1) Find

$$\lim_{h \to 0} \left(\frac{\sin(10x + 10h) - \sin(10x)}{h} \right)$$

a) $-10\cos(10x)$

b) $10\sin(10x)$

c) 0

d) $-10\sin(10x)$

e) $10\cos(10x)$

2) The function g is defined by the formula

$$g(x) = \int_0^x e^{6t}\,dt$$

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

a) $6e^6$

b) e^6

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

d) $\frac{1}{6}(e^6 - 1)$

e) $e^6 - 1$

3) Find

$$\lim_{x \to \infty} \left(\frac{4x - 1}{\sqrt{x^2 + 8}} \right)$$

a) 4

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

c) 1

d) $-\frac{1}{8}$

e) The limit does not exist.

4) The given function f has a removable discontinuity at $x = -5$. Find A.

$$f(x) = \begin{cases} 5x^2 + 10 & x < -5 \\ 10x & x = -5 \\ Ax + 10 & -5 < x \end{cases}$$

a) -15

b) -5

c) 5

d) -4

e) -25

5) If $f'(x) = -4(x-2)^2(x-8)$ which of the following is true about $y = f(x)$?

a) f has a point of inflection at $x = 2$ and a local maximum at $x = 8$.

b) f has a local maximum at $x = 2$ and a local minimum at $x = 8$.

c) f has a local minimum at $x = 2$ and a local maximum at $x = 8$.

d) f has a point of inflection at $x = 2$ and a local minimum at $x = 8$.

e) f has a local minimum at $x = 2$ and a point of inflection at $x = 8$.

6) Find $f'(9)$, given that

$$f(x) = 8x^2 + 5\sqrt{x}$$

a) 663

b) 693

c) $\frac{869}{6}$

d) 159

e) $\frac{437}{3}$

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

$$f(x) = e^{7x}$$

a) $\frac{1}{7}\left(e^{28} - 1\right)$

b) $\frac{1}{28}\left(e^{28} - 1\right)$

c) $\frac{1}{28}e^{28}$

d) $\frac{1}{4}\left(e^{28} - 1\right)$

e) $\frac{1}{7}e^{28}$

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

$$f(x) = 11^x \ln\left(7e^x\right)$$

a) $\ln(7) + 1$

b) 1

c) $\ln(11)\ln(7) + 1$

d) $\ln(11)\ln(7) + 11$

e) $\ln(77) + 1$

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

$$f(x) = \frac{x^2 + 6}{(8x)}$$

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

b) $\frac{1}{32}$

c) $\frac{7}{4}$

d) $-\frac{5}{8}$

e) $\frac{7}{32}$

10) Find

$$\lim_{x \to 0}\left(\frac{\sin(10x)\cos(x) - \sin(10x)}{x^2}\right)$$

a) The limit does not exist.

b) -10

c) 1

d) 0

e) 10

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

$$3x + y^2 = 12$$

a) $\frac{9}{2y^3}$

b) $-\frac{3}{2y^2}$

c) $\frac{9}{4y^3}$

d) $-\frac{9}{4y^3}$

e) $\frac{3}{2y^2}$

12) Given that $f(x) = 7\sin^2(4x)$, find $f''\left(\frac{1}{24}\pi\right)$.

a) $28\sqrt{3}$

b) $28\sqrt{2}$

c) 28

d) 112

e) 0

13) Find the midpoint rectangular approximation for $\int_0^3 10x^3\,dx$ using 3 subintervals of equal length.

a) $\frac{765}{2}$

b) 360

c) $\frac{765}{4}$

d) 720

e) $\frac{125}{4}$

14) Find the derivative of the function $y = \cos^{-1}(3x)$.

a) $-3\sin^{-1}(3x)$

b) $-3\sin(3x)$

c) $3\sin(3x)$

d) $-\frac{3}{\sqrt{1-9x^2}}$

e) $\frac{3}{\sqrt{1+9x^2}}$

15) Find

$$\frac{\partial}{\partial x}\left(\int_5^x \ln(5+t)\,dt\right)$$

a) $\frac{5}{5+x}$

b) $5\ln(5+x)$

c) $\dfrac{1}{5+x}$

d) $\ln(5+x)$

e) $-\ln(5+x)$

16) Find the equation of the tangent line to the given curve at the point (0, 9).

