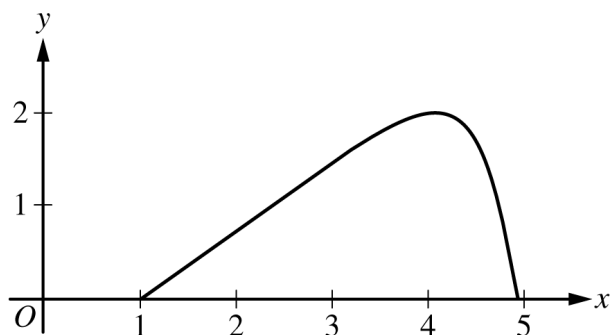




2. For  $0 \leq t \leq \pi$ , a particle is moving along the curve shown so that its position at time  $t$  is  $(x(t), y(t))$ , where  $x(t)$  is not explicitly given and  $y(t) = 2 \sin t$ . It is known that  $\frac{dx}{dt} = e^{\cos t}$ . At time  $t = 0$ , the particle is at position  $(1, 0)$ .
- (a) Find the acceleration vector of the particle at time  $t = 1$ . Show the setup for your calculations.
  - (b) For  $0 \leq t \leq \pi$ , find the first time  $t$  at which the speed of the particle is 1.5. Show the work that leads to your answer.
  - (c) Find the slope of the line tangent to the path of the particle at time  $t = 1$ . Find the  $x$ -coordinate of the position of the particle at time  $t = 1$ . Show the work that leads to your answers.
  - (d) Find the total distance traveled by the particle over the time interval  $0 \leq t \leq \pi$ . Show the setup for your calculations.

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**Write your responses to this question only on the designated pages in the separate Free Response booklet. Write your solution to each part in the space provided for that part.**

Name:

AP Calculus BC: **2023**

**END OF PART A**

**CALCULUS BC**

**SECTION II, Part B**

**Time—1 hour**

**4 Questions**

**NO CALCULATOR IS ALLOWED FOR THESE QUESTIONS.**

2. A particle moving along a curve in the  $xy$ -plane is at position  $(x(t), y(t))$  at time  $t > 0$ . The particle moves in such a way that  $\frac{dx}{dt} = \sqrt{1+t^2}$  and  $\frac{dy}{dt} = \ln(2+t^2)$ . At time  $t = 4$ , the particle is at the point  $(1, 5)$ .
- (a) Find the slope of the line tangent to the path of the particle at time  $t = 4$ .
  - (b) Find the speed of the particle at time  $t = 4$ , and find the acceleration vector of the particle at time  $t = 4$ .
  - (c) Find the  $y$ -coordinate of the particle's position at time  $t = 6$ .
  - (d) Find the total distance the particle travels along the curve from time  $t = 4$  to time  $t = 6$ .

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**Write your responses to this question only on the designated pages in the separate Free Response booklet. Write your solution to each part in the space provided for that part.**

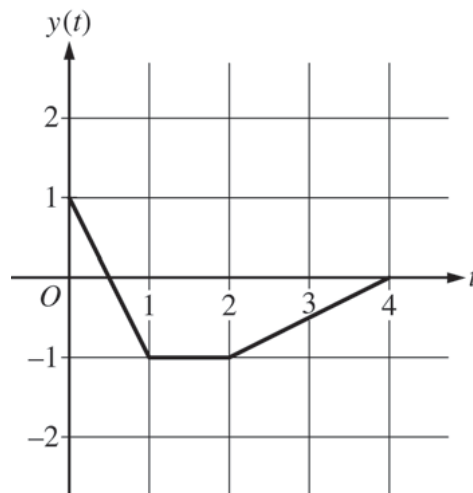
**END OF PART A**

Name:

AP Calculus BC: **2022**

**CALCULUS BC**  
**SECTION II, Part B**  
**Time—1 hour**  
**4 Questions**

**NO CALCULATOR IS ALLOWED FOR THESE QUESTIONS.**



2. At time  $t$ , the position of a particle moving in the  $xy$ -plane is given by the parametric functions  $(x(t), y(t))$ , where  $\frac{dx}{dt} = t^2 + \sin(3t^2)$ . The graph of  $y$ , consisting of three line segments, is shown in the figure above. At  $t = 0$ , the particle is at position  $(5, 1)$ .
- (a) Find the position of the particle at  $t = 3$ .
  - (b) Find the slope of the line tangent to the path of the particle at  $t = 3$ .
  - (c) Find the speed of the particle at  $t = 3$ .
  - (d) Find the total distance traveled by the particle from  $t = 0$  to  $t = 2$ .
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**END OF PART A OF SECTION II**