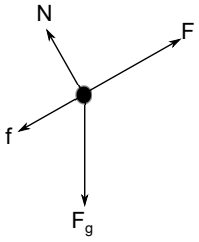
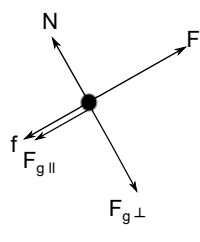




2 Memorandum: Work, energy and power

1.1	a. $W_g = F_g \Delta x \cos \Theta$ $= (60)(9,8)(3) \cos(90 - 40)^\circ$ $= (60)(9,8)(3) \cos(50)^\circ$ $= 1133,88 \text{ J}$ b. $W_N = N \Delta x \cos 90^\circ$ $= 0 \text{ J}$
1.2	a. $W_g = F_g \Delta x \cos \Theta$ $= F_g \Delta x \cos 90^\circ$ $= 0 \text{ J}$ b. $W_F = F \Delta x \cos 90^\circ$ $= 60(3,25) \cos 30^\circ$ $= 168,87 \text{ J}$
1.3	Method 1:  $W_N = N \Delta x \cos 90^\circ$ $= 0 \text{ J}$ $W_F = F \Delta x \cos \Theta$ $= 8000(3) \cos 0^\circ$ $= 24000 \text{ J}$ $W_f = f_k \Delta x \cos \Theta$ $= 20(3) \cos 180^\circ$ $= -60 \text{ J}$ $W_g = F_g \Delta x \cos \Theta$ $= (1200)(9,8)(3) \cos(90 + 30)^\circ$ $= (1200)(9,8)(3) \cos(120)^\circ$ $= -17640 \text{ J}$ $W_{net} = W_F + W_f + W_g + W_N$ $= 24000 - 60 - 17640 + 0$ $= 6300,00 \text{ J}$ Method 2:  $F_{net} = F + (-f) + (-F_{g })$ $= 8000 - 20 - (1200 \times 9,8 \times \sin 30^\circ)$ $= 2100,00 \text{ N, up the slope}$ $W_{net} = F_{net} \Delta x \cos \Theta$ $= (2100,00)(3) \cos 0^\circ$ $= 6300,00 \text{ J}$
1.4	Option 1 $W_{net} = \Delta E_K$ $W_N + W_F + W_f + W_g = \frac{1}{2}(m)(v_f^2 - v_i^2)$ $0 + 50(2,60) \cos 30^\circ + 4,2(2,60) \cos 180^\circ + (5)(9,8)(2,60) \cos 90^\circ = \frac{1}{2}(5)(v_f^2 - 0)$ $0 + 112,58 - 10,92 + 0 = \frac{1}{2}(5)(v_f^2 - 0)$ $101,66 = 2,5v_f^2$ $v_f = 6,38 \text{ m} \cdot \text{s}^{-1}$



1.4	Option 2 $W_{net} = \Delta E_K$ $F_{net}\Delta x \cos\theta = \frac{1}{2}(m)(v_f^2 - v_i^2)$ $(F_x + (-f))(2,60)\cos 0^\circ = \frac{1}{2}(5)(v_f^2 - 0)$ $((50\cos 30^\circ) - 4,2)(2,60)\cos 0^\circ = \frac{1}{2}(5)(v_f^2 - 0)$ $v_f = 6,38 \text{ m} \cdot \text{s}^{-1}$
1.5	a. $W_F = F\Delta x \cos\theta$ $= (200)(4,8)\cos 0^\circ$ $= 960,00 \text{ J}$
	b. The angle with the ground is $90 - 42 = 48^\circ$ Option 1 $W_{net} = \Delta E_K$ $W_N + W_F + W_f + W_g = \frac{1}{2}(m)(v_f^2 - v_i^2)$ $0 + 960,00 + 23(4,8)\cos 180^\circ + (720)(9,8)(4,8)\cos(90 - 48)^\circ = \frac{1}{2}(720)(v_f^2 - 0)$ $0 + 960,00 + 23(4,8)\cos 180^\circ + (720)(9,8)(4,8)\cos 42^\circ = \frac{1}{2}(720)(v_f^2 - 0)$ $0 + 960,00 - 110,40 + 25169,42 = 360v_f^2$ $v_f = 8,50 \text{ m} \cdot \text{s}^{-1}$
	Option 2 $W_{net} = \Delta E_K$ $F_{net}\Delta x \cos\theta = \frac{1}{2}(m)(v_f^2 - v_i^2)$ $(F + F_{g } + (-f))(4,8)\cos 0^\circ = \frac{1}{2}(720)(v_f^2 - 0)$ $(200 - 720(9,8)\sin 48^\circ - 23)(4,8)\cos 0^\circ = 360v_f^2$ $v_f = 8,50 \text{ m} \cdot \text{s}^{-1}$
2.1	a. The principle of conservation of mechanical energy: The total mechanical energy (sum of gravitational potential energy and kinetic energy) in an isolated system remains constant.
2.2	b. $E_{mechi} = E_{mechf}$ $mgh_i + \frac{1}{2}mv_i^2 = mgh_f + \frac{1}{2}mv_f^2$ $gh_i + \frac{1}{2}v_i^2 = gh_f + \frac{1}{2}v_f^2$ $9,8(2) + 0 = 9,8(0,5) + \frac{1}{2}v_f^2$ $v_f = 5,42 \text{ m} \cdot \text{s}^{-1}$



