From the 2017 Administration

AP CollegeBoard

Calculus BC

Practice Exam

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AP Central is the official online home for the AP Program: apcentral.collegeboard.org

Contents

Note: This publication shows the page numbers that appeared in the *2016–17 AP Exam Instructions* book and in the actual exam. This publication was not repaginated to begin with page 1.

Exam Instructions

The following contains instructions taken from the *2016–17 AP Exam Instructions* book.

AP® Calculus AB/BC Exam

Regularly Scheduled Exam Date: Tuesday morning, May 9, 2017

Late-Testing Exam Date: Thursday morning, May 18, 2017

Section I	**Total Time:** 1 hour 45 minutes **Number of Questions:** 45* **Percent of Total Score:** 50% **Writing Instrument:** Pencil required **The number of questions may vary slightly depending on the form of the exam.*	**Part A:** **Number of Questions:** 30 **Time:** 1 hour *No calculator allowed*	**Part B:** **Number of Questions:** 15 **Time:** 45 minutes *Graphing calculator required*
Section II	**Total Time:** 1 hour 30 minutes **Number of Questions:** 6 **Percent of Total Score:** 50% **Writing Instrument:** Either pencil or pen with black or dark blue ink **Note**: For Section II, if students finish Part A before the end of the timed 30 minutes for Part A, they cannot begin working on Part B. Students must wait until the beginning of the timed 1 hour for Part B. However, during the timed portion for Part B, students may work on the problems in Part A without the use of a calculator.	**Part A:** **Number of Questions:** 2 **Time:** 30 minutes **Percent of Section II Score:** 33.33% *Graphing calculator required*	**Part B:** **Number of Questions:** 4 **Time:** 1 hour **Percent of Section II Score:** 66.67% *No calculator allowed*

What Proctors Need to Bring to This Exam

- Exam packets
- Answer sheets
- AP Student Packs
- *2016-17 AP Coordinator's Manual*
- This book — *AP Exam Instructions*
- AP Exam Seating Chart template
- School Code and Home-School/Self-Study Codes
- Extra graphing calculators
- Pencil sharpener
- Container for students' electronic devices (if needed)
- Extra No. 2 pencils with erasers
- Extra pens with black or dark blue ink
- Extra paper
- Stapler
- Watch
- Signs for the door to the testing room
  - "Exam in Progress"
  - "Cell phones are prohibited in the testing room"

Before Distributing Exams: Check that the title on all exam covers is **Calculus AB** or **Calculus BC**. If there are any exam booklets with a different title, contact the AP coordinator immediately.

SEATING POLICY FOR AP CALCULUS AB AND CALCULUS BC EXAMS

Testing Window	Exams Administered at Schools in the United States, Canada, Puerto Rico, and the U.S. Virgin Islands	Exams Administered at Schools Outside the United States, Canada, Puerto Rico, and the U.S. Virgin Islands
Regularly Scheduled Exams	Students must be seated no less than four feet apart.	Students must be seated no less than five feet apart.
Late-Testing Exams	Students must be seated no less than five feet apart.	

Graphing calculators are required to answer some of the questions on the AP Calculus Exams. Before starting the exam administration, make sure each student has a graphing calculator from the approved list on page 49 of the *2016-17 AP Coordinator's Manual*. If a student does not have a graphing calculator from the approved list, you may provide one from your supply. If the student does not want to use the calculator you provide or does not want to use a calculator at all, he or she must hand copy, date, and sign the release statement on page 47 of the *AP Coordinator's Manual*.

During the administration of Section I, Part B, and Section II, Part A, students may have no more than two graphing calculators on their desks. Calculators may not be shared. **Calculator memories do not need to be cleared before or after the exam.** Students with Hewlett-Packard 48–50 Series and Casio FX-9860 graphing calculators may use cards designed for use with these calculators. Proctors should make sure infrared ports (Hewlett-Packard) are not facing each other. **Since graphing calculators can be used to store data, including text, proctors should monitor that students are using their calculators appropriately. Attempts by students to use the calculator to remove exam questions and/or answers from the room may result in the cancellation of AP Exam scores.**

The AP Calculus AB Exam and the AP Calculus BC Exam should be administered simultaneously. They may be administered in separate rooms, or in the same room if it is more convenient.

SECTION I: Multiple Choice

Do not begin the exam instructions below until you have completed the appropriate General Instructions for your group.

These exams include survey questions. The time allowed for the survey questions is in addition to the actual test-taking time.

Make sure you begin the exams at the designated time. Remember, you must complete a seating chart for this exam. See pages 325–326 for a seating chart template and instructions. See the *2016-17 AP Coordinator's Manual* for exam seating requirements (pages 51–54).

If you are giving the regularly scheduled exam, say:

It is Tuesday morning, May 9, and you will be taking either the AP Calculus AB Exam or the AP Calculus BC Exam.

If you are giving the alternate exam for late testing, say:

It is Thursday morning, May 18, and you will be taking either the AP Calculus AB Exam or the AP Calculus BC Exam.

In a moment, you will open the packet that contains your exam materials. By opening this packet, you agree to all of the AP Program's policies and procedures outlined in the *2016-17 Bulletin for AP Students and Parents*.

If you are giving the AP Calculus AB exam, say:

Look at your exam packet and confirm that the exam title is "AP Calculus AB." Raise your hand if your exam packet contains any title other than "AP Calculus AB" and I will help you.

If you are giving the AP Calculus BC exam, say:

Look at your exam packet and confirm that the exam title is "AP Calculus BC." Raise your hand if your exam packet contains any title other than "AP Calculus BC" and I will help you.

If you are giving both the AP Calculus AB and Calculus BC exams, say:

Look at your exam packet and confirm that the exam title is "AP Calculus AB" or "AP Calculus BC," depending upon which exam you are taking today. Raise your hand if your exam packet contains any other title and I will help you.

Once you confirm that all students have the correct exam, say:

You may now remove the shrinkwrap from your exam packet and take out the Section I booklet, but do not open the booklet or the shrinkwrapped Section II materials. Put the white seals aside. . . .

Carefully remove the AP Exam label found near the top left of your exam booklet cover. Now place it on page 1 of your answer sheet on the light blue box near the top right corner that reads "AP Exam Label."

If students accidentally place the exam label in the space for the number label or vice versa, advise them to leave the labels in place. They should not try to remove the label; their exam can still be processed correctly.

Read the statements on the front cover of Section I and look up when you have finished. . . .

Sign your name and write today's date. Look up when you have finished. . . .

Now print your full legal name where indicated. Are there any questions? . . .

Turn to the back cover of your exam booklet and read it completely. Look up when you have finished. . . .

Are there any questions? . . .

You will now take the multiple-choice portion of the exam. You should have in front of you the multiple-choice booklet and your answer sheet. You may never discuss the multiple-choice exam content at any time in any form with anyone, including your teacher and other students. If you disclose the multiple-choice exam content through any means, your AP Exam score will be canceled.

Open your answer sheet to page 2. You must complete the answer sheet using a No. 2 pencil only. Mark all of your responses beginning on page 2 of your answer sheet, one response per question. Completely fill in the circles. If you need to erase, do so carefully and completely. No credit will be given for anything written in the exam booklet. Scratch paper is not allowed, but you may use the margins or any blank space in the exam booklet for scratch work.

Section I is divided into two parts. Each part is timed separately, and you may work on each part only during the time allotted for it. Calculators are not allowed in Part A. Please put your calculators under your chair. Are there any questions? . . .

You have 1 hour for Part A. Part A questions are numbered 1 through 30. Mark your responses for these questions on page 2 of your answer sheet. Open your Section I booklet and begin.

Note Start Time here _____. Note Stop Time here _____. Check that students are marking their answers in pencil on page 2 of their answer sheets and that they are not looking beyond Part A. The line of A's at the top of each page will assist you in monitoring students' work. After 50 minutes, say:

There are 10 minutes remaining.

After 10 minutes, say:

Stop working on Part A and turn to page 24 in your Section I booklet. . . .

On that page, you should see an area marked "PLACE SEAL HERE." Making sure all of your other exam materials, including your answer sheet, are out of the way, take one of your seals and press it on that area and then fold the seal over the open edge to the front cover. Be sure you don't seal the Part B section of the booklet or let the seal touch anything except the marked areas. . . .

After all students have sealed Part A, say:

Graphing calculators are required for Part B. You may get your calculators from under your chair and place them on your desk. Part B questions are numbered 76 through 90. Fold your answer sheet so only page 3 is showing and mark your responses for these questions on that page. You have 45 minutes for Part B. You may begin.

Note Start Time here _____. Note Stop Time here _____. Check that students have sealed their booklets properly and are now working on Part B. The large B's in an alternating shaded pattern at the top of each page will assist you in monitoring their work. Proctors should make sure that students are using their calculators appropriately. Proctors should also make sure Hewlett-Packard calculators' infrared ports are not facing each other. After 35 minutes, say:

There are 10 minutes remaining.

After 10 minutes, say:

Stop working and turn to page 38. You have 3 minutes to answer Questions 91–94. These are survey questions and will not affect your score. Note that each survey question has five answer options. You may not go back to work on any of the exam questions. . . .

Give students approximately 3 minutes to answer the survey questions. Then say:

Close your booklet and put your answer sheet on your desk, face up. Make sure you have your AP number label and an AP Exam label on page 1 of your answer sheet. Sit quietly while I collect your answer sheets.

Collect an answer sheet from each student. Check that each answer sheet has an AP number label and an AP Exam label. After all answer sheets have been collected, say:

Now you must seal your Section I booklet. Remove the remaining white seals from the backing and press one on each area of your exam booklet cover marked "PLACE SEAL HERE." Fold each seal over the back cover. When you have finished, place the booklet on your desk, face up. I will now collect your Section I booklet. . . .

Collect a Section I booklet from each student. Check that each student has signed the front cover of the sealed Section I booklet.

There is a 10-minute break between Sections I and II. When all Section I materials have been collected and accounted for and you are ready for the break, say:

Please listen carefully to these instructions before we take a 10-minute break. All items you placed under your chair at the beginning of this exam must stay there, and you are not permitted to open or access them in any way. Leave your shrinkwrapped Section II packet on top of your desk during the break. You are not allowed to consult teachers, other students, notes, or textbooks during the break. You may not make phone calls, send text messages, use your calculators, check email, use a social networking site, or access any electronic or communication device. Remember, you may never discuss the multiple-choice exam content at any time in any form with anyone, including your teacher and other students. If you disclose the multiple-choice exam content through any means, your AP Exam score will be canceled. Are there any questions? . . .

You may begin your break. Testing will resume at _____.

SECTION II: Free Response

After the break, say:

May I have everyone's attention? Place your Student Pack on your desk. . . .

You may now remove the shrinkwrap from the Section II packet, but do not open the Section II exam booklet until you are told to do so. . . .

Read the bulleted statements on the front cover of the exam booklet. Look up when you have finished. . . .

Now take an AP number label from your Student Pack and place it on the shaded box. If you don't have any AP number labels, write your AP number in the box. Look up when you have finished. . . .

Read the last statement. . . .

Using a pen with black or dark blue ink, print the first, middle, and last initials of your legal name in the boxes and print today's date where indicated. This constitutes your signature and your agreement to the statements on the front cover. . . .

Turn to the back cover and, using your pen, complete Item 1 under "Important Identification Information." Print the first two letters of your last name and the first letter of your first name in the boxes. Look up when you have finished. . . .

In Item 2, print your date of birth in the boxes. . . .

In Item 3, write the school code you printed on the front of your Student Pack in the boxes. . . .

Read Item 4. . . .

