BC EXAM:
SECTION I, Part A
Time—55 minutes
Number of questions—28

A CALCULATOR MAY NOT BE USED ON THIS PART OF THE EXAMINATION.

Directions: Solve each of the following problems, using the available space for scratchwork. After examining the of the choices, decide which is the best of the choices given and fill in the corresponding oval on the answer she credit will be given for anything written in the test book. Do not spend too much time on any one problem.

In this Test: Unless otherwise specified, the domain of a function f is assumed to be the set of all real numbers which $f(x)$ is a real number.

1. In the xy-plane, the graph of the parametric equations $x = 1 + 2\cos 3t$ and $y = 1 - 2\sin 3t$, where $0 \leq t \leq 2\pi$, is a cir radius

(A) 1

(B) 2

(C) 3

(D) 5

(E) 6

GO ON TO THE NEXT PAG

2. Which of the following series converge?

I. $\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n}}$

II. $\sum_{n=1}^{\infty} \frac{3}{n}$

III. $\sum_{n=1}^{\infty} \frac{n}{n+5}$

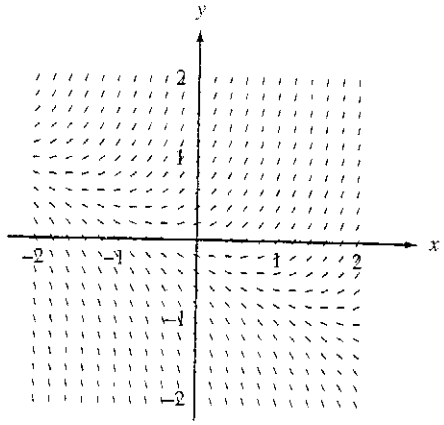
(A) None

(B) I only

(C) II only

(D) III only

(E) I and II only



3. Shown above is the slope field for which of the following differential equations?

(A) $\frac{dy}{dx} = y - 2$

(B) $\frac{dy}{dx} = x - 2$

(C) $\frac{dy}{dx} = x + 2y$

(D) $\frac{dy}{dx} = xy$

(E) $\frac{dy}{dx} = x + y$

4. For what values of x is the function f, where $f(x) = x^3 - 5x^2 - 8x + 5$, increasing?

(A) $x < -\frac{2}{3}$ or $x > 4$

(B) $-\frac{2}{3} < x < 4$

(C) $-4 < x < \frac{2}{3}$

(D) $x < -4$ or $x > \frac{2}{3}$

(E) $-2 < x < 12$

---

5. If $\sum_{n=0}^{\infty} \frac{3x^n}{n!}$ is a Taylor series that converges to $f(x)$ for all real x, then what is $f''(0)$?

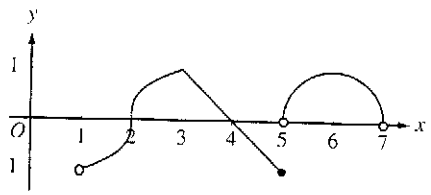
(A) $\frac{3}{4}$

(B) $\frac{3}{2}$

(C) 3

(D) 6

(E) 18



6. The function f, whose graph is shown in the figure above, is defined on the open interval $(1, 7)$. It has a vertical tar when $x = 2$ and a horizontal tangent when $x = 6$. For what values of x, $1 < x < 7$, is f not differentiable?

(A) 2 only

(B) 3 and 5 only

(C) 5 and 6 only

(D) 2, 3, and 5 only

(E) 2, 3, 5, and 6 only

---

7. A particle moves along a plane curve so that at any time $t > 0$ its x-coordinate is $\cos 2t$ and its y-coordinate is $\sin 3t$ At $t = \frac{\pi}{2}$ the acceleration vector of the particle is

