

NATIONAL ASSOCIATION OF STATE BOARDS OF GEOLOGY (ASBOG®)

**PROFESSIONAL GEOLOGISTS
CANDIDATE HANDBOOK**

ASBOG® is not affiliated with, nor does it provide information for/to, or endorse, any examination preparation course(s), study guide/manuals/aid (e.g., flash cards), or publication other than its own “Professional Geologists Candidate Handbook”. This Candidate Handbook is designed to help you prepare for the ASBOG® National Geology Examinations. ASBOG® has not authorized use of its name by any commercial enterprise.

(Revised: June 2008)

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ON HONOR

The English poet, Richard Lovelace wrote, “*I would not love you ne’er so much, loved I not honor more.*” Robert E. Lee of Confederate fame wrote, “*Duty then is the [most sublime] word in the English language....*”

Honor is all-important. In the National Association of State Boards of Geology (ASBOG®) examination, it means an honorable endeavor, without collusion. By signing in for the examination, the candidate has pledged that he or she will neither give, nor receive, information concerning an examination question, nor transmit knowledge of examination questions to another.

That there are means now available to ascertain if collusion has taken place, should alert the candidate to an awareness that these means are being used and, should a candidate be found to have engaged in collusion, serious consequences are forthcoming.

Examination questions, which have been compromised, (1) seriously impinge on the honor of the one giving or receiving information, (2) would tarnish the value of all examination scores, and (3) greatly diminish the value of registration. Candidates who have given, or received, information may be penalized; the results of their examination voided, and could even be denied the opportunity to re-take the examination(s).

In taking the examination, the foremost reason is to become a registered/licensed geologist. Information that you give, or received from, another may so impact your score that you fail rather than pass.

The honor of the examination is yours to uphold. The choice is yours – make it wisely!

Benjamin S. Persons

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ASBOG® Council of Examiners

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INTRODUCTION

The *National Association of State Boards of Geology (ASBOG[®])* is an organization through which its state Member Boards may act and counsel together to better discharge their responsibilities. ASBOG[®] provides a forum to promote, foster, and advance the common interests and purposes of its Member Boards. The supporting membership of ASBOG[®] is its Member Boards. Member Boards are dues-paying State Boards or other legal entities constituted by states, territories and the District of Columbia of the United States of America to administer the registration/licensure of geologists.

One of ASBOG[®]'s principal duties is to develop standardized written examinations for assessing qualifications of applicants seeking licensure as professional geologists. The ASBOG[®] National Geology Examination development and validation procedures are designed to maximize the fairness and quality of the examinations. State Member Boards of registration/licensure are provided with uniform examinations that are valid measures of competency related to the practice of the profession. This process benefits those candidates who are taking the examinations and enhances the protection of the general public.

The National Geology Examinations are administered by the ASBOG[®] Member Boards simultaneously in the spring and fall of each year. Currently, ASBOG[®] provides its Member Boards with two multiple-choice examinations -- the *Fundamentals of Geology (FG)* and the *Practice of Geology (PG)*. Each examination is up to four hours in length. The FG and PG examinations have been developed to assess common knowledge and skills related to the practice of geology throughout the nation. The FG examination emphasizes knowledge and skills that are typically acquired in an academic setting and lead to a baccalaureate degree. The PG examination emphasizes skills and knowledge acquired or expanded in a practice or job setting. Individual Member Boards may require additional testing on local geology, statutes, rules and regulations that address state-specific issues.

Italicized words here and elsewhere in this document, except for the opening sentence, refer to terms listed in the Glossary (Appendix 1, page 9). Some sentences are in italics for emphasis.

Candidates are reminded that *ASBOG[®] is not affiliated with, nor does it provide information for/to, or endorse, any examination preparation course(s), study guide/manuals/aid (e.g., flash cards), or publication other than this "Professional Geologists Candidate Handbook". This Candidate Handbook is designed to help you prepare for the ASBOG[®] National Geology Examinations. ASBOG[®] has not authorized use of its name by any commercial enterprise.*

We hope you find the information useful. We extend our best wishes for your success on these examinations and in your practice of geology.

STATE LICENSING REQUIREMENTS

QUALIFICATIONS

The primary purpose of registration/licensure is to safeguard life, health and property and to promote the public welfare. Evaluation of the qualifications of candidates seeking registration/licensure provides the first step toward ensuring that this objective is met. While examinations offer one means of measuring the competency levels of candidates, most jurisdictions also screen candidates on the basis of education and experience requirements set forth in state laws, rules, and regulations. The requirements vary across the nation. As the examination shall be administered only to those candidates who have met the statutory and regulatory prerequisites of the state in which they are seeking registration/licensure, it is important that candidates contact the state Member Board office where they are seeking registration/licensure to obtain information with respect to the specific requirements for that state.

APPLICATION PROCEDURES/FILING DEADLINES

Application forms and instructional information for the examination are available from individual state Member Boards. You should be aware that examination requirements, filing deadlines, and fees vary from state to state. You are responsible for contacting the state Member Board Examination Administrator for this type of information. (NOTE: Some state Member Boards utilize the service of a professional testing service for examination administration purposes. You will need to confirm what entity is actually handling the administration of your examination.) You are encouraged to allow sufficient time to complete the application process and assemble required data such as transcripts and letters of recommendation. The state Member Board Examination Administrator will notify you regarding your approval status (i.e., accept/reject).

EXAMINATION SCHEDULE AND ADMINISTRATION

The ASBOG® National Geology Examinations are given during the spring and fall of each year. Contact the state Member Board Examination Administrator regarding specific dates (especially the deadline you must meet for submission of your application and other credentials to be approved to sit for the examination as stated above) and locations. Candidates should understand that the state Member Board may have an earlier cut-off date for submission of examination requests/approval in order to make ASBOG®'s cut-off date for ordering examinations. ASBOG® honors the cut-off date selected by its individual state Member Boards. The *Fundamentals of Geology (FG)* Examination (total questions = 130) is administered in a four-hour session. The *Practice of Geology (PG)* Examination (total questions = 100) is also administered during a four-hour session. The FG and PG are separate examinations and scores are reported for each. Different forms of the examinations are constructed for each administration.