Are there any questions? . . .

I need to collect the Student Pack from anyone who will be taking another AP Exam. You may keep it only if you are not taking any other AP Exams this year. If you have no other AP Exams to take, place your Student Pack under your chair now. . . .

Read the information on the back cover of the exam booklet, paying careful attention to the bulleted statements in the instructions. Do not open the exam booklet or break the seals in the exam booklet until you are told to do so. Look up when you have finished. . . .

Collect the Student Packs. Then say:

Are there any questions? . . .

Section II also has two parts that are timed separately. You are responsible for pacing yourself and may proceed freely from one question to the next within each part. Graphing calculators are required for Part A, so you may keep your calculators on your desk. You must write your answers in the appropriate space in the exam booklet using a No. 2 pencil or a pen with black or dark blue ink. Do not break the seals for Part B at this time.
Are there any questions? . . .

You have 30 minutes to answer the questions in Part A. If you need more paper during the exam, raise your hand. At the top of each extra sheet of paper you use, be sure to write only your AP number and the question

number you are working on. Do not write your name. Open your exam booklet and begin.

Note Start Time here _____. Note Stop Time here _____. Check that students are working on Part A only and writing their answers in their exam booklets using pencils or pens with black or dark blue ink. The pages for the Part A questions are marked with large 1's or 2's at the top of each page to assist you in monitoring their work. After 20 minutes, say:

There are 10 minutes remaining in Part A.

After 10 minutes, say:

Stop working on Part A. Calculators are not allowed for Part B. Please put all of your calculators under your chair. . . .

Turn to page 13. You have 1 hour for Part B. During this time you may go back to Part A, but you may not use your calculator. Remember to show your work and write your answer to each part of each problem in the appropriate space in the exam booklet. Are there any questions? . . .

Using your finger, break open the seals on Part B. Do not peel the seals away from the booklet. You may go on to the next page and begin Part B.

Note Start Time here _____. Note Stop Time here _____. After 50 minutes, say:

There are 10 minutes remaining in Part B.

After 10 minutes, say:

Stop working and close your exam booklet. Place it on your desk, face up. . . .

If any students used extra paper for a question in the free-response section, have those students staple the extra sheet(s) to the first page corresponding to that question in their exam booklets. Complete an Incident Report. A single Incident Report may be completed for multiple students per exam subject per administration (regular or late testing) as long as all of the required information is provided. Include all exam booklets with extra sheets of paper in an Incident Report return envelope (see page 62 of the *2016-17 AP Coordinator's Manual* for complete details). Then say:

Remain in your seat, without talking, while the exam materials are collected. . . .

Collect a Section II exam booklet from each student. Check for the following:

- Exam booklet front cover: The student placed an AP number label on the shaded box and printed his or her initials and today's date.
- Exam booklet back cover: The student completed the "Important Identification Information" area.

When all exam materials have been collected and accounted for, return to students any electronic devices you may have collected before the start of the exam.

If you are giving the regularly scheduled exam, say:

You may not discuss or share the free-response exam content with anyone unless it is released on the College Board website in about two days. Your AP Exam score results will be available online in July.

If you are giving the alternate exam for late testing, say:

None of the content in this exam may ever be discussed or shared in any way at any time. Your AP Exam score results will be available online in July.

If any students completed the AP number card at the beginning of this exam, say:

Please remember to take your AP number card with you. You will need the information on this card to view your scores and order AP score reporting services online.

Then say:

You are now dismissed.

Post-Exam Tasks

Be sure to give the completed seating chart to the AP coordinator. Schools must retain seating charts for at least six months (unless the state or district requires that they be retained for a longer period of time). Schools should not return any seating charts in their exam shipments unless they are required as part of an Incident Report.

The exam proctor should complete the following tasks if asked to do so by the AP coordinator. Otherwise, the AP coordinator must complete these tasks.

All exam materials must be placed in secure storage until they are returned to the AP Program after your school's last administration. Before storing materials, check the "School Use Only" section on page 1 of the answer sheet and:

- Fill in the appropriate section number circle in order to access a separate AP Instructional Planning Report (for regularly scheduled exams only) or subject score roster at the class section or teacher level. See "Post-Exam Activities" in the *2016-17 AP Coordinator's Manual*.
- Check your list of students who are eligible for fee reductions and fill in the appropriate circle on their registration answer sheets.

Student Answer Sheet for the Multiple-Choice Section

Use this section to capture student responses. (Note that the following answer sheet is a sample, and may differ from one used in an actual exam.)

AP Answer Sheet 2017

AP Number Label
(from Student Pack)

123456789

AP Exam Label
(from Section I Booklet)

CollegeBoard

COMPLETE THIS AREA AT EVERY EXAM. **USE NO. 2 PENCIL ONLY**

To maintain the security of the exam and the validity of my AP score, I will allow no one else to see the multiple-choice exam content. I will seal the multiple-choice booklet when asked to do so, and I will not discuss the exam content with anyone at any time after completing the section. I am aware of and agree to the AP Program's policies and procedures as outlined in the *2016-17 Bulletin for AP Students and Parents*, including using testing accommodations (e.g., extended time, computer, etc.) only if I have been preapproved by College Board Services for Students with Disabilities.

A. SIGNATURE Sign your legal name as it will appear on your college applications. Date

B. LEGAL NAME Omit apostrophes, Jr., II.

Legal Last Name — First 15 Letters | Legal First Name — First 12 Letters | MI

C. YOUR AP NUMBER

D. EXAM DATE Month Day

E. EXAM START TIME AM PM

F. MULTIPLE-CHOICE BOOKLET SERIAL NUMBER S

G. ONLINE PROVIDER CODE

H. AP EXAM I AM TAKING USING THIS ANSWER SHEET Exam Name: Form: Form Code:

792107

SCHOOL USE ONLY

Section Number (1) (2) (3) (4) (5) (6) (7) (8) (9)

Fee Reduction Granted (1) Option 1 (2) Option 2

COMPLETE THIS AREA ONLY ONCE.

I. AREA CODE AND PHONE NUMBER

INTERNATIONAL PHONE

J. SCHOOL YOU ATTEND

SCHOOL CODE | School Name | City | State | Country

K. DATE OF BIRTH

Month (Jan) (Feb) (Mar) (Apr) (May) (Jun) (Jul) (Aug) (Sep) (Oct) (Nov) (Dec) Day Year

L. SOCIAL SECURITY NUMBER (Optional)

M. COLLEGE TO RECEIVE YOUR AP SCORE REPORT

COLLEGE CODE

Using the college code listed in the AP Student Pack, indicate the **ONE** college that you want to receive your AP score report.

College Name | City | State | Country

N. CURRENT GRADE LEVEL

- Not yet in 9th grade
- 9th
- 10th
- 11th
- 12th
- No longer in high school

O. STUDENT SEARCH SERVICE®

Colleges and scholarship programs may request your information to inform you of educational opportunities and financial aid.

Would you like us to supply your information?

- Yes
- No

If you don't answer and previously chose to participate in this service, we will continue providing your information.

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Q4298/1-4

COMPLETE THIS AREA AT EACH EXAM (IF APPLICABLE).

P. SURVEY QUESTIONS — Answer the survey questions in the AP Student Pack. Do not put responses to exam questions in this section.

1	A B C D E F G H I	4	A B C D E F G H I	7	A B C D E F G H I
2	A B C D E F G H I	5	A B C D E F G H I	8	A B C D E F G H I
3	A B C D E F G H I	6	A B C D E F G H I	9	A B C D E F G H I

Q. LANGUAGE — Do not complete this section unless instructed to do so.

If this answer sheet is for the French Language and Culture, German Language and Culture, Italian Language and Culture, Spanish Language and Culture, or Spanish Literature and Culture Exam, please answer the following questions. Your responses will not affect your score.

1. Have you lived or studied for one month or more in a country where the language of the exam you are now taking is spoken?

○ Yes ○ No

2. Do you regularly speak or hear the language at home?

○ Yes ○ No

QUESTIONS 1–75

Indicate your answers to the exam questions in this section (pages 2 and 3). Mark only one response per question for Questions 1 through 120. If a question has only four answer options, do not mark option E. Answers written in the multiple-choice booklet will not be scored.

COMPLETE MARK ● EXAMPLES OF INCOMPLETE MARKS 

You must use a No. 2 pencil and marks must be complete. Do not use a mechanical pencil. It is very important that you fill in the entire circle darkly and completely. If you change your response, erase as completely as possible. Incomplete marks or erasures may affect your score.

1	A B C D E	26	A B C D E	51	A B C D E
2	A B C D E	27	A B C D E	52	A B C D E
3	A B C D E	28	A B C D E	53	A B C D E
4	A B C D E	29	A B C D E	54	A B C D E
5	A B C D E	30	A B C D E	55	A B C D E
6	A B C D E	31	A B C D E	56	A B C D E
7	A B C D E	32	A B C D E	57	A B C D E
8	A B C D E	33	A B C D E	58	A B C D E
9	A B C D E	34	A B C D E	59	A B C D E
10	A B C D E	35	A B C D E	60	A B C D E
11	A B C D E	36	A B C D E	61	A B C D E
12	A B C D E	37	A B C D E	62	A B C D E
13	A B C D E	38	A B C D E	63	A B C D E
14	A B C D E	39	A B C D E	64	A B C D E
15	A B C D E	40	A B C D E	65	A B C D E
16	A B C D E	41	A B C D E	66	A B C D E
17	A B C D E	42	A B C D E	67	A B C D E
18	A B C D E	43	A B C D E	68	A B C D E
19	A B C D E	44	A B C D E	69	A B C D E
20	A B C D E	45	A B C D E	70	A B C D E
21	A B C D E	46	A B C D E	71	A B C D E
22	A B C D E	47	A B C D E	72	A B C D E
23	A B C D E	48	A B C D E	73	A B C D E
24	A B C D E	49	A B C D E	74	A B C D E
25	A B C D E	50	A B C D E	75	A B C D E

ETS USE ONLY

Exam		0 1 2 3 4 5 6 7 8 9
		0 1 2 3 4 5 6 7 8 9
Exam		0 1 2 3 4 5 6 7 8 9
		0 1 2 3 4 5 6 7 8 9

SELECTED MEDIA EXAMS	R	W	O	OTHER EXAMS	R	W	O
PT02				TOTAL			
PT03				Subscore (if applicable)			
PT04				Subscore (if applicable)			

DO NOT WRITE IN THIS AREA

QUESTIONS 76–120

Be sure each mark is dark and completely fills the circle. If a question has only four answer options, do not mark option E.

76	A B C D E	91	A B C D E	106	A B C D E
77	A B C D E	92	A B C D E	107	A B C D E
78	A B C D E	93	A B C D E	108	A B C D E
79	A B C D E	94	A B C D E	109	A B C D E
80	A B C D E	95	A B C D E	110	A B C D E
81	A B C D E	96	A B C D E	111	A B C D E
82	A B C D E	97	A B C D E	112	A B C D E
83	A B C D E	98	A B C D E	113	A B C D E
84	A B C D E	99	A B C D E	114	A B C D E
85	A B C D E	100	A B C D E	115	A B C D E
86	A B C D E	101	A B C D E	116	A B C D E
87	A B C D E	102	A B C D E	117	A B C D E
88	A B C D E	103	A B C D E	118	A B C D E
89	A B C D E	104	A B C D E	119	A B C D E
90	A B C D E	105	A B C D E	120	A B C D E

QUESTIONS 121–126

For Students Taking AP Biology

Write your answer in the boxes at the top of the griddable area and fill in the corresponding circles. Mark only one circle in any column. You will receive credit only if the circles are filled in correctly.

