

AP CALCULUS AB AND BC

UNIT 5

Analytical Applications of Differentiation



Remember to go to [AP Classroom](#)
to assign students the online



UNIT
5

Analytical Applications of Differentiation

Enduring Understanding	Topic	Suggested Skills	Class Periods
FUN-1	5.1 Using the Mean Value Theorem	3.E 3 U R Y L G H U H D V R Q V R U U D W L R Q D O H V I R U V R O X W L R Q V D Q G F R Q F O X V L R Q V	&/\$ 6 6 3(5,2'6 é \$% ê &/\$ 6 6 3(5,2'6 é % & ê
	5.2 Extreme Value Theorem, Global Versus Local Extrema, and Critical Points	3.E 3 U R Y L G H U H D V R Q V R U U D W L R Q D O H V I R U V R O X W L R Q V D Q G F R Q F O X V L R Q V	
	5.3 Determining Intervals on Which a Function is Increasing or Decreasing	2.E Suggested Skills BT 0 T 0..239 re f .9011 Tm2alTex4339>520411 T[(Skl)-10 tch8 (eGr)31 0 1 ordD600134 .0013 0 0/GS1 gs /C15 <h ox25415600030C0059>-m9a900442Ch ox2alBh 500.	
FUN-4			

SAMPLE INSTRUCTIONAL ACTIVITIES

7KH VDPSOH DFWLYLWLHV RQ WKLV SDJH DUH RSWLRQDO DQG DUH R-HUHG WR SU LQFRUSRUDWH YDULRXV LQVWUXFWLRQDO DSSURDFKHV LQWR WKH FODVVURRP 7H WKHVH DFWLYLWLHV RU LQVWUXFWLRQDO DSSURDFKHV DQG DUH IUHH WR DOWHU

Activity	Topic	Suggested Activity
1	5.3	Critique Reasoning Arrange students in groups of four to six, provide them with a function's derivative $H g'(x)=5x+3$, and ask them to determine if $g(x)$ is increasing or decreasing at a spec L@FyDOXH IR Ux #H3D P\$S/ONHV WXGHQWV WR VKDUH WKH UHDVRQLQ FRQFOXVLRQ ZLWK FODVVPDWHV LQ WKHLU JURXS OHPEHUV RI WIHHGEDFN DQG VXJJHVWLQV
2	5.4 5.7	Think-Pair-Share Provide students with a graph of f and a graph of f' \$VN WKHP WR LGHQWL\ UHODWLYH WUHPD DQG SUDFWLFH ZULWLQJ MXVWL@FDWLRQV IRU UHODWLYH GHULYDWLYH WHVW 2QFH WKH\oYH ZULWWHQ WKHLU MXVWL@FDWLRQV DQG VKDUH WKHLU MXVWL@FDWLRQV 6WXGHQWV FDQ WKHQ GLVFX WKHLU MXVWL@FDWLRQ ZRUGLQJ
3	5.5	Create a Plan 3URYLGH VWXGHQWV ZLWK D IXQFWLRQ UHSUHVHQWHG DQDO\WLF D to discuss and write x YDOXHV WKDW DUH YLDEOH FDQGLGDWHV IRU DEVRO they have established the viable candidates, ask them to design a method for analyzing WKH EHKDYLRLU RI WKH IXQFWLRQoV JUDSK DW WKH FDQGLGDWHV D
4	5.8 5.9	3URYLGH VWXGHQWV ZLWK WKH JUDSK RI D GL-HUHQWLDEOH IXQFWLRQ f(x)=x ³ -4x ² +4x+1 EXW GR QRW SURYLGH WKH UXOH IRU WKH IXQFWLF WR VNHWFK D JUDSK RI WKH GHULYDWLYH RI WKH IXQFWLRQ 2QFH the rule for f(x) \$VN VWXGHQW M(x) and Es GxQD W Graph f (x) and FRPSDUH LW WR WKHLU VNHWFKHG JUDSK

UNIT
5

Analytical Applications of Differentiation

SUGGESTED SKILL

✓ - X V W L fi F D W L R Q

3.E

Provide reasons or

rationales for solutions

D Q G F R Q F O X V L R Q V

TOPIC 5.2

Extreme Value Theorem, Global Versus Local Extrema, and Critical Points

SUGGESTED SKILL

 - X V W L f i F D W L R Q

3.E

Provide reasons or
rationales for solutions and
F R Q F O X V L R Q V

AVAILABLE RESOURCES

 Classroom
Resource > [Why
We Use Theorem in
Calculus](#) Professional
Development >

SUGGESTED SKILL

 & R Q Q H F W L Q J
5 H S U H V H Q W D W L R Q V

2.E

Describe the relationships among different representations of functions and their
G H U L Y D W L Y H V



AVAILABLE RESOURCE

-  The Exam >
Commentary on the Instructions for the Free Response Section of the AP Calculus Exams
 On the Role of Sign Charts in AP Calculus Exams

TOPIC 5.3

Determining Intervals on Which a Function Is Increasing or Decreasing

Required Course Content

ENDURING UNDERSTANDING

FUN-4

\$ I X Q F W L R Q o V G H U L Y D W L Y H F D Q E H X V H G W R X Q G H U V W D Q G V

LEARNING OBJECTIVE

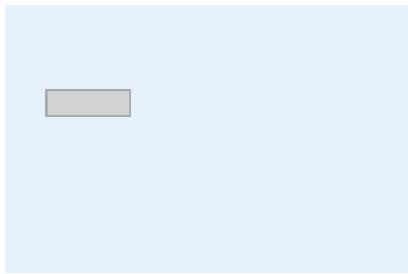
FUN-4.A

Justify conclusions about the behavior of a function based on the behavior of its
G H U L Y D W L Y H V

