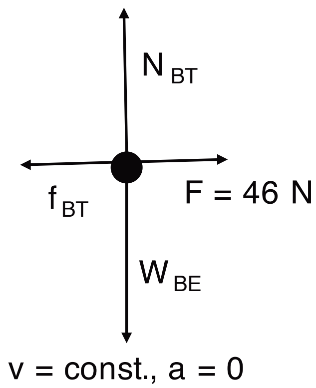
4.32



Var	Given value	Units	Description
F	46	N	applied force on brick
f_{BT}		N	friction on brick by table
μ			coefficient of friction
N_{BT}		N	normal force on brick by table
W_{BE}		N	weight on brick by earth
m	10	kg	mass of brick
g	9.8	$\frac{m}{s^2}$	acc. due to grav. on earth

$$F - f_{BT} = 0$$

4.32 (continued)

$$N_{BT} + - W_{BE} = 0$$

$$f_{BT} = F = 46\,N$$

$$N_{BT} = W_{BE} = m\,g$$

$$= (10\,\mathrm{kg})\left(9.8\,\frac{\mathrm{m}}{\mathrm{s}^2}\right)$$

$$= 98.\,\mathrm{N}$$

$$f_{BT} = \mu\,N_{BT}$$

$$f_{BT} = \mu\,N_{BT}$$

$$\mu = \frac{f_{BT}}{N_{BT}}$$

$$= \frac{46\,\mathrm{N}}{98.\,\mathrm{N}}$$

$$= 0.47$$ ✓

4.34 a

Var	Given value	Units	Description
f		N	friction
μ	0.45		coefficient of friction
N		N	normal force
W		N	weight
m	1.00	kg	mass
g	9.80	$\frac{m}{s^2}$	acc. due to grav. on earth

$$N = W = m g$$

$$= (1.00\,\text{kg})\left(9.80\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= 9.80\,\text{N}$$

$$f = \mu N$$

$$= (0.45)(9.80\,\text{N})$$

$$= 4.4\,\text{N}$$ ✓

4.4 *N* >3.0 *N so object won't move*

4.34 part b

Var	Given value	Units	Description
f	3.00	N	friction
μ			coefficient of friction
N		N	normal force
W		N	weight
m	1.00	kg	mass
g	9.80	$\frac{m}{s^2}$	acc. due to grav. on earth
F	3.00	N	applied force in x–dir.

at the point where the object just begins to move, friction equals the applied force ($F_{NET} = 0$).

$$N = W = mg$$

$$= (1.00\,\text{kg})\left(9.80\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= 9.80\,\text{N}$$

$$f = \mu N$$

$$\mu = \frac{f}{N}$$

$$= \frac{3.00\,\text{N}}{9.80\,\text{N}}$$

4.34 part b (continued)

$$= 0.306$$ ✓

4.34 part c

Var	Given value	Units	Description
f		N	friction
μ	0.20		coefficient of friction
N		N	normal force
W		N	weight
m	1.00	kg	mass
g	9.80	$\frac{m}{s^2}$	acc. due to grav. on earth
F	3.00	N	applied force in x–dir.
F_{NET}		N	net force
a		$\frac{m}{s^2}$	acceleration

$$F_{NET} = m a$$

$$F_{NET} = F - f$$

$$N = W = m g$$

$$= (1.00\,\text{kg})\left(9.80\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= 9.80\,\text{N}$$

$$f = \mu N$$

4.34 part c (continued)

$$= (0.20)(9.80\,\text{N})$$

$$= 2.0\,\text{N}$$ ✓

$$F_{\text{NET}} = F - f$$

$$= (3.00\,\text{N}) - (2.0\,\text{N})$$

$$= 1.0\,\text{N}$$ ✓

$$a = \frac{F_{\text{NET}}}{m}$$

$$= \frac{1.0\,\text{N}}{1.00\,\text{kg}}$$

$$= 1.0\,\frac{\text{m}}{\text{s}^2}$$ ✓

4.36

on the whole system:

Var	Given value	Units	Description
F_{NET}		N	net force on whole system
m_{TOT}		kg	total mass of system
a	1.00	$\frac{m}{s^2}$	acc. of system
m_1	5.00	kg	mass of concrete block
m_2	4.00	kg	mass of hanging object
g	9.80	$\frac{m}{s^2}$	acc. due to gravity
f		N	friction on concrete block
μ			coefficient of friction
N		N	normal force on concrete block

$$m_{TOT} = m_1 + m_2$$

$$= (5.00\,kg) + (4.00\,kg)$$

$$= 9.00\,kg \quad ✓$$

$$F_{NET} = m_{TOT}\, a$$

$$= (9.00\,kg)\left(1.00\,\frac{m}{s^2}\right)$$

4.36 (continued)

$$= 9.00\,\text{N}$$ ✓

$$F_{NET} = m_2 g - f$$

$$f = \mu N$$

$$N = m_1 g$$

$$= (5.00\,\text{kg})\left(9.80\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= 49.0\,\text{N}$$ ✓

