National Exams May 2018

17-Pet-A4, Oil and Gas Well Drilling and 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

Marking Scheme"

1. (a) 12.5 marks; (b) 12.5 marks

2. (a) 12 marks; (b) 4 marks; (c) 2 marks; (d) 2 marks; (e) 5 marks

3. 25 marks

4. 25 marks

5. (a)12.5 marks; (b) 12.5 marks

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Question -1 (25 points}

You are planning to drill a well with a rig where 8 lines are strung between traveling block and crown block.

Drilling line currently in use has a line strength of 90000 lbf.

The drill string consists of 4.5 in. - 20 lb/ft drill pipes and 6.5 in.- 100 lb/ft drill collars.

The drillstring design requires that the drill collar length must be 15 % of the total drill string length (i.e. 15% of the total depth).

Company policy requires the use of a safety factor of 1.5 in all rig load design calculations.

Ignore the buoyancy effect and the weight of the hook and travelling block.

a-) (12.5 points) Based on the capacity of the available drilling line and block & tackle system, determine the maximum depth you can drill with this rig.

b-) (12.5 points) What is the maximum hoisting speed you could have when the hook load is at its highest possible level. See relevant data below.

Engine Efficiency: 85%
Engine (Output) to Drawworks Power Transmission System Efficiency: 90%
Hourly Fuel (Gasoline) Consumption Rate: 20 gal/hr
Heat of combustion of Gasoline: 20,000 BTU/lb.
The density of gasoline: 6.6 lb/gal.

1BTU = 779 ft-lbf
1 HP = 33,000 ft-lbf/min

Question-2 (25 Points)

Drill Hole Data :
Depth: 14,000 ft
Casing   : 9 5/8 in. x 9.0 in. set at 9000 ft.
Mud Weight : 13 ppg.
Open Hole Diameter : 8.0 in.
Reduced Speed Pump Circulating Rate :   250 gpm.
Total Frictional Pressure Losses at 250 gpm. : 950 psi.
Surface Temperature   : 60°F
Geothermal Gradient : 1 °F /100 ft

Drill String Data :
Drill Pipe : 4.5 in x 3.826 in , 12,600 ft.
Drill Collars : 6.0 in 3.0 in , 1400 ft.
Capacity of Drillpipe: 0.0142 bbl/ft
Capacity of Drill Collar: 0.0087 bbl/ft
Capacity of Drill collar-Openhole annulus: 0.0272 bbl/ft
Capacity of Drillpipe-Openhole annulus: 0.0425 bbl/ft
Capacity of Drillpipe- Casing annulus: 0.0590 bbl/ft

Initial Kick Data :
Pit Gain :   40 Bbl.   Methane Kick (assume kick moves as a slug)
Shut-in Casing Pressure : 1000 psi.
Shut-in Drill Pipe Pressure : 300 psi

It was decided to circulate the kick out of the well using **Driller's method**.
After pumping in 125 Bbl of drilling fluid, determine the following parameters;

a-) (12 points)   Length of the kick zone, ft.
c-) (4 points)   Equivalent mud density at the casing shoe, ppg.
b-) (2 point)   Casing pressure at the surface, psi
d-) (2 point)   Pit gain (i.e., Volume of mud level increase in the mud tank), bbl
e-) (5 points)   During the 2nd circulation of the Driller's method determine the drill
pipe pressure schedule (i.e., how the drill pipe pressure changes vs. time) as the kill
mud is being pumped down the well.

Question-3 (25 points)
The drilling rate of 50 ft/hr was recorded while drilling in a shale formation located at
8,000 ft depth. The drilling fluid density was 9.5 ppg and formation pore pressure
gradient was 9.0 ppg.

Using Bourgoyne and Young model, determine the new drilling rate (ft/hr) if you
suddenly drill into a high pressure zone with a recorded formation pore pressure
gradient of 10.0 ppg.

You may assume all the other operational parameters remain unchanged.

a2 = 0.0001   a3= 0.0001   a4= 0.00002   a5= 0.9   a6= 0.9   a7= 0.5   a8= 0.4

Question-4 (25 points)
Design the drill string for the following conditions.

Depth: 12,000
Hole Size: 8 1/2 in.
Weight on bit: 20,000 lb
Mud density: 12 ppg.
Design Factor for BHA Design: 1.5
Margin of Overpull (MOP): 120,000 lbf

Available Drill Collars:
6.0 in x 3.0 in, 72 lb/ft

Available Drillpipes:
4.5 in x 3. 64 in, 20.0 lb/ft, E-75
4.5 in   x 3.64 in, 20.0 lb/ft, X-95
4.5 in   x 3.64 in, 20. lb/ft, G-105

Assume Class 3 Wear (37.5%) for Drillpipes

Determine the drillstring composition (i.e. length of Drill Collar and length & grade of drill pipe section(s)) that should be used to drill safely and economically at depth 12,000ft.

Question-5 (25 points)
Directional well trajectory correction operation requires to change the direction from N10W to N20W while increasing the inclination from 10 to 13 degrees. The trajectory correction needs to be done over the 80 ft (measured length) of drilling.

a-)(12.5 points) If casing running program requires that dog leg severity should not exceed 8 degrees/100 ft at any location along the well. Would you be able to run the casing through this well after the trajectory correction is made?

b-) (12.5 points) Determine tool face angle and the orientation of the BHA (bend sub + mud motor) with respect to high side of the well (i.e. need to determine the direction of tool face setting)