121 122 123 124 125 126

QUESTIONS 131–142

For Students Taking AP Computer Science Principles, AP Physics 1, or AP Physics 2

Mark two responses per question. You will receive credit only if both correct responses are selected.

131	A B C D	135	A B C D	139	A B C D
132	A B C D	136	A B C D	140	A B C D
133	A B C D	137	A B C D	141	A B C D
134	A B C D	138	A B C D	142	A B C D

DO NOT WRITE IN THIS AREA

COMPLETE THIS AREA ONLY ONCE.

R. YOUR MAILING ADDRESS

Use the address abbreviations from your AP Student Pack. Fill in only one circle per column. Indicate a space in your address by leaving a blank box; do not grid that column.

STREET ADDRESS (include street number, street name, apartment number, etc.)

CITY

ZIP OR POSTAL CODE

COUNTRY CODE

STATE

AK	HI	MI	NY	VT
AL	IA	MN	OH	WA
AR	ID	MO	OK	WI
AZ	IL	MS	OR	WV
CA	IN	MT	PA	WY
CO	KS	NC	RI	Puerto Rico
CT	KY	ND	SC	
DC	LA	NE	SD	AA
DE	MA	NH	TN	AE
FL	MD	NJ	TX	AP
GA	ME	NM	UT	Other
		NV	VA	

V. SEX

- Female
- Male

W. WHICH LANGUAGE DO YOU KNOW BEST?

- English
- English and another language about the same
- Another language

X. RACIAL/ETHNIC GROUP

Please answer both questions about Hispanic origin and about race. For the following questions about your identity, Hispanic origins are not races.

(You may mark all that apply.)

a. Are you of Hispanic, Latino, or Spanish origin?

- No, not of Hispanic, Latino, or Spanish origin
- Yes, Cuban
- Yes, Mexican
- Yes, Puerto Rican
- Yes, another Hispanic, Latino, or Spanish origin

b. What is your race?

- American Indian or Alaska Native
- Asian (including Indian subcontinent and Philippines origin)
- Black or African American (including Africa and Afro-Caribbean origin)
- Native Hawaiian or other Pacific Islander
- White (including Middle Eastern origin)

Y. PARENTAL EDUCATION LEVEL

In the first column, indicate the highest level of education of one parent/guardian, and indicate whether this is your mother/female guardian or father/male guardian. Then, if applicable, indicate the highest level of education of your other parent/guardian in the second column, and indicate whether this is your mother/female guardian or father/male guardian.

Mother or female guardian	
Father or male guardian	
Grade school	
Some high school	
High school diploma or equivalent	
Vocational or trade school	
Some college	
Associate or two-year degree	
Bachelor's or four-year degree	
Some graduate or professional school	
Graduate or professional degree	

S. FOR STUDENTS OUTSIDE THE UNITED STATES ONLY

- If your address does not fit in the spaces provided in Item R, fill in as many circles as you can, then fill in the circle in Item S and print the remainder of your address in the spaces provided.

Address	City	State or Province	Country	ZIP or Postal Code

T. STUDENT IDENTIFIER (Student ID Number)

U. EMAIL ADDRESS

By providing your email address, you are granting the College Board permission to use your email address in accordance with the policies in the *2016-17 Bulletin for AP Students and Parents*.

Section I: Multiple-Choice Questions

This is the multiple-choice section of the 2017 AP exam.
It includes cover material and other administrative instructions
to help familiarize students with the mechanics of the exam.
(Note that future exams may differ in look from the following content.)

AP® Calculus BC Exam

SECTION I: Multiple Choice

2017

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

At a Glance

Total Time
1 hour and 45 minutes
Number of Questions
45
Percent of Total Score
50%
Writing Instrument
Pencil required

Part A

Number of Questions
30
Time
1 hour
Electronic Device
None allowed

Part B

Number of Questions
15
Time
45 minutes
Electronic Device
Graphing calculator required

Instructions

Section I of this exam contains 45 multiple-choice questions and 4 survey questions. For Part A, fill in only the circles for numbers 1 through 30 on page 2 of the answer sheet. For Part B, fill in only the circles for numbers 76 through 90 on page 3 of the answer sheet. Because Part A and Part B offer only four answer options for each question, do not mark the (E) answer circle for any question. The survey questions are numbers 91 through 94.

Indicate all of your answers to the multiple-choice questions on the answer sheet. No credit will be given for anything written in this exam booklet, but you may use the booklet for notes or scratch work. After you have decided which of the suggested answers is best, completely fill in the corresponding circle on the answer sheet. Give only one answer to each question. If you change an answer, be sure that the previous mark is erased completely. Here is a sample question and answer.

Sample Question	Sample Answer
Chicago is a (A) state (B) city (C) country (D) continent	Ⓐ ● Ⓒ Ⓓ Ⓔ

Use your time effectively, working as quickly as you can without losing accuracy. Do not spend too much time on any one question. Go on to other questions and come back to the ones you have not answered if you have time. It is not expected that everyone will know the answers to all of the multiple-choice questions.

Your total score on the multiple-choice section is based only on the number of questions answered correctly. Points are not deducted for incorrect answers or unanswered questions.

Form I
Form Code 4NBP4-S

CALCULUS BC

SECTION I, Part A

Time—1 hour

Number of questions—30

NO CALCULATOR IS ALLOWED FOR THIS PART OF THE EXAM.

Directions: Solve each of the following problems, using the available space for scratch work. After examining the form of the choices, decide which is the best of the choices given and fill in the corresponding circle on the answer sheet. No credit will be given for anything written in this exam booklet. Do not spend too much time on any one problem.

In this exam:

(1) Unless otherwise specified, the domain of a function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number.

(2) The inverse of a trigonometric function f may be indicated using the inverse function notation f^{-1} or with the prefix "arc" (e.g., $\sin^{-1} x = \arcsin x$).

GO ON TO THE NEXT PAGE.

1. If $f(x) = \cos^2(3x - 5)$, then $f'(x) =$

   (A) $6\cos(3x - 5)$

   (B) $-3\sin^2(3x - 5)$

   (C) $-2\sin(3x - 5)\cos(3x - 5)$

   (D) $-6\sin(3x - 5)\cos(3x - 5)$

---

2. $\displaystyle\int \frac{1}{t\sqrt{t}}\,dt =$

   (A) $-2t^{-1/2} + C$

   (B) $-\dfrac{3}{2}t^{-5/2} + C$

   (C) $-\dfrac{2}{5}t^{-5/2} + C$

   (D) $2t^{1/2}\ln t + C$

GO ON TO THE NEXT PAGE.

3. If $f(x) = \dfrac{5 - x}{x^3 + 2}$, then $f'(x) =$

(A) $\dfrac{-4x^3 + 15x^2 - 2}{\left(x^3 + 2\right)^2}$

(B) $\dfrac{-2x^3 + 15x^2 + 2}{\left(x^3 + 2\right)^2}$

(C) $\dfrac{2x^3 - 15x^2 - 2}{\left(x^3 + 2\right)^2}$

(D) $\dfrac{4x^3 - 15x^2 + 2}{\left(x^3 + 2\right)^2}$

GO ON TO THE NEXT PAGE.

4. The position of a particle moving in the xy-plane is given by the vector $\langle 4t^3, y(2t) \rangle$, where y is a twice-differentiable function of t. At time $t = \frac{1}{2}$, what is the acceleration vector of the particle?

   (A) $\langle 3, 2y''(1) \rangle$

   (B) $\langle 6, 4y''(1) \rangle$

   (C) $\langle 12, 2y''(1) \rangle$

   (D) $\langle 12, 4y''(1) \rangle$

---

5. To what number does the series $\sum_{k=0}^{\infty} \left(\frac{-e}{\pi} \right)^k$ converge?

   (A) 0 (B) $\frac{-e}{\pi + e}$ (C) $\frac{\pi}{\pi + e}$ (D) The series does not converge.

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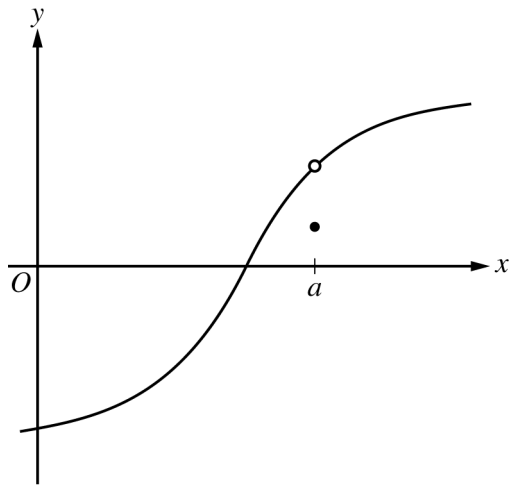

Graph of f

6. The graph of $y = f(x)$ is shown above. Which of the following is true?

(A) $\lim_{h \to 0} \dfrac{f(a+h) - f(a)}{h}$ exists.

(B) $\lim_{x \to a^+} f(x) \neq \lim_{x \to a^-} f(x)$

(C) $\lim_{x \to a} f(x) \neq f(a)$

(D) $\lim_{x \to a} f(x)$ does not exist.

GO ON TO THE NEXT PAGE.

7. If $\int_4^{-10} g(x)\,dx = -3$ and $\int_4^{6} g(x)\,dx = 5$, then $\int_{-10}^{6} g(x)\,dx =$

(A) -8 (B) -2 (C) 2 (D) 8

---

8. The length of the curve $y = \sin(3x)$ from $x = 0$ to $x = \dfrac{\pi}{6}$ is given by

(A) $\displaystyle\int_0^{\pi/6} \left(1 + 9\cos^2(3x)\right)\,dx$

(B) $\displaystyle\int_0^{\pi/6} \sqrt{1 + \sin^2(3x)}\,dx$

(C) $\displaystyle\int_0^{\pi/6} \sqrt{1 + 3\cos(3x)}\,dx$

(D) $\displaystyle\int_0^{\pi/6} \sqrt{1 + 9\cos^2(3x)}\,dx$

GO ON TO THE NEXT PAGE.

9. The slope of the line tangent to the graph of $y = xe^x$ at $x = \ln 2$ is

(A) $2 \ln 2$ (B) $2 \ln 2 + 2$ (C) $e^2(\ln 2) + e^2$ (D) $2 + \dfrac{2 \ln 2}{e}$

---

10. Let $y = f(x)$ be the solution to the differential equation $\dfrac{dy}{dx} = x - y$ with initial condition $f(2) = 8$. What is the approximation for $f(3)$ obtained by using Euler's method with two steps of equal length, starting at $x = 2$?

(A) 2 (B) $\dfrac{5}{2}$ (C) $\dfrac{15}{4}$ (D) $\dfrac{61}{4}$

GO ON TO THE NEXT PAGE.

