

ACT WorkKeys®: Awarding College Credit through the National Career Readiness Certificate ACT

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The ACT WorkKeys assessment system measures job skills that are valuable for any occupation – skilled or professional – at any level and in any industry.



The ACT National Career Readiness Certificate™ is an industry-recognized, portable, evidence-based credential that certifies achievement of foundational skills essential for workplace success.

Executive Summary

The National Career Readiness Certificate is awarded at four levels of achievement—Bronze, Silver, Gold, and Platinum—based on performance on three of the assessments: Applied Math, Workplace Documents, and Graphic Literacy. The three updated assessments replace the former WorkKeys assessments of Applied Mathematics, Reading for Information, and Locating Information. ACT designed the three updated assessments to build on the strengths of the former assessments, as well as incorporating features of the changing work environment.

In 2016, after reviewing materials, documentation, and test forms, the American Council on Education (ACE) recommended that institutions award in the vocational certificate category to individuals who have earned a Silver NCRC certificate, 3 semester hours in quantitative reasoning and 1 semester hour in information literacy for a total of 4 semester hours. For individuals who have earned a Gold or Platinum certificate, ACE recommended that institutions award in the lower-division baccalaureate/associate degree category, 3 semester hours in quantitative reasoning and 1 semester hour in information literacy for a total of 4 semester hours.

Although the credit recommendation was provided for the NCRC based on the former assessments, the NCRC credit recommendation is still effective when examinees test using the updated assessments until an ACE review is completed. (ACE will conduct a review of the updated assessments and provided a revised credit recommendation in 2018.)

ACT WorkKeys® assessments incorporate a rigorous process of item development to ensure that all scored items are workplace-relevant, fair, and align to well-defined specifications. ACT content staff collaborate with psychometricians to ensure that all forms are built to exact content and statistical specifications. ACT carefully monitors the administration of all WorkKeys tests to ensure the standardization, integrity, security, and fairness of the testing process.



In awarding college credits to students who have achieved a Gold or Platinum NCRC, an institution would be rewarding students who demonstrate that they have developed the foundational skills needed for today's economy. Further, the institutions would be facilitating students' efforts to achieve their academic degrees. With the recent attention focused on the problem of student loan debt and the low graduation rates of some institutions, colleges may want to seek innovative ways to assist highly qualified students to attain academic success. A recent Gallup/Lumina Foundation poll showed that 87% of students felt they should receive college credit for knowledge and skills mastered outside the classroom, and 75% said they would be more likely to enroll in a higher education institution if they could be evaluated and receive college credit for what they already know. This last point is particularly relevant for highly-qualified at-risk students. They are also the students who are most likely to drop out, fail to graduate, and experience problems with financial debt. For these reasons, at-risk students are the individuals who would stand to benefit the most from a skills-based educational system—a system that would allow them to earn credit by demonstrating their 21st century skills through the attainment of a high-level NCRC®. An institution would benefit by adopting this type of skills-based approach by demonstrating that they are putting students first and considering alternative paths to achieving higher education success.

Background

ACT began issuing the NCRC in 2006 as a unique portable,¹ evidence-based credential certifying that an individual possesses the essential problem-solving and critical thinking foundational skills needed for workplace success. More than four million certificates have been registered to date. The NCRC is awarded at four levels of achievement—Bronze, Silver, Gold, and Platinum— based on performance on three of the assessments: Applied Math, Workplace Documents, and Graphic Literacy. Since the WorkKeys assessment program was launched in 1992, more than twenty million assessments have been administered.

The NCRC is available in all 50 states and the District of Columbia, and serves as a bridge for emerging, transitional, and current workers seeking to enter or reenter the workplace, receive job-related training, or pursue advanced opportunities. It is a proven predictor of performance both in the workplace and in college- and industry-based training/educational programs (Borman, 1991; Mayo, 2012). ACT proposed in 2012 that the American Council on Education (ACE) review and recommend the NCRC as a credential students could use to achieve college credit. ACT proposed to ACE that they recommend the awarding of college credit to students who have earned a high-level NCRC. Granting college credit to students who have achieved the NCRC would be consistent with a skills-based educational approach while facilitating the opportunity for them to earn their degree.

As a part of the accreditation process, an ACE review team traveled to ACT in 2012 to evaluate the program and provide recommendations. Following the review process, ACE recommended that institutions may award three undergraduate credits, at the lower-divisional level, in critical thinking to students who earned a Gold or Platinum certificate. Lastly, the NCRC assessment program would be evaluated in four years, and ACE would re-issue the credit recommendation.

