1) Find

$$\int_{1}^{9} \frac{5}{\sqrt{x}}\, dx$$

a) 30
b) 10
c) 89
d) 90
e) 20

2) If

$$f'(x) = -4\,(x-5)^2\,(x-10)$$

which of the following is true about $y = f(x)$?

a) f has a local minimum at $x = 5$ and a point of inflection at $x = 10$.
b) f has a local minimum at $x = 5$ and a local maximum at $x = 10$.
c) f has a point of inflection at $x = 5$ and a local minimum at $x = 10$.
d) f has a point of inflection at $x = 5$ and a local maximum at $x = 10$.
e) f has a local maximum at $x = 5$ and a local minimum at $x = 10$.

3) A curve is described by parametric equations

$$[x = 4\ln(t),\ y = t^2 - 5]$$

where $t > 0$. Give an expression for

$$\frac{\partial^2}{\partial x^2} y$$

a) $\frac{1}{2}t$
b) $\frac{1}{4}t$
c) $\frac{1}{2}t^2$
d) $\frac{1}{4}t^2$
e) t

4) Give the value for

$$\lim_{x \to 0} \left(\frac{1}{7} \frac{3^x - 1}{x} \right)$$

a) 0
b) $\frac{1}{7}\ln(3)$
c) 1
d) $7\ln(3)$
e) *The limit does not exist.*

5) Which of the following series converge?

I.

$$\sum_{n=1}^{\infty} \frac{\sin(n)}{n!}$$

II.

$$\sum_{n=1}^{\infty} \frac{x^{2n}}{n!}$$

III.

$$\sum_{n=1}^{\infty} \frac{1}{n(n+1)}$$

a) I and II only
b) II only
c) II and III only
d) I only
e) I, II and III

6) If $g(f(x)) = x$, $g(4) = 2$ and $g'(4) = 11$, then $f'(2)$ is

a) $\frac{4}{11}$
b) $\frac{1}{4}$
c) $-\frac{1}{4}$
d) $\frac{1}{11}$
e) $-\frac{1}{11}$

7) If f is a differentiable function and $f(0) = -2$ and $f(5) = 4$, then which of the following must be true?

I. There exists a c in [0,5] where $f(c) = 0$.
II. There exists a c in [0,5] where $f'(c) = 0$.
III. There exists a c in [0,5] where $f'(c) = 6/5$.

a) II only
b) I only
c) I and III only
d) II and III only
e) I, II and III

8) Evaluate

$$\int_{-2}^{2} \frac{3}{x^2}\, dx$$

a) *The integral diverges.*
b) 0
c) $\frac{1}{4}$

d) $\frac{1}{2}$

e) $\frac{1}{8}$

9) Find the area enclosed by the graphs of

$$y = e^x + 1$$
$$y = 8$$

and the *y*-axis.

a) $24\ln(2) + 8$

b) $24\ln(2) - 8$

c) $7\ln(7) - 6$

d) $8\ln(7) + 7$

e) $8\ln(7) - 7$

10) What is the minimum value of the function

$$f(x) = \frac{6}{\sqrt{x}} + 4\sqrt{x}$$

a) $4\sqrt{6}$

b) $2\sqrt{6}$

c) $\frac{3}{2}$

d) $\frac{1}{2}\sqrt{6}$

e) $\sqrt{6}$

11) Give the value of

$$\int_{\pi}^{2\pi} \frac{\cos(3x)}{2 + \sin(3x)}\, dx$$

a) $-\frac{1}{3}$

b) $\frac{1}{3}$

c) $\frac{1}{6}$

d) 0

e) 1

12) The side of a cube is expanding at a constant rate of 5 inches per second. What is the rate of change of the surface area, in in^2 per second, when the volume of the cube is 64 in^3?