(A) $(-1, -1)$

(B) $(0, 0)$

(C) $(1, 1)$

(D) $(2, 3)$

(E) $(4, 9)$

---

8. $\displaystyle\int \frac{dx}{x^2 - 5x + 6} =$

(A) $2 \ln \left| \dfrac{x-2}{x-3} \right| + C$

(B) $\ln \left| \dfrac{x-2}{x-3} \right| + C$

(C) $\ln \left| \dfrac{x-3}{x-2} \right| + C$

(D) $\dfrac{1}{2} \ln \left| \dfrac{x-2}{x-3} \right| + C$

(E) $\dfrac{1}{2} \ln \left| \dfrac{x-3}{x-2} \right| + C$

---

9. For what values of x does the series $\displaystyle\sum_{n=1}^{\infty} \frac{(2x+1)^n}{\sqrt[3]{n^4}}$ converge?

(A) $-1 \leq x \leq 1$

(B) $-1 < x < 0$

(C) $-1 \leq x < 0$

(D) $-1 \leq x \leq 0$

(E) $-1 \leq x < 1$

GO ON TO THE NEXT PAGE

10. $\int_0^\infty xe^{-x^2}\,dx$ is

(A) -1

(B) $-\frac{1}{2}$

(C) 0

(D) $\frac{1}{2}$

(E) divergent

---

11. If f is a vector-valued function defined by $f(t) = (e^{2t}, \ln t)$, then $f'''(t) =$

(A) $\frac{4e^{2t}}{t^3}$

(B) $8e^{2t} - \frac{2}{t^3}$

(C) $\left(e^{2t}, -\frac{2}{t^3}\right)$

(D) $\left(4e^{2t}, -\frac{1}{t^2}\right)$

(E) $\left(8e^{2t}, \frac{2}{t^3}\right)$

---

12. $\lim\limits_{x \to 2} \dfrac{\displaystyle\int_2^x e^{t-2}\,dt}{x^2 - 4}$ is

(A) $\dfrac{e^{-2}}{2}$

(B) $\dfrac{1}{4}$

(C) $\dfrac{1}{2}$

(D) e^2

(E) nonexistent

---

13. The length of the path described by the parametric equations $x(t) = t^2 + 1$ and $y(t) = \cos t$, where $0 \le t \le 2$, is given by

(A) $\displaystyle\int_0^2 2t \cos t\,dt$

(B) $\displaystyle\int_0^2 \sqrt{(t^2+1)^2 + \cos^2 t}\,dt$

(C) $\displaystyle\int_0^2 \sqrt{4t^2 - \sin^2 t}\,dt$

(D) $\displaystyle\int_0^2 2t \sin t\,dt$

(E) $\displaystyle\int_0^2 \sqrt{4t^2 + \sin^2 t}\,dt$

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14. The population $P(t)$ of butterflies in a particular location satisfies the logistic differential equation $\frac{dP}{dt} = P\left(4 - \frac{P}{200}\right)$. If the initial population at $t = 0$ is $P(0) = 300$ and t is the time in months, what is $\lim_{t \to \infty} P(t)$?

(A) 50

(B) 200

(C) 500

(D) 800

(E) 1100

---

15. The area of the region inside the polar curve $r = 2\cos\theta$ and outside the polar curve $r = \sqrt{3}$ is given by

(A) $\frac{1}{2}\int_{-\frac{\pi}{6}}^{\frac{\pi}{6}} (4\cos^2\theta - 3)\, d\theta$

(B) $\frac{1}{2}\int_{\frac{\pi}{6}}^{\frac{11\pi}{6}} (4\cos^2\theta - 3)\, d\theta$

(C) $\frac{1}{2}\int_{-\frac{\pi}{6}}^{\frac{\pi}{6}} (2\cos\theta - \sqrt{3})^2\, d\theta$

(D) $\frac{1}{2}\int_{\frac{\pi}{3}}^{\frac{5\pi}{3}} (2\cos\theta - \sqrt{3})^2\, d\theta$

(E) $\frac{1}{2}\int_{-\frac{\pi}{3}}^{\frac{\pi}{3}} (2\cos\theta - \sqrt{3})^2\, d\theta$

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16. If $\frac{d}{dx}f(x) = \tan^2 x$ and $g(x) = e^x$, then $\frac{d}{dx}f(g(x)) =$