11. If $x^2 + xy - 3y = 3$, then at the point $(2, 1)$, $\dfrac{dy}{dx} =$

(A) 5 (B) 4 (C) $\dfrac{7}{3}$ (D) 2

---

12. $\displaystyle\int \frac{3x + 1}{x^2 - 4x + 3}\, dx =$

(A) $-2 \ln |x - 3| + 5 \ln |x - 1| + C$

(B) $\dfrac{1}{5} \ln|x - 3| - \dfrac{1}{2} \ln |x - 1| + C$

(C) $\dfrac{1}{2} \ln|x - 3| - \dfrac{1}{2} \ln |x - 1| + C$

(D) $5 \ln|x - 3| - 2 \ln |x - 1| + C$

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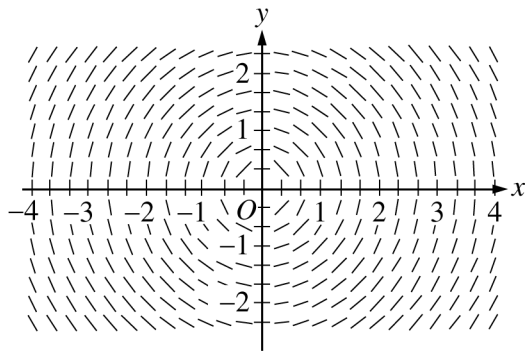
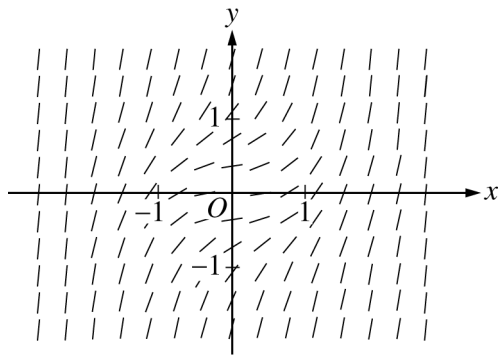
13. Which of the following is a slope field for the differential equation $\frac{dy}{dx} = x^2 + y^2$?

(A)



(B)



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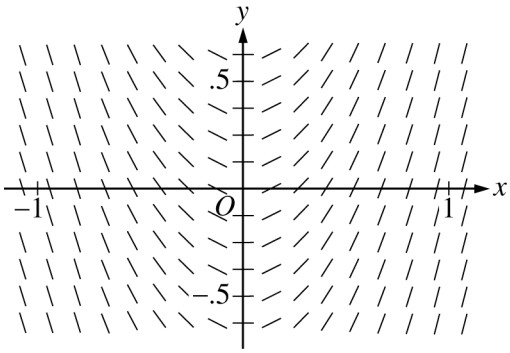
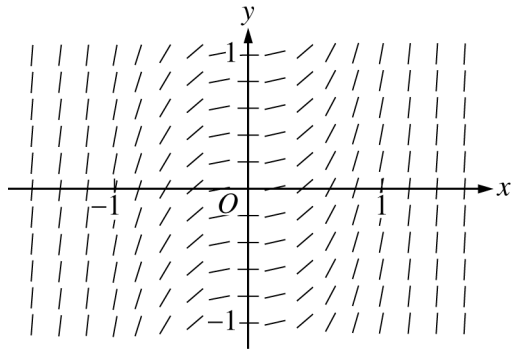


(D)



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14. If $f(x) = 3x^2 + 2x$, then $f'(x) =$

(A) $\lim\limits_{h \to 0} \dfrac{\left(3x^2 + 2x + h\right) - \left(3x^2 + 2x\right)}{h}$

(B) $\lim\limits_{x \to 0} \dfrac{\left(3x^2 + 2x + h\right) - \left(3x^2 + 2x\right)}{h}$

(C) $\lim\limits_{h \to 0} \dfrac{\left(3(x+h)^2 + 2(x+h)\right) - \left(3x^2 + 2x\right)}{h}$

(D) $\lim\limits_{x \to 0} \dfrac{\left(3(x+h)^2 + 2(x+h)\right) - \left(3x^2 + 2x\right)}{h}$

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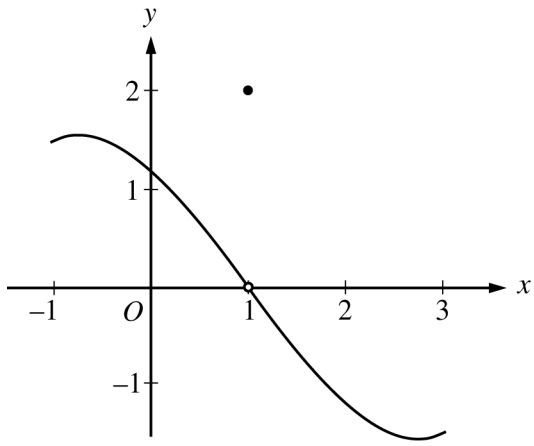
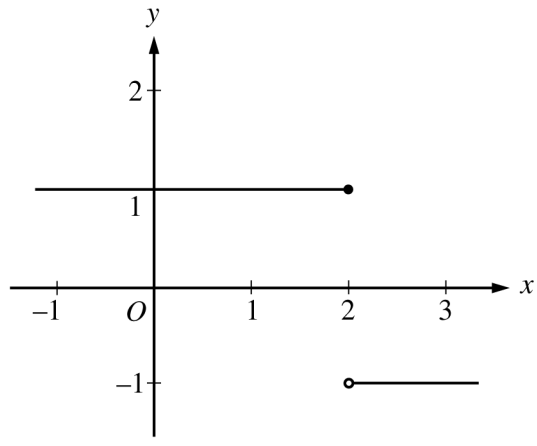


Graph of f



Graph of g

15. The graphs of the functions f and g are shown in the figures above. Which of the following statements is false?

(A) $\lim_{x \to 1} f(x) = 0$

(B) $\lim_{x \to 2} g(x)$ does not exist.

(C) $\lim_{x \to 1} (f(x)\, g(x+1))$ does not exist.

(D) $\lim_{x \to 1} (f(x+1)\, g(x))$ exists.

16. Which of the following is the interval of convergence for the series $\sum_{n=0}^{\infty} \frac{(x+2)^n}{2^n}$?

(A) $-4 < x < 0$

(B) $-4 \leq x < 0$

(C) $-2 < x < 2$

(D) $-2 \leq x < 2$

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17. $\int_0^5 \sqrt{\frac{5-x}{5}}\, dx =$

(A) $\frac{2}{3}$ (B) $\frac{10}{3}$ (C) 5 (D) $\frac{50\sqrt{5}}{3}$

GO ON TO THE NEXT PAGE.

18. Which of the following limits are equal to -1 ?

I. $\lim\limits_{x \to 0^-} \dfrac{|x|}{x}$

II. $\lim\limits_{x \to 3} \dfrac{x^2 - 7x + 12}{3 - x}$

III. $\lim\limits_{x \to \infty} \dfrac{1 - x}{1 + x}$

(A) I only (B) I and III only (C) II and III only (D) I, II, and III

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19. Let f be the function given by $f(x) = 2\cos x + 1$. What is the approximation for $f(1.5)$ found by using the line tangent to the graph of f at $x = \dfrac{\pi}{2}$?

(A) -2 (B) 1 (C) $\pi - 2$ (D) $4 - \pi$

GO ON TO THE NEXT PAGE.

20. A particle moves in the xy-plane so that its position for $t \geq 0$ is given by the parametric equations $x = \ln(t + 1)$ and $y = kt^2$, where k is a positive constant. The line tangent to the particle's path at the point where $t = 3$ has slope 8. What is the value of k ?

(A) $\frac{1}{192}$ (B) $\frac{1}{3}$ (C) $\frac{4}{3}$ (D) $\frac{16}{3}$

Time (weeks)	0	2	6	10
Level	210	200	190	180

21. The table above gives the level of a person's cholesterol at different times during a 10-week treatment period. What is the average level over this 10-week period obtained by using a trapezoidal approximation with the subintervals [0, 2], [2, 6], and [6, 10] ?

(A) 188 (B) 193 (C) 195 (D) 198

GO ON TO THE NEXT PAGE.

22. $\displaystyle\int \frac{x}{2} e^{-3x/4}\, dx =$

(A) $\displaystyle -\frac{3x}{4} e^{-3x/4} + \frac{3}{4} e^{-3x/4} + C$

(B) $\displaystyle -\frac{2x}{3} e^{-3x/4} - \frac{8}{9} e^{-3x/4} + C$

(C) $\displaystyle -\frac{x}{2} e^{-3x/4} + \frac{3}{8} e^{-3x/4} + C$

(D) $\displaystyle \frac{x}{2} e^{-3x/4} - \frac{1}{2} e^{-3x/4} + C$

GO ON TO THE NEXT PAGE.

23. If $f(x) = \sum_{n=1}^{\infty} \frac{x^{2n}}{n!}$, then $f'(x) =$

(A) $\frac{x^3}{3} + \frac{x^5}{5 \cdot 2!} + \frac{x^7}{7 \cdot 3!} + \frac{x^9}{9 \cdot 4!} + \cdots + \frac{x^{(2n+1)}}{(2n+1)n!} + \cdots$

(B) $x + \frac{3x^3}{2!} + \frac{5x^5}{3!} + \frac{7x^7}{4!} + \cdots + \frac{(2n-1)x^{(2n-1)}}{n!} + \cdots$

(C) $2 + 2x^2 + x^4 + \frac{x^6}{3} + \cdots + \frac{2x^{2(n-1)}}{(n-1)!} + \cdots$

(D) $2x + 2x^3 + x^5 + \frac{x^7}{3} + \cdots + \frac{2nx^{(2n-1)}}{n!} + \cdots$

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24. If the average value of a continuous function f on the interval $[-2, 4]$ is 12, what is $\int_{-2}^{4} \frac{f(x)}{8}\,dx$?

(A) $\frac{3}{2}$ (B) 3 (C) 9 (D) 72

GO ON TO THE NEXT PAGE.

25. What is the radius of convergence of the Maclaurin series for $\frac{2x}{1+x^2}$?

(A) $\frac{1}{2}$ (B) 1 (C) 2 (D) infinite

---

26. Let f be the function with $f(0) = \frac{1}{\pi^2}$, $f(2) = \frac{1}{\pi^2}$, and derivative given by $f'(x) = (x+1)\cos(\pi x)$. How many values of x in the open interval $(0, 2)$ satisfy the conclusion of the Mean Value Theorem for the function f on the closed interval $[0, 2]$?

(A) None

(B) One

(C) Two

(D) More than two

GO ON TO THE NEXT PAGE.

27. The number of students in a cafeteria is modeled by the function P that satisfies the logistic differential equation $\frac{dP}{dt} = \frac{1}{2000}P(200 - P)$, where t is the time in seconds and $P(0) = 25$. What is the greatest rate of change, in students per second, of the number of students in the cafeteria?

(A) 5 (B) 25 (C) 100 (D) 200

GO ON TO THE NEXT PAGE.

28. A cube with edges of length x centimeters has volume $V(x) = x^3$ cubic centimeters. The volume is increasing at a constant rate of 40 cubic centimeters per minute. At the instant when $x = 2$, what is the rate of change of x, in centimeters per minute, with respect to time?

(A) $\frac{10}{3}$ (B) $\sqrt{\frac{40}{3}}$ (C) 5 (D) 10

GO ON TO THE NEXT PAGE.

29. Which of the following is a power series expansion of $\frac{e^x + e^{-x}}{2}$?

(A) $1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} + \cdots + \frac{x^{2n}}{(2n)!} + \cdots$

(B) $1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \cdots + (-1)^n \frac{x^{2n}}{(2n)!} + \cdots$

(C) $x + \frac{x^3}{3!} + \frac{x^5}{5!} + \frac{x^7}{7!} + \cdots + \frac{x^{2n+1}}{(2n+1)!} + \cdots$

(D) $x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots + (-1)^n \frac{x^{2n+1}}{(2n+1)!} + \cdots$

GO ON TO THE NEXT PAGE.

30. Which of the following statements about the series $\sum_{n=1}^{\infty} \frac{1}{2^n - n}$ is true?

(A) The series diverges by the nth term test.

(B) The series diverges by limit comparison to the harmonic series $\sum_{n=1}^{\infty} \frac{1}{n}$.

(C) The series converges by the nth term test.

