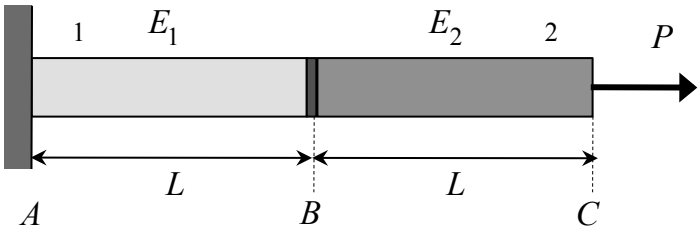
Conceptual question 6.1

A rod is made up of elements 1 and 2, each having a length of L and cross-sectional area A. Element 1 has an elastic modulus of E_1, and element 2 has a modulus of E_2, with $E_2 > E_1$. Let F_1 and F_2 represent the axial load carried by elements 1 and 2, respectively. Circle the correct answer below:

a) $|F_1| > |F_2|$

b) $|F_1| = |F_2|$

c) $|F_1| < |F_2|$



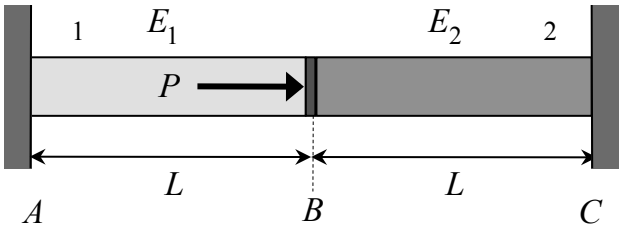
Conceptual question 6.2

A rod is made up of elements 1 and 2, each having a length of L and cross-sectional area A. Element 1 has an elastic modulus of E_1, and element 2 has a modulus of E_2, with $E_2 > E_1$. Let F_1 and F_2 represent the axial load carried by elements 1 and 2, respectively. Circle the correct answer below:

a) $|F_1| > |F_2|$

b) $|F_1| = |F_2|$

c) $|F_1| < |F_2|$



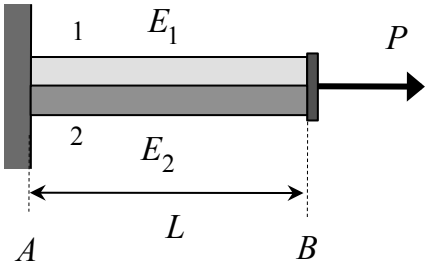
Conceptual question 6.3

A rod is made up of elements 1 and 2, each having a length of L and cross-sectional area A. Element 1 has an elastic modulus of E_1, and element 2 has a modulus of E_2, with $E_2 > E_1$. Let F_1 and F_2 represent the axial load carried by elements 1 and 2, respectively. Circle the correct answer below:

a) $|F_1| > |F_2|$

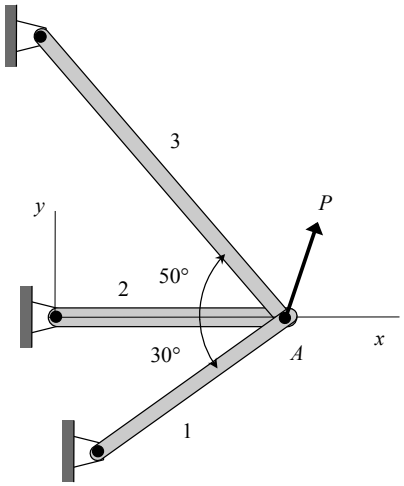
b) $|F_1| = |F_2|$

c) $|F_1| < |F_2|$



Conceptual question 6.4

A truss is made up of elements 1, 2 and 3 connected by a pin joint at A. Let u_A and v_A represent the x- and y-components of the displacement of joint A as a result of the applied force P. Also, let e_1, e_2 and e_3 represent the elongation of elements 1, 2, and 3, respectively. The following equations are to represent the relationship betweent the elemental elongations and the displacement of A:



$$e_1 = u_A cos\theta_1 + v_A sin\theta_1$$

$$e_2 = u_A cos\theta_2 + v_A sin\theta_2$$

$$e_3 = u_A cos\theta_3 + v_A sin\theta_3$$

For this problem, what are the numerical values for the angles θ_1, θ_2 and θ_3?

