



# UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

SECOND SEMESTER EXAMINATIONS, NOV/DEC 2018

**COURSE NO:** PE 373  
**COURSE NAME:** DRILLING ENGINEERING II  
**CLASS:** PE III      **TIME:** 3 HOURS

Name: \_\_\_\_\_ Index Number: \_\_\_\_\_

**ANSWER SECTION A IN THE OBJECTIVE ANSWER BOOKLET  
SECTIONS B AND C SHOULD BE ANSWERED IN THE NORMAL ANSWER  
BOOKLET**

**SECTION A (1 Mark Each for each correct answer. A wrong answer will attract a negative mark of 0.5 while unanswered question attracts no marks)**

*Read the following statements carefully and provide the correct answer to each of them (either TRUE or FALSE)*

1. An API methylene blue test, could be used to give an indication of total surface area of active solids in a drilling mud.
2. A kill line is a low pressure pipeline between side outlet, opposite the choke line outlet, on the BOP stack and the mud pumps. It provides a means of pumping fluids downhole when the normal method of circulating down the drillstring is not possible.
3. A roughneck is an employee of a drilling contractor who works on a drill floor under the direction of a driller.
4. A Step-out well is drilled to delineate the boundaries of a reservoir.
5. A toolpusher or rig superintendent is an employee of an operator who is responsible for the drilling rig and its crew.
6. A Trip tank (Possum) or active tank is recommended to be use to measure or monitor mud volume during tripping operations.
7. A well that cannot produce hydrocarbons in commercial quantities is called a dry hole.
8. Air gap is distance between a jackup barge and the sea surface.
9. All drill ships have more cross sectional area in the water line than semi-submersibles.
10. All mobile floating platforms are anchored during drilling operations.
11. All wells are logged but not cored.
12. Applying very high weight-on-bit may buckle the drill pipe as well as damage the bit, and will almost certainly cause problems because of low drilling torque.
13. Applying very high rotary speed can drastically reduce the life of many roller cone bits, thereby increasing their cost per foot.
14. Arctic submersibles have a reinforced hull called caisson to deflect floes.
15. Coring samples may undergo physical changes as they move to the surface for analyse but are able to produce coherent rocks.
16. Cost per foot, drill rate, depth, torque, breakeven analysis are some of the parameters to keep in mind when determining when to pull the bit.

17. Directional drilling is defined as the science and act of directing a wellbore along a predetermined trajectory to intersect a designated surface target.
18. Drill Stem Test (DST) may provide flow capability, type of fluids (oil, natural gas or water) present in the formation and pressure of the formation.
19. Choke line provides a means of pumping fluids downhole when the normal method of circulating down the drillstring is not possible.
20. The Kill line carries the mud and influx from the BOP stack to the choke manifold.
21. Stripping is the process by which pipe is allowed to move through the closed BOPs under its own weight.
22. Snubbing is the process of forcing a pipe through a BOP mechanically.
23. To check for swabbing it is recommended that a drillbit is only pulled back to the previous casing shoe and then run back to bottom before pulling out of hole completely. This process is known as short trip.
24. For a typical solid removal equipment arrangement, a mud/gas separator would be placed after the shale shaker.
25. Volumetric method of controlling a well is employed during normal drilling operations, thus when a drillstring is still in hole.
26. For drilling a hard formations, the recommended RPM and WOB is to apply moderately high WOB with minimum RPM.
27. For drilling a soft formations, the recommended RPM and WOB is to increase RPM and apply relatively low WOB.
28. In most drilling operations, the Rotary Table Elevation is used as the working depth reference since it is relatively simple, for the driller for instance, to measure depths relative to this point.
29. Logging operations are used for well diagnostics purposes and to answer all formation problems.
30. Logging-While-Drilling (LWD) data can provide direction and inclination information of a well.
31. Lost circulation occurs when a fractured or very high permeability, formation is being drilled. Whole mud is lost to the formation and this reduces the height of the mud column in the borehole.
32. One example of inert high-gravity solids and active low-gravity solids needed in a drilling fluid is bentonite and barite respectively.
33. Preloading are done offshore to determine the weight of a jackup barge and additional ballast water to be used to drive the legs securely into the sea-bottom to prevent further penetration while operations are carried out.
34. Processing in sequence aids solids to be removed in a sequence more efficiently according to sizes - smallest particle size to be removed last.
35. Relief wells are deviated to pass as close as possible to an uncontrolled well to pump lighter mud to overcome the pressure to help bring a wild well under control.
36. ROV is an underwater robot which stands for remotely operated vehicle and allows an operator to be on surface while the ROV works in hazardous environment onshore.
37. Surging is the process by which fluids are sucked into a borehole, from a formation, when a drillstring is being pulled out of hole.
38. Tender barge, semi-submersible and jack-up, are all shallow offshore drilling rigs.

