Final Exam Review 2016

GNG1105

4.108 A 12-m pole supports a horizontal cable CD and is held by a ball and socket at A and two cables BE and BF. Knowing that the tension in cable CD is 14 kN and assuming that CD is parallel to the x axis ($\mathbf{f} = 0$), determine the tension in cables BE and BF and the reaction at A.

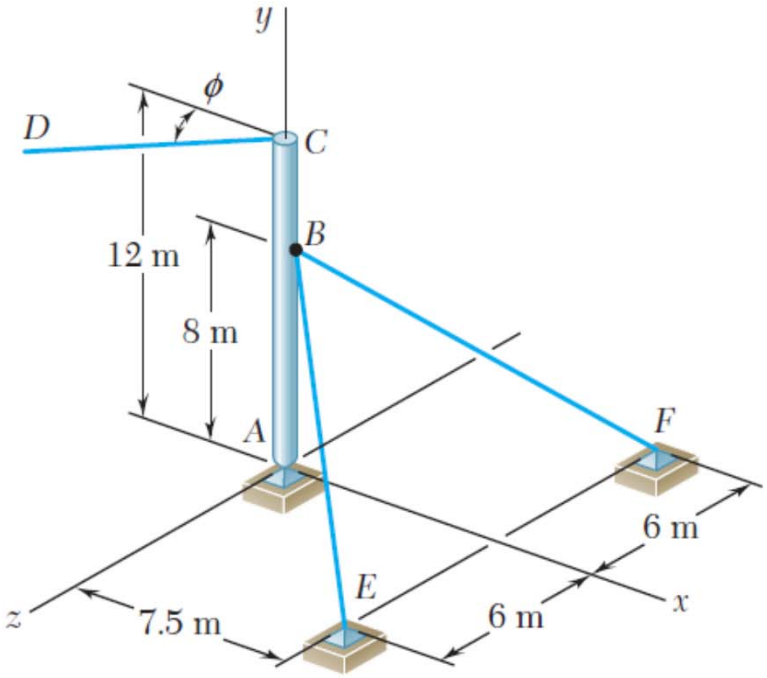
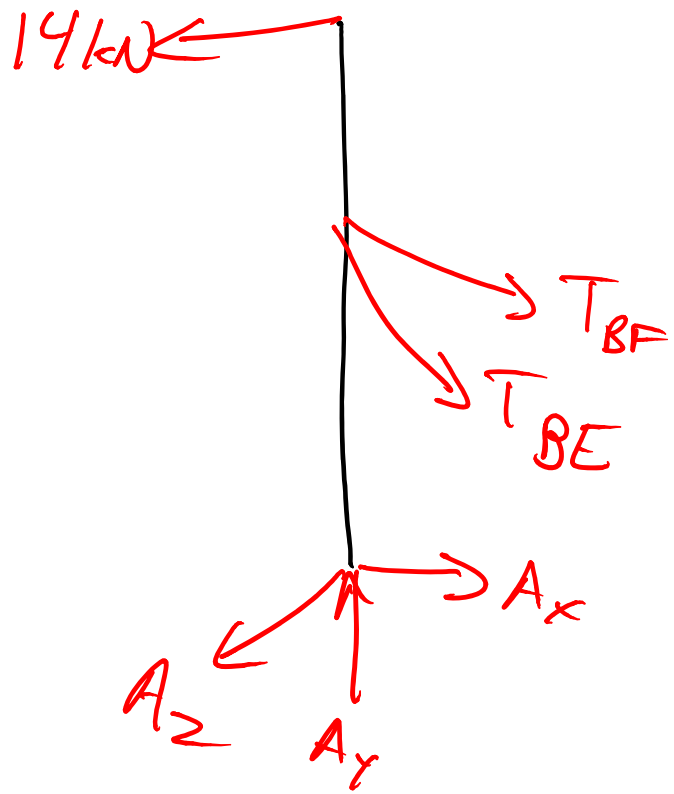


