

National Exams: May 2016

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**. This is a **CLOSED Book exam**.
3. This exam paper consists of four pages (including this cover page). There are two parts: **Part 1** (Questions 1-12) conveys questions related to Sedimentology and Sedimentary Processes whereas **Part 2** (questions 13-20) conveys questions related to Stratigraphy and sedimentary basin analysis.
4. Part 1 consists of 12 questions. Answer **eight** questions of your choice. Each question weighs 10 points. Therefore, this Part 1 has total marks 80 (8 questions X 10 = 80 points)
5. Part 2 consists of 8 questions. Answer **five** questions of your choice. Each question weighs 10 points. Therefore, this Part 2 has total marks of 50 (5 questions X 10 = 50 points).
6. The **maximum attainable grade is 130/130** (80 for Part 1, and 50 for Part 2).
7. Most questions require an answer in essay format. Clarity and organization of the answers are important.
8. **Please note:** The first number of questions permitted to answer in each part (i.e., Part 1 & Part 2) will be marked as they appear in the answer book. Thus, don't answer more than what you were instructed to answer.

Part 1: to Sedimentology and Sedimentary Processes

Answer any eight of the following 12 questions. 10 points each (8 X 10 = 80 points total).

- 1- Rock-forming evaporite minerals are mainly marine precipitates. a) What are the requirements for their precipitation in a sedimentary marine basin? b) Explain the structural groups of anhydrite / gypsum rocks.
- 2- Paleocurrent analysis is very essential for interpreting the depositional processes of sandstones. State three sedimentary structures that provide paleocurrent trends. Sketch and explain three paleocurrent patterns and depositional processes they represent.
- 3- a) Define the term "sedimentary facies". b) Give an example of a facies succession by sketching a vertical stratigraphic log that grade from subtidal through intertidal to supratidal carbonate lithofacies units (i.e., shallowing-upward succession). Show the sedimentary structures expected in each lithofacies. Give a legend as a key for your sketch and/or give brief description beside each lithofacies in the sketch.
- 4- Sandstones commonly consist of framework grains, interstitial finer materials (or matrix) and cement. a) Of these three components (framework grains, matrix and cement), distinguish primary syn-sedimentary particles from diagenetically-added, post-sedimentary materials. b) What are the grains that commonly form framework particles of sandstones? c) Which one is most reliable in indicating the source (provenance) rock of the sandstones?
- 5- a) What is diagenesis? b) State the different diagenetic stages with at least one example of diagenetic process or products in each stage.
- 6- - a) Define the term delta. b) Sketch a deltaic depositional system; depict its subenvironments and state their characteristic sediments. c) Sketch & label a prograding (regressive) sequence of a deltaic system.
- 7- Explain how compaction affects grain contacts and porosity with increasing burial depth. Sketch(es) to support your explanation are welcome
- 8- The sequence of coal series, from low to high fixed carbon content, follows which trend? (choose the most appropriate one):
 - a) Anthracite → Bituminous → subbituminous → lignite → peat
 - b) Peat → Lignite → Subbituminous → Bituminous → Anthracite
 - c) Bituminous → subbituminous → Anthracite → peat → lignite
 - d) Peat → Anthracite → Lignite → subbituminous → Bituminous

- 9- Provide the classification scheme of carbonate rocks following Dunham's classification (1962) with modifications by Embry & Klovan (1972). A table format is acceptable.
- 10- a) What is (are) the criterion (criteria) of distinguishing arenite from wacke sandstones? b) State and define the properties of different types of arenites and wackes.
- 11- Which one of the following ichnofacies (trace fossils) is indicative for a high energy, sandy shore depositional environment?
a) *Cruziana* b) *Skolithos* c) *Zoophycus* d) *Trypanites*
- 12- Carbonate platforms are extensive, shallow marine sites dominated by carbonate deposition. a) Explain the different types of carbonate platforms. b) For each type of a platform, explain its energy distribution and how it affects the carbonate facies.

Part 2: Stratigraphy and sedimentary basin analysis.

Answer five of the following eight questions (10 points each. Total points: 5 X 10 = 50)

- 13- State and explain the principal categories of biozones.
- 14- Stratigraphic contacts can be either conformable or unconformable. a) Explain the differences between them? b) Describe the different types of (i) conformable contacts and (ii) unconformable contacts.
- 15- a) Explain the terms: chronostratigraphic unit and geochronologic unit. b) State the ranks of chronostratigraphic units and corresponding geochronologic units. A table format is acceptable.
- 16- The geologic time scale divides the Earth's age into smaller portions arranged in a sequential order (from Precambrian to Recent). List the geologic time periods of the Paleozoic, Mesozoic and Cenozoic eras in ascending (oldest to youngest) order.
- 17- A biostratigraphic unit may encompass ----- (choose the most appropriate answer from the list)
a) a portion of a lithostratigraphic member. b) one complete formation.
c) two or more entire members or formations. d) all of the above.
- 18- Explain the term "Depositional Sequence" and the different system tracts that may constitute a sequence. Relate the systems tracts to eustatic sea level changes.

19- Explain the different types of parasequences that can be generated by the interplay between rate of sediment supply (S) and rate of accommodation space generation (A). Consider the situations when $S > A$, $S = A$ and $S < A$.

20- From the list below, choose (circle) all types of sedimentary basins related to extensional tectonic regime?

- a) Rift basin b) Passive margin basin c) Foreland basin d) Aulacogen
e) Retro-arch basin f) Intracratonic basin g) Fore-arch basin