The FG Examination will start promptly at 8:00 a.m. and end at 12:00 p.m. The PG Examination will start promptly at 1:00 p.m. and end at 5:00 p.m. Ample time for instructions will be allowed prior to the actual start time of each examination. Please be sure to contact your state Member Board Examination Administrator to confirm examination location, arrival time, and whether you will need an admittance pass, etc. All information will be provided by the individual state Member Board Examination Administrator.

DESCRIPTION OF EXAMINATIONS

EXAMINATION VALIDITY

The FG and PG Examinations are developed following guidelines established in the Standards for Educational and Psychological Testing (1999) published by the American Educational Research Association, the American Psychological Association, and the National Council on Measurement in Education. The procedures are designed to maximize the fairness and quality of the examinations.

COUNCIL OF EXAMINERS (COE)

A committee of professional geologists serve as *Subject Matter Experts (SMEs)* on the *Council of Examiners (COE)*. These SMEs represent the profession in terms of geography, ethnicity, gender, and area of practice. They supply the expertise that is essential in developing fair and impartial examinations for measuring competency within the profession.

SMEs attend two COE examination development and validation workshops each year. The COE Workshops are held shortly after the examinations have been administered so that the COE can evaluate candidates' comments and statistical information related to the examinations. The process is designed to maximize the fairness and quality of the examinations as measures of competency.

Examination questions are (1) based on the results of a *Task Analysis Survey (TAS)*, and are, therefore, representative of the important tasks needed for competent practice in the profession, and (2) are written and reviewed by the COE. Statistical analyses are also reviewed by the COE so that any substandard items can be eliminated before generating candidates' final scores. The following sections further outline the process used in developing and validating the FG and PG Examinations.

ASBOG® TEST BLUEPRINTS

ASBOG® conducts a *Task Analysis Survey (TAS)* of the profession every five years to maximize the relevance of the examinations for candidates seeking licensure as professional geologists. The TAS is used to verify those tasks performed by the profession related to public protection. The findings are used to develop *test blueprints* (test specifications, content outlines) for constructing examinations and writing questions. The test blueprints list the geologic tasks and the number of questions for each geologic task to be included in both the FG and PG exams. The COE reviews examination questions to verify that each question accurately reflects one or more of the tasks listed in the test blueprints.

The FG and PG test blueprints specify the *domains/content areas* for each examination. The relative importance of different content areas can be determined by examining the test blueprints shown in Appendix 2 (Page 11). The construction of the questions differs between the FG and PG examinations. The FG examination emphasizes knowledge and skills that are typically acquired in an academic setting and lead to a baccalaureate degree. The PG examination emphasizes skills and knowledge acquired or expanded in a practice or job setting.

EXAMINATION DEVELOPMENT PROCEDURES

Professional geologists (i.e., SMEs, as defined on Page 3) have spent a considerable amount of time developing the FG and PG Examinations as fair measures of professional competence. As mentioned earlier, questions on the examinations are reviewed by SMEs during regularly scheduled COE Workshops. These SMEs review statistical results for each item as well as written feedback from candidates who have just taken the examinations. This information is extremely valuable in evaluating the accuracy and fairness of each item in the examinations. Both ASBOG® and the individual state boards are always working to improve the quality of the examinations as fair measures of an individual's competence to practice before the public. The following paragraphs provide more detail regarding the development of the ASBOG® National Geology Examinations.

Each FG and PG Examination question written by the SMEs at COE Workshops is subjected to a minimum of four peer reviews.

The first peer review occurs during the development of the question. During the COE Workshop, each question is written by one or more members of the COE. Each new question is then reviewed independently by three other members of the COE. The purpose of the peer review process is to verify that the *keyed answer* is the one and only correct answer. This process is also used to make sure that the question is clear and is appropriate for use on the examination.

All new questions that are accepted are entered into the ASBOG® *Examination Item Bank* and subjected to the second peer review at a subsequent COE Workshop. During this second peer review, the question is evaluated by three members (SMEs) of the COE and checked to verify that typographical errors were not introduced when the question was entered into the question (item) bank. The question is subjected to the third peer review by the COE when it is included in the examination, which is reviewed in its entirety before the actual administration.

The fourth peer review occurs after the administration of the examinations. ASBOG® encourages candidates to provide comments about specific questions while taking the examinations. Candidate comments become part of the examination review process during the post-examination COE Workshop. The COE reviews all new items and also any items that exhibit unusual statistical properties (e.g., difficult items, items with negative correlations). This review process makes it possible to improve the accuracy of the questions across time.

If the SMEs deem that a particular question has “no correct answer” (based on candidate comments, statistical information, or an evaluation of the accuracy of the question), then the item is not scored. Candidates will not be given credit for an item which has been deemed to have “no correct answer”. If the SMEs deem that a particular question has two correct answers (i.e., is a double-keyed question), then candidates who select either answer will be given credit. This process enhances the fairness of the examinations because substandard items (that have no correct answers) are eliminated before calculating candidates' final scores.

SCORING PROCEDURES

Raw scores are calculated by summing the number of correct responses for each candidate. Credit is given for correct responses, while no points are received for incorrect responses. Note that only one response should be marked for each question because questions that contain two or more marked responses or all blank responses (i.e., omitted questions) are scored as incorrect responses. There is no penalty for guessing; therefore, it is to your advantage to answer all questions in the exams.

To assure national uniformity, ASBOG[®] provides each jurisdiction with a nationally recommended passing score. A *scaled score* of 70 has been established as a standard of *minimum competency* and 100 is the highest score possible. Failing scaled scores range from 0 (no correct responses) to 69 (highest failing score). However, the legal authority for making registration/licensure decisions rests solely with the individual jurisdictions and not with ASBOG[®].

Candidates who fail the examinations receive feedback on their performance levels for the content domains listed in the FG and PG Test Blueprints. A "+" indicates acceptable performance in a particular content domain, whereas a "-" shows substandard performance. The feedback is designed to assist candidates in evaluating their proficiency levels in preparation for subsequent examinations.

PASSING SCORES

The passing scores on the ASBOG[®] FG and PG Examinations reflect minimum competency and are determined using a criterion-referenced procedure which measures a candidate's performance based on a standard established by the COE. The COE evaluates the difficulty levels of the examination items in relation to minimum competency. Passing scores are adjusted (scaled) based on the difficulty level of each question in each examination so that candidates have the same probability of passing any version of the examinations.