(A) $\tan^2(e^x)$

(B) $e^x \tan^2(e^x)$

(C) $2e^x \tan(e^x)$

(D) $2e^x \tan(e^x)\sec^2(e^x)$

(E) $e^x \tan^2 x$

---

17. If $\frac{dy}{dx} = -2xy^2$ and if $y = 3$ when $x = 1$, what is the value of y when $x = 3$?

(A) $-\frac{3}{23}$

(B) $-\frac{1}{9}$

(C) $\frac{3}{28}$

(D) $\frac{1}{9}$

(E) $\frac{3}{25}$

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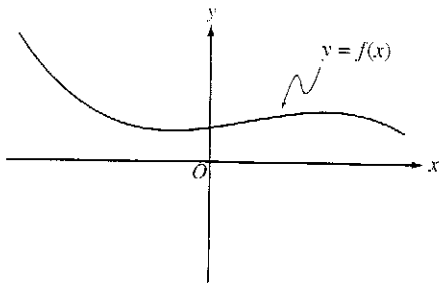
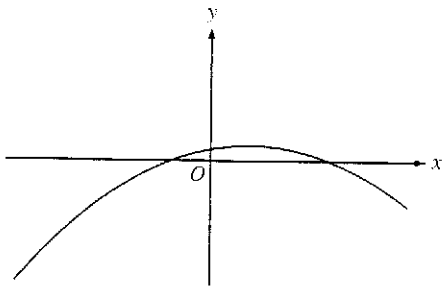
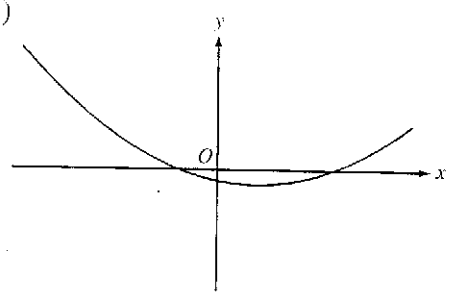


18. The graph of the function $f(x)$ is shown above. Which of the following could be the graph of $y = f'(x)$?

(A)



(B)



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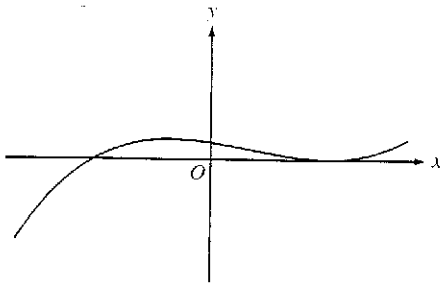
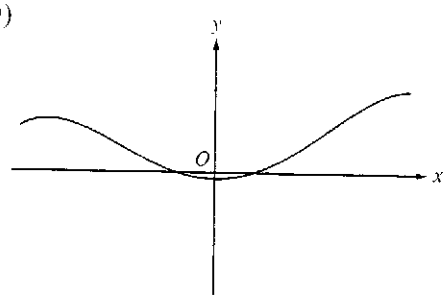
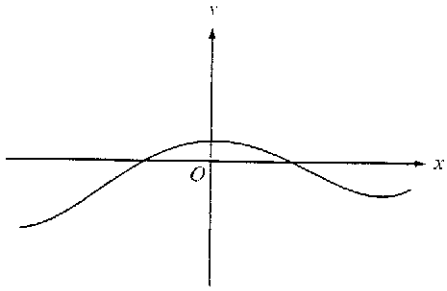


(D)



(E)



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19. The slope of the line tangent to the curve $x^2y + (y^3 + 1)^2 = 8$ at the point $(-2, 1)$ is

(A) $-\frac{1}{2}$

(B) $-\frac{1}{4}$

(C) 0

(D) $\frac{1}{4}$

(E) $\frac{1}{2}$

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20. The volume of a sphere of radius r is given by $V = \frac{4}{3}\pi r^3$. The surface area of a sphere of radius r is given by $A = 4\pi r^2$. For what radius r will the rate of change of the volume be numerically equal to the rate of change of the surface area?

