Introduction to $\mathcal{E}_k$ and $\mathcal{E}_{pg}$

KINETIC:

1. $\mathcal{E}_k = \frac{1}{2}mv^2 = \frac{1}{2}(4.0\,kg)(5.0\,m/s)^2 = \underline{50\,J}$
2. $\mathcal{E}_k = \frac{1}{2}mv^2 = \frac{1}{2}(2.0\,kg)(8.0\,m/s)^2 = \underline{64\,J}$
3. $\mathcal{E}_k = \frac{1}{2}mv^2 = \frac{1}{2}(12\,kg)(4.0\,m/s)^2 = \underline{96\,J}$
4. $\mathcal{E}_k = \frac{1}{2}mv^2 = \frac{1}{2}(0.2\,kg)(10\,m/s)^2 = \underline{10\,J}$
5. $\mathcal{E}_k = \frac{1}{2}mv^2 = \frac{1}{2}(6\,kg)(13\,m/s)^2 = \underline{507\,J}$
6. $\mathcal{E}_k = \frac{1}{2}mv^2 = \frac{1}{2}(0.7\,kg)(9\,m/s)^2 = \underline{28.35\,J}$ $\left(700g \times \frac{1kg}{1000g} = 0.700kg\right)$
7. $\mathcal{E}_k = \frac{1}{2}mv^2 = \frac{1}{2}(2.222\,kg)(17\,m/s)^2 = \underline{321.079\,J}$
8. $\mathcal{E}_k = \frac{1}{2}mv^2 = \frac{1}{2}(0.82\,kg)(16\,m/s)^2 = \underline{104.96\,J}$
9. $\mathcal{E}_k = \frac{1}{2}mv^2 = \frac{1}{2}(0.062\,kg)(699\,m/s)^2 = \underline{15146.631\,J}$
10. $\mathcal{E}_k = \frac{1}{2}mv^2 = \frac{1}{2}(14\,kg)(27.\overline{7}\,m/s)^2 = \underline{5401.23\,J}$ $\left(100\frac{km}{h} \times \left(\frac{1000m}{km}\right) \times \left(\frac{1h}{60min}\right) \times \left(\frac{1min}{60s}\right) = 27.\overline{7}\,m/s\right)$
11. $\mathcal{E}_k = \frac{1}{2}mv^2 \Rightarrow 2\mathcal{E}_k = mv^2$

$$\frac{2\mathcal{E}_k}{m} = v^2$$

$$\sqrt{\frac{2\mathcal{E}_k}{m}} = v \rightarrow v = \sqrt{\frac{2(100J)}{8kg}} = \underline{5\,m/s}$$

12. $\mathcal{E}_k = \frac{1}{2}mv^2 \Rightarrow 2\mathcal{E}_k = mv^2$

$$\frac{2\mathcal{E}_k}{m} = v^2$$

$$\sqrt{\frac{2\mathcal{E}_k}{m}} = v \rightarrow v = \sqrt{\frac{2(24J)}{12kg}} = \underline{2\,m/s}$$

13. $\mathcal{E}_k = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{\frac{2\mathcal{E}_k}{m}} = \sqrt{\frac{2(5000J)}{100kg}} = \underline{10\,m/s}$

14. $\mathcal{E}_k = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{\frac{2\mathcal{E}_k}{m}} = \sqrt{\frac{2(4.9J)}{0.200kg}} = \underline{7\,m/s}$

Gravitational

① $\mathcal{E}_{pg} = mgh = 2.0kg\,(9.8\,m/s^2)(10m) = \underline{196J}$

② $\mathcal{E}_{pg} = mgh = 5.0kg\,(9.8\,m/s^2)(4.0m) = \underline{196J}$

③ $\mathcal{E}_{pg} = mgh = 100kg\,(9.8\,m/s^2)(10m) = \underline{9800J}$

④ $\mathcal{E}_{pg} = mgh = 0.50kg\,(9.8\,m/s^2)(3m) = \underline{14.7J}$

⑤ $\mathcal{E}_{pg} = mgh = 33.744kg\,(9.8\,m/s^2)(19.621m) = \underline{6488.492035\,J}$

⑥ $\mathcal{E}_{pg} = mgh = 17kg\,(9.8\,m/s^2)(0.056m) = \underline{9.3296\,J}$

⑦ * $410g \times \left(\frac{1kg}{1000g}\right) = \underline{0.410kg}$

$\mathcal{E}_{pg} = mgh = 0.410kg\,(9.8\,m/s^2)(8m) = \underline{32.144\,J}$

⑧ * $97cm \times \left(\frac{1m}{100cm}\right) = 0.97m$

$\mathcal{E}_{pg} = mgh = 2.0kg\,(9.8\,m/s^2)(0.97m) = \underline{19.012\,J}$

⑨ * $125g \times \left(\frac{1kg}{1000g}\right) = 0.125kg$; $244cm \times \left(\frac{1m}{100cm}\right) = 2.44m$

$\mathcal{E}_{pg} = mgh = 0.125kg\,(9.8\,m/s^2)(2.44m) = \underline{2.989\,J}$

⑩ $\mathcal{E}_{pg} = mgh \Rightarrow h = \frac{\mathcal{E}_{pg}}{mg} = \frac{633J}{14kg(9.8\,m/s^2)} = 4.613702624m \simeq \underline{4.6m}$

⑪ $\Delta\mathcal{E}_{pg} = mg\Delta h \Rightarrow \Delta h = \frac{\Delta\mathcal{E}_{pg}}{mg} = \frac{10J}{1.2kg(9.8\,m/s^2)} = 0.850340136m \simeq \underline{0.85m}$

⑫ * $0.80kJ \times \frac{1000J}{kJ} = 800J \Rightarrow \Delta\mathcal{E}_{pg} = -800J$ (it loses 800J)

$\Delta\mathcal{E}_{pg} = mg\Delta h \Rightarrow \Delta h = \frac{\Delta\mathcal{E}_{pg}}{mg} = \frac{-800J}{25kg(9.8\,m/s^2)} = -3.265306122 \simeq -3.3m$

$\Rightarrow$ <u>height is DECREASED by 3.3m</u>

⑬ $70.07kJ \times \left(\frac{1000J}{1kJ}\right) = 70070J$

$\Delta\mathcal{E}_{pg} = mg\Delta h$

$m = \frac{\Delta\mathcal{E}_{pg}}{g\Delta h} = \frac{70070J}{9.8\,m/s^2(26m)} = \underline{275kg}$