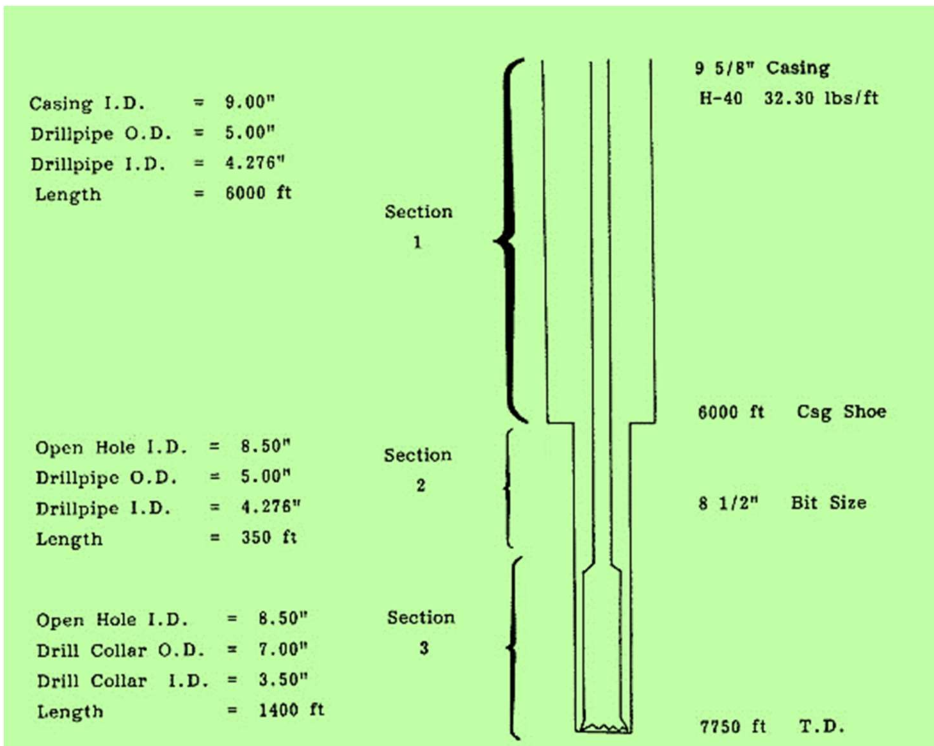
Salahaddin University/Erbil
College of Science
Earth & Petroleum Department
Drilling – Q bank

Exercise-1

Determine the pump output (POP) in bbls/stroke, at 97% efficiency for a triplex pump with a stroke length of 12 inches and a liner diameter of 6 inches.

Exercise-2

A pump with output of 0.10181 bbls/stroke is used pumping at a rate of 100 SPM. Using the information used in drawing the well profile, calculate the ***lag and down time***.



Exercise-3

A pump with output of 0.10183 bbls/stroke is used pumping at a rate of 100 SPM. Draw a well profile and calculate the ***lag and down time*** using volume method.

The following data are given

- *Casing /open hole*
- Surface casing OD 13 $_{3/8}$(ID 9”) @ 4500 ft
- Intermediate casing OD 9 $_{5/8}$ “ (ID 8.75”) @ 6000 ft
- 8.5” open hole TD @ 7750 ft

Drill string:

- OD 5” **DP** (ID 4.276”) = 6450 ft
- OD?? **HWDP** (ID 3”) = 800 ft
- OD 6.5” **DC** (ID 3.5”)=500 ft

Exercise-4

From the diagram, determine the following:

