2019 AB \#2
(calculator-active)
(a)
$v_{P}(t)$ is given as differentiable so it is also continuous for $0.3 \leq t \leq 2.8$.
So the Mean Value Theorem guarantees that there must be at least one time $t$,
for $0.3<t<2.8$ such that $v_{P}^{\prime}(t)=\frac{v_{P}(2.8)-v_{P}(0.3)}{2.8-0.3}=\frac{55-55}{2.8-0.3}=0$
(b)

$$
\frac{1}{2}(0.3-0)(55+0)+\frac{1}{2}(1.7-0.3)(-29+55)+\frac{1}{2}(2.8-1.7)(55+(-29)) \quad 40.75
$$

(c)
$v_{Q}(t)=60 \Rightarrow v_{Q}(t)-60=0 \Rightarrow t \approx 1.8661815=a$ and $3.5191744=b$ for $0 \leq t \leq 4$.
Graphing $v_{Q}(t)$ shows that $v_{Q}(t) \geq 60$ for $a \leq t \leq b$.
The distance traveled for $a \leq t \leq b$ is $\int_{a}^{b}\left|v_{Q}(t)\right| d t \approx 106.1087505$ meters
Note: $\left|v_{Q}(t)\right|$ was not needed for total distance since $v_{Q}(t)>0$ on the interval.
(d)

Distance between $P$ and $Q$ at $t=2.8$ is $\left|x_{P}(2.8)-x_{Q}(2.8)\right|$.
$x_{P}(2.8)=x_{P}(0)+\int_{0}^{2.8} v_{P}(t) d t \approx 0+40.75=40.75$
$x_{Q}(2.8)=x_{Q}(0)+\int_{0}^{2.8} v_{Q}(t) d t \approx-90+\int_{0}^{2.8} v_{Q}(t) d t \approx 45.9376535$
$\left|x_{P}(2.8)-x_{Q}(2.8)\right| \approx 5.187653502$ meters

