1. PREAMBLE
The geological knowledge required by APEGA for registration as a Professional Geoscientist (P.Geo.) follows the national syllabi of minimum qualifications recommended by Geoscientists Canada for both Geology and Environmental Geoscience. Information about these recommendations is provided on the Geoscientists Canada website (geoscientistscanada.ca), which includes a link to the downloadable booklet, "Geoscience Knowledge and Experience (GKE) Requirements for Professional Registration in Canada" at: http://geoscientistscanada.ca/resources/publications/

Minimum Required Knowledge
Examinations offered by APEGA do not cover all possible knowledge subjects that qualify (see the GKE requirements on the Geoscientists Canada website for a longer list). The APEGA Syllabus of Geology Examinations is a selection that allows applicants to demonstrate knowledge requirements to the satisfaction of the Board of Examiners.

The fundamental unit of knowledge in the GKE requirements outlined 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 honours 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)

IA. SPECIFIED SCIENCE (3 EUs required)
- Mathematics - 1 EU
- Physics - 1 EU
- Chemistry - 1 EU

AND

IB. ADDITIONAL SCIENCE (6 EUs required; maximum of two in any subject, e.g. two in biology, two in computer science, etc.)
- Mathematics
- Physics
- Statistics
- Chemistry
- Biology
- Computer science
SECTION II: GEOSCIENCE as outlined by Geoscientists Canada
(18 EUs, at second year level or higher, required in addition to Section I Fundamental Science)

IIA. REQUIRED FOUNDATION GEOSCIENCE  (4 EUs required)
- Field practice (knowledge from field-based instruction, not classroom lectures)
- Mineralogy & petrology
- Stratigraphy and sedimentation
- Structural geology

IIB. ADDITIONAL FOUNDATION GEOSCIENCE  (5 EUs required from one column, with at least one but not more than two EUs credited in each of the three sub-groups; additional credits can be credited in Section IIC)

Either: Geology
- Igneous petrology
- Sedimentary petrology
- Metamorphic petrology

Or: Environmental Geoscience
- Hydrology or Hydrogeology
- Principles of geotechnics

- Geochemistry
- Geophysics

- Geomorphology or Glacial geology
- Advanced sedimentology
- Remote sensing & photogeology

- Geochemistry
- Geophysics

- Geomorphology or Soil science
- Glacial geology
- Remote sensing & photogeology

IIC. OTHER GEOSCIENCE SUBJECTS  (9 EUs required, with at least 7 in Geoscience*)

Nine additional EUs are required, with not fewer than seven EUs in geoscience and not more than two EUs in science other than geoscience.

*Definition of Geoscience: the constituent associations of Geoscientists Canada 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. For the purpose of credit in Section C, however, up to two EUs in these subjects or other science listed in Section I can be credited as science other than geoscience.

2. APEGA SYLLABUS OF UNIVERSITY-level SUBJECTS and EQUIVALENT EXAMINATIONS

A. UNIVERSITY-level SUBJECTS IN FUNDAMENTAL SCIENCE & EQUIVALENT APEGA EXAMS (Applicable to Section I)

2010-GFund-1a + 1b ≡ APEGA Exam 04-Prelim-1  Calculus
Limits, continuity; differentiation, derivatives of the elementary functions (including trigonometric and exponential functions and their inverses), related rates, the mean Value Theorem, curve sketching, extremum problems, the definite integral, the Fundamental Theorem of Calculus, techniques of integration, area, volume, arc length, moments and centres of mass, parametric and polar considerations, sequences, series, Taylor series functions of several variables, partial derivatives, and applications.
2010-GFund-1a Elementary Calculus I  (no equivalent APEGA exam)
2010-GFund-1b Elementary Calculus II  (no equivalent APEGA exam)
II: Differentiation and integration of trigonometric, exponential and logarithmic functions. Indeterminate forms and improper integrals. Applications.

2010-GFund-2a + 2b ≡ APEGA Exam 04-Prelim-3  Physics
Basic mechanics (Motion: in one and two dimensions. Conservation Laws: energy and momentum. Newton’s Laws: applied to point masses. Equilibrium of point masses and rigid bodies); Waves and related subjects (simple harmonic motion, travelling waves, simple acoustics); Electricity (electric forces and fields, electrostatic potential, capacitors): Magnetism (magnetic fields, electro-magnetic induction); Circuits (simple D.C. and A.C. circuits).