39. The Build and Hold trajectory is employed in deep wells with small horizontal displacements.
40. All the following are the functions of the wave motion compensator system; constant bit weight control, higher penetration rates, longer drill bit life, prevent marine riser collapse, proper landing of the BOP and other tool.
41. Secondary well control is the control of formation pressure by closing off the BOP valves at surface. It is used during abnormal drilling operations to compliment the operations of the primary well control to bring the well back to normal well control or secondary control.
42. Dilution costs for mud chemicals and barite, reduced bit life, decreased swab and surge pressures, disposal costs for mud hauled away and greater risk of production impairment are all significant effects of inadequate or improper removal of drilling fluids solids.
43. When particle size plugging occurs during solids screening, the screen size must be washed to prevent plugging (blinding) of the screen.
44. Two sizes of hydrocyclones are commonly used for muds. These are larger diameter 6-in. desilters and smaller than 6-in. diameter desanders.
45. Mixing hoppers are used to add fluid additives (materials) to build and maintain a mud system.
46. Chemical barrels are used primarily to solubilise materials in water before adding them to the active mud system.
47. The first step to take when a kick is detected is to close the shear preventer of the BOP valves, to seal off the drillstring to wellhead annulus at the surface.
48. The function of a float valve installed in a drillstring is to prevent upward flow in the drillstring, but allow normal circulation to continue.
49. The importance of drill-off test is to help determine the most appropriate WOB, RPM and swabbing to employ in a given field.
50. The main goal of solids control (equipment) at the rig site is to maintain the type, size and concentration of mud solids at a reasonable cost.
51. The Mean Sea Level (MSL) and wellhead are permanent, national and well documented datums whereas datum such as the Rotary Table Elevation (RTE) only exists when the drilling rig is on site.
52. The purpose of a diverter is to allow the well to flow to surface safely, where it can be expelled safely expelled through a pipeline leading away from the rig.
53. The two basic methods of killing a well when a drillstring is at the bottom of the borehole are by the one Circulation Method or the Drillers Method.
54. The type of formation, depth, hole geometry, pressure; and the nature of an influx are the main factors that influences the severity of a kick.
55. There are a number of tools and techniques which can be used to change the direction in which a bit will drill. These tools and techniques can be used to change the inclination or the azimuthal direction of the wellbore or both.
56. There are a number of tools and techniques which can be used to change the direction in which a bit will drill. The first principle is to introduce a bit tilt angle into the axis of the BHA just above the bit and the second is to introduce a side-force to the bit.
57. Well cuttings are collected at regular intervals to establish a lithologic of a well.
58. All deviation tools and techniques work on one of two basic principles. The first principle is to introduce a bit tilt angle into the axis of the BHA just above the bit and the second is to introduce a side-force to the bit.

59. The one circulation method is generally considered better than the Drillers method since it is safer, simpler and quicker over the drillers' method.
60. The most common secondary indicators that a kick has occurred include: drilling break, gascut mud, changes in pump pressure and reduction in mud density.

### **SECTION B (2 MARKS EACH)**

61. State four functions of the marine riser system.
62. List any four causes of mudweight reduction during normal drilling operations.
63. Why is shale considered to be less dangerous than a sand in a kicking well?
64. The purpose for implementing a solids control programme is to improve the performance of a mud's basic functions, list any two of the basic functions.
65. What is perforation in terms of well completion?