ASBOG[®] does not use "fixed-percentage" passing scores such as 70 percent or 75 percent because they fail to consider the difficulty levels of the questions in an examination and their relationship to minimum competency. Similarly, ASBOG[®] avoids "grading on the curve" because registration/licensure is designed to ensure that practitioners possess enough knowledge to perform professional activities in a way that protects the public welfare. The key issue is whether candidates are competent to practice individually and not whether they are competent compared to other candidates.

RELEASE OF CANDIDATE SCORES

ASBOG[®] only releases the examination results (by secure, traceable means) to its state Member Board Examination Administrators (or authorized testing service) within sixty (60) days following receipt of all of the examination materials back in the ASBOG[®] office. Candidates shall contact their state Member Board Examination Administrator (or its authorized testing service) to acquire any information regarding examination scores. Under no circumstances does ASBOG[®] (1) release examination results directly to the candidate(s), (2) transmit results by e-mail or fax, or (3) release results over the telephone. Further, ASBOG[®] supports the following testing standard regarding the confidential nature of candidate examination scores: "Test results identified by the names of individual test takers, or by other personally identifying information, should be released only to persons with a legitimate, professional interest in the test taker or who are covered by the informed consent of the test taker or a legal representative, unless otherwise required by law." (*Standards for Educational and Psychological Testing* (1999), published by the American Educational Research Association, the American Psychological Association, and the National Council on Measurement in Education, Standard 8.5, p. 87.)

STATISTICAL ANALYSES

Statistical analyses are conducted on each form of the FG and PG Examinations. The statistics are valuable in evaluating the performance of the examinations (e.g., estimated reliability, mean, standard error of measurement etc.). The statistical results indicate the examinations are reliable and performing well.

The statistical analyses are also useful for isolating items that possess unusual statistical properties (e.g., very difficult, negative correlations). Items that possess negative correlations reveal that candidates with high test scores did poorer on these items compared to candidates with low test scores. Any items that exhibit negative correlations are reviewed by the COE before scores are mailed to the Examination Administrators.

Sample questions for the FG and PG Examinations are presented in Appendix 3 (Page 14). The sample questions do not make up complete examinations; however, they do represent the general content areas and formats. They are presented herein as a guide in your preparation for the examinations. The FG and PG Examinations measure some of the same competencies related to the practice of geology, but construction of the questions differs between the two levels. FG questions are primarily to recall factual information, and the PG questions are focused on candidates' competencies to apply the basic principles of geology, based mainly upon work experience.

EXAMINATION REVIEW AND/OR MANUAL RE-GRADE

If a state Member Board is not mandated by law to provide examination review services, ASBOG® does not independently do so. Any request for a review by a candidate shall be made directly to the state Examination Administrator in writing. The Examination Administrator shall then submit a written request to ASBOG® within thirty (30) calendar days after the release of the examination results to the Examination Administrator, accompanied by the prescribed fee. The prescribed fee for a post-examination review shall be paid by the requesting candidate, or the Examination Administrator, and must accompany the written request. The Examination Administrator will set the deadline for receipt of such requests from that Member Board's candidates in order to meet the 30-day turn-around to ASBOG®. ASBOG® does not allow challenges to individual examination items as part of a post-examination review process, nor does it release the answer key. Only one post-examination review per part shall be allowed for each candidate per examination administration. The Examination Administrator shall instruct candidates that no notes shall be taken during the examination review process, nor are they to write on in the examination booklet.

Requests for a manual re-grade of a candidate's answer sheet must also be submitted to ASBOG® in writing by the Examination Administrator within the 30-calendar day time frame. The costs for a manual re-grade shall be paid by the requesting candidate, or the Examination Administrator, and the prescribed fee must accompany the written request. The purpose of the manual re-grade is to verify the accuracy of a candidate's machine score. The request for a manual re-grade does not guarantee that the candidate will receive additional credit and/or a revised grade. Again, the exclusive purpose of the manual re-grade is to check the accuracy of the candidate's machine score. If a candidate requests both a post-examination review and a manual re-grade, such requests (accompanied by the prescribed fees) shall be submitted at the same time. ASBOG®'s peer review process and Task Analysis process conducted by the COE provide a redundant system to verify that the keyed answer is the only correct answer for that question.

TAKING THE EXAMINATIONS

DISTRIBUTION OF BOOKLETS

The Examination Administrators' *Proctor(s)* will distribute the examination packets containing the examination booklet, answer sheet, and *Candidate Comment Form*. All instructions should be read very carefully. Special attention should be given to the language on the front of the examination booklet pertaining to disclosure of proprietary information.

Copying, reproduction, taking notes, or any action taken to reveal the contents of examinations in whole or in part is unlawful. Removal of the examination booklets from the Examination room by unauthorized persons is prohibited.

Unlawful disclosure is extended to include the transmission of examination content in any form (verbal, written, electronic, or computerized, etc.) either during or after the examination administration.

INSTITUTION CODES

Candidates will be asked to provide on their answer sheet(s), for both the FG and PG examination administrations, the "*Institution Code*" for the college/university from which they received their geological science degree(s); i.e., (BA/BS and MA/MS or PhD/DSc). This information will be used only to provide institutions with aggregate data on how their students – on the average – performed on the National Geology Examination(s). Individual candidate examination scores are considered confidential information and will not be provided to the institutions (See "*RELEASE OF CANDIDATE SCORES*" on Page 5 of this *Handbook*). Candidates who do not find their institution(s) on the *Institution Codes List* will be given instructions by the Examination Administrators' *Proctor(s)* on how to proceed; e.g., there will be a place on the cover of the examination booklet for you to write the name of your institution(s). The *Institution Codes List with Index* is available on the ASBOG® Web site (www.asbog.org), under Examination. This *List* will be updated as changes/new codes are assigned.

ANSWER SHEETS

All examinations are machine-scored. To provide proper scoring of your examination, it is imperative that you listen to the *Proctor's* instructions and follow the instructions printed on the examination booklet and answer sheets. As a matter of examination security, please **use only the #2 pencils provided**. The answer spaces must be completely blackened.

