1) Find

$$\lim_{h \to 0} \left(\frac{\sin(7x + 7h) - \sin(7x)}{h} \right)$$

a) $-7\cos(7x)$
b) $7\sin(7x)$
c) 0
d) $-7\sin(7x)$
e) $7\cos(7x)$

2) The function *g* is defined by the formula

$$g(x) = \int_0^x e^{5t}\,dt$$

Find the slope of the tangent line at *x* = 1.

a) $e^5 - 1$
b) $\frac{1}{5}e^5$
c) $\frac{1}{5}(e^5 - 1)$
d) e^5
e) $5e^5$

3) Find

$$\lim_{x \to \infty} \left(\frac{5x - 4}{\sqrt{x^2 + 12}} \right)$$

a) The limit does not exist.
b) 1
c) $-\frac{1}{3}$
d) 5
e) $\frac{5}{12}$

4) The given function *f* has a removable discontinuity at *x* = -4. Find *A*.

$$f(x) = \begin{cases} 5x^2 + 8 & x < -4 \\ 8x & x = -4 \\ Ax + 8 & -4 < x \end{cases}$$

a) -4
b) -20
c) 4
d) -12
e) -3

5) If *f* ' (*x*) = $-6(x-3)^2(x-9)$ which of the following is true about *y* = *f* (*x*)?

a) *f* has a point of inflection at *x* = 3 and a local minimum at *x* = 9.
b) *f* has a local maximum at *x* = 3 and a local minimum at *x* = 9.
c) *f* has a local minimum at *x* = 3 and a local maximum at *x* = 9.
d) *f* has a local minimum at *x* = 3 and a point of inflection at *x* = 9.
e) *f* has a point of inflection at *x* = 3 and a local maximum at *x* = 9.

6) Find *f* ' (4), given that

$$f(x) = 2x^2 + 5\sqrt{x}$$

a) $\frac{37}{2}$
b) 42
c) 26
d) $\frac{69}{4}$
e) 52

7) Find the average value of the given function *f* over the interval [0, 4].

$$f(x) = e^{5x}$$

a) $\frac{1}{20} e^{20}$
b) $\frac{1}{5} (e^{20} - 1)$
c) $\frac{1}{20} (e^{20} - 1)$
d) $\frac{1}{4} (e^{20} - 1)$
e) $\frac{1}{5} e^{20}$

8) Find *f* ' (0), given that

$$f(x) = 5^x \ln(2 e^x)$$

a) $\ln(5)\ln(2) + 1$
b) 1
c) $\ln(2) + 1$
d) $\ln(5)\ln(2) + 5$
e) $\ln(10) + 1$

9) Find *f* ' (1), given that

$$f(x) = \frac{x^2 + 8}{(7x)}$$

a) $-\frac{1}{49}$
b) $\frac{15}{49}$
c) -1
d) $\frac{15}{7}$
e) $\frac{16}{7}$

10) Find

$$\lim_{x \to 0} \left(\frac{\sin(2x)\cos(x) - \sin(2x)}{x^2} \right)$$

a) 0
b) 2
c) -2
d) 1
e) The limit does not exist.

11) Given the following curve, find $\frac{d^2y}{dx^2}$.

$$9x + y^2 = 18$$

a) $\frac{81}{2y^3}$
b) $-\frac{9}{2y^2}$
c) $\frac{81}{4y^3}$
d) $-\frac{81}{4y^3}$
e) $\frac{9}{2y^2}$

12) Given that $f(x) = 6\sin^2(5x)$, find $f''\left(\frac{1}{30}\pi\right)$.

a) 0
b) 150
c) $30\sqrt{2}$
d) 30
e) $30\sqrt{3}$

13) Find the midpoint rectangular approximation for $\int_0^3 6x^3\,dx$ using 3 subintervals of equal length.

a) $\frac{75}{4}$
b) $\frac{459}{2}$
c) 432
d) $\frac{459}{4}$
e) 216

14) Find the derivative of the function $y = \cos^{-1}(4x)$.

