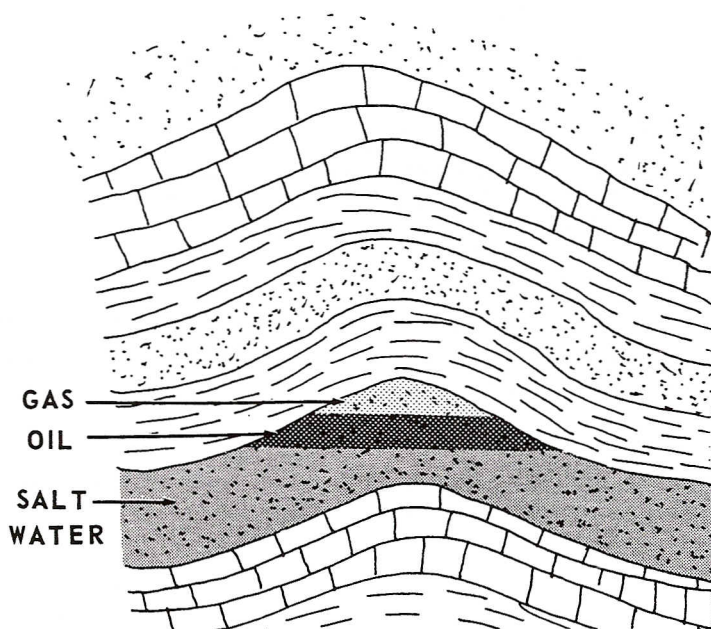


UNIT 1

THE STRUCTURE OF A PRODUCING WELL

Exhibits 1 and 2 are placed in the center of the book so that they may be removed easily for reference. Please remove them now so that you will have them available when needed.

1. Oil is found trapped in underground formations, or reservoirs.

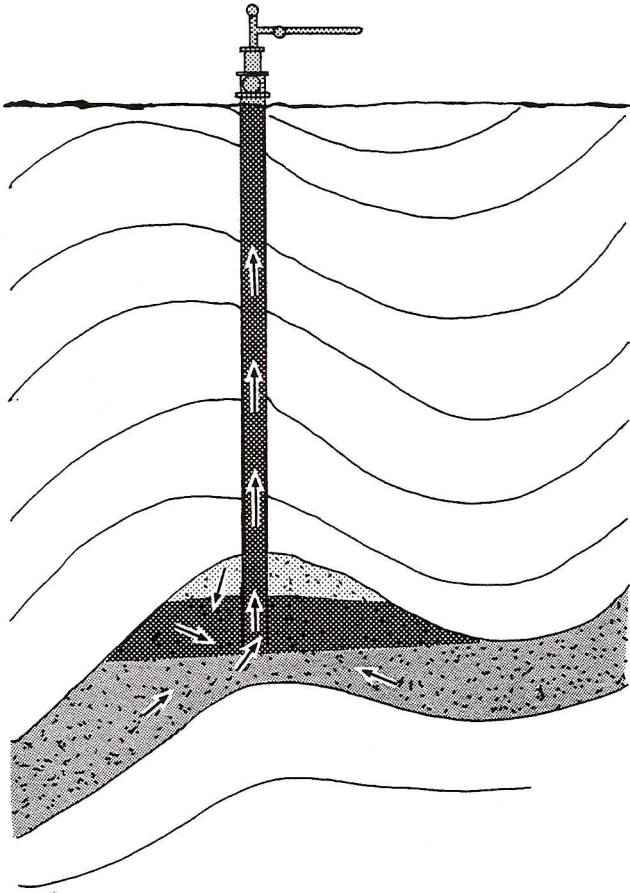


Along with the oil, the formation rock may also have trapped salt _____ and hydrocarbon _____.

2. The fluid produced from a well may include _____, salt _____, and _____.
3. The pressure of the fluid trapped in the reservoir depends on the way the reservoir was formed, on its depth, and on the rock formations around and above it.

In different reservoirs, the fluids are under (the same pressure/different pressures).

4. A well-bore opens the reservoir to a low-pressure area at the surface of the earth.



In many wells, the fluids _____ continuously to the surface when the well is opened.

