



GEOLOGY

SYLLABUS OF EXAMINATIONS

2005 Edition

For textbook information please refer to the **Textbooks** section on page 3 of the document entitled **Information for Students and Examinations Candidates**.

1. PREAMBLE

The geological knowledge required by APEGGA for registration as a Professional Geologist (P. Geol.) closely matches the minimum qualifications recommended by the Canadian Council of Professional Geoscientists in either Geology or Environmental Geoscience. Information about the CCPG recommendations is provided at the CCPG's web site (www.ccpge.ca).

Minimum Required Knowledge

Examinations offered by APEGGA do not cover all possible knowledge subjects that qualify. The Syllabus of Geology Examinations is a selection that allow applicants to demonstrate knowledge requirements to the satisfaction of the Board of Examiners.

The fundamental unit of knowledge in the outline below is the educational unit (EU). One educational unit in a subject is defined as formal instruction equivalent to a one-term (one semester) course in an honors B.Sc. degree program at a Canadian university. For example, one EU could consist of approximately 3 hours of lecture or equivalent per week, with or without a lab, for thirteen weeks. An EU can be considered as the equivalent of one 3-credit hour course in a 120 credit-hour, 4-year degree program.

SECTION I: FUNDAMENTAL SCIENCE

(9 EUs required)

A. SPECIFIED SCIENCE

(6 EUs required)

- Mathematics - Minimum 1 EU
- Physics - Minimum 1 EU
- Chemistry - Minimum 1 EU

AND

3 additional EUs from Mathematics, Physics, Chemistry, or Biology, with maximum credit of ***2 EUs*** in Biology in sections A and B combined.

B. ADDITIONAL SCIENCE

(3 EUs required)

- Mathematics
- Physics

- Statistics
- Chemistry
- Biology
- Computer science

SECTION II: GEOLOGY as outlined by CCPG
(20 EUs required in addition to Fundamental Science in Section I)

AND
Section II applies.
OR
Section III applies

A. FIELD PRACTICE OR FIELD TECHNIQUES*
(1 EU required)

*Knowledge from field-based instruction, not lectures

B. FUNDAMENTAL SUBJECTS
(5 EUs required, with not more than one EU credited in one subject)

- Mineralogy
- Stratigraphy or sedimentology
- Petrology
- Structural geology
- Geochemistry
- Geophysics

C. ADDITIONAL SUBJECTS
(14 EUs required, of which at least 12 must be in Geoscience)*

Fourteen additional EUs are required which can be all in geoscience, with not fewer than twelve EUs in geoscience and not more than two EUs in science other than geoscience.

**Definition of Geoscience:* the constituent associations of the CCPG regulate the practice of professional geoscience as defined in the applicable Acts. They do not regulate activity in fields such as Earth system science, atmospheric science, meteorology, or oceanography. Those areas presently fall outside the scope of regulated professional geoscience in Canadian jurisdictions. However, for the purpose of credit in section C, up to two EUs in these or other sciences can be credited as science other than geoscience.

SECTION III: ENVIRONMENTAL GEOSCIENCE as outlined by CCPG
(20 EUs required in addition to Fundamental Science in Section I)

A. FIELD PRACTICE OR FIELD TECHNIQUES*
(1 EU required)

*Knowledge from field-based instruction, not lectures

B. FUNDAMENTAL SUBJECTS

(5 EUs required, with not more than one EU credited in one subject)

- Mineralogy
- Stratigraphy or sedimentology
- Geomorphology
- Quaternary geology
- Hydrology or hydrogeology
- Geochemistry

C. ADDITIONAL SUBJECTS

(14 EUs required, of which at least 12 must be in Geoscience)*

Fourteen additional EUs are required which can be all in geoscience, with not fewer than twelve EUs in geoscience and not more than two EUs in science other than geoscience.

**Definition of Geoscience:* see Section II above.

An example of an Examiner check sheet for the assessment of an applicant's academic qualifications is given in the attached Appendix.