2010-GFund-2a General Physics I  (no equivalent APEGA exam)
2010-GFund-2b General Physics II  (no equivalent APEGA exam)
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 resonances, 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.

2010-GFund-3a + 3b ≡ APEGA Exam 04-Prelim-4  Chemistry
Stoichiometry; Chemical periodicity; Basic reaction types; Gases; Condensed phases; Chemical equilibrium; Acid-base equilibria; Thermochemistry; Entropy and chemical spontaneity; Electrochemistry; Chemical kinetics; Atomic structure and quantum theory; Chemical bonding; Solids; liquids; intermolecular forces; Organic chemistry; Nuclear chemistry.

2010-GFund-3a General Chemistry I  (no equivalent APEGA exam)
2010-GFund-3b General Chemistry II  (no equivalent APEGA exam)

2010-GFund-4 ≡ NTExam 04-BS-5  Advanced Mathematics
Numerical Methods: Use of computers for numerical solution of engineering problems, including techniques involving library subroutines and spreadsheets. Approximations and errors, interpolation, systems of linear and non-linear algebraic equations, curve fitting, numerical integration and differentiation, and ordinary differential equations.

2010-GFund-5 ≡ NTExam 04-BS-1  Mathematics
Calculus, Vector, and Linear Algebra: Applications involving matrix algebra, determinants, eigenvalues; first and second order linear ordinary differential equations, Laplace transforms. Vector algebra; vector functions and operations; orthogonal curvilinear coordinates; applications of partial derivatives, Lagrange multipliers, multiple integrals, line and surface integrals; integral theorems (Gauss, Green, Stokes). Power series.
2010-GFund-6  ≡ APEGA Exam 04-Prelim-2  Computing
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.

2010-GFund-7  ≡ NTExam 04-BS-10  Engineering Thermodynamics
Thermodynamic states of simple systems; the laws of thermodynamics; equilibrium, PVT and other thermodynamic diagrams; equation of state; compressibility charts and steam tables; calculation of property changes; enthalpy; applications of thermodynamics, cycles, reversibility; thermodynamics of phase changes, Gibbs phase rule, gas-vapour mixtures.

2010-GFund-8  ≡ NTExam 04-BS-13  Biology
Cellular reproduction, growth, and differentiation; metabolism and bioenergetics of living cells; cell structure and function related to the material properties of plant and animal tissues; introductory microbiology — characteristics and classification of microorganisms; interactions of microorganisms with man in the natural world; kinetics and mathematical models of microbial growth; engineered biological systems such as bioreactors, bio-instrumentation, and waste treatment systems.

2010-GFund-9  Physical Chemistry  (no equivalent APEGA exam)

2010-GFund-10 ≡ NTExam 04-BS-12  Organic Chemistry
Principles of organic chemistry developed around the concepts of structure and functional groups. The main classes of organic compounds. Properties of pure substances. Introduction to molecular structure, bond types, properties, synthesis and reactions, reaction mechanisms, as a means of systematizing organic reactions.

2010-GFund-11  Inorganic Chemistry  (no equivalent APEGA exam)
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.

2010-GFund-12  ≡ NTExam 04-BS-2  Probability and Statistics
Concepts of probability, events and populations, probability theorems, concept of a random variable, continuous and discrete random variables, probability distributions, distributions of functions of a random variable, sampling and statistical estimation theory, hypothesis testing, simple regression analysis.

B. UNIVERSITY-level SUBJECTS IN GEOSCIENCE & EQUIVALENT EXAMS
(Applicable to Section II)

2010-Glgy-1  ≡ NTExam 04-Geol-A1  Mineralogy and Petrology
Introduction to crystallography and crystal chemistry. Physical and chemical properties of minerals in hand specimens. Identification of minerals and rocks with the petrographic microscope. Field and laboratory classification of igneous and metamorphic rocks. The nature of magmas and processes of magmatic differentiation. Metamorphic facies concepts. Interpretation of mineral assemblages of igneous and metamorphic rocks in the light of the phase rule and phase relations of relevant mineral assemblages. Textural and physical properties of rocks relevant to engineering problems.
2010-Glgy-2  NTExam 4-Geol-A3  Sedimentation and Stratigraphy

2010-Glgy-3  Igneous Petrology  (no equivalent APEGA exam)
Mineralogical and chemical classification of igneous rocks. Physics and chemistry of igneous rock formation.