Examination items (questions or problems) are generally organized with an introductory statement (the *stem*) followed by four options (choices to finish the statement in the stem or answers to the problem). In evaluating options, candidates should read all options and then select the best or most appropriate answer from the options given. You must select one of the options given even if there might be a better response to a question that is not included among any of the options given.

No credit is given for multiple answers. If you decide to change an answer, completely erase the first answer. Incomplete erasures and stray marks may be read as intended answers. (**NOTE:** Your sketches, notes, graphical solutions and calculations are NOT considered to be part of your answer and are not inspected or graded. *All work must be turned in with your examination booklet.* Graph paper and scratch paper are provided at the back of the examination booklet for you to use. Thumbtacks, cardboard and tracing paper are not necessary.)

CANDIDATE COMMENTS

ASBOG® is always working to improve the quality and reliability of its examinations. Although each examination has gone through an extensive review process by the SMEs during the COE Workshops, ASBOG® encourages candidates to provide comments about specific questions. *Candidate comments* become part of the examination review process during the post-examination COE Workshop. Candidate comments are anonymous and used only to improve the quality of the examination questions. Candidates are reminded that they should complete the examination first, then go back and address any questions they have concerns or comments about to ensure that they have time to complete the examination.

STARTING AND COMPLETING THE EXAMINATION

The Examination Proctor will provide instructions as to when to open your examination booklet as well as how to fill in your answer sheet. Be sure to note your start/finish time on the front of your examination booklet. This information has no impact on the scoring of your examination and is only used to evaluate the length of the examinations. You are responsible for returning the numbered examination booklet assigned to you, as well as all working papers, etc., to the Proctor.

REFERENCES/HAND INSTRUMENTS

The FG and PG are closed-book examinations. **No references are permitted**; however, portable (battery-operated or solar-powered), silent, non-printing, non-alpha programmable calculators are allowed. Please note that calculators, or any other wireless electronic devices that have e-mail/Internet/text messaging capability will **NOT** be allowed and will be confiscated if policy is violated. This applies to cellular phones and scanning pens as well. A protractor, straight edge, engineer's scale, and colored pencils may be brought to the examination. ASBOG® provides Number Two pencils which will be distributed by the Examination Proctor.

SPECIAL ACCOMMODATIONS

The Examination Administrator will provide for reasonable accommodations to qualified candidates with disabilities. If you have a disability and require special accommodations to take the examination, contact your Examination Administrator as soon as possible and inquire about any necessary "documentation of disability" to be submitted with your application. If special accommodation is not requested in advance, the Examination Administrator cannot guarantee the availability of accommodation on site at the time of testing. Any request for modification to the examination(s) must be submitted in writing by the Examination Administrator and received by ASBOG® no later than ninety (90) calendar days prior to the scheduled examination.

APPENDIX 1

GLOSSARY

CANDIDATE COMMENT FORMS. Forms provided to examination candidates as part of the examination process to allow for feedback to ASBOG®. The *Fundamentals of Geology (FG)* forms are “Yellow” and the *Practice of Geology (PG)* forms are “Green”. Valid, written comments from a candidate who has already taken the Examinations are always welcome and may become a part of the examination review process during the post-examination *Council of Examiners (COE)* Workshop. Candidate comments are anonymous and used only to improve the quality of the examination items (questions).

COE. See *Council of Examiners*.

COUNCIL OF EXAMINERS (COE). ASBOG® National Examination committee composed of selected individuals who are *Subject Matter Experts (SME)* in their respective domains and who represent a cross-section of geography, gender, area of practice (specialty), experience, and ethnicity. The *COE* meets twice yearly as part of the ASBOG® *COE* Workshops, usually about three weeks after the administration of the *FG* and *PG* examinations; one of the two Workshops is held in conjunction with the ASBOG® Annual Meeting each fall.

CRITERION-REFERENCED APPROACH. Psychometric procedure used to determine passing scores that reflect a standard of minimum competency.

DOMAINS/CONTENT AREAS. The subject matter within a profession; for example, geophysics, hydrogeology or field methods within the geosciences.

EXAMINATION ADMINISTRATOR. The state Member Board, or its authorized testing service, actually responsible for administering (proctoring) the examination. Some state boards use their own staff to proctor the examination; some have a state department of testing (bureau/agency), and some use a professional testing service. See *Proctor*.

EXAMINATION ITEM. Question or problem used in an examination.

EXAMINATION ITEM BANK. Data base of examination items which are stored on computer after acceptance by the *COE*.

FUNDAMENTALS OF GEOLOGY (FG) EXAMINATION. ASBOG® National Examination with items related to knowledge and skills acquired in an academic setting that leads to a baccalaureate degree; consists of 130 questions.

KEYED ANSWER (KEY). The one and only correct answer. A new question, developed by one or more of the members of the *COE*, is independently reviewed/critiqued by three other members (*SMEs*). The peer review process verifies the keyed answer. The review also focuses on the quality of the item to ensure the question is clear and is appropriate for use on the examination.

MINIMUM COMPETENCY. The standard used in establishing passing scores on ASBOG® Examinations.

PROCTOR. Individual(s) actually administering the examination(s). See *Examination Administrator*.

PRACTICE OF GEOLOGY (PG) EXAMINATION. ASBOG® National Examination with items that assess skills and knowledge acquired or expanded through employment, typically after five years of work experience; consists of 100 questions.

RAW SCORE. Actual, unadjusted score on an examination based on the total number of correct responses. If the *COE Subject Matter Experts (SMEs)* deem a particular question to have “no correct answer” (based on candidate comments, statistical information, evaluation of the accuracy of the question, etc.), then that item is not scored (i.e., the *FG* examination would be graded on the basis of 129 instead of 130 questions. Similarly, the *PG* examination would be scored on the basis of 99, not 100 questions.) Candidates will not be given credit for an item which has been deemed to have “no correct answer”. If the *SMEs* deem that a particular question has two correct answers (i.e., is a double-keyed question), then candidates who select either answer will be given credit. This process enhances the fairness of the examinations because substandard items (that have no correct answers) are eliminated before calculating candidates' final scores.

SCALED SCORE. Adjusted score, based on the average difficulty level on each examination (*FG* and *PG*). A scaled score of 70 has been established as a standard of minimum competency. On all forms of the ASBOG® National Examinations, a scaled score of 70 is the minimum score required to pass and 100 is the highest score possible. Failing scaled scores range between 0 (no correct responses) and 69 (highest failing score).

