

MAA

MATHEMATICAL ASSOCIATION OF AMERICA

29th Annual

**American Mathematics Competitions
American Invitational
Mathematics Examination**

TEACHERS' MANUAL

Instructions and Reporting Forms
for School Contest Managers

dates to remember:

AIME - Thursday, March 17, 2011

Alternate AIME - Wednesday, March 30, 2011

Please read this booklet thoroughly upon receipt.

PLEASE NOTE: USA(J)MO TEACHERS' MANUAL ON FLIP SIDE





American Mathematics Competitions

To All AIME Managers:

Please read this manual regarding the AIME rules and regulations thoroughly. Note our policy for the official administration of the AIME. The AIME I can only be given officially on THURSDAY, March 17th, and the AIME II can only be given officially on WEDNESDAY, March 30, 2011. The contest should be scheduled from 9AM to 12 noon if possible.

All students who are in the top 5% of all American Mathematics Contest 12 (AMC 12) participants or score at least 100 points on the AMC 12 and those with a score in the top 2.5% of the American Mathematics Contest 10 (AMC 10) participants or score at least 120 points, are invited to take the AIME. The AIME is the second in the sequence of mathematics contests which leads to participation in the USA Mathematical Olympiad and the designation of Winners of the USA(J)MO. The AIME is a 15-question, 3-hour examination. All answers are integers ranging from 000 to 999, inclusive. The score is the number of correct answers. There is neither partial credit nor a penalty for wrong answers.

I call your attention to several items found in this manual which answer inquiries I frequently receive from AIME Managers:

1. All administrations of the AIME must take place on the scheduled dates.
There will be a expedited handling fee for the second AIME as follows: 1-10 students = \$25, 11+ students = \$50. We will need your payment before the answer forms can be graded. A special envelope and payment form will be included with your AIME material, if you have AIME qualifiers. All AIME answer forms must be returned by "express mail" so that they arrive in the AMC office by April 1st, 2011.
2. Email requests for the second AIME may be sent to: AIMEQUAL@AMC.UNL.EDU
Email requests should include the school's CEEB number and complete mailing address, teacher name, teacher email address, number of students taking the AIME II, and method of payment. You may also register online using a credit card at www.unl.edu/~amc/registration
3. Under no circumstances can a student take both AIMEs.
4. In section V you will find a discussion of how and when you will receive results.
5. On the reverse side of this Manual you will find a section relating to the USAMO & USAJMO. In this section you will find all the information and forms relevant to the taking of the USA(J)MO. If you have had students qualify for the USA(J)MO in the past, or you are anticipating this to be so this year, please look over this new material. REGARDLESS, do not throw this Manual away until you have received the results of this year's AIME. You may need the USA(J)MO forms.
6. The second AIME on Wednesday, March 30, 2011 is a new set of 15 questions, completely different from, but comparable in difficulty to the AIME on March 17, 2011.
7. Selection of USAMO & USAJMO participants will depend on the AMC 10/12 score, and AIME score..

We feel that the 2011 AIME will be interesting and challenging to your student(s). On behalf of the Committee on the American Mathematics Competitions, I send my appreciation to you for assisting with the implementation of this examination.

Sincerely,

Steven R. Dunbar
Director
MAA, American Mathematics Competitions

American Mathematics Competitions

University of Nebraska - Lincoln | PO Box 880658 | 1740 Vine Street | Lincoln, NE 68588-0658
402.472.2257/phone | 402.472.6087/ | amcinfo@maa.org | amc.maa.org

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I. List of the Sponsors

The American Mathematics Competitions	
are Sponsored by	
The Mathematical Association of America - MAA	www.maa.org
The Akamai Foundation	www.akamai.com
Contributors	
Academy of Applied Sciences - AAS.....	www.aas-world.org
American Mathematical Association of Two-Year Colleges - AMATYC	www.amatyc.org
American Mathematical Society - AMS.....	www.ams.org
American Statistical Association - ASA.....	www.amstat.org
Art of Problem Solving - AoPS.....	www.artofproblemsolving.com
Awesome Math	www.awesomemath.org
Canada/USA Mathcamp - C/USA MC	www.mathcamp.org
Casualty Actuarial Society - CAS	www.casact.org
D.E. Shaw & Co.	www.deshaw.com
IDEA Math.....	www.ideamath.org
Institute for Operations Research and the Management Sciences - INFORMS.....	www.informs.org
Jane Street	www.janestreet.com
MathPath.....	www.mathpath.org
Math Zoom Academy	www.mathzoom.org
Mu Alpha Theta - MAT	www.mualphatheta.org
National Council of Teachers of Mathematics - NCTM.....	www.nctm.org
Pi Mu Epsilon - PME	www.pme-math.org
Society of Actuaries - SOA	www.soa.org
U.S.A. Math Talent Search - USAMTS	www.usamts.org
W.H. Freeman and Company	www.whfreeman.com

II. Contents of Package

You will find enclosed, in addition to this Teachers' Manual, the following material:

- A list of your qualified AIME students.
- A sealed envelope containing one AIME for each of your qualified students and an extra copy for you. The envelope must NOT be opened until just before the examination is given on the authorized date.
- AIME Answer Forms. One for each participating student.
- One AIME School Identification Form.
- One AIME Report Envelope.
- One Alternate AIME Payment Form (page 11 in this Manual) and Return Envelope

We will mail the Solutions for the AIME with your AIME school report.