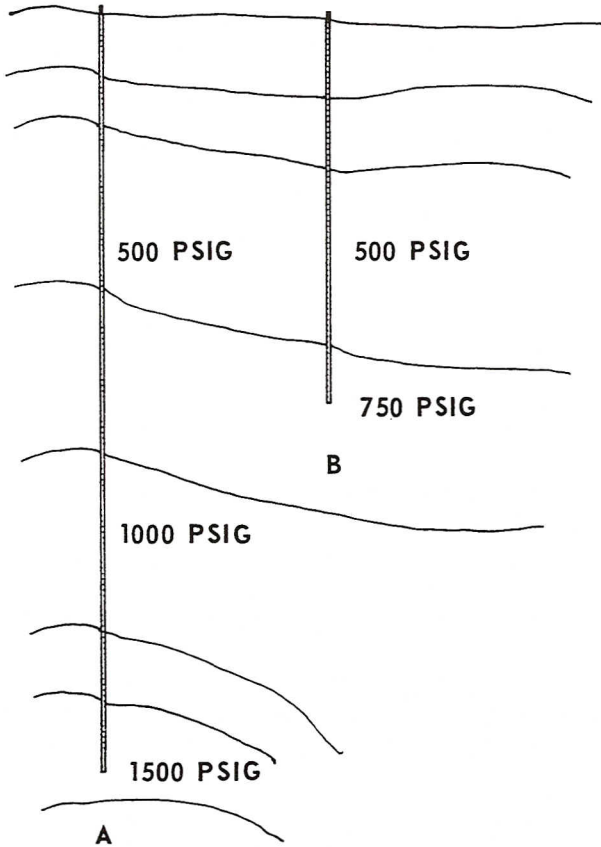
5. A well that is produced solely from the pressure of the reservoir fluid is called a _____ well.
6. When pumps or other methods of artificial lift are needed to bring the fluid to the surface, the well is not a _____ well.
7. The pressure drop across a flowing fluid determines the rate of flow.

A well may produce a profitable volume of fluid by natural flow if the pressure drop from the underground _____ to the surface flow lines is large enough.

8. A fluid flowing upward is under hydrostatic pressure from its own weight.

Hydrostatic pressure tends to (cause/prevent) the upward flow of fluids.

9. This drawing shows the hydrostatic pressures in two well-bores.



With the same density of fluid filling each well-bore, hydrostatic pressure is greater at the bottom of well-bore (A/B).

10. At the same depth in each well, hydrostatic pressures are (the same/different), when the density of the fluid is the same.
11. Hydrostatic pressure depends only on the _____ and on the _____ of the fluids in the well-bore.
12. The pressure at the bottom of a flowing well is called *flowing bottom-hole pressure*, or flowing BHP.

For the well to produce by natural flow, flowing BHP must be (more/less) than hydrostatic BHP.

13. If all the pressure at the bottom of a well-bore is hydrostatic BHP, the well (will/will not) flow.

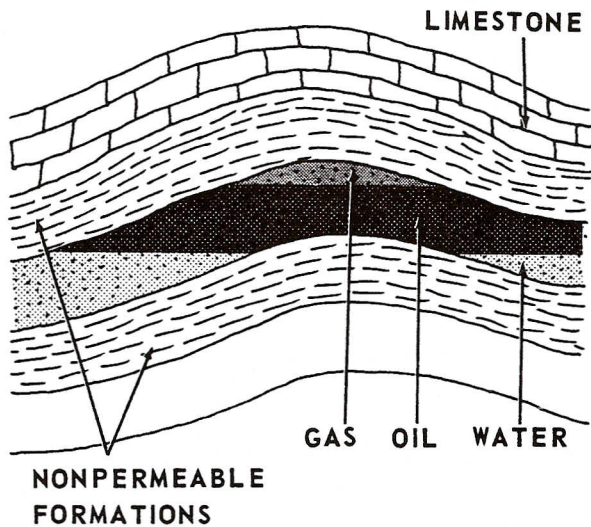
14. Suppose flowing BHP is 5000 PSIG and the hydrostatic BHP is calculated at 2000 PSIG.

This well probably (produces/does not produce) by natural flow.

15. The difference between flowing BHP and hydrostatic BHP is supplied by the pressure in the _____.

THE OIL RESERVOIR

16. An oil or gas reservoir is a porous rock formation.



The fluids in the producing formation are trapped between two nonpermeable _____.

17. In the reservoir the fluids may separate out according to their different densities, with the _____ rising above the oil and the _____ settling below the oil.

