SECTION II — PART A **30 minutes**
CALCULATOR ALLOWED — Graphing calculator required

Question 1 **9 points**

t (hours)	0	1	2	3	4	5	6
$R(t)$ (liters per hour)	12	15	19	24	20	16	11

Water is removed from an irrigation reservoir at a rate modeled by a differentiable function R, where $R(t)$ is measured in liters per hour and t is measured in hours. Selected values of $R(t)$ are shown in the table. Water enters the reservoir at the rate

$$W(t) = 18 + 6\sin\left(\frac{t^2}{9}\right), \qquad 0 \le t \le 6,$$

measured in liters per hour. At time $t = 0$, the reservoir contains 80 liters of water.

(a) Approximate $R'(2)$ using the average rate of change of R over $1 \le t \le 3$. Show your work and indicate units. **[2 points]**

(b) Use a midpoint Riemann sum with subintervals $[0, 2]$, $[2, 4]$, and $[4, 6]$ to approximate $\int_0^6 R(t)\,dt$. Interpret the integral in context. **[3 points]**

(c) Use your answer from part (b) to estimate the volume of water in the reservoir at $t = 6$. Show the setup for your calculation. **[2 points]**

(d) Must there be a time c, with $3 < c < 4$, when water enters and leaves the reservoir at the same rate? Justify your answer. **[2 points]**

Question 1

9 points

Response page

(a) 2 points

(b) 3 points

(c) 2 points

(d) 2 points