

**FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
PETROLEUM ENGINEERING DEPARTMENT**

2019/2020 RAIN SEMESTER EXAMINATION

PET306: PETROLEUM PRODUCTION I

TIME: 3HRS

Instructions: Answer 5 questions.

1. (a) A gas reservoir has the following gas compositions.

Component	C ₁	C ₂	C ₃	IC ₄	NC ₄	NC ₅	C ₆	C ₇₊	N ₂	CO ₂
Mole %	70	7	4	3.85	3	2	0.15	1	3	6

Determine; (i) The Pseudocritical Temperature and Pressure (ii) The Z-factor at 2500 psig and 250°F (iii) The specific gravity of the gas (iv) The density and specific volume assuming an ideal gas behaviour (v) The density of the gas phase at 2000 psig and 200°F, assuming a real gas behavior (vi) Compare the result of the density value gotten assuming a real gas behavior with that gotten for an ideal gas behavior and calculate the absolute percentage error.

(b) A gas well is producing at a reservoir pressure of 3000 psi and a temperature of 200°F. Calculate; (i) The apparent molecular weight (ii) The gas density and specific volume at reservoir conditions [Specific gravity of the produced gas is 0.64].

2. (a) With the aid of a well labelled diagram, describe a multicomponent system, thus defining; (i) Critical point (ii) Cricondentherm (iii) Cricondenbar (iv) Retrograde condensation (v) Dry gas reservoir (vi) Wet gas reservoir (vii) Gas cap (viii) Bubble point curve (ix) Dew point curve (x) Gas condensate (xi) Two phase region (xii) Single phase region (xiii) Path of production and equally give the theoretical definitions as well

(b) (i) Explain the following (1) Bubble point pressure (2) Gas solubility (3) Crude oil viscosity (4) Specific gravity (5) Z -factor (6) Crude oil density .Use diagrams where applicable.

(ii) Separator Test where conducted on a crude oil sample obtained from Eziobodo Field. Results of the tests in terms of the separator gas/oil ratio and the specific gravity of the separated gas are given in the table below: Determine the specific gravity of separated Gas

Separator	Press. psig	Temp °F	GOR	Specific gravity
High high pressure	850	200	723	0.65
High pressure	700	180	700	0.68
Intermediate pressure 1	350	150	450	0.74
Intermediate pressure 2	200	130	400	0.79
Low pressure	90	80	215	0.85
Stock tank	0	70	80	1.20

3 (a) (i) State the ranges of GOR of oil production for associated gas, non-associated gas and condensate (ii) Use diagram to represent 3ai above (iii) What is the implication of FVF (iv) Express Two-phase FVF with an equation (v) State the two effects reflected by FVF (vi) State two common causes of formation damage (vii) With a diagram, explain the classifications of oil and gas.

(b) (i) Calculate oil production from a reservoir whose permeability is 30md, reservoir thickness of 20ft and pressure at 2800psi if the wellbore flowing pressure is 2401psi and well bore radius is 0.5ft (Oil Viscosity = 0.8cp; FVF = 1.306; re = 1000ft). (ii) Give the productivity index of the reservoir at the height of 20ft

4 (a) Explain the following terms: (i) Differentiate between Pour Point and Bubble Point (ii) FVF (iii) Two-phase FVF (iv) Productivity Index (v) Throughput (vi) Shrinkage Factor (vii) Solution GOR (viii) Boiling Point (ix) Drawdown

(b) (i) Calculate oil production from a reservoir whose permeability is 40 Md, reservoir thickness, 30ft and pressure, 3000 psi if the wellbore flowing pressure is 2540 psi and well bore radius, 0.5ft. (Oil Viscosity = 0.7cp; FVF = 1.406; re = 1000 ft).

(ii) Give the productivity index of the reservoir at the height of 20 ft.

5. (a) List and briefly explain the three classes of a single-zone completion method.
- (b) A well set for production in the Addax field, has the following tubing characteristics: ($2\frac{7}{8}$ " OD, 9.80 lb/ft, N80, Depth = 12,000ft). (i) determine the burst pressure in psi, from the chart and compute the S.F, what is the technical implication of your result? (ii) differentiate between completion fluid and work over fluid.
- (c) Write short note on the following Terms: (i) Master Valve (ii) Wing Valve (iii) Fracturing and (iv) Inhibitor.
6. (a) In a tabular form, state two major functions of the following Term: (i) Packer (ii) Liner (iii) Tubing String.
- (b) A Well in Addax oil Field is to be placed on intermittent flow, on the basis of opening pressure at 60°F. Given the following Data below: Available pressure = 700 psig; Fluid production = 100 bbl/d; Productivity index = 0.3 bbl/d/psi; Tubing size = 2 inch; gradient = 0.5 psi/ft; Bottom valve to be set at = 4000 ft.; Interm. Unloading gradient = 0.04psi/ft; Gravity (air =1) = 0.06. Calculate the valve spacing. Note, (that 'Well unloaded into pit, Well Full of water, Spring Tension = 100psi, AV/Ab = 0.11, Valve Opening Pressure = 650, 600, 550, 500 and 450).
7. (a) Assume that an oil well in Niger-Delta is flowing in a steady-state production mode, in the reservoir described with the attributes below; has a drainage area equal to 640 acres ($r_e = 2980$ ft); with an outer boundary constant pressure of 5652 psi, calculate the steady state production rate if the flowing bottomhole pressure is equal to 4265 psi. Use a skin effect equal to +8. Given the following data: $k_H = 8.2$ md; $h = 54$ ft; $p_i = 5652$ psi; $p_b = 1323$ psi; $c_o = 1.4 \times 10^{-5}$ psi⁻¹; $c_w = 3 \times 10^{-6}$ psi⁻¹ ; $c_f = 2.8 \times 10^{-6}$ psi⁻¹; $c_t = 1.29 \times 10^{-5}$ psi⁻¹; $\mu = 1.65$ cp; $B = 1.1$ res bbl/STB; $R_s = 150$ SCF/STB; $\phi = 0.19$; $S_w = 0.34$; $API^\circ = 28$; $r_w = 0.328$ ft
Describe two mechanisms to increase the flow rate by 60%. Show Calculations.
- (b) Differentiate between under-saturated and saturated oil.
- (c) Explain perforation, highlighting it's relevance in the oil and gas industry.
- (d) Describe two main methods used in perforation.
8. (a) Using the well and variables in 7a.) above, develop a production rate profile for 12 months; assuming that no boundary effects emerge and that it is an infinite acting well. Do this in an increment of 2 months and use a flowing bottomhole pressure of 4565 psi. Show full working and substitute k_H for k where necessary in the relevant equation.
- (b) Explain the term "Multiple Completions"? Also, describe how multiple completions can be achieved in practice?
- (c) How does a perforation gun work?
- (d) Mention five (5) key advantages of cased and perforated completions over open hole completion.
- (e) Define an "Under-saturated oil".