

National Exams May 2016  
**Pet-A4, Oil & Gas Well Drilling & Completion for May 2016**  
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.

### Question-1

The block& tackle system of the rig is equipped with 10 lines.

The drilling line is 1 in. diameter extra improved plow steel.

Drill string will consist of:

Drill pipe: 5 in., 20 lb/ft

Drill collars : 6 in by 2 in, 100 lb/ft, the length of the drill collar is 10 % of the total depth (i.e. 10% of the total drill string length).

Equivalent Derrick Load:  $F_{de} = 800,000$  lbf

Drillpipe Breaking Strength: 600,000 lbf

Available Horsepower at the Hook: 800 HP

The tripping speed of the drill string is selected as to be 60 ft/min

Ignore correction for the buoyancy effect.

Ignore the weight of the travelling block and hook.

Use safety factor 2 for your design calculations wherever it is applicable.

Calculate maximum drilling depth that can be drilled under the current rig operating conditions.

Nominal Diameter	Approximate Mass	Extra improved plow steel
in	lbm/ft	lbf
1/4	0.46	26,600
9/16	0.59	33,600
5/8	0.72	41,200
3/4	1.04	58,800
7/8	1.42	79,600
1	1.85	103,400
1 1/8	2.34	130,000
1 1/4	2.89	159,800
1 3/8	3.5	192,000
1 1/2	4.16	228,000
1 5/8	4.88	264,000
1 3/4	5.67	306,000
1 7/8	6.5	348,000
2	7.39	396,000

**Question-2**

One of the two types of drilling bits has to be run into the hole at depth 12,000 ft., bit A or bit B. Select the bit to drill from 12,000 ft downwards. Make your selection on the base of cost/ft criteria.

The drilling rate equation is the same for both bits;

$$(dD/dt) = 300 e^{-0.00025 * D}$$

Where;

D = Depth, ft

t = Time, hrs

Bit lives and their prices are different and they are;

Bit Type	Bit Life, hrs	Bit Cost, \$
A	40	25000
B	25	8000

The drilling rig operational cost is  $C_R = \$ 1000/hr$

Trip time function is  $t_t = 0.001 D_{out}$  (hrs)

Connection time: 2 min/single pipe

Length of 1 single pipe : 30 ft.

Note: Tripping time to be considered using only  $D_{out}$ .

$D_{out}$  : Depth where the bit is pulled out, ft.

### Question-3

#### Drill Hole Data :

Casing: 11.75 in. x 11 in. set at 4500 ft.  
Current Drilling Depth: 10,000 ft.  
Mud Weight : 10 ppg.  
Open Hole Diameter: 8.75 in.  
Surface Temperature: 60 F  
Geothermal Gradient: 2.0 F/ 100 ft.

#### Drill String Data :

Drill Pipe: 5.0 in. x 4.0 in., 25.6 ppf  
Drill Collars: 6.5 in. x 3.0 in. x 89 ppf, 750 ft.

#### Initial Kick Data :

Pit Gain: 20 Bbl  
Shut in Casing Pressure: 400 psi  
Shut in Drillpipe Pressure : 200 psi

#### Other Relevant Data :

Kill Mud Rate: 5 bbl/min  
Reduced Speed Pump Pressure: 600 psi

It was decided to circulate the kick out of the well after increasing the mud weight up to kill mud weight (**Engineer's Method**). Now, provide the numerical values of the following parameters **when the top of the kick zone reaches to the casing shoe;**

- a-) Length of kick zone, ft.
- b-) Equivalent mud density at the casing shoe, ppg.
- c-) Casing pressure at the surface, psig
- d-) Volume of Mud pumped, bbl
- e-) Total Pit gain (Total Mud level increase in the mud tank), bbl
- f-) Determine the drillpipe pressure schedule to be followed as the heavy mud is being pumped down.

**Question-4**

Design the drill string for the following conditions.

Depth: 10,000

Hole Size: 8 1/2 in.

Weight on bit: 30,000 lb

Mud density: 10 ppg.

Design Factor for BHA Design: 1.2

Margin of Overpull (MOP): 100,000 lbf

Available Drillpipes:

4.5 in x 3.826 in, 16.6 ppf, E-75

4.5 in x 3.64 in, 20 ppf, G-105

Assume Class 3 Wear for Drillpipes

Available Drill Collars:

6 in x 3 in, 72 lb/ft

Determine the drillstring ( i.e., Drill Collar + Drill pipe ) composition, length, weight, and grade that should be used to drill at depth 10,000ft.

**Question-5**

Directional well trajectory correction operation requires to change the direction from S10W to S20E while increasing the inclination from 10 to 12 degrees. Required trajectory correction needs to be done within drilling 75 ft of course length.

a-) If casing running program requires dog leg severity should be less than 10 degrees/100 ft. Would you be able to run the casing through this well after trajectory correction is made?

b-) Determine tool face angle and the orientation of the BHA (bend sub + mud motor) with respect to high side of the well .

**NOMENCLATURE:**

BHA: Bottom Hole Assembly

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