$$y = 2x^2 + 4x + 9$$

a) $y = 8x$

b) $y = 9x + 2$

c) $y = -2x + 9$

d) $y = 4x + 9$

e) $y = 4x - 9$

17) If $g(f(x)) = x$, $g(5) = 2$ and $g'(5) = 13$, then $f'(2)$ is

a) $\dfrac{1}{13}$

b) $-\dfrac{1}{13}$

c) $\dfrac{1}{5}$

d) $-\dfrac{1}{5}$

e) $\dfrac{5}{13}$

18) Given that $\displaystyle\int_0^{16} e^x \, dx = m$

find $\displaystyle\int_0^4 x\, e^{x^2} \, dx$

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

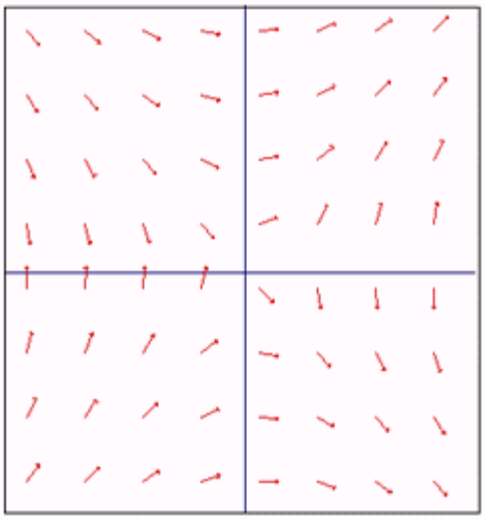
b) m

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

b) $\frac{dy}{dx} = \frac{1}{2} x y$

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

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?

$$f(x) = \frac{x}{\ln(2x)}$$

a) $\left(0, \frac{1}{2} e\right)$

b) $(1, 2e)$

c) $\left(0, \frac{1}{2}\right)$

d) $(1, 2)$

e) $\left(1, \frac{1}{2} e\right)$

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

$$y = 4x^2$$

and

$$y = 3x$$

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

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

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

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

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

22) Find

$$\int_1^4 \frac{3}{\sqrt{x}}\,dx$$

a) 12
b) 3
c) 23
d) 24
e) 6

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* = -4. The volume of this solid can be represented by:

a) $2\pi\int_0^{\frac{1}{2}\pi} (3\sin(x)+4)^2\,dx$

b) $\pi\int_0^{\frac{1}{2}\pi} \left(9\sin(x)^2-16\right)\,dx$

c) $2\pi\int_0^{\frac{1}{2}\pi} 9\sin(4+x)^2\,dx$

d) $\pi\int_0^{\frac{1}{2}\pi} \left((3\sin(x)+4)^2-16\right)\,dx$

e) $2\pi\int_0^{\frac{1}{2}\pi} \left(9\sin(x)^2+4\right)\,dx$

24) The side of a cube is expanding at a constant rate of 4 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) 36
b) 108
c) 72
d) 12
e) 216

25) The solution to the differential equation

$$\frac{dy}{dx} = 12\,x\,y$$

with the initial condition *y*(0) = 3 is
a) $e^{6x^2}+3$
b) $3\,e^{6x^2}$
c) $e^{6x^2}+2$

d) $\ln(6x^2 + 3)$

e) $3\ln(6x^2)$

26) $\int \sec^2(7x)\,dx =$

a) $\frac{1}{7}\tan(7x) + C$

b) $7\tan(7x) + C$

c) $-7\tan(7x) + C$

d) $7\tan^2(7x) + C$

e) $\frac{1}{7}\tan^2(7x) + C$

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

$$x(t) = 2(t-3)^3$$

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

a) 54

b) 98

c) 294

d) 162

e) 18

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

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

a) 1

b) 8

c) 16

d) 2

e) 4

29) If f is a differentiable function and $f(0) = -6$ and $f(2) = 12$, then which of the following must be true?

