

## 2005 AP<sup>®</sup> CALCULUS AB FREE-RESPONSE QUESTIONS

2. The tide removes sand from Sandy Point Beach at a rate modeled by the function  $R$ , given by

$$R(t) = 2 + 5 \sin\left(\frac{4\pi t}{25}\right).$$

A pumping station adds sand to the beach at a rate modeled by the function  $S$ , given by

$$S(t) = \frac{15t}{1 + 3t}.$$

Both  $R(t)$  and  $S(t)$  have units of cubic yards per hour and  $t$  is measured in hours for  $0 \leq t \leq 6$ . At time  $t = 0$ , the beach contains 2500 cubic yards of sand.

- (a) How much sand will the tide remove from the beach during this 6-hour period? Indicate units of measure.
  - (b) Write an expression for  $Y(t)$ , the total number of cubic yards of sand on the beach at time  $t$ .
  - (c) Find the rate at which the total amount of sand on the beach is changing at time  $t = 4$ .
  - (d) For  $0 \leq t \leq 6$ , at what time  $t$  is the amount of sand on the beach a minimum? What is the minimum value? Justify your answers.
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**WRITE ALL WORK IN THE TEST BOOKLET.**