ESSENTIAL KNOWLEDGE

FUN-4.A.1

7 K H ® U V W G H U L Y D W L Y H R I D I X Q F W L R Q information about the function and its graph, including intervals where the function is
L Q F U H D V L Q J R U G H F U H D V L Q J



ENDURING UNDERSTANDING**FUN-4****LEARNING OBJECTIVE****FUN-4.A**

Justify conclusions about the behavior of a function based on the behavior of its
G H U L Y D W L Y H V

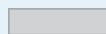
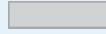
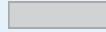
ESSENTIAL KNOWLEDGE**FUN-4.A.3**

Absolute (global) extrema of a function on a closed interval can only occur at critical points
R U D W H Q G S R L Q W V

LEARNING OBJECTIVE

FUN-4.A

Justify conclusions about
the behavior of a function
based on the behavior of its
G H U L Y D W L Y H V



LEARNING OBJECTIVE**FUN-4.A**

Justify conclusions about the behavior of a function based on the behavior of its
G H U L Y D W L Y H V

ESSENTIAL KNOWLEDGE**FUN-4.A.7**

The second derivative of a function may determine whether a critical point is the location of a relative (local) maximum or P L Q L P X P

FUN-4.A.8

When a continuous function has only one

TOPIC 5.8

Sketching Graphs of Functions and Their Derivatives

SUGGESTED SKILL

 & R Q Q H F W L Q J
5 H S U H V H Q W D W L R Q V

2.D

Identify how mathematical characteristics or properties of functions are related in different
U H S U H V H Q W D W L R Q V

ENDURING UNDERSTANDING

FUN-4

\$ I X Q F W L R Q o V G H U L Y D W L Y H F D Q E H X V H G W R X Q G H U V W D Q G V R P H E H K D Y L R U V

LEARNING OBJECTIVE

FUN-4.A

Justify conclusions about the behavior of a function based on the behavior of its
G H U L Y D W L Y H V

ESSENTIAL KNOWLEDGE

FUN-4.A.9

Key features of functions and their derivatives
F D Q E H L G H Q W L ® H G D Q G U H O D W H G W R W K H L U J U D S K L F D
Q X P H U L F D O D Q G D Q D O \ W L F D O U H S U H V H Q W D W L R Q V

FUN-4.A.10

Graphical, numerical, and analytical information from f' and f'' can be used to predict and explain the behavior of f

SUGGESTED SKILL

& R Q Q H F W L Q J
5 H S U H V H Q W D W L R Q V

2.D

Identify how mathematical characteristics or properties of functions are related in different

U H S U H V H Q W D W L R Q V

TOPIC 5.9

Connecting a Function, Its First Derivative, and Its Second Derivative

ENDURING UNDERSTANDING

FUN-4

\$ IXQFWLRQoV GHULYDWLYH FDQ EH XVHG WR XQGHUVWDQG V

LEARNING OBJECTIVE

FUN-4.A

Justify conclusions about the behavior of a function based on the behavior of
L W V { G H U L Y D W L Y H V

ESSENTIAL KNOWLEDGE

FUN-4.A.11

Key features of the graphs of f , f' , and f'' are
U H O D W H G W R R Q H D Q R W K H U

TOPIC 5.10

Introduction to Optimization Problems

SUGGESTED SKILL

& R Q Q H F W L Q J
5 H S U H V H Q W D W L R Q V

2.A

ENDURING UNDERSTANDING

FUN-4

\$ IXQFWLRQoV GHULYDWLYH FDQ EH XVHG WR XQGHUVWDQG VRPH EHKDYLURUV

LEARNING OBJECTIVE

FUN-4.B

Calculate minimum and maximum values in applied contexts or analysis of
IXQFWLRQV

ESSENTIAL KNOWLEDGE

FUN-4.B.1

The derivative can be used to solve
RSWLP[L]DWLRQ SUREOHPV WKDW LV ®QGLQJD
minimum or maximum value of a function on a
JLYHQ LQWHUYDO

TOPIC 5.11



Solving Optimization Problems

TOPIC 5.12

Exploring Behaviors of Implicit Relations

SUGGESTED SKILLS

, P S O H P H Q W L Q J
O D W K H P D W L F D O
3 U R F H V V H V

1.E

Apply appropriate mathematical rules or procedures, with and Z L W K R X W W H F K Q R O R J V

- X V W L f i F D W L R Q

3.E

Provide reasons or rationales for solutions and F R Q F O X V L R Q V

Required Course Content

ENDURING UNDERSTANDING

FUN-4

\$ I X Q F W L R Q o V G H U L Y D W L Y H F D Q E H X V H G W R X Q G H U V W D Q G V R P H E H K D Y L R U V

LEARNING OBJECTIVE

FUN-4.D

Determine critical points of L P S O L F L W U H O D W L R Q V
Justify conclusions about the behavior of an implicitly G H ® Q H G I X Q F W L R Q V
H Y L G H Q F H I U R P L W V

ESSENTIAL KNOWLEDGE

FUN-4.D.1

\$ S R L Q W R Q D Q L P S O L F L W U H O D W L R Q Z K H U H W K H ® U V W
Derivative equals zero or does not exist is a F U L W L F D O S R L Q W R I W K H I X Q F W L R Q

FUN-4.E.1

Applications of derivatives can be extended to L P S O L F L W O \ G H ® Q H G I X Q F W L R Q V

FUN-4.E.2

Second derivatives involving implicit

G L ¬ H U H Q W L D W L R Q P x D y, and $\frac{dy}{dx}$ U H O D W L R Q V R I

