

AP CALCULUS PROBLEM SETS 10 ANSWER KEY
INTEGRATION RATES AND MODELLING

1. a) $G'(5) = -24.588$ The rate at which gravel is arriving is decreasing by 24.588 tons per hour at time $t = 5$ hours.
 b) 825.551 tons
 c) $G(5) = 98.140764 < 100$ The rate at which gravel is arriving is less than the rate at which it is being processed. Therefore the amount of unprocessed gravel is decreasing at time $t = 5$.
 d) 635.376 tons/hour
2. a) 6004
 b) \$104 041, \$104 048
 c) $H'(17) = -380.281$.
 There were 3725 people in the park at $t = 17$, and the number was decreasing at 380 people/hr.
 d) $t = 15.794$
3. a) 258.6 gallons
 b) yes – Mean Value Theorem
 c) 10.785 gallons/hr
4. a) 2474 cars
 b) $F'(7) = -1.872$, decreasing
 c) 81.899 cars/min
 d) 1.517 cars/min²
5. a) 31.815 yd³
 b) $Y(t) = 2500 + \int_0^t ((S(x) - R(x)))dx$
 c) $Y'(4) = -1.909$ yd³/min
 d) min at $t = 5.117$ is 2492.369 yd³
6. a) 8264 gal.
 b) decreasing on $[0, 1.617]$ and $[3, 5.076]$
 c) abs. max at 3 hours, 5127 gal.
7. a) 142.274 ft³
 b) -59.582 ft³/hr
 c) $h(t) = \begin{cases} 0, & 0 \leq t \leq 6 \\ 125(t-6), & 6 < t \leq 7 \\ 125+108(t-7), & 7 < t \leq 9 \end{cases}$
 d) 26.334 ft³
8. b) $T_{avg} = 87^\circ$
 c) $5.2309 \leq T \leq 18.7691$
 d) \$5.10
9. a) $\frac{dh}{dt} = 0.038$ cm/min
 b) Max. volume at $t = 25$ min.
 c) $V(25) = 60000 + \int_0^{25} (2000 - R(t))dt$
10. a) $\frac{14}{3}$ gallons
 b) $\frac{148}{3}$ gallons
 c) $A(t) = 30 + 8t - \int_0^t \sqrt{x+1} dx$
 or $8t - \frac{2}{3}(t+1)^{3/2} + \frac{92}{3}$
 d) $t = 63$ minutes
11. a) 3200 people
 b) increasing
 c) longest line at $t = 3$, 1500 people
 d) $0 = 700 + \int_0^t r(s)ds - 800t$