a) 60

b) 240

c) 120

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13) Give the area inside one petal of the polar graph of

$$r = 3\sin(2\theta)$$

a) $\frac{3}{2}$

b) $\frac{9}{2}\pi$

c) $\frac{9}{16}\pi$

d) $\frac{9}{8}\pi$

e) $\frac{9}{4}\pi$

14) Give the solution to the initial value problem

$$[y' = 6x^2 y, y(1) = 1]$$

a) $e^{2x^3 - 2}$

b) e^{2x^3}

c) $e^{2x^3} - 2$

d) $\frac{1}{2}\ln(x^3) + e$

e) $\frac{1}{2}\ln(x^3) + 1$

15) The position of a particle moving along a horizontal line is given by

$$x(t) = 4\,(t-2)^3$$

What is the maximum speed of the particle for $0 \le t \le 10$?

a) 48

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c) 768

d) 96

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16) $\int [\sec(5x)]^2\, dx =$

a) $-5\tan(5x) + C$

b) $5\tan(5x) + C$

c) $\frac{1}{5}\tan(5x) + C$

d) $5[\tan(5x)]^2 + C$

e) $\frac{1}{5}[\tan(5x)]^2 + C$

17) Define the function

$$f(x) = x\,e^{-6x}$$

for $x > 0$. Give the interval on which the function is increasing.

a) $(1, 6)$

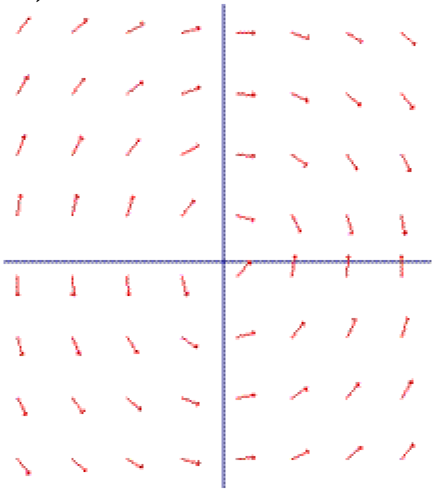
b) $\left(0, \frac{1}{6}\right)$

c) $\left(1, \frac{1}{6}e\right)$

d) $\left(0, \frac{1}{6} e\right)$

e) $(0, 6)$

18)



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a) $\frac{dy}{dx} = -\frac{x}{y}$

b) $\frac{dy}{dx} = \frac{y}{x}$

c) $\frac{dy}{dx} = -\frac{y}{x}$

d) $\frac{dy}{dx} = \frac{x}{y}$

e) $\frac{dy}{dx} = 3xy$

19) Evaluate

$$\lim_{h \to 0} \left(\frac{\cos(6x + 6h) - \cos(6x)}{h} \right)$$

a) $6 \sin(6x)$

b) $-6 \sin(6x)$

c) $6 \cos(6x)$

d) $-6 \cos(6x)$

e) *The limit does not exist.*

20) If $\int_0^9 e^x \, dx = m$ then $\int_0^3 x e^{x^2} \, dx$ is

a) m

b) $\frac{1}{2} m$

c) $2m$

d) m^2

e) $\frac{1}{2} m^2$

21) Find the area of the region enclosed by the graph of

$$y = 4x^2$$

and the line

$$y = 3x$$

a) $\frac{3}{32}$

b) $\frac{9}{16}$

c) $\frac{9}{32}$

d) $\frac{32}{27}$

e) $\frac{64}{27}$

22) Suppose

$$z = e^y$$
$$y = 5x^3 - 5$$

and

$$x = 1 + Ln(t^2)$$

What is dz/d*t* when *t* = 1?

a) 30

b) 5

c) 15

d) $\frac{15}{2}$

e) 20

23) Evaluate

$$\int_0^{\frac{1}{2}\pi} \cos^2(7x)\sin(7x)\,dx$$

a) $\frac{1}{21}$

b) $\frac{1}{7}$

c) $\frac{1}{42}$

d) $-\frac{1}{21}$

e) $-\frac{1}{42}$

24) Give an equation for the tangent line to the parametric curve

$$[x = e^t, y = t^2 + 3t]$$

at *t* = 0.