An ACE review team returned to ACT in 2016 to review the NCRC and the three assessments constituting the credential. Following the 2016 review, ACE modified the recommendation to state that they recommend institutions award in the vocational certification category to individuals who have earned a Silver credential, 3 semester hours in quantitative reasoning and 1 semester hour in information literacy for a total of 4 semester hours of credit. For individuals who have earned a Gold or Platinum certificate, ACE recommended that institutions award in the lower-division baccalaureate/associate degree category,



3 semester hours in quantitative reasoning and 1 semester hour in information literacy for a total of 4 semester hours of credit.

The purpose of this paper is to provide information to postsecondary institutions regarding why students who have earned a high-level credential should be awarded college credit. To make this case, the paper presents supporting information related to the ACT National Career Readiness Certificate®, ACT WorkKeys® test development and administration standards, and 21st century skills and the awarding of college credit.

National Career Readiness Certificate

ACT recognized 25 years ago that in the fast-paced, technologically driven global economy, employers were looking for individuals who have the necessary skills to perform the jobs of today and to adapt to the jobs of tomorrow. ACT established the WorkKeys system in response to a very real need for better information about employability skills and job readiness. To develop the system, ACT consulted with employers, educators, and labor organizations to define essential, functional workplace skills. ACT selected and defined the initial WorkKeys skills by collaborating with a panel of advisors made up of educators and business leaders, reviewing the literature on employer-identified skill needs, and surveying employers and educators. Survey participants, charter members of the WorkKeys development effort, came primarily from seven states and a network of community colleges in California. These charter members and panelists assisted in the design and reviewed the initial plans and materials.

As a part of the WorkKeys system, ACT has profiled more than 21,000 individual jobs across the United States to determine the skills and skill levels needed. According to research, three skills are highly relevant for success across most jobs: reading and applying information contained in workplace documents, applying mathematical and quantitative principles, and using information found in graphic resources. These skills constitute the three assessments of the NCRC. Each assessment is described below.

The assessment *Workplace Documents* measures the extent to which individuals can read and comprehend written documents in order to do a job. The written documents include electronic messages, letters, directions, signs, notices, bulletins, policies, contracts, and regulations. The Workplace Documents assessment measures skills that individuals use when they read workplace documents and use that information to make decisions and solve problems.

Applied Math measures the skills people use when they apply mathematical reasoning and problem-solving techniques to work-related problems. The test questions require the test-taker to set up and solve the types of problems and do the types of calculations that actually occur in the workplace.

Graphic Literacy measures the locating, comparative, summarization, and analytic skills people use when they work with workplace graphics such as charts, graphs, tables, forms, flowcharts, diagrams, floor plans, maps, and instrument gauges.

(For a detailed description of the construct of each assessment, the skill levels associated with each assessment, and the level score distribution, please see the paper's Appendix.)

All three assessments contain items presented in multiple choice format. Most items have associated stimuli in the form of passages, graphs, charts, or tables. At higher levels, multiple items may be based on a common stimulus. All three assessments are criterion-referenced based on defined skill levels. An examinee who takes the three assessments receives a score report for each assessment providing both



a scaled score and a level score. The score report provides descriptions of the skills that the examinee has demonstrated. It also provides a list of skills that he or she needs to improve upon to raise the level score. For all three assessments, examinees achieve a level score of <3, 3, 4, 5, 6, or 7. To achieve an NCRC, an examinee must score a minimum of Level 3 on all three assessments. Table 1 provides the criteria for achieving each credential level.

Table 1: NCRC Skill Levels

Credential Level	Skill Level
Bronze	Signifies an individual has scored at least a Level 3 on each of the three assessments.
Silver	Signifies an individual has scored at least a Level 4 on each of the three assessments.
Gold	Signifies an individual has scored at least a Level 5 on each of the three assessments.
Platinum	Signifies an individual has scored at least a Level 6 on each of the three assessments.

WorkKeys® Test Development and Administrative Standards

WorkKeys assessments are administered in both paper/pencil and computer-based format at secure test locations across the United States. To meet the demands of examinees, educators, and businesses, ACT is engaged in a process of continuous item and form development.

Item Development

ACT incorporates a rigorous process of item development to ensure that all scored items are workplace-relevant, fair to all examinees, and align to well-defined content and statistical specifications.

Item writers are recruited in a variety of ways and represent a diversity of occupations and employment settings. They receive training and coaching from ACT Content Specialists, and they write items to defined WorkKeys skill levels (e.g., a writer may develop an item to measure Workplace Documents skills at Level 4). Along with the item, writers are required to submit workplace justifications. All items undergo ACT's thorough editing process to ensure clarity. Following the editorial review, items are reviewed by external reviewers for content relevance as well as cultural and job fairness. Before an item becomes a scored item, it is embedded in a test form for pretesting. Following pretest review, if it meets the defined statistical criteria, it becomes eligible for use as a scored item.

