Chapter **7** (Benson)

E07 $m=1.8\,\text{kg},\ \mu_k=0.25,\ s=2.0\,\text{m}\ \&\ \theta=45^0$: $F=\mu_k mg/(\cos\theta-\mu_k\sin\theta)=8.32\,\text{N}$; (a) $W_F=Fs\cos\theta=11.8\,(\text{J})$; (b) $W_f=-fs=-11.8\,\text{J}$; (c) $W_g=0$.

E24 $\Delta x=1\,\text{km}$: $K=mv^2/2$, $W=F\Delta x=\Delta K$, $F=\Delta K/\Delta x$ (a) $9.34\times10^6\,\text{N}$; (b) $1.31\times10^7\,\text{N}$; (c) $2.79\times10^7\,\text{N}$.

E38 $v=30\,\text{m/s}\ \&\ \mu_s=0.8$: $-mv^2/2=-F_sd=-\mu_s mgd$, $d\geq v^2/(2\mu_s g)=57.4\,\text{m}$.

E40 $m=0.5\,\text{kg},\ A=20\,\text{cm},\ \mu_k=0.4\ \&\ k=80\,\text{N/m}$: (a) $W_{sp}=kA^2/2=1.60\,\text{J}$; (b) $W_f=-\mu_k mgA=-0.392\,\text{J}$; (c) $\Delta K=W_{sp}+W_f=1.21$, $v_1=2.28\,\text{m/s}$; (d) $0-mv_1^2/2=-\mu_k mgs$, $s=0.617\,\text{m}$.

E41 $F=24\text{N},\ \theta=60^0,\ k=20\text{N/m},\ \mu_k=0.1,\ s=0.40\text{m}\ \&\ m=3\text{kg}$. $N=mg-F\sin\theta=8.62\,\text{N}$, $f_k=\mu_k N=0.86\,\text{N}$; (a) $W_F=Fs\cos\theta=4.8\,\text{J}$; (b) $W_f=-f_ks=-0.34\,\text{J}$; (c) $W_{sp}=-ks^2/2=-1.6\,\text{J}$; (d) $W_{net}=mv^2/2=2.86\,\text{J}$, $v=1.38\,\text{m/s}$.

E60 $F=450\,\text{N},\ v=6\,\text{km/s}\ \&\ \theta=30^0$: $P=(2F\cos\theta)\,v=1300\,\text{W}=1.74\,\text{hp}$.

E65 $m=14\,\text{kg},\ d=1.8\,\text{m},\ \theta=10^0,\ v_i=0.5\,\text{m/s}\ \&\ v_f=1.5\,\text{m/s}$: (a) $W_g=-mgd\sin\theta=-42.9\,\text{J}$; (b) $\Delta K=m(v_f^2-v_i^2)/2=14\,\text{J}$; (c) Net work $=\Delta K=14\,\text{J}$; (d) $W_g+W_p=\Delta K$, so $W_p=56.9\,\text{J}$.

E79 $m=145\,\text{g}\ \&\ H=42\,\text{m}$: (a) $W_g=-mg\Delta y=-59.7\,\text{J}$; (b) $W_h=59.7\,\text{J}$; (c) $d=0.8\,\text{m}$, $W_h=Fd$, $F=74.6\,\text{N}$.

P03 $Pdt=dK=d\,(mv^2/2)$, $Pt=mv^2/2$, $v=\sqrt{2Pt/m}$, $dx=vdt$, $\int dx=\sqrt{2P/m}\int t^{1/2}dt=\sqrt{8Pt^3/9m}$.

P05 $m=2\text{kg},\ k=20\text{N/m},\ \mu_k=1/6,\ s=0.40\text{m}\ \&\ \theta=53^0$. (a) $W_{sp}=-ks^2/2=-1.6\,\text{J}$; (b) $W_f=-\mu_k(mg\cos\theta)\,s=0.79\,\text{J}$; (c) $W_g=mgs\sin\theta=6.27\text{J}$; (d) $\Delta K=W_{net}$, $v^2=3.89$, $v=1.97\text{m/s}$; (e) $mgd\sin\theta=md^2/2-\mu_k mgs\cos\theta$, $d=1.37\,\text{m}$.

P06 (a) $P=F_dv=av+bv^3$, $3730=13.5a+13.5^3b\ \&\ 9700=22.2a+22.2^3b\Rightarrow a=182\,\text{N}\ \&\ b=0.517\,\text{kg/m}$; (b) $v=30\,\text{m/s}$, $P=26\,\text{hp}$.

P07 Let Δl be the change in rope's length between the hand and the pulley. $\Delta l=l_2-l_1$, where $2/\sin15^0=l_1/\sin30^0=l_2/\sin45^0$, thus $l_1=3.86\,\text{m}$, $l_2=5.46\,\text{m}\ \&\ \Delta l=1.6\,\text{m}$. $W=mg\Delta l=392\,\text{J}$. (Teacher: Jyh-Shinn Yang, 89.11.04)

P11 $dW=\vec{F}\cdot d\vec{s}=m(d\vec{v}/dt)\cdot\vec{v}dt=m\vec{v}\cdot d\vec{v}=md(v^2)/2$, $W=m(v_f^2-v_i^2)/2$.