1. The position of a particle at any time $t \geq 0$ is given by $x = t - t^2$ and $y = \frac{4}{3}t^{3/2}$. What is the total distance traveled by the particle from $t = 1$ to $t = 3$?

(A) 7.165 (B) 8.268 (C) 9.431 (D) 10.346

2. The position of particle at any time $t \geq 0$ is given by $x(t) = a(\cos t + t\sin t)$ and $y(t) = a(\sin t - t\cos t)$. What is the total distance traveled by the particle from $t = 0$ to $t = \pi$?

(A) $\frac{1}{2}\pi a$ (B) $\pi a^2$ (C) $\frac{1}{2}\pi^2 a$ (D) $\frac{1}{2}\pi^2 a^2$

3. The length of the path described by the parametric equations $x = \sin t + \ln(\cos t)$ and $y = \cos t$, for $\frac{\pi}{6} \leq t \leq \frac{\pi}{3}$, is given by

(A) $\int_{\pi/6}^{\pi/3} \sqrt{\cos^2 t + 2\sin t + 2}\ dt$

(B) $\int_{\pi/6}^{\pi/3} \sqrt{\sin^2 t + 2\cos t + 2}\ dt$

(C) $\int_{\pi/6}^{\pi/3} \sqrt{\cot^2 t + 2\cos t}\ dt$

(D) $\int_{\pi/6}^{\pi/3} \sqrt{\sec^2 t - 2\sin t}\ dt$

1. If a particle moves in the $xy$-plane so that at time $t>0$ its position vector is $(t^3-1, \ln\sqrt{t^2+1})$, then at time $t=1$, its velocity vector is

(A) $(0,\frac{1}{2})$ (B) $(1,\frac{1}{2})$ (C) $(3,\frac{1}{2})$ (D) $(3,\frac{1}{4})$

2. A particle moves in the $xy$-plane so that at any time $t$ its coordinates are $x=t^3-t^2$ and $y=t+\ln t$. At time $t=2$, its acceleration vector is

(A) $(4,\frac{1}{2})$ (B) $(6,\frac{1}{4})$ (C) $(8,\frac{3}{4})$ (D) $(10,-\frac{1}{4})$

3. A particle moves in the $xy$-plane so that its position at time $t>0$ is given by $x(t)=e^t\cos t$ and $y(t)=e^t\sin t$. What is the speed of the particle when $t=2$?

(A) $\sqrt{2}e$ (B) $\sqrt{2}e^2$ (C) $2e$ (D) $2e^2$

4. If $f$ is a vector-valued function defined by $f(t)=\left(\ln(\sin t),\ t^2+e^{-t}\right)$, then the acceleration vector is

(A) $(-\csc^2 t,\ 2+e^{-t})$

(B) $(\sec^2 t,\ 2+e^{-t})$

(C) $(\csc^2 t,\ 2-e^{-t})$

(D) $(-\csc^2 t\cdot\cot t,\ 2+e^{-t})$

5. A particle moves on the curve $y=x+\sqrt{x}$ so that the $x$-component has velocity $x'(t)=\cos t$ for $t\ge 0$. At time $t=0$, the particle is at the point $(1,0)$. At time $t=\frac{\pi}{2}$, the particle is at the point

(A) $(0,0)$ (B) $(1,\ 2)$ (C) $(\frac{\pi}{2},\ \frac{\pi}{2}+\sqrt{\frac{\pi}{2}})$ (D) $(2,\ 2+\sqrt{2})$

5.1 A particle moving in the $xy$- plane has velocity vector given by $v(t)=\left\langle e^t-t,\ t\sin t\right\rangle$ for time $t\ge 0$. What is the magnitude of the displacement of the particle between time $t=0$ and $t=2$?

(A) 4.722 (B) 4.757 (C) 4.933 (D) 5.109

6. An object moving along a curve in the $xy$-plane has position $(x(t),\ y(t))$ at time $t \geq 0$, with $\frac{dx}{dt} = t - \sin(e^t)$. The derivative $\frac{dy}{dt}$ is not explicitly given. At time $t = 1$, the value of $\frac{dy}{dt}$ is 3 and the object is at position $(1, 4)$.

(a) Find the $x$-coordinate of the position of the object at time $t = 5$.

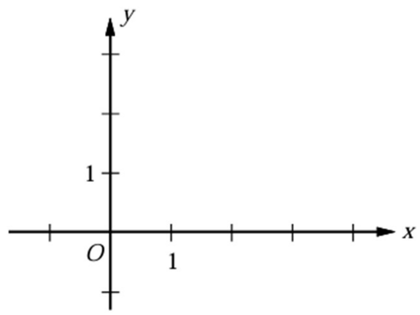
(b) Write an equation for the line tangent to the curve at the point $(x(1),\ y(1))$.

(c) Find the speed of the object at time $t = 1$.

(d) Suppose the line tangent to the curve at $(x(t),\ y(t))$ has a slope of $(t-2)$ for $t \geq 0$. Find the acceleration vector of the object at time $t = 3$.

7. The position of a particle moving in the $xy$-plane is given by the parametric equations $x(t) = t - \sin(\pi t)$ and $y(t) = 1 - \cos(\pi t)$ for $0 \leq t \leq 2$.

(a) On the axis provided below, sketch the graph of the path of the particle from $t = 0$ to $t = 2$. Indicate the direction of the particle along its path.




(b) Find the position of the particle when $t = 1$.

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

(d) Write and evaluate an integral expression, in terms of sine and cosine, that gives the distance traveled of the particle from $t = 0$ to $t = 2$.