III. Preparation Instructions

1. Please study the contents of this Teachers' Manual.
2. Reserve a room for 3 1/2 hours from 8:45 AM - 12:15 PM to administer the AIME on Thursday, March 17, 2011 from 9AM - 12 noon. This allows 15 minutes for pre- and post-examination activities and 3 hours for the examination itself. In extreme cases where you cannot administer the AIME between 7:00 am and 3:00 pm, please complete the academic integrity pledge form on page 13.
3. Inform the students well in advance of the time and place. Urge them to prepare for the AIME by studying past AIME exams and solutions and other challenging problems. Refer to Order Form C- AIME ORDER FORM FOR PRIOR YEAR EXAMS on Page 10 in this manual for ordering information relating to prior year AIME exams.
4. Review the Examination Rules printed on the sealed envelope which contains the examination.
5. Obtain a supply of:
 - a. Number 2 lead pencils with good erasers
 - b. Unmarked scratch paper
 - c. Rulers, compasses, protractors, and graph paper.
6. Calculators and Computers are NOT permitted.
7. Complete the AIME School Identification Form using the instructions found on the Form.
8. Please study the AIME STUDENT ANSWER FORM. Have each student complete Side 1 of the Form using the instructions found on the Form. Please carefully follow the marking instructions printed on both the identification and student answer forms, and double check to see that all the items are filled out correctly. Students may not complete the personal information after the time allowed for the test. Only the information which has been properly blackened will be read by the Opscan reader. Be sure to mark the AMC 10 or AMC 12 score in the appropriate area, including decimals if needed.
9. The AIME Answer Form is now ready for distribution to your qualified students on Thursday, March 17th.
10. Make arrangements to mail your AIME Report Envelope by First Class Mail (or Express Mail if taking the alternate date). Please note that this is an oversized envelope and thus requires special postage even if it weighs one ounce or less.

IV. Day of the AIME Instructions

1. Sign the Certification Form to certify that the package was opened within an hour before the contest (on page 7).
2. Seat participants in alternate seats.
3. Ensure that each participant has the supplies listed on Item 5 under Section III.
4. Inform the students that they are not to open the exam booklet until instructed to do so.
5. Pass out the examination and have the students read the instructions on the front cover.
6. Next, distribute the AIME Answer Forms (which you or your students previously marked) to the students. Inform them that their answers should be marked with a pencil on SIDE 2 of the Form and that each problem has only one correct answer, an integer between 000 and 999 inclusive.
7. Read aloud the following instructions for recording answers to the problems:
 - a. For each question you answer, USING A #2 PENCIL, for your reference write your answer at the top of the problem answer columns using 3 digits, then in each of these columns blacken the one circle which is labeled with the digit you have written at the top. PLEASE NOTE: A single digit answer, such as 7, should be written and blackened as 007 and a two digit answer, such as 43, should be written and blackened as 043.
 - b. DO NOT BLACKEN ANSWERS UNTIL YOU ARE CERTAIN OF YOUR FINAL CHOICE. AVOID, IF POSSIBLE, ERASURES IN THE CIRCLES.
 - c. The results will be graded by computer. Only the blackened circles will be graded.
8. Ask the students if they have any questions about using the AIME Answer Form or about the instructions for the examination.
9. Start the Examination.
10. Check to see if each student is marking his/her Answer Form properly.
11. Allow exactly 3 hours working time.
12. If there is an urgent need to use a bathroom, inform the students that only one student may leave at one time and the AIME answer form and exam should be retained by you during the departure period. If there is a health or medical emergency a backup exam manager should be available for such a contingency.
13. At the end of 3 hours, instruct the students to:
 - a. STOP.
 - b. Put aside the booklet and scratch paper and look again to be sure the AIME Answer Form has been filled out correctly.
 - c. Be sure the written answers on the top of the AIME Answer Form are in agreement with the blackened circles' coded answers.
 - d. Sign their name on Side 2 of the answer form.
 - e. Hand in the AIME Answer Form.
 - f. Keep the examination booklet for their reference in conjunction with your review of the Solutions. Inform the students that they may now leave the examination room.

AIME 2011 Teacher Manual

14. Complete the Certification Form (form A) and USA(J)MO Information Form (form B) found on pages 7 and 8.
 15. The following material should be sealed in the AIME Report Envelope, postmarked NO LATER THAN 24 hours after the examination is given, and sent to the AMC Office:
 - a. Signed AIME Certification Form A and USA(J)MO Information Form B.
 - b. AIME School Identification Form.
 - c. One AIME Answer Form for each participating student. Please do not paper clip or staple the forms together. Do not fold the forms.
- APO/FPO AND USA EMBASSY SCHOOLS must return materials by AIR EXPRESS MAIL (DHL, Federal Express, etc.).
16. Please note that if you have requested the “Alternate” AIME you will need to send your payment separately and in advance of the Wednesday, March 30th test date.

V. Report of the AIME Results

The AIME score of your student(s), Certificates of Participation, an AIME Solutions Pamphlet and the list of USA(J)MO selectees will be sent to you.

Please retain this report for future reference, either in your files or with the student counselor’s office. Many students cite these scores on college applications.

VI. Eligibility

Any student who is officially enrolled in high school (or below) and is taking at least one course at the school, and has not graduated, is eligible to take the AIME (with qualifying score). US and Canadian Citizens and students residing in the United States (with qualifying scores) are eligible to take the USA(J)MO.

Home School Students age 19.5 and under are eligible for the AIME (with qualifying score).

Students learning “English as a Second Language” (ESL) may use a book or dual-language nontechnical dictionary between their native language and English. A student may use the dictionary only the first time that he/she takes the AIME. The dictionary must be given to the school contest manager to examine and retain for the 24-hour period preceding the contest. The proctor must announce to other students that the student(s) has/have been given special permission to use the dictionary during the contest.

