National Exams May 2015

98-Pet-A4, Oil & Gas Well Drilling & Completion

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.

2. This is an OPEN BOOK EXAM.
Any non-communicating calculator is permitted.

3. Four (4) questions constitute a complete exam paper.

The first four questions as they appear in the answer book will be marked.

4. Each question is of equal value.

Front Page

1-) Your company wants to complete a well at 15,000 ft. using a 6 5/8 in. production casing. Relevant drill hole data are given below:

Open Hole Diameter : 8 1/2 in.
Mud Weight @ 15,000 ft. : 16 ppg
Formation Pore Pressure Gradient @ 15,000 ft. : 15.5 ppg
Formation Fracture Pressure Gradient@ 15,000 ft.: 17.6 ppg
Formation Temperature @ 15,000 ft : 180 ºF
Normal Formation Pressure Gradient: 0.465 psi/ft.

Please prepare a casing program for this well. Your design should provide Grade , Weight, and length of the each casing section selected. Consider anticipated collapse burst and tensile load for your design. Assume that the gas is going to be produced.

Casing Design Factors

Burst	1.1
Collapse	1.0
Tensile	1.6

Available Casings	Burst Rating, psi	Collapse Rating, psi	Body Strength, lbf	Joint Strength Buttress, lbf
N-80, 24 lb/ft	7,440	5,760	555,000	615,000
N-80, 32 lb/ft	10,040	10,320	734,000	814,000
P-110, 32 lb/ft	13,800	13,220	1,009,000	1,040,000

2-) Select a liner size for a single-acting triplex mud pump to circulate the drilling fluid at the minimum required flow rate for effective cuttings transport in the annulus.

Current drilling depth: 10,000 ft.
10 ¾ in casing (ID: 9.5 in) is set at 4000 ft.
Open hole diameter : 8 ½ in.
Minimum required annular fluid velocity for cuttings transport = 90 ft/min.
Pump:
- Volumetric efficiency = 80%.
- Stroke length = 20".
- Rod Diameter = 2 ¼".
- Pump speed = 60 SPM

Drill String:
Drill pipe: O.D. = 4", weight = 11.85 lb/ft.
Drill collar: O.D. = 6", weight = 90 lb/ft., 1000 ft.

3-) It is desired to increase the density of 2000 bbl of 10 lb/gal drilling fluid to 11.0 lb/gal using API Barite (Specific Gravity : 4.2). The final volume (i.e. drilling fluid storage tank capacity) is limited to 2000 bbl. Compute the volume of old mud that should be discarded initially and the number of sacks of Barite required.

Density of Water : 8.34 lb/gal
Weight of 1 Sack of Barite : 100 lb

4-) Given the following data:

Drilling Fluid Density : 12 ppg
Well Depth: 10,000 ft.
Drill Bit Nozzle Sizes: 13-13-13
Pump Horsepower: 1800
Pump Volumetric Efficiency: 80%
Maximum Pump Pressure: 4,500 psi
Minimum Flow Rate: 350 gpm
Parasitic pressure losses of 2,173 psi and 1,388 psi are anticipated while circulating mud at flow rates 500 gpm and 390 gpm respectively.

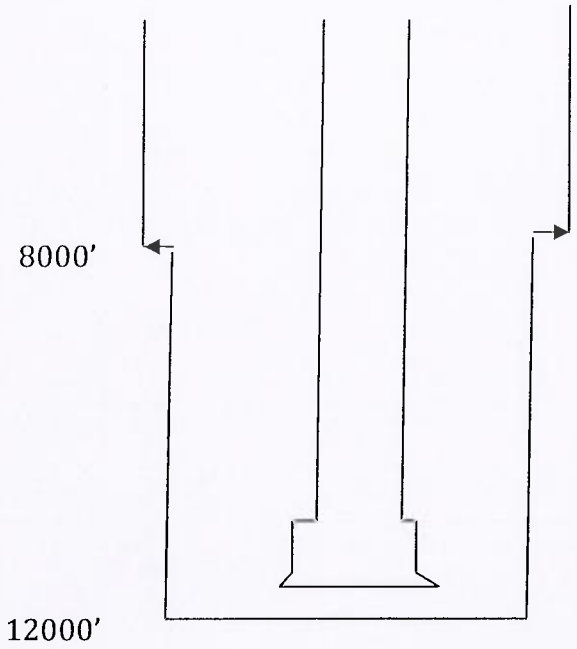
a-) (10 points) Determine the parasitic pressure losses when the bit hydraulic horsepower is maximum.

b-) (5 points) Determine the optimum flow rate when the bit hydraulic horsepower is maximum.

c-) (5 points) Determine the pressure drop across bit nozzles when the bit hydraulic horsepower is maximum.

d-) (5 points) Determine the optimum sizes of three nozzles to be used for the next bit run using the maximum bit hydraulic horsepower criteria.

5-) The well was shut-in after receiving a kick while drilling at 12,000 ft depth.
Use **Engineer's Method** to circulate the kick out of the well.



Current drilling Depth: 12,000ft
Casing setting depth: 8,000 ft
DC – Openhole Annulus Capacity = 0.0272 Bbl/ft
DP – Open hole Annulus Capacity = 0.0425 Bbl/ft.
DP - Casing Annulus Capacity = 0.059 Bbl/ft.
DP Capacity = 0.014 Bbl/ft
DC – Capacity = 0.0087 Bbl/ft.

L_{DC} = 1000 ft
MW = 11 lb/gal.
SIDPP = 190 psig.
SICP = 400 psi
Pit Gain = 15 Bbl
T_s = 60°F
T_f @ 12,000 ft = 220°F

Safety factor for Circulation = 100 psi

Safety margin for Kill Mud Weight = 0.2 ppg

Pump Pressure @ Kill Mud Rate (Reduced Speed Pump Pressure) = 900 psi

Kill Mud Rate = 5 Bbl/min

a) (15 points) Determine casing pressure at the surface when the top of the kick reaches to surface .
b) (5 points) Determine mud volume pumped when the top of the kick reaches to surface.
c) (5 points) Drill pipe pressure schedule as the kill mud is circulated down the hole.

NOMENCLATURE:

DP = Drill pipe

DC= Drill collar

L_{DC} = Drill collar length, ft

MW = Mud density, lb/gal

SIDPP = Shut in Drillpipe Pressure, psi

SICP = Shut in Casing Pressure, psi

T_s = Surface temperature , °F

T_f = Formation temperature, °F