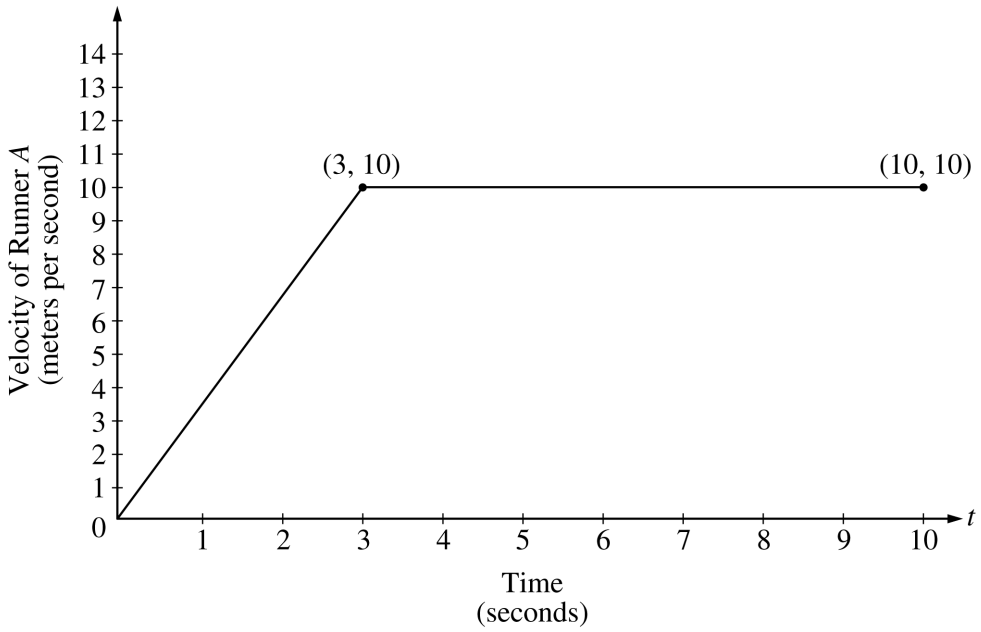


2. Two runners, $A$ and $B$, run on a straight racetrack for $0 \le t \le 10$ seconds. The graph above, which consists of two line segments, shows the velocity, in meters per second, of Runner $A$. The velocity, in meters per second, of Runner $B$ is given by the function $v$ defined by $v(t) = \dfrac{24t}{2t + 3}$.

   (a) Find the velocity of Runner $A$ and the velocity of Runner $B$ at time $t = 2$ seconds. Indicate units of measure.

   (b) Find the acceleration of Runner $A$ and the acceleration of Runner $B$ at time $t = 2$ seconds. Indicate units of measure.

   (c) Find the total distance run by Runner $A$ and the total distance run by Runner $B$ over the time interval $0 \le t \le 10$ seconds. Indicate units of measure.

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3. The Taylor series about $x = 5$ for a certain function $f$ converges to $f(x)$ for all $x$ in the interval of convergence. The $n$th derivative of $f$ at $x = 5$ is given by $f^{(n)}(5) = \dfrac{(-1)^n n!}{2^n (n + 2)}$, and $f(5) = \dfrac{1}{2}$.

   (a) Write the third-degree Taylor polynomial for $f$ about $x = 5$.

   (b) Find the radius of convergence of the Taylor series for $f$ about $x = 5$.

   (c) Show that the sixth-degree Taylor polynomial for $f$ about $x = 5$ approximates $f(6)$ with error less than $\dfrac{1}{1000}$.

**END OF PART A OF SECTION II**

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**CALCULUS BC**

**SECTION II, Part B**

**Time—45 minutes**

**Number of problems—3**

**No calculator is allowed for these problems.**

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4. A moving particle has position $(x(t), y(t))$ at time $t$. The position of the particle at time $t = 1$ is $(2,6)$, and the velocity vector at any time $t > 0$ is given by $\left(1 - \frac{1}{t^2}, 2 + \frac{1}{t^2}\right)$.

   (a) Find the acceleration vector at time $t = 3$.

   (b) Find the position of the particle at time $t = 3$.

   (c) For what time $t > 0$ does the line tangent to the path of the particle at $(x(t), y(t))$ have a slope of 8 ?

   (d) The particle approaches a line as $t \to \infty$. Find the slope of this line. Show the work that leads to your conclusion.

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5. Consider the curve given by $xy^2 - x^3y = 6$.

   (a) Show that $\frac{dy}{dx} = \frac{3x^2y - y^2}{2xy - x^3}$.

   (b) Find all points on the curve whose $x$-coordinate is 1, and write an equation for the tangent line at each of these points.

   (c) Find the $x$-coordinate of each point on the curve where the tangent line is vertical.

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