Chapter 1.

(1) (a) Use the data to determine a formula of the form $Q = Q_0 e^{rt}$ which would give the number of rabbits, Q, at time t (in months).

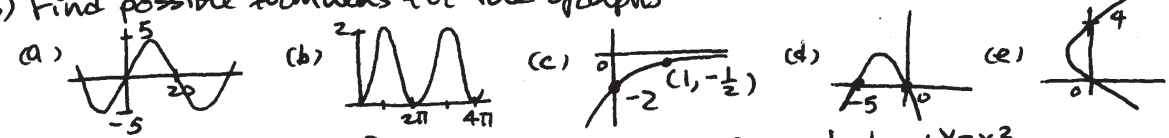
t	0	1	2	3	4	5
Q	25	43	75	130	226	391

(b) What is the approximate doubling time for this population? (1 month 8 days)

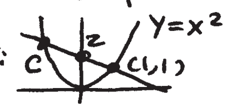
(c) When the rabbit population will reach 1000?

(2) Draw the graph of a function $f(x)$ satisfying the following: As $x \to \infty$, $f(x) \to 0$; As $x \to -\infty$, $f(x) \to +\infty$; $f(x)$ has roots -3, 1, and 2.

(3) Find possible formulas for the graphs



(4) Given the functions, find the coordinates of C.



(5) Find the half-life of a radioactive substance that is reduced by 30% in 20 hours? $\left(-20\left(\frac{\ln 2}{\ln 0.7}\right)\right)$

Chapter 2.

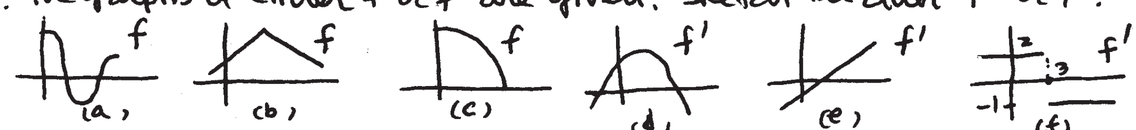
1. An economist is interested in how the price of a certain commodity affects its sales. Suppose that at a price of $\$p$, a quantity q of the commodity is sold. If $q = f(p)$, explain the meaning of the statements $f(10) = 240{,}000$ and $f'(10) = -29{,}000$.

2. Given the values for a function $J_0(x)$. Estimate the derivatives.

x	0	.1	.2	.3	.4	.5
$J_0(x)$	1	.9975	.99	.9776	.9604	.9385
$J_0'(x)$	?	?	?	?	?	?

Estimate also $J_0'(0.2)$ and $J_0''(0.3)$.

3. The graphs of either f or f' are given. Sketch the other f' or f.



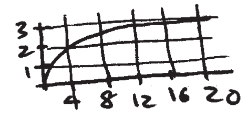
4. Use definition to find the derivatives of (a) $f(x) = 2x$, (b) $g(x) = \frac{1}{x} + 5$.

5. A continuous function defined for all x has the following properties:
   - f increasing, • f concave down, • $f(5) = 2$, • $f'(5) = \frac{1}{2}$

   (a) Sketch a possible graph of f. (b) How many zeros does f have?
   (c) What could be $\lim_{x \to -\infty} f(x)$? (d) Is it possible that $f'(1) = \frac{1}{4}$?

Chapter 3

1. A graph of $y=f(x)$ is given. Estimate $\int_0^{20} f(x)dx$



2. A table of $y=f(x)$ is given. Estimate $\int_0^8 f(x)dx$

x	0	2	4	6	8
$f(x)$	80	52	28	10	0

3. How many subdivisions are needed for the integral $\int_0^2 5e^{-x^2}dx$ in order for the left sum to approximate the true value within 0.1 accuracy? Find the left sum. Does it over-estimate the true value and why? (99) What is the average value of $5e^{-x^2}$ in $[0,2]$?

4. (a) Use your calculator to sketch a graph of $\sin(x^2)$ and mark on it the points $x=\sqrt{\pi}, \sqrt{2\pi}, \sqrt{3\pi}, \sqrt{4\pi}$.

(b) Use your graph to decide which of the four numbers

$$\int_0^{\sqrt{n\pi}} \sin(x^2)\,dx, \quad n=1,2,3,4$$

is largest. Which is smallest? How many of the numbers are positive?

5. If $\int_0^2 f(x)dx = 0.98$, $\int_0^1 f(x)dx = 0.9$, what are the values of

(a) $\int_1^2 f(x)dx$, (b) $\int_{-1}^1 f(x)dx$ if $f(x)$ is odd (c) $\int_2^{-1} f(x)dx$ if f is even (d) $\int_0^1 \frac{f(x)}{2}dx$

Chapter 4

1. Find the derivatives of the functions.

(a) $\sqrt{\frac{\sin(2z)}{\cos(2z)}}$ (b) $(t\cos t+\tan^3(t^5))^4$ (c) $\ln\left(\frac{1-\cos^3 t}{1+\cos^3 t}\right)$ (d) $\frac{y}{e^{5y}+a}$

(e) $(\ln z)^t$ (f) $2x-\frac{1}{\sqrt[3]{x}}+3^x-e$ (g) $\cos(\sin^{-1}x)$ (h) $w^3\ln(10\ln w)$