Fig. P4.108

FBD



$$\Sigma M_A = 0$$

$$\Sigma r \times F = 0$$

$$8\hat{j} \times \left(\overline{T}_{BE} + \overline{T}_{BF}\right)$$

$$+ 12\hat{j} \times -14\hat{i} = 0$$

$$\vec{T}_{BE} = T_{BE}\,\hat{\lambda}_{BE} = T_{BE}\,\frac{\vec{BE}}{BE}$$

$$BE = \sqrt{x^2 + y^2 + z^2}$$

$$= \sqrt{7.5^2 + 8^2 + 6^2} = 12.5 \text{ m}$$

$$\vec{BE} = 7.5\,\hat{\imath} - 8\,\hat{\jmath} + 6\,\hat{k}$$

$$\vec{T}_{BE} = T_{BE}\,(0.6\,\hat{\imath} - 0.64\,\hat{\jmath} + 0.48\,\hat{k})$$

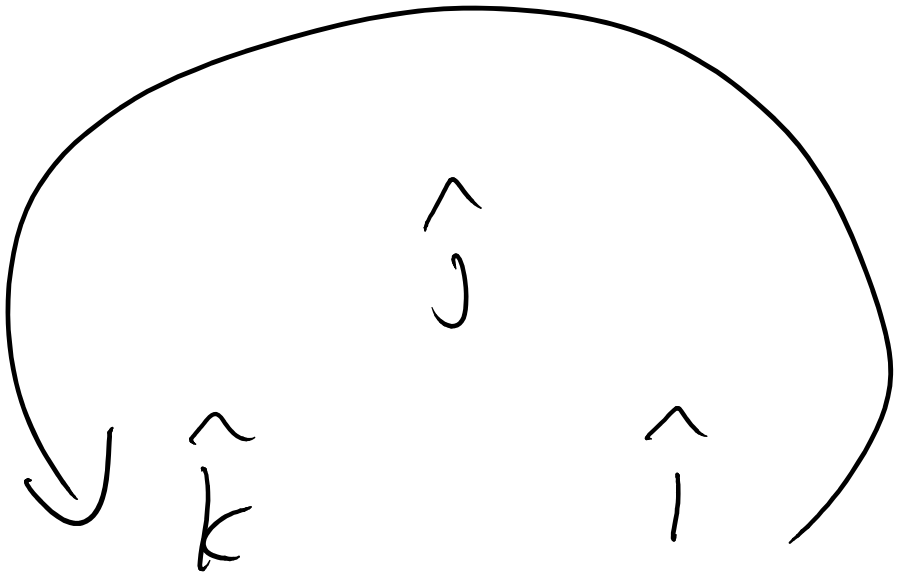
$$\vec{T}_{BF} = T_{BF}(0.6\hat{i} - 0.64\hat{j} - 0.48\hat{k})$$

$$\Sigma M_A = 0$$

$$8\hat{j} \times T_{BE}(0.6\hat{i} - 0.64\hat{j} + 0.48\hat{k}) + 8\hat{j} \times T_{BF}(0.6\hat{i} - 0.64\hat{j} - 0.48\hat{k})$$

$$+ 12\hat{j} \times (-14\hat{i}) = 0$$

$$-4.8T_{BE}\hat{k} + 3.84T_{BE}\hat{i} - 4.8T_{BF}\hat{k} - 3.84T_{BF}\hat{i} + 168\hat{k} = 0$$