a) $-\frac{4}{\sqrt{1-16x^2}}$
b) $\frac{4}{\sqrt{1+16x^2}}$
c) $-4\sin(4x)$
d) $4\sin(4x)$
e) $-4\sin^{-1}(4x)$

15) Find

$$\frac{\partial}{\partial x}\left(\int_5^x \ln(8+t)\,dt\right)$$

a) $5\ln(8+x)$
b) $-\ln(8+x)$

c) $\ln(8 + x)$

d) $\dfrac{1}{8 + x}$

e) $\dfrac{5}{8 + x}$

16) Find the equation of the tangent line to the given curve at the point (0, 7).

$$y = 3x^2 + 6x + 7$$

a) $y = 7x + 3$

b) $y = 6x - 7$

c) $y = 6x + 7$

d) $y = -3x + 7$

e) $y = 12x$

17) If $g(f(x)) = x$, $g(7) = 2$ and $g'(7) = 10$, then $f'(2)$ is

a) $-\dfrac{1}{10}$

b) $\dfrac{1}{10}$

c) $\dfrac{1}{7}$

d) $-\dfrac{1}{7}$

e) $\dfrac{7}{10}$

18) Given that $\displaystyle\int_0^4 e^x \, dx = m$

find $\displaystyle\int_0^2 x\, e^{x^2} \, dx$

a) $\dfrac{1}{2} m$

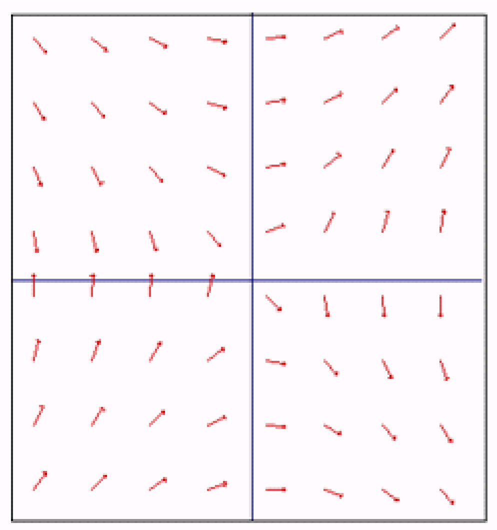
b) m

c) $2m$

d) m^2

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

19) Which of the following differential equations corresponds to the slope field shown in the figure below?



a) $\frac{dy}{dx} = \frac{1}{4} x y$

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

c) $\frac{dy}{dx} = \frac{1}{8} x y$

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

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

20) Given the following function, with $x > 0$, on which interval is the function decreasing?

$$f(x) = \frac{x}{\ln(5x)}$$

a) $(1, 5e)$

b) $\left(0, \frac{1}{5}e\right)$

c) $\left(0, \frac{1}{5}\right)$

d) $(1, 5)$

e) $\left(1, \frac{1}{5}e\right)$

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

$$y = 2x^2$$

and

$$y = 4x$$

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

b) $\frac{16}{3}$

c) $\frac{8}{3}$

d) $\frac{1}{12}$

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

22) Find

$$\int_{1}^{4} \frac{6}{\sqrt{x}}\, dx$$

a) 12
b) 6
c) 47
d) 24
e) 48

23) The region bounded by the following graph

$$y = 3\sin(x)$$

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

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

24) The side of a cube is expanding at a constant rate of 3 inches per second. What is the rate of change of the volume, in in^3 per second, when the total surface area of the cube is 54 in^2?
a) 81
b) 27
c) 54
d) 9
e) 162

25) The solution to the differential equation

$$\frac{dy}{dx} = 8\,x\,y$$

with the initial condition $y(0) = 5$ is
a) $\ln(4x^2 + 5)$
b) $e^{4x^2} + 5$
c) $e^{4x^2} + 4$

d) $5\ln(4x^2)$

e) $5e^{4x^2}$

26) $\int \sec^2(4x)\,dx =$

a) $\frac{1}{4}\tan(4x) + C$

b) $4\tan(4x) + C$

c) $-4\tan(4x) + C$

d) $4\tan^2(4x) + C$

e) $\frac{1}{4}\tan^2(4x) + C$

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

$$x(t) = 3(t-4)^3$$

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

a) 108
b) 324
c) 144
d) 576
e) 48

28) Using the information below, find $\frac{dz}{dt}$ when $t = 0$.

$$z = \ln(y)$$
$$y = 4x^2 + 4$$
$$x = 3t + 1$$

a) 12

b) 3

c) 24

d) $\frac{3}{8}$

e) $\frac{3}{4}$

29) If f is a differentiable function and $f(0) = -4$ and $f(5) = 8$, 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 $f'(c) = 12/5$.

