2901/204
PETROLEUM GEOCHEMISTRY
Oct./Nov. 2021
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN PETROLEUM GEOSCIENCE

MODULE II

PETROLEUM GEOCHEMISTRY

3 hours

INSTRUCTIONS TO CANDIDATES

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

This paper consists of 6 printed pages.

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

1. (a) Table I shows quantities of Total Organic Carbon (TOC) in three rock samples X, Y and Z. Use if to answer the questions that follows.

Table I

Rock sample	TOC quantities (wt%
X	0.03
Y	1.2
Z	0.2

(i) Identify each of the rock sample as either lime stone, shale or sandstone. (3 marks)

(ii) Stae **two** reasons for each of the response in (i). (6 marks)

(iii) By citing reasons for each response, rank the three rock samples, from the highest to the lowest, based on the potential of hydrocarbon generation. (4 marks)

(b) With the aid of a labelled diagram, illustrate the plotting of the four kerogen types on the Van Krevelen diagram. (7 marks)

2. (a) Describe each of the following driving forces in petroleum secondary migration:

(i) Buoyancy; (3 marks)

(ii) capillary pressure. (6 marks)

(b) List the **five** chemical elements of oil in order of decreasing concentration. (5 marks)

(c) (i) Name the following hydrocarbons:

(I) H_3C-CH_3 (1 mark)

(II)  (1 mark)

(ii) Give the conventional and the skeletal formula for each of the following hydrocarbons:

(I) 2, 3 - dimethylbutane; (2 marks)

(II) 2 - methylhexane. (2 marks)

3. (a) Table II shows the volumes of three reservoirs rock samples X, Y and Z, before and after pyrolysis. Use it to answer the questions that follow.

Table II

Reservoir rock samples	X	Y	Z
Volume before pyrolysis (cm^3)	20	30	40
Volume after pyrolysis (cm^3)	15	20	25

(i) Determine the porosity of the reservoir rock samples X, Y and Z. (9 marks)

(ii) Given that the porosity determined in (i) is primary porosity. Identify the likely reservoir rocks represented by each of the samples X, Y and , giving explanations the responses. (9 marks)

(b) Name **two** types of petroleum traps. (2 marks)

4. (a) Explain **two** causes of API gravity variation of oil in reservoirs. (6 marks)

(b) Table III shows parameters of oil samples collected from wells A, B and C drilled through the same reservoir. Use it to answer the questions that follow.

Table III

Parameters \ Wells	A	B	C
Producing depth (ft)	4,350	5,170	5,850
Percentage asphaltenes	1.3	3.3	8
Nickle (PPM)	41	106	259

(i) Correlate the properties of the oil samples from the **three** wells. (9 marks)

(ii) Explain a possible cause of any variation in the oil samples parameters. (5 marks)

5. (a) (i) Explain the term 'surface geochemical prospecting'. (4 marks)

(ii) Explain **six** types of chemical analysis done during surface geochemical prospecting. (12 marks)

(b) Explain **two** causes of failures of surface geochemical prospecting to locate a hydrocarbon deposit. (4 marks)

Turn over

6. (a) Figure 1 shows a set-up sketch of a petroleum geochemical method. Study and use it to answer the questions that follow.

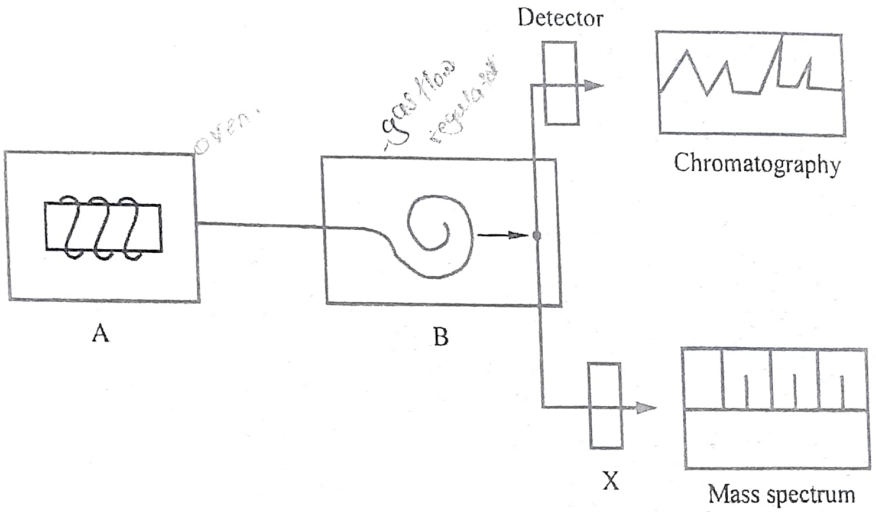

Fig. 1

(i) Identify the geochemical method. (1 mark)
(ii) Identify the parts labelled A and B. (2 marks)
(iii) State the functions of each of the parts identified in a(ii). (2 marks)
(iv) Explain the importance of the two properties of a carrier gas. (4 marks)
(v) Name **two** examples of carrier gases. (2 marks)
(vi) Name the equipment appropriate for each of the part labelled **detector** and **X**. (2 marks)
(vii) State the purpose of the analytical data obtained at each of the parts labelled chromatogram and the mass spectrum. (2 marks)

(b) Explain the vitrinite reflectance method used in petroleum exploration. (5 marks)

7. (a) Petroleum geoscience students identified four sources rock samples A, B, C and D with pollen material bearing light yellow, brown, dark brown and black colours respectively. Give the value on the thermal Alteration Index (TAI) scale of each sample.

