AP Calculus Riemann Sum Tabular Approximations

1. UPS delivered packages between 9 a.m. (t = 0) and 7 p.m. (t = 10). The number of packages delivered *t* hours after 9 a.m. is modeled by a differentiable function P for $0 \le t \le 10$. $P''(t) > 0$ for all t. Values of P(t), in thousands of packages, at various times of t are show in the table below.

t (hours)	0	5	6	9	10
P(t) (thousands of packages)	0	3	4	6	11

a) Use right Riemann sums with 4 subintervals given by the table to approximate $\int_0^{10} P(t)dt$. What does this answer mean?

b) Use a trapezoidal sum with 4 subintervals to approximate $\int_0^{10} P(t)dt$.

c) Use midpoint Riemann sums to approximate $\int_0^{10} P(t)dt$.

d) Suppose we had $\frac{1}{10}\int_0^{10} P(t)dt$. What does this solution mean?

2. A passenger jet fuel consumption rate, in gallons per minute, is recorded during a flight. The function that expresses this rate is a twice-differentiable increasing function *C* of time *t*, where $C''(t) < 0$ for all *t*. A table of selected values of *C(t)*, for the time interval $0 \leq t \leq 100$ is shown.

t (minutes)	0	30	40	70	80	100
C(t) (gallons per minute)	10	40	50	65	70	85

a) Using correct units, explain the meaning of $\int_0^{100} C(t)dt$ in the context of this problem.

b) Approximate the value of $\int_0^{100} C(t)dt$ using left Riemann sums with 5 subintervals. Is this an overestimate or underestimate of the actual value of $\int_0^{100} C(t)dt$?

c) Approximate the value of $\int_0^{100} C(t)dt$ using trapezoidal sums with 5 subintervals.