2. APEGGA SYLLABUS OF EXAMINATIONS

A. EXAMINATIONS IN FUNDAMENTAL SCIENCE

(Applicable to Section I of Outline)

2005-GFund-1a Elementary Calculus I

2005-GFund-1b Elementary Calculus II

I: Review of analytical geometry. Differentiation and integration of simple functions. Applications.

II: Differentiation and integration of trigonometric, exponential and logarithmic functions. Indeterminate forms and improper integrals. Applications.

2005-GFund-2a General Physics I

2005-GFund-2b General Physics II

I: Vectors, kinematics in 1D, kinematics in 2D, forces and Newton's laws of motion, work and kinetic energy, potential energy and conservative forces, linear momentum and collisions, linear and rotational kinematics, rotational dynamics, static equilibrium, gravitational forces, elasticity and simple harmonic motion, oscillations and resonance, waves and sound.

II: Fluids, temperature and heat, kinetic theory of gases, thermodynamics, phase changes, electric charge, electric field, electric potential and potential energy, electric currents, DC circuits, AC circuits, magnetism, Ampere's law, magnetic flux and Faraday's law of induction.

2005-GFund-3a General Chemistry I

2005-GFund-3b General Chemistry II

I: Basic chemical concepts. Stoichiometry. Gas laws. Periodic table and the chemistry of selected elements. Atomic and molecular structure. Chemical bonding. Structures of organic compounds. States of matter and phase changes. Properties of solutions.

II: Acid/base concepts. Chemical kinetics and equilibrium. Acid-base and solubility equilibria. Elementary thermodynamics. Oxidation and reduction, electrochemistry.

2005-GFund-4 Differential Equations and Transform Methods

Linear ordinary differential equations; the Laplace transformation; series solutions of differential equations; boundary value problems and orthogonal functions; Fourier series; Fourier integrals.

2005-GFund-5 Linear Algebra and Vector Analysis

Linear transformations; matrices and matrix operations; determinants; simultaneous linear algebraic equations; eigenvalues and eigenvectors. Vector algebra; vector functions and operators; orthogonal curvilinear multiple coordinates; applications of partial derivatives, multiple integrals, line and surface integrals; integral theorems.

2005-GFund-6 Computing Science

Candidates must develop familiarity with a high level programming language (one of Fortran, Pascal, or C) and develop facility in writing computer programs.

Organization of stored program computers; principles of structured programming (input/output, assignment, selection and repetition, modular design using functions and procedures/subroutines, data structures including arrays and text files; design and testing of algorithms; introduction to numerical methods) curve fitting, numerical integration, root finding.

2005-GFund-7 Thermodynamics

Thermodynamic states of simple systems; the laws of thermodynamics; equilibrium, PVT and other thermodynamic diagrams; energy of state; compressibility charts and steam tables; calculation of property changes; enthalpy; applications of thermodynamics, cycles, reversibility; thermodynamics of phase changes, the Gibbs phase rule; gas-vapor mixtures, psychometrics.

2005-GFund-8 Biology

The subject matter covers the four principal areas of biology, i.e., (1) unity, (2) diversity, (3) continuity and (4) interaction. Unity encompasses the historical events leading to major biological concepts, the chemistry of cells, cell structure and hereditary mechanisms. Diversity deals with the variety of cell types, organ systems and organisms from developmental and evolutionary points of view. Continuity covers the mechanisms of heredity as they relate to evolution. Darwinian evolution and the evolution of man are emphasized. Interaction places the emphasis on the ecosystem and the interaction of organisms with their environment.

2005-GFund-9 Physical Chemistry

Fundamental concepts of matter in relation to energy. The laws of classical thermodynamics and their application to the properties of gases, liquids, solids and solution. Transport phenomena. The basic laws of chemical kinetics, and their application to reactions in gaseous and liquid phases. Catalysis.

2005-GFund-10 Organic Chemistry

A study of compounds of carbon with emphasis on reaction mechanisms to illustrate the basic principles of organic chemistry. Structure and bonding, physical properties, and stereochemistry; addition, elimination, and displacement reactions by function group classification; structure-reactivity relationships; aromaticity and aromatic substitution; condensation reactions; spectroscopic methods for structure determination.

