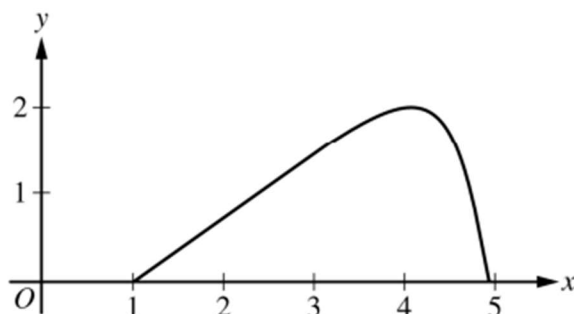


FRQ #2b (Calculator) – Vectors, Parametric (tangent lines), displacement vs total distance traveled, position/velocity/acceleration, net change theorem

AP[®] Calculus BC 2023 Free-Response Questions



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 $(1, 0)$.
- Find the acceleration vector of the particle at time $t = 1$. Show the setup for your calculations.
 - 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.
 - 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.
 - Find the total distance traveled by the particle over the time interval $0 \leq t \leq \pi$. Show the setup for your calculations.

FRQ #2c (Calculator) – Vectors, Polar (x, y, r, θ), Parametric (tangent lines), polar derivatives, position/velocity/acceleration, displacement vs total distance traveled

2015 AP[®] CALCULUS BC FREE-RESPONSE QUESTIONS

2. At time $t \geq 0$, a particle moving along a curve in the xy -plane has position $(x(t), y(t))$ with velocity vector $v(t) = (\cos(t^2), e^{0.5t})$. At $t = 1$, the particle is at the point $(3, 5)$.
- (a) Find the x -coordinate of the position of the particle at time $t = 2$.
 - (b) For $0 < t < 1$, there is a point on the curve at which the line tangent to the curve has a slope of 2. At what time is the object at that point?
 - (c) Find the time at which the speed of the particle is 3.
 - (d) Find the total distance traveled by the particle from time $t = 0$ to time $t = 1$.