VII. Policy on AIME Administration

You must give the AIME on the official date (March 17th) to all students in the same place and at the same time; invited students who cannot be there miss this opportunity. Be advised that if students miss the exam, Thursday, March 17, 2011, they may take the alternate sitting of the exam, Wednesday, March 30, 2011. The second AIME on Wednesday, March 30, 2011 is a new set of 15 questions completely different from, but comparable to the AIME on March 17, 2011.

If you need to have a student or students sit for the second exam on March 30th, read below for the applicable details and then contact the AMC office if you have questions. There is a minimal charge for the second exam due to compressed shipping considerations. These two dates will be the only dates acceptable for qualifying for the USA(J)MO.

There is a processing fee for the second AIME as follows: 1-10 students = \$25, 11+ students = \$50. We need your payment before we grade the answer forms. A special envelope and payment form has been included with your AIME material. All Alternate AIME (AIME II) answer forms must be returned by “express mail” so that they arrive in the AMC office by April 1, 2011.

Email requests for the second AIME may be sent to:

AIMEQUAL@AMC.UNL.EDU

Email requests should include the school’s CEEB number and complete mailing address, teacher name, teacher email address, number of students taking the AIME II, and method of payment. Or, you may wish to register online using a credit card at www.unl.edu/~amc/registration. The AMC office will send a confirmation of registration for the AIME II. Please note that you will be billed for all AIME II shipped, unless you cancel your order before March 17, 2011.

Under no circumstances can a student take both AIME’s.

VIII. Visually Impaired and Learning Disabled Students

If one of your AIME qualified students is visually impaired and/or learning disabled please call the AMC office and we will discuss the options available to you. We do not have copies available in braille. The time allowance for students with learning disabilities is 4.5 hours.

IX. Request for Student Names

The following statement appears on the student answer forms for the AMC 10 and AMC 12:

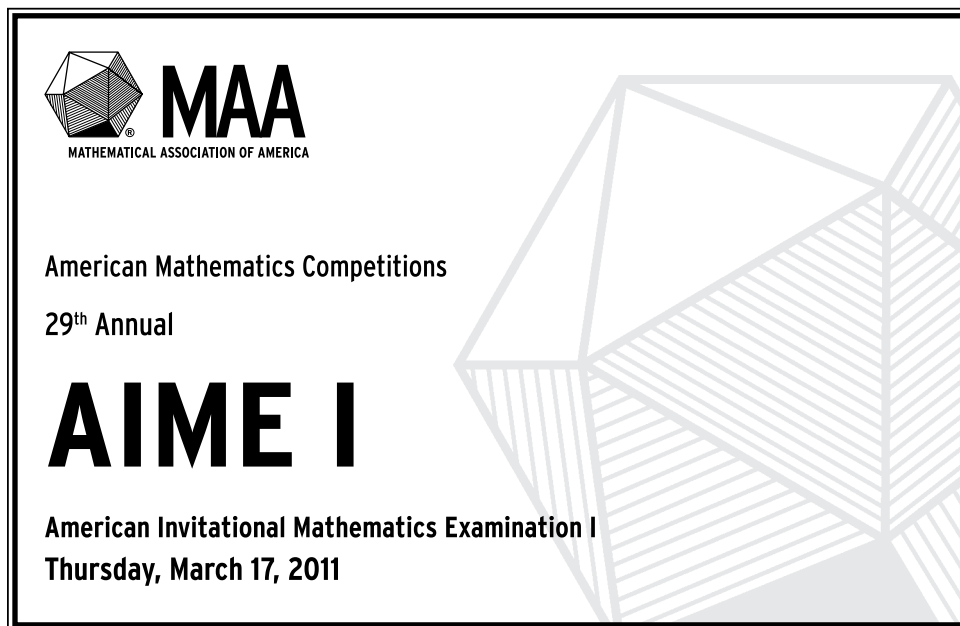
1. The American Mathematics Competitions (AMC) receives requests from educational institutions and organizations for the names, addresses and grade levels of high scoring students. This information is used for recruiting and academic purposes.
2. Blacken this circle if you give the AMC permission to release this information to these organizations. (Your score will not be affected if you do not blacken the circle.)

Receiving information is an “opt-in” decision for each individual student.

The AMC handles requests from institutions and organizations on a case-by-case basis and evaluates each individually for appropriateness. We provide legitimate educational institutions of all levels, both secondary and collegiate/university level, with one-time use of selected names and addresses for postal mailings. We also provide professional and scholarly organizations such as those listed as contributors to the AMC with one-time use of names and addresses for postal mailings, generally for professional or career information.

The only information we provide is the name, address, city, state, and zip code necessary for a postal mailing. We do not list individual scores or awards.

X. Fascimile of the March 17, 2011 AIME Front Cover



1. DO NOT OPEN THIS BOOKLET UNTIL YOUR PROCTOR GIVES THE SIGNAL TO BEGIN.
2. This is a 15-question, 3-hour examination. All answers are integers ranging from 000 to 999, inclusive. Your score will be the number of correct answers; i.e., there is neither partial credit nor a penalty for wrong answers.
3. No aids other than scratch paper, graph paper, ruler, compass, and protractor are permitted. In particular, **calculators and computers are not permitted.**
4. A combination of the AIME and the American Mathematics Contest 12 are used to determine eligibility for participation in the USA Mathematical Olympiad (USAMO). A combination of the AIME and the American Mathematics Contest 10 are used to determine eligibility for participation in the USA Junior Mathematical Olympiad (USAJMO). The USAMO & the USAJMO will be given in your school on WEDNESDAY and THURSDAY, April 27 & 28, 2011.
5. Record all of your answers, and certain other information, on the AIME answer form. Only the answer form will be collected from you.