2005-GFund-11 Inorganic Chemistry

The structure of many-electron atoms, bonding and stereochemistry in inorganic compounds, elementary crystallography, solid-state science and aspects of inorganic solution chemistry. The chemistry of metals and ligand field theory; coordination compounds, metal carbonyls and organo-metallic compounds of the transition elements; descriptive chemistry of the first-row transition elements; industrial extraction of metals; uses of transition metal complexes as catalysts; an introduction to the role of metals in biology.

2005-GFund-12 Statistics

Random variables and frequency distributions. Averages and variance. The binomial and normal distribution. Sampling distributions and elementary inference. X^2 -test for contingency tables. Regression and correlation. Analysis of variance.

B. EXAMINATIONS IN FUNDAMENTAL GEOSCIENCE SUBJECTS

(Applicable to Sections II and III)

2005-Glgy-1 Mineralogy & Crystallography

Morphological crystallography, crystal systems, crystal symmetry including planes, rotation and inversion axes, crystal classes, Miller indices, axial ratios and stereographic projection. Theoretical principles of mineralogy. Determinative and descriptive mineralogy.

2005-Glgy-2 Principles of Stratigraphy and Sedimentation

Sedimentary processes, environments and facies; properties and classification of sedimentary rocks; code of stratigraphic nomenclature and the stratigraphic column; stratigraphic relationship and interpretations.

2005-Glgy-3 Igneous Petrology

Mineralogical and chemical classification of igneous rocks. Physics and chemistry of igneous rock formation.

2005-Glgy-4 Sedimentary Petrology

Processes of clastic and chemical sedimentation, and diagenesis; sedimentary environments and facies; laboratory techniques in the study of sedimentary rocks.

2005-Glgy-5 Metamorphic Petrology

Mineralogy and textures of metamorphic rocks. Concepts of metamorphic facies and facies series, and their pressure-temperature-composition interpretation.

2005-Glgy-6 Structural Geology

Orientation, measurement, representation and geometric analysis of planar and linear geologic structures. Description and geometric analysis of faults and folds; relation of faults to stress. Geologic maps, subsurface maps, structure contour maps and cross sections. Descriptive geometry, stereographic and equal area projections. Mechanical principles; stress, strain and deformation in rocks. Analysis of joints, secondary foliations and lineations.

2005-Glgy-7 Geochemistry

Chemical processes taking place in geologic settings with emphasis on the abundance relationships of the elements in the Earth's crust and the laws governing the migration and distribution of elements of the Earth; the application of geochemistry in the search for mineral deposits.

2005-Glgy-8 Geophysics

Elasticity of rocks; types of waves generated in earthquakes and explosions; structure of the earth; gravity and the figure of the earth, earth tides; the magnetic field; secular variations; electromagnetic induction; rock magnetism; heat flow; geochronology; geodynamics.

2005-Glgy-9 Geomorphology

Landforms and the processes which create and modify them; weathering, mass-wasting, stream erosion, wave erosion, wind erosion, glaciation and permafrost; study of landforms on aerial photographs and topographic maps.

2005-Glgy-10 Glacial and Quaternary Geology

Elements of glaciology; character and origin of glacial deposits and landforms; geological processes, sediments and landforms in the periglacial environment; frozen and ground phenomena, including permafrost; glacio-isostatic rebound and eustatic changes in sea level; glacial history of Western Canada.

2005-Glgy-11 Hydrogeology

The occurrence of groundwater; rock properties that affect groundwater, quality of groundwater; geology of groundwater basins; procedures for surface and subsurface investigations. Hydrology of groundwater flow, derivation of Darcy's law from fundamental concepts of fluid mechanics, and its generalization to spatially varied flows. Permeability parameters and validity of Darcy's law in terms of Reynold's number.

C. EXAMINATIONS IN ADDITIONAL GEOSCIENCE SUBJECTS (APPLICABLE TO SECTIONS II AND III)

2005-Glgy-12 Paleontology

Principles of classification; comparison of fossils with modern forms; classification and study of fossil invertebrates.