18. The oil, gas, and water trapped in these reservoirs have been compressed and heated over millions of years.

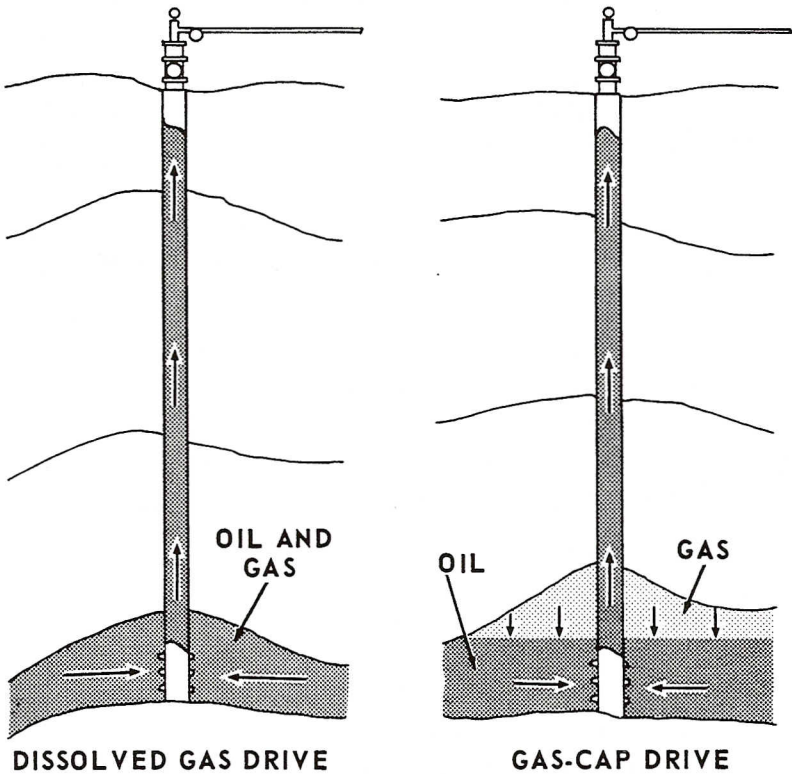
Geological compression and heat have stored _____ in the reservoir fluids.

19. At very high pressures, gas is *held in solution*, or dissolved in the oil.

In some reservoirs, very high pressures hold most of the _____ in solution with the oil.

Gas Drive Reservoirs

20. This drawing shows the two kinds of gas drive reservoirs.



Production from gas dissolved in the oil is called a (gas-cap/dissolved gas) drive.

21. Separated gas above the oil is called a _____-_____ drive.

22. In a dissolved gas drive, the reservoir gas is:

_____ held in solution in the oil.
_____ separated out of the oil.

23. Gas that is held in solution is compressed into a liquid state.

The reservoir gas is actually in a liquid form in a (gas-cap/dissolved gas) reservoir.

24. The pressures and temperatures at which gas bubbles form in a liquid is the *bubble point* of the fluid.

Without changing the pressure, you can form gas bubbles in a liquid by adding enough _____.

25. You can also form gas bubbles in a liquid by decreasing the pressure.

When a liquid evaporates at the suction of a pump, this is usually because (the liquid has been heated/the pump has lost suction pressure).

26. Bubbles form in a liquid when temperatures (increase/decrease) enough or when pressures (increase/decrease) enough.

27. The specific temperatures and pressures at which gas bubbles form in a liquid is called the _____ point of the fluid.

28. The higher the temperature of the fluid, the (more/less) pressure it takes to hold the molecules in liquid form.

29. So when a liquid is very hot, the *bubble point pressure* of the liquid is also very high.

When fluid pressures drop below this bubble point pressure, _____ will begin to form in the liquid.

30. The bubble point of a fluid also depends on the density of the fluid.

Different fluid mixtures have (the same/a different) set of bubble point pressures and temperatures.

31. Samples of reservoir fluids are tested to find their bubble points.

The fluids in different formations have (the same/different) bubble points.

32. When reservoir pressure is above the bubble point for the fluid at the existing reservoir temperature, gas is held in solution.

When reservoir pressure drops below the bubble point, gas begins to _____ out of the oil.

33. Dissolved gas begins to form bubbles in the oil when fluid pressures (increase/decrease) enough.

34. When gas is dissolved in the oil, the oil has a lower *viscosity*, or thickness.

Oil flows more easily when it is (more viscous/less viscous).

