Circle on this test sheet your choice of correct or nearest item on the list for each of the following:

1. A 4-ft concrete post is reinforced by four steel bars, each of 0.75-in. diameter. It is known that $E_s = 29 \times 10^6$ psi, $\alpha_s = 6.5 \times 10^{-6}/\degree F$, $E_c = 3.6 \times 10^6$ psi, and $\alpha_c = 5.5 \times 10^{-6}/\degree F$. If the tensile stress developed in the concrete due to thermal expansion is known to be 50 psi, the temperature rise $\Delta T$ is
   (a) 74.6°F. (b) 76.1°F. (c) 77.6°F. (d) 79.1°F. (e) 80.6°F. (f) 82.1°F. (g) 83.6°F. (h) 85.1°F.

![Fig. P1 and P2](image1)

![Fig. P3 and P4](image2)

![Fig. P5](image3)

2. Refer to Problem 1. The change in length $\delta_{post}$ of the post is
   (a) 0.0228 in. (b) 0.0224 in. (c) 0.0220 in. (d) 0.0216 in. (e) 0.0212 in. (f) 0.0208 in. (g) 0.0204 in.

3. The horizontal shaft $AD$ is attached to a fixed base at $D$ and is subjected to the torques as shown, where $T_A = 650 \text{ lb-ft}$ and $T_B = 700 \text{ lb-ft}$. A 2-in.-diameter hole has been drilled into portion $CD$ of the shaft. If the entire shaft is made of steel for which $G = 11.2 \times 10^6$ psi, the angle of twist $\phi$ at end $A$ is
   (a) 1.235°. (b) 1.339°. (c) 1.442°. (d) 1.545°. (e) 1.649°. (f) 1.752°. (g) 1.855°. (h) 1.959°.

4. Refer to Problem 3. The maximum shearing stress $\tau_{max}$ developed in portion $CD$ of the shaft is
   (a) 9.61 ksi. (b) 9.27 ksi. (c) 8.94 ksi. (d) 8.61 ksi. (e) 8.28 ksi. (f) 7.95 ksi. (g) 7.62 ksi. (h) 7.29 ksi.

5. The built-up wooden beam shown is subjected to a vertical shear of 5.1 kN. If the spacing of nail is s 45 mm and each nail is 90 mm long, the shearing force in each nail is
   (a) 336 N. (b) 343 N. (c) 350 N. (d) 357 N. (e) 363 N. (f) 370 N. (g) 377 N. (h) 384 N.

(Cont’d on Page 2 of 2)
Circle on this test sheet your choice of correct or nearest item on the list for each of the following:

6. It is desired to ascertain the range of values of $\theta$ for which the magnitude of the normal stress acting on the plane normal to the $x'$ axis is $|\sigma'| \leq 22$ ksi. If this range is given by $\theta_1 \leq \theta \leq \theta_2$, the value of $\theta_1$ is
   (a) $-129.3^\circ$.  (b) $-132.0^\circ$.  (c) $-135.0^\circ$.  (d) $-138.5^\circ$.  (e) $2.47^\circ$.  (f) $5.15^\circ$.  (g) $8.13^\circ$.  (h) $11.60^\circ$.

7. It is desired to ascertain the range of values of $\theta$ for which the magnitude of the normal stress acting on the plane normal to the $x'$ axis is $|\sigma'| \leq 22$ ksi. If this range is given by $\theta_1 \leq \theta \leq \theta_2$, the value of $\theta_2$ is
   (a) $-129.3^\circ$.  (b) $-132.0^\circ$.  (c) $-135.0^\circ$.  (d) $-138.5^\circ$.  (e) $2.47^\circ$.  (f) $5.15^\circ$.  (g) $8.13^\circ$.  (h) $11.60^\circ$.

8. The segments $AB$ and $BC$ of the stepped beam shown have flexural rigidities $EI$ and $2EI$, respectively. If $Q = 6P$, the slope $\theta_A$ at the free end $A$ is
   (a) $\frac{10Pa^2}{EI}$.  (b) $\frac{35Pa^2}{4EI}$.  (c) $\frac{15Pa^2}{2EI}$.  (d) $\frac{25Pa^2}{4EI}$.  (e) $\frac{5Pa^2}{EI}$.  (f) $\frac{15Pa^2}{4EI}$.  (g) $\frac{5Pa^2}{2EI}$.  (h) $\frac{5Pa^2}{4EI}$.

9. The segments $AB$ and $BC$ of the stepped beam shown have flexural rigidities $EI$ and $2EI$, respectively. If $Q = 6P$, the deflection $y_A$ at the free end $A$ is
   (a) $-\frac{3Pa^3}{EI}$.  (b) $-\frac{9Pa^3}{2EI}$.  (c) $-\frac{6Pa^3}{EI}$.  (d) $-\frac{15Pa^3}{2EI}$.  (e) $-\frac{9Pa^3}{EI}$.  (f) $-\frac{21Pa^3}{2EI}$.  (g) $-\frac{12Pa^3}{EI}$.

10. A beam is loaded and supported as shown, where $M_0 = 5PL$. The vertical reaction force $A_y$ at $A$ is
    (a) $\frac{P}{6} \uparrow$.  (b) $\frac{P}{6} \downarrow$.  (c) $\frac{P}{4} \uparrow$.  (d) $\frac{P}{4} \downarrow$.  (e) $\frac{P}{3} \uparrow$.  (f) $\frac{P}{3} \downarrow$.  (g) $\frac{5P}{12} \uparrow$.  (h) $\frac{5P}{12} \downarrow$.  (i) $\frac{P}{2}$ \