Given Information:
- The diameter of the sun = 864327 miles
- Avogadro's $6.02214086 \times 10^{23}$ mol$^{-1}$
- 1 American Beer Barrel = 31 gallons

Bonus Questions (0.1 points)
1. TRUE or FALSE. ISIS has been capturing and executing Shiite Muslims.

2. The Battle of Midway is considered the turning point in the US war against Japan in World War Two's Pacific theater. In what year did this battle take place?

   1942

3. What right was guaranteed by the 19th Amendment to the US Constitution?

   Women's Right to Vote

4. Who is the only college football player to have been awarded the Heisman Trophy twice?

   Archie Griffin

5. Who will win the 2015 Heisman Trophy?

   Derrick Henry (Obama)

6. The current Vegas line for Army-Navy is Navy -23. Who you got?

   Navy 21, Army 17 (Navy -4)

7. On what date did Mao Zedong declare the formation of the People's Republic of China?

   Oct. 1, 1949

8. What frightening head of state recently stated, "Hopefully, no nukes will be needed" (against ISIS)?

   Vladimir Putin

9. TRUE or FALSE. Lafayette College shared the College Football National Championship with Alabama in 1926.
1. (5 points). The problem below consists of a simply-supported, uniformly-loaded beam in strong-axis bending that has continuous lateral support of the compression flange, while also subjected to an axial force. Circle the correct answer.

![Diagram of a beam with uniformly distributed load and lateral brace](image)

A. \( KL_x = 20' \), \( KL_y = 20' \), \( L_b = 20' \)
B. \( KL_x = 20' \), \( KL_y = 0' \), \( L_b = 20' \)
C. \( KL_x = 20' \), \( KL_y = 0' \), \( L_b = 0' \)
D. \( KL_x = 0' \), \( KL_y = 20' \), \( L_b = 20' \)
E. \( KL_x = 0' \), \( KL_y = 20' \), \( L_b = 0' \)

2. (5 points). For which condition (A, B, or C) can a greater axial force \( P \) be safely applied, per ASD?

![Diagram of a beam with uniformly distributed load and lateral brace](image)

Legend:
- \( X \) = Lateral Brace

A. Always stronger in tension
B. Always stronger in compression
C. Cannot be determined from the given information

3. (5 points). Situation: You must accommodate a round hole for mechanical piping through one of the beams that you’ve designed. Which is the preferred location for the hole (circle A or B)?

![Diagram of a beam with a hole](image)

A. Hole in max shear
B. No shear in

4. (5 points). Determine \( V_n \) for an A992 W16x26 beam in strong-axis bending.

\[
\frac{V_n}{S} = 70.5 \text{ k} \quad \Rightarrow \quad \text{Normally SL = 1.5}
\]

\[
\text{But exceeds } \frac{h}{tw} \text{ limit: } \Omega = 1.67 \Rightarrow V_n = (1.67)(70.5) = 118 \text{ k}
\]
5. (25 points). If the beam shown must be selected per ASD, for what moment $M$, unbraced length $L_b$, and $C_b$ factor would it be designed for? Given: the concrete slab was cast on metal decking that was welded to the top flange of the beam. The uniform loading of $w = 1$ kip/ft includes the beam self-weight and all other loads.

Uniform Load $w = 1$ kip/ft

Concrete Slab

$V = 3.33 k$  
$\delta = 3.33 k$  
$M = 5.555 k$  
$M(x) = 3.33 \frac{k}{x} - \frac{x^2}{2} = 0$  
$= 6.666 = x$  
$L_{b2} = 12 - 6.666 = 5.333' \text{ (Not Controlling)}$

Final Answers

$M = 32.0 \text{ kip-ft}$

$L_b = 8' \text{ ft}$

$C_b = 1$
(55 points). Determine if member AB is safe per ASD but do not consider shear or deflection.

Given: A is a pinned support. B is pinned connection. Position B contains a brace that prevents lateral movement (in or out of the page). C is a pinned support. Member AB is an A992 W16x36 shape, oriented as shown. The distributed loading on AB includes the self-weight of AB. Assume that the B₁ multiplier for second-order effects is 1.05.

\[ FBD \ AB \]

\[ A_x = 24k \]
\[ A_y = 10k \]
\[ B_x = 24k \]
\[ B_y = \frac{5}{12} \]

\[ P = 24k \]
\[ M_{nt} = \frac{wL^2}{8} = \frac{2(10)^2}{8} = 25 \text{ k-ft} \]
\[ M = (1.05)(25) = 26.25 \text{ k-ft} \]

\[ \frac{Pn}{A} \]
\[ KL_x = KL_y = 10' \]
\[ KL_y \text{ controls} \]
\[ k = 1 \]

\[ \frac{KL}{\xi} = \frac{120''}{1.52' = 78.9} \]
\[ \frac{F_{ct}}{A} = 19.0 \text{ ksi} \]
\[ \frac{P_n}{A} = \frac{F_{ct} \cdot A}{A} = 201.4k \]

\[ M_{nt} = \text{WEAK-AXIS} \]
\[ A_y = 26.9 \text{ k-ft (TABLE 3-4)} \]

\[ P_{10} = \frac{24}{201.4} = 0.1192 \]
\[ M_{10} = \frac{26.25}{26.9} = 0.9762 \]

**INTERACTION**
\[ \frac{1}{2}(0.1192) + 0.9762 = 1.045 \]

\[ N_G \]