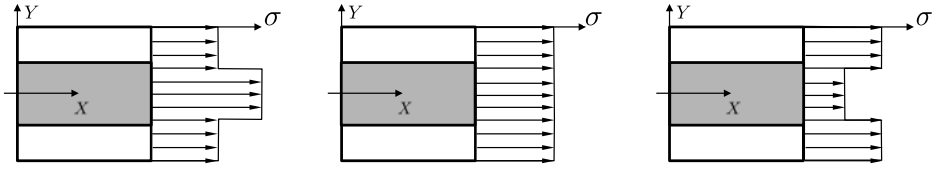
Conceptual question 6.5

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

(b) A bimetallic bar with square cross section comprised of two elastic materials is subjected to an axial for *P*. 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.

(b) 

Answer: _____



(1) (2) (3)

Conceptual question 6.6

Use only the compatibility condition for the truss structure shown in the figure to find the value of the elongation of member 2 (e_2) if the elongation of member 1 is 0.001 ft. ($e_1 = 0.001$ ft.) and the elongation of member 3 is 0.0005 ($e_3 = 0.0005$ ft.).

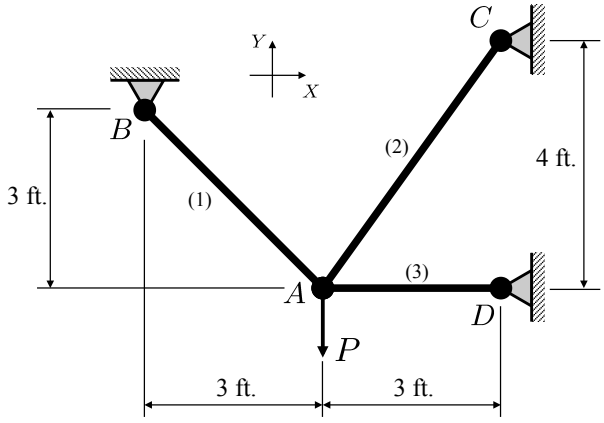
(a) Determine the compatibility condition at *A*:

$$e_2 = a\, e_1 + b\, e_3$$

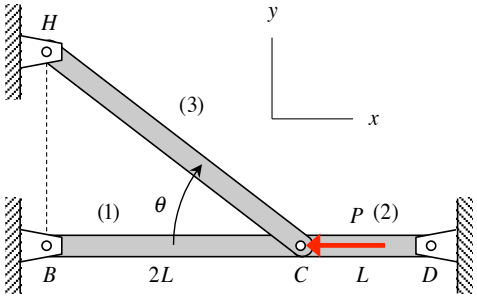
where a and b are numbers.
Please notice that you are not required to solve for the internal axial forces at equilibrium.

(b) Determine e_2 for the given values of e_1 and e_3.

Please show your work and thought process.



Conceptual question 6.7



The truss shown above is made up of truss elements (1), (2) and (3). A horizontal force P is applied to joint C.

(i) Draw a free body diagram (FBD) for joint C.

(ii) Let σ_3 be the axial stress in element (3). Circle the correct description of σ_3 below (consider your FBD from above):

a) $\sigma_3 > 0$ (*tension*)

b) $\sigma_3 = 0$

c) $\sigma_3 < 0$ (*compression*)

(iii) Let v_C be the *vertical* component of displacement of joint C. Circle the correct description of v_C below:

a) $v_C > 0$ (*UP*)

b) $v_C = 0$

c) $v_C < 0$ (*DOWN*)

Conceptual question 6.8

Use only the compatibility condition for the truss structure shown in the figure to find the value of the elongation of member 2 (e_2) in terms of the elongation of member 1 (e_1), and the elongation of member 3 (e_3). Specifically:

