AP Calculus BC
Section 5.1 – Area Approximation Methods

1. Estimate $\int_0^{120} f(t)dt$ using the indicated method and number of subintervals.

t	0	20	40	60	80	100	120
$f(t)$	1.2	2.8	4.0	4.7	5.1	5.2	4.8

   a. LRAM, six subintervals

   b. RRAM, six subintervals

   c. MRAM, three subintervals

   d. TRAP, six subintervals

   e. TRAP, three subintervals

   f. SIMP, six subintervals

   g. SIMP, three subintervals

2. Estimate $\int_0^{100} g(t)dt$ using the indicated method and number of subintervals.

t	0	40	70	90	100
$g(t)$	150	180	195	184	172

   a. LRAM, 4 subintervals

   b. RRAM, 4 subintervals

   c. TRAP, 4 subintervals

3. The rate, $R(t)$ in people per hour, that people are entering a local office is given below for various times, t, in hours. $R(t)$ is decreasing on the interval $0 \le t \le 7$.

t	0	1	3	4	7
$R(t)$	12	7	5	2	1

a. Use a left Riemann sum with 4 subintervals to approximate the total number of people entering the office over the interval $0 \le t \le 7$.

b. Use a right Riemann sum with 4 subintervals to approximate the total number of people entering the office over the interval $0 \le t \le 7$.

c. Use a trapezoidal approximation with 4 subintervals to approximate the total number of people entering the office over the interval $0 \le t \le 7$.

d. Are your estimates from parts a) and b) overestimates or underestimates? Justify your answers.

4. Gasoline is being pumped into a car. The rate, $G(t)$ in gallons per second, that the gas is being pumped is given in the table below at selected times (seconds).

t	0	4	8	12	16	20	24
$G(t)$	0	.34	.42	.56	.45	.34	.22

a. Use a right Riemann Sum with 6 subintervals to approximate the total gallons of gasoline pumped in the car over the 24 seconds.

b. Use a midpoint Riemann Sum with 3 subintervals of equal size to approximate the total gallons of gasoline pumped in the car over the 24 seconds.

c. Use Simpson's Rule with 6 subintervals to approximate the total gallons of gasoline pumped in the car over the 24 seconds.

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t	0	20	40	60	80	100	120
$f(t)$	1.2	2.8	4.0	4.7	5.1	5.2	4.8

a. LRAM, six subintervals $20(1.2+2.8+4.0+4.7+5.1+5.2) = 460$

b. RRAM, six subintervals $20(2.8+4.0+4.7+5.1+5.2+4.8) = 532$

c. MRAM, three subintervals $40(2.8+4.7+5.2) = 508$

d. TRAP, six subintervals $\frac{1}{2}(20)\left[1.2+2(2.8)+2(4)+2(4.7)+2(5.1)+2(5.2)+4.8\right] = 496$

e. TRAP, three subintervals $\frac{1}{2}(40)\left[2.8+2(4.7)+5.2\right] = 348$

f. SIMP, six subintervals $\frac{1}{3}(20)\left[1.2+4(2.8)+2(4.0)+4(4.7)+2(5.1)+4(5.2)+4.8\right] = 500$

g. SIMP, three subintervals NOT POSSIBLE

2. Estimate $\int_0^{100} g(t)dt$ using the indicated method and number of subintervals.

t	0	40	70	90	100
$g(t)$	150	180	195	184	172

a. LRAM, 4 subintervals $40(150)+30(180)+20(195)+10(184) = 17{,}140$

b. RRAM, 4 subintervals $40(180)+30(195)+20(184)+10(172) = 18{,}450$

c. TRAP, 4 subintervals $\frac{1}{2}(40)(150+180)+\frac{1}{2}(30)(180+195)+\frac{1}{2}(20)(195+184)$
$+\frac{1}{2}(10)(184+172) = 17{,}795$

3. The rate, $R(t)$ in people per hour, that people are entering a local office is given below for various times, t, in hours. $R(t)$ is decreasing on the interval $0 \le t \le 7$.

t	0	1	3	4	7
$R(t)$	12	7	5	2	1

a. Use a left Riemann sum with 4 subintervals to approximate the total number of people entering the office over the interval $0 \le t \le 7$.

$1(12) + 2(7) + 1(5) + 3(2) = 37$

OVERESTIMATE SINCE R(t) IS DECREASING.

b. Use a right Riemann sum with 4 subintervals to approximate the total number of people entering the office over the interval $0 \le t \le 7$.

$1(7) + 2(5) + 1(2) + 3(1) = 22$

UNDERESTIMATE SINCE R(t) IS DECREASING.

c. Use a trapezoidal approximation with 4 subintervals to approximate the total number of people entering the office over the interval $0 \le t \le 7$.

$\frac{1}{2}(1)(12+7) + \frac{1}{2}(2)(7+5) + \frac{1}{2}(1)(5+2) + \frac{1}{2}(3)(2+1) = 29.5$

d. Are your estimates from parts a) and b) overestimates or underestimates? Justify your answers.

SEE ABOVE.

4. Gasoline is being pumped into a car. The rate, $G(t)$ in gallons per second, that the gas is being pumped is given in the table below at selected times (seconds).

t	0	4	8	12	16	20	24
$G(t)$	0	.34	.42	.56	.45	.34	.22

a. Use a right Riemann Sum with 6 subintervals to approximate the total gallons of gasoline pumped in the car over the 24 seconds.

$4(.34 + .42 + .56 + .45 + .34 + .22) = 9.32$

b. Use a midpoint Riemann Sum with 3 subintervals of equal size to approximate the total gallons of gasoline pumped in the car over the 24 seconds.

$8(.34 + .56 + .34) = 9.92$

c. Use Simpson's Rule with 6 subintervals to approximate the total gallons of gasoline pumped in the car over the 24 seconds.

$\frac{1}{3}(4)(0 + 4(.34) + 2(.42) + 4(.56) + 2(.45) + 4(.34) + .22) = 9.226$

OR

9.227