Lesson 7—Law of Conservation of Energy

PRACTICE EXERCISES ANSWERS AND SOLUTIONS

1. $\Delta E_k + \Delta E_p + \Delta TE = 0$

$\Delta E_k + \Delta E_p = -\Delta TE$

$\frac{1}{2}m(v^2 - v_0^2) + mg\Delta h = F_{fr}d$

$\frac{1}{2}(12\text{ kg})(v^2 - 0) + (12\text{ kg})(9.81\text{ m/s}^2)(-6.0\text{ m})$

$= -(5.0\text{ N})(11.0\text{ m})$

$(6.0\text{ kg})(v^2) - 706.3\text{ J} = -55.0\text{ J}$

$(6.0\text{ kg})(v^2) = 651.3\text{ J}$

$v = \sqrt{\frac{651.3\text{ J}}{6.0\text{ kg}}}$

$= 10\text{ m/s}$

2. $\Delta E_k + \Delta E_p + \Delta TE = 0$

$\Delta E_k + \Delta E_p = -\Delta TE$

$\frac{1}{2}m(v^2 - v_0^2) + mg\Delta h = F_{fr}d$

$\frac{1}{2}(45.0\text{ kg})((5.0\text{ m/s})^2 - 0)$

$+(45.0\text{ kg})(9.81\text{ m/s}^2)(-5.0\text{ m}) = -(F_{fr})(12.5\text{ m})$

$562.5\text{ J} - 2207.3\text{ J} = -(F_{fr})(12.5\text{ m})$

$F_{fr} = \frac{562.5\text{ J} - 2207.3\text{ J}}{-12.5\text{ m}}$

$= 1.3 \times 10^2\text{ N}$

3. $\Delta E_k + \Delta E_p + \Delta TE =$ work done by external force

$\frac{1}{2}m(v^2 - v_0^2) + mg\Delta h =$ work done by external force

$\frac{1}{2}(12\text{ kg})((8\text{ m/s})^2 - (2\text{ m/s})^2)$

$+0 + F_{fr}d = (85\text{ N})(15\text{ m})$

$360\text{ J} + 0 + F_{fr}(15\text{ m}) = 1\,275\text{ J}$

$F_{fr} = \frac{1\,275\text{ J} - 360\text{ J}}{15\text{ m}}$

$= 61\text{ N}$

$F_{fr} = \mu F_N$

$\mu = \frac{F_{fr}}{F_N}$

$= \frac{61\text{ N}}{(12\text{ kg})(9.81\text{ m/s}^2)}$

$= 0.52$

4. Find Δh

$\sin 30.0^\circ = \frac{\Delta h}{5.0\text{ m}}$

$\Delta h = 2.5$

$\Delta E_k + \Delta E_p + \Delta TE =$ work done by external force

$0 + mg\Delta h + \Delta TE =$ work done by external force

$0 + (8.0\text{ kg})(9.81\text{ m/s}^2)(2.5\text{ m}) + \Delta TE = (75\text{ N})(5.0\text{ m})$

$0 + 196\text{ J} + \Delta TE = 375\text{ J}$

$\Delta TE = 375\text{ J} - 196\text{ J}$

$= 1.8 \times 10^2\text{ J}$

5. Find Δh

$\sin 30^\circ = \frac{\Delta h}{0.850\text{ m}}$

$\Delta h = 0.425\text{ m}$

$\Delta E_k + \Delta E_p + \Delta TE = 0$

$\Delta E_k + \Delta E_p = -\Delta TE$

$\frac{1}{2}m(v^2 - v_0^2) + mg\Delta h = F_{fr}d$

$\frac{1}{2}(2.5\text{ kg})(v^2 - 0)$

$+(2.5\text{ kg})(9.81\text{ m/s}^2)(-0.425\text{ m}) = -(3.2\text{ N})\ (0.850\text{ m})$

$(1.25\text{ kg})(v^2) - 10.42\text{ J} = -2.72\text{ J}$

$v = \sqrt{\frac{-2.72\text{ J} + 10.42\text{ J}}{1.25\text{ kg}}}$

$= 2.5\text{ m/s}$

6. Convert weight to mass:

$F_g = mg$

$m = \frac{F_g}{g}$

$= \frac{18.0\text{ N}}{9.81\text{ m/s}^2}$

$= 1.83\text{ kg}$

Find Δh

$\sin 30^\circ = \frac{\Delta h}{0.750\text{ m}}$

$\Delta h = 0.375\text{ m}$