MORIN SOLUTIONS

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1. Solutions

1.1. **Problem 5.5.** To ensure that the speed remains constant, we need the vertical speed to remain v_0, so only the horizontal speed can increase. Clearly, we must have:

$$\frac{1}{2}m(v_x^2+v_y^2)=\frac{1}{2}mv_0^2-mgy(x)\Rightarrow\frac{1}{2}mv_x^2=-mgy(x)$$

for all t. Now, note that $\frac{v_y}{v_x}=y'(x)$, so it follows that $v_x=\frac{v_0}{y'(x)}$. Thus:

$$\frac{1}{2}m\frac{v_0^2}{[y'(x)]^2}=-mgy(x)\Rightarrow y'(x)=\sqrt{-\frac{2g}{v_0^2y(x)}}$$

Thus, we must have:

$$\int\sqrt{y}\,dy=\sqrt{-\frac{2g}{v_0^2}}\int\,dx\Rightarrow\frac{3}{2}y^{3/2}=\sqrt{-\frac{2g}{v_0^2}}x\Rightarrow\boxed{y(x)=-\frac{g}{2v_0^2}x^2}$$

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