$\hat{j}$
$\hat{k}$
$\hat{i}$

$\hat{\imath}$: $3.84 T_{BE} - 3.84 T_{BF} = 0$

$\therefore T_{BE} = T_{BF}$

$\hat{k}$: $-4.8 T_{BE} - 4.8 T_{BF} + 168 = 0$

$T_{BE} = T_{BF} = 17.5 \text{ kN}$

$$\Sigma F = 0$$

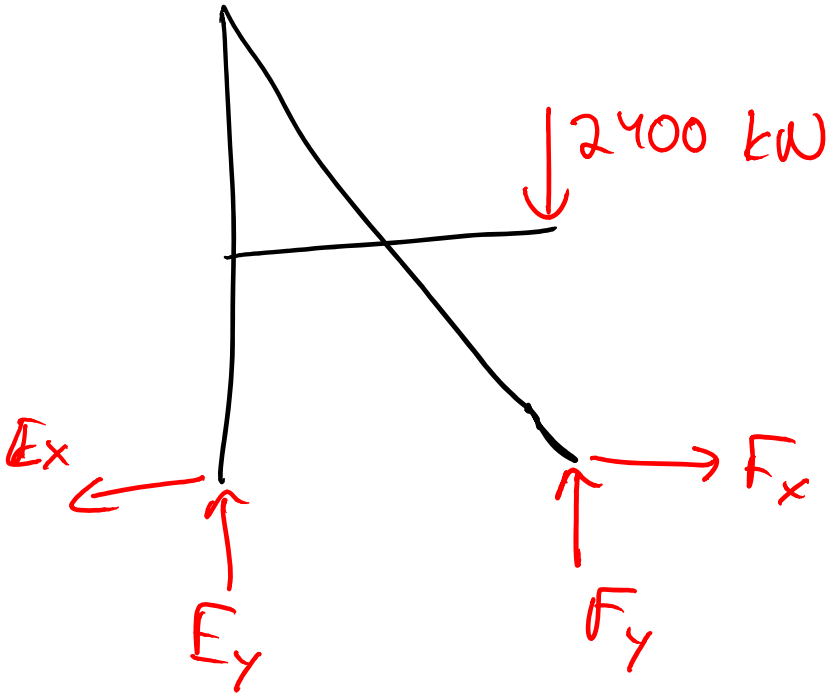
$$\Sigma F_x = 0 \qquad A_x + 2(0.6)(12.5) - 14\,kN = 0$$

$$A_x = 7\ kN$$

$$\Sigma F_y = 0 \qquad A_y = 22.4\ kN$$

$$\Sigma F_z = 0 \qquad A_z = 0$$

6.99 and 6.100 For the frame and loading shown, determine the components of all forces acting on member *ABE*.



