2901/203
ROCK, FLUIDS AND RESERVOIR
GEOPHYSICS
June/July 2022
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

# DIPLOMA IN PETROLEUM GEOSCIENCE

## MODULE II

ROCK, FLUIDS AND RESERVOIR GEOPHYSICS

**3 hours**

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## INSTRUCTIONS TO CANDIDATES

*You should have the following for this examination:*
*Answer booklet;*
*Mathematical tables/non-programmes scientific calculator.*
*This paper consists of **EIGHT** questions.*
*Answer question **ONE (COMPULSORY)** and any other **FOUR** questions in the answer booklet provided.*
*All questions carry equal marks.*
***Candidates should answer the questions in English.***

**This paper consists of 5 printed pages.**

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

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1. (a) Figure 1 shows igneous rock structures.

(i) Name the intrusive igneous bodies labelled A, B, C, D and E.
(ii) Explain the formation of igneous rocks.
(iii) Describe the following rock bodies:

I. extrusive rocks;
II. intrusive rocks. (17 marks)

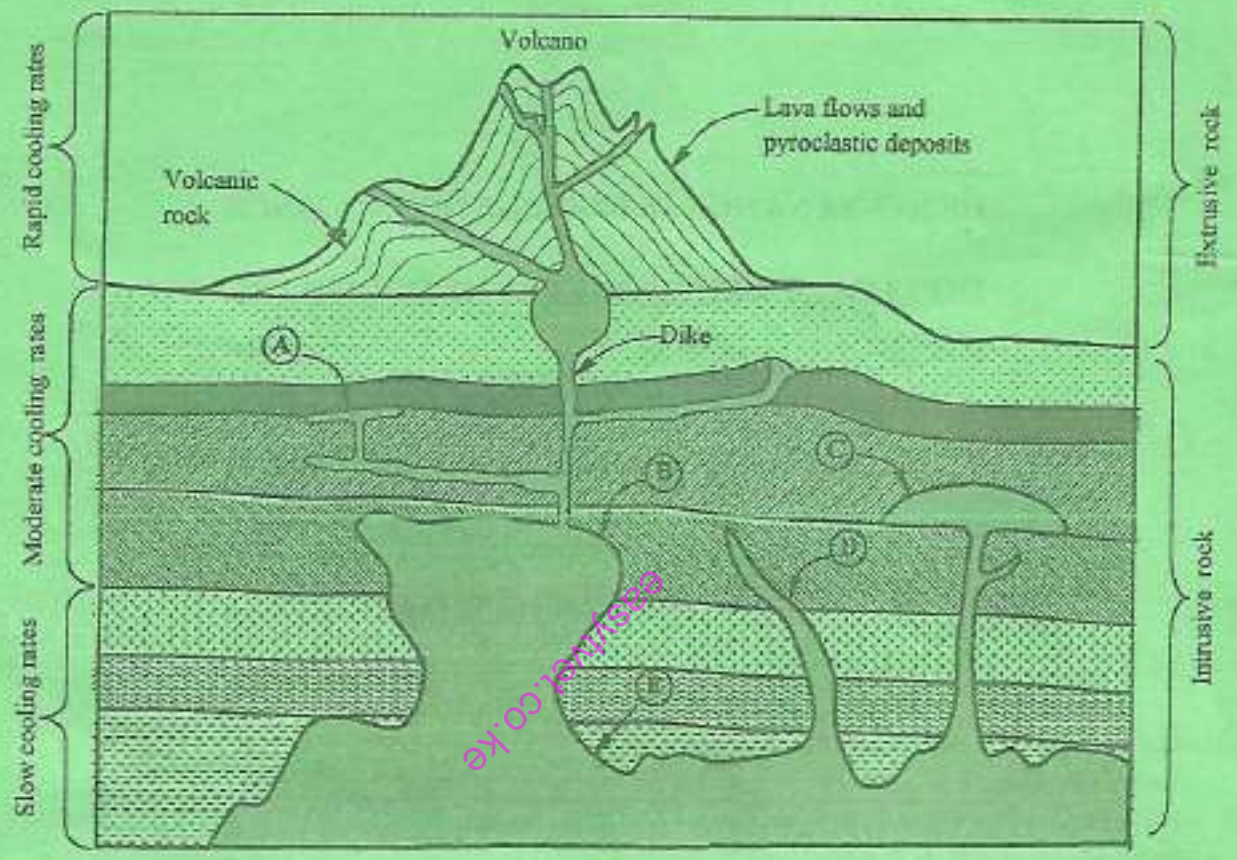


Fig. 1

(b) Describe granite rocks. (3 marks)

2. (a) (i) State the Gassmann equation for estimating fluid saturation effect on bulk modulus and define the symbols used.