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

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

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

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

III. $h(x) = \begin{cases} 5x + 1 & x \leq 0 \\ x^2 + 1 & 0 < x \end{cases}$

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

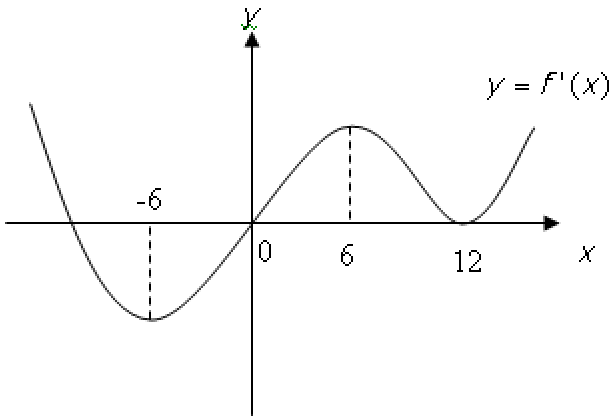
31) The area of the region in the first quadrant bounded by the graphs of $y = 7\cos(x)$, $y = 7\sin(x)$, and the y-axis is

a) $7\sqrt{2}$
b) 14
c) $7\sqrt{2} + 1$
d) $7\left(\sqrt{2} - 1\right)$
e) $\dfrac{7}{2}\sqrt{2}$

32) Air is pumped into a spherical balloon at a rate of 7cm^3 per second. At what rate is the radius of the sphere changing when its volume is 36π cm^3?

a) $\dfrac{7}{3\pi}$ cm/sec
b) $\dfrac{7}{36\pi}$ cm/sec
c) $\dfrac{7}{24\pi}$ cm/sec
d) $\dfrac{7}{9\pi}$ cm/sec
e) $\dfrac{7}{72\pi}$ cm/sec

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, 12].
b) f is increasing on [-6, 6].
c) f has a local maximum at $x = 0$.
d) f has a local minimum at $x = -6$.
e) f has a point of inflection at $x = 12$.
34) 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) I, II and III
b) II and III only
c) I and III only
d) II only
e) I only
35) The region enclosed by the graphs of

$$y = 3\,\mathrm{e}^x$$

and the line

$$y = 3$$

for $0 \leq x \leq 1$, is revolved about the y-axis. Which of the following integrals gives the volume generated?

a) $\pi \int_3^{3\mathrm{e}} \left(3 - \ln\left(\frac{1}{3}y\right)\right)^2 \mathrm{d}y$

b) $\pi \int_0^1 (3\,\mathrm{e}^x - 3)^2 \,\mathrm{d}x$

c) $\pi \int_3^{3\mathrm{e}} \left(1 - \left(\ln\left(\frac{1}{3}y\right)\right)^2\right) \mathrm{d}y$

d) $\pi \int_0^3 \left(1 - \ln\left(\frac{1}{3}y\right)\right)^2 \mathrm{d}y$

e) $\pi \int_3^{3\mathrm{e}} \left(1 - \ln\left(\frac{1}{3}y\right)\right)^2 \mathrm{d}y$

36) If

$$2x^2 + xy - \cos(y) = 5$$

then $\frac{dy}{dx}$ is

a) $-\frac{(y+4x)}{x+\sin(y)}$

b) $\frac{y-4x}{x-\sin(y)}$

c) $-\frac{4x}{x+\sin(y)}$

d) $\frac{y+x}{x-\sin(y)}$

e) $-\frac{(x+\sin(y))}{y+4x}$

37) The sum of two positive integers *x* and *y* is 150. Find the value of *x* that minimizes

$$P = x^3 - 150\,x\,y$$

a) $x = 25$

b) $x = 75$

c) $x = 50$

d) $x = 125$

e) $x = 100$

38) A particle moves along a straight line, and its velocity at time *t* is given by

$$v(t) = 6 - \ln(t)$$

What is the total distance the particle travels from *t* = 1 to *t* = e?

