Question 1 *Find the limits of functions including the infinite limits, ∞, $-\infty$. Otherwise write DNE. (Do not use L'hospital theorem.)*

(1.6) a) $\lim\limits_{x \to 5} (x^3 - 3x + 4)$

(1.6) b) $\lim\limits_{x \to -2} \left[\dfrac{x^3 + 2x^2 - 1}{5 - 3x} \right]$

(1.6) c) $\lim\limits_{x \to -1} \left[\dfrac{2x^2 + 3x + 1}{x^2 - 2x - 3} \right]$

(1.6) d) $\lim\limits_{h \to 0} \left[\dfrac{(2 + h)^3 - 8}{h} \right]$

(1.6) e) $\lim\limits_{t \to 0} \left[\dfrac{\sqrt{t^2 + 4} - 2}{t^2} \right]$

(1.5) f) $\lim\limits_{x \to 3^-} \dfrac{2x}{x - 3}$

(1.5) g) $\lim\limits_{x \to 3^+} \dfrac{2x}{x - 3}$

(1.5) h) $\lim\limits_{x \to 0} \dfrac{1}{x^2}$

(1.5) i) $\lim\limits_{x \to 0} \dfrac{1}{x^3}$

(1.6) j) $\lim\limits_{x \to 1} \dfrac{|x - 1|}{x - 1}$

(2.4) k) $\lim\limits_{x \to 0} \left[\dfrac{\sin(5x)}{3x} \right]$

(2.4) l) $\lim\limits_{\theta \to 0} \left[\dfrac{\cos \theta - 1}{\sin \theta} \right]$

(2.4) m) $\lim\limits_{x \to 0} \left[\dfrac{\sin(3x)\sin(5x)}{x^2} \right]$

(2.4) n) $\lim\limits_{\theta \to 0} \left[\dfrac{\cos \theta - 1}{2\theta^2} \right]$

(3.4) o) $\lim\limits_{x \to \infty} \left[\dfrac{2x^2 - 7}{5x^2 + x - 3} \right]$

(3.4) p) $\lim\limits_{x \to -\infty} \left[\dfrac{x - 2}{x^2 + 1} \right]$

(3.4) q) $\lim\limits_{x \to \infty} \left[\dfrac{x + 3x^2}{4x - 1} \right]$

(3.4) r) $\lim\limits_{x \to \infty} \left[\dfrac{\sqrt{x + 3x^2}}{4x - 1} \right]$

(3.4) s) $\lim\limits_{x \to -\infty} \left[\dfrac{\sqrt{x + 3x^2}}{4x - 1} \right]$

(3.4) t) $\lim\limits_{x \to \infty} \left[\sqrt{9x^2 + x} - 3x \right]$

(3.4) u) $\lim\limits_{x \to -\infty} \left[\sqrt{4x^2 + 3x} + 2x \right]$

(3.4) v) $\lim\limits_{x \to -\infty} \left[\sqrt{4x^2 + 3x} - 2x \right]$

(3.4) w) $\lim\limits_{x \to \infty} x \cdot \sin\left(\dfrac{2}{x} \right)$

(3.4) x) $\lim\limits_{x \to \infty} \sqrt{x} \cdot \sin\left(\dfrac{2}{x} \right)$

(2.2, honor) y) $\lim\limits_{x \to 1} \left[\dfrac{x^{2015} - 1}{x - 1} \right]$

(4.3, honor) z) $\lim\limits_{h \to 0} \dfrac{1}{h} \displaystyle\int_2^{2+h} \sqrt{1 + t^3}\, dt$

Question 2 (1.5) *Use the given graph of f to state the value of each quantity, if exists. If it does not exist, explain why.*
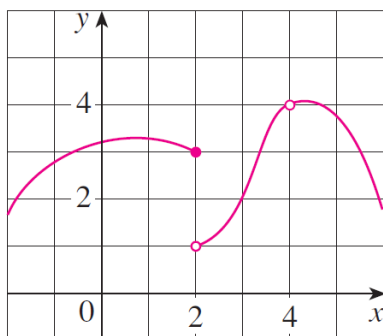
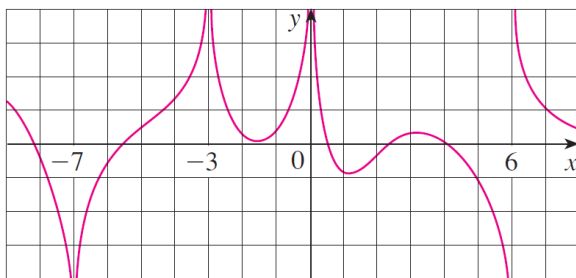a) $\lim\limits_{x \to 2^-} f(x)$

