National Exams May 2019

17-Pet-B4, Petroleum Geology

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.

2. This is a CLOSED BOOK exam.

3. Candidates may use one of two calculators, the Casio or Sharp approved models.

4. FIVE (5) sections constitute a complete exam paper. Each section contains between 2 and 5 questions.

5. The value of each section is indicated. All parts in a multipart question have equal weight unless otherwise stated.

6. Clarity and organization of your answers are important, clearly explain your logic.

7. Pay close attention to units, some questions involve oilfield units, and these should be answered in the field units. Questions that are set in other units should be answered in the corresponding units.

Section 1 – Terminology (30 Marks)

Q1 Explain, with the aid of an appropriate definition, and/or well-labeled diagram, and/or formulae, the following terms. Be sure to indicate the difference(s) between the three items in each set:

a) Petroleum, Crude Oil, Natural Gas
b) Heavy Oil, Light Oil, Bitumen
c) Oil Sands, Oil Shale, and Coalbed Methane unconventional resources
d) Alkanes, Napthenes, Aromatics hydrocarbon compounds
e) Water Washing, Biodegradation, Thermal Cracking of petroleum deposits

Section 2 – Hydrocarbon Source Rocks (18 Marks)

Q2-1 (2 marks) Define kerogen.
Q2-2 (10 marks) List the main kerogen types, including specific maceral names, progenitors of each kerogen type, and the typical petroleum products ultimately produced from each.
Q2-3 (3 marks) Sketch the main kerogen types on a 'modified' Van-Krevelen diagram.
Q2-4 (3 marks) Sketch the main kerogen types on a Hydrogen Index versus Oxygen Index diagram.

Section 3 – Hydrocarbon Maturation (22 Marks)

Q3-1 (10 marks) Describe the three main stages of organic maturation leading to the production of petroleum. Be sure to include: temperature boundaries and the type and relative amounts of the different petroleum compounds generated at each stage.
Q3-2 (6 marks) Define vitrinite and vitrinite reflectance, and explain how vitrinite reflectance can be used as a geothermometer in the context of the three stages of organic maturation.
Q3-2 (6 marks) Name and explain the use of two (of the many) other geothermometers in petroleum exploration.

Section 4 – Stratigraphic Traps (15 Marks)

Q4-1 (3 marks) Name three different (major) types of stratigraphic traps.
Q4-2 (9 marks) Sketch a simple cross-section of each of the three (major) types. Label the sketches clearly so as to make the trapping mechanism and reservoir interval clear.
Q4-3 (3 marks) Cite an example of each type of trap. (i.e., Canadian, US, or elsewhere)

Section 5 – Structural Traps (15 Marks)

Q5-1 (3 marks) Name the three major types of structural traps.
Q5-2 (12 marks) Sketch and explain the different sub-types within the three major types of structural traps. Label the sketches clearly so as to make the trapping mechanism and reservoir interval clear.