Properties of Sections

1. Select all that apply to the characteristics of the Center of Gravity:
   A) 1. The point about which the body is stable or balanced
       2. The point of application of the resultant weight

2. Sketch the center of area for the following body shapes:
   A)

   ![Image of body shapes]

3. What is generally known about the centroid of an area with two axes of symmetry.
   A) The centroid of the area is at the crossing of the axes of symmetry.

4. The diagram shown demonstrates the location of the centroid of a simple triangle with the given dimensions. Find the centroidal x and y distances as shown on the diagram.
   A)
   \[
   \bar{x} = \frac{12\text{"}}{3} = 4\text{"
   }\]
   \[
   \bar{y} = \frac{6\text{"}}{3} = 2\text{"
   }
   \]

5. What sectional properties are computed using the centroid as a reference?
   A) Static Moment of Area and Moment of Inertia

6. What does the center of gravity of a mass represent?
   A) The point at which the entire mass could be concentrated with the same static effect.
      The point at which the mass could be held and be in balance in all directions.

7. The centroid of an area is not always located within the bounds of the area. (T or F)
   A) true
Moment of Inertia – Ch 6.2

1. The Moment of Inertia is a gage of what?
   A) Cross sectional stiffness.

2. For any cross section, which of the following changes will increase the moment of inertia?
   A) Increase the depth, without changing the area
      Increase the width, by adding area
      Increase the area in any way

3. For two beams of equal span, material and loading, if beam A has a moment of inertia of 1000 in$^4$, and beam B has a moment of inertia of 2000 in$^4$ what is true?
   A) A will deflect more than B

4. Which of the configurations of the 3 2x6’s (full dimension) would give the highest moment of inertia?
   A) A

5. What is the moment of inertia for section C above?
   A) 108 in$^4$

6. A beam loaded flat wise is less stiff than the same beam loaded edge wise. This is primarily because?
   A) The moment of inertia is greater for the greater depth

7. What is the equation for calculating the moment of inertia of a rectangle?
   A) $I = (bh^3)/12$

8. Which orientation of the same cross-section has the larger moment of inertia?
   A) The cross-section at the left
9. Calculate the moment of inertia of the following shape:

A) \[
\frac{6 \times 8^3}{12} - \frac{4 \times 6^3}{12} = 256 - 72 = 184 \text{ in}^4
\]

10. Determine whether the following is true about Radius of Gyration:

The larger the radius of gyration, the more resistant the section is to buckling.

A) True

11. In order to find the moment of inertia about the major centroidal X axis for the cross section shown below, the perpendicular distances between the major centroidal X axis and the parallel axis that passes through the centroid of each component are required. Determine the distances, \( d_{y1}, d_{y2} \) and \( d_{y3} \) for each component.

A) \[

d_{y1} = \frac{6''}{2} - \frac{1''}{2} = 2.5''
\]
\[
d_{y2} = 0''
\]
\[
d_{y3} = \frac{6''}{2} - \frac{1''}{2} = 2.5''
\]

12. The following tables have been constructed to calculate the moment of inertia for the cross section shown. Using the given information in the tables, determine the major centroidal axes from the reference origin and the moment of inertia of the total cross-section about the major centroidal x and y axis.

<table>
<thead>
<tr>
<th>Component</th>
<th>Area</th>
<th>( y )</th>
<th>( Ay )</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ \text{[Diagram 1]} ]</td>
<td>11.8 in.(^2)</td>
<td>( \frac{d + b_2 - x}{2} = \frac{18 + 0.52 - 0.78}{17.74} )</td>
<td>209.3 in.(^3)</td>
</tr>
<tr>
<td>[ \text{[Diagram 2]} ]</td>
<td>14.7 in.(^2)</td>
<td>( \frac{d}{2} = \frac{18}{2} = 9'' )</td>
<td>132.3 in.(^3)</td>
</tr>
<tr>
<td>Component</td>
<td>$A$</td>
<td>$I_x$</td>
<td>$d_y$</td>
</tr>
<tr>
<td>-----------</td>
<td>-----</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td></td>
<td>11.8 in.$^2$</td>
<td>9.23</td>
<td>$y_1 - \bar{y}$</td>
</tr>
<tr>
<td></td>
<td>14.7 in.$^2$</td>
<td>800</td>
<td>$y_2 - \bar{y}$</td>
</tr>
</tbody>
</table>