Form Development

New test forms are developed continuously. The general exam cycle consists of numerous forms per year, in both paper/pencil and computer-based formats. Additionally, special forms are developed for clients during the year.



New test forms are developed to be parallel and equivalent to all other forms. ACT's Psychometric Research Division (PRD) utilizes sophisticated statistical methods to ensure each new form is on the identical score scale as the test's base form. All new forms are anchored to a previously administered form. A new form will contain seven to ten items from the anchor form. The remaining items are added from the pool of eligible items to conform to content and statistical requirements. A draft of the new form with item history and keys are reviewed and approved for content standards by WorkKeys test development and for statistical and psychometric standards by PRD. (All PRD psychometricians associated with WorkKeys have doctoral degrees, and PRD staff frequently publish papers and present at professional conferences in this field.) Upon approval, PRD issues a memo describing the type of equating performed and item statistics used to evaluate the form.

With the approval of a new form, WorkKeys Content Specialists lead the process of form publication. When the form is published, it and its associated keys and score conversion files are reviewed and approved by test development and PRD.

Test Administration

All WorkKeys tests, regardless of where testing occurs, are administered under standardized procedures. WorkKeys has well-developed supervisor manuals for paper/pencil and computer-based delivery. The Supervisor's Manual specifically describes the requirements for selecting staff to assist with coordinating and administering the WorkKeys assessments. The manual defines various testing roles. Requirements for each role are specified. Individuals responsible for overall supervision and coordination must complete and sign a statement of agreement. Conditions that disqualify an individual from performing a role are described, and there are penalties for violating any policy.

The Supervisor's Manual also describes several measures that are taken to ensure the security of the exams during administration. These measures include a general policy describing confidentiality: who may observe testing, conditions of fair testing, investigation procedures, and re-testing policy. It defines specific requirements regarding facilities, including the physical requirements and the equipment that must be present.

Supervisors are instructed on measures to safeguard testing materials including limiting access, instructions for checking in materials, storing materials, and how to report suspected breaches. Supervisors must complete irregularity reports for any variation from the standard administration.

Finally, all examinees are required to read and sign (for paper/pencil administration) or electronically agree (for computer-based administration) to the Terms and Conditions of testing.

Test Form Analysis

ACT's PRD conducts the analysis and evaluation of items and forms following an administration. PRD utilizes classical and Item Response Theory to evaluate test forms and individual items. Item data is stored in ACT's secure data system and is reviewed by Content Specialists.

Quantitative Reasoning and Information Literacy

The ACE review recommended the awarding of three semester credits in the area of quantitative reasoning and one semester credit in information literacy, at the lower divisional level, for the



achievement of a Gold or Platinum credential. Because the combined NCRC® assessments overlap several academic disciplines, they determined that the combined assessments were best aligned to quantitative reasoning and informational literacy.

Quantitative and information literacy are two skills identified by Association of American Colleges and Universities (AACU, 2007) as essential learning outcomes. The AACU identified six critical skills, of which quantitative reasoning and information literacy are identified, that postsecondary institutions should emphasize across all curriculum areas to prepare students for the challenges they will encounter in the 21st century economy.

The skill definitions for levels 5, 6, and 7 (see Appendix for skill definitions) align well with academic conceptualizations of quantitative reasoning (Applied Math and Graphic Literacy) and information literacy (Workplace Documents and Graphic Literacy). Elrod (2014) argues that quantitative reasoning requires individuals to think critically and apply mathematical skills to understand and solve problems. Quantitative reasoning intersects “critical thinking, basic mathematical skills, and the disciplines or real-world contexts for learning” (Elrod, 2014, p. 1). Examples of quantitative reasoning are found in all disciplines, and the application of quantitative reasoning to work-related problems is required in numerous careers.

Information literacy is a set of skills requiring individuals to “recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information” (American Library Association, 1989, p.1). Information literacy is necessary for lifelong learning, and, due to its ever increasing abundance, it is a foundational skill that is critical for nearly all academic disciplines and numerous careers. Students need to be able to access, evaluate, and use information effectively to prosper in the new economy (American Library Association, 1989).

At higher levels, NCRC® skill levels require examinees to demonstrate the ability to solve quantitative problems, identify data trends, infer word and phrase meaning from context, apply instructions to new situations, identify implied details, sort through distracting information, and use data and information to make informed decisions. These foundational skills demonstrate the ability to use information, both quantitative and verbal, to solve problems and make informed decisions.

