Derivative of Trig Functions AP 2013 2A **Name:** Answers

AP Calculus

Work on the problem below. Note: We don't know yet how to do part b. Why is that? Think about what we need to learn in order to be able to do part b. You may use a calculator.

On a certain workday, the rate, in tons per hour, at which unprocessed gravel arrives at a gravel processing plant is modeled by $G(t) = 90 + 45\cos\left(\frac{t^2}{18}\right)$, where t is measured in hours and $0 \le t \le 8$. At the beginning of the workday ($t = 0$), the plant has 500 tons of unprocessed gravel. During the hours of operation, $0 \le t \le 8$, the plant processes gravel at a constant rate of 100 tons per hour.

(a) Find $G'(5)$. Using correct units, interpret your answer in the context of the problem.

(b) Find the total amount of unprocessed gravel that arrives at the plant during the hours of operation on this workday.

(c) Is the amount of unprocessed gravel at the plant increasing or decreasing at time $t = 5$ hours? Show the work that leads to your answer.

(d) What is the maximum amount of unprocessed gravel at the plant during the hours of operation on this workday? Justify your answer.

a) $G'(t) = -45\sin\left(\frac{t^2}{18}\right)\cdot\frac{2t}{18}$

$G'(5) = -45\sin\left(\frac{25}{18}\right)\cdot\frac{2(5)}{18} = -24.588$

The rate at which unproc. gravel is arriving at $t=5$ is decreasing by 24.588 tons/hour each hour

b) $\int_0^8 \left(90 + 45\cos\left(\frac{t^2}{18}\right)\right)dt =$ 825.551 tons

c) $G(5) = 90 + 45\cos\left(\frac{25}{18}\right) = 98.141$ tons/hr

Since plant processes gravel at 100 tons/hr, at $t=5$ the amt. of unprocessed gravel is decreasing.

d) Max. amount:

Amount of gravel $A(x) = 500 + \int_0^x (G(t) - 100)\,dt$

$A'(x) = G(x) - 100$

$0 = 90 + 45\cos\left(\frac{x^2}{18}\right) - 100$

$x = 4.923$

x	$A(x)$
0	500
4.923	635.376
8	525.551

The max. amt. of unprocessed gravel during the workday is 635.376 tons

To find values, can use home screen & change upper limit of $\int$

or use $y_1 = 500 + \int_0^x (90 + 45\cos\left(\frac{x^2}{18}\right) - 100)\,dx$

& look at table