13. What theorem provides a simple way to compute moment of inertia of composite areas?
   A) Parallel Axis Theorem (or Transfer Equation)

14. Which shape has a greater moment of inertia with respect to the neutral axis? Both shapes have the same area.
   A) A

15. A centroid of area is similar in concept to a
   A) Center of gravity.

16. Areas with one axis of symmetry
   A) Have a centroid which will lie somewhere on the axis of symmetry.
17. What is the distance to the centroidal axis, y-bar, for the section shown below?
   A) 6"

18. What is the moment of inertia, \( I_x \), for the section at the right?
   A) 326 in\(^4\)

19. What is the moment of inertia, \( I_y \), for the section above?
   A) 29.5 in\(^4\)

20. What is the radius of gyration for a solid circular section with a radius of 4"?
    A) 2"

21. Two circular sections have the same area. One is solid and one is hollow. The radius of gyration for the solid section is
    A) is less than that of the hollow section.

22. The four illustrations below describe the sign convention for shear and moment in beams. Match the illustration to the descriptions at the left.
   - positive shear
     (A) B
   - positive moment
     (A) C
   - negative shear
     (A) A
   - negative moment
     (A) D
27. A steel wide flange section W6x25 has an $I_x = 53.4 \text{ IN}^4$. How deep would a 4" wide, rectangular piece of basswood have to be to attain the same geometric stiffness, $I_x$?

$E_{\text{steel}} = 29000 \text{ ksi}$  
$E_{\text{wood}} = 1400 \text{ ksi}$

A) 5.43 IN

28. A point loaded beam has section shown below. Fill in the blanks with $f_T$, $f_C$, $c_T$, $c_C$, and neutral axis:

- $f_T$: Maximum internal tension stress
- $f_C$: Maximum internal compression stress
- $c_T$: The controlling tension extreme fiber distance
- $c_C$: The controlling compression extreme fiber distance
- $NA$: Neutral axis

29. When the allowable stress for tension and compression are equal, which description below is true for the beam above?

A) the maximum tension stress is greater

30. Following are sections of beam. Which of them has the largest moment of inertia ($I_{xx}$)?

*Material is homogeneous.*

*Answer could be more than one.*

(A) B, D
31. For the hollow pipe section shown at right the centroid of area is
   A. at the center of the pipe

32. The two methods commonly used to calculate the centroid of area are
   A. addition and subtraction

33. For a homogenous, symmetric "T" shown, the center of gravity can be found by inspection (without calculation) for the coordinates in
   A) x and y only

34. Which of the pictured sections has the largest moment of inertia (I) about the N.A. shown?
   (A) D
35. Given the rectangular section shown below, what is the resulting maximum bending stress (in psi) under a load producing a maximum moment of 5000 ft-lbs?

![Rectangular section diagram]

\[ I = 72 \text{ in}^4 \]

(A) 2500 psi

36. The Moment of Inertia is a gauge of?

A) Cross sectional stiffness.

37. The stiffness of a cross-section is described by?

A) Moment of Inertia (I)

38. What effect does the hole have on the centroid of the section?

A) Shifts it upward

39. For each pair of cross sections, which has a greater moment of inertia with respect to the axis shown? The drawings are to scale and each cross section has the same total area.

![Cross section images]

A) A & B have the same moment of inertia

A) Moment of inertia of B is greater
40. For the beam shown in elevation, compare the differences of fiber stress and moment for the two possible beam shapes shown in section. *Note: section A and B have the same areas and depths.*

(A)

The maximum fiber stress in section A would be _____ less _____ (more/less/same) than section B.

The maximum moment in section A would be _____ the same _____ (more/less/same) than section B.