Carnevale and Smith (2013) summarized the skills that people need and employers want in the 21st century knowledge-based economy. These skills included basic skills (reading, writing, and mathematics), foundational skills (knowing how to learn), communications skills (listening and oral communication), adaptability (problem solving and creative thinking), and group effectiveness (interpersonal skills, negotiation skills, and teamwork). They maintained that to survive in the 21st century, workers need robust skills including “reading processes that allow them to locate information and use higher-level thinking strategies to solve problems” (Carnevale & Smith, 2013, p. 4). The WorkKeys skill definitions at the higher levels align to the 21st century skills identified by Carnevale and Smith.

Case Study: New Options—New Mexico

In the New Options—New Mexico (NONM) project, Innovate+Educate studied the employment opportunities for at-risk youth (ages 16 to 24) in the state of New Mexico. The project focused on the question of employer hiring practices. If employers changed their hiring practices to focus on a skills-



based approach, would it assist or hinder at-risk youth (Mayo, 2012)? Mayo believed that traditional methods of hiring, using diploma-based practices, reduced employment opportunities for at-risk students. She maintained that many non-cognitive factors resulted in at-risk students not being able to finish school and earn a diploma or degree. The non-cognitive factors that interfered with at-risk youths' school success included the ability to afford school, to navigate arcane college admissions and financial support systems, the requirement to work full-time to support one's family, and the responsibility to care for younger brothers and sisters.

NONM provided at-risk youth in high-poverty high schools the opportunity to take the three NCRC® assessments and earn the credential. The students participating in the study were at high risk of dropping out of high school, and few of the students were expected to attend post-secondary schools. With over 500 students taking the WorkKeys® assessments, the test score findings are reported in Table Two.

Although 38% of at-risk youth lacked the skills necessary for entry-level positions, 62% of the students demonstrated that they were qualified for entry-level positions or higher. From the study, Mayo (2012) concluded that a skills-based hiring approach would greatly increase the likelihood of employment opportunities for many at-risk youth. Although the majority of these 62% had experienced difficulties in school and their opportunities appeared limited, they had developed the skills necessary for job success. NONM followed up on the testing by placing these students into jobs or job training programs. Employers generally found that the students performed well, and that they were very pleased with their new employees (Mayo, 2012).

This same skills-based hiring approach can be applied in higher education by awarding college credit to students who demonstrate that they possess 21st century knowledge-based skills. In awarding college credits to students who have achieved a Gold or Platinum NCRC, an institution would be rewarding students who demonstrate that they have developed the skills needed for today's economy. Further, the institutions would be facilitating students as they strive to achieve their academic degrees. With the recent attention focused on the problem of student loan debt and the low graduation rates of some institutions, colleges need to be seeking innovative ways to assist highly qualified students attain academic success.

Table 2: Results of Testing of At-Risk Youth NONM WorkKeys Certificate

Certificate	Percent Achieving	NONM Description
No Certificate	38%	Unable to perform an entry-level job.
Bronze	28%	Qualified for entry-level job. New Mexico high school graduates typically test at this level.
Silver	30%	Qualified for blue- or pink-collar job. New Mexico college graduates typically test at this level.
Gold	4%	Well-qualified for white-collar job. Admission to competitive U.S. colleges occurs at this level.
Platinum	0%	Less than 1% nationwide achieves Platinum. Rare combination of cognitive skill.



Recent surveys conducted by Gallup (2013) indicate that most Americans (87%) think that higher education institutions should award credit for knowledge and skills acquired outside the classroom. The same survey also found that most people indicate they would be more likely to enroll in higher education programs if such credit was awarded (75%) and that the credits should be given based on mastery of content versus seat time in a classroom (70%). These findings are particularly relevant for highly-qualified at-risk students. As Mayo (2012) explained, at-risk students are the individuals who would benefit most from skills-based hiring practices. They are also the students who are most likely to drop out, fail to graduate, and experience problems with debt. For these reasons, at-risk students are the individuals who would stand to benefit the most from a skills-based educational system—a system that would allow them to earn credit by demonstrating their 21st century skills through the attainment of a high-level NCRC®.

From an institution's perspective, awarding college credit for the attainment of the Gold or Platinum NCRC would signify to students that the school is putting students first and considering alternative paths to achieving higher education success. Such a decision would be important for students who, for financial or personal reasons, need to proceed as rapidly as possible toward their degree. For some students, it might encourage them to enter a more challenging field of study. It also could build bridges for transitioning workers seeking to upgrade their skills to become more marketable. For at-risk students who earned the Gold certificate (for example, the 4% of at-risk students who earned the Gold credential in the NONM study), providing credit might enable them to see that college is a viable option and that they could succeed in college studies.

