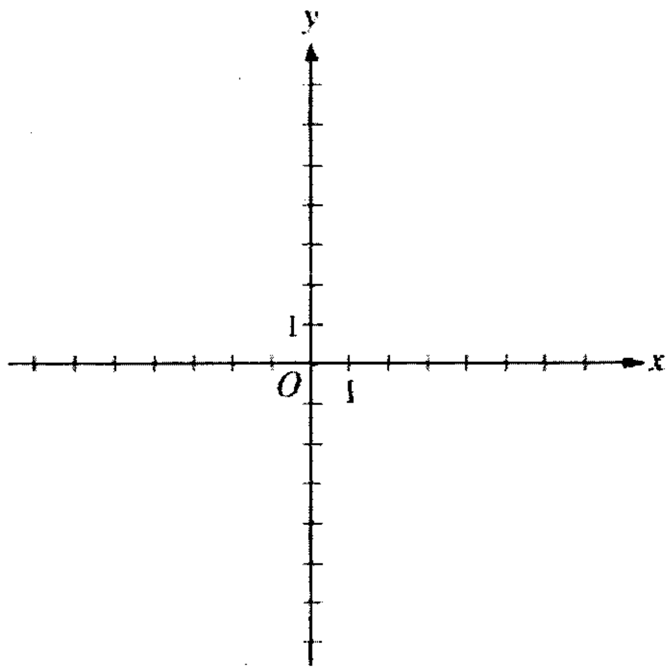
1997 BC1

During the time period from $t = 0$ to $t = 6$ seconds, a particle moves along the path given by $x(t) = 3\cos(\pi t)$ and $y(t) = 5\sin(\pi t)$.

(a) Find the position of the particle when $t = 2.5$.

(b) On the axes provided below, sketch the graph of the path of the particle from $t = 0$ to $t = 6$. Indicate the direction of the particle along its path.



(c) How many times does the particle pass through the point found in part (a)?

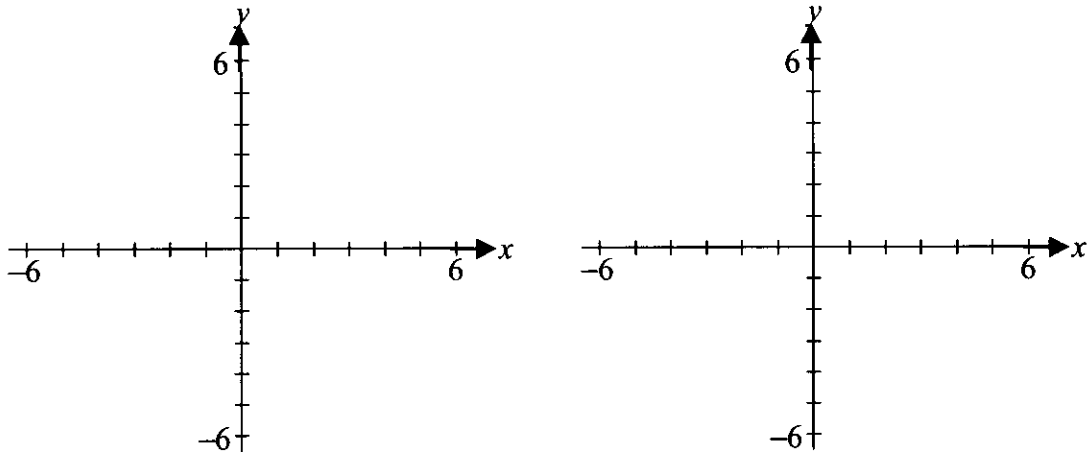
(d) Find the velocity vector for the particle at any time t.

(e) Write and evaluate an integral expression, in terms of sine and cosine, that gives the distance the particle travels from $t = 1.25$ to $t = 1.75$.

1996 AB4/BC4

This problem deals with functions defined by $f(x) = x + b\sin x$, where b is a positive constant and $-2\pi \le x \le 2\pi$.

(a) Sketch the graphs of two of these functions, $y = x + \sin x$ and $y = x + 3\sin x$.



(b) Find the x-coordinates of all points, $-2\pi \le x \le 2\pi$, where the line $y = x + b$ is tangent to the graph of $f(x) = x + b\sin x$.

(c) Are the points of tangency described in part (b) relative maximum points of f? Why?

(d) For all values of $b > 0$, show that all inflection points of the graph of f lie on the line $y = x$.

1995 BC1

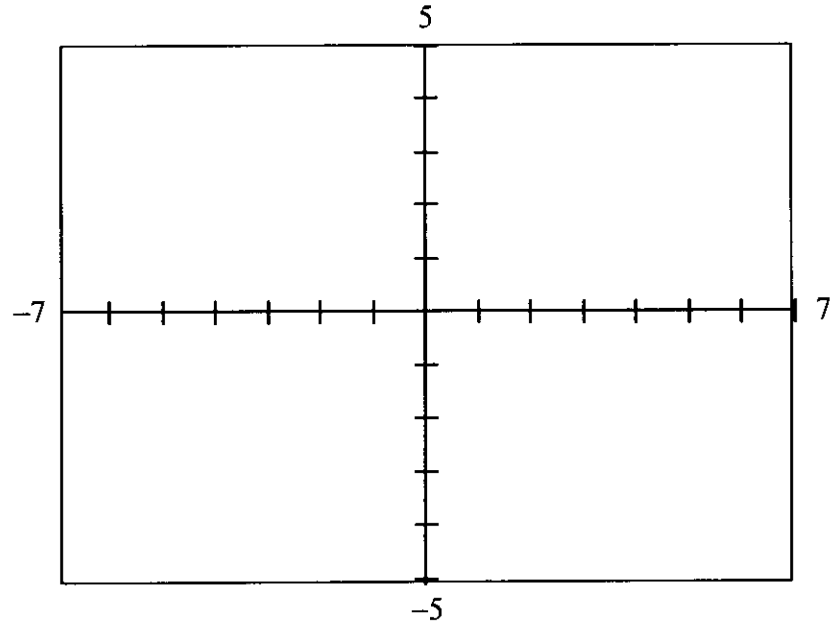
Two particles move in the *xy*-plane. For time $t \geq 0$, the position of particle A is given by $x = t - 2$ and $y = (t-2)^2$, and the position of particle B is given by $x = \frac{3t}{2} - 4$ and $y = \frac{3t}{2} - 2$.

(a) Find the velocity vector for each particle at time $t = 3$.

(b) Set up an integral expression that gives the distance traveled by particle A from $t = 0$ to $t = 3$. Do not evaluate.

(c) Determine the exact time at which the particles collide; that is, when the particles are at the same point at the same time. Justify your answer.

(d) In the viewing window provided below, sketch the paths of particles A and B from $t = 0$ until they collide. Indicate the direction of each particle along its path.



Viewing Window
$[-7, 7] \times [-5, 5]$