After the contest period, permission to make copies of individual problems in paper or electronic form including posting on web pages for educational use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear the copyright notice.

FORM A - Examination Certification 2011 AIME

Certification by the Examination Manager:

I certify that the 2011 American Invitational Mathematics Examination was given today, Thursday, March 17, 2011 / Wednesday, March 30, 2011 (circle appropriate date); that all students who took it did so at the same time and place; that only invited students took it; that the 3-hour time limit was strictly enforced; that the test envelope was sealed until the time of the test; that no student had access to the test questions in advance; that the students were continually supervised by a proctor while they were taking the test; that I am returning those materials as required in Section IV; and that all other rules for administering the test were followed.

YES NO If no, describe the exceptions on a separate sheet of paper.

I also certify that I understand and accept the following for our school. The Committee on the American Mathematics Competitions reserves the right to:

1. Disqualify all scores from our school if it is determined that the required security procedures were not followed.
2. Re-examine students if, after an inquiry, there is a reasonable basis to believe that the scores do not validly represent the ability of the students. (The procedures for disqualification, follow-up inquiries and re-examination are similar to those for the AMC 10 and AMC 12, as outlined in the AMC 10/12 Teachers' Manual.)

Signature of AIME School Manager _____

Email _____

Date _____ School Telephone # _____

Name of School _____

State _____ School Identification Number (CEEB) _____

The AIME was administered on (circle correct date, and circle yes or no) March 17, 2011 March 30, 2011 YES NO (please circle)

Starting Time _____ Ending Time _____

Student(s) who qualified for the AIME at multiple locations:

Student Name: _____

Reg.attended school: CEEB#: _____ Name: _____

Other location: CEEB#: _____ Name: _____

Student Name: _____

Reg.attended school: CEEB#: _____ Name: _____

Other location: CEEB#: _____ Name: _____

If there are more than 2 students, please attach a separate page with this information listed for each student.

The Examination Manager and the Principal, Vice Principal, or Headmaster must sign this form. Return it with your student Answer Forms.

Certification by the Principal, Official or person with comparable title:

I agree that the contest manager followed all the rules and procedures listed above.

Signature _____ Time _____

Title _____ Date _____

Please also complete the OLYMPIAD INFORMATION Form B, found on Page 8.

FORM B - USAMO/USAJMO Information Form

When a student qualifies for the United States of America Mathematical Olympiad (USA(J)MO), both the student and the USA(J)MO School Manager are notified at least one week before the USA(J)MO date. Don't worry about an invitation getting lost in the mail. When a USA(J)MO invitation is extended, both the student and the USA(J)MO School Manager must complete and return a USA(J)MO Response Form. If the Form is not returned, we do a follow-up.

Please provide the information requested below if you agree to administer the USA(J)MO. There is no fee for participating in the USA(J)MO.

AGREEMENT STATEMENT:

In the event that I have a qualifying student(s), I or my designee (indicated below) agree to:

1. Serve as the USA(J)MO School Manager.
2. Administer the USA(J)MO on Wednesday, April 27th, and Thursday, April 28th, 2011, to the student(s) in my school who qualify and not to any other students.
3. Arrange for the exclusive use of a room for four and a half hours (from 12:30pm to 5:00pm, eastern daylight time or your time zone equivalent, see below) on the designated days which will be used to administer the USA(J)MO.
4. Have a proctor present in the room to supervise the student(s) during the entire nine hours duration of the examination.
5. Have the ability to fax the students answer sheets to the AMC fax number immediately, to be graded with the rest of the papers by the AMC.

I understand that results of my participating USA(J)MO students could be voided if the rules and procedures associated with the administration of the USA(J)MO are not followed.

Signature _____

Telephone Number _____ Date _____

Name of USA(J)MO School Manager _____

eMail _____

School _____ CEEB#: _____

City _____ State _____ Zip _____

PLEASE NOTE THIS YEARS 4.5 HOURS PER DAY TIME LENGTH AND 2 DAYS LENGTH FOR THE 2011 USA(J)MO:

WEDNESDAY, April 27, 2011

12:30-5:00 p.m., Eastern Daylight Time
11:30-4:00 p.m., Central Daylight Time
10:30-3:00 p.m., Mountain Daylight Time
9:30-2:00 p.m., Pacific Daylight Time

&

THURSDAY, April 28, 2011

12:30-5:00 p.m., Eastern Daylight Time
11:30-4:00 p.m., Central Daylight Time
10:30-3:00 p.m., Mountain Daylight Time
9:30-2:00 p.m., Pacific Daylight Time

All other time zones, contact the AMC office at amcinfo@maa.org

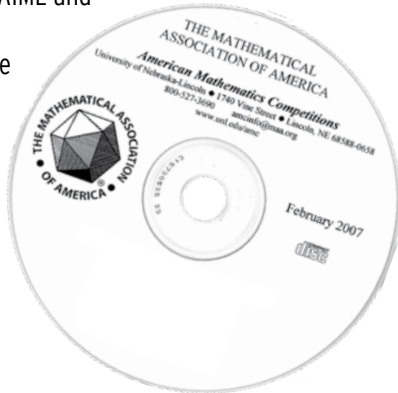
The Mathematical Association of America American Mathematics Competitions

NEW this year CD's with all the Contests – \$20 each

1. AJHSME & AMC 8 (1985-2007) + worksheets (1999-2007)
2. AHSME 1 (1950-1974)
3. AHSME 2 (1975-1999)

OR . . . Buy the Math Club Package! – \$25 each

Tips and ideas for High School - use with your Math Club or Circle, or with students in class. Includes 50 new question worksheets and an appendix on "Elusive Formulas" Contains a CD of the AMC contests for the last 10 years of AMC 8, AMC 10, and AMC 12 and for the AIME and USAMO from 2001. The CD also includes problem worksheets we have developed thus far from the questions, from the AMC 8 and the AMC 10 and AMC 12.



front

back



back of black shirt

NEW!!

