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Before You Choose This UExcel Exam

Uses for the Examination

- Excelsior College, the test developer, recommends granting three (3) semester hours of lower-level undergraduate credit to students who receive a letter grade of C or higher on this examination. The examination may be used to help fulfill the quantitative requirement for all Excelsior College degree programs that do not specify a higher level of math.

- Other colleges and universities also recognize this exam as a basis for granting credit or advanced standing.

- Individual institutions set their own policies for the amount of credit awarded and the minimum acceptable score.

Exam-takers enrolled in an Excelsior College degree program should ask their academic advisor where this exam fits within their degree program.

Exam-takers not enrolled in an Excelsior College degree program should check with the institution from which they wish to receive credit to determine whether credit will be granted and/or to find out the minimum grade required for credit. Those who intend to enroll in an Excelsior College degree program should ask an admissions counselor where this exam fits within their intended degree program.

Examination Length and Scoring

The examination consists of approximately 60 questions, most of which are multiple choice; for samples of all the item types on this exam, see the sample items in the back of this guide. Some items are unscored, pretest items. The pretest items are embedded throughout the exam and are indistinguishable from the scored items. You will have two (2) hours to complete the examination. Your score will be reported as a letter grade.

UExcel Exam Resources

Excelsior College Bookstore

The Excelsior College Bookstore offers recommended textbooks and other resources to help you prepare for UExcel exams.

The bookstore is available online at: www.excelsior.edu/bookstore

UExcel Practice Exams

The official UExcel practice exams are highly recommended as part of your study plan. Once you register for your UExcel exam, you are eligible to purchase the corresponding practice exam, which can be taken using any computer with a supported Web browser. Each practice exam includes two forms that you may take within a 180-day period.
Excelsior College Library

Enrolled Excelsior College students can access millions of authoritative resources online through the Excelsior College Library. Created through our partnership with the Sheridan Libraries of The Johns Hopkins University, the library provides access to journal articles, books, websites, databases, reference services, and many other resources. Special library pages relate to the nursing degree exams and other selected exams. To access it, visit www.excelsior.edu/library (login is required).

Our library provides:

- 24/7 availability
- The world’s most current authoritative resources
- Help and support from staff librarians

Online Tutoring

Excelsior College offers online tutoring through SMARTTHINKING™ to connect with tutors who have been trained in a variety of academic subjects. To access SMARTTHINKING, go to www.excelsior.edu/smarthinking. Once there, you may download a copy of the SMARTTHINKING Student Handbook as a PDF.

MyExcelsior Community

MyExcelsior Community enables Excelsior College students and alumni to interact with their peers online. As members, students can participate in real-time chat groups, join online study groups, buy and sell used textbooks, and share Internet resources. Enrolled students have automatic access from their MyExcelsior page. Visit www.excelsior.edu/myexcelsiorcommunity.

Preparing for UExcel Exams

How Long Will It Take Me to Study?

A UExcel exam enables you to show that you’ve learned material comparable to one or more 15-week college-level courses. As an independent learner, you should study and review as much as you would for a college course. For a 3-credit course in a subject they don’t know, most students would be expected to study nine hours per week for 15 weeks, for a total of 135 hours.

Study Tips

Become an active user of the resource materials. Aim for understanding rather than memorization. The more active you are when you study, the more likely you will be to retain, understand, and apply the information.

The following techniques are generally considered to be active learning:

- preview or survey each chapter
- highlight or underline text you believe is important
- write questions or comments in the margins
- practice re-stating content in your own words
- relate what you are reading to the chapter title, section headings, and other organizing elements of the textbook
- find ways to engage your eyes, your ears, and your muscles, as well as your brain, in your studies
- study with a partner or a small group (if you are an enrolled student, search for partners on MyExcelsior Community)
- prepare your review notes as flashcards or create recordings that you can use while commuting or exercising

When you feel confident that you understand a content area, review what you have learned. Take a second look at the material to evaluate your understanding. If you have a study partner, the two of you can review by explaining the content to each other or writing test questions for each other to answer. Review questions from textbook chapters may be helpful for partner or individual study, as well.