SME. See *Subject Matter Expert*.

STEM. The introductory portion of an examination item that states a question or presents an incomplete statement.

SUBJECT MATTER EXPERTS (SME). Geoscientists who serve on the ASBOG® *Council of Examiners*; *SMEs* represent the profession in terms of geography, ethnicity, gender and area of practice.

TASK ANALYSIS SURVEY (TAS). A survey form prepared by the *Council of Examiners (COE)* to represent the geologic tasks performed by geologists. The list focuses on tasks that involve protection of the health, safety and welfare of the public. The survey form is mailed to licensed geologists selected at random from the lists of registered/licensed geologists provided by those Member Board states with geologist registration/licensure requirements. (NOTE: The 2005 *TAS* was distributed in 28 states and 10 Canadian provinces and territories.) Geologists rate (1) the time spent performing each geologic task, and (2) the importance of each task on protecting the health, safety and welfare of the public. Results from the *TAS* determine the number of questions for each geologic task to be included in both the *FG* and *PG* Examinations.

TEST BLUEPRINT. An outline that lists the *domains/content areas* (subject matter) and their percentage weights in the *FG* and *PG* Examinations.

APPENDIX 2

FG AND PG TEST BLUEPRINTS

CONTENT DOMAINS	FG %	PG %
A. General Geology: Field Geology, Geophysics, Imagery, Modeling, & Graphical Methods	17	18
B. Mineralogy, Petrology, & Petrography	15	4
C. Sedimentology, Stratigraphy, & Paleontology	14	6
D. Quaternary Geology, Geomorphology, & Surficial Processes	10	5
E. Structure, Tectonics, & Seismology	14	9
F. Hydrogeology & Environmental Geochemistry	14	22
G. Engineering Geology	9	20
H. Economic Geology & Energy Resources	7	16
TOTALS	100	100

A. General Geology: Field Geology, Geophysics, Imagery, Modeling, and Graphical Methods

Knowledge Base

FIELD GEOLOGY

Project management, organization, economics, and ethics; Subsurface exploration, techniques, and interpretations; Geologic and geophysical tools, application, and interpretation; Surface mapping and map applications; Cross-section construction; Photogrammetry, terrain measurement, GPS, and GIS; Image analysis and interpretation; Scale and scale analysis; Measurement theory: accuracy and precision; Documentation and record keeping; Modeling concepts (FG/PG)

Task Statements

1. Plan and conduct field operations including human and ecological health, safety, and regulatory considerations (FG/PG)
2. Select, construct, and interpret maps, cross-sections, and other data for field investigations (FG/PG)
3. Develop and utilize Quality Assurance/Quality Control (QA/QC) procedures (FG/PG)
4. Determine scales, distances, and elevations from imagery and maps (FG/PG)
5. Design, implement, and interpret data from surface or subsurface geophysical programs (FG/PG)
6. Prepare and interpret logs, cross-sections, maps, and other graphics from field investigations (FG/PG)
7. Design, apply, and interpret analytical or numerical models (FG/PG)

B. Mineralogy, Petrology, and Petrography

Knowledge Base

MINERALOGY AND PETROLOGY

Rock and mineral identification; Crystal symmetry, systems, and forms; Igneous rocks and processes; Sedimentary rocks and processes; Metamorphic rocks and processes; Geochemical reactions and diagenesis (FG/PG)
Project management, organization, economics, and ethics (PG)

Task Statements

8. Plan and conduct mineralogic or petrologic investigations (PG)
9. Identify minerals and rocks and their characteristics (FG)
10. Identify and interpret rock and mineral sequences, associations, and genesis (FG)
11. Evaluate geochemical data and/or construct geochemical models related to rocks and minerals (FG/PG)
12. Determine type, degree, and effects of rock and mineral alteration (FG)

C. Sedimentology, Stratigraphy, and Paleontology

Knowledge Base

SEDIMENTARY AND HISTORICAL GEOLOGY

Geologic time; Geochronology; Fossil record and evolution; Stratigraphic principles; Geochemical reactions; Weathering and soil formation; Erosion; Sediment transport; Depositional environments; Facies analysis; Basin analysis; Sedimentary structures; Diagenesis (FG/PG)

Project management, organization, economics, and ethics (PG)

Task Statements

13. Plan and conduct sedimentologic, stratigraphic, or paleontologic investigations (PG)
14. Select appropriate stratigraphic nomenclature and establish correlations (FG)
15. Identify and interpret sedimentary structures, depositional environments, and sediment provenance (FG/PG)
16. Interpret sediment or rock sequences, positions, and ages (FG)
17. Identify fossils and fossil assemblages for age or paleoecologic interpretations (FG)

D. Quaternary Geology, Geomorphology, and Surficial Processes

Knowledge Base

SURFICIAL PROCESSES

Geomorphic processes; Sea level change; Landform analysis ; Weathering; Groundwater and surface water; Low temperature geochemistry; Human-land interaction; Soil development and classification (FG/PG)

Project management, organization, economics, and ethics (PG)

Task Statements

18. Plan and conduct geomorphic investigations (PG)
19. Identify and classify landforms (FG)
20. Determine absolute or relative age relationships of landforms and soils (FG)
21. Evaluate geomorphic processes and development of landforms and soils (FG/PG)

E. Structure, Tectonics, and Seismology

Knowledge Base

STRUCTURAL GEOLOGY

Fractures, faulting, and folding; Rock fabric; Mechanical properties of rocks; Structural interpretation and analysis; Plate tectonics; Tectonic regimes; Volcanic processes; Structural and seismic history (FG/PG)

Earthquake processes and hazards; Project management, organization, economics, and ethics (PG)

Task Statements

22. Plan and conduct structural, tectonic, and seismic investigations (PG)
23. Identify and determine structural features, orientations, and interrelationships (FG)
24. Develop deformational history through structural analyses (FG/PG)
25. Interpret tectonic history (FG)
26. Interpret paleoseismic history (FG)
27. Evaluate and delineate earthquake and seismic hazards (PG)