a) $6e - 7$

b) $6e - 1$

c) $6e + 1$

d) $6e + 6$

e) $e - 7$

39) The function *f* is defined as

$$f(x) = \frac{(x-4)^2}{x-7}$$

$$x \neq 7$$

Which of the following is **false**?

a) *f* is concave up for *x* > 7.

b) *f* is decreasing on [4, 7].

c) *f* has a local maximum at *x* = 4.

d) *f* has a horizontal asymptote at *y* = 1.

e) *f* has a vertical asymptote at *x* = 7.

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

$$y = 2\sqrt{x}$$

the *x*-axis, and

the line *x* = 2

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) $\int_0^2 2\sqrt{x}\,dx$

b) $\int_0^2 4x\,dx$

c) $\int_0^2 2x\,dx$

d) $\int_0^1 4x\,dx$

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

41) 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 6 hours. Roughly how many hours does it take for the population to reach 10000?

a) 17.4

b) 31.2

c) 13.2

d) 19.8

e) 24.6

42) Given that $F'(x) = f(x)$, find

$$\int_{-1}^{6} x f(x^2)\,dx$$

a) $\frac{F(36) - F(1)}{(2)}$

b) $6F(36) + F(1)$

c) $2F(\sqrt{6}) - 2F(\mathrm{I})$

d) $\frac{36F(36) - F(1)}{(2)}$

e) $2F(36) - 2F(1)$

43) The line normal to

$$3x^2 + 4y + y^2 = 3$$

at x = m is parallel to the *y*-axis. What is *m*?

a) 3

b) -2

c) 0

d) -3

e) 2

44) *f* and *g* are two differentiable functions such that

$$f(1) = g(1) = 3$$
$$f'(1) = g'(1) = 6$$

$f'(3) = 3$
$g'(3) = 6$

If $h(x) = (f \circ g)(x)$, then $h'(1)$ is

a) 9
b) 6
c) 18
d) 36
e) 1

45) If $\frac{dy}{dx} = ye^{x}$ and $y(0) = 3$, then $y\ln(2) =$

a) $3\,e^{2}$
b) $3\,e$
c) $3\,e^{3}$
d) $3\,e^{-2}$
e) $3\,e^{-1}$

1) Find

$$\lim_{h \to 0} \left(\frac{\sin(7x + 7h) - \sin(7x)}{h} \right)$$

a) $-7\cos(7x)$
b) $7\sin(7x)$
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2) The function *g* is defined by the formula

$$g(x) = \int_0^x e^{5t}\,dt$$

Find the slope of the tangent line at *x* = 1.
a) $e^5 - 1$
b) $\frac{1}{5} e^5$
c) $\frac{1}{5}(e^5 - 1)$
*d) e^5
e) $5e^5$
3) Find

$$\lim_{x \to \infty} \left(\frac{5x - 4}{\sqrt{x^2 + 12}} \right)$$

a) The limit does not exist.
b) 1
c) $-\frac{1}{3}$
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4) The given function *f* has a removable discontinuity at *x* = -4. Find *A*.

$$f(x) = \begin{cases} 5x^2 + 8 & x < -4 \\ 8x & x = -4 \\ Ax + 8 & -4 < x \end{cases}$$

a) -4
*b) -20
c) 4
d) -12
e) -3
5) If *f* ' (*x*) = $-6(x-3)^2(x-9)$ which of the following is true about *y* = *f* (*x*)?
a) *f* has a point of inflection at *x* = 3 and a local minimum at *x* = 9.
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c) $\ln(2) + 1$

d) $\ln(5)\ln(2) + 5$

e) $\ln(10) + 1$

9) Find *f* ' (1), given that

$$f(x) = \frac{x^2 + 8}{(7x)}$$

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$$\lim_{x \to 0} \left(\frac{\sin(2x)\cos(x) - \sin(2x)}{x^2} \right)$$