Using UExcel Practice Exams

We recommend taking the first form of the practice exam when you begin studying, to see how much you already know. After taking the first practice exam, check your performance on each question and find out why your answer was right or wrong. This feedback will help you improve your knowledge of the subject and identify areas of weakness that you should address before taking the exam. Take the second form of the practice exam after you have finished studying. Analyze your results to identify the areas that you still need to review.
Although there is no guarantee, our research suggests that students who do well on the practice exams are more likely to pass the actual exam than those who do not do well (or do not take advantage of this opportunity).

**About Test Preparation Services**

Preparation for UExcel® exams and Excelsior College® Examinations, though based on independent study, is supported by Excelsior College with a comprehensive set of exam learning resources and services designed to help you succeed. These learning resources are prepared by Excelsior College so you can be assured that they are current and cover the content you are expected to master for the exams. These resources, and your desire to learn, are usually all that you will need to succeed.

There are test-preparation companies that will offer to help you study for our examinations. Some may imply a relationship with Excelsior College and/or make claims that their products and services are all that you need to prepare for our examinations.

Excelsior College is not affiliated with any test preparation firm and does not endorse the products or services of these companies. No test preparation vendor is authorized to provide admissions counseling or academic advising services, or to collect any payments, on behalf of Excelsior College. Excelsior College does not send authorized representatives to a student’s home nor does it review the materials provided by test preparation companies for content or compatibility with Excelsior College examinations.

To help you become a well-informed consumer, we suggest that before you make any purchase decision regarding study materials provided by organizations other than Excelsior College, you consider the points outlined on our website at [www.excelsior.edu/testprep](http://www.excelsior.edu/testprep).

**Preparing for This Exam**

**Prior Knowledge**

A knowledge of arithmetic and elementary algebra is assumed.

**Using the Content Outline**

Each content area in the outline includes (1) the recommended minimum hours of study to devote to that content area and (2) the most important sections of the recommended resources for that area. These annotations are not intended to be comprehensive. You may need to refer to other chapters in the recommended textbooks. Chapter numbers and titles may differ in other editions.

This content outline contains examples of the types of information you should study. Although these examples are numerous, do not assume that everything on the exam will come from these examples. Conversely, do not expect that every detail you study will appear on the exam. Any exam is only a broad sample of all the questions that could be asked about the subject matter.

**Using the Sample Questions and Rationales**

Each content guide provides sample questions to illustrate those typically found on the exam. These questions are intended to give you an idea of the level of knowledge expected and the way questions are typically phrased. The sample questions do not sample the entire content of the exam and are not intended to serve as an entire practice test.

**Recommended Resources for the UExcel Exam in Contemporary Mathematics**

The study materials listed below are recommended by Excelsior College as the most appropriate resources to help you study for the examination. For information on ordering from the Excelsior College Bookstore, see page 1 of this guide. You may
also find resource materials in college libraries. Public libraries may have some of the textbooks or may be able to obtain them through an interlibrary loan program.

You should allow sufficient time to obtain resources and to study before taking the exam.

**Textbook**

Material on this exam has been drawn from chapters of two different textbooks to achieve the desired content coverage. This material is available in a single custom text (including an e-text format) from the Excelsior College Bookstore:


The textbook above was used by the examination development committee to verify all questions on the exam.

The custom text includes both the chapter content and material like worked solutions that would usually require the purchase of a supplementary workbook. If you choose not to purchase the custom text, you will need to access both of the following texts during your preparation for the exam:


**Open Educational Resources**

No complete courses that match this exam have been found, but you should be able to find lectures on many of the individual topics at Khan Academy (khanacademy.org). Promising material on iTunes U includes Harrisburg Community College’s Principles of Mathematics.


**Reducing Textbook Costs**

Many students know it is less expensive to buy a used textbook, and buying a previous edition is also an option. The Excelsior College bookstore includes a buyback feature and a used book marketplace, as well as the ability to rent digital versions of textbooks for as long as students need them. Students are encouraged to explore these and the many other opportunities available online to help defray textbook costs.
Content Outline

General Description of the Examination

The UExcel Contemporary Mathematics examination is based on material typically taught in a one-semester, three-credit, lower-level course in applied mathematics. The content of the examination corresponds to course offerings such as Mathematics in Contemporary Society, Liberal Arts Math, or Math for Non-STEM (science, technology, engineering, and mathematics) Majors.