3.1	$W_{nc} = \Delta E_k + \Delta E_p$ $(W_N) + W_F + W_f = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i)$ $0 + 0 + 20000(4)\cos 0^\circ + 1200(4)\cos 180^\circ = \frac{1}{2}(2000)(3,1^2 - 3^2) + 2000(9,8)h$ $80000 - 4800 = 610 + 19600h$ $h = 3,81 \text{ m}$
3.2	a. $f_k = \mu_k N$ $= 0,18 F_{g\perp}$ $= 0,18(10 \times 9,8 \cos 30^\circ)$ $= 0,18(84,87)$ $= 15,28 \text{ N}$ $W_{net} = \Delta E_k$ $(W_N) + W_F + W_g + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$ $0 + F(3)\cos 0^\circ + (10 \times 9,8)(3)\cos(90 + 30)^\circ + 15,28(3)\cos 180^\circ = \frac{1}{2}(10)(3^2 - 2^2)$ $F = 72,61 \text{ N}$
	b. $\Delta t = \left(\frac{v_i + v_f}{2}\right)\Delta t$ $3 = \left(\frac{2 + 3}{2}\right)\Delta t$ $\Delta t = 1,20 \text{ s}$ $P = \frac{W}{\Delta t}$ $= \frac{72,16(3)\cos 0^\circ}{1,20}$ $= 181,53 \text{ W}$
4.1	$W_{net} = \Delta E_k$ $(W_N) + W_g + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$ $0 + 0 + 10(2)\cos 180^\circ = \frac{1}{2}(7,02)(0 - v_i^2)$ $v_i = 2,39 \text{ m} \cdot \text{s}^{-1}$
4.2	Principle of conservation of linear momentum: The total linear momentum of a closed system remains constant (is conserved).
4.3	$\Sigma p_i = \Sigma p_f$ $p_{1i} + p_{2i} = p_{1\&2}$ $mv_{1i} + mv_{2i} = (m_1 + m_2)v_f$ $0,02v_{1i} + 0 = (7 + 0,02)(2,39)$ $v_{1i} = 838,89 \text{ m} \cdot \text{s}^{-1}$



5.1	$E_{mechi} = E_{mechf}$ $mgh_i + \frac{1}{2}mv_i^2 = mgh_f + \frac{1}{2}mv_f^2$ $gh_i + \frac{1}{2}v_i^2 = gh_f + \frac{1}{2}v_f^2$ $(9,8)5 + 0 = 0 + \frac{1}{2}v_f^2$ $v_f = 9,90 \text{ m} \cdot \text{s}^{-1}$
5.2	$F_{net}=0 \therefore a = 0$ (Newton I) $\therefore v$ constant $\therefore E_k$ constant or $F_{net}=0 \therefore W_{net} = 0$ (Newton I) $\therefore E_k$ constant
5.3	A conservative force is a force for which the work done in moving an object between two points is independent of the path taken. Examples are gravitational force, the elastic force in a spring and electrostatic forces (coulomb forces).
5.4	$W_{nc} = \Delta E_K + \Delta E_P$ $(W_N) + W_f = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i)$ $(0) + 18\Delta x \cos 180^\circ = \frac{1}{2}(5)(0 - (9,90)^2) + 9,8(5)(3 - 0)$ $\Delta x = 5,45 \text{ m}$ $\sin \theta = \frac{3}{5,45}$ $\theta = 33,40^\circ$