Ultimately, there is a need for postsecondary institutions to produce graduates who possess the workplace skills that employers want, the evidence for which could be measured by the NCRC. The problem-solving and critical thinking foundational skills measured by the NCRC have been shown by ACT research to be required for the majority of jobs profiled and in all of the U.S. Department of Labor Industry Competency Models. Of concern is recent evidence of a skills gap for these foundational work readiness skills for individuals who complete four or more years of postsecondary education for jobs that require a similar level of educational attainment (ACT, 2013).

The question has been asked frequently how credits earned for quantitative reasoning and information literacy fit into an academic program of study. Both of these skills are interdisciplinary subjects and are taught across the curriculum. Because every institution and program of study is unique in its requirements and offerings, each institution should be granted the leeway to determine how best to implement quantitative reasoning and information literacy in their curricular offerings. Institutions should be able to determine how the credit achieved through a high-level NCRC is awarded. Regarding the aforementioned goals of preparing students to be successful in the workplace and providing alternative paths to education success, ACT proposes that the four credits awarded for a Gold or Platinum NCRC be granted in a manner that aligns with an institution's mission, curricular offerings, and student learning goals.

Note

1 A credential is considered portable when it is recognized and accepted as verifying the qualifications of individuals in other settings—most often geographic regions or employing companies.

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Appendix

Section 1: Workplace Documents Content

Section 2: Applied Math Content

Section 3: Graphic Literacy Content

Section 1: Workplace Documents Test Content

Designed to measure the reading skills required for entering and succeeding in a wide range of jobs, Workplace Documents is based on the premise that workers who possess foundational reading skills can more readily learn job-specific skills through experience or additional training.

Workplace Documents is a multiple-choice test designed to measure skills in reading work-related documents. The documents—which include electronic messages, letters, directions, signs, notices, bulletins, policies, contracts, and regulations—are based on material that reflects the actual reading demands of the workplace. All of the reading selections and items formulated for inclusion in the Workplace Documents assessment are based on a construct defined by three aspects: (1) text complexity, (2) reading skills, and (3) document types.

ACT translated this theoretical construct of the reading of Workplace Documents into a working set of test specifications, which is used to guide the construction of standardized test forms. Guided by these specifications, ACT selects items for the test that present reading problems in the context of a job in which the problems are defined in terms of specific reading skills and document types, both of which increase in complexity by skill level. In addition, ACT used its World-of-Work Career Clusters to ensure that the test items present reading problems in a variety of workplace situations.

Experts in reading education and workplace productivity agree that proficiency in reading is essential to successful participation in today's knowledge-based economy. The National Council of Teachers of English and the International Reading Association note in their current *Standards for the English Language Arts* that:

Literacy expectations are likely to accelerate in the coming decades. To participate fully in society and the workplace in 2020, citizens will need powerful literacy abilities that until now have been achieved by only a small percentage of the population. At the same time, individuals will need to develop technological competencies undreamed of as recently as ten years ago. One unexpected outcome of the recent explosion in electronic media has been a remarkable increase in the use of written language, suggesting that predictions about the decline of conventional literacy have been misplaced and premature (<http://www.ncte.org/standards/ncte-ira>).

Understanding the requirements of the workplace, ACT designed Workplace Documents to assess a wide range of skills related to reading and understanding workplace information, instructions, procedures, and policies. The action-oriented texts found in many workplaces differ from the explanatory and narrative texts upon which most academic reading programs are based. In addition, unlike academic texts, which are usually organized to ease understanding, workplace communications are not necessarily well-written



or easy to read. The reading selections in Workplace Documents are based on actual workplace materials representing a variety of occupations and workplace situations. These selections and their associated test items are designed to the Workplace Documents construct.

The Workplace Documents construct, defined by three aspects, is enumerated below.

Text Complexity:

- Level 3
- Level 4
- Level 5
- Level 6
- Level 7

Reading Skills:

- Identifying main ideas or details
- Understanding the meanings of words and phrases
- Applying instructions and information

Document Types:

- Instructional
- Informational
- Policies
- Contracts
- Multiple-related Documents

Performance Level Definitions for Workplace Documents

Workplace Documents Level 3

Examinees scoring at Level 3 are able to read and comprehend relatively short workplace documents which contain no extra information. The document contains short sentences using common, everyday workplace vocabulary. All the information in these documents is clearly and directly stated, and it contains a small number of details. In reading these documents, they are able to:

- Identify the main idea
- Identify specific details
- Choose when to perform a step in a series of short steps
- Apply information/instructions to a situation that is the same as the situation in the reading materials

Workplace Documents Level 4

Examinees scoring at Level 4 are able to read and comprehend workplace documents written in straightforward sentences that use familiar vocabulary and the occasional use of conditionals and a few advanced words. In reading these documents, they are able to:

- Identify the main idea
- Identify specific details
- Use the reading materials to figure out the meanings of words that are not defined for them
- Choose when to perform a step in a series of steps



