AP CALCULUS PROBLEM SETS #10 INTEGRATION RATES AND MODELLING
ANSWER KEY

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/min^2

5. a) 31.815 yd^3

b) $Y(t) = 2500 + \int_0^t ((S(x) - R(x))dx$

c) $Y'(4) = -1.909$ yd^3/min

d) min at $t = 5.117$ is 2492.369 yd^3

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 ft^3

b) -59.582 ft^3/hr

c) $h(t) = \begin{cases} 0, & 0 \le t \le 6 \\ 125(t-6), & 6 < t \le 7 \\ 125 + 108(t-7), & 7 < t \le 9 \end{cases}$

d) 26.334 ft^3

8. b) $T_{avg} = 87^\circ$
c) $5.2309 \le T \le 18.7691$
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) $0 = 700 + \int_0^t r(s)ds - 800t$