I. There exists a c in [0,2] where $f(c) = 0$.
II. There exists a c in [0,2] where $f'(c) = 0$.
III. There exists a c in [0,2] where $f'(c) = 9$.

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

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

III. $h(x) = \begin{cases} 8x + 1 & x \leq 0 \\ x^2 + 1 & 0 < x \end{cases}$

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

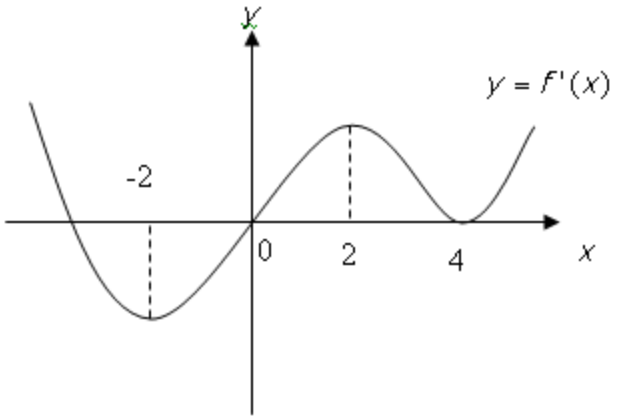
31) The area of the region in the first quadrant bounded by the graphs of $y = 6\cos(x)$, $y = 6\sin(x)$, and the y-axis is

a) $6\left(\sqrt{2} - 1\right)$
b) $3\sqrt{2}$
c) 12
d) $6\sqrt{2} + 1$
e) $6\sqrt{2}$

32) Air is pumped into a spherical balloon at a rate of 6cm^3 per second. At what rate is the radius of the sphere changing when its volume is $36\pi\ \text{cm}^3$?

a) $\frac{2}{3\pi}$ cm/sec
b) $\frac{2}{\pi}$ cm/sec
c) $\frac{1}{4\pi}$ cm/sec
d) $\frac{1}{12\pi}$ cm/sec
e) $\frac{1}{6\pi}$ cm/sec

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



a) f has a point of inflection at $x = 4$.
b) f is increasing on [-2, 2].
c) f has a local maximum at $x = 0$.
d) f is concave down on [0, 4].
e) f has a local minimum at $x = -2$.

34) A particle is moving along the x-axis and its position at time $t \geq 0$ is given by

$$S(t) = (t-4)^2\,(t-6)$$

Which of the following is (are) true?
I. The particle changes direction at $x = 4$ and $x = 6$.
II. The particle is slowing down on [0, 4].
III. The particle is speeding up on [4, 6].
a) II and III only
b) I only
c) II only
d) I and III only
e) I, II and III

35) The region enclosed by the graphs of

$$y = 6\,e^x$$

and the line

$$y = 6$$

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

a) $\pi \int_0^1 \left(6\,e^x - 6\right)^2 dx$

b) $\pi \int_6^{6e} \left(1 - \left(\ln\left(\frac{1}{6}y\right)\right)^2\right) dy$

c) $\pi \int_6^{6e} \left(6 - \ln\left(\frac{1}{6}y\right)\right)^2 dy$

d) $\pi \int_0^6 \left(1 - \ln\left(\frac{1}{6}y\right)\right)^2 dy$

e) $\pi \int_6^{6e} \left(1 - \ln\left(\frac{1}{6}y\right)\right)^2 dy$

36) If

$$3x^2 + xy - \cos(y) = 5$$

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

a) $-\frac{6x}{x + \sin(y)}$

b) $\frac{y - 6x}{x - \sin(y)}$

c) $-\frac{(y + 6x)}{x + \sin(y)}$

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

e) $-\frac{(x + \sin(y))}{y + 6x}$

37) The sum of two positive integers *x* and *y* is 30. Find the value of *x* that minimizes

$$P = x^3 - 30xy$$

a) $x = 20$

b) $x = 5$

c) $x = 25$

d) $x = 10$

e) $x = 15$

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

$$v(t) = 7 - \ln(t)$$

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

a) $e - 8$

b) $7e + 1$

c) $7e + 7$

d) $7e - 8$

e) $7e - 1$

39) The function *f* is defined as

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

$$x \neq 6$$

Which of the following is **false**?

a) *f* is concave up for $x > 6$.

b) *f* is decreasing on [2, 6].

c) *f* has a local maximum at $x = 2$.