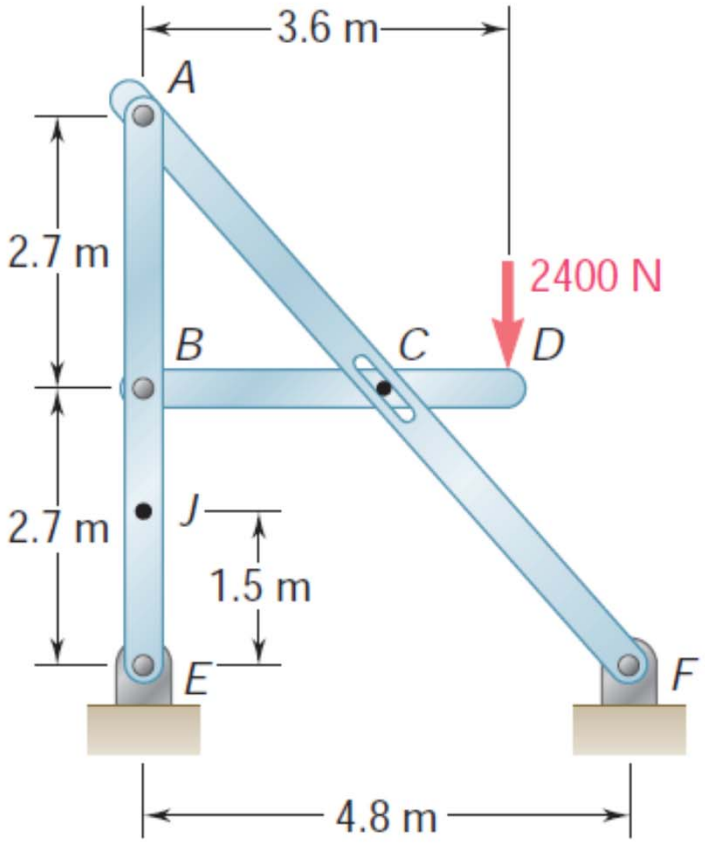


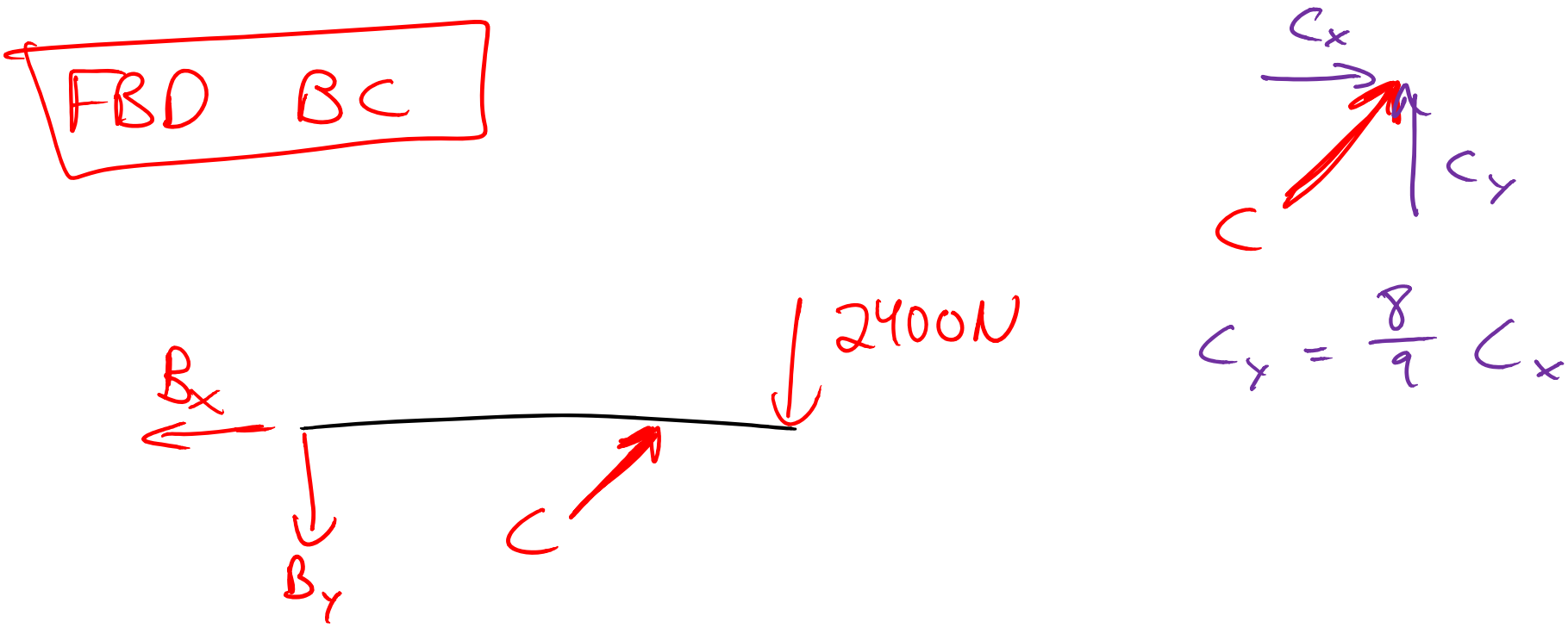
Fig. P6.100

$$\Sigma M_F = 0$$

$$1.2(2400) - 4.8(E_y) = 0$$

$$E_y = 600\ N \uparrow$$

FBD BC



$$C_y = \frac{8}{9} C_x$$

$$\Sigma M_C = 0$$

$$2.4 B_y - 1.2(2400) = 0$$

$$\therefore B_y = 1200 N \downarrow$$

$$\Sigma F_y = 0$$

$$-1200 + C_y - 2400 = 0$$

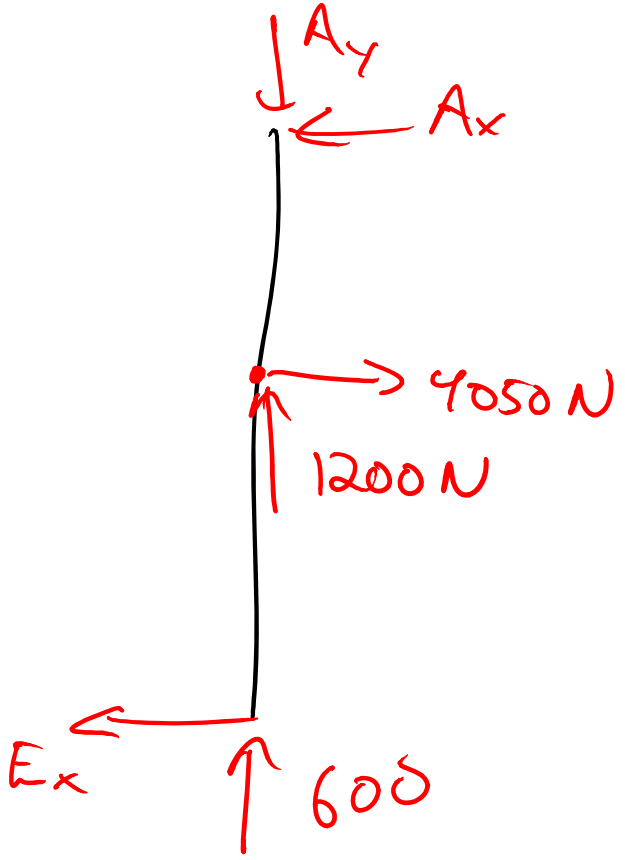
$$C_y = 3600\,N \uparrow$$

$$C_x = \frac{9}{8} C_y = 4050\,N \rightarrow$$

$$\Sigma F_x = 0$$

$$B_x = 4050\,N \leftarrow$$

FBD ABE



$$\Sigma M_A = 0$$

$$E_x = 2025\ N \leftarrow$$

$$\Sigma F_x = 0$$

$$A_x = 2025\ N \leftarrow$$

$$\Sigma F_y = 0$$

$$A_y = 1800\ N \downarrow$$

12.30 The coefficients of friction between blocks A and C and the horizontal surfaces are $\mu_s = 0.24$ and $\mu_k = 0.20$. Knowing that $m_A = 5$ kg, $m_B = 10$ kg, and $m_C = 10$ kg, determine (*a*) the tension in the cord, (*b*) the acceleration of each block.