MAA AMC T-Shirt – \$15 each

Choose from a black t-shirt with the theme, "6 Decades of the American Mathematics Competitions." Design on back, logo on front left chest; or choose a light blue t-shirt featuring the new MAA logo. Design on front chest and upper back.

Men's sizes available: Small, Medium, Large and X-Large. Quantities are limited in black.

- CD-AJHSME/AMC 8 1985-2007#___ @ \$20/ea=\$_____
- CD-AHSME 1, 1950-1974, contests & solutions#___ @ \$20/ea=\$_____
- CD-AHSME 2, 1975-1999, contests & solutions#___ @ \$20/ea=\$_____
- CD-AIME, 1983-2008 + USAMO, 1972-2008.....#___ @ \$20/ea=\$_____
- MAA AMC T-Shirt#___ @ \$15/ea=\$_____
- Men's sizes: Small___ Medium___ Large___ X-Large___
- Colors: Black___ Light Blue___
- AMC 8 Math Club Package w/ decade CD#___ @ \$25/ea =\$_____
- AMC 10/12 Math Club Package w/ decade CD#___ @ \$25/ea =\$_____
- TOTAL (Minimum order \$10)**.....\$_____
- Postage & Handling (See TERMS below)**.....\$_____
- GRAND TOTAL**.....\$_____

PAYABLE in U.S. Funds ONLY
ALLOW 2-3 WEEKS FOR DELIVERY

MAA AMC Ordering – TERMS

1. Minimum order \$10 is required.
2. VISA and MasterCard accepted.
3. Make checks payable to: **AMERICAN MATHEMATICS COMPETITIONS**
4. PAYMENT IN U.S. FUNDS ONLY.
5. **U.S. contiguous 48 states only:** There is no additional fee for shipping.
6. **All other including Canadian & International Orders:**
Additional shipping required for International/overseas addresses, please contact the AMC office at amcinfo@maa.org for more information.
7. Purchase Orders, and checks in U.S. funds will also be accepted.
8. Prices good until September 1, 2011.
9. Please allow 2-3 weeks for delivery.

FAX: 402-472-6087
Please fax or send your order to:
MAA American Mathematics Competitions
ATTN: AMC Publications
PO Box 81606
Lincoln, NE 68501-1606

Shipping Address

PLEASE FILL IN ALL THE INFORMATION

If other than a school, please strike out school and any other irrelevant headers and fill in the name, and ship-to address.

(Please Print)

Name: _____

School Name: _____

Street Address: _____

City: _____ State: _____ Zip: _____

Phone #: _____ (_____) _____

E-mail address: _____

CHARGE INFORMATION:

Card Name (Print): _____

VISA/MC #: _____

Exp. Date: _____

E-mail address: _____

Address: _____

For additional publications please visit the MAA online store
<https://www.maa.org/EbusPPRO/>

FORM C - AIME Order Form for Prior Years Exams

If you wish to order any of these publications complete the order form below and mail to:
 American Mathematics Competitions, ATTN: Publications, PO Box 81606, Lincoln, NE 68501-1606.
 To expedite delivery you may fax your order (402-472-6087). VISA & MASTERCARD accepted.

For each publication below write the quantity of each you wish to order in the blank beside the year or volume
AMERICAN INVITATIONAL MATHEMATICS EXAMINATION

(Starting in 2000 there were 2 versions of the AIME given)

91___ 93___ 95___ 96___ 97___ 98___ 99___
 AIME I 00___ 01___ 03___ 04___ 05___ 07___ 08___ 09___ 10___
 AIME II 00___ 01___ 03___ 04___ 05___ 06___ 07___ 08___ 09___ 10___

Total quantity of AIMEs _____ @ \$ 2.00 = \$ _____

CD - AIME & USA(J)MO \$ 20 each

A CD with PDFs of all the AIME Contests - 1983-2008, and all the USAMOs - 1972-2008

All the questions and solutions are included in PDF form. The CD also contains over 50 AIME worksheets.

AIME/USA(J)MO Contests CD _____ @ \$ 20.00 = \$ _____

USA -No Shipping

Subtotal \$ _____

CANADIAN & INTERNATIONAL POSTAGE:

Under 2 pounds \$30.00
 Over 2 pounds \$50.00 \$ _____

PAYABLE ONLY IN U.S. FUNDS

\$\$\$ GRAND TOTAL \$ _____

ORDER RECORD (Please Print)

VISA or MASTERCARD Number:

CEEB # _____

Name _____

Exp. Date _____

School _____

Cardholder Signature

City _____

State _____

Zip _____

Email _____

FORM D - Alternate AIME Payment Form

2011 Alternate AIME

Wednesday, March 30, 2011

The Alternate AIME on Wednesday, March 30, 2011 is a new set of 15 questions, completely different from, but comparable to the AIME on March 17, 2011. Please send payment before March 25, 2011. If you are using a credit card, you may register online at www.math.unl.edu/~amc/registration/

PLEASE PRINT

School CEEB # _ _ _ _ _

Contest Manager: _____

School Name: _____

School Address: _____

City: _____ State: _____ Zip: _____

School Phone #: _____

Email: _____

There will be a processing fee for the second AIME as follows: 1-10 students = \$25, 11+ students = \$50. We will need your payment before the answer forms can be graded. A special envelope and payment form has been included with your AIME material. All AIME answer forms must be returned by "express mail" so that they arrive in the AMC office by April 1, 2011.

