A particle, $P$, is moving along the $x$-axis. The velocity of particle $P$ at time $t$ is given by $v_P(t) = \sin\left(t^{1.5}\right)$ for $0 \le t \le \pi$. At time $t = 0$, particle $P$ is at position $x = 5$.

A second particle, $Q$, also moves along the $x$-axis. The velocity of particle $Q$ at time $t$ is given by $v_Q(t) = (t - 1.8) \cdot 1.25^t$ for $0 \le t \le \pi$. At time $t = 0$, particle $Q$ is at position $x = 10$.

(a) Find the positions of particles $P$ and $Q$ at time $t = 1$.

(b) Are particles $P$ and $Q$ moving toward each other or away from each other at time $t = 1$ ? Explain your reasoning.

(c) Find the acceleration of particle $Q$ at time $t = 1$. Is the speed of particle $Q$ increasing or decreasing at time $t = 1$ ? Explain your reasoning.

(d) Find the total distance traveled by particle $P$ over the time interval $0 \le t \le \pi$.

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**Write your responses to this question only on the designated pages in the separate Free Response booklet. Write your solution to each part in the space provided for that part.**

**END OF PART A**

**CALCULUS AB**

**SECTION II, Part B**

**Time—1 hour**

**4 Questions**

**NO CALCULATOR IS ALLOWED FOR THESE QUESTIONS.**