The examination measures the ability to apply mathematical knowledge and concepts to understand and analyze practical contemporary mathematical problems. Specifically, the exam covers graph theory, mathematical reasoning, statistics, and probability, and the application of mathematics to politics.

Those beginning to study for this exam should be familiar with arithmetic and elementary algebra.

Learning Outcomes

After you have successfully worked your way through the recommended study materials, you should be able to demonstrate the following learning outcomes:

1. Understand voting and apportionment using mathematical principles.
2. Demonstrate a basic understanding of statistical concepts.
3. Analyze data statistically.
4. Calculate simple probabilities.
5. Reason mathematically.
6. Explain and understand graphs, paths, and circuits.
Content Outline

The content outline describes the various areas of the test, similar to the way a syllabus outlines a course. To fully prepare requires self-direction and discipline. Study involves careful reading, reflection, and systematic review.

The major content areas on the Contemporary Mathematics examination, the percent of the examination, and the hours to devote to each content area are listed below.

<table>
<thead>
<tr>
<th>Content Area</th>
<th>Percent of the Examination</th>
<th>Hours of Study</th>
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<tr>
<td>I. Mathematical Reasoning</td>
<td>25%</td>
<td>34</td>
</tr>
<tr>
<td>II. Probability and Statistics</td>
<td>30%</td>
<td>41</td>
</tr>
<tr>
<td>III. Mathematics and Politics</td>
<td>20%</td>
<td>27</td>
</tr>
<tr>
<td>IV. Graph Theory</td>
<td>25%</td>
<td>34</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: Occasionally, examples will be listed for a content topic to help clarify that topic. However, the content of the examination is not limited to the specific examples given.

I. Mathematical Reasoning

<table>
<thead>
<tr>
<th>25 PERCENT OF EXAM</th>
<th>34 HOURS OF STUDY</th>
</tr>
</thead>
</table>

Custom Ch. 11 and 12, Problem Solving and Critical Thinking (Blitzer Ch. 1)

Custom Ch. 13 and 14, Logic (Blitzer Ch. 3)

A. Thinking critically
   1. Inductive reasoning
   2. Deductive reasoning
   3. Connective reasoning

B. Problem solving
   1. Problem solving techniques
      a. Polya’s four steps

II. Probability and Statistics

<table>
<thead>
<tr>
<th>30 PERCENT OF EXAM</th>
<th>41 HOURS OF STUDY</th>
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</thead>
</table>

Custom Ch. 15 and 16, Counting Methods and Probability Theory (Blitzer Ch. 11)

Custom Ch. 9 and 10, Descriptive Statistics and Ch. 19 and 20, Statistics (Blitzer Ch. 12)

A. Statistics
   1. Sampling
      a. Random samples
   2. Frequency distributions
   3. Histograms
   4. Measures of central tendency
      a. Mean
      b. Median
      c. Mode
   5. Measures of dispersion
a. Range
b. Variance
c. Standard deviation
d. Percentiles
e. Quartiles
6. Normal distribution

B. Probability
1. Counting
2. Permutations
3. Combinations
4. Simple probability
   a. Sample space
   b. Events
5. Dependence and independence
6. Expected value

III. Mathematics and Politics

20 PERCENT OF EXAM  |  27 HOURS OF STUDY

Custom Ch. 1 and 2, The Mathematics of Voting
(Tannenbaum Ch. 1)
Custom Ch. 3 and 4, The Mathematics of Apportionment
(Tannenbaum Ch. 4)
Custom Ch. 17 and 18, Voting and Apportionment
(Blitzer Ch. 14)

A. Voting
1. Preference ballots
2. Preference schedules
3. Plurality method
4. Borda count method
5. Plurality-with-elimination method
6. Pairwise comparison method
7. Flaws in all voting methods
   a. Majority criterion
   b. Condorcet criterion
   c. Monotonicity criterion
   d. Independent of irrelevant alternatives

