AP Calculus
Real World Wednesday #4

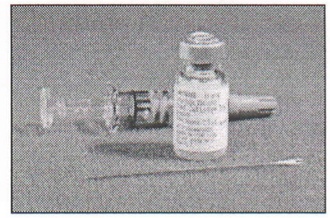
Name: ______________________

Date: __________________ Per: ____

Directions: Read the article associated with the FRQ problem, then on a separate sheet of paper (folded in half: a,b on front; c, d on back similar to the AP test) complete the FRQ. * indicated calculator active.

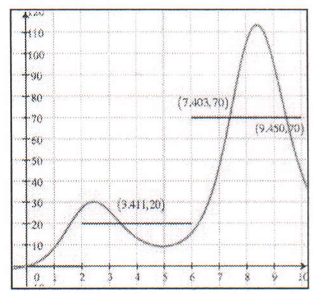
Volume 1-22: The Honolulu Star Advertiser 3/13/2013 *calculator allowed

Drug for smallpox, a disease long gone, costs U.S. millions



The United States government is buying enough of a new smallpox medicine to treat 2 million people in the event of a bioterrorism attack, and took delivery of the first shipment of it last week. But the purchase has set off a debate about the lucrative contract, with some experts saying the government is buying too much of the drug at too high a price. Smallpox was eradicated by 1980 and the only known remaining virus is in government laboratories in the United States and Russia. But there have long been rumors of renegade stocks that could be sprayed in airports or sports stadiums. Experts say the virus could also be re-engineered into existence in a sophisticated genetics lab. As part of its efforts to prepare for a possible bioterrorism attack, the government is paying over $200 for each course of treatment.

The problem below revolves around making and disseminating a medication (therapeutic vaccine) for a disease.



A violent strain of flu hits the United States. 100,000 people have the flu before the government comes out with a therapeutic vaccine that will fight it. This medication is effective only if a person has the flu. For a period of 10 months, the number of people who contract the flu changes at a rate modeled by $f(t) = 5te^{\cos(t-2)}$ where t is measured in months since the government came out with the vaccine and f is measured in 100,000 people per month. The rate at which the government makes and dispenses the vaccine is modeled by the piecewise function $v(t)$ where t is measured in months and $v(t)$ is measured in 100,000 people per month.

$$v(t) = \begin{cases} 0 \text{ for } 0 \le t < 2 \\ 20 \text{ for } 2 \le t \le 6 \\ 70 \text{ for } 6 < t \le 10 \end{cases}$$. At time $t = 0$, the government has stockpiled no vaccine.

The graph of $f(t)$ and $g(t)$ is shown above with the intersection points.

*a) How many people will have contracted the flu by the end of 10 months? (nearest thousand)

*b) Find the rate of change of the difference between people who have had the flu and people who have been vaccinated at $t = 10$ months. (nearest thousand)

c) Let $h(t)$ represent the total number of people who have been vaccinated at time t. Express $h(t)$ as a piecewise function.

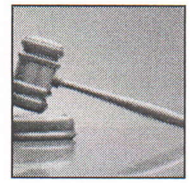
*d) What is the maximum number of people (nearest 1,000) who have contracted the flu who have not been vaccinated? Show your reasoning.

CALCULUS: RIPPED FROM THE HEADLINES

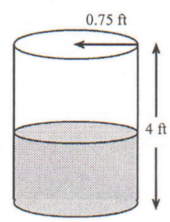
MasterMathMentor.com

Volume 1-19: The Pennsylvania Record: 3/27/2013 *calculator allowed

Family of elderly woman who died from scalding injuries sues plumbing company



The family of an elderly Philadelphia woman who allegedly died as a result of being scalded by hot bath water in what the plaintiffs contend was an act of negligence have filed suit against the plumbers who worked on the late woman's house prior to her death. During February 2012, the home's hot water heater began to leak, and the defendant was brought in to replace the device. In early March of last year, following the installation of the hot water heater, the woman attempted to take a bath when scalding hot water came out of the faucet while it was turned to the cold position, causing the water temperature to reach a "dangerous and life threatening temperature," the lawsuit says. The woman's grandson heard the woman's agonized screams, and rushed to the bathroom, where he discovered his grandmother had been scalded by the hot water. He shut off the water and lifted his grandmother from the tub, but the damage had already been done, the complaint states, with the scalding hot water causing second-degree burns to the woman's trunk, abdomen, back, buttocks and arms.
The problem below revolves around a leaking water heater.



The figure to the right shows a cylindrical water heater with a radius of 0.75 feet and a height of 4 feet. The heater contains 2 ft^3 of water at time $t = 0$. For 2 hours, water is pumped into the water heater at the rate of $P(t)$ cubic feet per hour. The table below gives values of the continuous function $P(t)$ for selected values of t, expressed in minutes. During the same interval, water is leaking from the water heater at the rate of $L(t)$ cubic feet per hour where $L(t) = 7e^{-0.7t}$.

t (min)	0	20	40	60	80	100	120
$P(t)$ $(\text{ft}^3/\text{hour})$	0	3	7	8	6	5	2

a) Find the difference between using a midpoint Riemann sum with 3 subintervals of equal length and using a trapezoidal rule with 6 intervals to approximate the amount of water that was pumped into the water heater over the 2-hour period. Show the computations that lead to your answer.

*b) If there are 7 gallons to a cubic foot of water, calculate the number of gallons that leaked out of the water heater over the time interval $0 \le t \le 2$ hours.

c) Use the answers from the trapezoidal approximation in a) and b) to approximate the volume of the water in the water heater in gallons at time $t = 2$ hours.

d) There is an interval on the 2 –hour period for which the volume of the water in the water heater is increasing. What value of t in the table above must be in this interval? Explain.

*e) How fast is the water level in the water heater changing at $t = 1$ hour? Indicate units of measure.