PROBLEM 2.1

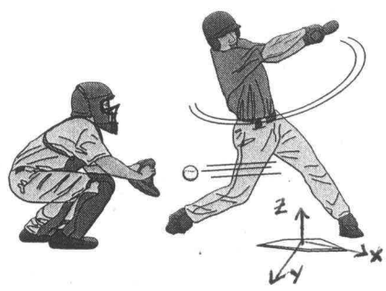


Fig. P2.1

$$KE = \frac{1}{2} m V^2 \quad \leftarrow \text{relative to home plate}$$

$$= \frac{1}{2}(0.316)\left\{ 94 \frac{\text{miles}}{\text{h}} \left| \frac{1\,\text{h}}{3600\,\text{s}} \right| \left| \frac{5280\,\text{ft}}{1\,\text{mile}} \right| \right\}^2$$

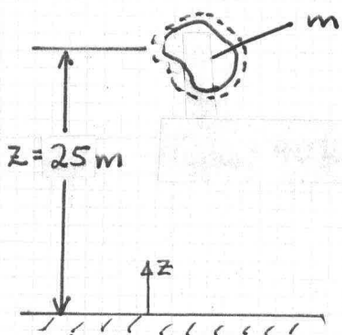
$$= 2851.1 \ \frac{\text{lb}\cdot\text{ft}}{\text{s}^2} \left| \frac{1\,\text{lbf}}{32.2\,\text{lb}\cdot\text{ft/s}^2} \right| \left| \frac{1\,\text{Btu}}{778\,\text{ft}\cdot\text{lbf}} \right| \quad \text{(rounded)}$$

$$KE = 0.114\ \text{Btu} \leftarrow$$

PROBLEM 2.2

KNOWN: An object of known mass is located at a specified elevation relative to the surface of the earth.

FIND: Determine gravitational potential energy of the object.



ENGR. MODEL: (1) The object is a closed system. (2) The acceleration of gravity is constant.

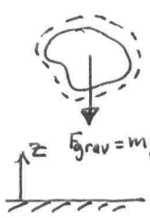
ANALYSIS: The gravitational potential energy is

$$PE = mgz$$

$$= (400\,\text{kg})\left(9.78 \frac{\text{m}}{\text{s}^2}\right)(25\,\text{m}) \left| \frac{1\,\text{N}}{\text{kg m/s}^2} \right| \left| \frac{1\,\text{kJ}}{1000\,\text{N}} \right| \left| \frac{1\,\text{kJ}}{1\,\text{kN}\cdot\text{m}} \right|$$

$$= 97.8\ \text{kJ} \leftarrow \text{PE}$$

PROBLEM 2.3



$\Delta KE = -500\ \text{ft}\cdot\text{lbf}$
$\Delta PE = +1500\ \text{ft}\cdot\text{lbf}$
$V_1 = 40\ \text{ft/s}$
$z_1 = 30\ \text{ft}$

(a) $\Delta KE = \frac{1}{2} m \left[V_2^2 - V_1^2 \right]$, $m = \frac{F_{grav}}{g} = \frac{100\,\text{lbf}}{(32.2\,\text{ft/s}^2)} \left| \frac{32.2\,\text{lb}\cdot\text{ft/s}^2}{1\,\text{lbf}} \right| = 100\,\text{lb}$

Solving for V_2,

$$V_2 = \left[\frac{2\Delta KE}{m} + V_1^2 \right]^{\frac{1}{2}} = \left[\frac{2(-500\,\text{ft}\cdot\text{lbf})}{100\,\text{lb}} \left| \frac{32.2\,\text{lb}\cdot\text{ft/s}^2}{1\,\text{lbf}} \right| + \left(40 \frac{\text{ft}}{\text{s}}\right)^2 \right]^{1/2}$$

$$= 35.75\ \text{ft/s} \leftarrow$$

(b) $\Delta PE = mg(z_2 - z_1) \Rightarrow 1500\,\text{ft}\cdot\text{lbf} = 100\,\text{lbf}(z_2 - 30\,\text{ft})$

($mg = F_{grav}$)

Solving,

$$z_2 = 45\ \text{ft} \leftarrow$$