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e) $y=12x$

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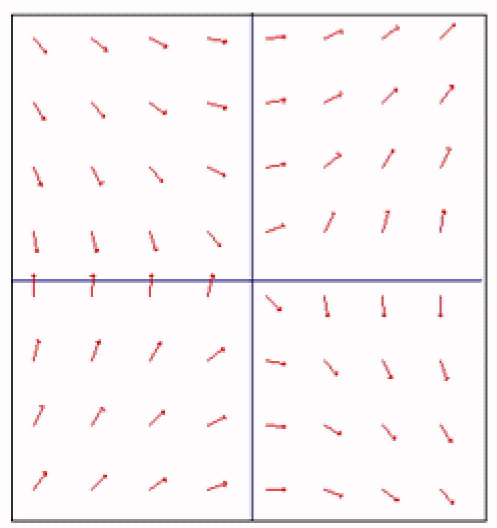

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c) $\frac{dy}{dx} = \frac{1}{8} x y$

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

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

20) Given the following function, with $x > 0$, on which interval is the function decreasing?

$$f(x) = \frac{x}{\ln(5\, x)}$$

a) $(1, 5\, e)$

*b) $\left(0, \frac{1}{5}\, e\right)$

c) $\left(0, \frac{1}{5}\right)$

d) $(1, 5)$

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c) $\pi \int_0^{\frac{1}{2}\pi} \left(9\sin(x)^2 - 4\right) dx$

d) $2\pi \int_0^{\frac{1}{2}\pi} 9\sin(x+2)^2\, dx$

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b) $e^{4x^2} + 5$
c) $e^{4x^2} + 4$

d) $5 \ln(4 x^2)$

*e) $5 e^{4 x^2}$

26) $\int \sec^2 (4 x)\, dx =$

*a) $\frac{1}{4} \tan(4 x) + C$

b) $4 \tan(4 x) + C$

c) $-4 \tan(4 x) + C$

d) $4 \tan^2 (4 x) + C$

e) $\frac{1}{4} \tan^2 (4 x) + C$

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d) $\frac{3}{8}$

e) $\frac{3}{4}$

29) If f is a differentiable function and $f(0) = -4$ and $f(5) = 8$, 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 $f\,'(c) = 12/5$.

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

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

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

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

III. $h(x) = \begin{cases} 5x + 1 & x \leq 0 \\ x^2 + 1 & 0 < x \end{cases}$

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

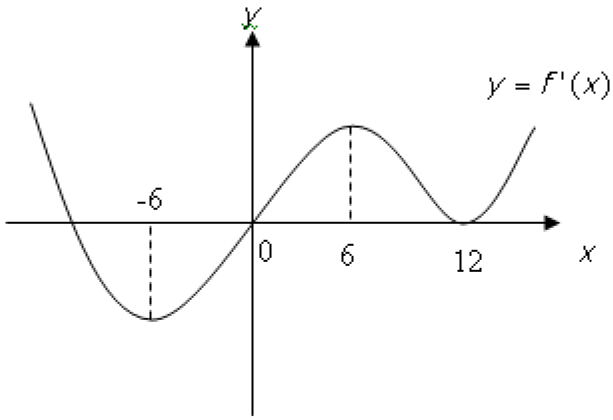
31) The area of the region in the first quadrant bounded by the graphs of $y = 7\cos(x)$, $y = 7\sin(x)$, and the y-axis is

a) $7\sqrt{2}$
b) 14
c) $7\sqrt{2} + 1$
*d) $7\left(\sqrt{2} - 1\right)$
e) $\dfrac{7}{2}\sqrt{2}$

32) Air is pumped into a spherical balloon at a rate of 7cm^3 per second. At what rate is the radius of the sphere changing when its volume is 36π cm^3?

a) $\dfrac{7}{3\pi}$ cm/sec
*b) $\dfrac{7}{36\pi}$ cm/sec
c) $\dfrac{7}{24\pi}$ cm/sec
d) $\dfrac{7}{9\pi}$ cm/sec
e) $\dfrac{7}{72\pi}$ cm/sec

