Rate in/Rate out

A large flea market is held at the local fairgrounds on the first Saturday of each month. The rates at which people enter and leave the fairgrounds are recorded for a 3-hour period beginning when the market is open to the public. The rate at which people arrive is modeled by the function $A(t) = 45\sin(0.03t - 0.7) + 71$. The function $L(t) = 42\sin(0.034t - 1.52) + 42$ models the rate at which people leave. Both $A(t)$ and $L(t)$ are measured in people per minute and t is measured for [0, 180] minutes. When the count begins at t = 0, there are already 1572 people in the flea market area of the fairgrounds.

a. How many additional people arrive for the flea market during the 3-hour period after it opens to the public?

3H = 180 min.

$$\int_0^{180} A(t)\,dt = 13945.846 \text{ people}$$

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b. Write an expression for P(t), the total number of people at the flea market at time t.

$$\boxed{P(t) = 1572 + \int_0^t (A(x) - L(x))\,dx}$$

How many people are at the flea market at $t = 60$ min?

$P(60) = 4788.160$ people

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c. Find the value of P'(75) and explain its meaning.

people/min

$$P'(t) = A(t) - L(t)$$

$$P'(75) = A(75) - L(75)$$

$$= 37.984 \text{ people/min}$$

At time t = 75, the rate of change of the people at the flea market is 37.984 people/min.

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d. For [0, 180], at what time is the number of people at the flea market at a maximum? Justify.

$t = 180$ min
because there are no critical values and the max occurs at an endpoint.

t	
0	1572
180	$1572 + \int_0^{180} (A(t) - L(t))\,dt$ 7756.583

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e. For [0, 180], at what time is the rate of change of people at the flea market at a maximum? What is the maximum rate of change? Justify.

$P'(t) = A(t) - L(t)$

$P''(t) = A'(t) - L'(t)$

$0 = A'(t) - L'(t)$

t	$P'(t)$
0	41.956
32.255	58.154 max rate
180	25.738