Given Information:
For Steel, $E = 29000$ ksi, $G = 11200$ ksi;  A36 Steel ($F_y=36$ ksi, $F_u=58$ ksi);  A992 Steel ($F_y=50$ ksi, $F_u=65$ ksi)

**J Formulae for a Closed Rectangle**

$$J = \frac{2t_1t_2b^2h^2}{bt_2^2 + h^2 t_1}$$

If $b/t > 10$

**J Formula for Open Sections, Composed of Thin Plates**

$$J = \frac{1}{3} \sum bt^3$$

Where $b$ is the length of the long dimension of each plate and $t$ is the thickness.

**Bonus Questions (0.1 points each)**

1. According to the Swanson Pyramid of Greatness, *crying* is acceptable for only two occasions. What are they?

2. Fill in the Blanks:
   - Tyrol __________________ -Wallace
   - __________________ King
   - D’Squarius __________________
   - __________________ Tacktheritrix
   - __________________ T. Billings-Clyde
   - D’Jasper __________________
   - Javaris Jamar __________________
   - __________________ McCringleberry
   - L’Carpetron __________________

**Engineering Bonus Question (4 points):**

- For Problem 2, on the exam, determine the maximum uniform load $w$ that may be sustained without a shear failure resulting.
1. (3 points) TRUE or FALSE. Lateral-torsional buckling is prevented at all locations along the continuous I-shaped beam below due to the presence of the slab.

![Diagram of a continuous I-shaped beam with a concrete slab and uniform load]

**Concrete Slab**

**Uniform Load**
2. (25 points) The rolled shape shown was loaded with a uniform load \( w \) until it actually failed in bending. Assuming this failure is perfectly predicted by AISC specifications, determine the uniform loading \( w \) that caused this failure.

Given:
- \( F_y = 50 \text{ ksi} \)
- Web is compact
- Flange \( \lambda_p = 9.15 \)
- Flange \( \lambda_r = 24.1 \)
- \( I_x = 6730 \text{ in}^4 \)
- \( I_y = 1167 \text{ in}^4 \)
- \( L_p = 19.3 \text{ ft.} \)
- \( L_r = 54.7 \text{ ft} \)

Final Answer:
\[
\text{Max } w = \underline{\text{______}_\text{kip/ft}}
\]
3. (40 points). Determine the maximum safe centerpoint load $P$ that may be applied per ASD AISC specifications.

Given:
- Built-up (welded) section
- $F_y = 50$ ksi
- 1”x12” flanges
- ½”x19” web
- Braces at the supports and at midspan
- Ignore self-weight (negligible)
- $L_r = 32.8$ ft
- Do not consider shear or deflection

Final Answer:
Max $P = \underline{\text{_____________}}$kip
4. (32 points) Determine the maximum normal stress acting within the beam, due to bending.

Given:
- W21 x48 ($F_y = 50$ ksi) beam in strong-axis bending.
- Distributed load $w = 1$ kip/ft, including the self-weight
- $L_o = 6.09'$, $L_r = 16.5'$
- There is a concrete slab on top of the beam
- A is a fixed support, B is a shear connection, C is a roller support.
- Supports are assumed to act as braces

Final Answer:
Max Normal Stress due to Bending: 

[Box with space for ksi]