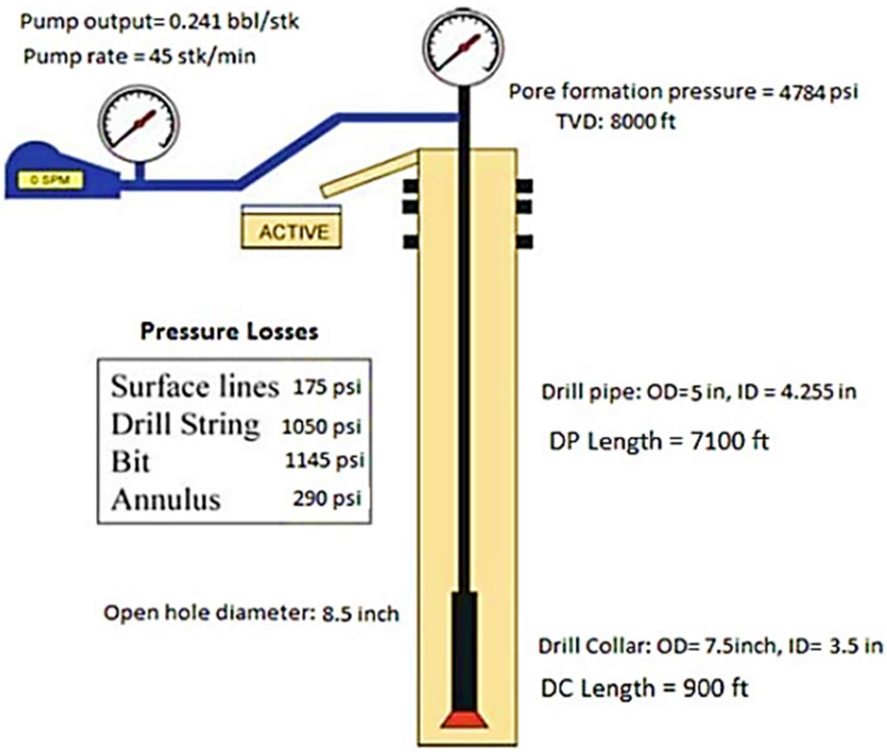
a. Pump pressure

b. Pressure reading at the bottom of the bit

c. Equivalent Mud Weight (EMW)

d. Equivalent Circulating Density (ECD)

e. Time taken to circulate mud from surface to surface.



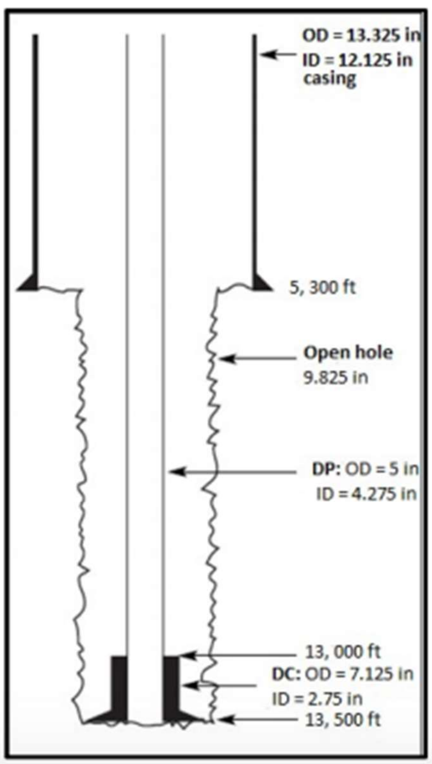
Exercise-5

1- For the well shown below, find

1. a-the capacity of the drillpipe in bbl/ft.
   b-the capacity if the drill collar in bbl/ft.
2. the capacity of the annulus in bbl/ft.
3. the volume of mud in the drillstring in bbl.
4. the volume of mud in the annulus in bbl.
5. the total volume in the drillstring and the annulus in bbl.

If one pump is operating at 100 strokes/min with a pump outcome of 0.2 bbl/stroke, determine:

6. the pump output in bbl/min
7. the circulating time from Bit to Surface in min.
8. the circulating time from Surface to Bit in min.
9. the total hole circulation time in min.



Exercises 6

1-Well TVD = 8000 ft. Calculate Mud Hydrostatic pressure for each of the following Mud Weights.

11 ppg 12 ppg 14 ppg

2-What Mud Weight is required to give a pressure gradient of 0.59 psi/ft?

3-Mud Hydrostatic = 3900 psi at the bottom of an 8000 ft. TVD well. What would be the pressure gradient for the mud?

4-For question above what is the equivalent Mud Weight (ppg)?

5-Pressure Gradient = 0.57 psi/ft. What is hydrostatic at 12000 ft. TVD?

6-Find ECD if pressure loss in annulus is 210 psi, mud weight is10.2 ppg, and TVD is 10500 ft.

The formula are:

- North = SUM ((MD2 - MD1) * Sin WD2 * Cos HAZ2)
- East = SUM ((MD2 - MD1) * Sin WD2 * Sin HAZ2)
- **TVD** = SUM ((MD2 - MD1) * Cos WD2)

Exercise-7

Q1) Drilling mud consisting of water and bentonite was used in the drilling process and to control the well. In addition to it, (1000 sack of a barite) and become its volume (800 bbl.) .