a) $y = 3x - 3$

b) $y = \frac{3(x-1)}{e}$

c) $y = 3e(x-1)$

d) $y-1=3x$

e) $y-1=3x-3$

25) Evaluate

$$\frac{\partial}{\partial x}\int_{5}^{8x}\ln(5t)\,dt$$

a) $8\ln(40x)-16\ln(5)$

b) $\frac{8}{5x}$

c) $5\ln(40x)$

d) $8\ln(8x)-16\ln(5)$

e) $8\ln(40x)$

26) The region bounded by

$$y=4\sin(x)$$

and the *x*-axis, for $0 \le x \le \frac{1}{2}\pi$, is rotated about the line $y = -3$. The volume of this solid can be represented by:

a) $\pi\int_{0}^{\frac{1}{2}\pi}\left((4\sin(x)+3)^2-9\right)dx$

b) $2\pi\int_{0}^{\frac{1}{2}\pi}\left(16\sin(x)^2+3\right)dx$

c) $\pi\int_{0}^{\frac{1}{2}\pi}\left(16\sin(x)^2-9\right)dx$

d) $2\pi\int_{0}^{\frac{1}{2}\pi}16\sin(x+3)^2\,dx$

e) $2\pi\int_{0}^{\frac{1}{2}\pi}(4\sin(x)+3)^2\,dx$

27) Give the third degree Taylor polynomial about $x = 1$ of

$$f(x)=\ln(x)$$

a) $(x-1)-\frac{1}{2}(x-1)^2+\frac{1}{6}(x-1)^3$

b) $(x-1)-\frac{1}{2}(x-1)^2+\frac{1}{3}(x-1)^3$

c) $(x-1)-\frac{1}{3}(x-1)^2+\frac{1}{5}(x-1)^3$

d) $(x-1)+\frac{1}{3}(x-1)^2+\frac{1}{3}(x-1)^3$

e) $(x-1)+(x-1)^2+2(x-1)^3$

28) Which of the following integrals gives the length of the graph of

$$f(x)=e^{4x}$$

for *x* between 0 and 2?

a) $\int_0^2 \sqrt{1 + e^{8x}}\, dx$

b) $\int_0^2 \sqrt{1 + 16\, e^{8x}}\, dx$

c) $\int_0^2 \sqrt{x + 16\, e^{8x}}\, dx$

d) $\int_0^2 \sqrt{x + e^{8x}}\, dx$

e) $\int_0^2 \sqrt{e^{4x} + 16\, e^{8x}}\, dx$

29) Find the average value of the function

$$f(x) = e^{6x}$$

over the interval [0, 4].

a) $\frac{1}{4}\left(e^{24} - 1\right)$

b) $\frac{1}{6}\left(e^{24} - 1\right)$

c) $\frac{1}{24}e^{24}$

d) $\frac{1}{6}e^{24}$

e) $\frac{1}{24}\left(e^{24} - 1\right)$

30) What is the *y*-intercept of the line tangent to the curve $y = x^2 + 7$ at $x = 3$?

a) $(0, 2)$

b) $(0, -11)$

c) $(0, 11)$

d) $(0, -2)$

e) $(0, 1)$

31) Which of the following function(s) is continuous and differentiable?

I. $f(x) = \frac{7}{\sqrt{x}}$

II. $g(x) = x\,|x|$

III. $h(x) = \begin{cases} 7x + 1 & x \leq 0 \\ x^2 + 1 & 0 < x \end{cases}$

a) I and III only

b) III only

c) I and II only

d) I only

e) II only

32) Find *m*

$$\lim_{x \to 0} \left(\frac{e^{m x^2} - \cos(8x)}{x^2} \right) = 64$$

a) 128

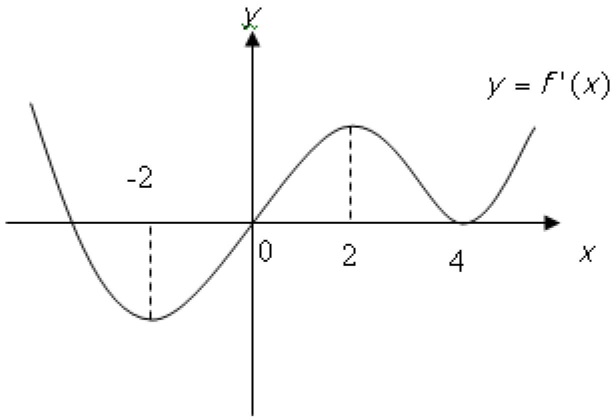
b) 32

c) 4

d) 16

e) 2

33) The graph of the derivative of *f* is shown below. Which of the following must be true?



