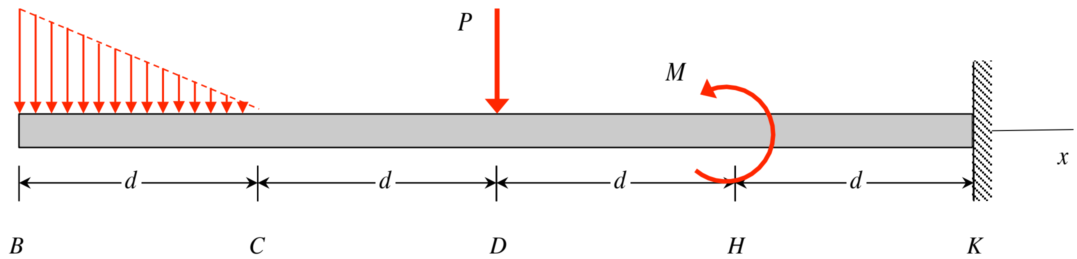


The cantilevered beam is loaded with concentrated moments and concentrated forces. This loading is unknown; however, the bending moment diagram for the beam is known and provided above.

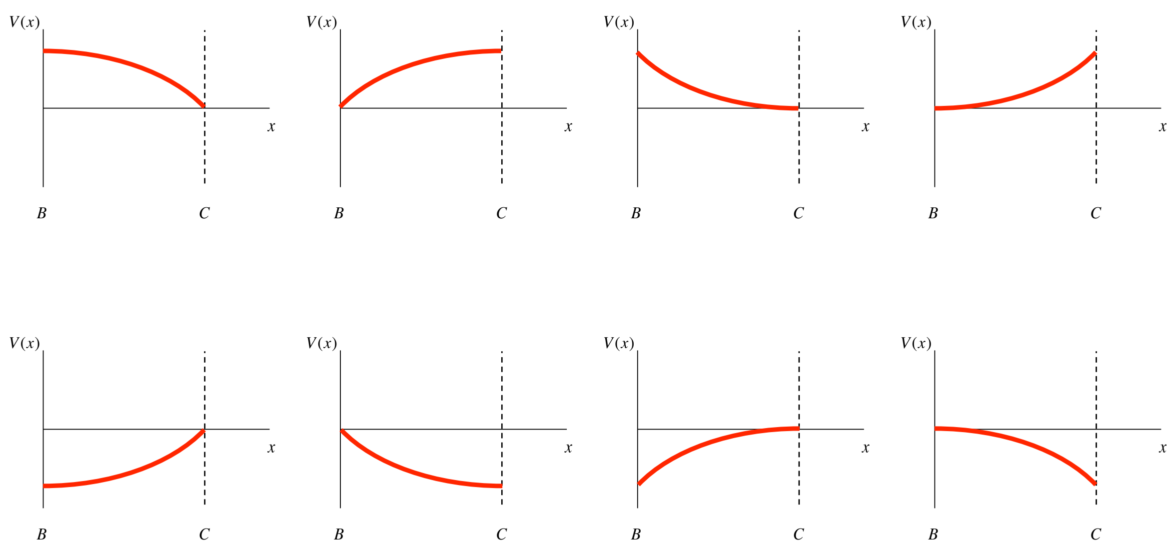
a) Determine the maximum value of the magnitude of *internal shear force* V in the beam.

b) If the beam has a square cross section with a cross-sectional area of $A = 2\,ft^2$, determine the maximum value of the magnitude of *shear stress* τ_{xy} in the beam?

Conceptual question 9.3



The above loading is applied to a cantilevered beam. *Circle* the figure below which most accurately describes the internal shear force resultant in the beam between locations B and C.



Conceptual question 9.4

The schematics presented below correspond to beams with span L and loaded with either a couple at the left end or with a force per unit of length with different distributions (i.e., linear, constant or quadratic).

Which schematic corresponds to a beam whose bending moment is equal to

$$M(x) = \frac{x\, w_0 L}{10} - \frac{w_0\, x^3}{6\, L}$$

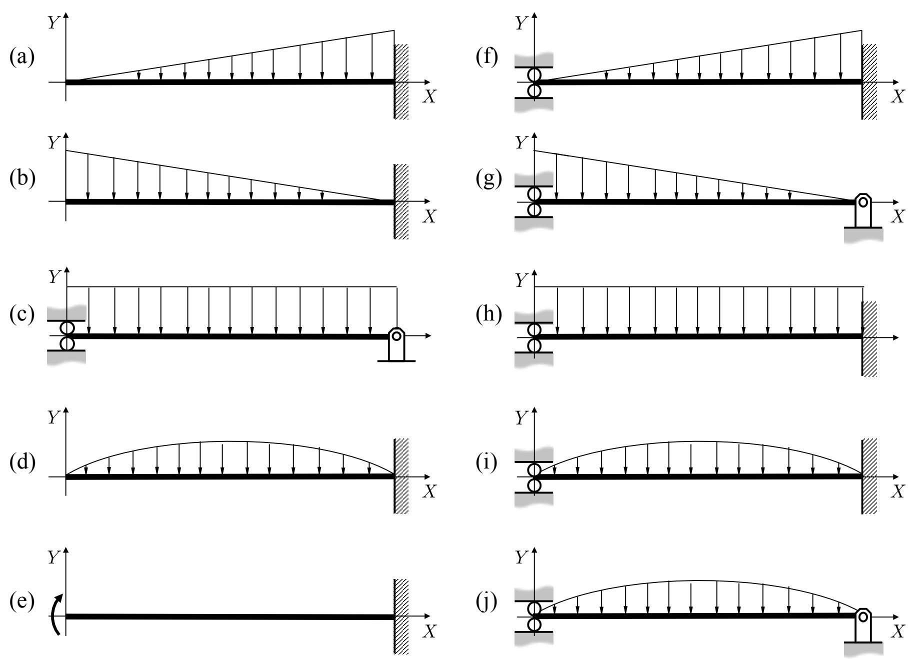
Circle the correct answer (a) (b) (c) (d) (e) (f) (g) (h) (i) (j)

Which schematic corresponds to a beam whose bending moment is equal to

$$M(x) = \frac{w_0\, x^4}{12} - \frac{w_0\, L\, x^3}{6}$$

Circle the correct answer (a) (b) (c) (d) (e) (f) (g) (h) (i) (j)

<u>**HINT**</u>: Identify which supports and loads are compatible with the given bending moments.



Conceptual question 9.5