(D) The series converges by limit comparison to the geometric series $\sum_{n=1}^{\infty} \frac{1}{2^n}$.

END OF PART A

IF YOU FINISH BEFORE TIME IS CALLED,
YOU MAY CHECK YOUR WORK ON PART A ONLY.

DO NOT GO ON TO PART B UNTIL YOU ARE TOLD TO DO SO.

PART B STARTS ON PAGE 26.

CALCULUS BC

SECTION I, Part B

Time—45 minutes

Number of questions—15

A GRAPHING CALCULATOR IS REQUIRED FOR SOME QUESTIONS ON THIS PART OF THE EXAM.

Directions: Solve each of the following problems, using the available space for scratch work. After examining the form of the choices, decide which is the best of the choices given and fill in the corresponding circle on the answer sheet. No credit will be given for anything written in this exam booklet. Do not spend too much time on any one problem.

BE SURE YOU ARE USING PAGE 3 OF THE ANSWER SHEET TO RECORD YOUR ANSWERS TO QUESTIONS NUMBERED 76–90.

YOU MAY NOT RETURN TO PAGE 2 OF THE ANSWER SHEET.

In this exam:

(1) The exact numerical value of the correct answer does not always appear among the choices given. When this happens, select from among the choices the number that best approximates the exact numerical value.

(2) Unless otherwise specified, the domain of a function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number.

(3) The inverse of a trigonometric function f may be indicated using the inverse function notation f^{-1} or with the prefix "arc" (e.g., $\sin^{-1} x = \arcsin x$).

GO ON TO THE NEXT PAGE.

76. Let f be a twice-differentiable function for all real numbers x. Which of the following additional properties guarantees that f has a relative minimum at $x = c$?

(A) $f'(c) = 0$

(B) $f'(c) = 0$ and $f''(c) < 0$

(C) $f'(c) = 0$ and $f''(c) > 0$

(D) $f'(x) > 0$ for $x < c$ and $f'(x) < 0$ for $x > c$

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77. Let $H(x)$ be an antiderivative of $\dfrac{x^3 + \sin x}{x^2 + 2}$. If $H(5) = \pi$, then $H(2) =$

(A) -9.008 (B) -5.867 (C) 4.626 (D) 12.150

GO ON TO THE NEXT PAGE.

78. The continuous function f is positive and has domain $x > 0$. If the asymptotes of the graph of f are $x = 0$ and $y = 2$, which of the following statements must be true?

(A) $\lim_{x \to 0^+} f(x) = \infty$ and $\lim_{x \to 2} f(x) = \infty$

(B) $\lim_{x \to 0^+} f(x) = 2$ and $\lim_{x \to \infty} f(x) = 0$

(C) $\lim_{x \to 0^+} f(x) = \infty$ and $\lim_{x \to \infty} f(x) = 2$

(D) $\lim_{x \to 2} f(x) = \infty$ and $\lim_{x \to \infty} f(x) = 2$

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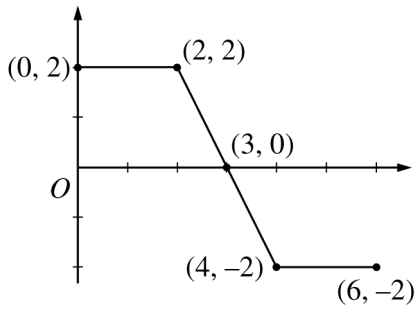

Graph of f

79. The graph of a function f, consisting of three line segments, is shown above. The function f is defined on the closed interval $[0, 6]$. Let $g(x) = \int_2^x f(t)\,dt$. What is the maximum value of $g(x)$ for $0 \le x \le 6$?

(A) 0 (B) 1 (C) 5 (D) 10

---

80. The position of an object moving along a path in the xy-plane is given by the parametric equations $x(t) = 5\sin(\pi t)$ and $y(t) = (2t - 1)^2$. The speed of the particle at time $t = 0$ is

(A) 3.422

(B) 11.708

(C) 15.580

(D) 16.209

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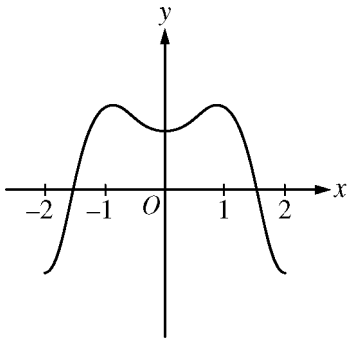
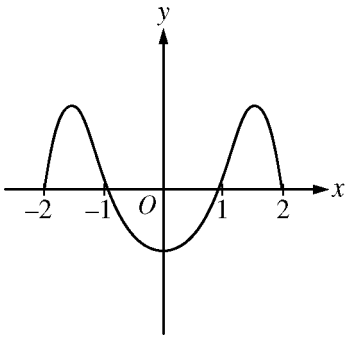


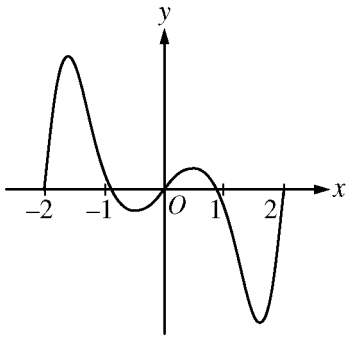
Graph of f

81. The graph of the function f is shown above for $-2 \le x \le 2$. Which of the following could be the graph of an antiderivative of f ?

(A)



(B)



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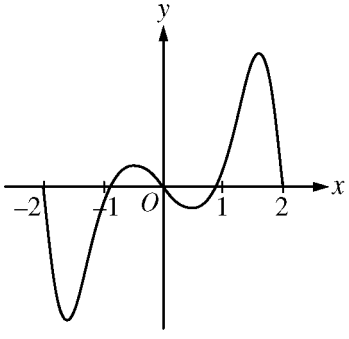

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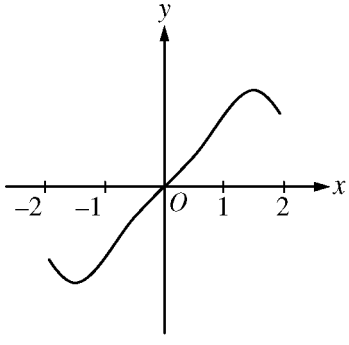

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82. The derivative of the function f is given by $f'(x) = e^{-x}\cos\left(x^2\right)$, for all real numbers x. What is the minimum value of $f(x)$ for $-1 \le x \le 1$?

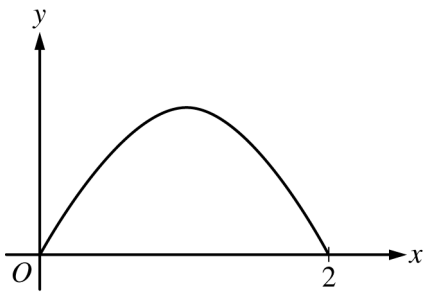
(A) $f(-1)$

(B) $f(-0.762)$

(C) $f(1)$

(D) There is no minimum value of $f(x)$ for $-1 \le x \le 1$.

GO ON TO THE NEXT PAGE.



83. The base of a solid is the region bounded by a portion of the graph of $y = \sin\left(\frac{\pi}{2}x\right)$ and the x-axis, as shown in the figure above. For the solid, each cross section perpendicular to the x-axis is a rectangle of height 3. Which of the following expressions gives the volume of the solid?

(A) $\int_0^2 3\sin\left(\frac{\pi}{2}x\right)\,dx$

(B) $\int_0^2 3\sin^2\left(\frac{\pi}{2}x\right)\,dx$

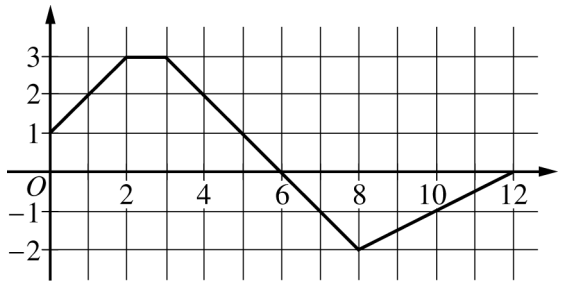
(C) $\int_0^2 3\pi\sin\left(\frac{\pi}{2}x\right)\,dx$

(D) $\int_0^2 3\pi\sin^2\left(\frac{\pi}{2}x\right)\,dx$

GO ON TO THE NEXT PAGE.

84. If g is a twice-differentiable function, where $g(1) = 0.5$ and $\lim_{x \to \infty} g(x) = 4$, then $\int_1^{\infty} g'(x)\,dx$ is

(A) -3.5 (B) 3.5 (C) 4.5 (D) nonexistent



Graph of f

85. The graph of the function f is shown above. If g is the function defined by $g(x) = \int_2^x f(t)\,dt$, what is the value of $g(10) \cdot g'(10)$?

(A) $\frac{25}{4}$ (B) $\frac{5}{4}$ (C) $-\frac{5}{2}$ (D) $-\frac{25}{2}$

GO ON TO THE NEXT PAGE.

$$f''(x) = x(x-1)^2(x+2)^3$$
$$g''(x) = x(x-1)^2(x+2)^3 + 1$$
$$h''(x) = x(x-1)^2(x+2)^3 - 1$$

86. The twice-differentiable functions f, g, and h have second derivatives given above. Which of the functions f, g, and h have a graph with exactly two points of inflection?

(A) g only

(B) h only

(C) f and g only

(D) f, g, and h

---

87. The velocity vector of a particle moving in the xy-plane has components given by $\frac{dx}{dt} = \sin(t^2)$ and $\frac{dy}{dt} = e^{\cos t}$. At time $t = 4$, the position of the particle is $(2, 1)$. What is the y-coordinate of the position vector at time $t = 3$?

(A) 0.410 (B) 0.590 (C) 0.851 (D) 1.410

GO ON TO THE NEXT PAGE.

88. The function f is increasing on the interval $[1, 3]$ and nowhere else. The first derivative of f, f', is continuous for all real numbers. Which of the following could be a table of values for $f'(x)$?

(A)

x	$f'(x)$
0	–1
1	0
2	2
3	0
4	–2

(B)

x	$f'(x)$
0	–1
1	1
2	2
3	1
4	–2

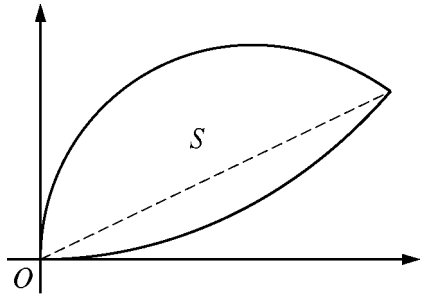
(C)

x	$f'(x)$
0	1
1	0
2	1
3	2
4	0

(D)

x	$f'(x)$
0	1
1	0
2	2
3	0
4	–2

GO ON TO THE NEXT PAGE.



89. Let S be the region in the first quadrant bounded above by the graph of the polar curve $r = \cos\theta$ and bounded below by the graph of the polar curve $r = 2\theta$, as shown in the figure above. The two curves intersect when $\theta = 0.450$. What is the area of S ?

(A) 0.232 (B) 0.243 (C) 0.271 (D) 0.384

---

90. If the infinite series $S = \sum_{n=1}^{\infty} (-1)^{n+1} \frac{2}{n}$ is approximated by $P_k = \sum_{n=1}^{k} (-1)^{n+1} \frac{2}{n}$, what is the least value of k for which the alternating series error bound guarantees that $|S - P_k| < \frac{3}{100}$?

