

National Exams December 2014

98-Pet-A1, Principles of Stratigraphy & Sedimentation

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 NO CALCULATOR PERMITTED EXAM. CLOSED BOOK EXAM.
3. This exam paper consists of three pages (including this cover page). There are two parts: **Part A** (Questions 1-15) conveys questions related to Sedimentology and Sedimentary Processes whereas **Part B** (questions 16-24) conveys questions related to Stratigraphy.
4. Part A consists two portions (**A1** and **A2**, Questions 1-7 and 8-15, respectively). Answer **four (4)** questions from Part A1 and **five (5)** questions from Part A2. Part B consists of 9 questions (Questions 16 to 24). Answer **six (6)** out of these 9 questions.
5. Each question of Part A1 is 5 points (4 questions X 5 each = 20 points) whereas those of Part A2 are 3 points each (5 questions X 3 each = 15 points). Questions of Part B are 5 points each (6 questions X 5 each = 30 points). The maximum attainable grade is 65/65.
6. Most questions require an answer in essay format. Clarity and organization of the answers are important.
7. **Please note:** The first number of questions permitted to answer in each part (i.e., Part A & Part B) or subpart (i.e., A1 & A2) will be marked as they appear in the answer book. Thus, do not answer more than what you have been asked to answer.

Part 1: Questions on Sedimentary processes (total points = 35)

A1 : Answer any four (4) of the following 7 questions. 5 points each (20 points total).

- 1- Describe how the distance of sediment transportation (from provenance site to depositional site) affects size, roundness and sphericity of sedimentary particles.
- 2- Sieving analysis of sand-size sediments allows a graphical representation of the sediments' cumulative curve when grain size (in phi or ϕ along the X-axis) is plotted against the sediments' cumulative weight percent (on the Y-axis). Sediments with different grain size properties can produce differently-sloping cumulative curves. Explain the textural differences between two sediments, one with steep cumulative curve and one with gently-sloping curve. Give an example of possible depositional environment for each sediment type.
- 3- Explain the term "Carbonate Platform" and describe the different types of carbonate platforms.
- 4- Explain Bouma Sequence (annotated sketch is acceptable) and its sedimentological significance.
- 5- Define the terms textural maturity and mineralogical maturity of sandstone. Is it possible to have a sandstone that is both texturally and mineralogically mature? If no, explain why, if yes, give an example.
- 6- Describe the term "Diagenesis" and briefly explain how it affects the reservoir rock quality.
- 7- Provide the classification scheme of carbonate rocks following Dunham's classification (1962) with modifications by Embry & Klovan (1972). A table format is acceptable.

A2 : Give brief answers to the following questions. Choose the correct answer where there are multiple choices. Answer only five of these 8 questions (8-15). (3 points each, 15 points total).

- 8- Which of the following grain types in a sandstone offers the best clue to decipher the lithology of the parent rock (at the provenance site) from which the sandstone-forming particles originate?
a) Quartz particles b) Rock fragments c) Feldspars d) Clay minerals
- 9- List the different types of framework grains that constitute carbonate sediments.
- 10- What does herringbone cross-lamination indicate?
- 11- How do detrital grain contacts change with increasing burial pressure (increasing depth)?

12-Which of the following trace fossils (ichnofacies) indicates high energy, sandy shore deposits?

- a) *Cruziana* b) *Skolithos* c) *Zoophycus* d) *Trypanites*

13-What are the various ways in which sediments are transported in a fluvial (river) system?

14-Explain the stability / instability of calcitic shells (e.g., shells of pelagic organisms) with respect to increasing depth of the marine environment (from sea surface to deep abyssal plains).

15-Describe how sedimentary grain sorting of a rock (e.g., well sorted versus poorly sorted) influences reservoir qualities of rocks.

Part B: Questions on Stratigraphy and Stratigraphic principles. Answer six of the following nine questions (5 points each. Total points to answer: 5 X 6 = 30)

16-Define the term "Unconformity". State and describe the different types of unconformities.

17-What is the difference between chronostratigraphic and geochronologic units? Give one example of a chronostratigraphic unit and one of geochronologic unit.

18-State and define the different ranks of lithostratigraphic units.

19-What are the basic stratigraphic principles that Earth Scientists use in order to establish the relative ages of the various stratigraphic units of a given area?

20-What are index fossils and how are they useful for stratigraphic applications?

21-Explain how progradational parasequence set is different from retrogradational parasequence set (sketches with proper labeling are accepted). Also explain where they occur in a depositional sequence and what conditions, in terms of relative sea level fluctuations, are attributed for their formation.

22- What are the different possible ways in which conformable lithostratigraphic units may stack one above the other?

23-Which of the following sequences of Paleozoic periods is correct in order, from oldest to youngest?

- a. Devonian → Cambrian → Ordovician → Carboniferous → Silurian → Permian
- b. Cambrian → Ordovician → Silurian → Carboniferous → Devonian → Permian
- c. Cambrian → Ordovician → Silurian → Devonian → Carboniferous → Permian
- d. Cambrian → Ordovician → Devonian → Carboniferous → Silurian → Permian
- e. Devonian → Cambrian → Ordovician → Carboniferous → Permian → Silurian

24- Give short descriptions of the following four terms

- a- Accommodation space b- Seismic facies c- Paleosol d- Correlation