2016 BC1

(a) $R'(2) \approx \frac{R(3)-R(1)}{3-1} = \frac{950-1190}{3-1} = -120$ liters/hr^2	$2: \begin{cases} 1: \text{estimate} \\ 1: \text{units} \end{cases}$
(b) The total amount of water removed is given by $\int_0^8 R(t)\,dt$. $\int_0^8 R(t)\,dt \approx 1 \cdot R(0) + 2 \cdot R(1) + 3 \cdot R(3) + 2 \cdot R(6)$ $= 1(1340) + 2(1190) + 3(950) + 2(740)$ $= 8050$ liters This is an overestimate since R is a decreasing function.	$3: \begin{cases} 1: \text{left Riemann sum} \\ 1: \text{estimate} \\ 1: \text{overestimate with reason} \end{cases}$
(c) Total $\approx 50000 + \int_0^8 W(t)\,dt - 8050$ $= 50000 + 7836.195325 - 8050 \approx 49786$ liters	$2: \begin{cases} 1: \text{integral} \\ 1: \text{estimate} \end{cases}$
(d) $W(0) - R(0) > 0$, $W(8) - R(8) < 0$, and $W(t) - R(t)$ is continuous.	$2: \begin{cases} 1: \text{considers } W(t) - R(t) \\ 1: \text{answer with explanation} \end{cases}$

2015 BC1

(a) $\int_0^8 R(t)\,dt = 76.570$	$2: \begin{cases} 1: \text{integrand} \\ 1: \text{answer} \end{cases}$
(b) $R(3) - D(3) = -0.313632 < 0$ Since $R(3) < D(3)$, the amount of water in the pipe is decreasing at time $t = 3$ hours.	$2: \begin{cases} 1: \text{considers } R(3) \text{ and } D(3) \\ 1: \text{answer and reason} \end{cases}$
(c) The amount of water in the pipe at time t, $0 \le t \le 8$, is $30 + \int_0^t [R(x) - D(x)]\,dx$. $R(t) - D(t) = 0 \Rightarrow t = 0,\ 3.271658$	$3: \begin{cases} 1: \text{considers } R(t) - D(t) = 0 \\ 1: \text{answer} \\ 1: \text{justification} \end{cases}$

t	Amount of water in the pipe
0	30
3.271658	27.964561
8	48.543686

The amount of water in the pipe is a minimum at time $t = 3.272$ (or 3.271) hours.

(d) $30 + \int_0^w [R(t) - D(t)]\,dt = 50$	$2: \begin{cases} 1: \text{integral} \\ 1: \text{equation} \end{cases}$

2014 BC1

(a) $\dfrac{A(30)-A(0)}{30-0} = -0.197$ (or -0.196) lbs/day	1 : answer with units
(b) $A'(15) = -0.164$ (or -0.163) The amount of grass clippings in the bin is decreasing at a rate of 0.164 (or 0.163) lbs/day at time $t = 15$ days.	$2 : \begin{cases} 1 : A'(15) \\ 1 : \text{interpretation} \end{cases}$
(c) $A(t) = \dfrac{1}{30}\int_0^{30} A(t)\,dt \Rightarrow t = 12.415$ (or 12.414)	$2 : \begin{cases} 1 : \dfrac{1}{30}\int_0^{30} A(t)\,dt \\ 1 : \text{answer} \end{cases}$
(d) $L(t) = A(30) + A'(30)\cdot(t-30)$ $A'(30) = -0.055976$ $A(30) = 0.782928$ $L(t) = 0.5 \Rightarrow t = 35.054$	$4 : \begin{cases} 2 : \text{expression for } L(t) \\ 1 : L(t) = 0.5 \\ 1 : \text{answer} \end{cases}$

2013 BC 1

(a) $G'(5) = -24.588$ (or -24.587) The rate at which gravel is arriving is decreasing by 24.588 (or 24.587) tons per hour per hour at time $t = 5$ hours.	$2 : \begin{cases} 1 : G'(5) \\ 1 : \text{interpretation with units} \end{cases}$
(b) $\int_0^8 G(t)\,dt = 825.551$ tons	$2 : \begin{cases} 1 : \text{integral} \\ 1 : \text{answer} \end{cases}$
(c) $G(5) = 98.140764 < 100$ At time $t = 5$, the rate at which unprocessed gravel is arriving is less than the rate at which it is being processed. Therefore, the amount of unprocessed gravel at the plant is decreasing at time $t = 5$.	$2 : \begin{cases} 1 : \text{compares } G(5) \text{ to } 100 \\ 1 : \text{conclusion} \end{cases}$
(d) The amount of unprocessed gravel at time t is given by $A(t) = 500 + \int_0^t (G(s) - 100)\,ds$. $A'(t) = G(t) - 100 = 0 \Rightarrow t = 4.923480$	$3 : \begin{cases} 1 : \text{considers } A'(t) = 0 \\ 1 : \text{answer} \\ 1 : \text{justification} \end{cases}$

t	$A(t)$
0	500
4.92348	635.376123
8	525.551089

The maximum amount of unprocessed gravel at the plant during this workday is 635.376 tons.