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

e) *f* has a vertical asymptote at $x = 6$.

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

$$y = 3\sqrt{x}$$

the *x*-axis, and

the line $x = 3$

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) $\int_0^1 3\sqrt{x}\ dx$

b) $\int_0^3 3x\ dx$

c) $\int_0^1 9x\ dx$

d) $\int_0^3 9x\ dx$

e) $\int_0^3 3\sqrt{x}\ dx$

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 3 hours. Roughly how many hours does it take for the population to reach 10000?

a) 15.6

b) 12.3

c) 9.9

d) 6.6

e) 8.7

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

$$\int_{-3}^{5} x f(x^2)\ dx$$

a) $2F(25) - 2F(9)$

b) $2F(\sqrt{5}) - 2F(\mathrm{I}\sqrt{3})$

c) $\frac{25F(25) - 9F(9)}{(2)}$

d) $\frac{F(25) - F(9)}{(2)}$

e) $5F(25) + 3F(9)$

43) The line normal to

$$5x^2 + 3y + y^2 = 3$$

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

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

b) 5

c) -5

d) 0

e) $-\frac{3}{2}$

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

$f(1) = g(1) = 5$
$f'(1) = g'(1) = 9$
$f'(5) = 5$
$g'(5) = 9$

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

a) 1
b) 25
c) 81
d) 45
e) 9

45) If $\frac{dy}{dx} = ye^x$ and $y(0) = 4$, then $y\ln(2)$ =

a) $4\,e$
b) $4\,e^2$
c) $4\,e^3$
d) $4\,e^{-2}$
e) $4\,e^{-1}$

1) Find

$$\lim_{h \to 0} \left(\frac{\sin(10x + 10h) - \sin(10x)}{h} \right)$$

a) $-10\cos(10x)$
b) $10\sin(10x)$
c) 0
d) $-10\sin(10x)$
*e) $10\cos(10x)$

2) The function g is defined by the formula

$$g(x) = \int_0^x e^{6t}\,dt$$

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

a) $6e^6$
*b) e^6
c) $\frac{1}{6}e^6$
d) $\frac{1}{6}(e^6 - 1)$
e) $e^6 - 1$

3) Find

$$\lim_{x \to \infty} \left(\frac{4x - 1}{\sqrt{x^2 + 8}} \right)$$

*a) 4
b) $\frac{1}{2}$
c) 1
d) $-\frac{1}{8}$
e) The limit does not exist.

4) The given function f has a removable discontinuity at $x = -5$. Find A.

$$f(x) = \begin{cases} 5x^2 + 10 & x < -5 \\ 10x & x = -5 \\ Ax + 10 & -5 < x \end{cases}$$

a) -15
b) -5
c) 5
d) -4
*e) -25

5) If $f'(x) = -4(x-2)^2(x-8)$ which of the following is true about $y = f(x)$?

*a) f has a point of inflection at $x = 2$ and a local maximum at $x = 8$.
b) f has a local maximum at $x = 2$ and a local minimum at $x = 8$.
c) f has a local minimum at $x = 2$ and a local maximum at $x = 8$.
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d) $\ln(11)\ln(7) + 11$

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

$$f(x) = \frac{x^2 + 6}{(8x)}$$

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

b) $\frac{1}{32}$

c) $\frac{7}{4}$

*d) $-\frac{5}{8}$

e) $\frac{7}{32}$

10) Find

$$\lim_{x \to 0}\left(\frac{\sin(10x)\cos(x) - \sin(10x)}{x^2}\right)$$

a) The limit does not exist.

b) -10

c) 1

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

$$3x + y^2 = 12$$

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16) Find the equation of the tangent line to the given curve at the point (0, 9).