(A) 64 (B) 66 (C) 68 (D) 70

GO ON TO THE NEXT PAGE.

END OF SECTION I

**IF YOU FINISH BEFORE TIME IS CALLED,
YOU MAY CHECK YOUR WORK ON PART B ONLY.**

DO NOT GO ON TO SECTION II UNTIL YOU ARE TOLD TO DO SO.

MAKE SURE YOU HAVE DONE THE FOLLOWING.

- **PLACED YOUR AP NUMBER LABEL ON YOUR ANSWER SHEET**
- **WRITTEN AND GRIDDED YOUR AP NUMBER CORRECTLY ON YOUR ANSWER SHEET**
- **TAKEN THE AP EXAM LABEL FROM THE FRONT OF THIS BOOKLET AND PLACED IT ON YOUR ANSWER SHEET**

AFTER TIME HAS BEEN CALLED, TURN TO PAGE 38 AND ANSWER QUESTIONS 91–94.

Section II: Free-Response Questions

This is the free-response section of the 2017 AP exam.
It includes cover material and other administrative instructions
to help familiarize students with the mechanics of the exam.
(Note that future exams may differ in look from the following content.)

AP® Calculus BC Exam

SECTION II: Free Response

2017

DO NOT OPEN THIS BOOKLET OR BREAK THE SEALS ON PART B UNTIL YOU ARE TOLD TO DO SO.

At a Glance

Total Time
1 hour and 30 minutes
Number of Questions
6
Percent of Total Score
50%
Writing Instrument
Either pencil or pen with black or dark blue ink
Weight
The questions are weighted equally, but the parts of a question are not necessarily given equal weight.

Part A

Number of Questions
2
Time
30 minutes
Electronic Device
Graphing calculator required
Percent of Section II Score
33.33%

Part B

Number of Questions
4
Time
1 hour
Electronic Device
None allowed
Percent of Section II Score
66.67%

IMPORTANT Identification Information

PLEASE PRINT WITH PEN:

1. First two letters of your last name ☐☐
   First letter of your first name ☐
2. Date of birth
   ☐☐ Month ☐☐ Day ☐☐☐☐ Year
3. Six-digit school code ☐☐☐☐☐☐
4. Unless I check the box below, I grant the College Board the unlimited right to use, reproduce, and publish my free-response materials, both written and oral, for educational research and instructional purposes. My name and the name of my school will not be used in any way in connection with my free-response materials. I understand that I am free to mark "No" with no effect on my score or its reporting.
   No, I do not grant the College Board these rights. ☐

Instructions

The questions for Section II are printed in this booklet. Do not break the seals on Part B until you are told to do so. Write your solution to each part of each question in the space provided. Write clearly and legibly. Cross out any errors you make; erased or crossed-out work will not be scored.

Manage your time carefully. During Part A, work only on the questions in Part A. You are permitted to use your calculator to solve an equation, find the derivative of a function at a point, or calculate the value of a definite integral. However, you must clearly indicate the setup of your question, namely the equation, function, or integral you are using. If you use other built-in features or programs, you must show the mathematical steps necessary to produce your results. During Part B, you may continue to work on the questions in Part A without the use of a calculator.

As you begin each part, you may wish to look over the questions before starting to work on them. It is not expected that everyone will be able to complete all parts of all questions.

- Show all of your work, even though a question may not explicitly remind you to do so. Clearly label any functions, graphs, tables, or other objects that you use. Justifications require that you give mathematical reasons, and that you verify the needed conditions under which relevant theorems, properties, definitions, or tests are applied. Your work will be scored on the correctness and completeness of your methods as well as your answers. Answers without supporting work will usually not receive credit.
- Your work must be expressed in standard mathematical notation rather than calculator syntax. For example, $\int_1^5 x^2\,dx$ may not be written as fnInt(X^2, X, 1, 5).
- Unless otherwise specified, answers (numeric or algebraic) need not be simplified. If you use decimal approximations in calculations, your work will be scored on accuracy. Unless otherwise specified, your final answers should be accurate to three places after the decimal point.
- Unless otherwise specified, the domain of a function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number.

Form I
Form Code 4NBP4-S

CALCULUS BC

SECTION II, Part A

Time—30 minutes

Number of questions—2

A GRAPHING CALCULATOR IS REQUIRED FOR THESE QUESTIONS.

GO ON TO THE NEXT PAGE.

1. For $0 \le t \le 8$, a particle moving in the xy-plane has position vector $\langle x(t), y(t) \rangle = \langle \sin(2t), t^2 - t \rangle$, where $x(t)$ and $y(t)$ are measured in meters and t is measured in seconds.

   (a) Find the speed of the particle at time $t = 2$ seconds. Indicate units of measure.

   (b) At time $t = 4$ seconds, is the speed of the particle increasing or decreasing? Explain your answer.

Do not write beyond this border.

Continue question 1 on page 5.

(c) Find the total distance the particle travels over the time interval $0 \le t \le 5$ seconds.

(d) At time $t = 8$ seconds, the particle begins moving in a straight line. For $t \ge 8$, the particle travels with the same velocity vector that it had at time $t = 8$ seconds. Find the position of the particle at time $t = 10$ seconds.

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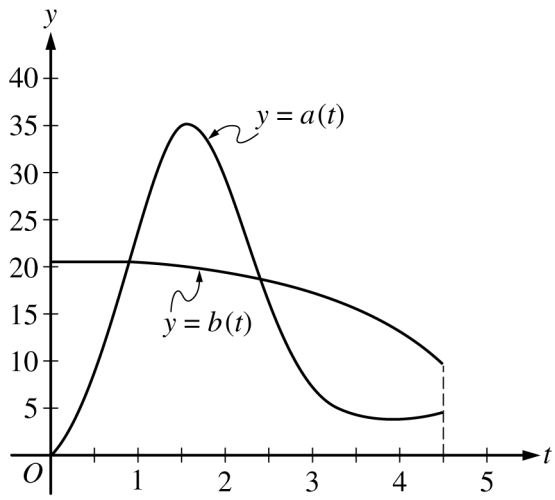


2. During the time interval $0 \le t \le 4.5$ hours, water flows into tank A at a rate of $a(t) = (2t - 5) + 5e^{2 \sin t}$ liters per hour. During the same time interval, water flows into tank B at a rate of $b(t)$ liters per hour. Both tanks are empty at time $t = 0$. The graphs of $y = a(t)$ and $y = b(t)$, shown in the figure above, intersect at $t = k$ and $t = 2.416$.

(a) How much water will be in tank A at time $t = 4.5$?

(b) During the time interval $0 \le t \le k$ hours, water flows into tank B at a constant rate of 20.5 liters per hour. What is the difference between the amount of water in tank A and the amount of water in tank B at time $t = k$?

Do not write beyond this border.

Continue question 2 on page 7.

(c) The area of the region bounded by the graphs of $y = a(t)$ and $y = b(t)$ for $k \le t \le 2.416$ is 14.470. How much water is in tank B at time $t = 2.416$?

(d) During the time interval $2.7 \le t \le 4.5$ hours, the rate at which water flows into tank B is modeled by $w(t) = 21 - \dfrac{30t}{(t-8)^2}$ liters per hour. Is the difference $w(t) - a(t)$ increasing or decreasing at time $t = 3.5$? Show the work that leads to your answer.

Do not write beyond this border.

GO ON TO THE NEXT PAGE.

END OF PART A

IF YOU FINISH BEFORE TIME IS CALLED,
YOU MAY CHECK YOUR WORK ON PART A ONLY.

DO NOT GO ON TO PART B UNTIL YOU ARE TOLD TO DO SO.

CALCULUS BC

SECTION II, Part B

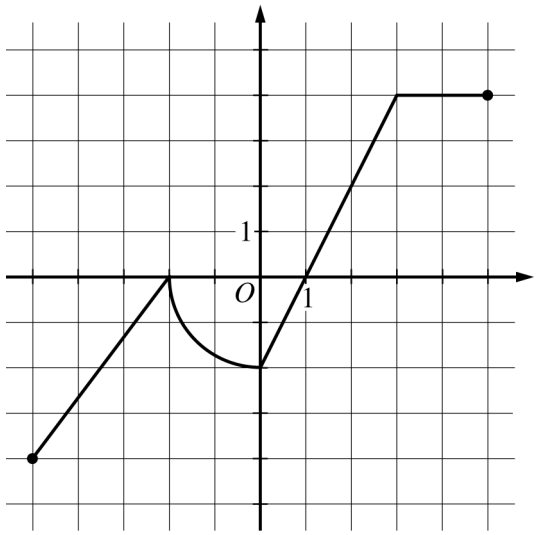
Time—1 hour

Number of questions—4

NO CALCULATOR IS ALLOWED FOR THESE QUESTIONS.

DO NOT BREAK THE SEALS UNTIL YOU ARE TOLD TO DO SO.

NO CALCULATOR ALLOWED



Graph of f

3. The graph of the function f, consisting of three line segments and a quarter of a circle, is shown above. Let g be the function defined by $g(x) = \int_1^x f(t)\,dt$.

(a) Find the average rate of change of g from $x = -5$ to $x = 5$.

(b) Find the instantaneous rate of change of g with respect to x at $x = 3$, or state that it does not exist.

Do not write beyond this border.

Continue question 3 on page 15.

(c) On what open intervals, if any, is the graph of g concave up? Justify your answer.

(d) Find all x-values in the interval $-5 < x < 5$ at which g has a critical point. Classify each critical point as the location of a local minimum, a local maximum, or neither. Justify your answers.

Do not write beyond this border.

NO CALCULATOR ALLOWED

x	0	1	2	3	4	5	6
$f'(x)$	4	3.5	2	0.8	1.7	5.8	7

4. The function f satisfies $f(0) = 20$. The first derivative of f satisfies the inequality $0 \le f'(x) \le 7$ for all x in the closed interval $[0, 6]$. Selected values of f' are shown in the table above. The function f has a continuous second derivative for all real numbers.

   (a) Use a midpoint Riemann sum with three subintervals of equal length indicated by the data in the table to approximate the value of $f(6)$.

   (b) Determine whether the actual value of $f(6)$ could be 70. Explain your reasoning.

Do not write beyond this border.

Continue question 4 on page 17.

(c) Evaluate $\int_2^4 f''(x)\,dx$.

(d) Find $\lim_{x \to 0} \dfrac{f(x) - 20e^x}{0.5f(x) - 10}$.

NO CALCULATOR ALLOWED

5. Consider the differential equation $\frac{dy}{dx} = -1 + \frac{y^2}{x}$.

(a) Show that $\frac{d^2y}{dx^2} = \frac{2y^3 - y^2 - 2xy}{x^2}$.

(b) Let $y = g(x)$ be the particular solution to the differential equation $\frac{dy}{dx} = -1 + \frac{y^2}{x}$ with initial condition $g(4) = 2$. Does g have a relative minimum, a relative maximum, or neither at $x = 4$? Justify your answer.

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Continue question 5 on page 19.

NO CALCULATOR ALLOWED

(c) Let $y = h(x)$ be the particular solution to the differential equation $\frac{dy}{dx} = -1 + \frac{y^2}{x}$ with initial condition $h(1) = 2$. Write the second-degree Taylor polynomial for h about $x = 1$.

(d) For the function h given in part (c), it is known that $\left|h'''(x)\right| \leq 60$ for all x in the interval $0.9 \leq x \leq 1.1$. Let A represent the approximation of $h(1.1)$ found by using the second-degree Taylor polynomial for h about $x = 1$ from part (c). Use the Lagrange error bound to show that A differs from $h(1.1)$ by at most 0.01.