(A) 1

(B) 2

(C) 3

(D) 4

(E) 6

GO ON TO THE NEXT PAGE

21. If f is the function given by

$$f(x) = \begin{cases} e^2 x, & x < 0 \\ \cos x + 1, & x \geq 0 \end{cases}$$

then $\lim_{x \to 0} f(x)$ is

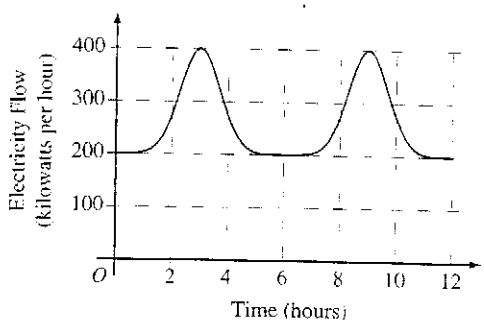
(A) 0

(B) 1

(C) 2

(D) 3

(E) nonexistent



22. The flow of electricity, in kilowatts per hour, through an electric meter is shown in the graph above. Which of the followi best approximates the amount of electricity that passed through the meter over the twelve-hour period?

(A) 600 kilowatts

(B) 1250 kilowatts

(C) 2400 kilowatts

(D) 3000 kilowatts

(E) 4500 kilowatts

---

23. Which of the following is the approximation for $\cos 0.1$ using the first three nonzero terms of a Maclaurin series?

(A) $1 - 0.1 + \frac{0.01}{2}$

(B) $0.1 - \frac{0.001}{6} + \frac{0.00001}{120}$

(C) $0.1 - \frac{0.01}{2} + \frac{0.001}{4}$

(D) $1 - \frac{0.01}{2} + \frac{0.0001}{24}$

(E) $0.1 - \frac{0.001}{3} + \frac{0.00001}{5}$

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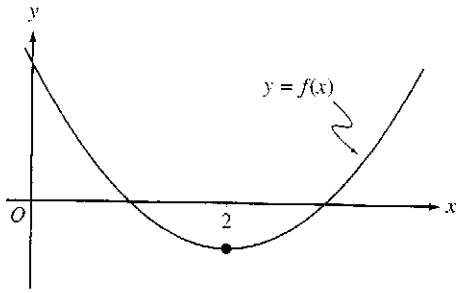

24. The graph of the twice differentiable function $f(x)$ is shown in the figure above. Which of the following statements is tru

(A) $f(2) < f'(2) < f''(2)$

(B) $f(2) < f''(2) < f'(2)$

(C) $f'(2) < f(2) < f''(2)$

(D) $f'(2) < f''(2) < f(2)$

(E) $f''(2) < f(2) < f'(2)$

25. If f is the function defined by $f(x) = 2x^6 - 5x^4 + 2x$, what are all the x-coordinates of points of inflection on the graph of f?

(A) -1

(B) 0

(C) 1

(D) -1 and 1

(E) -1, 0, and 1

---

26. $\int x \sec^2 x \, dx =$

(A) $x \tan x - \ln|\sec x| + C$

(B) $x \tan x - \sec^2 x + C$

(C) $x \tan x - \frac{1}{2} \tan^2 x + C$

(D) $\frac{1}{2} x^2 \tan x + C$

(E) $\frac{1}{2} \tan^2 x + C$

---

time (seconds)	0	15	30	45	60
velocity (feet per second)	6	10	8	7	4

27. The table above gives values for the velocity of a particle at certain times t between $t = 0$ and $t = 60$. The approximati of the total distance traveled by the particle during the time period $0 \leq t \leq 60$, computed using a right-hand Riemann s with four equal subintervals, is

(A) 29 feet

(B) 435 feet

(C) 450 feet

(D) 465 feet

(E) 525 feet

BC EXAM:

SECTION I, Part A

Time—55 minutes

Number of questions—28

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radius

(A) 1

(B) 2

(C) 3

(D) 5

(E) 6

GO ON TO THE NEXT PAG

1. Which of the following series converge?

I. $\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n}}$

II. $\sum_{n=1}^{\infty} \frac{3}{n}$

III. $\sum_{n=1}^{\infty} \frac{n}{n+5}$

(A) None

(B) I only

(C) II only

(D) III only

(E) I and II only

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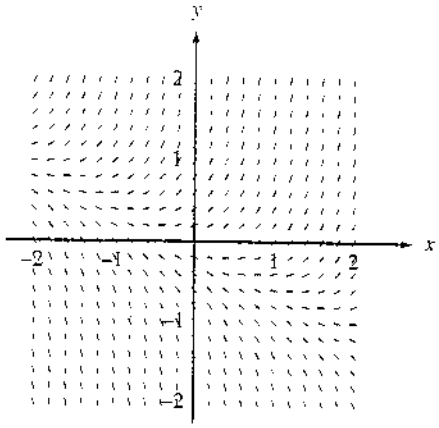