b) $\lim\limits_{x \to 2^+} f(x)$

c) $\lim\limits_{x \to 2} f(x)$

d) $f(2)$

e) $\lim\limits_{x \to 4} f(x)$

f) $f(4)$

Question 3 (1.5) *For the function f whose graph is shown, state the following.*
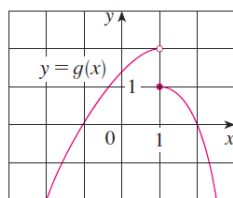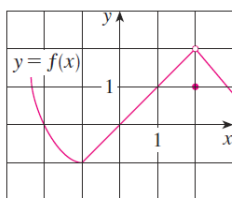

a) $\lim_{x \to -7} f(x)$

b) $\lim_{x \to -3} f(x)$

c) $\lim_{x \to 0} f(x)$

d) $\lim_{x \to 6^-} f(x)$

e) $\lim_{x \to 6^+} f(x)$

f) *The equations of the vertical asymptote(s).*

Question 4 (1.6) *Using squeeze theorem, show*

$$\lim_{x \to 0} x \sin \frac{1}{x} = 0$$

Question 5 (1.6) *The graphs of f and g are given. State the following. Use $\infty, -\infty$ for infinite limits. If the limit does not exist or is not infinite limits, explain why.*

a) $\lim_{x \to 1^-} (f(x) + g(x))$.

b) $\lim_{x \to -1} \dfrac{f(x)}{g(x)}$.

c) $\lim_{x \to 1} \sqrt{3 + f(x)}$.

Question 6 (1.6)   a) *What is wrong with the following equation?*

$$\frac{x^2 + x - 6}{x - 2} = x + 3$$

b) *Explain why the following equation is correct.*

$$\lim_{x \to 2} \frac{x^2 + x - 6}{x - 2} = \lim_{x \to 2} (x + 3)$$

Question 7 (1.6,1.8) *Let*

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

a) *Find* $\lim_{x \to 1^-} f(x)$ *and* $\lim_{x \to 1^+} f(x)$

b) *Does* $\lim_{x \to 1} f(x)$ *exist?*

c) *Is f continuous at* $x = 1$? *Explain.*

d) *Sketch the graph f.*

Question 8 (1.6,1.8) *Let*

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

a) *Find* $\lim_{x \to 2^-} f(x)$ *and* $\lim_{x \to 2^+} f(x)$

b) *Does* $\lim_{x \to 2} f(x)$ *exist?*

c) *Is f continuous at* $x = 2$? *Explain.*

d) Sketch the graph f.

Question 9 (1.6) *If* $\lim\limits_{x \to 1} \dfrac{f(x) - 8}{x - 1} = 10$, *find* $\lim\limits_{x \to 1} f(x)$.

Question 10 (1.8) *Explain why the function f is discontinuous at the given number a.*

a) $a = 0$

$$f(x) = \begin{cases} \cos x & if\ x < 0 \\ 0 & if\ x = 0 \\ 1 - x^2 & if\ x > 0 \end{cases}$$

b) $a = 1$

$$f(x) = \begin{cases} \frac{x^2 - x}{x^2 - 1} & if\ x \neq 1 \\ 1 & if\ x = 1 \end{cases}$$

Question 11 (1.8) *Find the values of a and b that make f continuous everywhere.*

$$f(x) = \begin{cases} \frac{x^2 - 4}{x - 2} & if\ x < 2 \\ ax^2 - bx + 3 & if\ 2 \leq x < 3 \\ 2x - a + b & if\ x \geq 3 \end{cases}$$

Question 12 (1.8) *Use IVT to show there is a root of the given equation in the specified interval.*

a)

$$x^4 + x - 3 = 0, \quad (1, 2)$$

b) Use the calculator.