2010-Glgy-4  Sedimentary Petrology
Processes of clastic and chemical sedimentation, and diagenesis; sedimentary environments and facies; laboratory techniques in the study of sedimentary rocks.

2010-Glgy-5  Metamorphic Petrology  (no equivalent APEGA exam)

2010-Glgy-6  NTExam 04-Geol-A4  Structural Geology

2010-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.

2010-Glgy-8  NTExam 10-GP-M6  Global Geophysics
Theory and research applications in gravitation, rotation and figure of the Earth, seismology and Earth structure, free oscillations of the Earth, seismic risk, geomagnetism and the core, paleomagnetism and continental drift. Thermal energy at plate boundaries and hot-spots. Mantle convection.

2010-Glgy-9  NTExam 04-Geol-B4  Geomorphology and Pleistocene Geology

2010-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.

2010-Glgy-11  NTExam 04-Geol-A2  Hydrogeology
2010-Glgy-12 Paleontology  
Principles of classification; comparison of fossils with modern forms; classification and study of fossil invertebrates.

2010-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.

2010-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.

2010-Glgy-15  
≡ NTExam 04-Geol-B6-3  
Metallic and Industrial Mineral Deposits
Nature, mode of occurrence and processes of formation of metallic and industrial minerals including minerals deposited from magmas, high-temperature vapours and aqueous solutions; formed by evaporation or precipitation in surface waters; formed by mechanical accumulation or accumulated by residual weathering. Processes of element/mineral migration and concentration. Stratigraphic and structural controls on occurrence. Solution geochemistry and isotopic characteristics of ore bearing fluids and ore deposits. Illustrative case histories for important deposits of sulphides, oxides, native elements, silicates, and ionic salts.

2010-Glgy-16 Stratigraphy of Western North America
Historical geology of Western North America from the Precambrian to the Recent.

2010-Glgy-17 Geotectonics and Global Geology  
(no equivalent APEGA exam)
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.

2010-Glgy-18  
≡ NTExam 04-Geol-A7  
Applied Geophysics
Basic principles, interpretation, and limitations of geophysical methods applied to the exploration for coal, oil and natural gas, minerals, groundwater, and for geotechnical studies of the surface and subsurface. Introduction to electrical, electromagnetic, and magnetotelluric surveys; magnetic and gravity surveys; seismic reflection and refraction surveys; radiometric methods. Introduction to geophysical well logging techniques. Case histories of applications to engineering problems.

2010-Glgy-19 Optical Mineralogy/Advanced Mineralogy  
(no equivalent APEGA exam)
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.

2010-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.

2010-Glgy-21 Advanced Igneous and/or Metamorphic Petrology  
(no equivalent APEGA exam)
Origin and formation of igneous and/or metamorphic rocks in the light of field, mineralogical, chemical and experimental evidence.
2010-Glgy-22 Advanced Geochemistry  \textit{(no equivalent APEGA exam)}  
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.

2010-Glgy-23 $\equiv$ NTExam 04-Geol-A5  Rock Mechanics  

2010-Glgy-24 Advanced Paleontology  \textit{(no equivalent APEGA exam)}  
Nomenclature and taxonomy, the species concept, mechanisms of evolution, adaptation, biometrics, paleoecology and preparatory techniques.

2010-Glgy-25 Advanced Structural Geology  \textit{(no equivalent APEGA exam)}  

2010-Glgy-26 Geostatistics  \textit{(no equivalent APEGA exam)}  
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.

2010-Glgy-27 $\equiv$ NTExam 04-Geol-B1  Contaminant Hydrogeology  

2010-Glgy-28 $\equiv$ NTExam 04-Geol-B6-1  Petroleum Deposits  
Physical properties, geochemistry, origin, migration, accumulation, and history of oil and natural gas, and their associated waters. Geological conditions of oil and gas entrapment. Structural and stratigraphic factors controlling the distribution of reservoir rocks, porosity, permeability and fluid saturations. Environmental problems associated with the development of hydrocarbons.