(4 marks)

(b) Figure 2 shows a graph of depth against vitrinite reflectance for a primary and recycled vitrinite samples. Study and use it to answer the questions that follow:

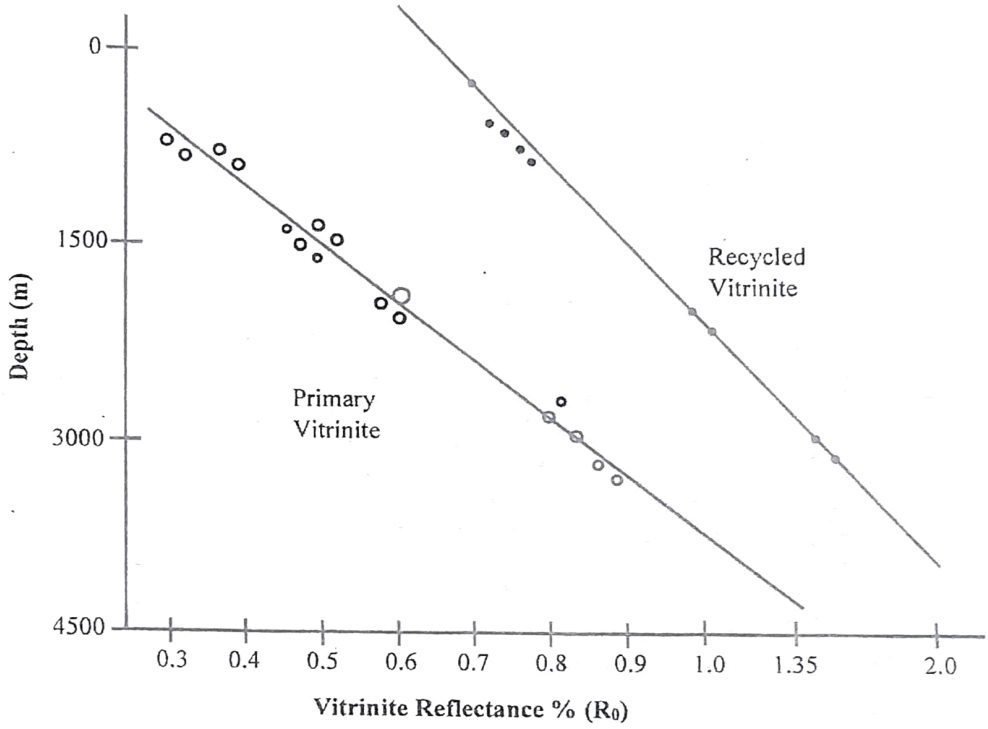

Fig. 2

(i) Explain **three** differences in the distribution of the two vitrinite samples.

(9 marks)

(ii) Outline the appropriate sample out of the two samples for determining the maturity source rock, giving reasons for the response . (5 marks)

(c) List **two** types of secondary porosity in reservoir rocks. (2 marks)

8. (a) State **two** hydrocarbon pathways. (2 marks)

(b) Explain **four** occurrence of hydrocarbon seepage. (12 marks)

(c) Figure 3 shows a petroleum reservoir experiencing a macroseep. Study and use it to answer the question that follows.

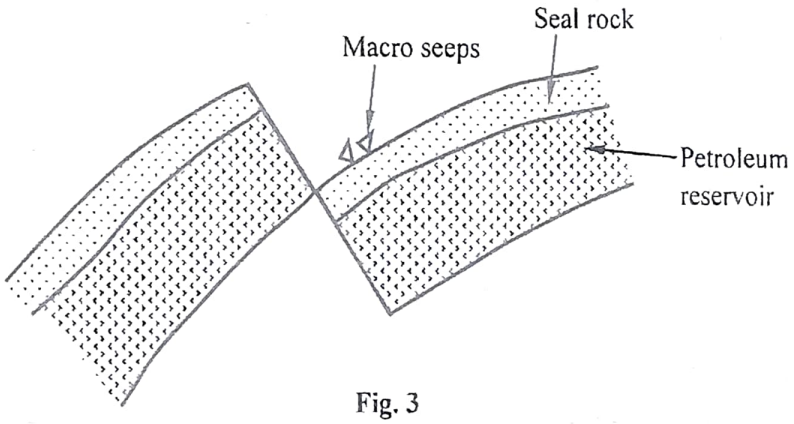

Fig. 3

Explain the process causing the seepage. (6 marks)

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