

**2017 AP<sup>®</sup> CALCULUS AB FREE-RESPONSE QUESTIONS**

5. Two particles move along the  $x$ -axis. For  $0 \leq t \leq 8$ , the position of particle  $P$  at time  $t$  is given by

$$x_P(t) = \ln(t^2 - 2t + 10), \text{ while the velocity of particle } Q \text{ at time } t \text{ is given by } v_Q(t) = t^2 - 8t + 15.$$

Particle  $Q$  is at position  $x = 5$  at time  $t = 0$ .

- (a) For  $0 \leq t \leq 8$ , when is particle  $P$  moving to the left?
  - (b) For  $0 \leq t \leq 8$ , find all times  $t$  during which the two particles travel in the same direction.
  - (c) Find the acceleration of particle  $Q$  at time  $t = 2$ . Is the speed of particle  $Q$  increasing, decreasing, or neither at time  $t = 2$ ? Explain your reasoning.
  - (d) Find the position of particle  $Q$  the first time it changes direction.
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