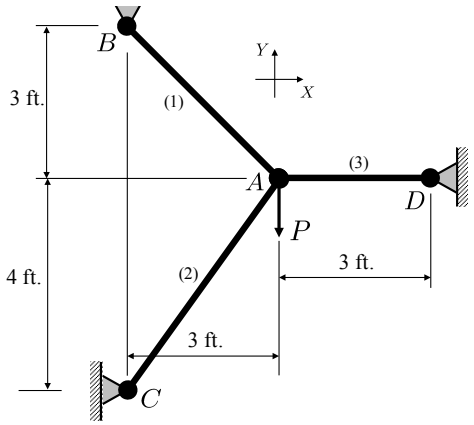
Determine an expression for the compatibility condition at *A*:

$$e_2 = a\, e_1 + b\, e_3$$

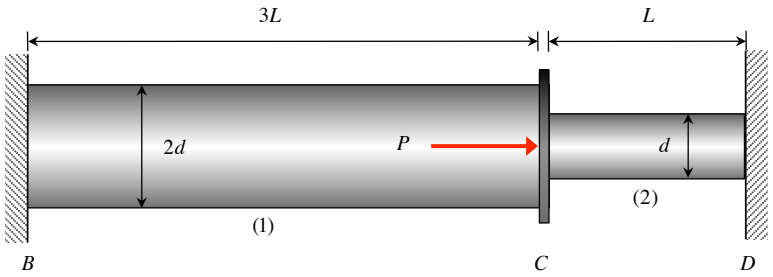
where a and b are numbers.

Please notice that you are not required to solve for the internal axial forces at equilibrium.

Please show your work and thought process.



Conceptual question 6.9



A rod is made up of solid elements (1) and (2) joined by a rigid connector C, with the material of (1) and (2) having the same modulus of elasticity E. An axial load P is applied to C with no thermal loads being present. Let F_1 and F_2 represent the axial loads in elements (1) and (2), respectively. Circle the response below which most accurately describes the relative sizes of $|F_1|$ and $|F_2|$:

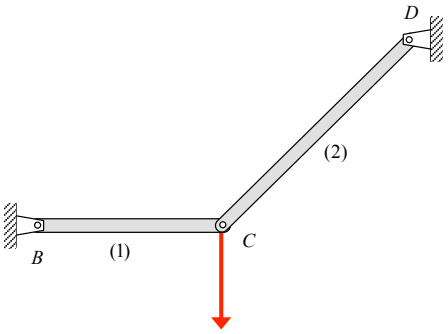
a) $|F_1| > |F_2|$

b) $|F_1| = |F_2|$

c) $|F_1| < |F_2|$

d) More information is needed to answer this question.

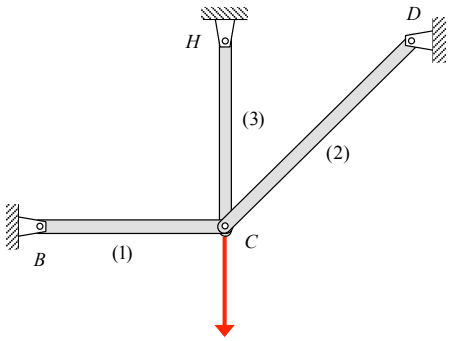
Conceptual question 6.10



Consider the truss above that is made up of elements (1) and (2).

TRUE or *FALSE*: The stress in element (1) depends on the material makeup of element (2).

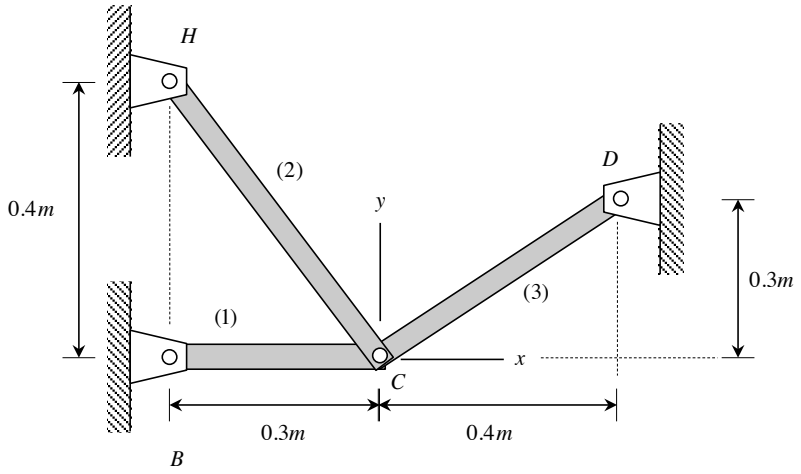
Conceptual question 6.11



Consider the truss above that is made up of elements (1), (2) and (3).