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, 12].
b) f is increasing on [-6, 6].
c) f has a local maximum at $x = 0$.
d) f has a local minimum at $x = -6$.
*e) f has a point of inflection at $x = 12$.
34) 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) I, II and III
b) II and III only
c) I and III only
*d) II only
e) I only
35) The region enclosed by the graphs of

$$y = 3\,e^x$$

and the line

$$y = 3$$

for $0 \leq x \leq 1$, is revolved about the y-axis. Which of the following integrals gives the volume generated?

a) $\pi \int_3^{3e} \left(3 - \ln\left(\frac{1}{3}y\right)\right)^2 dy$

b) $\pi \int_0^1 (3\,e^x - 3)^2\, dx$

*c) $\pi \int_3^{3e} \left(1 - \left(\ln\left(\frac{1}{3}y\right)\right)^2\right) dy$

d) $\pi \int_0^3 \left(1 - \ln\left(\frac{1}{3}y\right)\right)^2 dy$

e) $\pi \int_3^{3e} \left(1 - \ln\left(\frac{1}{3}y\right)\right)^2 dy$

36) If

$$2x^2 + xy - \cos(y) = 5$$

then $\frac{dy}{dx}$ is

*a) $-\frac{(y + 4x)}{x + \sin(y)}$

b) $\frac{y - 4x}{x - \sin(y)}$

c) $-\frac{4x}{x + \sin(y)}$

d) $\frac{y + x}{x - \sin(y)}$

e) $-\frac{(x + \sin(y))}{y + 4x}$

37) The sum of two positive integers *x* and *y* is 150. Find the value of *x* that minimizes

$$P = x^3 - 150xy$$

a) $x = 25$

b) $x = 75$

*c) $x = 50$

d) $x = 125$

e) $x = 100$

38) A particle moves along a straight line, and its velocity at time *t* is given by

$$v(t) = 6 - \ln(t)$$

What is the total distance the particle travels from *t* = 1 to *t* = e?

*a) $6e - 7$

b) $6e - 1$

c) $6e + 1$

d) $6e + 6$

e) $e - 7$

39) The function *f* is defined as

$$f(x) = \frac{(x-4)^2}{x-7}$$

$$x \neq 7$$

Which of the following is **false**?

a) *f* is concave up for *x* > 7.

b) *f* is decreasing on [4, 7].

c) *f* has a local maximum at *x* = 4.

*d) *f* has a horizontal asymptote at *y* = 1.

e) *f* has a vertical asymptote at *x* = 7.

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

$$y = 2\sqrt{x}$$

the *x*-axis, and

the line *x* = 2

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) $\int_0^2 2\sqrt{x}\,dx$

*b) $\int_0^2 4x\,dx$

c) $\int_0^2 2x\,dx$

d) $\int_0^1 4x\,dx$

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

41) 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 6 hours. Roughly how many hours does it take for the population to reach 10000?

a) 17.4

b) 31.2

c) 13.2

*d) 19.8

e) 24.6

42) Given that $F'(x) = f(x)$, find

$$\int_{-1}^{6} x f(x^2)\,dx$$

*a) $\frac{F(36) - F(1)}{(2)}$

b) $6F(36) + F(1)$

c) $2F(\sqrt{6}) - 2F(\mathrm{I})$

d) $\frac{36F(36) - F(1)}{(2)}$

e) $2F(36) - 2F(1)$

43) The line normal to

$$3x^2 + 4y + y^2 = 3$$

at x = m is parallel to the *y*-axis. What is *m*?

a) 3

b) -2

*c) 0

d) -3

e) 2

44) *f* and *g* are two differentiable functions such that

$$f(1) = g(1) = 3$$
$$f'(1) = g'(1) = 6$$

$f'(3) = 3$
$g'(3) = 6$

If $h(x) = (f \circ g)(x)$, then $h'(1)$ is

a) 9

b) 6

*c) 18

d) 36

e) 1

45) If $\frac{dy}{dx} = ye^{x}$ and $y(0) = 3$, then $y\ln(2) =$

a) $3e^{2}$

*b) $3e$

c) $3e^{3}$

d) $3e^{-2}$

e) $3e^{-1}$