B. Apportionment
1. The problem of apportionment
2. Hamilton’s method
3. Jefferson’s method
4. Adams’ method
5. Webster’s method
6. Huntington-Hill method
7. Paradoxes and flaws
   a. Alabama
   b. New states
   c. Population paradox
   d. Quota rule
8. Belinski and Young

IV. Graph Theory

25 PERCENT OF EXAM  |  34 HOURS OF STUDY

Custom Ch. 5 and 6, The Mathematics of Getting Around
(Tannenbaum Ch. 5)
Custom Ch. 7 and 8, The Mathematics of Touring
(Tannenbaum Ch. 6)
Custom Ch. 21 and 22, Graph Theory (Blitzer Ch. 15)

A. Graphs, paths, and circuits
1. Definitions and graph theory
2. Modeling
   a. Delivering the mail
   b. Travelling salesman
   c. The seven bridges of Königsberg
B. Euler paths and Euler circuits
1. The degree of vertex
2. Euler’s theorem
3. Fleury’s algorithm
C. Hamilton paths and Hamilton circuits
1. Travelling salesman problem
2. Weighted graph
3. Methods of finding the most efficient circuit
a. Nearest neighbor
b. Brute force
c. Cheapest link
Sample Questions

The sample questions give you an idea of the level of knowledge expected in the exam and how questions are typically phrased. They are not representative of the entire content of the exam and are not intended to serve as a practice test.

Rationales for the questions can be found on pages 12−14 of this guide. In that section, the correct answer is identified and each answer is explained. The number in parentheses at the beginning of each rationale refers to the corresponding section of the content outline. For any questions you answer incorrectly, return to that section of the content outline for further study. You will be provided with an erasable white board to use during your exam. A basic 8-function calculator will also be available on your computer. A typical calculator is printed at the back of this content guide.

The calculator button is in the top left hand corner of the page as each question is presented.

1. What is the next number in this pattern?
   8, 15, 29, 57, 113
   1) 191
   2) 197
   3) 213
   4) 225

2. Let \( p \) and \( q \) represent the following simple statements:
   \( p \): Dogs bark.
   \( q \): Cats meow.
   Which corresponds to the symbolic statement \( \sim p \lor q \)?
   1) Dogs do not bark or cats meow.
   2) Dogs bark or cats do not meow.
   3) Dogs bark or cats meow.
   4) Dogs do not bark or cats do not meow.

3. In one game, a basketball team took 95 shots. The team made 12 of its 15 free-throw attempts (worth one point each), 30 out of 68 two-point shot attempts, and 5 out of 12 three-point shot attempts. Which piece of information is unnecessary in determining the number of points the team scored?
   (Select the 2 that apply.)
   1) the number of two-point shots made
   2) the number of shots taken
   3) the number of shots made
   4) the number of three-points shots made
   5) the number of free-throw attempts made

4. If the US population increases by one percentage point per year and the population is currently 310,000,000, what will the population be in two years?
   1) 312,000,000
   2) 312,231,000
   3) 316,200,000
   4) 316,231,000
5. What is the median of the following data set? 14, 26, 13, 11, 0, 0, 35, 39
   1) 13.5  
   2) 17.2  
   3) 20  
   4) 23

6. Consider the following array of scores on a standardized test:
   390  410  440  450  460  490  530  570  590  600  640  670  710
   The 15th percentile is given by which score?
   1) 400  
   2) 410  
   3) 420  
   4) 430

7. How many pairs of items can be created by choosing one item from a group of $M$ items and one item from a group of $N$ items?
   1) $M + N$  
   2) $M \times N$  
   3) $M \binom{N}{2}$  
   4) $M \binom{N}{2}$

8. What is $200!/198!$?
   1) 37,800  
   2) 39,600  
   3) 39,800  
   4) 40,200

9. What is the probability that, of two people selected at random, at least one was born on a Friday?
   1) $1 \div 7$  
   2) $2 \div 7$  
   3) $11 \div 49$  
   4) $13 \div 49$

10. A basketball player makes 20% of her three-point shots and 40% of her two-point shots. Based on this information, what is the expected value of one shot?
    1) 0.8 points  
    2) 1 point  
    3) 1.2 points  
    4) 1.4 points

