KEY

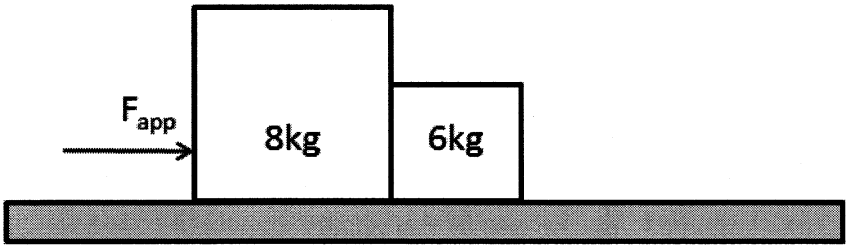
First Name:_____ Last Name:_____

L09 – Worksheet – Blocks pushing Blocks

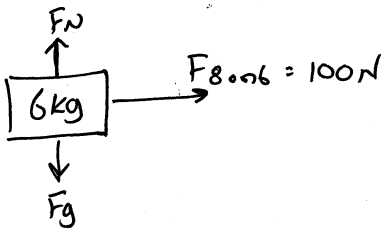
Section #1: Blocks pushing Blocks (no friction)

Q1: The Force of the 6kg block on the 8kg block is 100N. What is the applied force (F_{app}) on the 8kg block? *(3 marks)*

1 mark – Free-Body Diagram of 6kg block
1 mark – Acceleration of System
1 mark – Applied Force



If F_{6on8} is 100N, then F_{8on6} is also 100N, but in the other direction.



$$\vec{a} = \frac{\vec{F}_{net}}{m} = \frac{100\,N}{6\,kg} = 16.67\,m/s^2\,[R]$$

If the 6kg block accelerates at $16.67\,m/s^2\,[R]$, then the whole SYSTEM accelerates at $16.67\,m/s^2\,[R]$.

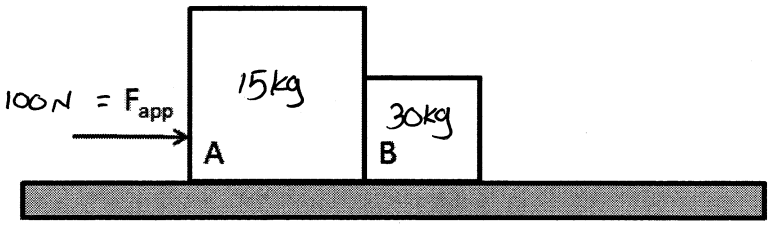
System

$$\vec{F}_{net} = m\vec{a}$$
$$= (14kg)(16.67\,m/s^2)$$
$$= 233.38\,N$$

$F_{app} = 233.38\,N$

KEY

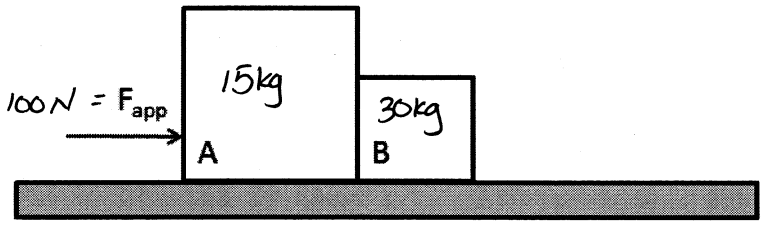
Q2: If $m_A = 15kg$, $m_B = 30kg$, and $F_{app} = 100N$, what is the acceleration of the system?



$$\vec{a} = \frac{\vec{F}net}{m} = \frac{100\,N\,[R]}{45kg} = 2.22\,m/s^2\,[R]$$

KEY

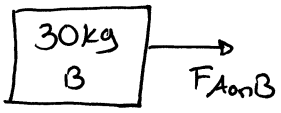
Q3: If m_A = 15kg, m_B = 30kg, and F_{app} = 100N, what is the force of block B on block A (magnitude and direction)?