Number of AIME qualifiers who will be taking the Alternate AIME on Wednesday, March 30, 2011:

Number of Alternate Exams Requested: # _____

1-10 student qualifiers @ \$25.00 = \$ _____
OR

11+ student qualifiers @ \$50.00 = \$ _____

Method of Payment:

Check enclosed (US funds only) made payable and mailed with this form in the BUSINESS REPLY/postpaid envelope provided:

AMERICAN MATHEMATICS COMPETITIONS
University of Nebraska-Lincoln
PO Box 880658
Lincoln, NE 68588-0658

Charge to Visa/Mastercard #: _____

Name on card (print): _____

Signed: _____

Expiration Date: _____ Telephone: _____

Email: _____

Form E - Rescoring Request Form

I would like to have the following student's answer form rescored. I understand that there is a \$10.00 charge for each student answer form rescored.

\$ 10.00/each

Student Name _____ \$ _____

Contest taken: AMC 10-A AMC 10-B AMC12-A AMC12-B AIME AIME II

Student Name _____ \$ _____

Contest taken: AMC 10-A AMC 10-B AMC12-A AMC12-B AIME AIME II

Student Name _____ \$ _____

Contest taken: AMC 10-A AMC 10-B AMC12-A AMC12-B AIME AIME II

Grand Total _____ \$ _____

School Name _____ CEEB # _____

Name: _____

Email: _____

Address: _____

City _____ State: _____ Zip _____

Method of Payment:

Check (US funds only) made payable and mailed with this form to:

AMERICAN MATHEMATICS COMPETITIONS

University of Nebraska-Lincoln

P.O. Box 81606

Lincoln, NE 68501-1606

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FORM F – AMC Academic Integrity Form

ETS/CEEB # _____

American Invitational Mathematics Examination (AIME)*On-site Official***Section 1 – Student**

This disclaimer statement is to be completed by all students taking the AIME in their school on the scheduled date of the contest, but at a later time from the other students, due to the requirement of attendance at an official academic function, which conflicted with the regularly scheduled time of the administration of the AIME. Reexamination may be requested if, after an inquiry, there is a reasonable basis to believe that a high score is well beyond a student's ability due to extremely lucky guessing, dishonesty or some other circumstance.

I certify that prior to my taking of the 2011 AIME on Thursday, March 17, 2011, I had absolutely no contact or communication with any student who participated in the contest, nor had I seen any of this year's contest questions.

Signed: _____ Date: _____

Name of School: _____

Section 2 – Contest Administrator

This section is to be completed by the teacher who administered the AIME on the day of the contest (Thursday, March 17, 2011) but at a time different from the regularly scheduled time.

This student (these students) participated in an officially sanctioned academic function. The student(s) had no contact or communication with any student who participated in the contest, nor had they seen any of this year's AIME. All contest papers were collected after any previous administrations, and students were instructed not to discuss the questions.

I administered the AIME to the student(s) indicated in Section 1 on (DATE): _____

Contest time period: From _____ to _____

Name (please print): _____

Title (please print): _____

Signature: _____

School name and address: _____

Date this form completed: _____

PLEASE INCLUDE THIS FORM WITH THE ANSWER FORMS OF THE STUDENTS.

IX. EXAM AUXILIARY MATERIAL

Practice Worksheets

Find the remainder when

$$9 \cdot 99 \cdot 999 \cdots \underbrace{99 \cdots 9}_{999 \text{ 9's}}$$

is divided by 1000.

2010 AIME 1, Problem #2—
“Compute the product modulo 1000”

(Answer: 109)

Let N be the product in the problem. Then

$$N \equiv 9 \cdot 99(-1)^{997} \equiv -891 \equiv 109 \pmod{1000}.$$

Thus the desired remainder is 109.

NCTM Standard: Number and Operations Standard: understand meanings of operations and how they relate to one another.

Problem Worksheets, continued

A point P is chosen at random in the interior of a unit square S . Let $d(P)$ denote the distance from P to the closest side of S . The probability that $\frac{1}{5} \leq d(P) \leq \frac{1}{3}$ is equal to $\frac{m}{n}$, where m and n are relatively prime positive integers. Find $m + n$.

2010 AIME 2, Problem #2—

“The region determined by the conditions is between two concentric squares”

(Answer: 281)

Note that because the square has area 1, the requested probability is equal to the area of the region determined by the given conditions. For $0 < r < 1$, let S_r denote the square concentric with S which has side length r . Every point P inside S except its center lies on the boundary of S_r for exactly one r , and for such a point, the distance $d(P)$ is $\frac{1-r}{2}$. The given inequality is satisfied if P is inside $S_{3/5}$ but outside $S_{1/3}$. This occurs with probability

$$\frac{9}{25} - \frac{1}{9} = \frac{56}{225},$$

and the requested sum is 281.

NCTM Standard: Geometry Standard: explore relationships (including congruence and similarity) among classes of two- and three-dimensional objects

AIME 2011 Teacher Manual
Problem Worksheets, continued

Let $P(x)$ be a quadratic polynomial with real coefficients satisfying

$$x^2 - 2x + 2 \leq P(x) \leq 2x^2 - 4x + 3$$

for all real numbers x , and suppose $P(11) = 181$. Find $P(16)$.