F. Hydrogeology and Environmental Geochemistry**Knowledge Base****ENVIRONMENTAL GEOLOGY**

Landform analysis; Weathering; Groundwater and surface water; Low temperature aqueous geochemistry; Contaminant transport and geochemistry; Hydraulic properties of fluids and earth materials; Human-land interaction; Site investigation methods, tools, and applications; Project management, organization, economics, and ethics (FG/PG); Well drilling, design, and construction; Soil and water remediation techniques; Water resource protection (PG)

Task Statements

28. Plan and conduct hydrogeological, geochemical, and environmental investigations (FG/PG)
29. Define and characterize saturated and vadose zone flow systems (FG)
30. Design groundwater monitoring, observation, extraction, production, or injection wells (PG)
31. Characterize and determine hydraulic properties (FG)
32. Interpret age dating, isotopic, and tracer studies (FG/PG)
33. Characterize water quality and evaluate chemical fate and transport (FG/PG)
34. Manage, protect, or remediate soils, surface water, or groundwater resources (PG)

G. Engineering Geology**Knowledge Base****ENGINEERING GEOLOGY**

Landform analysis; Soil and rock weathering; Groundwater and surface water; Low temperature geochemistry; Human-land interaction; Soil and rock mechanics; Soil and rock classification and engineering properties; Hazardous geologic processes; Hazard and risk analyses; Cost/benefit analyses; Site investigation methods, tools, and applications; Project management, organization, economics, and ethics (FG/PG)
Land restoration and hazard mitigation; Mine closure (PG)

Task Statements

35. Plan and conduct engineering geological investigations (FG/PG)
36. Interpret historical land use, landforms, or environmental conditions from imagery, maps, or other records (FG/PG)
37. Interpret and analyze geologic site characteristics, and provide recommendations for engineering and land use (FG/PG)
38. Identify, map, and evaluate geologic and geomorphic hazards (FG/PG)
39. Conduct geological evaluations for surface and underground mine closure and land reclamation (PG)
40. Design programs for hazard mitigation and land restoration (PG)

H. Economic Geology and Energy Resources**Knowledge Base****EARTH RESOURCES**

Hazard and risk analyses; Exploration and development techniques; Petroleum systems; Mineralization processes; Characteristics of hydrocarbon traps; Characteristics of mineral deposits; Mineral economics; Exploration risk; Resource/reserve assessment; Project management, organization, economics, and ethics; Safety considerations (FG/PG)
Land restoration and hazard mitigation; Mine and well decommission (PG)

Task Statements

41. Plan and conduct mineral, rock, hydrocarbon, or energy resource exploration and evaluation programs (FG/PG)
42. Interpret data for economic evaluations, resource assessments, and probability of success (FG/PG)
43. Predict distribution of resources on basis of exposures and subsurface data (FG/PG)
44. Estimate resource volume from surface mapping, imagery, and subsurface data (FG/PG)
45. Evaluate safety hazards associated with mineral, petroleum, or energy exploration and development (PG)
46. Perform geological evaluations for abandonment, closure, and restoration of mineral and energy development or extraction operations (PG)

APPENDIX 3

FG SAMPLE QUESTIONS AND ANSWERS

1. According to the Unified Soil Classification, a soil described as a GW is a (an):
 - A) well-graded gravel or gravel-sand mixture, with no or few fines
 - B) poorly graded gravel or gravel-sand mixture, with no or few fines
 - C) coarse clayey gravel
 - D) organic silt of low plasticity

2. Which one of the following minerals dissolves into soluble ions without residue?
 - A) kaolinite
 - B) pyrite
 - C) selenite
 - D) orthoclase

3. A phaneritic igneous rock composed of orthoclase, oligoclase, biotite, hornblende, and quartz is:
 - A) monzonite
 - B) syenite
 - C) latite
 - D) granodiorite

4. What group of commonly occurring sedimentary deposits forms by precipitation of salts from land-locked bodies of concentrated solutions or brines?
 - A) sulfuric sedimentary rocks
 - B) organic sedimentary rocks
 - C) evaporitic sedimentary rocks
 - D) phosphatic sedimentary rocks

5. A map at the scale of 1:24,000 compared to a map at the scale of 1:62,500 is:
 - A) a smaller scale map
 - B) a larger scale map
 - C) larger scale or smaller scale dependent upon the units of measurement
 - D) larger scale or smaller scale dependent upon the ground area shown

6. An aerial photograph taken with a camera having a focal length of 6 inches flying 10,000 feet above the datum has a scale of:
 - A) 1:10,000
 - B) 1:20,000
 - C) 1 inch = 10,000 feet
 - D) Scale cannot be determined from the data given.

7. According to Darcy's Law:
- A) The velocity of flow in clay is higher than in sand.
 - B) The higher the gradient, the lower the velocity.
 - C) The water table is generally flatter in an area of high transmissivity.
 - D) Spring flow is independent of the hydraulic characteristics of the aquifer.
8. Prediction of swelling potential in soil is possible using which of the following?
- A) grain size
 - B) organic content of the soil
 - C) Atterberg limits
 - D) color
9. A pathfinder element used in exploration for gold deposits is:
- A) cobalt
 - B) selenium
 - C) arsenic
 - D) aluminum
10. Which of the following indicates the highest measurement of permeability?
- A) 1-9 millidarcy
 - B) 10-99 millidarcy
 - C) 100-999 millidarcy
 - D) 1-2 darcies
11. Black and white vertical stereo aerial photographs are taken of an area which has a variety of mass movement phenomena present. For purposes of practical geologic and geomorphic interpretation of the photographs, one of the principal DISADVANTAGES of a flight time close to noon (sun time) is:
- A) the film's spectral sensitivity to blue light is affected
 - B) the resolving power of the camera lens is minimized
 - C) thermal diffraction in the air distorts the image
 - D) the high sun angle minimizes shadows and modeling of the terrain
12. A site location map must include scale, orientation, title, and:
- A) topographic contours
 - B) geologic units
 - C) geographic reference
 - D) dip and strike symbols