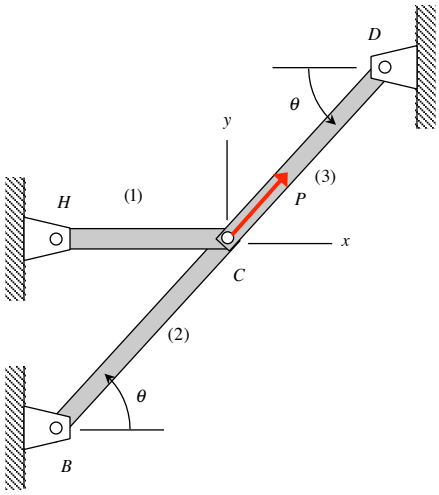
TRUE or *FALSE*: The stress in element (1) depends on the material makeup of elements (2) and (3).

Conceptual question 6.12



The truss shown above is loaded at joint C in such a way that the horizontal and vertical components of displacement of joint C are $(u_C, v_C) = (2,6)\ mm$. Determine the elongation of member (2) of the truss.

Conceptual question 6.13



In the truss shown above, member (1) is horizontal, with members (2) and (3) aligned and at an angle of θ with respect to the horizontal. A load P is applied to joint C in a direction that is aligned with members (2) and (3). Simultaneously, the temperature of member (2) is *increased*, with the temperatures of the remaining members being held constant. Let e_1 be the elongation of member (1), and $\left(u_C, v_C\right)$ being the x- and y-components of displacement of joint C due to the load P.

For this loading on the truss, the axial stress in member (1) is (circle the correct response):

a) compressive.

b) tensile.

c) zero.

HINT: consider an FBD of joint C.

Also, for this loading the *displacement* of joint C is (circle the correct response):

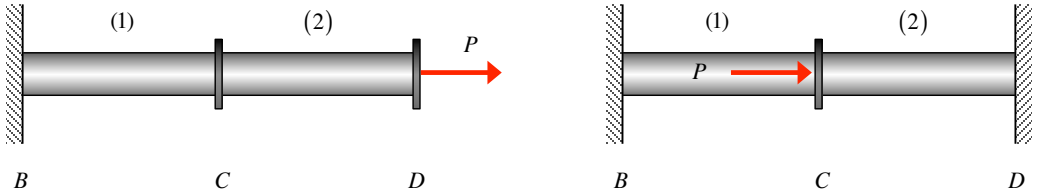
a) up and to the right ($u_C > 0$ and $v_C > 0$)

b) directly to the right ($u_C > 0$ and $v_C = 0$)

c) directly up ($u_C = 0$ and $v_C > 0$)

d) zero ($u_C = 0$ and $v_C = 0$)

Conceptual question 6.14



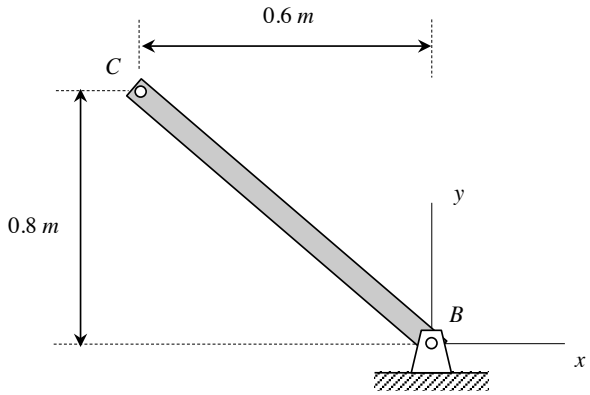
Rod I ***Rod II***

In Rods I and II above, member (1) is made up of steel, whereas the material of member (2) is unknown.

a) TRUE or FALSE: In Rod I, the stress in member (2) depends on the material makeup of member (2).

b) TRUE or FALSE: In Rod II, the stress in member (2) depends on the material makeup of member (2).