The well is cased to a depth of 3000 ft (7 inch) pressure 3000 psi is opposite of the drilling pipes (ID = 3.5 and OD= 4.5 inch) and fraction factor is 0.18.

the collar pipes (ID=2.5 and OD=6) opposite open hole (7.5 inch) using the following data :-

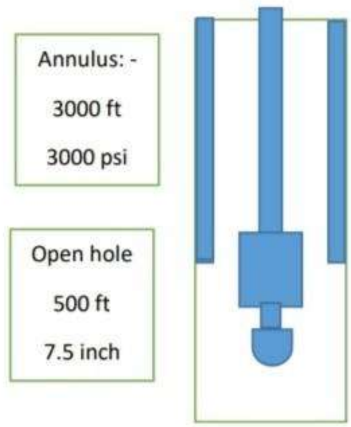
Pump flow rate = 200 ft3/min

Mud viscosity = 2 cp

Material pipe from IRON cast

Calculate: -

1. Pressure gradient at any section
2. Initial Mud density



Exercise-8/ Calculate the mud volume required to fill the hole per stand when pulled dry if you know
Drill pipe capacity = 0.01776 bbls/ft
Drill pipe metal displacement = 0.0083 bbls/ft
Average stand length = 93 ft

Exercise-9/ Calculate the mud volume required to fill the hole per stand when pulled wet use the above information

Exercise-10/ Two stand of drill collar are pulled from the well (dry), how many barrels of drilling mud should be pumped into the well (*One stand length = 90 ft)*
Drill collar capacity = 0.0073 bbls/ft *Drill pipe metal displacement = 0.0370 bbls/ft*

Exercise-11/ On pulling out of the well from 10000 feet, the first 930 feet drill pipe is pulled wet without filling the hole, what is the drop in bottom hole pressure? If you know hole capacity= 0.074 bbl/ft, drill pipe capacity= 0.0178 bbl/ft, drill pipe displacement= 0.0077 bbl/ft and mud weight 11.4 ppg**.**

Exercise-12/ What will happen to U-tube? If a heavy slug of 10 bbl is pumped into the drill string with below-given data and the well is shut by closing BOP and FOSV in the drill string.
Well TVD 10000 ft. *Slug volume: 10 bbl.*
Mud weight: 10 ppg. *Drill pipe Metal Disp 0.008 bbl/ft*
Slug density: 16.8 ppg. *Drill pipe Capacity 0.0176 bbl/ft*

A. A back pressure of 200 psi will visible on the drill string gauge.
B. A back pressure of 150 psi will be visible on the annulus gauge.
C. A back pressure of 200 psi will be visible on the annulus gauge.
D. A back pressure of 150 psi will visible on the drill string gauge.
E. The Well is under balance due to a heavy slug in the drill string.

Exercise-13/ A vertical well has been drilled to a depth of 7480 feet, how many complete stands can be pulled dry before the well flows? **Assume 1 stand equal 93ft**

Exercise-14

: Determine the hydrostatic pressure decrease when pulling pipe out of the hole (dry):
Number of stands pulled = 10
Pipe displacement = 0.0055 bbl/ft
Average length per stand = 91 ft
Casing capacity = 0.0873 bbl/ft
Mud weight = 12.0 ppg

Total depth = 10,800 ft Hole size = 8.50 in Casing OD = 9.625 in Casing ID = 8.835 in Casing setting depth = 9000 ft Drill collars = 400 ft long, 6.75 in OD x 3.5 in ID Drill pipe = 5.0 in OD x 4.276 in ID Mud weight = 13.2 lb/gal Pump: Triplex w/6.5 in diameter x 12.0 in stroke liners, volumetric efficiency = 95%

a) Calculate the displacement in bbl/ft for the drill collars.

b) Calculate the volume of mud required to fill the hole if 5 stands (triples) of drillpipe are pulled before filling the hole using the displacement equal to 0.0075 bbl/ft.

c) Given the annulus capacity factor of 0.0515 bbl/ft and a drillpipe capacity factor of 0.0178 bbl/ft, calculate the distance that the fluid level would fall if 5 stands of drillpipe were pulled.

Problem 2 A drill string is composed of 9,500 ft of 5-in x 4.276-in, 19.5 lb/ft drillpipe and 1200 ft of drill collars having a 8.0-in OD x 3.0-in ID. Compute the following: a) Capacity of the drillpipe in barrels. b) Capacity of the drill collars in barrels c) Displacement of the drillpipe in bbl/ft. Neglect tool joints. d) Displacement of the drill collars in bbl/ft. e) Loss in fluid level in the well if 10 stands (thribbles) of drillpipe are pulled without filling the hole. The ID of the casing in the hole is 10.050 n. f) Loss of fluid level in the well if one stand of drill collars is pulled without filling the hole. Note that all DPs are pulled out of well and only DCs are in the hole. g) Change in fluid level in the mud tank if the mud tank is 10 ft wide and 20 ft long, assuming that the hole is filled after pulling 11 stands of drillpipe. h) Change in fluid level in a 3-ft x 3-ft trip tank after pulling 11 stands of drillpipe.

