PART 5

Given $\dot{v}(0) > 0 \quad \Rightarrow \frac{u(0)}{m_0} - g > 0$

$$\Rightarrow u(0) > m_0 g$$

$u^*(t)$ only takes 2 values — 0 or u_{max}.

$\therefore u_{max} > m_0 g$ & $u(0)$ can't be 0

$\Rightarrow \boxed{u^*(0) = u_{max}}$

From previous part, we know u_{max} is optimal only if $\phi(t) < 0$

$\Rightarrow \boxed{\phi(0) < 0}$