$$\sin x = x^2 - x, \quad (1, 2)$$

(honor) c) Use the calculator.

$$\sqrt{x - 5} = \frac{1}{x + 3}, \quad (-\infty, \infty)$$

Question 13 (1.6,1.8, honor) *For what values of x is f continuous?*

a)

$$f(x) = \begin{cases} 0 & if\ x\ is\ rational \\ 1 & if\ x\ is\ irrational \end{cases}$$

b)

$$f(x) = \begin{cases} 0 & if\ x\ is\ rational \\ x & if\ x\ is\ irrational \end{cases}$$

Question 14 *Find derivatives.*

(2.3) a) $f(x) = 2^{12}$

(2.3) b) $f(x) = 3x^2 - 4x + 1$

(2.3) c) $f(x) = \dfrac{1}{2}x - \dfrac{1}{3}$

(2.3) d) $f(x) = (x-2)(2x+3)$

(2.3) e) $f(x) = (1 + x + x^2)(2 - x^4)$

(2.3) f) $f(x) = \dfrac{2x+1}{x+4}$

(2.3) g) $f(x) = \dfrac{x^2-1}{2x-3}$

(2.3) h) $f(x) = \dfrac{x}{(x-1)^2}$

(2.3) i) $f(x) = \dfrac{x}{x^2-1}$

(2.3) j) $f(x) = x^{-2}$

(2.3) k) $f(x) = \sqrt{x} - x$

(2.3) l) $f(x) = \dfrac{x^2 + 4x + 3}{\sqrt{x}}$

(2.3) m) $f(x) = \dfrac{\sqrt{x} + x}{x^2}$

(2.3) n) $f(x) = \dfrac{4}{1-x}$

(2.4) o) $f(x) = 3x^2 - 2\cos x$

(2.4) p) $f(x) = \sec x \cdot \tan x$

(2.4) q) $f(x) = \dfrac{\tan x - 1}{\sec x}$

(2.4) r) $f(x) = \sqrt{x} \sin x$

(2.5) s) $f(x) = \sin(\sqrt{x})$

(2.5) t) $f(x) = \sqrt{\sin x}$

(2.5) u) $f(x) = (2x^3 + 5)^4$

(2.5) v) $f(x) = \sqrt{1 - 2x}$

(2.5) w) $f(x) = \sqrt{x^2 + 4}$

(2.5) x) $f(x) = \sqrt{x + \sqrt{x}}$

(2.5) y) $f(x) = \sec^2 x + \tan^2 x$

(2.5) z) $f(x) = \sin(x^2) + \cos x$

(2.5) aa) $f(x) = \sin(\tan(2x))$

Question 15 *Find $f'(x)$ using the **definition of the derivative**.*

(2.1) a) $f(x) = 3x^2 - 4x + 1$

(2.1) b) $f(x) = \dfrac{1}{x}$

(2.1) c) $f(x) = 2\sqrt{x}$

(2.4) d) $f(x) = \sin x$

Question 16 (2.3) *Suppose that $f(4) = 2, g(4) = 5, f'(4) = 6, g'(4) = -3$. Find $h'(4)$.*

a) $h(x) = 3f(x) + 8g(x)$

b) $h(x) = f(x)g(x)$

c) $h(x) = \dfrac{f(x)}{g(x)}$

d) $h(x) = \dfrac{g(x)}{f(x) + g(x)}$

Question 17 (2.3) *If $h(2) = 4$ and $h'(2) = -3$, find*

$$\frac{d}{dx}\left(\frac{h(x)}{x}\right)\Bigg|_{x=2}$$

Question 18 (2.5) *If $h(x) = \sqrt{4 + 3f(x)}$, where $f(1) = 7$ and $f'(1) = 4$, find $h'(1)$.*

Question 19 *Find an equation of the tangent line to the curve at the given point.*