Exercise-15-22

A drill string is composed of 9,500 ft of 5-in x 4.276-in, 19.5 lb/ft drillpipe and 1200 ft of drill collars having a 8.0-in OD x 3.0-in ID. Compute the following:

a) Capacity of the drillpipe in barrels.
b) Capacity of the drill collars in barrels.
c) Displacement of the drillpipe in bbl/ft. Neglect tool joints.
d) Displacement of the drill collars in bbl/ft.
e) Loss in fluid level in the well if 10 stands (thribbles) of drillpipe are pulled without filling the hole. The ID of the casing in the hole is 10.050 in.
f) Loss of fluid level in the well if one stand of drill collars is pulled without filling the hole. Note that all DPs are pulled out of well and only DCs are in the hole.
g) Change in fluid level in the mud tank if the mud tank is 10 ft wide and 20 ft long, assuming that the hole is filled after pulling 11 stands of drillpipe.
h) Change in fluid level in a 3-ft x 3-ft trip tank after pulling 11 stands of drillpipe.

Exercise-23

A well has the following profile:

Casing

Total depth 16,400' (vertical well)

16" Open Hole, Surface casing 13 3/8" OD and 12 3/7" ID of 68.00 lb/ft set at 2000'.

12.5" Open Hole, Intermediate Casing 9 5/8"OD and ID of 8 2/3", 47 lb/ft, set at 8,458'

8.5" Open Hole, Drilling liner 7" (6" ID) (Grade N-80) interval between 8,400' to 14,200'

Open Hole, Bit diameter 5.5"

Drill string:

5" drill pipe 19.50 lb/ft nominal weight, (4.276" ID) surface to 8300'.

3 1/2 drill pipe 13.30 lb/ft nominal weight between 8,300' to 15,200'.

(For the ID on the 3 1/2" drill pipe remember that density of steel is 65.5 lb/gal)

Drill collars, 4 3/4" OD, x 2 1/4" ID, 46.70 ppf, 15200' to TD.

Surface mud system:

3 mud tanks, each 9' high, 7' wide, 36' long.

With the entire drill string out of the hole:

Mud level in tanks No. 1 & 2 is 72" of mud and tank No. 3 has 60" of mud (M.W: 11 ppg)

For the following questions 2 to 9, do calculation by hand using equations from the lectures.

2 Calculate the total capacity of the surface mud system in bbl. ____________ bbls

3 Calculate total mud volume in the three tanks in bbls. ____________ bbls

4 Calculate the capacity in bbl/ft for each well section. ____________ bbl/ft

5 Calculate total hole volume with the entire drill string out of the hole. ______ bbls

6 Calculate the displacement of the 5" drill pipe. ____________ bbl/ft

7 Calculate the displacement of the complete drill string. ____________ bbls

8 Calculate the total hole volume with the bit on the bottom. ____________ bbls

9 Calculate the hydrostatic pressure at bottom of hole. ____________ psi

Exercise-24// calculate the reduction in bottom hole pressure when circulating gas cut mud in the following well

Vertical well = 7000 ft
Surface to 800 feet   MW = 11.2 ppg
800-2100feet   MW = 11.8ppg
2100 feet to bottom   MW = 12.5 ppg
Original mud weight = 12.5 ppg

Exercise-25// pressure recorders located below the drill stem test tools show that swab pressure when pulling a stand was 250 psi.
Drilling fluid density in the hole is 10 ppg
Top of reservoir is at 9500 ft
If the well does not flow when the pipe is static, what would the reservoir pressure have to be to allow it to flow at this swab pressure?

Exercise-26// when pulling out of the hole from the top of the reservoir at 10000 ft swab are calculated to be 150 psi
MW= 10.2 ppg
FP= 5200 psi
Will the well flow?

Exercise-27// whilst drilling ahead partial losses are measure at 10 bbls/hour. A total power loss occurs
Annular capacity 0.1512 bbls/ft
MW= 10.2 ppg
If the hole cannot be filled, what will be the reduction in bottom hole pressure after 4 hours?

Exercise-28// severe losses occurred while drilling. The pumps were stopped and the mud in the well could not be seen. The well was filled to the top with water
MW= 12 ppg
Sea water weight= 8.6 ppg
Equivalent height of water column= 150 ft of annulus
What is the reduction in bottom hole pressure with the 150 ft of water?
Exercise-29// gas/water contact in a reservoir at 10000 ft
Top of gas cap at 9000 ft
Gas gradient 0.1 psi/ft
Formation water gradient= 0.465 psi/ft
Calculate the require mud weight for drilling in well **B** and compare with the well **A (discuss)**

Exercise-30/ during normal drilling operations 30 bbls of light mud is pumped into the drill string followed by original mud

The driller shuts down with the light mud still inside the drill pipe and observes the well

Well depth (TVD) = 9000 ft

Drill pipe capacity 0.0176 bbls/ft

Original MW = 12 ppg

Light MW = 10 ppg

Which of the following is correct

a) BHP will remain the same but 177 psi drop in drill pipe
b) BHP will increase 177 psi
c) BHP will drop by 177 psi