3. Shown above is the slope field for which of the following differential equations?

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(D) $\frac{dy}{dx} = xy$

(E) $\frac{dy}{dx} = x + y$

4. For what values of x is the function f, where $f(x) = x^3 - 5x^2 - 8x + 5$, increasing?

(A) $x < -\frac{2}{3}$ or $x > 4$

(B) $-\frac{2}{3} < x < 4$

(C) $-4 < x < \frac{2}{3}$

(D) $x < -4$ or $x > \frac{2}{3}$

(E) $-2 < x < 12$

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5. If $\sum_{n=0}^{\infty} \frac{3x^n}{n!}$ is a Taylor series that converges to $f(x)$ for all real x, then what is $f''(0)$?

(A) $\frac{3}{4}$

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(C) 3

(D) 6

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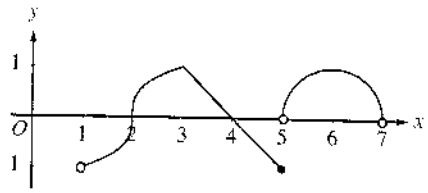

6. The function f, whose graph is shown in the figure above, is defined on the open interval $(1, 7)$. It has a vertical tan when $x = 2$ and a horizontal tangent when $x = 6$. For what values of x, $1 < x < 7$, is f not differentiable?

(A) 2 only

(B) 3 and 5 only

(C) 5 and 6 only

(D) 2, 3, and 5 only

(E) 2, 3, 5, and 6 only

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7. A particle moves along a plane curve so that at any time $t > 0$ its x-coordinate is $\cos 2t$ and its y-coordinate is $\sin 3t$ At $t = \frac{\pi}{2}$ the acceleration vector of the particle is

(A) $(-1, -1)$

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8. $\displaystyle\int \frac{dx}{x^2 - 5x + 6} =$

(A) $2 \ln \left| \frac{x-2}{x-3} \right| + C$

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(C) $\ln \left| \frac{x-3}{x-2} \right| + C$

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9. For what values of x does the series $\displaystyle\sum_{n=1}^{\infty} \frac{(2x+1)^n}{\sqrt[3]{n^4}}$ converge?

(A) $-1 \leq x \leq 1$

(B) $-1 < x < 0$

(C) $-1 \leq x < 0$

(D) $-1 \leq x \leq 0$

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GO ON TO THE NEXT PAGE

10. $\int_0^\infty xe^{-x^2}\,dx$ is

(A) -1

(B) $-\frac{1}{2}$

(C) 0

(D) $\frac{1}{2}$

(E) divergent

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11. If f is a vector-valued function defined by $f(t) = (e^{2t}, \ln t)$, then $f'''(t) =$

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(B) $8e^{2t} - \frac{2}{t^3}$

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12. $\lim_{x \to 2} \dfrac{\int_2^x e^{t-2}\,dt}{x^2 - 4}$ is

(A) $\dfrac{e^{-2}}{2}$

(B) $\dfrac{1}{4}$

(C) $\dfrac{1}{2}$

(D) e^2

(E) nonexistent

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13. The length of the path described by the parametric equations $x(t) = t^2 + 1$ and $y(t) = \cos t$, where $0 \le t \le 2$, is given by

(A) $\displaystyle\int_0^2 2t \cos t\,dt$

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(C) $\displaystyle\int_0^2 \sqrt{4t^2 - \sin^2 t}\,dt$

(D) $\displaystyle\int_0^2 2t \sin t\,dt$

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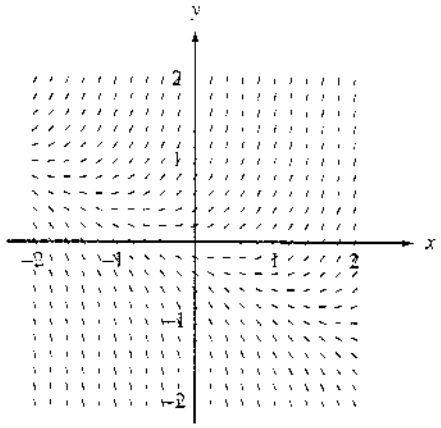