2010 AIME 1, Problem #6—

“Complete the square on the bounding quadratics”

(Answer: 406)

Completing the square yields

$$(x - 1)^2 + 1 \leq P(x) \leq 2(x - 1)^2 + 1.$$

The left hand and right hand expressions represent parabolas with a vertex at $(1, 1)$, so $P(x)$ must also represent a parabola with vertex at $(1, 1)$. Therefore $P(x) = a(x - 1)^2 + 1$, $P(11) = 100a + 1 = 181$, and $a = \frac{9}{5}$. Thus $P(x) = \frac{9}{5}(x - 1)^2 + 1$, and $P(16) = 406$.

NCTM Standard: Algebra Standard: understand relations and functions and select, convert flexibly among, and use various representations for them.

Problem Worksheets, continued

Let N be the number of ordered pairs of nonempty sets \mathcal{A} and \mathcal{B} that have the following properties:

- $\mathcal{A} \cup \mathcal{B} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$,
- $\mathcal{A} \cap \mathcal{B} = \emptyset$,
- The number of elements of \mathcal{A} is not an element of \mathcal{A} ,
- The number of elements of \mathcal{B} is not an element of \mathcal{B} .

Find N .

2010 AIME 2, Problem #8—

“Let $|\mathcal{A}| = k$. Be careful about sets of size 6. After assigning k to \mathcal{B} and $12 - k$ to \mathcal{A} count how many ways \mathcal{A} may be chosen.”

(Answer: 772)

Let $|\mathcal{M}|$ represent the number of elements in the set \mathcal{M} .

Let $|\mathcal{A}| = k$. Then the first two properties imply that $|\mathcal{B}| = 12 - k$, and because \mathcal{A} and \mathcal{B} are nonempty, it follows that $k \neq 0$ and $k \neq 12$. The last two properties imply that $k \notin \mathcal{A}$ and $12 - k \notin \mathcal{B}$. Thus the first property implies that $k \in \mathcal{B}$ and $12 - k \in \mathcal{A}$. Furthermore, k cannot equal 6, because otherwise, $|\mathcal{A}| = |\mathcal{B}| = 6$. Thus $6 \in \mathcal{A} \cap \mathcal{B}$, which violates the second property. After assigning k to \mathcal{B} and $12 - k$ to \mathcal{A} , the remaining $k - 1$ elements of \mathcal{A} can be chosen in $\binom{10}{k-1}$ ways, and the remaining $11 - k$ elements must belong to set \mathcal{B} . Thus

$$N = \left(\sum_{k=1}^{11} \binom{10}{k-1} \right) - \binom{10}{6-1} = 2^{10} - 252 = 772,$$

and the answer is 772.

NCTM Standard: Data Analysis and Probability Standard: understand and apply basic concepts of probability.

Problem Worksheets, continued

Let $ABCDEF$ be a regular hexagon. Let $G, H, I, J, K,$ and L be the midpoints of sides $AB, BC, CD, DE, EF,$ and $AF,$ respectively. The segments $AH, BI, CJ, DK, EL,$ and FG bound a smaller regular hexagon. Let the ratio of the area of the smaller hexagon to the area of $ABCDEF$ be expressed as a fraction $\frac{m}{n}$ where m and n are relatively prime positive integers. Find $m + n$.

2010 AIME 2, Problem #9—

“Place $ABCDEF$ in the first and second quadrants of the coordinate plane with $A = (0, 0)$ and $B = (2, 0)$ ”

(Answer: 011)

Without loss of generality, let $AB = 2$, and place $ABCDEF$ in the first and second quadrants of the coordinate plane with $A = (0, 0)$ and $B = (2, 0)$. Then $C = (3, \sqrt{3}), E = (0, 2\sqrt{3}), F = (-1, \sqrt{3}), G = (1, 0), H = \left(\frac{5}{2}, \frac{\sqrt{3}}{2}\right)$, and $L = \left(-\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$. Then line AH has equation $y = \frac{\sqrt{3}}{5}x$, line FG has equation $y = -\frac{\sqrt{3}}{2}x + \frac{\sqrt{3}}{2}$, and line EL has equation $y = (3\sqrt{3})x + 2\sqrt{3}$. The intersection of lines AH and FG is then $X = \left(\frac{5}{7}, \frac{\sqrt{3}}{7}\right)$, and the intersection of lines EL and FG is $Y = \left(\frac{-3}{7}, \frac{5\sqrt{3}}{7}\right)$. Then \overline{XY} is a side of the smaller hexagon, and the ratio of the areas is the square of the ratio of the sides, which is

$$\left(\frac{XY}{2}\right)^2 = \left(\frac{1}{2}\sqrt{\left(\frac{8}{7}\right)^2 + \left(-\frac{4\sqrt{3}}{7}\right)^2}\right)^2 = \frac{\frac{64}{49} + \frac{48}{49}}{4} = \frac{112}{196} = \frac{4}{7},$$

so $m + n = 11$.

NCTM Standard: Geometry Standard: explore relationships (including congruence and similarity) among classes of two- and three-dimensional objects

Publicity

The sample Contest Announcement news release below, should be prepared and distributed to the newspapers, radio and television stations in your region. To make preparation of the news release easier, visit our web site, and download the text from the online copy of the AIME Teachers' Manual. See the AMC website, or the 2010 Summary of Results for statistics and figures from the 2010 contest. Statistics and figures for the 2011 Contest will be available on our website in late March and early April 2011. Printing this on a sheet of school stationery gives an official look to the page.