2005-Glgy-13 Petroleum and Natural Gas

Origin and distribution of petroleum. Geochemistry and maturation of organic matter; microbiological and thermal degradation of hydrocarbons, conventional and unconventional source and reservoir rocks; principles of primary and secondary migration; diagenesis of carbonate and clastic reservoir rocks, with reference to seals and traps.

2005-Glgy-14 Economic Geology

The economics of exploration and exploitation with respect to metalliferous raw materials. Exploration logistics and planning. Property and prospect evaluation. Drilling and sampling techniques. Reserve and grade estimation.

2005-Glgy-15 Metallic Mineral Deposits

Processes of ore formation and concentration in association with all the major geological processes. Stratigraphic and structural control of ore deposits. Examples of the occurrence of the economically important types of deposits in Canada and the world. Study of ores in polished and thin section. The application of chemical principles to the understanding of ore deposits; solution chemistry, phase equilibria, isotope geochemistry. Exploration for, and evaluation of metallic mineral deposits.

2005-Glgy-16 Stratigraphy of Western North America

Historical geology of Western North America from the Precambrian to the Recent.

2005-Glgy-17 Geotectonics and Global Geology

Global aspects of plate tectonics and regional geology through time. Application of fundamental stratigraphic and structural principles. Contributions of geophysics, geochemistry, experimental and theoretical petrology to the modern plate tectonic model. Analysis and interpretation of major structural provinces as they relate to the plate boundary interactions.

2005-Glgy-18 Exploration Geophysics*

Principles and applications of the following geophysical techniques: seismic reflection, seismic refraction, gravity, magnetic, electronic and electromagnetic, radioactive, well logging.

*can include mining geophysics

2005-Glgy-19 Optical Mineralogy/Advanced Mineralogy

Optical crystallography with indicatrix theory. Optical techniques in determinative mineralogy with emphasis on transmitted-light microscopy and its application to common rock-forming minerals. Mineral associations, textures and elementary ideas on the origin of igneous, metamorphic and sedimentary rocks.

2005-Glgy-20 Advanced Sedimentology

Processes of sedimentation: weathering, transportation, deposition and diagenesis; classification and description of the principal types of detrital and chemical sedimentary rocks.

2005-Glgy-21 Advanced Igneous and/or Metamorphic Petrology

Origin and formation of igneous and/or metamorphic rocks in the light of field, mineralogical, chemical and experimental evidence.

2005-Glgy-22 Advanced Geochemistry

Application of physical chemistry to problems in igneous, metamorphic and sedimentary geology. Use of thermodynamic calculations to estimate physical and chemical conditions of mineral stability.

2005-Glgy-23 Principles of Geotechnics

Geotechnical investigation, site surveys and exploration, geological aspects of a given site with regard to the engineering design of foundations, hydraulic structures and the stability of natural or man-made slopes and open cuts. Provision of advice on fluvial geomorphology. Mapping and comment on the geologic factors affecting tunneling. The emphasis is the application of geologic

expertise by the provision of geologic information in the form of maps and reports concerning design and construction of engineering projects.

2005-Glgy-24 Advanced Paleontology

Nomenclature and taxonomy, the species concept, mechanisms of evolution, adaptation, biometrics, paleoecology and preparatory techniques.

2005-Glgy-25 Advanced Structural Geology

Structural features of complexly folded and faulted strata. Simple statistical analysis of structural data. Analysis of strains. Computer-based procedures for determining the geometry of faults and folds. Structural analysis in plutonic and metamorphic rocks.

2005-Glgy-26 Geostatistics

Analysis of quantitative geological data using digital computers, simple and multivariate statistical models (multiple regression, factor analysis and discriminant functions). Application of these methods to real and hypothetical geological situations.

2005-Glgy-27 Advanced Hydrogeology

Chemical and contaminant hydrogeology. Chemical and biological processes in surface water and groundwater systems. Water quality, contaminant transport and dispersal, fluid-sediment interaction, remediation of contamination. Use of thermo chemical models, numerical modelling of contaminant migration, case studies.