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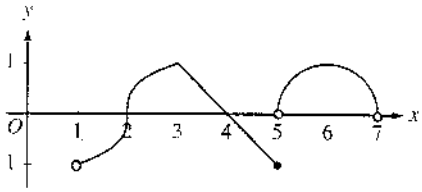

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(B) $\ln\left|\dfrac{x-2}{x-3}\right|-C$

(C) $\ln\left|\dfrac{x-3}{x-2}\right|+C$

(D) $\dfrac{1}{2}\ln\left|\dfrac{x-2}{x-3}\right|+C$

(E) $\dfrac{1}{2}\ln\left|\dfrac{x-3}{x-2}\right|+C$

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9. For what values of x does the series $\displaystyle\sum_{n=1}^{\infty}\frac{(2x+1)^n}{\sqrt[3]{n^4}}$ converge?

(A) $-1 \le x \le 1$

(B) $-1 < x < 0$

(C) $-1 \le x < 0$

(D) $-1 \le x \le 0$

(E) $-1 \le x < 1$

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10. $\int_0^\infty xe^{-x^2}\,dx$ is

(A) -1

(B) $-\frac{1}{2}$

(C) 0

(D) $\frac{1}{2}$

(E) divergent

---

11. If f is a vector-valued function defined by $f(t) = (e^{2t}, \ln t)$, then $f'''(t) =$

(A) $\frac{4e^{2t}}{t^3}$

(B) $8e^{2t} - \frac{2}{t^3}$

(C) $(e^{2t}, -\frac{2}{t^3})$

(D) $(4e^{2t}, -\frac{1}{t^2})$

(E) $(8e^{2t}, \frac{2}{t^3})$

---

12. $\lim_{x \to 2} \dfrac{\int_2^x e^{t-2}\,dt}{x^2 - 4}$ is

(A) $\dfrac{e^{-2}}{2}$

(B) $\dfrac{1}{4}$

(C) $\dfrac{1}{2}$

(D) e^2

(E) nonexistent

---

13. The length of the path described by the parametric equations $x(t) = t^2 + 1$ and $y(t) = \cos t$, where $0 \le t \le 2$, is given by

(A) $\displaystyle\int_0^2 2t \cos t\,dt$

(B) $\displaystyle\int_0^2 \sqrt{(t^2-1)^2 + \cos^2 t}\,dt$

(C) $\displaystyle\int_0^2 \sqrt{4t^2 - \sin^2 t}\,dt$

(D) $\displaystyle\int_0^2 2t \sin t\,dt$

(E) $\displaystyle\int_0^2 \sqrt{4t^2 - \sin^2 t}\,dt$

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14. The population $P(t)$ of butterflies in a particular location satisfies the logistic differential equation $\frac{dP}{dt} = P\left(4 - \frac{P}{200}\right)$. If the initial population at $t = 0$ is $P(0) = 300$ and t is the time in months, what is $\lim_{t \to \infty} P(t)$?

(A) 50

(B) 200

(C) 500

(D) 800

(E) 1100

---

15. The area of the region inside the polar curve $r = 2\cos\theta$ and outside the polar curve $r = \sqrt{3}$ is given by

(A) $\frac{1}{2}\int_{-\frac{\pi}{6}}^{\frac{\pi}{6}} (4\cos^2\theta - 3)\, d\theta$

(B) $\frac{1}{2}\int_{\frac{\pi}{6}}^{\frac{11\pi}{6}} (4\cos^2\theta - 3)\, d\theta$

(C) $\frac{1}{2}\int_{-\frac{\pi}{6}}^{\frac{\pi}{6}} (2\cos\theta - \sqrt{3})^2\, d\theta$

