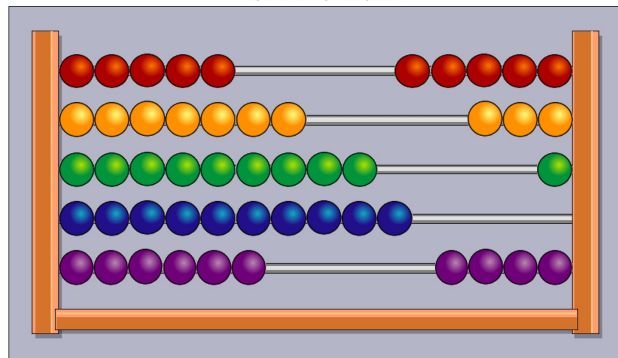


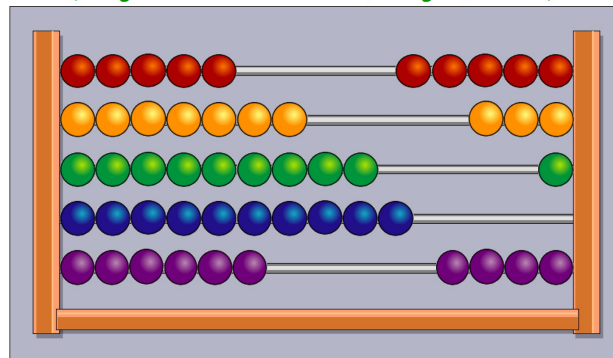
April 29

How can you use the second derivative to find minimums and maximums?



April 29

Students will verbally explain how to solve problems with calculus (using the words: derivative, integral, solve...)



AP<sup>®</sup> CALCULUS AB  
2007 SCORING GUIDELINES  
Question 2

The amount of water in a storage tank, in gallons, is modeled by a continuous function on the time interval  $0 \leq t \leq 7$ , where  $t$  is measured in hours. In this model, rates are given as follows:

(i) The rate at which water enters the tank is  $f(t)$   
 $f(t) = 100t \sin(t^2)$  gallons per hour for  $0 \leq t \leq 7$ .

(ii) The rate at which water leaves the tank is  $g(t)$   
 $g(t) = \begin{cases} 250 & \text{for } 0 \leq t < 3 \\ 2000 & \text{for } 3 \leq t \leq 7 \end{cases}$  gallons per hour.

The graphs of  $f$  and  $g$ , which intersect at  $t = 1.617$  and  $t = 5.076$ , are shown in the figure above. At time  $t = 0$ , the amount of water in the tank is 5000 gallons.  $A(0) = 5000$

(a) How many gallons of water enter the tank during the time interval  $0 \leq t \leq 7$ ? Round your answer to the nearest gallon.  
 $\int_0^7 f(t) dt = 8264$  gallons

(b) For  $0 \leq t \leq 7$ , find the time intervals during which the amount of water in the tank is decreasing. Give a reason for each answer.  
 $A' = 0 = f(t) - g(t)$   
 $g(t) = f(t)$

(c) For  $0 \leq t \leq 7$ , at what time  $t$  is the amount of water in the tank greatest? To the nearest gallon, compute the amount of water at this time. Justify your answer.

1: identifies  $t = 3$  as a candidate  
 1: integrated  
 5: 1: amount of water at  $t = 3$   
 1: amount of water at  $t = 7$   
 1: conclusion

$t$ (hours)	gallons of water
0	5000
3	$5000 + \int_0^3 f(t) dt - 250(3) = 5126.591$
7	$5126.591 + \int_3^7 f(t) dt - 2000(4) = 4513.807$

The absolute maximum is 5127 gallons. At that time, the amount of water in the tank, rounded to the nearest gallon, is 5127 gallons.

$\int_3^7 f(t) dt = 2000t \Big|_3^7$   
 $\int_3^7 2000 dt = 2000t \Big|_3^7 = 2000(7-3)$

CP | 1.617 | 3 | 5.076  
 Sign A' | - | + | - | +  
 below | dec | inc | dec | inc