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c) $2m$

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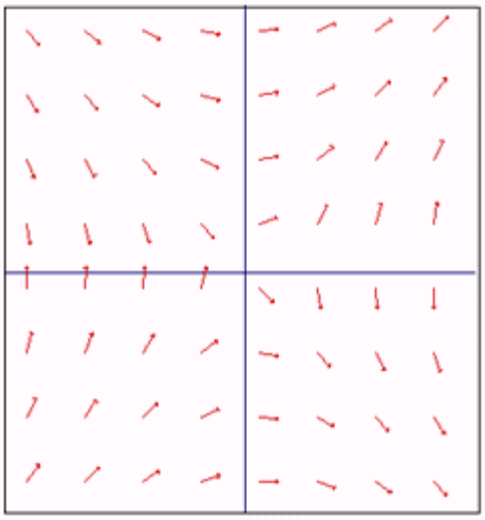

*a) $\frac{dy}{dx} = \frac{x}{y}$

b) $\frac{dy}{dx} = \frac{1}{2} x y$

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

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

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and
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$$\int_1^4 \frac{3}{\sqrt{x}}\,dx$$

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c) 23
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*b) $3\,e^{6x^2}$
c) $e^{6x^2}+2$

d) $\ln(6x^2 + 3)$

e) $3\ln(6x^2)$

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*a) $\frac{1}{7}\tan(7x) + C$

b) $7\tan(7x) + C$

c) $-7\tan(7x) + C$

d) $7\tan^2(7x) + C$

e) $\frac{1}{7}\tan^2(7x) + C$

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$$x(t) = 2(t-3)^3$$

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

a) 54

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*c) 294

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e) 18

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

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

a) 1

b) 8

c) 16

d) 2

*e) 4

29) If f is a differentiable function and $f(0) = -6$ and $f(2) = 12$, then which of the following must be true?

I. There exists a c in [0,2] where $f(c) = 0$.
II. There exists a c in [0,2] where $f'(c) = 0$.
III. There exists a c in [0,2] where $f'(c) = 9$.

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

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

III. $h(x) = \begin{cases} 8x + 1 & x \le 0 \\ x^2 + 1 & 0 < x \end{cases}$

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

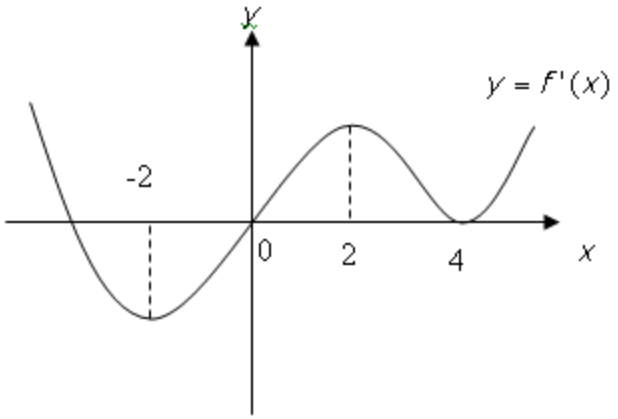
31) The area of the region in the first quadrant bounded by the graphs of $y = 6\cos(x)$, $y = 6\sin(x)$, and the y-axis is

*a) $6\left(\sqrt{2} - 1\right)$
b) $3\sqrt{2}$
c) 12
d) $6\sqrt{2} + 1$
e) $6\sqrt{2}$

32) Air is pumped into a spherical balloon at a rate of 6cm^3 per second. At what rate is the radius of the sphere changing when its volume is $36\pi\ \text{cm}^3$?

a) $\frac{2}{3\pi}$ cm/sec
b) $\frac{2}{\pi}$ cm/sec
c) $\frac{1}{4\pi}$ cm/sec
d) $\frac{1}{12\pi}$ cm/sec
*e) $\frac{1}{6\pi}$ cm/sec

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



*a) f has a point of inflection at $x = 4$.
b) f is increasing on [-2, 2].
c) f has a local maximum at $x = 0$.
d) f is concave down on [0, 4].
e) f has a local minimum at $x = -2$.