(D) $\int_{\frac{\pi}{6}}^{\frac{5\pi}{6}}$

16. If $\frac{d}{dx}f(x) = \tan^2 x$ and $g(x) = e^x$, then $\frac{d}{dx}f(g(x)) =$

(A) $\tan^2(e^x)$

(B) $e^x \tan^2(e^x)$

(C) $2e^x \tan(e^x)$

(D) $2e^x \tan(e^x)\sec^2(e^x)$

(E) $e^x \tan^2 x$

---

17. If $\frac{dy}{dx} = -2xy^2$ and if $y = 3$ when $x = 1$, what is the value of y when $x = 3$?

(A) $-\frac{3}{23}$

(B) $-\frac{1}{9}$

(C) $\frac{3}{28}$

(D) $\frac{1}{9}$

(E) $\frac{3}{25}$

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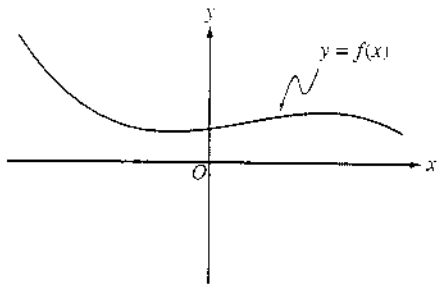
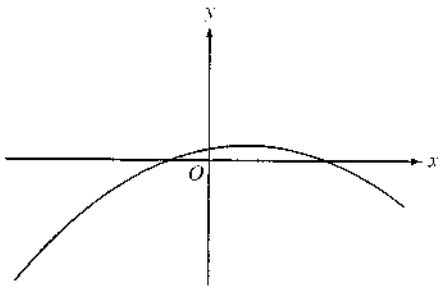


18. The graph of the function $f(x)$ is shown above. Which of the following could be the graph of $y = f'(x)$?

(A)



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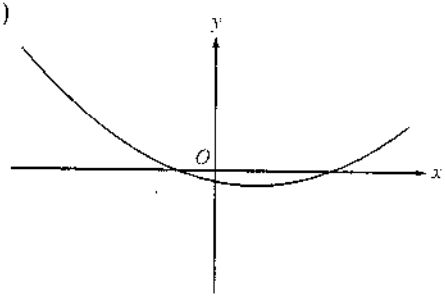

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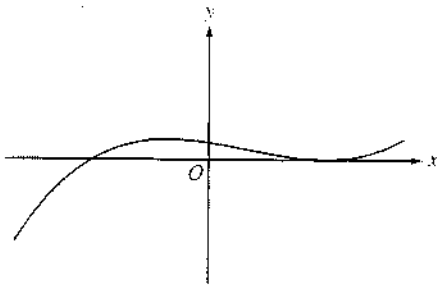

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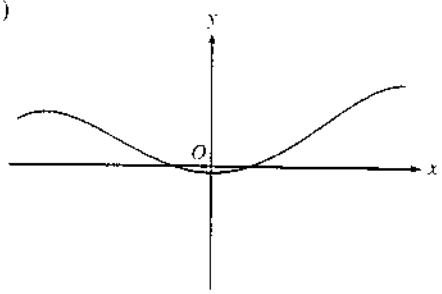
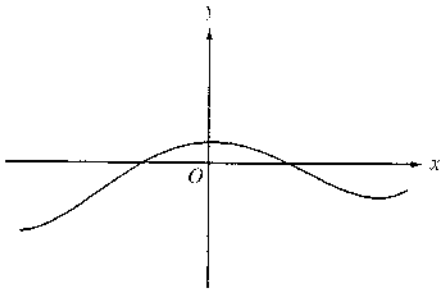


(E)



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19. The slope of the line tangent to the curve $x^2y + (y^3 + 1)^2 = 8$ at the point $(-2, 1)$ is

(A) $-\frac{1}{2}$

(B) $-\frac{1}{4}$

(C) 0

(D) $\frac{1}{4}$

(E) $\frac{1}{2}$

---

20. The volume of a sphere of radius r is given by $V = \frac{4}{3}\pi r^3$. The surface area of a sphere of radius r is given by $A = 4\pi r^2$.

For what radius r will the rate of change of the volume be numerically equal to the rate of change of the surface area?