35. So, oil flows more easily when it (contains/does not contain) dissolved gas.

36. As oil is removed from the reservoir, the pressure on the gas (increases/decreases).

37. In a dissolved gas drive, the gas will begin to form _____ in the oil as the reservoir is produced.

38. In a gas-cap drive, the gas cap occupies (more/less) space in the reservoir as oil is produced.

39. As the gas expands against the oil, it helps to push the _____ through the reservoir and into the well-bore.

40. The pressure of the gas expanding against the oil in the reservoir helps to maintain _____.

41. If the gas is taken out of the reservoir early in the production period of the well, reservoir pressure decreases rapidly.

Oil recovery is higher when the reservoir gas is produced as (rapidly/slowly) as possible.

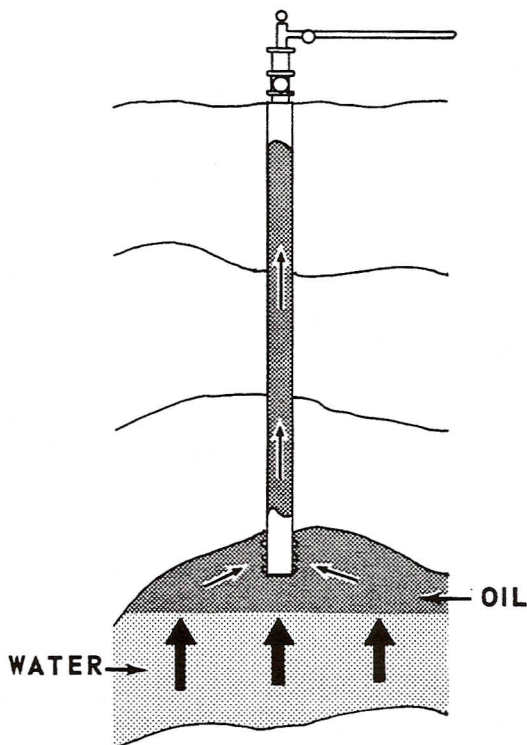
42. The GOR is the number of cubic feet of _____ produced with every barrel of _____.

43. With a rising GOR, the reservoir gas is being produced (faster/slower) than the oil.
44. This loss of reservoir gas (increases/decreases) reservoir pressure and flow.
45. For maximum recovery from a gas drive reservoir, the GOR of the produced fluid is held _____ as long as possible.
46. As gas expands, its pressure decreases.

In gas drive reservoirs, reservoir pressure gradually (rises/falls) as production continues.

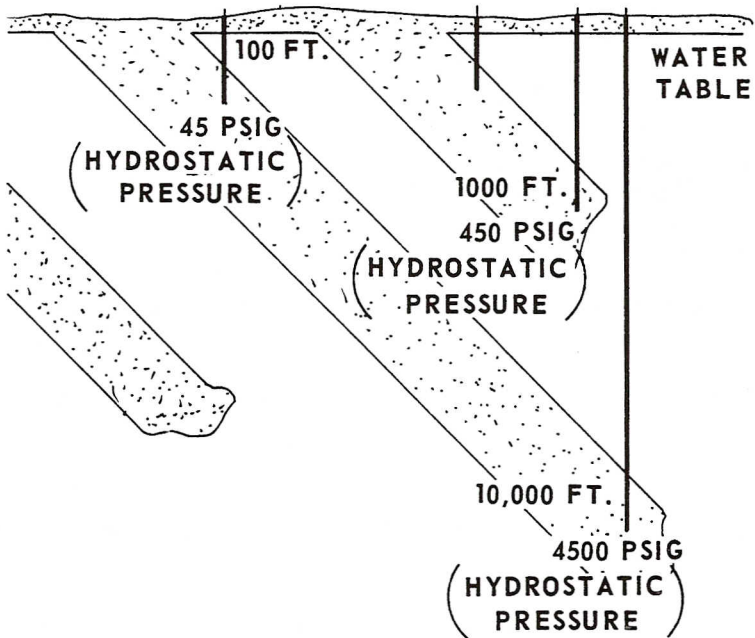
Water Drive Reservoirs

47. In some reservoirs, the water pressure is great enough to cause flow.



Water drive reservoirs are produced from the pressure of the water (above/under) the oil.

48. The pressure of the water forces the _____ up through the reservoir and well-bore.
49. This is called an active _____ drive reservoir.
50. The water in some reservoirs is connected by a continuous path to the *ground water table* under the surface of the earth.