SYSTEM

$$\vec{a} = \frac{\vec{F}_{net}}{m} = \frac{100\ N\ [R]}{45\ kg} = 2.22\ m/s^2\ [R]$$

ITEM



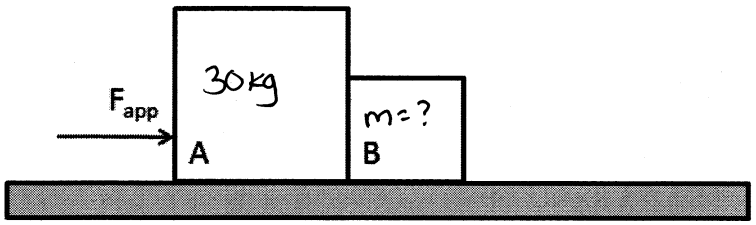
$$\vec{F}_{net} = m\vec{a}$$
$$= (30\ kg)(2.22\ m/s^2)$$
$$= 66.6\ N\ [R]$$

$\therefore F_{AonB} = 66.6\ N\ [R]$

$\therefore F_{BonA} = 66.6\ N\ [L]$

KEY

Q4: If $F_{B\ on\ A}$ = 300N [left], m_A = 30kg, and the acceleration of the system is 15m/s^2, what is the mass of block B?



Item

If $F_{B\ on\ A}$ = 300 N [L], then $F_{A\ on\ B}$ = 300 N [R]

B → $F_{A\ on\ B}$ = 300N [R]

$\vec{a} = \frac{\vec{F}_{net}}{m}$

$15\ m/s^2 = \frac{300\ N}{m}$

$m(15) = 300$

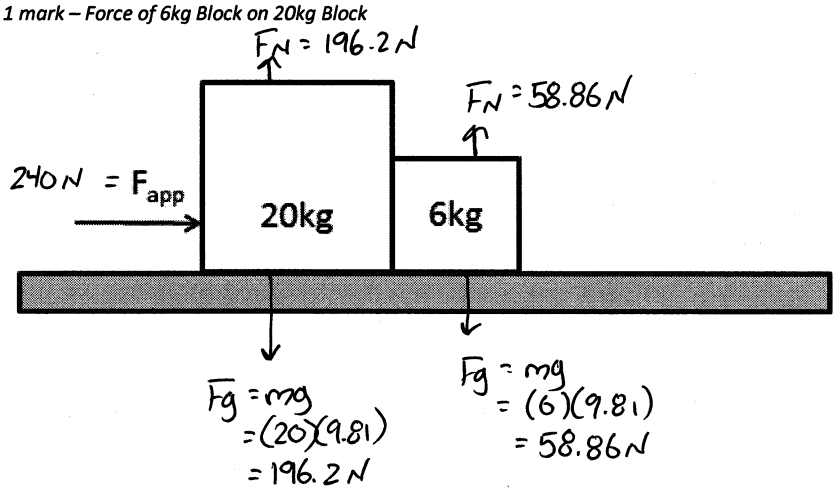
$\boxed{m = 20\ kg}$

KEY

Section #2: Blocks pushing Blocks (with friction)

Q5: A 20kg block is pushed by a force of 240N, which in turn pushes against a 6kg block. If the coefficient of kinetic friction between the blocks and the surface is 0.63, what is the force that the 6kg block applies on the 20kg block? *(4 marks)*

1 mark – Force of Friction on System
1 mark – Acceleration of System
1 mark – Free-Body Diagram on 6kg Block
1 mark – Force of 6kg Block on 20kg Block



