MC.1

1. At time $t \geq 0$, a particle moving in the xy-plane has velocity vector given by $v(t) = \langle t^2, 5t \rangle$. What is the acceleration vector of the particle at time $t = 3$?

(A) $\left\langle 9, \frac{45}{2} \right\rangle$ (B) $\langle 6, 5 \rangle$ (C) $\langle 2, 0 \rangle$ (D) $\sqrt{306}$ (E) $\sqrt{61}$

MC.2

Which of the following gives the length of the path described by the parametric equations $x = \sin\left(t^3\right)$ and $y = e^{5t}$ from $t = 0$ to $t = \pi$?

(A) $\int_0^{\pi} \sqrt{\sin^2\left(t^3\right) + e^{10t}}\, dt$

(B) $\int_0^{\pi} \sqrt{\cos^2\left(t^3\right) + e^{10t}}\, dt$

(C) $\int_0^{\pi} \sqrt{9t^4 \cos^2\left(t^3\right) + 25e^{10t}}\, dt$

(D) $\int_0^{\pi} \sqrt{3t^2 \cos\left(t^3\right) + 5e^{5t}}\, dt$

(E) $\int_0^{\pi} \sqrt{\cos^2\left(3t^2\right) + e^{10t}}\, dt$

MC.3

28. In the xy-plane, a particle moves along the parabola $y = x^2 - x$ with a constant speed of $2\sqrt{10}$ units per second. If $\frac{dx}{dt} > 0$, what is the value of $\frac{dy}{dt}$ when the particle is at the point $(2, 2)$?

(A) $\frac{2}{3}$ (B) $\frac{2\sqrt{10}}{3}$ (C) 3 (D) 6 (E) $6\sqrt{10}$

MC.4

The position of a particle moving in the xy-plane is given by the vector $\left\langle 4t^3, y(2t) \right\rangle$, where y is a twice-differentiable function of t. At time $t = \frac{1}{2}$, what is the acceleration vector of the particle?

(A) $\langle 3, 2y''(1) \rangle$

(B) $\langle 6, 4y''(1) \rangle$

(C) $\langle 12, 2y''(1) \rangle$

(D) $\langle 12, 4y''(1) \rangle$

MC.5

If $x(t) = t^2 + 4$ and $y(t) = t^4 + 3$, for $t > 0$, then in terms of t, $\dfrac{d^2y}{dx^2} =$

(A) $\frac{1}{2}$ (B) 2 (C) $4t$ (D) $6t^2$ (E) $12t^2$

MC.6

A particle moves in the xy-plane with position given by $(x(t), y(t)) = (5 - 2t, t^2 - 3)$ at time t. In whic direction is the particle moving as it passes through the point $(3, -2)$?

(A) Up and to the left

(B) Down and to the left

(C) Up and to the right

(D) Down and to the right

(E) Straight up

MC.7

A particle moves in the xy-plane so that its position for $t \geq 0$ is given by the parametric equations $x = \ln(t + 1)$ and $y = kt^2$, where k is a positive constant. The line tangent to the particle's path at the point where $t = 3$ has slope 8. What is the value of k ?

(A) $\frac{1}{192}$ (B) $\frac{1}{3}$ (C) $\frac{4}{3}$ (D) $\frac{16}{3}$

MC.9 (calculator)

The velocity vector of a particle moving in the xy-plane has components given by $\dfrac{dx}{dt} = \sin(t^2)$ and $\dfrac{dy}{dt} = e^{\cos t}$. At time $t = 4$, the position of the particle is $(2, 1)$. What is the y-coordinate of the position vector at time $t = 3$?

(A) 0.410 (B) 0.590 (C) 0.851 (D) 1.410

MC.10 (calculator)

The position of an object moving along a path in the xy-plane is given by the parametric equations $x(t) = 5\sin(\pi t)$ and $y(t) = (2t - 1)^2$. The speed of the particle at time $t = 0$ is

(A) 3.422

(B) 11.708

(C) 15.580

(D) 16.209