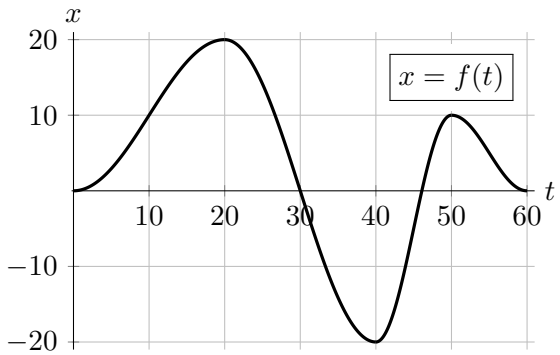
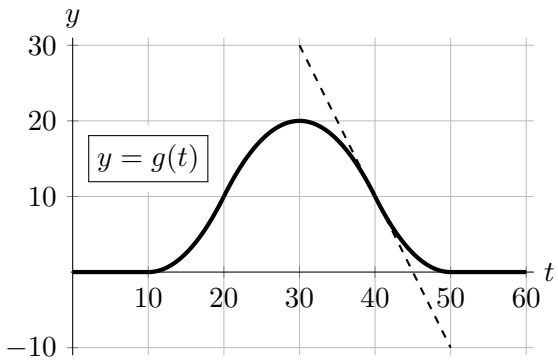
**7**. [12 points] Maria has a toy car that drives around her flat backyard. She describes the path of the car by typing a pair of parametric equations into a computer navigation system. The computer controller uses $x$- and $y$-coordinates, where the units of the axes are meters, the point where Maria will be standing corresponds to the origin $(x, y) = (0, 0)$, the positive $y$-axis points north, and the positive $x$-axis points east. The car's battery will only last 60 minutes, so Maria sets the domain of each of her parametric equations to be $0 \le t \le 60$, where $t$ is measured in minutes.

Maria enters the parametric equations $\boxed{x = f(t) \quad \text{and} \quad y = g(t)}$

where $f$ and $g$ are the functions shown in the graphs below.




**a**. [3 points] The tangent line to the graph of $y = g(t)$ at the point $t = 40$ has equation $y - 10 = -2(t - 40)$. (This is the dashed line shown in the $ty$-plane above.) Use this information to compute the instantaneous speed of Maria's car at time $t = 40$. Be sure to show your work clearly.

**b**. [2 points] At time $t = 0$, the car starts at Maria's location. Approximately how many meters away from Maria will the car be at time $t = 60$ (when it will run out of power)? Circle the <u>one</u> best estimate from among the choices below.

0 m  150 m  300 m  450 m  600 m  750 m

**c**. [3 points] At which of the times listed below is the slope of Maria car's path in the $xy$-plane the least (most negative)? Circle the <u>one</u> best answer from among the choices below.

$t = 15$  $t = 20$  $t = 28$  $t = 32$  $t = 38$

**d**. [4 points] Maria's friend William programs his car to move according to the parametric equations

$$x = \int_0^t f(s)\,ds \qquad \text{and} \qquad y = \int_0^t g(s)\,ds$$

where $f$ and $g$ are the functions shown in the graphs above. Compute the instantaneous speed of William's car at time $t = 20$. Be sure to show your work clearly.