(2.3) a)
$$y = x^4 + 2x^2 - x, \ (1, 2)$$

(2.3) b)
$$y = \frac{2x}{x+1}, \ (1, 1)$$

(2.3) c)
$$y = \frac{\sqrt{x}}{1 + x^2}, \ (1, \tfrac{1}{2})$$

(2.4) d)
$$y = \sec x, \ (\tfrac{\pi}{3}, 2)$$

(2.5) e)
$$y = \sqrt{1 + x^3}, \quad (2, 3)$$

(2.6) f)
$$x^2 + xy + y^2 = 3, \quad (1, 1)$$

Question 20 (2.6) *Find $\frac{dy}{dx}$.*

a)
$$x^2 + xy - y^2 = 4$$

c)
$$xy = \sqrt{x^2 + y^2}$$

b)
$$x^4 + x^2 y^2 + y^3 = 5$$

(honor) d)
$$\tan\left(\frac{x}{y}\right) = x + y$$

Question 21 (2.8) *Air is being pumped into a spherical balloon so that its volume increase at a rate of $100 cm^3/s$. How fast is the radius of the balloon increasing when the diameter is 50cm. Hint: $V = \frac{4\pi r^3}{3}$.*

Question 22 (2.8) *A ladder 10ft long rest against a vertical wall. If the bottom of the ladder slide away from the wall at a rate $1ft/s$, how fast is the top of the latter slding down the wall when the botton of the ladder is 6ft from the wall?*
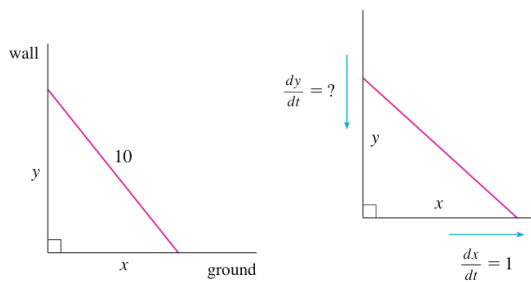
Question 23 (2.8) *A water tank has the shape of an inverted circular cone with base radius 2m and height 4m. If water is being pumped into the tank at a rate of $2m^3/min$, find **the rate at which the water level is rising** when the water is 3m deep. Hint: $V = \frac{1}{3}\pi r^2 h$.*
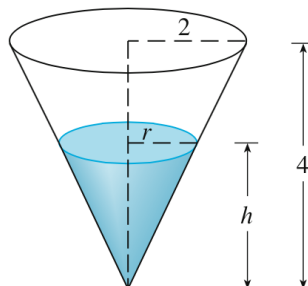
Question 24 (2.1, honor) *Determine whether $f'(0)$ exists.*

a)
$$f(x) = \begin{cases} x \sin \frac{1}{x} & if \ x \neq 0 \\ 0 & if \ x = 0 \end{cases}$$

b)
$$f(x) = \begin{cases} x^2 \sin \frac{1}{x} & if \ x \neq 0 \\ 0 & if \ x = 0 \end{cases}$$

Question 25 (2.2, honor) *Let*
$$f(x) = \begin{cases} x^2 + 1, & x < 1 \\ x + 1, & x \geq 1 \end{cases}$$

Is f differentiable at 1?
Hint: Use
$$f'_-(a) := \lim_{h \to a^-} \frac{f(h + a) - f(a)}{h} \quad , \ Left\text{-}hand \ derivative \ of \ f$$

$$f'_+(a) := \lim_{h \to a^+} \frac{f(h + a) - f(a)}{h} \quad , \ Right\text{-}hand \ derivative \ of \ f$$

and
$$f'(a) \ exists \ \Leftrightarrow \ f'_+(a) = f'_-(a)$$

5

Question 26 (2.3) *Let*

$$f(x) = \begin{cases} x^2, & x \le 2 \\ mx + b, & x > 2 \end{cases}$$

Find the value of m and b that make f differentiable everywhere.