Conceptual question 6.15

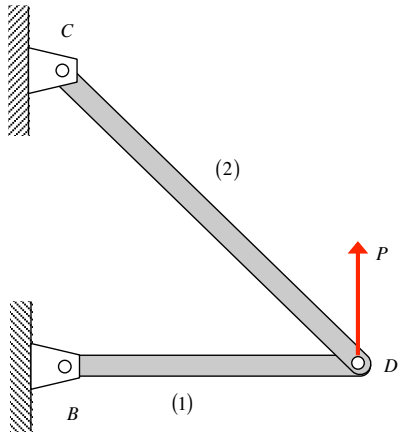


Truss member BC is known to be in an orientation shown above. As a result of loads being applied to the truss (neither the loading nor the other members of the truss are shown in figure), joint C is moved *16 mm to the RIGHT* and *12 mm UP*. For this motion:

a) What is the total displacement of joint C?

b) What is the elongation of member BC?

Conceptual question 6.16

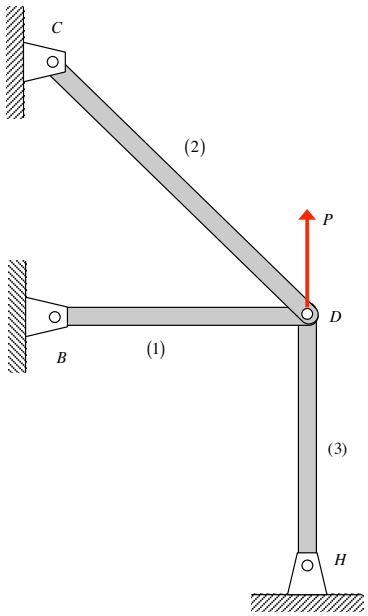


Consider the truss shown above made up on members (1) and (2).

TRUE or *FALSE*: The stress in member (1) depends on the material makeup of member (2).

Provide a written explanation for your answer.

Conceptual question 6.17

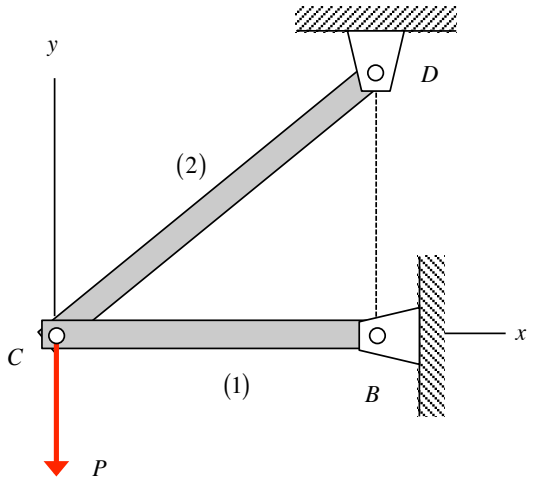


Consider the truss shown above made up on members (1), (2) and (3).

TRUE or *FALSE*: The stress in member (1) depends on the material makeup of members (2) and (3).

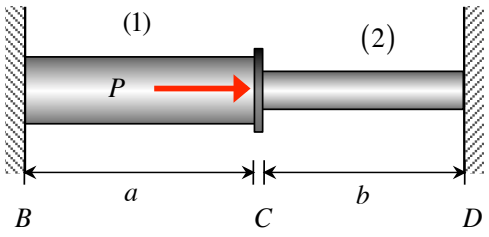
Provide a written explanation for your answer.

Conceptual question 6.18



You are reviewing work by a design team at your consulting firm related to the truss bracket shown above. The team's work indicates that if the Young's modulus for element (2) in the truss is doubled, the stress in that element is decreased by a factor of two. You know that this result is not correct. Provide an explanation here to your design team as to why the result is incorrect.

Conceptual question 6.19



A structure is made up of axial members (1) and (2) shown above with a load of P acting at the rigid connector C. You are asked to re-design the structure by changing the length *b* of member (2) in order to decrease the normal stress in that member. You are <u>*not*</u> able to change any other aspect of the design such as the material or the cross sectional area of the member. Circle the answer below that describes best your design options.

a) A *decrease* in the length *b* of member (2) will decrease the normal stress in the element.

b) An *increase* in the length *b* of member (2) will decrease the normal stress in the element.

c) Changing the length *b* of member (2) cannot change the normal stress in the element.