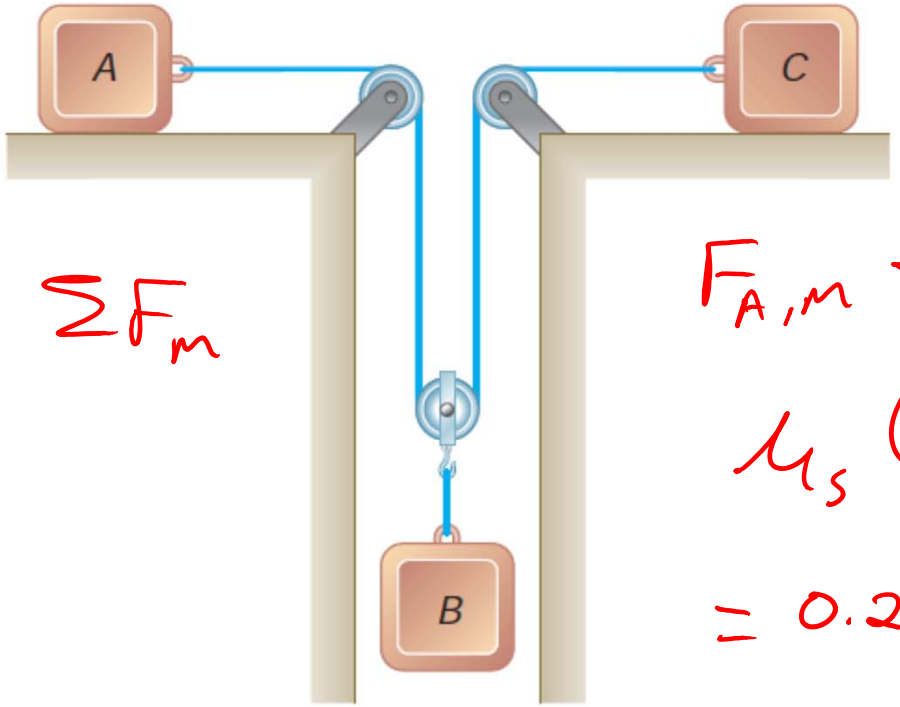


Fig. P12.30

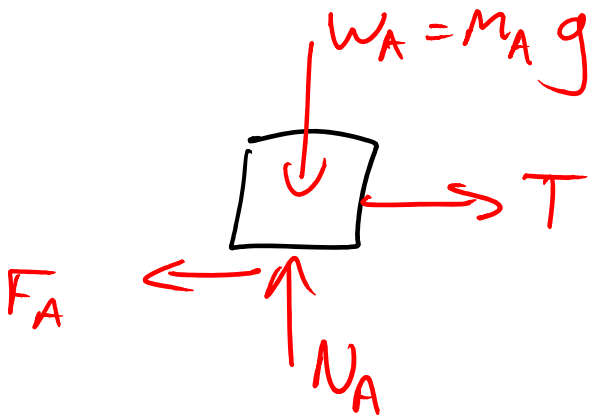
$W_B = 10g > \Sigma F_m$

$F_{A,m} + F_{C,m} = \mu_s (m_A + m_C) g$

$= 0.24 (5 + 10) g$

$= 3.6g$

Block A



$$\Sigma F_y = 0$$

$$N_A = m_A g$$

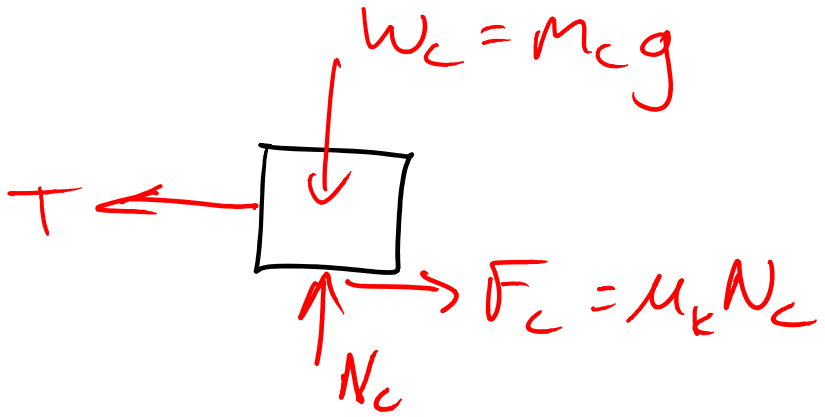
$$\Sigma F_x = m_A a_A$$

(1) $$T - 0.2 m_A g = m_A a_A$$

$$F_A = \mu_K N_A$$

$$= 0.2 m_A g$$

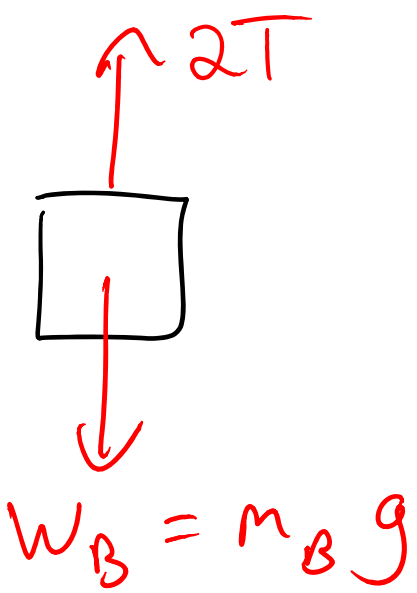
Block C



$$N_c = m_c g$$

② $$T - 0.2 m_c g = m_c a_c$$

Block B



$$\Sigma F_y = m_B a_B$$

(3) $$m_B g - 2T = m_B a_B$$

$$a_B = \frac{1}{2}(a_A + a_C) \qquad (4)$$