Question 27 (2.4) *Find the given derivative by finding the first few derivatives and observing the pattern that occurs.*

a) $\dfrac{d^{99}}{dx^{99}} (\sin x)$

(honor) b) $\dfrac{d^{30}}{dx^{30}} (x \cdot \sin x)$

Question 28 (2.8) *Suppose $y = \sqrt{2x+1}$ where x and y is functions of t.*

- *If $\frac{dx}{dt} = 3$, find $\frac{dy}{dt}$ when $x = 4$.*

- *If $\frac{dy}{dt} = 5$, find $\frac{dx}{dt}$ when $x = 12$.*

Question 29 (2.8) *Suppose $4x^2 + 9y^2 = 36$ where x and y is functions of t.*

- *If $\frac{dx}{dt} = 3$, find $\frac{dy}{dt}$ when $x = -2$ and $y = \frac{2\sqrt{5}}{3}$.*

- *If $\frac{dy}{dt} = \frac{1}{3}$, find $\frac{dx}{dt}$ when $x = 2$ and $y = \frac{2\sqrt{5}}{3}$.*

**Question 30 (2.9)** *Find the linearization $L(x)$ of the function f at a where*

$$L(x) = f(a) + f'(a)(x - a)$$

- *$f(x) = x^4 + 3x^2, \ a = -1$*

- *$f(x) = \sqrt{x}, \ a = 4$*

Question 31 (2.9) *Find the differential dy of each function.*

- *$y = x^2 \cdot \sin 2x$*

- *$y = \frac{s}{1+2s}$*

Question 32 (3.1) *Use the graph to state the absolute and local maximum and minimum **values** and corresponding **points** of the function f and g.**Note:** By Stewart's definition, **endpoints cannot be a local maximum or minimum.***
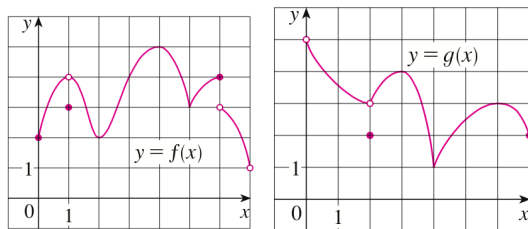
Question 33 (3.1) *Find the the critical number(s) of the function f.*

a) *$f(x) = 2x^3 - 3x^2 - 36x$.*

b) *$f(x) = |3x - 4|$.*

c) *$f(x) = \dfrac{x-1}{x^2 + 4}$.*

d) *$f(x) = 2\cos x + \sin^2 x$.*

Question 34 (3.1) *Find the the absolute maximum and minimum **values** of the function f.*

a) *$f(x) = 2x^3 - 3x^2 - 12x + 1, \ [-2, 3]$.*

b) $f(x) = 3x^4 - 16x^3 + 18x^2$, $[-1, 4]$.

c) $f(x) = x\sqrt{4 - x^2}$, $[-1, 2]$.

Question 35 (3.2) *Verify that the function satisfies the hypotheses of the Mean Value Theorem on the given interval, Then find all numbers c that satisfy the conclusion of the Mean Value Theorem.*

$$f(x) = x^3 - 3x + 2, \ \ [-2, 2]$$

Question 36 (3.2) *Show that the equation $x^3 - 12x + 1 = 0$ has exact one root in the interval $[-1, 1]$.*
HINT: *For the existence, use IVT. For the uniqueness, use Rolle's Theorem.*

Question 37 (3.3,3.4) *Given f,*

a) $f(x) = 2x^3 + 3x^2 - 36x$ 　　　　b) $f(x) = 3x^4 - 8x^3 - 24x^2 + 96x$ 　　c) $f(x) = \frac{x}{x^2+1}$

- *Find the intervals on which f is increasing. (Exclude endpoint(s) if exist(s).)*

- *Find the intervals on which f is decreasing. (Exclude endpoint(s) if exist(s).)*