- Apply information/instructions to a situation that is the same as the situation in the reading materials
- Choose what to do when changing conditions call for a different action

Workplace Documents Level 5

Examinees scoring at Level 5 are able to read and comprehend longer workplace documents written in more complex sentences that use more advanced vocabulary, including unfamiliar technical words, jargon, and acronyms. The information in Level 5 documents is generally stated directly, but specific details may be more difficult to find because of extraneous information. In reading these documents, they are able to:

- Identify specific details
- Infer the meaning of a word or phrase from context
- Apply information/instructions to a new situation that is similar to the one described in the document while considering changing conditions
- Apply information/instructions that include conditions to situations described in the document
- Identify the appropriate meaning of an acronym, jargon, or technical term defined in the document
- Apply technical terms and jargon to stated situations
- Make some inferences to accomplish a goal

Workplace Documents Level 6

Examinees scoring at Level 6 are able to read and comprehend longer workplace documents written in lengthy, complex sentences that use advanced vocabulary including unfamiliar words, jargon, and acronyms where the meaning is often implied. In reading these documents, they are able to:

- Infer implied details
- Infer the meaning of an acronym, jargon, or technical term from context
- Apply information/instructions to a situation not directly described or to a completely new situation
- Apply principles inferred in a passage to a situation not directly described or to a completely new situation
- Identify the rationale behind an entire document or a section of a document

Workplace Documents Level 7

Examinees scoring at Level 7 are able to read and comprehend long workplace documents containing many details and are written using lengthy, complex sentences that use advanced vocabulary (including esoteric words, jargon, and acronyms) where meanings must be inferred from context. In reading these documents, they are able to:

- Infer implied details
- Infer the meaning of an acronym, jargon, or technical term from context
- Apply information/instructions to a situation not directly described or to a completely new situation
- Apply principles inferred in a passage to a situation not directly described or to a completely new situation
- Identify the rationale behind an entire document or a section of a document

Section 2: Applied Math Test Construct



Applied Math is a multiple-choice test designed to measure the extent to which individuals can use the mathematics skills needed in workplaces, where the ability to think problems through in context and find and evaluate solutions is important. The assessment measures skills that individuals use when they apply mathematical reasoning and problem-solving to work-related problems.

Applied Math is based on a construct involving three aspects: (1) applied mathematical skills, (2) problem context, and (3) problem solving complexity.

Applied Math problems increase in complexity with respect to situations, concepts, and calculations. Problems include more information, and more steps are required to find solutions. The most complex problems present complicated situations in which arriving at the correct answer may require several steps. Typically, this means combining two or more applications, which increases complexity. For the most complex problems, it is necessary to think critically, make inferences, derive some information from what is given, and determine which information is not useful or relevant. The three aspects of the Applied Math construct are designed to vary in complexity, with functions performed relative to work-related applications found in a variety of jobs.

ACT translated this construct into a working set of test specifications, which is used to guide the construction of standardized test forms. The test specifications determine for each level of items how and in what forms numbers are used, the tasks test-takers need to perform, and the kinds of mathematical solutions required. These facets define the domain of mathematics skills covered in Applied Math. In addition, uses its World-of-Work Career Clusters to ensure that the test items present mathematical problems in a variety of workplace situations.

ACT designed the Applied Math assessment to measure the extent to which test takers can use the mathematical skills needed in work situations, where the ability to think problems through in context and find and evaluate solutions is important. Test-takers set up and solve the types of problems and do the types of calculations that actually occur in workplaces. Although test-takers may use calculators and a formula sheet as aids, they must use mathematics skills to solve job-related problems and to evaluate the accuracy of their solutions.

Applied Mathematical Skills:

- Basic operations with numbers including decimals
- Fractions
- Percentages/Ratios/Proportions
- Unit conversions
- Geometric measurement
- Applied mathematical reasoning

Problem Context:

- Quantity
- Money
- Time
- Measurement

Problem Solving Complexity:

- Level 3



- Level 4
- Level 5
- Level 6
- Level 7

Performance Level Definitions for Applied Math

Applied Math Level 3

Level 3 problems can easily be translated from a word problem to a math equation requiring a single type of math operation. All the needed information is presented in logical order and there is no extra information given. When examinees use Level 3 Applied Math skills, they are able to:

- Solve problems that require one type of mathematical operation. They add or subtract either positive or negative numbers (such as 10 or -2). They multiply or divide using only positive numbers (such as 10).
- Convert a familiar fraction (such as $\frac{1}{2}$ or $\frac{1}{4}$ to a decimal) and convert from a decimal to a common fraction; OR convert between decimals to percentages (such as 0.75 to 75%).
- Convert between familiar units of money and time (such as one hour equals 60 minutes or $\frac{1}{2}$ of a dollar equals \$0.50).
- Add the prices of several products together to find the total, and calculate the correct change for a customer.