(School or School District)

FOR IMMEDIATE RELEASE

(School) STUDENTS PARTICIPATE IN NATIONAL MATHEMATICS COMPETITION

(#) students at (School) participated in the 29th annual American Invitational Mathematics Examination (AIME). (Student names) qualified for the AIME by scoring in the top 2.5% of the American Mathematics Contest 10 (AMC 10, 10th grade and below). (Student names) qualified for the AIME by scoring 100 or more out of a possible 150 (approximately the top 5%) on the American Mathematics Contest 12 (AMC 12, 12th grade and below).

The AIME was held on Thursday, March 17, 2011, (or Wednesday, March 30, 2011). This contest was established in 1973 as an intermediate step between the high school (AMC 10 and AMC 12) contests and the U. S. A. Mathematical Olympiad (USA(J)MO). The AIME is a 15 question, 3 hour examination in which each answer is an integer number from 0 to 999, students are very unlikely to obtain the correct answer by guessing. The questions on the AIME cover high school mathematics, and are much more difficult than those on the AMC 10 and AMC 12. All problems on the AIME can be solved by pre-calculus methods. The use of calculators is not allowed. This contest leads to the USA(J)MO, MOSP (Mathematical Olympiad Summer Program) and the selection of the USA team sent to the International Mathematical Olympiad (IMO), the premier international high school level problem solving contest. This year the IMO will be held in Amsterdam, Netherlands, July 16-24, 2011.

According to Prof. Steven Dunbar, who serves as Director of the American Mathematics Competitions, the AIME is one of a series of contests sponsored each year by The Mathematical Association of America, through their program, the American Mathematics Competitions (AMC). The AMC offers the only math competition series in the country leading to the USA(J)MO and the Mathematical Olympiad Summer Program (MOSP). From this group of students, the AMC sends the highly competitive USA Team to the prestigious annual International Mathematical Olympiad. The AMC program includes:

American Mathematics Contest 8 (AMC8)	Grades 6- 8	November
American Mathematics Contest 10 (AMC 10)	Grades 10 & below	2 dates in January/February
American Mathematics Contest 12 (AMC 12)	Grades 12 & below	2 dates in January/February
American Invitational Mathematics Examination (AIME)	All who qualify	2 dates in March
USA Mathematical Olympiad (USAMO)	All who qualify	mid- to late-April
USA Junior Mathematical Olympiad (USAJMO)	All who qualify	mid- to late-April
Mathematical Olympiad Summer Program (MOSP)	Qualify thru USA(J)MO	June
International Mathematical Olympiad (IMO)	Top six from USA(J)MO, MOSP	July

The AMC is located at the University of Nebraska - Lincoln. and receives direct financial contributions from The Mathematical Association of America, The Akamai Foundation, Academy of Applied Sciences, American Mathematical Association of Two-Year Colleges, American Mathematical Society, American Statistical Association, Art of Problem Solving, Awesome Math, Canada/USA Mathcamp, Casualty Actuarial Society, IDEA Math, Institute for Operations Research and the Management Sciences, MathPath, Math Zoom Academy, Mu Alpha Theta, National Council of Teachers of Mathematics, Pi Mu Epsilon, Society of Actuaries, USA Math Talent Search, W. H. Freeman and Company, and Wolfram Research Inc. The Contests are given across the U.S.A, Canada, and in many schools abroad.

Details concerning the 2011 AIME contests for High School, as well as the rest of AMC's programs are available on the AMC web site: amc.maa.org.

American Mathematics Competitions

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American Mathematics Competitions

March, 2011

Dear Parent or Guardian:

On March 17, 2011 or March 30, 2011 your son or daughter participated in the 29th annual American Invitational Mathematics Examination (AIME). This contest was established in 1973 as an intermediate step between the high school (AHSME) contest and the USA Mathematical Olympiad (USA(J)MO). The AIME is taken by students who achieved a score of 100 or more out of a possible 150 (approximately the top 5%) on the AMC 12, and students who achieve a score of 120 or more (approximately the top 2.5%) on the AMC 10 .

The AIME is a 15 question, 3 hour examination in which each answer is an integer number from 0 to 999. The questions on the AIME are much more difficult than those on the AMC 10 and AMC 12, and students are very unlikely to obtain the correct answer by guessing. All problems on the AIME can be solved by pre-calculus methods. The use of calculators is not allowed.

This contest leads to the USAJMO, USAMO, MOSP (Mathematical Olympiad Summer Program) and the selection of the USA team sent to the International Mathematical Olympiad (IMO), the premier international high school level problem solving contest. This year the IMO will be held in Amsterdam, Netherlands, July 16-24, 2011.

The AIME provides the exceptional students who are invited to take it with yet another opportunity to challenge their mathematical abilities. Like all examinations, it is but a means towards furthering mathematical development and interest. The real value of the examination is in the learning that can come from the preparation beforehand and from further thought and discussion of the solutions.

Our organization regularly receives requests from well-known colleges and universities for the names of high scoring students. A few colleges offer scholarships to students in their region with high scores on the contests. But the real rewards come from challenging each student with mathematics that is new, different, and “outside of the box.” The problems on the contest are hard, but designed to be within reach. Even so, if your son or daughter managed to solve only one or two problems, one should still feel that they accomplished something, because these problems are meant to be more challenging than they routinely encounter in their mathematics courses.

Mathematics is increasingly important in our technological and scientific age. Taking enough mathematics in high school is the gateway to jobs and careers of all kinds, even those that are not explicitly mathematical, scientific, or technological. We hope that by offering these contests, we can challenge and inspire students to want to learn more mathematics. We hope that your son or daughter enjoyed the contests, and will continue to take mathematics courses and competitions in high school and beyond.

Sincerely,

Dr. Steven R. Dunbar

Director

MAA American Mathematics Competitions

American Mathematics Competitions

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