2005-Glgy-28 Reservoir Geology

Core analysis; methods for porosity, permeability and fluid saturation, and the conditions under which each method can be used. Log interpretation; use of logs for correlation and mapping, as well as for the determination of reservoir parameters - porosity, permeability, pore water. Drill stem tests, the reading of DST charts, significance and interpretation of pressure curves. Reservoir rocks and reservoir pore space characteristics; factors influencing porosity and permeability. Measurement methods. Reservoir fluids, reservoir conditions and reservoir mechanics.

2005-Glgy-29 Advanced Ore Deposits

A detailed study of ore occurrences and processes of formation with emphasis on Canadian deposits.

2005-Glgy-30 Photogeology and Remote Sensing

Application of aerial photographs to geological mapping and terrain analysis; interpretation of geological structure and landforms; remote sensing in geology; sensor principles and capabilities; analysis of imagery.

2005-Glgy-31 Precambrian Geology

The Precambrian geologic record with special reference to the stratigraphy, structure, petrology, mineral deposits, geochronology and metamorphism of the Shield areas of North America.

**APEGGA Geology Academic Assessment: Course-by-Course Equivalent Credits
Summary evaluation check sheet (Syllabus in effect 3 Dec 2005, review after 5 years)**

Applicant name: _____

FUNDAMENTAL SCIENCE (Total 9)

SECTION A: SPECIFIED SCIENCE (6 required)

ALL 3:

2005-F-1a Elementary Calculus I _____
 2005-F-2a General Physics I _____
 2005-F-3a General Chemistry I _____

AND 3 OF:

2005-F-1b Elementary Calculus II _____
 2005-F-2b General Physics II _____
 2005-F-3b General Chemistry II _____
 2005-F-8 Biology* _____

SECTION B: ADDITIONAL SCIENCE (3 required)

AND 3 OF:

2005-F-4 Diff. Eqns & Transforms _____
 2005-F-5 Lin. Algebra. & Vector Anal. _____
 2005-F-6 Computing & Numerical Anal. _____
 2005-F-7 Thermodynamics _____
 2005-F-8 Biology* _____
 2005-F-9 Physical Chemistry _____
 2005-F-10 Organic Chemistry _____
 2005-F-11 Inorganic Chemistry _____
 2005-F-12 Statistics _____

OR:

***Biology:** A biology course can be credited in either section A or B. Two biology courses can be credited either as one in A and one in B, or two in B.

*Any advanced university courses in **mathematics, physics, chemistry, statistics, computing or biology** can fulfil requirements of three subjects. Maximum two biology credits in the total of 9 fundamental sciences.*

GEOSCIENCE (Total 20 subjects; must satisfy A, B, and C requirements; and A + B + C = 20)

SECTION A: FIELD PRACTICE (Required: no APEGGA examination offered) _____

SECTION B: FUNDAMENTAL GEOSCIENCE: must satisfy one column

EITHER: (Minimum 5, maximum 6)

2005-G-1 Mineralogy & Crystallog. _____

 2005-G-2 Stratig. & Sedimentation _____
 2005-G-3, 4, 5 Petrology (any one) _____
 2005-G-6 Structural Geology _____
 2005-G-7 Geochemistry _____
 2005-G-8 Geophysics _____

OR: (Minimum 5, maximum 6)

2005-G-1 Mineralogy & Crystallog. _____
 2005-G-2 Stratig. & Sedimentation _____
 2005-G-7 Geochemistry _____
 2005-G-9 Geomorphology _____
 2005-G-10 Glacial & Quaternary _____
 2005-G-11 Hydrology or Hydrogeology _____

SECTION C: OTHER GEOSCIENCE (Additional 14 subjects required: min 12 in geoscience, max 2 in other science, for example biology)

1 _____	_____	8 _____	_____
2 _____	_____	9 _____	_____
3 _____	_____	10 _____	_____
4 _____	_____	11 _____	_____
5 _____	_____	12 _____	_____
6 _____	_____	13 _____	_____
7 _____	_____	14 _____	_____

COMMENTS:

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