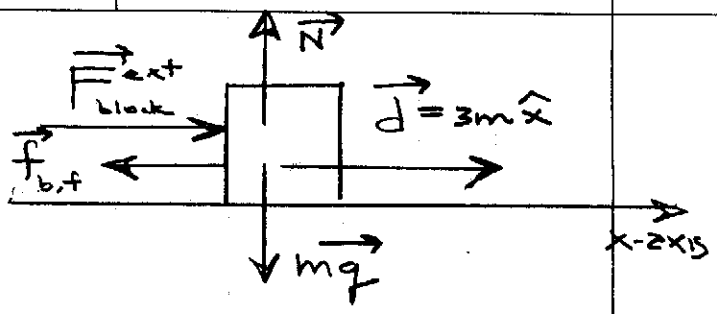
STAEDTLER® No. 937 811E Engineer's Computation Pad

••44 A horizontal force of magnitude 35.0 N pushes a block of mass 4.00 kg across a floor where the coefficient of kinetic friction is 0.600. (a) How much work is done by that applied force on the block–floor system when the block slides through a displacement of 3.00 m across the floor? (b) During that displacement, the thermal energy of the block increases by 40.0 J. What is the increase in thermal energy of the floor? (c) What is the increase in the kinetic energy of the block?



WORK-ENERGY THEOREM

$$W^{net}_{\text{on block+floor system}} = \Delta K_{\text{block+floor}} = \Delta K_{\text{block}}$$

$$\vec{F}^{ext}\cdot\vec{d} + \vec{f}_{b,f}\cdot\vec{d} = \Delta K$$

$$F^{ext}d + -\mu_k N d = \Delta K$$

NEWTON'S 2ND LAW FOR VERTICAL DIRECTION:

$$F_v^{net} = ma_v \Rightarrow N - mg = 0 \Rightarrow N = mg$$

$$F^{ext}d + -\mu_k mg d = \Delta K \quad \text{or}$$

$$F^{ext}d = \Delta K + \mu_k mg d \quad \text{or}$$

$$W^{ext}_{\text{block+floor system}} = \Delta K + \Delta E_{\text{thermal}} \quad \text{or}$$

$$W^{ext}_{\text{system}} = \Delta E_{mec} + \Delta E_{\text{thermal}} \quad (E_{mec} = K + U)$$

a) $$W^{ext}_{sys} = \vec{F}^{ext}\cdot\vec{d} = F^{ext}d = (35.0)(3.00) = 105 \text{ Joules}$$

$$\Delta E^{\text{System}}_{\text{thermal}} = -W_{\text{friction}} = -\vec{f}\cdot\vec{d} = \mu_k mg d$$

$$= (0.600)(4.00)(9.80)(3.00) = 70.6 \text{ Joules}$$

$$= \Delta E^{\text{thermal}}_{\text{block}} + \Delta E^{\text{thermal}}_{\text{floor}}$$

$$= +40.0\text{ J} + \Delta E^{\text{thermal}}_{\text{floor}}$$

b) $$\Rightarrow \Delta E^{\text{thermal}}_{\text{floor}} = 70.6 - 40.0 = 30.6 \text{ Joules}$$

$$W^{ext}_{sys} = \Delta E_m + \Delta E^{sys}_{\text{thermal}}$$

$$\Delta E_{mech} = \Delta K_{block} = W^{ext}_{sys} - \Delta E^{sys}_{\text{thermal}}$$

$$= 105 - 70.6$$

c) $$\Delta K_{block} = 34.4 \text{ Joules}$$