34) A particle is moving along the x-axis and its position at time $t \geq 0$ is given by

$$S(t) = (t-4)^2\,(t-6)$$

Which of the following is (are) true?
I. The particle changes direction at $x = 4$ and $x = 6$.
II. The particle is slowing down on [0, 4].
III. The particle is speeding up on [4, 6].
a) II and III only
b) I only
*c) II only
d) I and III only
e) I, II and III

35) The region enclosed by the graphs of

$$y = 6\,e^x$$

and the line

$$y = 6$$

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

a) $\pi \int_0^1 (6\,e^x - 6)^2\,dx$

*b) $\pi \int_6^{6e} \left(1 - \left(\ln\left(\frac{1}{6}y\right)\right)^2\right) dy$

c) $\pi \int_6^{6e} \left(6 - \ln\left(\frac{1}{6}y\right)\right)^2 dy$

d) $\pi \int_0^6 \left(1 - \ln\left(\frac{1}{6}y\right)\right)^2 dy$

e) $\pi \int_6^{6e} \left(1 - \ln\left(\frac{1}{6}y\right)\right)^2 dy$

36) If

$$3x^2 + xy - \cos(y) = 5$$

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

a) $-\frac{6x}{x + \sin(y)}$

b) $\frac{y - 6x}{x - \sin(y)}$

*c) $-\frac{(y + 6x)}{x + \sin(y)}$

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

e) $-\frac{(x + \sin(y))}{y + 6x}$

37) The sum of two positive integers *x* and *y* is 30. Find the value of *x* that minimizes

$$P = x^3 - 30xy$$

a) $x = 20$

b) $x = 5$

c) $x = 25$

*d) $x = 10$

e) $x = 15$

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

$$v(t) = 7 - \ln(t)$$

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

a) $e - 8$

b) $7e + 1$

c) $7e + 7$

*d) $7e - 8$

e) $7e - 1$

39) The function *f* is defined as

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

$$x \neq 6$$

Which of the following is **false**?

a) *f* is concave up for $x > 6$.

b) *f* is decreasing on [2, 6].

c) *f* has a local maximum at $x = 2$.

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

e) *f* has a vertical asymptote at $x = 6$.

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

$$y = 3\sqrt{x}$$

the *x*-axis, and

the line $x = 3$

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) $\int_0^1 3\sqrt{x}\ dx$

b) $\int_0^3 3x\ dx$

c) $\int_0^1 9x\ dx$

*d) $\int_0^3 9x\ dx$

e) $\int_0^3 3\sqrt{x}\ dx$

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 3 hours. Roughly how many hours does it take for the population to reach 10000?

a) 15.6

b) 12.3

*c) 9.9

d) 6.6

e) 8.7

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

$$\int_{-3}^{5} x f(x^2)\ dx$$

a) $2F(25) - 2F(9)$

b) $2F(\sqrt{5}) - 2F(\mathrm{I}\sqrt{3})$

c) $\frac{25F(25) - 9F(9)}{(2)}$

*d) $\frac{F(25) - F(9)}{(2)}$

e) $5F(25) + 3F(9)$

43) The line normal to

$$5x^2 + 3y + y^2 = 3$$

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

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

b) 5

c) -5

*d) 0

e) $-\frac{3}{2}$

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

$f(1) = g(1) = 5$
$f'(1) = g'(1) = 9$
$f'(5) = 5$
$g'(5) = 9$

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

a) 1
b) 25
c) 81
*d) 45
e) 9

45) If $\frac{dy}{dx} = ye^x$ and $y(0) = 4$, then $y\ln(2) =$

*a) $4e$
b) $4e^2$
c) $4e^3$
d) $4e^{-2}$
e) $4e^{-1}$