(A) 1

(B) 2

(C) 3

(D) 4

(E) 6

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21. If f is the function given by

$$f(x) = \begin{cases} e^2 x, & x < 0 \\ \cos x + 1, & x \geq 0 \end{cases}$$

then $\lim_{x \to 0} f(x)$ is

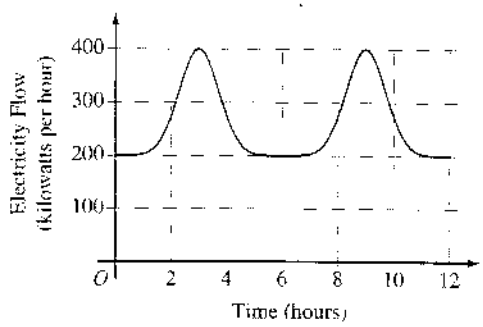
(A) 0

(B) 1

(C) 2

(D) 3

(E) nonexistent



22. The flow of electricity, in kilowatts per hour, through an electric meter is shown in the graph above. Which of the followi best approximates the amount of electricity that passed through the meter over the twelve-hour period?

(A) 600 kilowatts

(B) 1250 kilowatts

(C) 2400 kilowatts

(D) 3000 kilowatts

(E) 4500 kilowatts

---

23. Which of the following is the approximation for $\cos 0.1$ using the first three nonzero terms of a Maclaurin series?

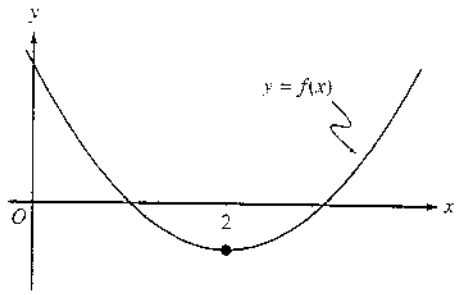
(A) $1 - 0.1 + \frac{0.01}{2}$

(B) $0.1 - \frac{0.001}{6} + \frac{0.00001}{120}$

(C) $0.1 - \frac{0.01}{2} + \frac{0.001}{4}$

(D) $1 - \frac{0.01}{2} + \frac{0.0001}{24}$

(E) $0.1 - \frac{0.001}{3} + \frac{0.00001}{5}$



24. The graph of the twice differentiable function $f(x)$ is shown in the figure above. Which of the following statements is tru

(A) $f(2) < f'(2) < f''(2)$

(B) $f(2) < f''(2) < f'(2)$

(C) $f'(2) < f(2) < f''(2)$

(D) $f'(2) < f''(2) < f(2)$

(E) $f''(2) < f(2) < f'(2)$

25. If f is the function defined by $f(x) = 2x^6 - 5x^4 + 2x$, what are all the x-coordinates of points of inflection on the graph of f?

(A) -1

(B) 0

(C) 1

(D) -1 and 1

(E) -1, 0, and 1

---

26. $\int x \sec^2 x \, dx =$

(A) $x \tan x - \ln|\sec x| - C$

(B) $x \tan x - \sec^2 x + C$

(C) $x \tan x - \frac{1}{2} \tan^2 x + C$

(D) $\frac{1}{2} x^2 \tan x + C$

(E) $\frac{1}{2} \tan^2 x + C$

---

time (seconds)	0	15	30	45	60
velocity (feet per second)	6	10	8	7	4

27. The table above gives values for the velocity of a particle at certain times t between $t = 0$ and $t = 60$. The approximati of the total distance traveled by the particle during the time period $0 \le t \le 60$, computed using a right-hand Riemann s with four equal subintervals, is

(A) 29 feet

(B) 435 feet

(C) 450 feet

(D) 465 feet

(E) 525 feet

28. If the series $\sum_{n=1}^{\infty} n^p$ converges, which of the following is false?

(A) $p < 1$

(B) $\sum_{n=1}^{\infty} n^{-p}$ converges.

(C) $\int_1^{\infty} x^p \, dx$ is finite.

(D) $\int_1^{\infty} x^{p-1} \, dx$ is finite.

(E) $\int_1^{\infty} x^{p-2} \, dx$ is finite.

END OF PART A OF SECTION I

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS PART ONLY.
DO NOT GO ON TO PART B UNTIL YOU ARE TOLD TO DO SO.