11. Four people are voting for the type of beverage to be served at a picnic. The choices are cola, ginger ale, and iced tea. Which could be among the valid preference ballots for this vote?
    (Select the 2 that apply.)
    1) Ballot Ballot Ballot Ballot
       1st Cola 1st Cola 1st Ginger ale 1st Iced tea
       2nd Iced tea 2nd Ginger ale 2nd Cola 2nd Ginger ale
       3rd Ginger ale 3rd Iced tea 3rd Iced tea 3rd Ginger ale

    2) Ballot Ballot Ballot Ballot
       1st Iced tea 1st Cola 1st Cola 1st Iced tea
       2nd Ginger ale 2nd Ginger ale 2nd Ginger ale 2nd Ginger ale
       3rd Cola 3rd Iced tea 3rd Iced tea 3rd Ginger ale

    3) Ballot Ballot Ballot Ballot
       1st Iced tea 1st Cola 1st Cola 1st Iced tea
       2nd Ginger ale 2nd Ginger ale 2nd Ginger ale 2nd Ginger ale
       3rd Cola 3rd Iced tea 3rd Iced tea 3rd Ginger ale

    4) Ballot Ballot Ballot Ballot
       2nd Cola 3rd Cola 3rd Cola 2nd Cola
       1st Iced tea 2nd Iced tea 2nd Iced tea 2nd Iced tea
       3rd Ginger ale 1st Ginger ale 3rd Ginger ale 3rd Ginger ale

    5) Ballot Ballot Ballot Ballot
       1st Cola 2nd Cola 1st Cola 2nd Cola
       3rd Ginger ale 3rd Iced tea 2nd Iced tea 1st Iced tea
       2nd Iced tea 1st Ginger ale 1st Ginger ale 3rd Ginger ale

12. The members of a class are holding an election to choose among four choices for a field trip. Their preference schedule is shown below:

<table>
<thead>
<tr>
<th>Preferences</th>
<th>1st choice</th>
<th>2nd choice</th>
<th>3rd choice</th>
<th>4th choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>96</td>
<td>Zoo</td>
<td>Museum</td>
<td>Museum</td>
<td>Farm</td>
</tr>
<tr>
<td>8</td>
<td>Park</td>
<td>Park</td>
<td>Park</td>
<td>Zoo</td>
</tr>
<tr>
<td>6</td>
<td>Farm</td>
<td>Zoo</td>
<td>Farm</td>
<td>Park</td>
</tr>
<tr>
<td>3</td>
<td>Museum</td>
<td>Farm</td>
<td>Zoo</td>
<td>Museum</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Using the Borda count method, which is the winning choice?
   1) farm
   2) museum
   3) park
   4) zoo
13. If a candidate wins an election and in a recount, one of the losing candidates withdraws, then the original winner should still win the election. This describes which voting criterion?
   1) majority
   2) Condorcet
   3) monotonicity
   4) independence-of-irrelevant-alternatives

14. Which method of apportionment might produce the Alabama paradox?
   1) Adams’s
   2) Hamilton’s
   3) Jefferson’s
   4) Webster’s

15. Which vertices have a degree of 3?
   (Select the 3 that apply.)
   1) A
   2) B
   3) C
   4) E
   5) G

16. Which graph has at least one Euler circuit?
   1)

17. What is the total weight of the Hamilton circuit D, B, E, C, A, D?

   1) 313
   2) 334
   3) 344
   4) 356

18. The chart below shows the distances between four cities, A, B, C, and D:

   Using the nearest neighbor method starting at A, what is the total distance for the Hamilton circuit obtained?
   1) 24
   2) 27
   3) 28
   4) 37
4. (IA1)
1) See 4).
2) See 4).
3) See 4).
*4) To determine the next number in the sequence, take the previous number, double it, and subtract one. Therefore $113 \times 2 - 1 = 225$.

2. (IA3)
*1) This is correct for $\neg p \lor q$.
2) This would be $p \lor \neg q$.
3) This would be $\neg(p \lor q)$.
4) This would be $\neg p \lor \neg q$.

