4-94 Replace the two forces by an equivalent resultant force and couple moment at point *O*. Set $F = 20$ lb.

4-94

Force Summation:

$\xrightarrow{+} F_{Rx} = \sum F_x ;$ $\qquad F_{Rx} = \frac{4}{5}(20) - 20 \sin 30° = 6 \text{ lb}$

$+\uparrow F_{Ry} = \sum F_y ;$ $\qquad F_{Ry} = 20 \cos 30° + \frac{2}{3}(20) = 29.32 \text{ lb}$

$$F_R = \sqrt{F_{Rx}^2 + F_{Ry}^2} = \sqrt{6^2 + 29.32^2} = 29.9 \text{ lb}$$

$$\theta = \tan^{-1} \frac{F_{Ry}}{F_{Rx}} = \tan^{-1} \frac{29.32}{6} = 78.4°$$ Ans

Moment summation:

$+ M_{Ro} = \sum M_O ;$ $\qquad M_{Ro} = 20 \sin 30^o (6 \sin 40^o) + 20 \cos 30^o (3.5 + 6 \cos 40^o)$

$$- \frac{4}{5}(20)(6 \sin 40°) + \frac{3}{5}(20)(3.5 + 6 \cos 40°)$$

$$= 214 \text{ lb} \cdot \text{in}$$ Ans

4-79 Determine the resultant couple moment of the two couples that act on the pipe assembly. The distance from *A* to *B* is $d = 400$ mm. Express the result as a Cartesian vector.

4-79

**Vector Analysis**

Position Vector:

$$\mathbf{r} = -0.4 \cos 30^{o} \mathbf{j} + 0.4 \sin 30^{o} \mathbf{k} = \{-0.3464\mathbf{j} + 0.2\mathbf{k}\} \text{ m}$$

Resultant moment in Cartesian Vector form:

$$\mathbf{M}_{\boldsymbol{R}} = \sum\mathbf{M}; \qquad \mathbf{M}_{R} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 0 & -0.3464 & 0.2 \\ 0 & 0 & 35 \end{vmatrix} + \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 0 & -0.3464 & 0.2 \\ -50 & 0 & 0 \end{vmatrix}$$

$$= [-0.3464(35) - 0]\mathbf{i} - 0\mathbf{j} + 0\mathbf{k} + 0\mathbf{i}$$

$$- [0 - (-50)(0.2)]\mathbf{j} + [0 - (-50)(-0.3464)]\,\mathbf{k}$$

$$\mathbf{M}_{R} = \{-12.1\mathbf{i} - 10\mathbf{j} - 17.3\mathbf{k}\} \text{ N} \cdot \text{m} \qquad \text{Ans}$$

4-126 Replace the loading by an equivalent resultant force and specify the location of the force on the beam, measured from point *B*.

4-138 Replace the loading by an equivalent resultant force and couple moment acting on the beam at point *O*.

4-126

$+\downarrow F_R = \sum F_y;$ $\quad F_R = \frac{1}{2}(5)(3) + \frac{1}{2}(3)(3) = 27 \text{ kN}$ Ans

$+ M_{R_B} = \sum M_B;$ $\quad 27(d) = \frac{1}{2}(3)(3)(1) + 5(3)(1.5) + \frac{1}{2}(5)(3)(4)$

$d = 2.11 \text{ m}$ Ans

4-138

$+\downarrow F_R = \sum F_y ;$ $\qquad F_R = \int dA = \int_0^{10} 2x^2\, dx = \frac{2x^3}{3}\Big|_0^{10} = 667 \text{ lb}\downarrow$ Ans

$$\bar{x} = \frac{\int_A x\, dA}{\int_A dA} = \frac{\int_0^{10} 2x^3\, dx}{667} = \frac{\frac{x^4}{2}\Big|_0^{10}}{667} = 7.50 \text{ ft}$$

$+ M_{Ro} = F_R(10 - \bar{x}) = 667(10 - 7.5) = 1667 \text{ lb}\cdot\text{ft} = 1.67 \text{ kip}\cdot\text{ft}$ Ans