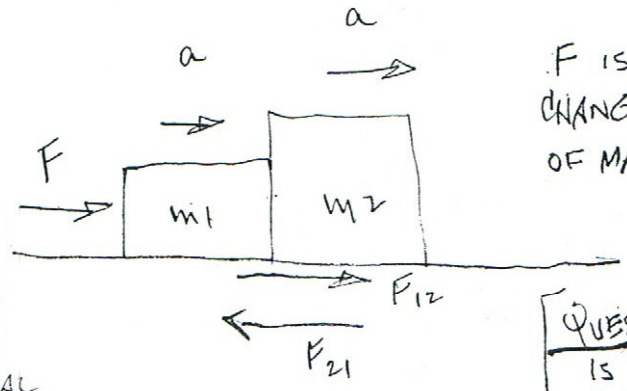
CHAP 4

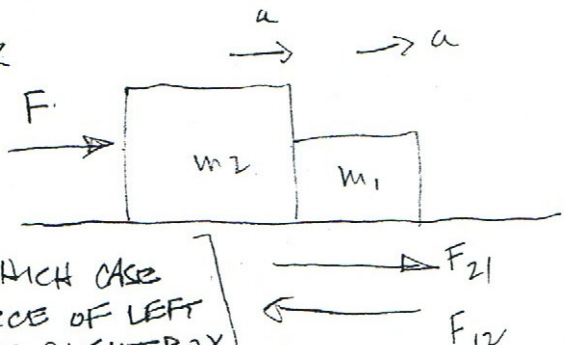
NO FRICTION

CASE 1



F IS SAME
CHANGE ORDER
OF MASSES

CASE 2



QUES: IN WHICH CASE IS THE FORCE OF LEFT BOX ON THE RIGHT BOX GREATER?

SAME ACCELERATION AS IN CASE 1

EXTERNAL FORCE

BOTH ACCELERATE AT THE SAME RATE

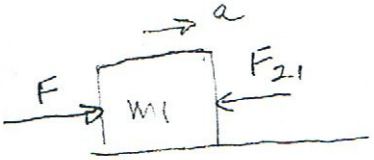
$$\sum F_x = F = (m_1 + m_2)\,a$$

$$a = \frac{F}{m_1 + m_2}$$

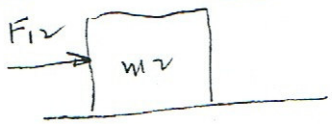
F IS THE SAME IN CASE 1 AND CASE 2

CASE 1

FORCES ON 1



FORCES ON 2



$F - F_{21} = m_1 a$

$F - m_1 a = F_{21}$

$F - m_1\left(\frac{F}{m_1+m_2}\right) = F_{21}$

$F\left(1 - \frac{m_1}{m_1+m_2}\right) = F_{21}$

$$F\left(\frac{m_2}{m_1+m_2}\right) = F_{21}$$

F_{21} & F_{12} opposite in direction

$F_{21} = F_{12}$ in magnitude [Newton's 3rd LAW]

$F_{12} = m_2 a$

$F_{12} = m_2\left(\frac{F}{m_1+m_2}\right)$

$$F_{12} = \frac{m_2}{m_1+m_2} \cdot F$$

CASE 2

For the reverse situation $m_1 \rightarrow m_2$

Forces still equal and opposite

$$F_{12} = F_{21} = \frac{m_1}{m_1+m_2} F$$

Note: F_{12} in CASE 1 IS GREATER THAN F_{21} in CASE 2

CASE 1

$m_1 = 4\text{kg}$

$m_2 = 6\text{kg}$

$F = 60\text{N}$

$$a = \frac{F}{m_1+m_2} = \frac{60}{10} = 6\ \frac{\text{m}}{\text{s}^2}$$

$$F_{21} = \left(\frac{6}{10}\right)60 = 36\text{N}$$

$$F_{12} = \left(\frac{6}{10}\right)60 = 36\text{N}$$

CASE 2

$$F_{21} = \left(\frac{4}{10}\right)60 = 24\text{N}$$

$F_{12} = 24\text{N}$ →