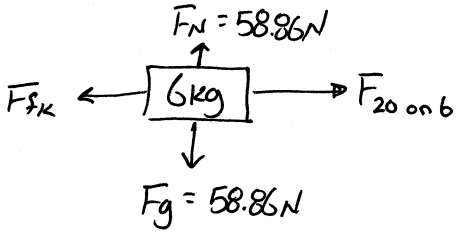
System

$F_{f_K} = \mu_K F_N$
$= (0.63)(196.2 + 58.86)$
$= 160.69N$

$\vec{F}_{net} = \vec{F}_{app} + \vec{F}_f$
$= 240N - 160.69N$
$= 79.31N$

$\vec{a} = \frac{\vec{F}_{net}}{m} = \frac{79.31N\,[R]}{26kg} = 3.05 m/s^2\,[R]$

Item



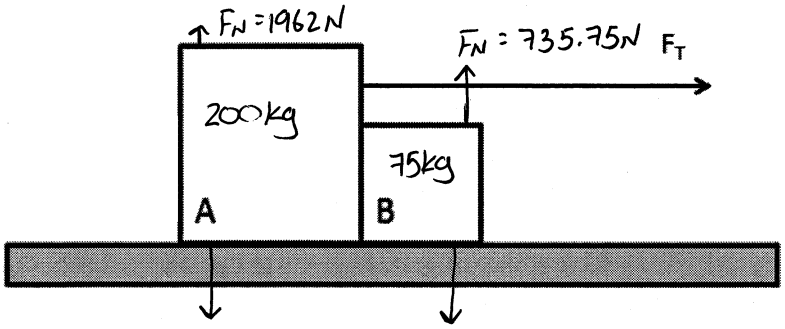
$F_f = \mu_K F_N$
$= (0.63)(58.86N)$
$= 37.08N$

$\vec{F}_{net} = m\vec{a}$
$= (6kg)(3.05 m/s^2)$
$= 18.3N[R]$

$F_{net} = F_{20\,on\,6} + F_{f_K}$
$18.3N = F_{20\,on\,6} + (-37.08N)$
$F_{20\,on\,6} = 55.38N\,[R]$
$F_{6\,on\,20} = 55.38N\,[L]$

KEY

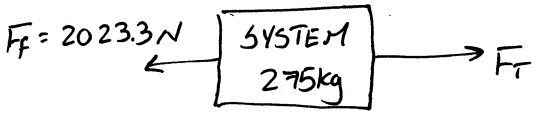
Q6: If $m_A = 200kg$, $m_B = 75kg$, $\mu_k = 0.75$, and $a = 3.5m/s^2$, what is the tension in the towing cable?



$F_{f_A} = \mu_k F_N$
$= (0.75)(1962N)$
$= 1471.5N$

$F_{f_B} = \mu_k F_N$
$= (0.75)(735.75N)$
$= 551.81N$

System

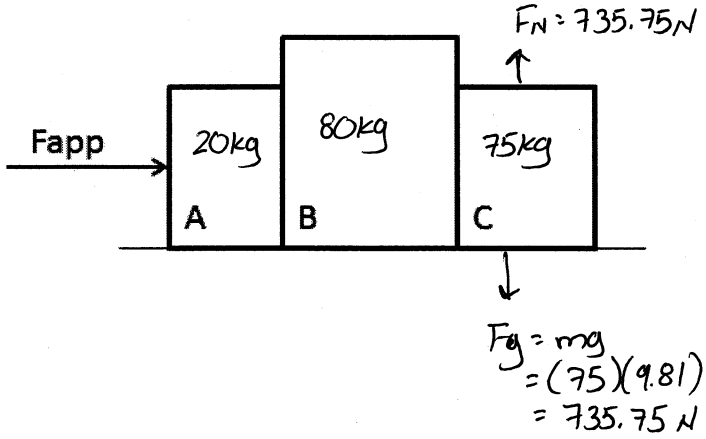


$\vec{F}_{net} = m\vec{a}$
$= (275kg)(3.5m/s^2)$
$= 962.5N\ [R]$

$\vec{F}_{net} = \vec{F}_T + \vec{F}_f$
$962.5 = F_T + (-2023.3N)$
$F_T = 2985.8N\ [R]$

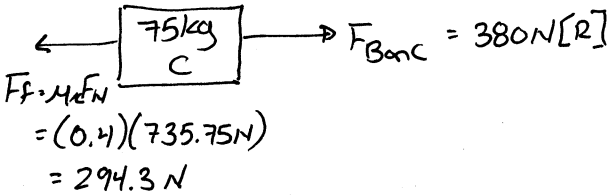
KEY

Q7: If $m_A = 20kg$, $m_B = 80kg$, $m_C = 75kg$, $F_{C\ on\ B} = 380N$ [left], and $\mu_k = 0.4$, what is the acceleration of the system?



If $F_{C\ on\ B} = 380N[L]$, then $F_{B\ on\ C} = 380N[R]$

Item



$$F_{net} = F_{B\ on\ C} + F_f$$
$$= (380N) + (-294.3N)$$
$$= 85.7N[R]$$

$$\vec{a} = \frac{\vec{F}_{net}}{m} = \frac{85.7N[R]}{75kg} = 1.14\ m/s^2[R]$$

Since accel of Block C is $1.14\ m/s^2[R]$, then accel of entire SYSTEM is also $1.14\ m/s^2[R]$.