- *Find the local minimum value(s).*

- *Find the local maximum value(s).*

- *Find the intervals on which f is concave upward.*

- *Find the intervals on which f is concave downward.*

- *Find (an) inflection point(s) if exists.*

Question 38 (3.4) *Sketch the curve.*

a) $y = \frac{2x^2}{x^2-1}$ 　　　　　　　　　　c) $y = \frac{x^2}{\sqrt{x+1}}$

b) $y = \frac{x}{x^2-9}$ 　　　　　　　　　　d) $y = \frac{x}{\sqrt{x^2+1}}$

- *Find the domain.*

- *Find x-and y-intercepts.*

- *Find the symmetry if exists.(even, odd, periodic).*

- *Find the asymptote(s).*

- *Find the interval(s) of Increase or Decrease.*

- *Find the local maximum and minimum value(s).*

- *Find concavity and points of inflection.*

- *Sketch the Curve.*

Question 39 (3.7) *A farmer has 2400ft of fencing and wants to fence off a rectangular file that border a straight river. He needs no fence along the river. What are the dimensions of the field that has the largest area?*
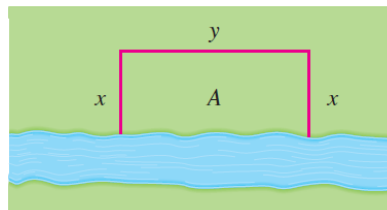
Question 40 (3.8) *Find the area of the largest rectangle that can be inscribed in a semicircle of radius $r = 4$.*

Hint: Describe y in terms of x. $0 \le x \le 4$, $0 \le y \le 4$.
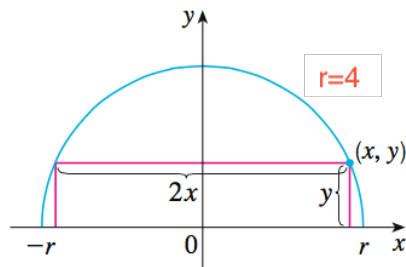
Question 41 (3.9) *Find the most general anti-derivative of each of the following functions.*

(3.9) a) $f(x) = \frac{1}{2}x^2 - 2x + 6$

(3.9) b) $f(x) = (x-1)^2$

(3.9) c) $f(x) = \frac{10}{x^9}$

(3.9) d) $f(x) = \sqrt{2}$

(3.9) e) $f(x) = \frac{3}{\sqrt{x}}$

(3.9) f) $f(x) = (x+1)(2x-1)$

(3.9) g) $f(t) = \frac{1+t+t^2}{\sqrt{t}}$

(3.9) h) $f(x) = \sqrt{\frac{3}{x}}$

(4.4) i) $f(x) = 2\sqrt{x} + 2\sec(x)\tan(x)$

(4.4) j) $f(x) = \sqrt{x} + 2\sin(x) + x$

(4.5) k) $f(x) = x^2\sqrt{x^3+1}$

(4.5) l) $f(x) = (1-2x)^9$

(4.5) m) $f(x) = (x^2+1)(x^3+3x)^4$

(4.5) n) $f(x) = \sec^3(x)\tan(x)$

(4.5) o) $f(x) = x\sqrt{1+x^2}$

(4.5) p) $f(x) = x^3\sqrt{1+x^2}$

Question 42 (3.9) *Find the function f if*

a) $f'(x) = 5x^4 - 2x^5$ and $f(0) = 4$.

b) $f''(x) = \sin(x) + \cos(x)$, $f(0) = 3$ and $f'(0) = 4$.

Question 43 (4.2) *Express the limit as a definite integral on the given interval.*

a)
$$\lim_{n\to\infty} \sum_{i=1}^{n} \frac{1-x_i^2}{4+x_i^2} \cdot \Delta x, \;\; [2,6]$$

b)
$$\lim_{n\to\infty} \sum_{i=1}^{n} \frac{i^4}{n^5}, \;\; [0,1]$$

Question 44 (4.2) *Using the **the definition of the (definite) integral** to evaluate the integral.*
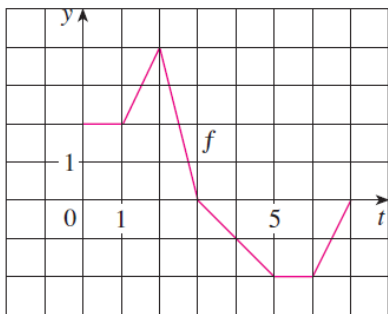
a) $\displaystyle\int_{2}^{5}(4-2x)dx$

b) $\displaystyle\int_{0}^{1} x^3 dx$

Question 45 (4.2) *If $\displaystyle\int_{0}^{9} f(x)dx = 37$ and $\displaystyle\int_{0}^{9} g(x)dx = 16$, find $\displaystyle\int_{0}^{9}[2f(x)+3g(x)]dx$.*

Question 46 (4.2) *If $\displaystyle\int_{1}^{5} f(x)dx = 12$ and $\displaystyle\int_{4}^{5} f(x)dx = 3.5$, find $\displaystyle\int_{1}^{4} 2f(x)dx$.*

