# MA 2051 B2013 — Quiz 1

**Name:** Solutions

**Section (circle):** 9 a.m. (Nathan) 10 a.m. (Ruofan) 11 a.m. (Alex) noon (Tuan) noon (Hector) 3 p.m. (Jesus)

**Instructions:** Work neatly. Show your work. Do your work on this paper. Use the back if needed.

"Source" in HW 8 1.5/1

1. (5 pts)

(a) Show that $v(t) = -gt + v_i$ is a solution of the initial-value problem $\frac{dv}{dt} = -g, \ , v(0) = v_i$.

DE: $\frac{d}{dt}(-gt + v_i) = -g + 0 = -g$ ✓

IC: $v(0) = -g \cdot 0 + v_i = v_i$ ✓

1.5/4 (b) This initial-value problem models the velocity $v(t)$ of a ball thrown vertically upwards. Use the solution $v(t) = -gt + v_i$ to find the time $T$ when the ball reaches its peak. Is the sign of $v_i$ important?

$v(T) = 0 \Rightarrow 0 = -gT + v_i \Rightarrow \boxed{T = v_i/g}$

Need $v_i > 0$ - otherwise, ball doesn't go up.

2.2/3 2. (5 pts) The differential equation $\frac{dP}{dt} = 0.015P - \cancel{0.200}\ H$ models a population of cells ($P$ is measured in millions) that is reproducing with a constant birth rate 0.015 day$^{-1}$ and being harvested at a constant rate $H$ cells/day. The culture begins with a population of $P(0) = 1.2$ million cells. Find the harvesting rate $H$ that will keep the population constant at 1.2 million.

P const. $\Rightarrow dP/dt = 0 = 0.015P - H \Rightarrow H = 0.015P$

$= 0.015 \cdot 1.2 = \boxed{.18 \text{ mil. cells/day} = H}$