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GO ON TO THE NEXT PAGE.

NO CALCULATOR ALLOWED

6. Let f be the function defined by $f(x) = \dfrac{1}{x^2 + 9}$.

(a) Evaluate the improper integral $\displaystyle\int_3^{\infty} f(x)\,dx$, or show that the integral diverges.

(b) Determine whether the series $\displaystyle\sum_{n=3}^{\infty} f(n)$ converges or diverges. State the conditions of the test used for determining convergence or divergence.

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Continue question 6 on page 21.

(c) Determine whether the series $\sum_{n=1}^{\infty} \frac{(-1)^n}{\left(e^n \cdot f(n)\right)} = \sum_{n=1}^{\infty} \frac{(-1)^n\left(n^2+9\right)}{e^n}$ converges absolutely, converges conditionally, or diverges.

Do not write beyond this border.

STOP

END OF EXAM

THE FOLLOWING INSTRUCTIONS APPLY TO THE COVERS OF THE SECTION II BOOKLET.

- **MAKE SURE YOU HAVE COMPLETED THE IDENTIFICATION INFORMATION AS REQUESTED ON THE FRONT AND BACK COVERS OF THE SECTION II BOOKLET.**
- **CHECK TO SEE THAT YOUR AP NUMBER LABEL APPEARS IN THE BOX ON THE FRONT COVER.**
- **MAKE SURE YOU HAVE USED THE SAME SET OF AP NUMBER LABELS ON ALL AP EXAMS YOU HAVE TAKEN THIS YEAR.**

Multiple-Choice Answer Key

The following contains the answers to
the multiple-choice questions in this exam.

Answer Key for AP Calculus BC Practice Exam, Section I

Question 1: D

Question 2: A

Question 3: C

Question 4: D

Question 5: C

Question 6: C

Question 7: D

Question 8: D

Question 9: B

Question 10: C

Question 11: A

Question 12: D

Question 13: B

Question 14: C

Question 15: C

Question 16: A

Question 17: B

Question 18: B

Question 19: C

Question 20: B

Question 21: B

Question 22: B

Question 23: D

Question 24: C

Question 25: B

Question 26: C

Question 27: A

Question 28: A

Question 29: A

Question 30: D

Question 76: C

Question 77: B

Question 78: C

Question 79: B

Question 80: D

Question 81: D

Question 82: A

Question 83: A

Question 84: B

Question 85: C

Question 86: C

Question 87: B

Question 88: A

Question 89: B

Question 90: B

Free-Response Scoring Guidelines

The following contains the scoring guidelines
for the free-response questions in this exam.

AP® CALCULUS BC
2017 SCORING GUIDELINES

Question 1

(a) $\sqrt{(x'(2))^2 + (y'(2))^2} = 3.272461$

The speed of the particle at time $t = 2$ seconds is 3.272 meters per second.

$2 : \begin{cases} 1 : \text{expression for speed} \\ 1 : \text{answer with units} \end{cases}$

(b) $s(t) = \sqrt{(x'(t))^2 + (y'(t))^2} = \sqrt{(2\cos(2t))^2 + (2t-1)^2}$

$s'(4) = 2.16265$

Since $s'(4) > 0$, the speed of the particle is increasing at time $t = 4$.

$2 : \begin{cases} 1 : \text{considers } s'(4) \\ 1 : \text{answer with reason} \end{cases}$

(c) $\int_0^5 \sqrt{(x'(t))^2 + (y'(t))^2}\, dt = 22.381767$

The total distance the particle travels over the time interval $0 \le t \le 5$ seconds is 22.382 (or 22.381) meters.

$2 : \begin{cases} 1 : \text{integral} \\ 1 : \text{answer} \end{cases}$

(d) $x(10) = x(8) + x'(8) \cdot 2 = \sin 16 + x'(8) \cdot 2 = -4.118541$

$y(10) = y(8) + y'(8) \cdot 2 = \left(8^2 - 8\right) + y'(8) \cdot 2 = 86$

The position of the particle at time $t = 10$ seconds is $(-4.119, 86)$ (or $(-4.118, 86)$).

$3 : \begin{cases} 1 : \text{uses position at } t = 8 \\ 1 : \text{uses velocity at } t = 8 \\ 1 : \text{position at } t = 10 \end{cases}$

AP® CALCULUS BC
2017 SCORING GUIDELINES

Question 2

(a) $\int_0^{4.5} a(t)\,dt = 66.532128$

At time $t = 4.5$, tank A contains 66.532 liters of water.

$2 : \begin{cases} 1 : \text{integral} \\ 1 : \text{answer} \end{cases}$

(b) $a(k) = 20.5 \Rightarrow k = 0.892040$

$\int_0^k (20.5 - a(t))\,dt = 10.599191$

At time $t = k$, the difference in the amounts of water in the tanks is 10.599 liters.

$3 : \begin{cases} 1 : \text{sets } a(k) = 20.5 \\ 1 : \text{integral} \\ 1 : \text{answer} \end{cases}$

(c) $\int_0^{2.416} b(t)\,dt = \int_0^k b(t)\,dt + \int_k^{2.416} b(t)\,dt$

$\int_0^k b(t)\,dt = 20.5 \cdot k = 18.286826$

On $k < t < 2.416$, tank A receives $\int_k^{2.416} a(t)\,dt = 44.497051$ liters of water, which is 14.470 more liters of water than tank B.
Therefore, $\int_k^{2.416} b(t)\,dt = \int_k^{2.416} a(t)\,dt - 14.470 = 30.027051$.

$\int_0^k b(t)\,dt + \int_k^{2.416} b(t)\,dt = 48.313876$

At time $t = 2.416$, tank B contains 48.314 (or 48.313) liters of water.

$2 : \begin{cases} 1 : \int_k^{2.416} a(t)\,dt \\ 1 : \text{answer} \end{cases}$

(d) $w'(3.5) - a'(3.5) = -1.14298 < 0$

The difference $w(t) - a(t)$ is decreasing at $t = 3.5$.

$2 : \begin{cases} 1 : w'(3.5) - a'(3.5) < 0 \\ 1 : \text{conclusion} \end{cases}$

AP® CALCULUS BC
2017 SCORING GUIDELINES

Question 3

(a) $\frac{g(5)-g(-5)}{5-(-5)} = \frac{12-(\pi+7)}{10} = \frac{5-\pi}{10}$	3 : $\begin{cases} 1 : \text{difference quotient} \\ 2 : \text{answer} \end{cases}$
(b) $g'(x) = f(x)$ $g'(3) = f(3) = 4$ The instantaneous rate of change of g at $x = 3$ is 4.	1 : answer
(c) The graph of g is concave up on $-5 < x < -2$ and $0 < x < 3$, because $g'(x) = f(x)$ is increasing on these intervals.	2 : intervals with justification
(d) $g'(x) = f(x)$ is defined at all x with $-5 < x < 5$. $g'(x) = f(x) = 0$ at $x = -2$ and $x = 1$. Therefore, g has critical points at $x = -2$ and $x = 1$. g has neither a local maximum nor a local minimum at $x = -2$ because g' does not change sign there. g has a local minimum at $x = 1$ because g' changes from negative to positive there.	3 : $\begin{cases} 1 : \text{considers } f(x) = 0 \\ 1 : \text{critical points at } x = -2 \text{ and } x = 1 \\ 1 : \text{answers with justifications} \end{cases}$

AP® CALCULUS BC
2017 SCORING GUIDELINES

Question 4

(a) $\int_0^6 f'(x)\,dx \approx 2 \cdot 3.5 + 2 \cdot 0.8 + 2 \cdot 5.8 = 20.2$

$f(6) - f(0) = \int_0^6 f'(x)\,dx$

$f(6) = f(0) + \int_0^6 f'(x)\,dx \approx 20 + 20.2 = 40.2$

3 : { 1 : midpoint sum; 1 : Fundamental Theorem of Calculus; 1 : answer }

(b) Since $f'(x) \le 7$, $\int_0^6 f'(x)\,dx \le 6 \cdot 7 = 42$.

$f(6) - f(0) \le 42 \Rightarrow f(6) \le 20 + 42 = 62$

Therefore, the actual value of $f(6)$ could not be 70.

2 : { 1 : integral bound; 1 : answer with reasoning }

(c) $\int_2^4 f''(x)\,dx = f'(4) - f'(2) = 1.7 - 2 = -0.3$

2 : { 1 : Fundamental Theorem of Calculus; 1 : answer }

(d) $\lim_{x \to 0} \left(f(x) - 20e^x \right) = 0$

$\lim_{x \to 0} (0.5 f(x) - 10) = 0$

Using L'Hospital's Rule,

$\lim_{x \to 0} \frac{f(x) - 20e^x}{0.5 f(x) - 10} = \lim_{x \to 0} \frac{f'(x) - 20e^x}{0.5 f'(x)} = \frac{4 - 20}{0.5(4)} = -8$

2 : { 1 : L'Hospital's Rule; 1 : answer }

AP® CALCULUS BC
2017 SCORING GUIDELINES

Question 5

(a) $\dfrac{d^2y}{dx^2} = \dfrac{x \cdot 2y\dfrac{dy}{dx} - y^2 \cdot 1}{x^2}$

$= \dfrac{2xy\left(-1 + \dfrac{y^2}{x}\right) - y^2}{x^2} = \dfrac{2y^3 - y^2 - 2xy}{x^2}$

$2 : \begin{cases} 1 : \text{quotient rule} \\ 1 : \dfrac{d^2y}{dx^2} \end{cases}$

(b) $\left.\dfrac{dy}{dx}\right|_{(x,y)=(4,\,2)} = -1 + \dfrac{4}{4} = 0$

$\left.\dfrac{d^2y}{dx^2}\right|_{(x,y)=(4,\,2)} = \dfrac{2 \cdot 8 - 4 - 16}{16} = -\dfrac{1}{4} < 0$

By the Second Derivative Test, g has a relative maximum at $x = 4$.

$2 : \begin{cases} 1 : \text{considers } \left.\dfrac{dy}{dx}\right|_{(x,y)=(4,\,2)} \\ 1 : \text{answer with justification} \end{cases}$

(c) $\left.\dfrac{dy}{dx}\right|_{(x,y)=(1,\,2)} = -1 + \dfrac{4}{1} = 3$

$\left.\dfrac{d^2y}{dx^2}\right|_{(x,y)=(1,\,2)} = \dfrac{2 \cdot 8 - 4 - 4}{1} = 8$

The second-degree Taylor polynomial for h about $x = 1$ is

$T_2(x) = 2 + 3(x-1) + \dfrac{8}{2!}(x-1)^2 = 2 + 3(x-1) + 4(x-1)^2$.

$3 : \begin{cases} 1 : \text{uses } \left.\dfrac{dy}{dx}\right|_{(x,\,y)=(1,\,2)} \text{ and } \left.\dfrac{d^2y}{dx^2}\right|_{(x,\,y)=(1,\,2)} \\ 2 : \text{Taylor polynomial} \end{cases}$

(d) $|h(1.1) - A| \le \dfrac{\max\limits_{1.0 \le x \le 1.1} |h'''(x)|\,|1.1-1|^3}{3!} \le \dfrac{60}{6} \cdot \dfrac{1}{1000} = \dfrac{10}{1000} = \dfrac{1}{100}$

$2 : \begin{cases} 1 : \text{form of the error bound} \\ 1 : \text{analysis} \end{cases}$

AP® CALCULUS BC
2017 SCORING GUIDELINES

Question 6

(a) $\displaystyle\int_3^\infty \frac{1}{x^2+9}\,dx = \lim_{b\to\infty}\int_3^b \frac{1}{x^2+9}\,dx = \lim_{b\to\infty}\left(\frac{1}{3}\tan^{-1}\left(\frac{x}{3}\right)\Big|_3^b\right)$

$\displaystyle= \lim_{b\to\infty}\left(\frac{1}{3}\tan^{-1}\left(\frac{b}{3}\right) - \frac{1}{3}\tan^{-1}(1)\right) = \frac{\pi}{6} - \frac{\pi}{12} = \frac{\pi}{12}$

3 : { 1 : antiderivative; 1 : limit expression; 1 : answer }

(b) The function f is continuous, positive, and decreasing on $[3, \infty)$.