(i) $\sin(\sin x+\cos x)$ (j) $(3x^2+\pi)(x^{2x}-4)$ (k) $\sqrt{\frac{1-\sin x}{1-\cos x}}$ (l) $\arcsin(\cos(\pi x))$

(m) $g(\theta)=\sqrt{a^2-\sin^2\theta}$ (n) $r(t)=\ln(\sin(\frac{t}{k}))$ (o) $k(x)=e^{a\tan(\sin x)}$

2. If $g(2)=3$ and $g'(2)=-4$, find $f'(2)$ for the following

(a) $f(x)=x^2-4g(x)$, (b) $f(x)=\frac{x}{g(x)}$, (c) $f(x)=(g(x))^2$, (d) $f(x)=x\sin(g(x))$, (e) $f(x)=x^2\ln(g(x))$

3. Assume y is a differentiable function of x and find dy/dx.

(a) $x^3+y^3-4x^2y=0$, (b) $\sin(ay)+\cos(bx)=xy$ (c) $x\ln y+y^3=\ln x$

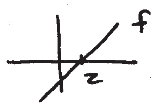
4. Find the limits.

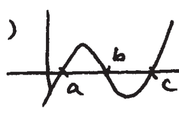
(a) $\lim_{x\to 1}\frac{\sin\sqrt{x-1}}{x-1}$ (b) $\lim_{x\to\infty}\frac{2x^3+5x^2}{3x^3-1}$ (c) $\lim_{x\to 0}\sqrt{x}\ln x$ (d) $\lim_{x\to 0}\frac{(\tan x)^{1/3}}{x}$

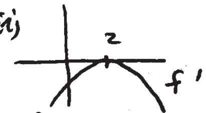
5. Find the equation of the tangent line to the graph of f at $x=1$ with $f(x)=x^2e^{-2x}$.

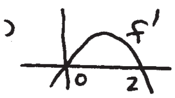
Chapter 5.

1. Given the graphs of f'. (a) Over what intervals is f increasing? Decreasing? (b) Does f have maxima or minima? If so, which, and where?

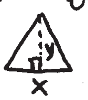
(i) 

(ii) 

(iii) 

(iv) 

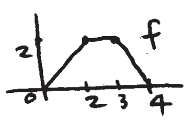
2. For each function, (a) find the critical points. (b) Use 1st derivative test to identify local extrema (c) Identify inflection points. (d) Use 2nd derivative test to confirm (b). (e) Sketch a graph of the function. (f) Confirm your answers using a calculator.
   (i) $f(x)=x^3+3x^2-9x-15$ (ii) $f(x)=x-2\ln x$ (iii) $f(x)=\frac{x^2}{x^2+1}$ (iv) $f(x)=x^5-15x^3+10$
3. Find the global extrema of f
   (a) $f(x)=x^3-2x^2$, $-1\le x\le 3$ (b) $f(x)=x^{-2/3}+x^{1/3}$, $1.2\le x\le 3.5$. (c) $f(x)=e^{-x}\sin x$, $0\le x\le 2\pi$.
   (f) $f(x)=xe^{-x}$, $0\le x<+\infty$ (g) $f(x)=3x^3-9x^2+12x+1$, $0\le x<+\infty$.
4. An equal latural triangle has a fixed circumference 4 m. What dimensions will maximize its area? $(x=4/3,\ y=2/\sqrt{3})$



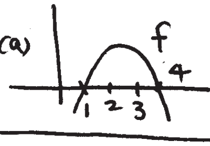
5. A ship is steaming due north at 12 knots (1 knot = 1.85 km/hr) and sights a large tanker 3 km away northwest steaming at 15 knot due east. Use a calculator to determine the shortest distance between them if they remain on their current headings.

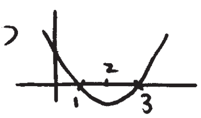
Chapter 6

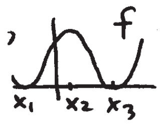
1. Find the indefinite integrals
   (a) $\int\left(x^{3/2}+\frac{\sqrt{x}}{5}-\frac{2}{x}\right)dx$ (b) $\int\frac{1}{\cos^2 x}\,dx$ (c) $\int\left(3\cos\psi+3\sqrt[3]{\psi}\right)d\psi$
   (d) $\int\frac{(x+5)^2}{x}\,dx$ (e) $\int\cos t\,(1+\sin t)^{29}\,dt$ (f) $\int 2xe^{x^2}\,dx$ (g) $\int\left(\sin\theta+\frac{1}{1+\theta^2}\right)d\theta$
2. Let $F(x)=\int_{\pi/2}^{x}\frac{\sin t}{t}\,dt$. Find the values of x between $\pi/2$ and $3\pi/2$ for which $F(x)$ has a global maximum and global minimum.
3. Given the graph, find $F(2)$, $F(4)$. if $F(0)=1$ and $F'(x)=f(x)$



4. Find solutions to the equations
   (a) $\frac{dy}{dx}=8x+\frac{1}{x}$ (b) $\frac{dy}{dt}=e^{2t}+5$, (c) $\frac{dy}{dx}=-x+1$, $y(0)=6$
5. Given $F'(x)=f(x)$, sketch a possible graph of $F(x)$ and identify extrema & inflect pts

(a) 

(b) 

(c) 

(d)