2010 AB #2

A zoo sponsored a one-day contest to name a new baby elephant. Zoo visitors deposited entries in a special box between noon (t = 0) and 8 P.M. (t = 8). The number of entries in the box *t* hours after noon is modeled by a differentiable function *E* for $0 \leq t \leq 8$. Values of *E(t)*, in hundreds of entries, at various times *t* are shown in the table.

t (hours)	0	2	5	7	8
$E(t)$ (hundreds of entries)	0	4	13	21	23

a) Use the data in the table to approximate the rate, in hundreds of entries per hour, at which entries were being deposited at time *t* = *6*. Show the computation that leads to your answer.

b) Use a trapezoidal sum with the four subintervals given by the table to approximate the value of $\frac{1}{8}\int_0^8 E(t)dt$. Using correct units, explain the meaning of $\frac{1}{8}\int_0^8 E(t)dt$ in terms of the number of entries.

c) At 8 P.M., volunteers began processing the entries. They processed the entries at a rate modeled by the function *P*, where $P(t) = t^3 - 30t^2 + 298t - 976$ hundreds of entries per hour for $8 \leq t \leq 12$. According to the model, how many entries had not yet been processed by midnight (t = 12)?

d) According to the model from part c), at what time were the entries being processed most quickly? Justify your answer.

2003 Form B #2

A tank contains 125 gallons of heating oil at time *t* = 0. During the time interval $0 \leq t \leq 12$ hours, heating oil is pumped into the take at the rate $H(t) = 2 + \frac{10}{(1+\ln(t+1))}$ gallons per hour. During the same time interval, heating oil is being removed from the take at the rate $R(t) = 12\sin\left(\frac{t^2}{47}\right)$ gallons per hour.

a) How many gallons of heating oil are pumped into the tank during the time interval $0 \leq t \leq 12$ hours?

b) Is the level of the heating oil in the tank rising or falling at time t = 6 hours? Give a reason for your answer.

c) How many gallons of heating oil is in the take at time t = 12 hours?

d) At what time t , $0 \leq t \leq 12$, is the volume of the heating oil in the tank the least? Show the analysis that leads to your conclusion.

2004 AB Form B #2

For $0 \le t \le 31$, the rate of change of the number of mosquitoes on Tropical Island at time t days is modeled by $R(t) = 5\sqrt{t}\cos\left(\frac{t}{5}\right)$ mosquitoes per day. There are 1000 mosquitoes on Tropical Island at time $t = 0$.

(a) Show that the number of mosquitoes is increasing at time $t = 6$.

(b) At time $t = 6$, is the number of mosquitoes increasing at an increasing rate, or is the number of mosquitoes increasing at a decreasing rate? Give a reason for your answer.

(c) According to the model, how many mosquitoes will be on the island at time $t = 31$? Round your answer to the nearest whole number.

(d) To the nearest whole number, what is the maximum number of mosquitoes for $0 \le t \le 31$? Show the analysis that leads to your conclusion.

2005 AB Form B #2

A water tank at Camp Newton holds 1200 gallons of water at time $t = 0$. During the time interval $0 \le t \le 18$ hours, water is pumped into the tank at the rate

$$W(t) = 95\sqrt{t}\sin^2\left(\frac{t}{6}\right) \text{ gallons per hour.}$$

During the same time interval, water is removed from the tank at the rate

$$R(t) = 275\sin^2\left(\frac{t}{3}\right) \text{ gallons per hour.}$$

(a) Is the amount of water in the tank increasing at time $t = 15$? Why or why not?

(b) To the nearest whole number, how many gallons of water are in the tank at time $t = 18$?

(c) At what time t, for $0 \le t \le 18$, is the amount of water in the tank at an absolute minimum? Show the work that leads to your conclusion.

(d) For $t > 18$, no water is pumped into the tank, but water continues to be removed at the rate $R(t)$ until the tank becomes empty. Let k be the time at which the tank becomes empty. Write, but do not solve, an equation involving an integral expression that can be used to find the value of k.