a) f is concave down on [0, 4].
b) f is increasing on [-2, 2].
c) f has a local maximum at x = 0.
d) f has a local minimum at x = -2.
e) f has a point of inflection at x = 4.
34) The sum of two positive integers x and y is 60. Find the value of x that minimizes

$$P = x^3 - 60\,x\,y$$

a) $x = 40$
b) $x = 10$
c) $x = 50$
d) $x = 20$
e) $x = 30$
35) A particle moves on the curve

$$[x = 7\sin(t),\ y = \sin(2\,t)]$$

find the speed of the particle at time $t = \pi$.
a) 7.1414
b) 6.7082
c) 7.2801
d) 3.3166
e) 3.0000
36) The function f is defined as

$$f(x) = \frac{(x-3)^2}{x-6}$$

$$x \neq 6$$

Which of the following is **false**?
a) f has a horizontal asymptote at y = 1.
b) f has a vertical asymptote at x = 6.
c) f is decreasing on [3, 6].
d) f has a local maximum at x = 3.
e) f is concave up for x > 6.
37) A particle is moving along the x-axis and its position at time $t \geq 0$ is given by

$$S(t) = (t-2)^2\,(t-6)$$

Which of the following is (are) true?
I. The particle changes direction at x = 2 and x = 6.

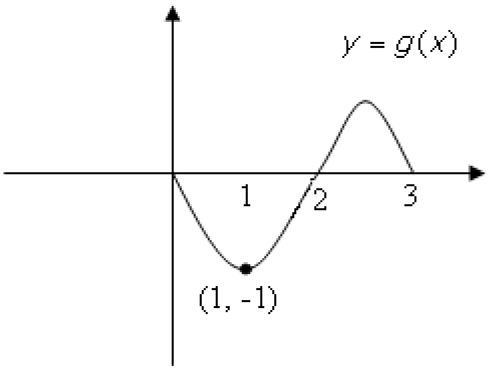
II. The particle is slowing down on [0, 2].
III. The particle is speeding up on [2, 6].
a) II and III only
b) I only
c) II only
d) I and III only
e) I, II and III
38) $f\,(x)$ is a differentiable function and it is decreasing on ($-\infty$, ∞).
If

$$g(x) = f\left(4x^3 - x^2\right)$$

then g has a local maximum at
a) $x = \frac{1}{6}$
b) $x = 0$
c) $x = 1$
d) $x = 2$
e) $x = \frac{1}{2}$
39) The rate at which a bacteria population grows is proportional to the number of bacteria present. Initially, there were 1000 bacteria present and the population doubled in 5 hours. Roughly how many hours does it take for the population to reach 10000?
a) 14.5
b) 26.0
c) 11.0
d) 16.5
e) 20.5
40) Find the radius of convergence of the series

$$\sum_{n=1}^{\infty} \frac{n\,(5x-1)^n}{2^n}$$

a) $\frac{5}{2}$
b) $\frac{2}{5}$
c) 2
d) $\frac{1}{5}$
e) $\frac{1}{2}$

41) 

$$g(x) = \int_0^x f(t)\, dt$$
for $0 \le x \le 3$

The graph of *g* is shown above. Which of the following must be true?

