2901/105
PETROLEUM GEOLOGY AND EXPLORATION TECHNIQUES
June/July 2022
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN PETROLEUM GEOSCIENCE

MODULE I

PETROLEUM GEOLOGY AND EXPLORATION TECHNIQUES

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Mathematical tables/a non programmable scientific calculator (fx-82).
*This paper consists of **EIGHT** questions.*
*Answer question **ONE** and any other **FOUR** questions in the answer booklet provided.*
Maximum marks for each part of a question are indicated.
Candidates should answer the questions in English.

This paper consists of 4 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

Turn over

1. (a) Outline **three** differences between reflected and refracted seismic methods. (6 marks)

(b) Explain **three** reasons why seismic method is dominantly used in petroleum exploration compared to other geophysical methods. (6 marks)

(c) Table I gives descriptions of seismic data processing techniques A, B, C and D. Study and use it to answer the questions that follow.

Table I

Processing techniques	Description
A	Compensates measured amplitude for attenuation suffered by the wave.
B	All weak traces are set to zero.
C	Moves all the apparent reflectors to their correct position along the seismic profile.
D	Counters the source receiver separation (offset).

(i) Identify the processing techniques A, B, C and D. (4 marks)

(ii) Outline the effect of failure to undertake each of the processing technique in (i) on the seismic result. (4 marks)

2. (a) (i) With the aid of a labelled diagrams, illustrate a time-distance curve of a seismic wave that has travelled through three rock layers and refracted at two discontinuities.

(ii) Indicate the three rock layers and the refracting discontinuities on the curve (i). (7 marks)

(b) Describe **three**:

(i) Onshore seismic energy sources; (6 marks)

(ii) Offshore seismic energy sources. (6 marks)

(c) Define the term noise as used in seismic survey. (1 mark)

3. (a) (i) Explain the principle of magnetic method in petroleum exploration. (2 marks)

(ii) Explain **four** factors that influence the magnetic anomalies of a rock. (8 marks)

(b) (i) Distinguish between absolute and relative gravity measurements. (2 marks)

(ii) Explain **two** methods of measuring the absolute gravity of an area without using a gravimeter. (8 marks)

4. (a) Outline **five** differences between ground and airborne geophysical surveys. (10 marks)

(b) (i) With the aid of a labelled diagram, illustrate the current and voltage electrode arrangement in each of the following arrays:

(I) Wenner array;

(II) Schlumberger array.

(ii) In each arrays in (i), indicate the location of resistivity meter and appropriately name the electrodes. (10 marks)

5. (a) Figure 1 shows a geological log of a petroleum well. Study and use it to answer the questions that follow.

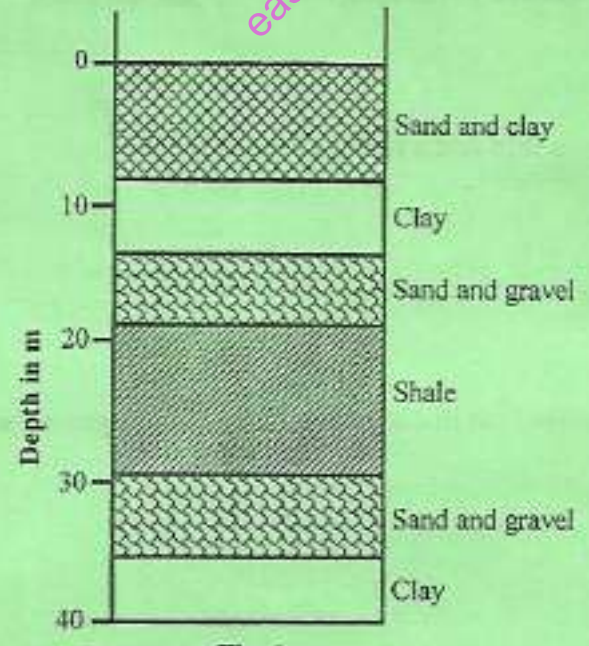

Fig. 1

Sketch a possible natural gamma log of the well, labelling the zones on the log corresponding to each rock unit. (8 marks)

(b) (i) Distinguish between primary and secondary porosity. (2 marks)

(ii) Name **one** known to bear each of the porosity type in (i) and explain how the porosity is formed in the rock. (10 marks)

6. (a) Table **II** gives the **three** stages of source rock maturation A, B and C and their descriptions. Study and use it to answer the questions that follow.

Table II

Stages of source rock maturation	**A**	**B**	**C**
Descriptions	Microbial activities are dominant	Borders metamorphism	Hydrogen concentration increases as oxygen diminishes

(i) Identify the stages A, B and C , giving **two** reasons for each answer. (9 marks)

(ii) List **two** products of each stage. (6 marks)

(b) Explain **five** factors influencing the type of hydrocarbon migration in a petroleum field. (5 marks)

7. Describe the formation of each of the following hydrocarbon traps:

(a) salt diaper; (5 marks)

(b) combined trap of a fold and a fault; (5 marks)

(c) statigraphic trap; (5 marks)

(d) pinch out trap. (5 marks)

8. Outline **five** activities carried out in each of the following stages of geological field mapping:

(a) desktop study; (5 marks)

(b) reconnaissance; (5 marks)

(c) data collection; (5 marks)

(d) reporting. (5 marks)

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