Applied Math Level 4

In Level 4 problems, tasks may present information out of order and may include extra, unnecessary information. One or two operations may be needed to solve the problem. A chart, diagram, or graph may be included. When examinees use Level 4 Applied Math skills, they are able to:

- Solve problems that require one or two mathematical operations. They can add, subtract, or multiply using positive or negative numbers (such as 10 or -2), and they can divide positive numbers (such as 10).
- Calculate the average or mean of a set of numbers (such as $\frac{(10+11+12)}{3}$). For this, they may use whole numbers and decimals.
- Figure out simple ratios (such as $\frac{3}{4}$), simple proportions (such as 10/100 cases), or rates (such as 10 mph).
- Add commonly known fractions, decimals, or percentages (such as $\frac{1}{2}$, 0.75, or 25%).
- Add or subtract fractions with a common denominator (such as $\frac{1}{4} + \frac{3}{4} + \frac{1}{4}$).
- Multiply a mixed number (such as 12 $\frac{1}{8}$) by a whole number or a decimal.
- Put the information in the right order before they perform calculations.

Applied Math Level 5

In Level 5 problems, the information may not be presented in logical order; the item may contain extraneous information; it may contain a graph or diagram; and the mathematical set-up may be complicated. In solving, the test taker may need to perform multiple operations. (For example, at this level, examinees may complete an order form by totaling an order and then calculating sales tax.) When examinees use Level 5 Applied Math skills, they are able to:



- Decide what information, calculations, or unit conversions to use to find the answer to a problem.
- Add and subtract fractions with unlike denominators (such as $\frac{1}{2} - \frac{1}{4}$).
- Convert units within or between systems of measurement (e.g., time, measurement, and quantity) where the conversion factor is given either in the problem or in the formula sheet.
- Solve problems that require mathematical operations using mixed units (such as adding 6 feet and 4 inches to 3 feet and 10 inches, or subtracting 4 hours and 30 minutes from 3.5 hours).
- Identify the best deal using one- or two-step calculations that meet the stated conditions.
- Calculate the perimeter or circumference of a basic shape or calculate the area of a basic shape
- Calculate a given percentage of a given number and then use that percentage to find the solution to a problem (e.g., find the percentage and then use it to find the discount, markup, or tax).
- Identify where a mistake occurred in a calculation (such as identifying the row in a spreadsheet where a problem occurred).

Applied Math Level 6

Level 6 problems may require considerable translation from verbal form to mathematical expression. They generally require considerable setup and involve multiple-step calculations. When examinees use Level 6 Applied Math skills, they are able to:

- Use fractions with unlike denominators and calculate reverse percentages.
- Convert units within or between systems of measurement (e.g., time, measurement, and quantity) where multiple-step conversions are required and the formulas are provided such as converting from kilometers to meters to feet.
- Identify why a mistake occurred in a solution.
- Find the best deal from a group of solutions and then use the result for another calculation.
- Find the area of basic shapes when it may be necessary to rearrange a formula, convert units of measurement in the calculations, or use the result in further calculations.
- Calculate the volume of rectangular solids (e.g., cubes)
- Calculate rates, productions rates, rate by time (such as, production rate is 59 cups produced per hour, how many will be produced in an 8 hour shift).
- Identify the correct equation for solving a problem.

Applied Math Level 7

Level 7 problems may be presented in an unusual format and information presented may be incomplete or require the test taker to make an assumption. Problems often involve multiple steps of logic and calculation. When examinees use Level 7 Applied Math skills, they are able to:

- Solve problems that include ratios, rates, or proportions where at least one of the quantities is a fraction.
- Identify the reason for a mistake.
- Convert between units of measurement using fractions, mixed numbers, decimals, and percentages.
- Calculate volumes of spheres, cylinders, or cones.
- Calculate the volume when it may be necessary to rearrange the formula, convert units of measurement in calculations, or use the result in further calculations.
- Set up and manipulate ratios, rates, or proportions where at least one of the quantities is a fraction.
- Determine the better economic value of several alternatives by using graphics, or determining the percentage difference, or by determining unit cost.



- Apply basic statistical concepts. For example, calculate the weighted mean, interpret measures of central tendency, or interpret measure of spread and tolerance.