By the integral test, since $\displaystyle\int_3^\infty f(x)\,dx$ converges, $\displaystyle\sum_{n=3}^\infty f(n)$ converges.

— OR —

$\displaystyle 0 < \frac{1}{n^2+9} < \frac{1}{n^2}$ for $n \ge 3$.

Since the series $\displaystyle\sum_{n=3}^\infty \frac{1}{n^2}$ converges, the series $\displaystyle\sum_{n=3}^\infty f(n) = \sum_{n=3}^\infty \frac{1}{n^2+9}$ converges by the comparison test.

2 : conclusion with conditions

(c) Consider the series $\displaystyle\sum_{n=1}^\infty \frac{1}{\left(e^n \cdot f(n)\right)} = \sum_{n=1}^\infty \frac{n^2+9}{e^n}$.

$\displaystyle\lim_{n\to\infty}\left|\frac{\frac{(n+1)^2+9}{e^{n+1}}}{\frac{n^2+9}{e^n}}\right| = \lim_{n\to\infty}\left|\frac{(n+1)^2+9}{n^2+9}\cdot\frac{1}{e}\right| = \frac{1}{e} < 1$

By the ratio test, $\displaystyle\sum_{n=1}^\infty \frac{1}{\left(e^n \cdot f(n)\right)}$ converges.

Therefore, $\displaystyle\sum_{n=1}^\infty \frac{(-1)^n}{\left(e^n \cdot f(n)\right)}$ converges absolutely.

4 : { 1 : sets up ratio; 1 : computes limit of ratio; 1 : conclusion of ratio test; 1 : converges absolutely }

Scoring Worksheets

The following provides scoring worksheets and conversion tables used for calculating a composite score of the exam.

2017 AP Calculus BC Scoring Worksheet

Section I: Multiple Choice

_____	×	1.2000	=	_____
Number Correct (out of 45)				Weighted Section I Score (Do not round)

Section II: Free Response

Question 1	_____	×	1.0000	=	_____
	(out of 9)				(Do not round)
Question 2	_____	×	1.0000	=	_____
	(out of 9)				(Do not round)
Question 3	_____	×	1.0000	=	_____
	(out of 9)				(Do not round)
Question 4	_____	×	1.0000	=	_____
	(out of 9)				(Do not round)
Question 5	_____	×	1.0000	=	_____
	(out of 9)				(Do not round)
Question 6	_____	×	1.0000	=	_____
	(out of 9)				(Do not round)

Sum = _____
Weighted Section II Score (Do not round)

Composite Score

_____	+	_____	=	_____
Weighted Section I Score		Weighted Section II Score		Composite Score (Round to nearest whole number)

AP Score Conversion Chart
Calculus BC

Composite Score Range	AP Score
65-108	5
54-64	4
39-53	3
24-38	2
0-23	1

2017 AP Calculus BC — AB Subscore Scoring Worksheet

Section I: Multiple Choice

Questions (1-3, 6-7, 9, 11, 13-15, 17-19, 21, 24, 26, 28, 76-79, 81-83, 85-86, 88)

_____ × 1.0000 = _____

Number Correct (out of 27) — Weighted Section I Score (Do not round)

Section II: Free Response

Question 2 _____ × 1.0000 = _____
(out of 9) (Do not round)

Question 3 _____ × 1.0000 = _____
(out of 9) (Do not round)

Question 4 _____ × 1.0000 = _____
(out of 9) (Do not round)

Sum = _____
Weighted Section II Score (Do not round)

Composite Score

_____ + _____ = _____

Weighted Section I Score + Weighted Section II Score = Composite Score (Round to nearest whole number)

AP Score Conversion Chart
Calculus AB Subscore

Composite Score Range	AP Score
34-54	5
28-33	4
21-27	3
13-20	2
0-12	1

Question Descriptors and Performance Data

The following contains tables showing the content assessed,
the correct answer, and how AP students performed on each question.

2017 AP Calculus BC

Question Descriptors and Performance Data

Multiple-Choice Questions

Question	Learning Objective	Essential Knowledge	Mathematical Practice for AP Calculus 1	Mathematical Practice for AP Calculus 2	Key	% Correct
1	2.1C	2.1C4	Implementing algebraic/computational processes	Building notational fluency	D	89
2	3.3B(a)	3.3B3	Implementing algebraic/computational processes	Building notational fluency	A	81
3	2.1C	2.1C3	Implementing algebraic/computational processes	Building notational fluency	C	88
4	2.3C	2.3C4	Implementing algebraic/computational processes	Connecting concepts	D	85
5	4.1B	4.1B1	Reasoning with definitions and theorems	Building notational fluency	C	58
6	1.2A	1.2A1	Connecting multiple representations	Reasoning with definitions and theorems	C	87
7	3.2C	3.2C2	Reasoning with definitions and theorems	Building notational fluency	D	84
8	3.4D	3.4D3	Reasoning with definitions and theorems	Connecting concepts	D	86
9	2.3B	2.3B1	Implementing algebraic/computational processes	Connecting concepts	B	90
10	2.3F	2.3F2	Implementing algebraic/computational processes	Building notational fluency	C	87
11	2.1C	2.1C5	Implementing algebraic/computational processes	Building notational fluency	A	83
12	3.3B(a)	3.3B5	Implementing algebraic/computational processes	Building notational fluency	D	81
13	2.3F	2.3F1	Connecting multiple representations	Connecting concepts	B	81
14	2.1A	2.1A3	Building notational fluency	Implementing algebraic/computational processes	C	83
15	1.1A(b)	1.1A3	Connecting multiple representations	Connecting concepts	C	54
16	4.2C	4.2C2	Implementing algebraic/computational processes	Connecting concepts	A	60
17	3.3B(b)	3.3B5	Implementing algebraic/computational processes	Building notational fluency	B	61
18	1.1A(b)	1.1A2	Connecting concepts	Implementing algebraic/computational processes	B	80
19	2.3B	2.3B2	Implementing algebraic/computational processes	Connecting concepts	C	69
20	2.1C	2.1C7	Implementing algebraic/computational processes	Connecting concepts	B	77
21	3.2B	3.2B2	Connecting multiple representations	Implementing algebraic/computational processes	B	71
22	3.3B(a)	3.3B5	Implementing algebraic/computational processes	Building notational fluency	B	66
23	4.2B	4.2B5	Implementing algebraic/computational processes	Building notational fluency	D	79
24	3.4B	3.4B1	Connecting concepts	Implementing algebraic/computational processes	C	64
25	4.2C	4.2C1	Connecting concepts	Reasoning with definitions and theorems	B	36
26	2.4A	2.4A1	Reasoning with definitions and theorems	Connecting concepts	C	50
27	3.5B	3.5B2	Implementing algebraic/computational processes	Connecting concepts	A	32
28	2.3C	2.3C2	Connecting concepts	Implementing algebraic/computational processes	A	80

2017 AP Calculus BC

Question Descriptors and Performance Data

Question	Learning Objective	Essential Knowledge	Mathematical Practice for AP Calculus 1	Mathematical Practice for AP Calculus 2	Key	% Correct
29	4.2B	4.2B2	Implementing algebraic/computational processes	Connecting concepts	A	53
30	4.1A	4.1A6	Reasoning with definitions and theorems	Building notational fluency	D	64
76	2.2A	2.2A1	Reasoning with definitions and theorems	Connecting concepts	C	76
77	3.3B(b)	3.3B2	Implementing algebraic/computational processes	Reasoning with definitions and theorems	B	74
78	1.1D	1.1D1	Building notational fluency	Connecting concepts	C	81
79	3.3A	3.3A3	Connecting multiple representations	Connecting concepts	B	67
80	2.3C	2.3C4	Implementing algebraic/computational processes	Connecting concepts	D	77
81	2.2A	2.2A3	Connecting multiple representations	Connecting concepts	D	65
82	2.2A	2.2A1	Implementing algebraic/computational processes	Connecting concepts	A	41
83	3.4D	3.4D2	Connecting concepts	Connecting multiple representations	A	67
84	3.2D	3.2D2	Connecting concepts	Building notational fluency	B	82
85	3.3A	3.3A3	Connecting multiple representations	Implementing algebraic/computational processes	C	74
86	2.2A	2.2A1	Connecting concepts	Connecting multiple representations	C	48
87	3.4C	3.4C2	Implementing algebraic/computational processes	Reasoning with definitions and theorems	B	65
88	2.2A	2.2A2	Connecting multiple representations	Connecting concepts	A	27
89	3.4D	3.4D1	Implementing algebraic/computational processes	Connecting multiple representations	B	37
90	4.1B	4.1B2	Reasoning with definitions and theorems	Connecting concepts	B	38

Free-Response Questions

Question	Learning Objective	Essential Knowledge	Mathematical Practice for AP Calculus	Mean
1	2.1C|2.2A|2.3C|3.4C	2.1C7|2.2A1|2.3C4|3.4C2	Reasoning with definitions and theorems|Connecting concepts|Implementing algebraic/computational processes|Building notational fluency|Communicating	3.9
2	2.3D|3.2C|3.4A|3.4D	2.3D1|3.2C2|3.4A2|3.4D1	Reasoning with definitions and theorems|Connecting concepts|Implementing algebraic/computational processes|Connecting multiple representations|Building notational fluency|Communicating	4.94
3	2.1A|2.2A|3.2C|3.3A	2.1A1|2.2A1|3.2C1|3.3A2,3.3A3	Reasoning with definitions and theorems|Connecting concepts|Implementing algebraic/computational processes|Connecting multiple representations|Building notational fluency|Communicating	5.15
4	1.1C|2.1C|3.2B|3.3B(b)	1.1C3|2.1C2|3.2B2|3.3B2	Reasoning with definitions and theorems|Connecting concepts|Implementing algebraic/computational processes|Connecting multiple representations|Building notational fluency|Communicating	4.1
5	2.1C|2.1D|2.2A|4.2A	2.1C5|2.1D1|2.2A1|4.2A2,4.2A4	Reasoning with definitions and theorems|Connecting concepts|Implementing algebraic/computational processes|Building notational fluency|Communicating	4.81
6	3.2D|3.3B(b)|4.1A	3.2D2|3.3B5|4.1A4,4.1A6	Reasoning with definitions and theorems|Connecting concepts|Implementing algebraic/computational processes|Building notational fluency|Communicating	2.85

AP Calculus BC

The College Board

The College Board is a mission-driven not-for-profit organization that connects students to college success and opportunity. Founded in 1900, the College Board was created to expand access to higher education. Today, the membership association is made up of over 6,000 of the world's leading educational institutions and is dedicated to promoting excellence and equity in education. Each year, the College Board helps more than seven million students prepare for a successful transition to college through programs and services in college readiness and college success — including the SAT® and the Advanced Placement Program®. The organization also serves the education community through research and advocacy on behalf of students, educators, and schools. The College Board is committed to the principles of excellence and equity, and that commitment is embodied in all of its programs, services, activities, and concerns.