2010-Glgy-29 Advanced Ore Deposits  \textit{(no equivalent APEGA exam)}  
A detailed study of ore occurrences and processes of formation with emphasis on Canadian deposits.

2010-Glgy-30 $\equiv$ NTExam 04-Geol-B2  Terrain Analysis  

2010-Glgy-31 Precambrian Geology  \textit{(no equivalent APEGA exam)}  
The Precambrian geologic record with special reference to the stratigraphy, structure, petrology, mineral deposits, geochronology and metamorphism of the Shield areas of North America.
Applicant name: ____________________________________________________________

**FUNDAMENTAL SCIENCE (Total 9)**

**SECTION 1A: SPECIFIED SCIENCE (3 required):**
- 2010-F-1a Elementary Calculus I ______
- 2010-F-2a General Physics I ______
- 2010-F-3a General Chemistry I ______

**SECTION 1B: ADDITIONAL SCIENCE (6 required):**
- 2010-F-1b Elementary Calculus II ______ 2010-F-9 Physical Chemistry ______
- 2010-F-2b General Physics II ______ 2010-F-10 Organic Chemistry ______
- 2010-F-3b General Chemistry II ______ 2010-F-11 Inorganic Chemistry ______
- 2010-F-4 Diff. Eqns & Transforms ______ 2010-F-12 Statistics ______
- 2010-F-7 Thermodynamics ______
- 2010-F-8 Biology ______

*Any advanced university courses in mathematics, physics, chemistry, statistics, computing or biology for science majors can fulfill requirements in additional science. There is a maximum of two credits in any subject in Section 1B, e.g., two biology, two computer science, etc.*

**GEOSCIENCE (Total 18 subjects at the second year level or higher; must satisfy A, B, and C requirements; and A + B + C = 18)**

**SECTION 2A: REQUIRED FOUNDATION GEOSCIENCE (ALL 4 required):**
- 2010-G-1 Mineralogy & Crystallography ______
- 2010-G-2 Stratigraphy & Sedimentation ______
- 2010-G-6 Structural Geology ______
- Field Practice (no APEGA examination offered) ______

**SECTION 2B: ADDITIONAL FOUNDATION GEOSCIENCE: (5 required; must satisfy one column, with minimum one, maximum two from each of the three sub-groups; credit extras in Section 2C):**

<table>
<thead>
<tr>
<th>EITHER: Geology</th>
<th>OR: Environmental Geoscience</th>
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<tbody>
<tr>
<td>2010-G-3 Igneous Petrology</td>
<td>2010-G-11 Hydrology or Hydrogeology</td>
</tr>
<tr>
<td>2010-G-4 Sedimentary Petrology</td>
<td>2010-G-23 Principles of Geotechnics</td>
</tr>
<tr>
<td>2010-G-5 Metamorphic Petrology</td>
<td>(Engineering Geology)</td>
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<tr>
<td>2010-G-7 Geochemistry</td>
<td>2010-G-7 Geochemistry</td>
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<tr>
<td>2010-G-8 or G-18 Geophysics</td>
<td>2010-G-8 or G18 Geophysics</td>
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<tr>
<td>2010-G-9 Geomorphology (or G-10 Glacial)</td>
<td>2010-G-9 Geomorphology (or Soil Science)</td>
</tr>
<tr>
<td>2010-G-20 Advanced Sedimentology</td>
<td>2010-G-10 Glacial &amp; Quaternary</td>
</tr>
</tbody>
</table>

**SECTION 2C: OTHER GEOSCIENCE (Additional 9 subjects required, at second year level or higher, with a minimum of 7 in geosciences and a maximum of 2 in other science, e.g. biology)**

1 ____________________ ______ 6 ____________________ ______
2 ____________________ ______ 7 ____________________ ______
3 ____________________ ______ 8 ____________________ ______
4 ____________________ ______ 9 ____________________ ______
5 ____________________ ______

Revised December 2009