Section 3: Graphic Literacy Test Content

Graphic Literacy is designed to assess individuals' skills to find, summarize, compare and analyze information to make decisions using graphic resources. Graphic resources are defined as including, but not limited to, tables, graphs, charts, digital dashboards, flow charts, timelines, forms, maps, and blueprints. Both educators and employers have noted the increasingly sophisticated kinds of document literacy, or graphic literacy skills, required in today's global economy. However, traditional academic instruction in graphic literacy may not provide workers with the skills they most need in the context of the workplace. Widespread concerns that American workers do not have the foundational skills in comprehending and using graphic resources needed for job success led ACT to develop the WorkKeys Graphic Literacy assessment. Designed to measure skills required for entering and succeeding in a wide range of jobs, Graphic Literacy is based on the premise that workers who possess these foundational skills can more readily learn job-specific skills through experience or additional training.

Graphic Literacy is a multiple-choice test designed to measure skills in using work-related graphics. These graphics are based on materials that reflect the actual graphic demands in the workplace. All of the graphics and items formulated for inclusion in the Graphic Literacy assessment are based on a construct defined by three aspects: (1) graphic complexity, (2) cognitive skill elicited by the test question, and (3) complexity level created by the interaction of the graphic complexity and the cognitive skill.

Similar to other WorkKeys foundational skill assessments, Graphic Literacy incorporates an aspect of increasing complexity with respect to the graphics and the skills assessed. WorkKeys skill levels in Graphic Literacy range from 3 to 7.

ACT translated the theoretical construct of Graphic Literacy into a working set of test specifications, which is used to guide the construction of standardized test forms. Guided by these specifications, ACT selects items for the test that present graphic literacy problems in the context of a job, where the problems are defined in terms of specific cognitive skills and types of graphics. In addition, ACT uses its World-of-Work Career Clusters to ensure that the test items present graphic literacy problems in a variety of workplace situations.

The Graphic Literacy construct is defined by three aspects, and they are enumerated below.

Graphic Complexity (Please see ACT's Graphic Literacy Technical Bulletin or Technical Manual for a more complete definition of Graphic Complexity.)

- Simple
- Low Moderate
- High Moderate
- Difficult

Cognitive Skill Complexity

- Locate or find information
- Assess trends, patterns, or relationships
- Make inferences or decisions
- Select the graphic to represent the information



Levels of Complexity created by the interaction of the graphic and skill:

- Level 3
- Level 4
- Level 5
- Level 6
- Level 7

Performance Level Definitions for Graphic Literacy

Graphic Literacy Level 3

Examinees scoring at Level 3 have demonstrated the following abilities:

- Locate and find information or identify the next step in a simple graphic
- Locate and find information or identify the next step in a low moderate graphic

Graphic Literacy Level 4

Examinees scoring at Level 4 have demonstrated the ability to find information or identify the next or missing step in a high moderate graphic. In addition, they have also demonstrated the following skills with low moderate graphics:

- Locate information in a graphic using information found in another graphic
- Compare two or more pieces of information
- Identify a trend/pattern/relationship
- Make an inference or decision
- Identify the graphic that accurately represents the data

Graphic Literacy Level 5

Examinees scoring at Level 5 have demonstrated the ability to locate and find information or identify the next or missing step in a difficult graphic. In addition, they have also demonstrated the following skills with a high moderate graphic:

- Locate information in a graphic using information found in another graphic
- Compare two or more pieces of information
- Identify a trend/pattern/relationship
- Make an inference or decision
- Identify the graphic that accurately represents the data

In addition, they have demonstrated the following skills with a low moderate graphic:

- Compare two or more trends/patterns/relationships
- Interpret a trend/pattern/relationship
- Make a reasonable inference or decision based on one graphic after finding information in another graphic
- Justify an inference or decision based on information
- Identify the most effective graphic given a defined purpose
- Justify the most effective graphic given a defined purpose



Graphic Literacy Level 6

Examinees scoring at Level 6 have demonstrated the following additional skills with a difficult graphic:

- Locate information in a graphic using information found in another graphic
- Compare two or more pieces of information
- Identify a trend/pattern/relationship
- Make an inference or decision
- Identify the graphic that accurately represents the data

In addition, they have demonstrated the following skills with a high moderate graphic:

- Compare two or more trends/patterns/relationships
- Interpret a trend/pattern/relationship
- Make a reasonable inference or decision based on one graphic after finding information in another graphic
- Justify an inference or decision based on information
- Identify the most effective graphic given a defined purpose
- Justify the most effective graphic given a defined purpose

Graphic Literacy Level 7

Examinees scoring at Level 7 have also demonstrated the following additional skills with a difficult graphic:

- Compare two or more trends/patterns/relationships
- Interpret a trend/pattern/relationship
- Make a reasonable inference or decision based on one graphic after finding information in another graphic
- Justify an inference or decision based on information
- Identify the most effective graphic given a defined purpose
- Justify the most effective graphic given a defined purpose