I. $\int_0^3 f(t)\, dt = 0$

II. $\int_1^2 f(t)\, dt = 1$

III. $\int_2^0 f(t)\, dt = -1$

a) II and III only
b) II only
c) I and III only
d) I and II only
e) I only

42) If the region bounded by $y = \tan^{-1}(x)$, $y = \frac{1}{4}\pi$ and the *y*-axis is rotated about the *y*-axis, the volume of the solid formed is

a) 0.674
b) 0.215
c) 1.348
d) 0.430
e) 0.413

43) $f(x)$ is represented by the Maclaurin series

$$1 - \frac{(2x)^2}{2!} + \frac{(2x)^4}{4!} - \ldots + (-1)^n \frac{(2x)^{2n}}{(2n)!} + \ldots$$

What is the slope of the line normal to the graph of *f* at $x = \frac{11}{4}\pi$?

a) 0

b) $\frac{1}{2}$

c) $-\frac{1}{2}$

d) 2

e) -2

44) What are all values of *h* for which

$$\int_0^{\infty} \frac{10\,x}{\left(x^2+1\right)^h}\,dx$$

converge?

a) $h \geq 1$
b) $h < 1$
c) $h > 1$
d) $h \leq 1$
e) $-1 < h < 1$

45) The base of a solid is the region bounded by

$$y = 7\sqrt{x}$$

the *x*-axis, and

the line $x = 7$

Each cross-section of the solid perpendicular to the *x*-axis is a square, with one side on the *xy*-plane. Which of the following expressions represents the volume of the solid?

a) $\int_0^7 7\sqrt{x}\,dx$
b) $\int_0^7 49\,x\,dx$
c) $\int_0^7 7\,x\,dx$
d) $\int_0^1 49\,x\,dx$
e) $\int_0^1 7\sqrt{x}\,dx$

1) Find

$$\int_1^9 \frac{5}{\sqrt{x}}\, dx$$

a) 30
b) 10
c) 89
d) 90
*e) 20
2) If

$$f'(x) = -4\,(x-5)^2\,(x-10)$$

which of the following is true about $y = f(x)$?
a) f has a local minimum at $x = 5$ and a point of inflection at $x = 10$.
b) f has a local minimum at $x = 5$ and a local maximum at $x = 10$.
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e) t
4) Give the value for

$$\lim_{x \to 0} \left(\frac{1}{7} \frac{3^x - 1}{x} \right)$$

a) 0
*b) $\frac{1}{7} \ln(3)$
c) 1
d) $7 \ln(3)$
e) *The limit does not exist.*
5) Which of the following series converge?

I.

$$\sum_{n=1}^{\infty} \frac{\sin(n)}{n!}$$

II.

$$\sum_{n=1}^{\infty} \frac{x^{2n}}{n!}$$

III.

$$\sum_{n=1}^{\infty} \frac{1}{n(n+1)}$$

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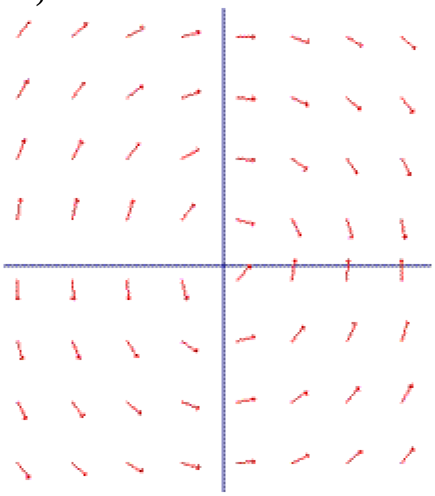

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c) $\pi\int_{0}^{\frac{1}{2}\pi}\left(16\sin(x)^2-9\right)dx$
d) $2\pi\int_{0}^{\frac{1}{2}\pi}16\sin(x+3)^2\,dx$
e) $2\pi\int_{0}^{\frac{1}{2}\pi}(4\sin(x)+3)^2\,dx$
27) Give the third degree Taylor polynomial about $x = 1$ of

$$f(x)=\ln(x)$$

a) $(x-1)-\frac{1}{2}(x-1)^2+\frac{1}{6}(x-1)^3$
*b) $(x-1)-\frac{1}{2}(x-1)^2+\frac{1}{3}(x-1)^3$
c) $(x-1)-\frac{1}{3}(x-1)^2+\frac{1}{5}(x-1)^3$
d) $(x-1)+\frac{1}{3}(x-1)^2+\frac{1}{3}(x-1)^3$
e) $(x-1)+(x-1)^2+2(x-1)^3$
28) Which of the following integrals gives the length of the graph of

$$f(x)=e^{4x}$$

for x between 0 and 2?