3. (IB1)
1) This must be known in order to calculate the total number of points scored by the team.
2) It is not necessary to know the number of shots taken to calculate the number of points scored by the team.
3) It is not necessary to know the number of shots made, separate from knowing how much each shot was worth.
4) See 1).
5) See 1).

4. (IB3)
1) This would be the population if it increased by one million per year.
2) See 4).
3) This would be the population if it increased by two percentage points every two years.
*4) $310 \text{ million } \times 1.01 = 313.1 \text{ million }$ and $313.1 \text{ million } \times 1.01 = 316.231 \text{ million}$.

5. (IIA4b)
*1) There are 8 data points. Arrange them in order. The median is the sum of the fourth and fifth values divided by 2 = 13.5.
2) This is the mean ($138 \div 8 = 17.2$).
3) This is an incorrect value.
4) This is 138 divided by 6 (using only the nonzero values).

6. (IIA5d)
1) See 2).
*2) There are 13 scores. Therefore, the locator for the 15th percentile is $(0.15) \times 13 = 1.95$. Because this is not a whole number, we round it up to 2. Thus, the 15th percentile is given by the second score, which is 410.
2) See 2).
3) See 2).
4) See 2).
7. (IIB1)
1) This would result from using the fundamental counting theorem as additive instead of multiplicative.
2) $M \times N$ is the correct answer according to the fundamental counting theorem.
3) This would result from confusing the fundamental counting theorem with combinations.
4) This would result from confusing the fundamental counting theorem with permutations.

8. (IIB2)
1) $37,800 = 200 \times 189$, which could be the result of a typo in computation.
2) $39,600 = 200 \times 198$, a mistake a person in a hurry might make by misreading the problem.
3) $200! / 198! = (200 \times 199 \times 198!) / 198! = 200 \times 199 = 39,800$
4) $40,200 = 200 \times 201$

9. (IIB4)
1) See 4).
2) See 4).
3) See 4).
4) In the sample space of 49 combinations, there are 7 in which the first person was born on Friday plus seven more in which the second person was born on Friday, minus one if they were both born on Friday. Therefore, the probability is $13 \div 49$.

10. (IIB6)
1) See 4).
2) See 4).
3) See 4).
4) $(.20 \times 3) + (.40 \times 2) = .4$ points

11. (IIIA1)
1) This is wrong because there are five ballots, not four.
2) This is not a linear preference ballot because cola does not appear on the last ballot.
3) This is a valid preference ballot for four voters and three choices.
4) This is wrong because no beverage is in first place.

12. (IIIA4)
1) The Farm comes in last with only 54 points.
2) The Museum is the majority winner, but by the Borda count method, it comes in second place with 71 points.
3) The Park is the winner by the Borda count method, with 77 points.
4) The Zoo appears first, winning the most common ballot, but it has only 68 points.

13. (IIIA7d)
1) See 4).
2) See 4).
3) See 4).
4) This is a description of the independence-of-irrelevant-alternatives criterion because the elimination of a non-winning candidate should not logically affect the top vote getter.

14. (IIIB7a)
1) See 2).
2) There is a flaw in Hamilton’s math. When the number of seats is increased, each state’s standard quota goes up, but not by the same amount. As the remainders change, some states can move ahead of others in the priority order for the surplus seats. This can result in a state losing a seat it already had.
3) See 2).
4) See 2).

*correct answer
15. (IVB)
   1) Vertex A has degree 2.
   2) Vertex B has degree 2.
   *3) Vertex C has degree 3.
   *4) Vertex E has degree 3.
   *5) Vertex G has degree 3.

16. (IVB1)
   1) There is no Euler circuit.
   2) See 1).
   *3) A, B, C, A, D, E, A is an Euler circuit.
   4) See 1).

17. (IVC2)
   1) See 3).
   2) See 3).
   *3) DB = 72; BE = 90; EC = 72; CA = 55; AE = 50
   4) See 3).

18. (IVC3a)
   1) See 3).
   2) See 3).
   *3) For path A, C, D, B, A, the total weight is
       \[3 + 7 + 6 + 12 = 28.\]
   4) See 3).

*correct answer
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