Scoring Guidelines
2006 AB2-BC2 (**5.93**)

(a) $\int_0^{18} L(t)\,dt \approx 1658$ cars	$2 : \begin{cases} 1 : \text{setup} \\ 1 : \text{answer} \end{cases}$
(b) $L(t) = 150$ when $t = 12.42831,\ 16.12166$ Let $R = 12.42831$ and $S = 16.12166$ $L(t) \ge 150$ for t in the interval $[R, S]$ $\frac{1}{S-R}\int_R^S L(t)\,dt = 199.426$ cars per hour	$3 : \begin{cases} 1 : t\text{-interval when } L(t) \ge 150 \\ 1 : \text{average value integral} \\ 1 : \text{answer with units} \end{cases}$
(c) For the product to exceed 200,000, the number of cars turning left in a two-hour interval must be greater than 400. $\int_{13}^{15} L(t)\,dt = 431.931 > 400$	$4 : \begin{cases} 1 : \text{considers 400 cars} \\ 1 : \text{valid interval } [h, h+2] \\ 1 : \text{value of } \int_h^{h+2} L(t)\,dt \\ 1 : \text{answer and explanation} \end{cases}$
OR	OR
The number of cars turning left will be greater than 400 on a two-hour interval if $L(t) \ge 200$ on that interval. $L(t) \ge 200$ on any two-hour subinterval of $[13.25304, 15.32386]$. Yes, a traffic signal is required.	$4 : \begin{cases} 1 : \text{considers 200 cars per hour} \\ 1 : \text{solves } L(t) \ge 200 \\ 1 : \text{discusses 2 hour interval} \\ 1 : \text{answer and explanation} \end{cases}$

2007 AB2-BC2 (**4.38**)

(a) $\int_0^7 f(t)\,dt \approx 8264$ gallons

2 : { 1 : integral; 1 : answer }

(b) The amount of water in the tank is decreasing on the intervals $0 \le t \le 1.617$ and $3 \le t \le 5.076$ because $f(t) < g(t)$ for $0 \le t < 1.617$ and $3 < t < 5.076$.

2 : { 1 : intervals; 1 : reason }

(c) Since $f(t) - g(t)$ changes sign from positive to negative only at $t = 3$, the candidates for the absolute maximum are at $t = 0,\ 3,$ and 7.

t (hours)	gallons of water
0	5000
3	$5000 + \int_0^3 f(t)\,dt - 250(3) = 5126.591$
7	$5126.591 + \int_3^7 f(t)\,dt - 2000(4) = 4513.807$

The amount of water in the tank is greatest at 3 hours. At that time, the amount of water in the tank, rounded to the nearest gallon, is 5127 gallons.

5 : { 1 : identifies $t = 3$ as a candidate; 1 : integrand; 1 : amount of water at $t = 3$; 1 : amount of water at $t = 7$; 1 : conclusion }

2010 AB1-BC1 (**5.39**)

(a) $\int_0^6 f(t)\,dt = 142.274$ or 142.275 cubic feet	$2: \begin{cases} 1: \text{integral} \\ 1: \text{answer} \end{cases}$
(b) Rate of change is $f(8) - g(8) = -59.582$ or -59.583 cubic feet per hour.	$1:$ answer
(c) $h(0) = 0$ For $0 < t \le 6$, $h(t) = h(0) + \int_0^t g(s)\,ds = 0 + \int_0^t 0\,ds = 0$. For $6 < t \le 7$, $h(t) = h(6) + \int_6^t g(s)\,ds = 0 + \int_6^t 125\,ds = 125(t-6)$. For $7 < t \le 9$, $h(t) = h(7) + \int_7^t g(s)\,ds = 125 + \int_7^t 108\,ds = 125 + 108(t-7)$. Thus, $h(t) = \begin{cases} 0 & \text{for } 0 \le t \le 6 \\ 125(t-6) & \text{for } 6 < t \le 7 \\ 125 + 108(t-7) & \text{for } 7 < t \le 9 \end{cases}$	$3: \begin{cases} 1: h(t) \text{ for } 0 \le t \le 6 \\ 1: h(t) \text{ for } 6 < t \le 7 \\ 1: h(t) \text{ for } 7 < t \le 9 \end{cases}$
(d) Amount of snow is $\int_0^9 f(t)\,dt - h(9) = 26.334$ or 26.335 cubic feet.	$3: \begin{cases} 1: \text{integral} \\ 1: h(9) \\ 1: \text{answer} \end{cases}$

2011 AB2-BC2 (**5.48**)

(a) $H'(3.5) \approx \frac{H(5) - H(2)}{5 - 2}$ $= \frac{52 - 60}{3} = -2.666$ or -2.667 degrees Celsius per minute	1 : answer
(b) $\frac{1}{10}\int_0^{10} H(t)\,dt$ is the average temperature of the tea, in degrees Celsius, over the 10 minutes. $\frac{1}{10}\int_0^{10} H(t)\,dt \approx \frac{1}{10}\left(2 \cdot \frac{66+60}{2} + 3 \cdot \frac{60+52}{2} + 4 \cdot \frac{52+44}{2} + 1 \cdot \frac{44+43}{2}\right)$ $= 52.95$	3 : { 1 : meaning of expression; 1 : trapezoidal sum; 1 : estimate }
(c) $\int_0^{10} H'(t)\,dt = H(10) - H(0) = 43 - 66 = -23$ The temperature of the tea drops 23 degrees Celsius from time $t = 0$ to time $t = 10$ minutes.	2 : { 1 : value of integral; 1 : meaning of expression }
(d) $B(10) = 100 + \int_0^{10} B'(t)\,dt = 34.18275;$ $H(10) - B(10) = 8.817$ The biscuits are 8.817 degrees Celsius cooler than the tea.	3 : { 1 : integrand; 1 : uses $B(0) = 100$; 1 : answer }

Score____________