### **SECTION C (ANSWER 3 QUESTIONS)**

**Answer Questions 1 and 2 and any other from 3 to 4**

1. During a normal (conventional) solids screening process, it was released downstream of the processing train that about 33% of barite in the mud was lost. A test upstream shows no sign of piggy-backing, solids loading, liquid loading or particle size plugging. As the mud engineer at site:
  - a. What do you think could have caused this? **(5 Marks)**
  - b. How could this problem be solved? **(5 Marks)**
2. Rearrange the following equipment for a typical unweighted drilling fluid under Solids Removal Region, Addition Region and Mud Check Region: **(10 Marks)**

*Equipment:*  
Methylene Blue Test, Mud/Gas Separator, Mixing Hopper, Viscometers, pH Meter, Chemical Barrel, Filter Press, Shale Shaker, Ageing Cell, Mud Guns, Sand Trap, Desilter, Mud Balance, Mixers-Agitators, Special Mixing/Shearing Devices, Degasser, Desander, Resort kit, Centrifuge(s), Marsh Funnel.
3. A fish was lost in a well at 1600 ft and was irretrievable, the company therefore decided to sidetrack the well from 1500 ft. The MSL elevation of the rig is at 200 ft. The sidetrack will be a build and hold profile with the following specifications: **(20 Marks)**

Target Depth: 10000 ft.  
Horizontal departure: 3500 ft.  
Build up Rate: 1.5° /100 ft.

Calculate the following with respect to the MSL elevation:

- a. The drift angle of the well;
- b. The AHD to end of build;
- c. The TVD and Horizontal displacements at the end of the build;
- d. The AHD to the target.

4. To drill a directional well at the TEN field, a drilling engineer considered the economics of using a tooth bit from a bit run data. The data are:

Bit - \$ 1491

Tool = Stabilizer \$ 250

Mud = \$ 2,000

Drill Time = Bit Life; 33 hr

Trip = 7 hr

Lost = Surveying after every trip; 0.3hr

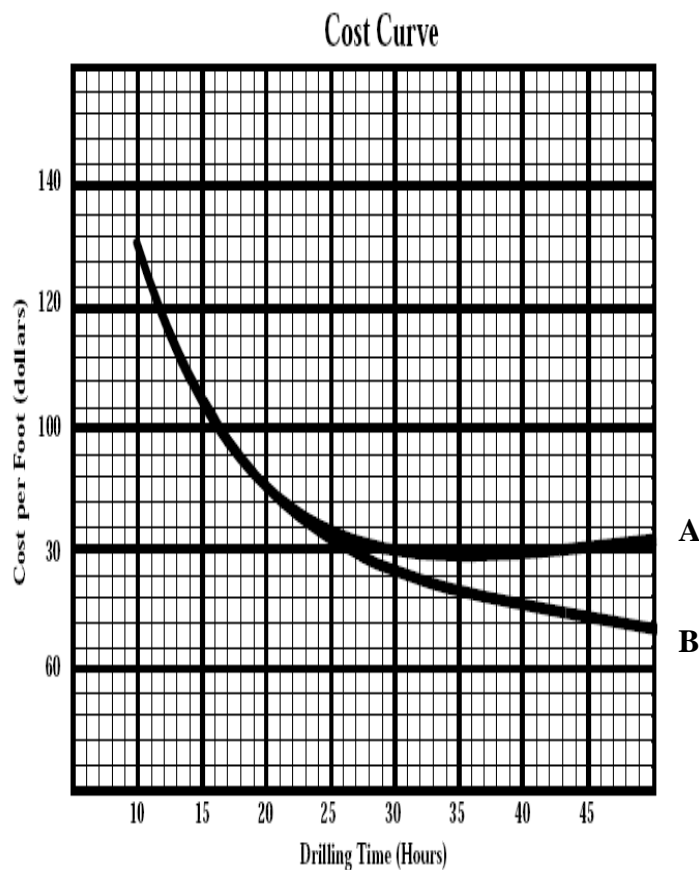
Support = Directional Driller; \$250hr

Tool Rental = Large drill collars; 9 \$/hr additional

Drill Rate = 13 ft/hr

The mud engineer on the team claims that spending \$ 4000 more on mud will cause bits to drill 12% faster and 25% longer.

- a. What would be your decision on his claim? *(14 Marks)*
- b. Using Fig. 1, and Cost per Foot Analysis, explain how the graph could be used to improve upon drilling optimisation. *(6 Marks)*



**Fig. 1**

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