13. Which one of the following minerals does NOT belong to the carbonate mineral group?
- A) barite
 - B) aragonite
 - C) rhodochrosite
 - D) smithsonite
14. Falling-head tests and constant-head tests are used to determine the:
- A) porosity of rock or soil
 - B) safety factors of critical reservoir levels
 - C) hydrostatic pressure on liners
 - D) permeability of rock or soil
15. The Laramide Orogeny occurred during what intervals of geologic time?
- A) Permian-Triassic
 - B) Late Precambrian-Paleozoic
 - C) Late Cretaceous-Paleocene
 - D) Pleistocene-Holocene
16. Rocks that show evidence of high ductile strain, are well-foliated, and contain porphyroclasts are referred to as:
- A) breccias
 - B) mylonites
 - C) cataclasites
 - D) gouges
17. Disappearing streams are NOT typically found in:
- A) karst terrain
 - B) glacial terrain
 - C) arid regions
 - D) volcanic areas
18. The free-air and Bouguer corrections are applied to which one of the following?
- A) gravity data
 - B) gamma-gamma logs
 - C) magnetic data
 - D) refraction data

19. Which of the following testing techniques is commonly used to determine the hydraulic conductivity of a shallow, low-permeability aquifer using a single well?
- A) constant head test
 - B) slug test
 - C) constant discharge test
 - D) surge-response test
20. A dotted line on a USGS geologic map indicates a(an):
- A) igneous-metamorphic contact
 - B) facies change
 - C) concealed contact
 - D) unconformable contact
21. Perched groundwater:
- A) has the same flow characteristics as the main aquifer
 - B) occurs in areas of thick sand or sandstone formations
 - C) is separated from the regional aquifer by an underlying unsaturated zone
 - D) is generally a reliable aquifer for municipal and industrial production wells
22. Hardness in water is typically caused by the presence of:
- A) total dissolved solids
 - B) carbonate and bicarbonate
 - C) calcium and magnesium ions
 - D) suspended matter
23. Which of the following is NOT a good indicator of depositional top and bottom?
- A) flute casts
 - B) graptolite orientation
 - C) graded bedding
 - D) mud cracks
24. While preparing a geologic report, you receive useful and valid original information in the form of a letter from another geologist. With the geologist's permission, this information may:
- A) be utilized in your report and cited as a personal communication
 - B) NOT be utilized in your report because it has not been peer-reviewed
 - C) NOT be utilized in your report because it has not been formally published
 - D) be utilized in your report but not cited as to source

Key for FG Sample Questions

1. a
2. c
3. d
4. c
5. b
6. b
7. c
8. c
9. c
10. d
11. d
12. c
13. a
14. d
15. c
16. b
17. b
18. a
19. b
20. c
21. c
22. c
23. b
24. a

PG SAMPLE QUESTIONS AND ANSWERS

1. Moderate exaggeration of vertical scale (up to 10X) on a geologic cross section is justified when:
 - A) it is common local practice.
 - B) it is needed to show small changes in angular relationships or units of small vertical extent.
 - C) the sections are highly speculative.
 - D) the geologic structure is primarily vertical.

2. Hot-water mineral alteration has occurred within a quartz porphyry dike associated with late phases of intrusion of a granitoid stock into Precambrian amphibolite. The mineral composition of the unaltered dike is: 15% quartz, 45% microcline, 30% oligoclase, 10% biotite.

From the groups of alteration products listed below, select the one most likely to have developed within, and surrounding, the porphyry dike.

 - A) calcite, calcium-aluminum garnet, epidote.
 - B) sericite, kaolinite and montmorillonite, hematite.
 - C) andalusite, calcium-iron garnet, chlorite.
 - D) sericite, opal, andalusite, epidote.

3. In the field you are attempting to separate a 150 ft thick outcrop of lavas into individual flows. From the following features, which one will NOT be suitable to differentiate between flow events?
 - A) Thin claystone beds containing clasts of volcanic rock.
 - B) A thin unit composed of pebbles and cobbles in a matrix of clay.
 - C) A zone of porphyritic texture that grades into the lava above.
 - D) A zone that grades upward into finely crystalline and glassy texture.

4. The term "growth fault" means which of the following?
 - A) any normal fault associated with sedimentary rocks
 - B) a fault radiating from a larger fault
 - C) a fault in a sedimentary rock sequence formed contemporaneously and continuously with deposition
 - D) thrust faults whose displacement has grown through time

5. You have been asked by the owner to evaluate the feasibility of redeveloping their chemically contaminated property for a shopping mall. As a first step in your evaluation, you should:
 - A) contact the local health inspector for an opinion on the site.
 - B) review the available records of the site for information relevant to the nature and extent of contamination.
 - C) request a review of the site by the appropriate state regulator.
 - D) determine the appropriate non-residential clean-up standards for the site.

6. Which of the following geophysical methods is most likely to be successful in locating shallowly buried 55-gallon steel barrels in dry sand?
 - A) ground penetrating radar
 - B) seismic reflection
 - C) seismic refraction
 - D) gravity

7. The proper treatment of septic tank effluent as it moves through soil after leaving the leach line system would be most likely under which one of the following sets of conditions?
- A) Aerobic conditions and a sufficient clearance from saturated zone ground water.
 - B) Septic conditions and the absence of aerobic bacteria.
 - C) Aerobic conditions and a phreatic surface at or above the leach line elevation.
 - D) Septic conditions and a phreatic surface at or above the leach line elevation.

8. Alkali-aggregate reaction is least likely to occur in portland cement concrete with aggregate composed of which one of the following?
- A) rhyolite
 - B) opal
 - C) chert
 - D) quartzite

9. Core samples from an exploration hole in an ore deposit indicate the following concentrations of copper. From the values of the percent copper given below, what is the average concentration of copper in the total cored interval?

Interval (ft)	Drilled (ft)	Recovered (ft)	Percent Copper
410-425	15	12	0.37
425-435	10	5	1.42
435-455	20	9	2.51
455-485	30	28	0.05
485-500	15	15	0.70

- A) 0.67 percent
 - B) 0.51 percent
 - C) 0.91 percent
 - D) 1.01 percent
10. Bottom-hole reservoir pressure can be derived by which of the following?
- A) the amount of gas recorded on the chromatograph after pulling the drill-pipe out of the hole and returning to bottom
 - B) the amount of solid cuttings suspended in the drilling mud system
 - C) drill-stem test shut-in pressure measurements
 - D) the diameter of the drill hole
11. Left and right can be ambiguous terms unless the convention for their usage is understood. In the United States, with respect to terms such as the left abutment of dams or the right bank of streams or rivers, which one of the following statements is correct?
- A) Left and right are as perceived by a person looking downstream.
 - B) Left and right are as perceived by a person looking upstream.
 - C) Left and right are as perceived by a person looking upstream for dams, but as perceived by a person looking downstream for rivers.
 - D) Left and right are as perceived by a person looking downstream for dams, but as perceived by a person looking upstream, for rivers.

