2017 AB #5
(no calculator)

(a)

$v_P(t) = x_P'(t) = \dfrac{2t-2}{t^2-2t+10} = 0$

$v_P(t) = 0 \Rightarrow t = 1$ and $v_P(t) < 0$ on [0,1) and $v_P(t) > 0$ on (1,8].

On [0,8], the particle moves to the left when $v_P(t) < 0$ and this occurs on [0,1).

(b)

$v_Q(t) = (t-5)(t-3) = 0$ when $t = 3,5$.

$v_Q(t) > 0$ on [0,3) and (5,8] and $v_Q(t) <$ on (3,5)

This tells us that particle Q moves to the right on [0,3) and (5,8] and left on (3,5).

So the particles move the same direction on (1,3) and (5,8]

since $v_P(t)$ and $v_Q(t)$ have the same signs on these intervals.

(c)

$a_Q(t) = v_Q'(t) = 2t-8 \quad \Rightarrow \quad a_Q(2) = 2(2)-8$ or -4

At $t = 2$ the speed of particle Q is **decreasing** because $a_Q(2)$ and $v_Q(2)$ have different signs.

Note: $a_Q(2) < 0$ and from part (b), $v_Q(2) > 0$ which means that particle Q is moving to the right

at a decreasing rate. Hence at $t = 2$ the particle is slowing down or the speed of the particle is decreasing .

(d)

The position of particle Q first changes direction when $t = 3,$ so

$x_Q(3) = x_Q(0) + \int_0^3 v_Q(t)\,dt$

$= 5 + \left[\dfrac{1}{3}t^3 - 4t^2 + 15t\right]_0^3$

$= 5 + (9 - 36 + 45)$ or 23