a) $\int_0^2 \sqrt{1 + e^{8x}}\, dx$

*b) $\int_0^2 \sqrt{1 + 16\, e^{8x}}\, dx$

c) $\int_0^2 \sqrt{x + 16\, e^{8x}}\, dx$

d) $\int_0^2 \sqrt{x + e^{8x}}\, dx$

e) $\int_0^2 \sqrt{e^{4x} + 16\, e^{8x}}\, dx$

29) Find the average value of the function

$$f(x) = e^{6x}$$

over the interval [0, 4].

a) $\frac{1}{4}\left(e^{24}-1\right)$

b) $\frac{1}{6}\left(e^{24}-1\right)$

c) $\frac{1}{24}e^{24}$

d) $\frac{1}{6}e^{24}$

*e) $\frac{1}{24}\left(e^{24}-1\right)$

30) What is the y-intercept of the line tangent to the curve $y = x^2 + 7$ at $x = 3$?

a) $(0, 2)$

b) $(0, -11)$

c) $(0, 11)$

*d) $(0, -2)$

e) $(0, 1)$

31) Which of the following function(s) is continuous and differentiable?

I. $f(x) = \frac{7}{\sqrt{x}}$

II. $g(x) = x\,|x|$

III. $h(x) = \begin{cases} 7x + 1 & x \le 0 \\ x^2 + 1 & 0 < x \end{cases}$

a) I and III only

b) III only

c) I and II only

*d) I only

e) II only

32) Find m

$$\lim_{x \to 0} \left(\frac{e^{m x^2} - \cos(8x)}{x^2} \right) = 64$$

a) 128

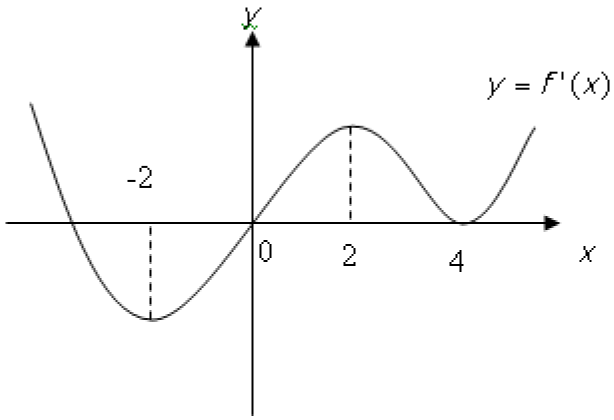
*b) 32

c) 4

d) 16

e) 2

33) The graph of the derivative of f is shown below. Which of the following must be true?



a) f is concave down on [0, 4].
b) f is increasing on [-2, 2].
c) f has a local maximum at $x = 0$.
d) f has a local minimum at $x = -2$.
*e) f has a point of inflection at $x = 4$.
34) The sum of two positive integers x and y is 60. Find the value of x that minimizes

$$P = x^3 - 60\,x\,y$$

a) $x = 40$
b) $x = 10$
c) $x = 50$
*d) $x = 20$
e) $x = 30$
35) A particle moves on the curve

$$[x = 7\sin(t), y = \sin(2\,t)]$$

find the speed of the particle at time $t = \pi$.
a) 7.1414
b) 6.7082
*c) 7.2801
d) 3.3166
e) 3.0000
36) The function f is defined as

$$f(x) = \frac{(x-3)^2}{x-6}$$

$$x \neq 6$$

Which of the following is **false**?
*a) f has a horizontal asymptote at $y = 1$.
b) f has a vertical asymptote at $x = 6$.
c) f is decreasing on [3, 6].
d) f has a local maximum at $x = 3$.
e) f is concave up for $x > 6$.
37) A particle is moving along the x-axis and its position at time $t \geq 0$ is given by

$$S(t) = (t-2)^2\,(t-6)$$

Which of the following is (are) true?
I. The particle changes direction at $x = 2$ and $x = 6$.