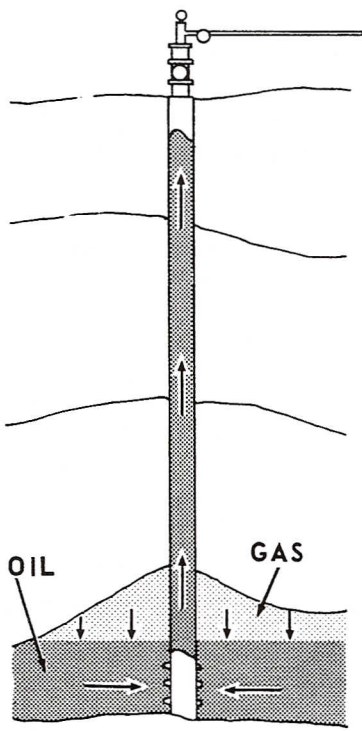


In these reservoirs, the ground water connection exerts hydrostatic _____ on the reservoir water.

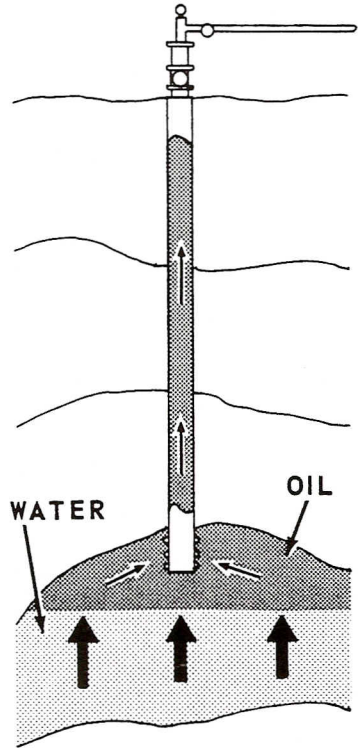
51. The deeper the reservoir, the (more/less) hydrostatic pressure that is exerted by such a ground water connection.
52. In these reservoirs, the hydrostatic pressure from the ground water connection is a continuing source of reservoir pressure.

With the same production, reservoir pressure is maintained longer when there (is/is not) a ground water connection to the reservoir.

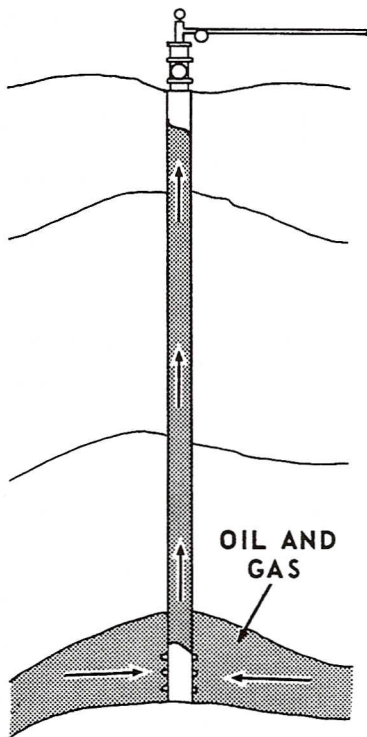
53. Identify these three types of reservoir drives.



A. _____



B. _____



C. _____

54. Gas is held in solution in oil when the pressures are (above/below) the bubble point.
55. For a dissolved gas drive to occur, reservoir pressure must be above the _____ of the reservoir fluid.
56. When the pressure on a liquid drops below the bubble point for the liquid at that temperature, _____ breaks out of the liquid.
57. For efficient recovery from a gas drive reservoir, gas is produced (rapidly/slowly) and the GOR is (allowed to rise/held steady) while the well is flowing.
58. In some reservoirs, the water is under hydrostatic pressure from a ground water connection.

These reservoirs may continue to produce from an active _____ drive after most of the gas has left the formation.

WELL-BORE STRUCTURE

The Flowing Well

For frame numbers 59 through 73 look at Exhibit 1, which shows a completed well-bore for a flowing well.

59. Exhibit 1 shows a completed well-bore for a flowing well.

Find the casing strings.

During drilling, the well-bore is lined with two or more strings of _____.

60. As drilling continues, casing strings with (larger/smaller) ODs are set in the borehole.
61. The well-bore in the exhibit is completed with (one/two/three) casing strings.
62. The first casing string set during drilling protects the borehole from loose surface formations and keeps drilling fluids out of fresh water supplies.

This casing string is called the _____ casing.