(ii) State **four** assumptions considered in the derivation of Gassman equation. (8 marks)

(b) Describe the following hydrocarbon indicators:

(i) bright spots;
(ii) gas chimneys;
(iii) polarity reversal. (12 marks)

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3. (a) Describe seismic attenuation. (3 marks)

(b) Explain the following causes of loss of energy in propagating seismic waves:

(i) geometrical spreading;
(ii) an elastic attenuation;
(iii) elastic attenuation. (12 marks)

(c) (i) Define poroelasticity in a porous media.
(ii) Describe **two** types of poroelascticity. (5 marks)

4. (a) Figure 2 shows a variograpm model:

(i) describe a variogram;
(ii) explain the following features for the model:

I. the nugget effect;
II. the total sill;
III. the range. (11 marks)

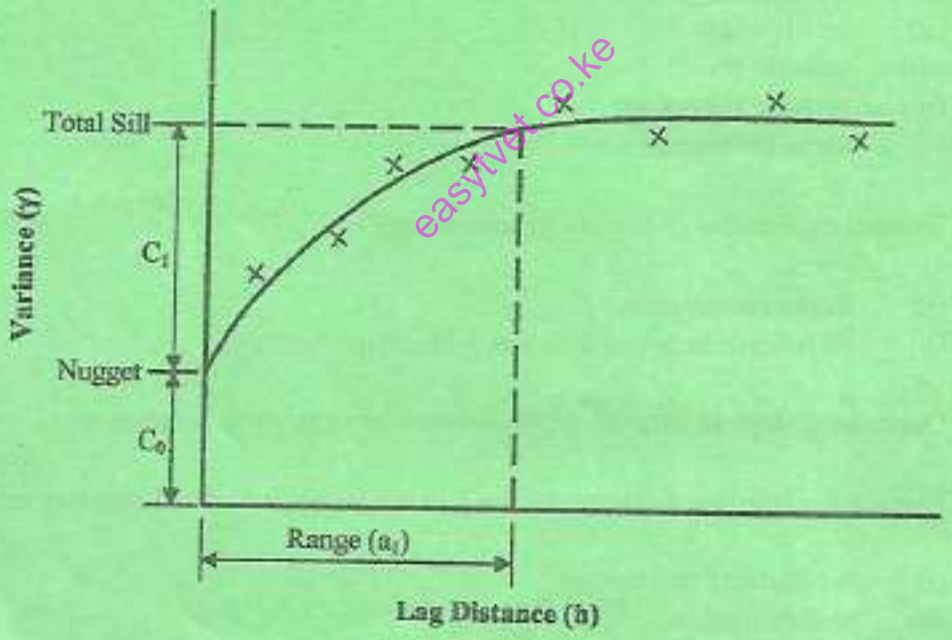


**Fig. 2: Variogram Model**

(b) Describe reservoir characterization with reference to reservoir geophysics. (6 marks)

(c) With reference to reservoir geophysics:

(i) define data quality control;
(ii) state **four** sources of data for reservoir characterization. (3 marks)

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5. (a) With reference to geospatial interspolation mapping method:

(i) describe Kriging method;
(ii) Outline the following methods of Kriging:

I. ordinary Kriging;
II. universal Kriging;
III. block Kriging;
IV. CoKriging.

(iii) Outline **three** limitations of Kriging method. (15 marks)

(b) Explain each of the following:

(i) spatial analysis;
(ii) spatial modelling. (5 marks)

6. (a) Define the following terms associated with seismology:

(i) seismograph;
(ii) seismology;
(iii) seismic wave;
(iv) seismic reflection;
(v) acoustic impedance. (5 marks)

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(b) Explain each of the following in seismology:

(i) depth conversion;
(ii) difference between 2-D and 3-D seismic survey. (9 marks)

(c) Outline the steps in time-to-depth conversion strategy in seismology. (6 marks)

7. (a) Explain the following stages involved in the formation of sedimentary rocks:

(i) weathering and erosion;
(ii) sedimentation;
(iii) lithification and diagenesis. (7 marks)

(b) Outline **six** characterise of sedimentary rocks. (6 marks)

(c) With the aid of sketches, describe the following types of structures in sedimentary rocks:

(i) graded bedding;
(ii) ripple marks. (7 marks)

8. (a) Describe each if the following with reference to metamorphic rocks:

(i) metamorphic rock;
(ii) the agents which bring about metamorphism in rocks. (10 marks)

(b) Explain each of the following types of metamorphism:

(i) cataclastic;
(ii) dynamic;
(iii) contact. (8 marks)

(c) State **four** basic metamorphic rock structures. (2 marks)

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