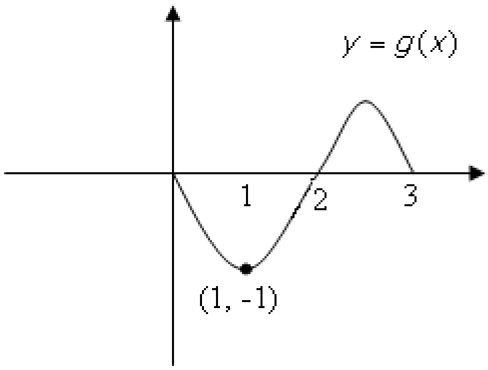
II. The particle is slowing down on [0, 2].
III. The particle is speeding up on [2, 6].
a) II and III only
b) I only
*c) II only
d) I and III only
e) I, II and III
38) $f(x)$ is a differentiable function and it is decreasing on $(-\infty, \infty)$.
If

$$g(x) = f(4x^3 - x^2)$$

then g has a local maximum at
*a) $x = \frac{1}{6}$
b) $x = 0$
c) $x = 1$
d) $x = 2$
e) $x = \frac{1}{2}$
39) The rate at which a bacteria population grows is proportional to the number of bacteria present. Initially, there were 1000 bacteria present and the population doubled in 5 hours. Roughly how many hours does it take for the population to reach 10000?
a) 14.5
b) 26.0
c) 11.0
*d) 16.5
e) 20.5
40) Find the radius of convergence of the series

$$\sum_{n=1}^{\infty} \frac{n\,(5x-1)^n}{2^n}$$

a) $\frac{5}{2}$
*b) $\frac{2}{5}$
c) 2
d) $\frac{1}{5}$
e) $\frac{1}{2}$

41) 

$$g(x) = \int_0^x f(t)\,dt$$
for $0 \le x \le 3$

The graph of *g* is shown above. Which of the following must be true?

I. $\int_0^3 f(t)\,dt = 0$

II. $\int_1^2 f(t)\,dt = 1$

III. $\int_2^0 f(t)\,dt = -1$

a) II and III only
b) II only
c) I and III only
*d) I and II only
e) I only

42) If the region bounded by $y = \tan^{-1}(x)$, $y = \frac{1}{4}\pi$ and the *y*-axis is rotated about the *y*-axis, the volume of the solid formed is
*a) 0.674
b) 0.215
c) 1.348
d) 0.430
e) 0.413

43) $f(x)$ is represented by the Maclaurin series

$$1-\frac{(2x)^2}{2!}+\frac{(2x)^4}{4!}-\ldots+(-1)^n\frac{(2x)^{2n}}{(2n)!}+\ldots$$

What is the slope of the line normal to the graph of *f* at $x = \frac{11}{4}\pi$?

a) 0

b) $\frac{1}{2}$

*c) $-\frac{1}{2}$

d) 2

e) -2

44) What are all values of *h* for which

$$\int_0^{\infty} \frac{10\,x}{\left(x^2+1\right)^h}\,dx$$

converge?

a) $h \geq 1$

b) $h < 1$

*c) $h > 1$

d) $h \leq 1$

e) $-1 < h < 1$

45) The base of a solid is the region bounded by

$$y = 7\sqrt{x}$$

the *x*-axis, and

the line $x = 7$

Each cross-section of the solid perpendicular to the *x*-axis is a square, with one side on the *xy*-plane. Which of the following expressions represents the volume of the solid?

a) $\int_0^7 7\sqrt{x}\,dx$

*b) $\int_0^7 49\,x\,dx$

c) $\int_0^7 7\,x\,dx$

d) $\int_0^1 49\,x\,dx$

e) $\int_0^1 7\sqrt{x}\,dx$