Answer Key: Civil Engineering Licensure Exam – Mock Exam (Day 29: Static Equilibrium and Force Systems)

February 24, 2025

Answer Key

Section A: Multiple Choice Solutions

1. A force system is in equilibrium when: **(a) The sum of all forces and moments is zero.**
2. Conditions for static equilibrium in 2D: **(a)** $\sum F_x = 0, \sum F_y = 0, \sum M = 0$
3. Moment of a force about a point: **(a)** $M = F \times d$
4. Static equilibrium of a beam: **(c) Zero**
5. A simply supported beam has: **(a) Two reaction forces**

Section B: Problem-Solving Solutions

1. Components of a 500 N force at 30 degrees:

$$F_x = 500 \cos 30^\circ = 500 \times 0.866 = 433N$$

$$F_y = 500 \sin 30^\circ = 500 \times 0.5 = 250N$$

2. Beam reactions:

$$\sum M_A = 0 \Rightarrow R_B \times 6 = 300 \times 2$$

$$R_B = \frac{600}{6} = 100N$$

$$R_A = 300 - R_B = 200N$$

3. Moment generated by a 200 N force:

$$M = F \times d = 200 \times 0.8 = 160 \text{ Nm}$$

4. Beam reactions for a uniform beam:

$$R_A + R_B = 600 + 400 = 1000N$$

$$\sum M_A = 0 \Rightarrow R_B \times 6 = (600 \times 3) + (400 \times 3)$$

$$R_B = \frac{3000}{6} = 500N$$

$$R_A = 1000 - 500 = 500N$$

5. Third force required for equilibrium:

$$\sum F_x = 500 + F_3 \cos\theta = 0$$

$$\sum F_y = 300 + F_3 \sin\theta = 0$$

$$F_3 = \sqrt{500^2 + 300^2} = \sqrt{250000 + 90000} = \sqrt{340000} = 583N$$

$$\theta = \tan^{-1}\left(\frac{300}{500}\right) = \tan^{-1}(0.6) = 30.96^\circ$$