(1) $\rightarrow$ $a_A = 0.2T - 0.2g$

(2) $\rightarrow$ $a_C = 0.1T - 0.2g$

(3) $\rightarrow$ $a_B = g - 0.2T$

(4) $\rightarrow \quad g - 0.2T = \frac{1}{2}(0.2T - 0.2g + 0.1T - 0.2g)$

$$T = 33.6 \text{ N}$$

$$a_A = 4.76 \text{ m/s}^2$$

$$a_B = 3.08 \text{ m/s}^2$$

$$a_C = 1.40 \text{ m/s}^2$$

11.103 A volleyball player serves the ball with an initial velocity $\mathbf{v}_0$ of magnitude 13.40 m/s at an angle of 20° with the horizontal. Determine (*a*) if the ball will clear the top of the net, (*b*) how far from the net the ball will land.

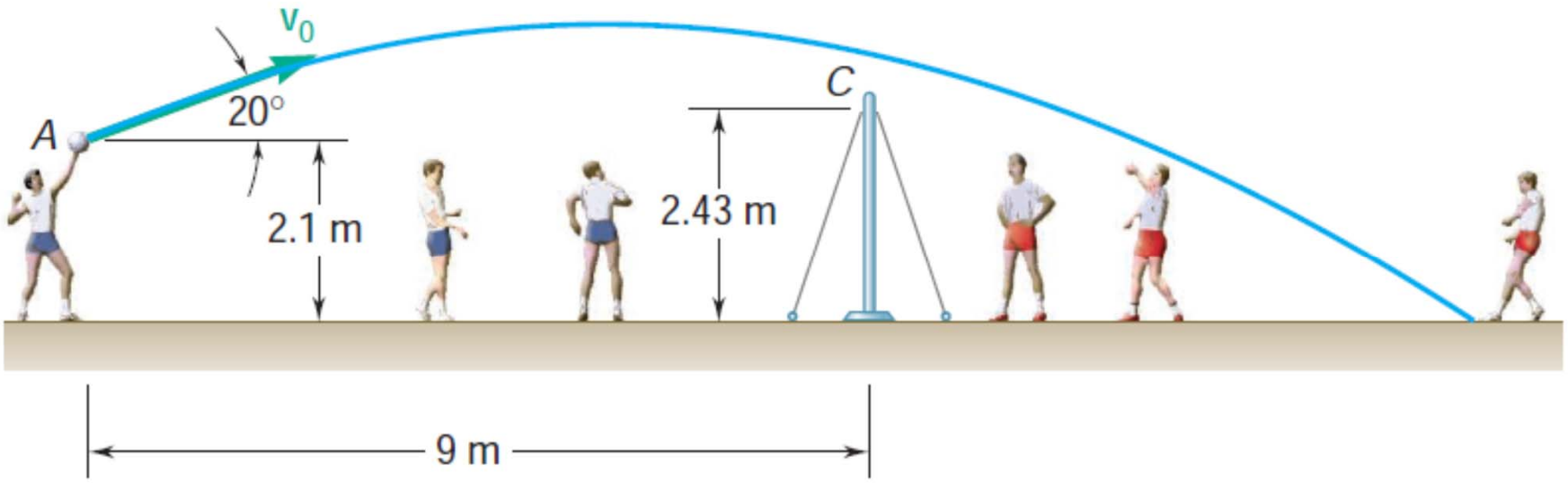


Fig. P11.103