$$F_{NET} = m_2 g - \mu N$$

$$\mu N = m_2 g - F_{NET}$$

$$\mu = \frac{m_2 g - F_{NET}}{N}$$

$$= \frac{(4.00\,\text{kg})\left(9.80\,\frac{\text{m}}{\text{s}^2}\right) - (9.00\,\text{N})}{49.0\,\text{N}}$$

$$= 0.616$$ ✓

4.38

Var	Given value	Units	Description
m_{TOT}		kg	total mass of system
m_1	4.0	kg	mass of wooden block
m_2	5.0	kg	mass of hanging object
F_{NET}		N	net force on system
a		$\frac{m}{s^2}$	acc. of system
g	9.80	$\frac{m}{s^2}$	acc. due to grav. on earth

to find acceleration, treat both objects as being one system

$$m_{TOT} = m_1 + m_2$$

$$= (4.0\,kg) + (5.0\,kg)$$

$$= 9.0\,kg$$ ✓

$$F_{NET} = m_{TOT}\,a$$

$$F_{NET} = m_2\,g$$

4.38 (continued)

$$= (5.0\,\text{kg})\left(9.80\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= 49.\,\text{N}$$ ✓

$$a = \frac{F_{\text{NET}}}{m_{\text{TOT}}}$$

$$= \frac{49.\,\text{N}}{9.0\,\text{kg}}$$

$$= 5.4\,\frac{\text{m}}{\text{s}^2}$$ ✓

to find tension, consider only the forces acting on the wooden block in the direction is is accelerating

Var	Given value	Units	Description
$F_{\text{NET,block}}$		N	net force on block
T		N	tension in string

$$F_{\text{NET,block}} = m_1\, a$$

$$= (4.0\,\text{kg})\left(5.4\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= 22.\,\text{N}$$ ✓

4.38 (continued)

$$T = F_{\text{NET,block}}$$

$$= 22.\text{ N}$$ ✓

4.40

Var	Given value	Units	Description
m_{TOT}		kg	total mass of system
m_1	6.00	kg	mass of pot 1 on table
m_2	3.00	kg	mass of pot 1 on table
m_3	4.00	kg	mass of hanging block
f_1		N	friction on pot 1
μ	0.350		coefficient of friction
g	9.80	$\frac{m}{s^2}$	acc. due to gravity
f_2		N	friction on pot 2
W_3		N	weight of hanging block
F_{NET}		N	net force on system
a		$\frac{m}{s^2}$	acceleration of system

$$m_{TOT} = m_1 + m_2 + m_3$$

$$= (6.00\,kg) + (3.00\,kg) + (4.00\,kg)$$

$$= 13.00\,kg$$ ✓

4.40 (continued)

On the whole system, the net force is equal to the weight of the hanging block minus the frictional forces on the two pots.

$$f_1 = \mu m_1 g$$

$$f_2 = \mu m_2 g$$

$$W_3 = m_3 g$$

$$F_{\text{NET}} = W_3 - f_1 - f_2$$

$$f_1 = \mu m_1 g$$

$$= (0.350)(6.00\,\text{kg})\left(9.80\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= 20.6\,\text{N} \quad \checkmark$$

$$f_2 = \mu m_2 g$$

$$= (0.350)(3.00\,\text{kg})\left(9.80\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= 10.3\,\text{N} \quad \checkmark$$

4.40 (continued)

$$W_3 = m_3 g$$

$$= (4.00\,\text{kg})\left(9.80\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= 39.2\,\text{N}$$ ✓

$$F_{\text{NET}} = W_3 - f_1 - f_2$$

$$= (39.2\,\text{N}) - (20.6\,\text{N}) - (10.3\,\text{N})$$

$$= 8.3\,\text{N}$$ ✓

$$a = \frac{F_{\text{NET}}}{m_{\text{TOT}}}$$

$$= \frac{8.3\,\text{N}}{13.00\,\text{kg}}$$

$$= 0.64\,\frac{\text{m}}{\text{s}^2}$$ ✓

4.40 (continued)

To find the tension in string one, consider the forces in the x–direction on pot 1.

Var	Given value	Units	Description
$F_{NET,\,1}$		N	net force on pot 1 in x–dir
T_1		N	tension in string 1

$$F_{NET,1} = m_1\, a$$

$$= (6.00\,\text{kg})\left(0.64\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= 3.8\,\text{N}$$

$$F_{NET,1} = T_1 - f_1$$

$$T_1 = f_1 + F_{NET,1}$$

$$= (20.6\,\text{N}) + (3.8\,\text{N})$$

$$= 24.4\,\text{N}$$

4.40 (continued)

To find the tension in string two, consider the forces in the x–direction on pot 2 (could also do forces in y–dir on hanging block as well).

Var	Given value	Units	Description
$F_{NET,2}$		N	net force on pot 2 in x–dir
T_2		N	tension in string 2

$$F_{NET,2} = m_2 a$$

$$= (3.00\,\text{kg})\left(0.64\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= 1.9\,\text{N}$$ ✓

$$F_{NET,2} = T_2 - f_2$$

$$T_2 = f_2 + F_{NET,2}$$

$$= (10.3\,\text{N}) + (1.9\,\text{N})$$

$$= 12.2\,\text{N}$$ ✓