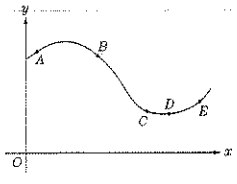
1. What is $\lim_{h \to 0} \dfrac{\cos\left(\frac{3\pi}{2} + h\right) - \cos\left(\frac{3\pi}{2}\right)}{h}$?

   (A) 1
   (B) $\frac{\sqrt{2}}{2}$
   (C) 0
   (D) -1
   (E) The limit does not exist.

2. At which of the five points on the graph in the figure at the right are $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ both negative?



   (A) A
   (B) B
   (C) C
   (D) D
   (E) E

3. The slope of the tangent to the curve $y^3x + y^2x^2 = 6$ at $(2, 1)$ is

   (A) $-\frac{3}{2}$
   (B) -1
   (C) $-\frac{5}{14}$
   (D) $-\frac{3}{14}$
   (E) 0

4. Let S be the region enclosed by the graphs of $y = 2x$ and $y = 2x^2$ for $0 \le x \le 1$. What is the volume of the solid generated when S is revolved about the line $y = 3$?

   (A) $\pi \int_0^1 \left[(3 - 2x^2)^2 - (3 - 2x)^2\right] dx$
   (B) $\pi \int_0^1 \left[(3 - 2x)^2 - (3 - 2x^2)^2\right] dx$
   (C) $\pi \int_0^1 \left(4x^2 - 4x^4\right) dx$
   (D) $\pi \int_0^2 \left[\left(3 - \frac{y}{2}\right)^2 - \left(3 - \sqrt{\frac{y}{2}}\right)^2\right] dy$
   (E) $\pi \int_0^2 \left[\left(3 - \sqrt{\frac{y}{2}}\right)^2 - \left(3 - \frac{y}{2}\right)^2\right] dy$

5. Which of the following statements about the function given by $f(x) = x^4 - 2x^3$ is true?

   (A) The function has no relative extremum.
   (B) The graph of the function has one point of inflection and the function has two relative extrema.
   (C) The graph of the function has two points of inflection and the function has one relative extremum.
   (D) The graph of the function has two points of inflection and the function has two relative extrema.
   (E) The graph of the function has two points of inflection and the function has three relative extrema.

6. If $f(x) = \sin^2(3 - x)$, then $f''(0) =$

   (A) $-2 \cos 3$
   (B) $-2 \sin 3 \cos 3$
   (C) $6 \cos 3$
   (D) $2 \sin 3 \cos 3$
   (E) $6 \sin 3 \cos 3$

7. Which of the following is the solution to the differential equation $\frac{dy}{dx} = \frac{4x}{y}$, where $y(2) = -2$?

   (A) $y = 2x$ for $x > 0$
   (B) $y = 2x - 6$ for $x \ne 3$
   (C) $y = -\sqrt{4x^2 - 12}$ for $x > \sqrt{3}$
   (D) $y = \sqrt{4x^2 - 12}$ for $x > \sqrt{3}$
   (E) $y = -\sqrt{4x^2 - 6}$ for $x > \sqrt{1.5}$

8. What is the average rate of change of the function f given by $f(x) = x^4 - 5x$ on the closed interval $[0, 3]$?

   (A) 8.5
   (B) 8.7
   (C) 22
   (D) 33
   (E) 66

9. The position of a particle moving along a line is given by $s(t) = 2t^3 - 24t^2 + 90t + 7$ for $t \ge 0$. For what values of t is the speed of the particle increasing?

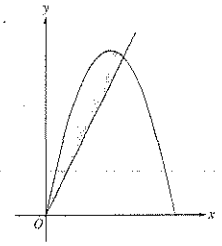
   (A) $3 < t < 4$ only
   (B) $t > 4$ only
   (C) $t > 5$ only
   (D) $0 < t < 3$ and $t > 5$
   (E) $3 < t < 4$ and $t > 5$

10. $\int (x - 1)\sqrt{x}\, dx =$

    (A) $\frac{3}{2}\sqrt{x} - \frac{1}{\sqrt{x}} + C$
    (B) $\frac{2}{3}x^{3/2} + \frac{1}{2}x^{1/2} + C$
    (C) $\frac{1}{2}x^2 - x + C$
    (D) $\frac{2}{5}x^{5/2} - \frac{2}{3}x^{3/2} + C$
    (E) $\frac{1}{2}x^2 + 2x^{3/2} - x + C$

11. What is $\lim_{x \to \infty} \dfrac{x^2 - 4}{2 + x - 4x^2}$?

    (A) -2
    (B) $-\frac{1}{4}$
    (C) $\frac{1}{2}$
    (D) 1
    (E) The limit does not exist.



12. The figure above shows the graph of $y = 5x - x^2$ and the graph of the line $y = 2x$. What is the area of the shaded region?

    (A) $\frac{25}{6}$
    (B) $\frac{9}{2}$
    (C) 9
    (D) $\frac{27}{2}$
    (E) $\frac{45}{2}$

13. If $y = 5 + \int_2^{2x} e^{-t^2}\, dt$, which of the following is true?

    (A) $\frac{dy}{dx} = e^{-x^2}$ and $y(0) = 5$
    (B) $\frac{dy}{dx} = e^{-x^2}$ and $y(1) = 5$
    (C) $\frac{dy}{dx} = e^{-4x^2}$ and $y(1) = 5$
    (D) $\frac{dy}{dx} = 2e^{-4x^2}$ and $y(0) = 5$
    (E) $\frac{dy}{dx} = 2e^{-4x^2}$ and $y(1) = 5$