Question 47 (4.2) *Use the properties of integrals to verify the inequality.*

$$2 \le \int_{-1}^{1} \sqrt{1+x^2}\,dx \le 2\sqrt{2}$$

8

Question 48 (4.3) *Let $g(x) = \int_0^x f(t)dt$, where f is the function whose graph is shown.*

- *Evaluate $g(0), g(1), g(2), g(3), g(6)$.*

- *On what interval is g increasing?*

- *Where g have a maximum value?*

- *Sketch a rough graph of g.*

Question 49 (4.3) *Use the fundamental theorem of Calculus to find the **derivative** of the function.*

a) $f(x) = \int_1^x \frac{1}{t^3+1}dt$

b) $f(x) = \int_x^\pi \sqrt{1 + \sec(t)}dt$

c) $f(x) = \int_0^{x^4} \cos^2(\theta)d\theta$

d) $f(x) = \int_1^{\sqrt{x}} \frac{t^2}{t^4+1}dt$

Question 50 *Evaluate.*

(4.3) a) $\displaystyle\int_{-1}^2 (x^3 - 2x)dx$

(4.3) b) $\displaystyle\int_{\frac{\pi}{6}}^\pi \sin\theta d\theta$

(4.3) c) $\displaystyle\int_1^2 (1 + 2y)^2 dy$

(4.4) d) $\displaystyle\int_0^2 |2x - 1|dx$

(4.4) e) $\displaystyle\int_{-1}^2 (x - 2|x|)\,dx$

(4.5) f) $\displaystyle\int_{-1}^1 x(1 - x)^2 dx$

(4.5) g) $\displaystyle\int_1^4 \sqrt{\frac{5}{x}}dx$

(4.5) h) $\displaystyle\int_0^{\frac{\pi}{2}} \cos(x)\sin(\sin(x))dx$

(4.5) i) $\displaystyle\int_1^2 x\sqrt{x - 1}dx$

(4.5) j) $\displaystyle\int_0^1 x^3\sqrt{1 + x^2}dx$

(4.4) k) $\displaystyle\int_1^9 \frac{x - 1}{\sqrt{x}}dx$

(4.4) l) $\displaystyle\int_{-2}^2 f(x)dx$ *where* $f(x) = \begin{cases} 2 & if \ -2 \leq x \leq 0 \\ 4 - x^2 & if \ 0 < x \leq 2 \end{cases}$

Question 51 (4.4) *What is wrong with the equation? Explain.*

$$\int_{-2}^1 x^{-4}dx = \left.\frac{x^{-3}}{-3}\right]_{-2}^1 = -\frac{3}{8}$$

Question 52 (4.3) *Evaluate the limit by recognizing the sum as a Riemman sum.*

$$\lim_{n\to\infty} \frac{1}{n}\left[\left(\frac{1}{n}\right)^3 + \left(\frac{2}{n}\right)^3 + \ldots + \left(\frac{n}{n}\right)^3\right]$$

Question 53 (4.3) *Evaluate the limit by recognizing the sum as a Riemman sum.*

$$\lim_{n\to\infty} \frac{1}{n}\left(\sqrt{\frac{1}{n}} + \sqrt{\frac{2}{n}} + \ldots + \sqrt{\frac{n}{n}}\right)$$

Question 54 (4.4) *The velocity function (in meters per second) is given for a particle moving along a line.*

$$v(t) = 3t - 5, 0 \leq t \leq 3$$

- *Find the displacement*

- *Find the distance traveled.*

Question 55 (4.5) *If f is continuous and $\int_0^4 f(x)dx = 10$, find $\int_0^2 f(2x)dx$.*

Question 56 (4.5) *If f is continuous and $\int_0^9 f(x)dx = 4$, find $\int_0^3 xf(x^2)dx$.*

Question 57 (5.1) *Find the area of the region enclosed by the parabola $y = 5x - x^2$ and the line $y = x$.*

- *Find the points of intersection.*

- *Find the area.*

Question 58 (5.1) *Find the area of the region enclosed by the parabolas $y = x^2$ and $y = 2x - x^2$.*

- *Find the points of intersection.*

- *Find the area.*