

# Solving 4.47 using equations from class

Had

$$(1) F - F_{21} = m_1 a$$

$$(2) F_{12} - F_{32} = m_2 a$$

$$(3) F_{23} = m_3 a$$

$$(4) F_{12} = F_{21}$$

$$(5) F_{23} = F_{32}$$

} via N3L

} via FBDs/N2L

Knowns

Unknowns

$$F = 12N$$

$$m_1 = 1kg$$

$$m_2 = 2kg$$

$$m_3 = 3kg$$

$$F_{12}$$

$$F_{21}$$

$$F_{23}$$

$$F_{32}$$

$$a$$

← we want this - the force exerted by 3 on 2

Sub (5) into (4):  $F_{23} = m_3 a$

$$F_{32} = m_3 a$$

Need a... Consider adding equations (1) and (2):

$$(1) + (2) \quad F - F_{21} = m_1 a$$

$$F_{12} - F_{32} = m_2 a$$

$$F - F_{21} + F_{12} - F_{32} = m_2 a + m_1 a$$

Apply (4)

$$F - \underbrace{F_{12} + F_{12}}_{\text{cancel}} - F_{32} = (m_1 + m_2) a$$

$$F - F_{32} = (m_1 + m_2) a$$

Solve for a:  $a = \frac{F - F_{32}}{m_1 + m_2}$  Sub into

$$F_{32} = m_3 \frac{(F - F_{32})}{(m_1 + m_2)}$$

Solve for  $F_{32}$ :

$$(m_1 + m_2) F_{32} = m_3 F - m_3 F_{32}$$

$$(m_1 + m_2 + m_3) F_{32} = m_3 F$$

$$F_{32} = \left( \frac{m_3}{m_1 + m_2 + m_3} \right) F = \frac{3kg}{(1kg + 2kg + 3kg)} 12N = \boxed{6N}$$