12. To map regional structural features and bedrock fracture patterns in a temperate, heavily vegetated area, which technique is most effective?
- A) side looking airborne radar imagery
 - B) LANDSAT false color infrared photography
 - C) high altitude NASA vertical photography
 - D) regional gravity maps
13. You have been retained to conduct a reconnaissance survey of a number of springs for possible development as a bottled water source in an agricultural area. Your initial sampling of these springs should include which of the following parameter lists?
- A) Safe Drinking Water Act primary parameters
 - B) RCRA Appendix IX parameters
 - C) CERCLA volatile organic compounds
 - D) SDWA pesticides and herbicides, RCRA metals
14. A bottled water processor is having problems with the presence of manganese in well water which serves as the raw water source for a processing facility in an area with a subtropical climate. Which of the following rock types would be most desirable for a drilling target in order to solve the processor's problem?
- A) interlayered amphibole and plagioclase-amphibole gneiss
 - B) biotite-quartz-feldspar gneiss, with layers of biotite concentration
 - C) garnet-quartz-feldspar-chlorite schist
 - D) biotite-muscovite-quartz-orthoclase granite
15. You want to record the field location of pebble samples taken for determining regional size distribution of gravelly beds within a 10,000-square mile-area in the Great Plains Province. What is the most useful method for locating the sample sites so you can plot them for a preliminary report?
- A) GPS (global positioning system)
 - B) theodolite and tape survey
 - C) plane table and alidade mapping
 - D) 1:250,000 scale topographic map
16. You have been assigned to supervise a mud rotary drilling operation and log the cuttings for a municipal well. The boring will pass through a known shallow salt water zone before entering the deeper fresh water artesian aquifer. Which of the following is appropriate?
- A) Change to an illite based mud.
 - B) Add barite to the drilling mud.
 - C) Cement surface casing past the salt zone.
 - D) Thicken the drilling mud.
17. Areas with localized alpine glaciation often are sources of moderately sorted materials. Identify the depositional environment of the deposits.
- A) terminal moraine
 - B) glaciofluvial
 - C) varves
 - D) periglacial

18. In many states, the law allows for the "severance of land" into the "surface estate" and the "mineral estate". You are evaluating the underground potential coal resources on a property slated for condemnation by the state. Where severance of the land has occurred, which statement listed below should govern your work effort?
- A) The surface estate is the superior estate and controls access to the minerals.
 - B) The mineral estate is the superior estate and controls access to the minerals.
 - C) Both estates have equal legal rights to the minerals and thus both estates control access.
 - D) The "superior" position makes no difference in conducting your studies.
19. To use historic aerial photographs to monitor slope movements of a large landslide, the photographs must be corrected for:
- A) optical scatter
 - B) radial distortion
 - C) stereoscopic error
 - D) film distortion
20. The drilling of angle holes, oriented perpendicular to the direction of river flow, in the channel section of a dam site, is generally done with the primary intention of exploring to determine:
- A) if near-vertical faults trend parallel to the channel
 - B) the thickness of the overburden
 - C) the accuracy of the geophysical surveys
 - D) if near-vertical faults trend perpendicular to the channel
21. When ordering a laboratory soil or groundwater analysis, it is advisable to request an analytical method with a result reporting limit that is:
- A) at the currently obtainable instrument or method detection limit
 - B) at the lowest limit that will meet all intended uses of the data
 - C) low enough to prevent matrix interference effects
 - D) at the current practical quantitative limit
22. A water sample from a domestic water-supply well has been tested for a variety of inorganic chemicals. The results are as follows:
- | | | | |
|----------|----------|-----------|---------|
| Hardness | 20 mg/l | Nitrate-N | 30 mg/l |
| Chloride | 15 mg/l | Sulfate | 20 mg/l |
| Iron | 0.1 mg/l | | |
- There are no alternative sources of drinking water. At the concentrations given above, which chemical is of health concern according to federal drinking water standards?
- A) iron, causing hardening of the arteries
 - B) chloride, causing cardiovascular problems
 - C) nitrate, causing methemoglobinemia ("blue-baby syndrome")
 - D) sulfate, causing laxative effects

23. A monthly monitoring program of a slope observed that the rate of displacement of the slope monuments has increased in a linear fashion and that the total displacement is 0.45 ft after 36 months of observations. The results of the most recent survey, however, indicate that the rate of displacement has increased with a corresponding displacement of 0.06 ft in one month. Your response to these new data is:
- A) Not to worry. The rate of monument displacement is not important. The total amount is of concern, and 0.06 ft. is significant.
 - B) The survey schedule need not be changed; however, the last survey should be checked for accuracy.
 - C) The slope is in immediate danger of failing and all downslope residents should be immediately evacuated.
 - D) The survey schedule should be increased to better define displacement rate. Slope failure may occur.
24. You are an independent geological consultant whose client needs preliminary results in not more than one week on the potential for limestone to make portland cement. You must evaluate a 2000-acre tract in a carbonate terrane. A preferred sequence of work elements should include:
- A) Prepare a detailed geologic map, drill holes on one-acre spacing, obtain analyses from selected samples, and write a report.
 - B) Conduct a literature search, obtain analyses from samples taken from area limestone quarries, conduct field reconnaissance of the client's tract, and write a report.
 - C) Conduct field reconnaissance, prepare detailed geologic map, obtain analyses from limestone outcrop samples in the area, and write a report.
 - D) Drill holes on one-acre spacing, obtain analyses from all limestone drill hole samples, construct cross-sections and write a report.

Key for PG Sample Questions

1. b
2. b
3. c
4. c
5. b
6. a
7. a
8. d
9. c
10. c
11. a
12. a
13. a
14. d
15. a
16. c
17. b
18. d
19. b
20. a
21. b
22. c
23. d
24. b