National Exams May 2013

98-Pet-A4, Oil and 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.

Question-1

You are planning to drill a well with a rig where 10 lines are strung between traveling block and crown block. Maximum anticipated drilling depth is 10,000 ft. The drill string consists of 4.5 in. - 20 lb/ft drill pipes and 7 in.- 120 lb/ft drill collars. The drillstring design requires that the drill collar length must be 10 % of the total drill string length. Company policy requires the use of a safety factor of 2.0 in all rig load design calculations. Ignore the buoyancy effect.

Determine the minimum drilling line size (i.e. smallest diameter possible) that can be safely used with this rig.

Nominal Breaking Strengths of Galvanised Wire

Nominal Diameter	Approximate Mass	Extra improved plow steel
in	lbm ft	lbf
½	0.46	26,600
9/16	0.59	33,600
5/8	0.72	41,200
¾	1.04	58,800
7/8	1.42	79,600
1	1.85	103,400
1 1/8	2.34	130,000
1 ¼	2.89	159,800
1 3/8	3.5	192,000
1 ½	4.16	228,000
1 5/8	4.88	264,000
1 ¾	5.67	306,000
1 7/8	6.5	348,000
2	7.39	396,000

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Question-2

A vertical well is being drilled currently at depth of 6500 ft. Other Relevant data:

Drill Pipe :   5 in. x 4.276 in.

Drill Collars: 7 in. x 3 in.- 900 ft.

Casing: 9 5/8 in. x 9.00 in. set @ 6500 ft. vertical depth

Mud density: 10 ppg

Formation Pore pressure at current depth just below the bit   : 3250 psi

The Length of One Stand of drillpipe is = 90 ft

a-) Determine the mud level drop if 15 stands of drillpipes are pulled out of the well without filling the well with mud.

b-) What is the reduction in the bottomhole pressure (psi) corresponding mud level drop calculated in part a.

c-) After pulling how many stands of drillpipes **out of the well** without filling the well with the mud, you would get a kick? (**i.e. determine the number of drillpipe stands stacked at the rig floor**)

Question-3

One of the two types of drilling bits has to be run into the hole at depth 10,000 ft., bit X or bit Y. Select the bit to drill from 10,000 ft downwards. The drilling rate equation is the same for both bits;

$$(dD/dt) = 200 \, e^{-0.0002303 \cdot D}$$

Where;

D = Depth, ft
t = Time, hrs

Bit lives and their prices are different and they are;

Bit Type	Bit Life, hrs	Bit Cost, $
X	30	25000
Y	20	5000

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.

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Question-4

You are assigned to a rig at the moment when drilling ahead is carried on. Company man wants to know the bottomhole pressure while drilling at 12,000 ft. Pumping rate with 11 ppg mud is 600 gpm. and the pump pressure is 3000 psi. You get information on drillstring composition and annular geometry and calculate the frictional pressure losses as follows:

Inside the surface lines : 50 psi
In the drillpipes: 800 psi
In the Drill Collars: 600 psi
In the drill collar annulus : 250 psi and
In the drill pipe annulus: 150 psi

Unfortunately nobody remembers the size of the nozzles installed in the bit.

a-) Calculate the effective (circulating) bottomhole pressure (psi) exerted by the flowing mud.

b-) If the formation fracture gradient is 12.5 lb/gal at 12,000 ft depth would you be able to continue drilling safely at this flowing bottomhole pressure safely?

c-) (10 points) Determine the size of the nozzles (in 32nd of an inch), if there are 3-nozzles installed at the bit.

Question-5

Your company wants to complete a well at 12,000 ft. using a 7 in. production casing. Relevant drill hole data are given below:

Open Hole Diameter : 8 3/4 in.
Mud Weight @ 12,000 ft. : 14.1 ppg
Formation Pore Pressure Gradient @ 12,000 ft. : 13.5 ppg
Formation Fracture Pressure Gradient@ 12,000 ft.: 15.5 ppg
Formation Temperature @ 12,000 ft : 180 °F
Normal Formation Pressure (Salt water) Gradient: 0.45 psi/ft.

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 Methane 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, 26 lb/ft	7,240	5,410	604,000	755,000
N-80, 32 lb/ft	10,040	10,320	745,000	889,000
P-110, 32 lb/ft	13,800	13,220	1,025,000	1,111,000