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**Faculty of Science 2ndSemester 2016-2017**

**Dept. Of Geology Date: 5/06/2017**

**Advanced well logging (606G) for Pre-master Students (Petroleum & Hydrogeology)**

**جامعة بنها – كلية العلوم – قسم الجيولوجيا**

**دراسات عليا(تمهيدى بترول ومياه)**

**يوم الامتحان: الاثنين**

**تاريخ الامتحان: 5/06/2017**

**الماده: تسجيلات آبار متقدمه (606 ج)**

**الممتحن: د/ وفاء الشحات عفيفى الشحات**

**أستاذ مساعد بقسم الجيولوجيا بكلية العلوم**

**الاسئله ونموذج الاجابه**

**ورقه كامله**

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**Faculty of Science 2ndSemester 2016-2017**

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**Answer the following questions:**

**Question1. (45Marks)**

***\*Write on three only of the following: (15 Marks each)***

**a**- The function of borehole casing

**b**- Drilling problems

**c**- Uncertainties and Limitations of: Cores, Sidewall Samples and Wireline Logs

**d**- Production logging

**Question2. (20Marks)**

***\*Write briefly about two only of the following: (10 Marks each)***

**a**-Permeability

**b**- Gamma Ray logging

**c**- Sonic log

**Question 3. (15 Marks)**

**What are the objectives of appraisal?**

**BEST WISHES**

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**Answer of Question1. (45 Marks)**

***\*Write on three only of the following:***

**a- Borehole casing**

conductor casing must be set before drilling can continue further.This casing is set for several reasons:

• To protect shallow fresh water aquifers from contamination.

• To support the unconsolidated, low pressure formations nearer the surface and prevent the loss of drilling mud as it is weighted up to permit deeper drilling.

• To provide a base for well control equipment.

**b- Drilling problems**

• Differential Sticking

Which occurs when the pipe comes in contact with a permeable formation and the string is sucked against the hole by the pressure differential existing between the mud column and the formation. This is most often encountered when heavy mud weights are used.

• Key Seating

Which occurs in very crooked holes when the drillpipe cuts into the wall of the hole, creating a slot which grips the pipe when a tool joint or wide drill collar is pulled out.

• Sloughing Shale

A problem that is the result of shale shavings breaking off from the sides of the wellbore. These shavings form "bridges", or tight spots, when they gather at bends in the hole, which then cause the pipe to stick

• Poor Mud Properties

Result in excessive mud cake on the walls of the hole or an inability of the mud to hold the cuttings when circulation stops. Either of these circumstances can cause the drill stem to become wedged in the hole.

• Fatigue Failures

Which are the result of metal fatigue, and cause the drillstring to "twist off" or break in two, leaving a portion in the hole.

• Foreign Objects

Such as bit cones that may break off, or a tool that may be dropped down the hole. All foreign objects must be retrieved before drilling continues.

**c- Uncertainties and Limitations of: Cores, Sidewall Samples and Wireline Logs**

*Uncertainties and Limitations of Cores*

The percentage recovery of a core determines its usefulness to a large extent. The percentage recovery describes what fraction of the total interval cored is recovered intact in the core barrel. In weak rock the action of the core head breaks the rock into small fragments which may escape in the same way as cuttings during normal drilling. In unconsolidated formations special techniques such as rubber sleeve coring are used to improve the recovery. Depth control is often difficult in low recovery cores. The material which is recovered may be

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broken into a number of short sections interspersed with many rock fragments, and it is difficult to determine the depth from which each piece of core originated.

*Uncertainties and Limitations of Sidewall Samples*

The main limitation of the sidewall sampling technique is the mechanical damage that occurs to the sample, which is therefore not suitable for quantitative measurements of rock properties.

*Uncertainties and Limitations of Wireline Logs*

Wireline logging can supply high quality, quantitative information about the formation provided the measuring conditions are good. Large and irregular boreholes will adversely affect the accuracy of the measurements. Interpretation of the measured data is required to evaluate the formation properties, which are not measured directly. The parameters required for these interpretation are not always known accurately, and must be estimated.

**d- Production logging**

Once a well is on production, there is often a requirement to determine the nature of the flow downhole. This can be carried out by running various production logging tools into the producing (or injecting) well. The principles behind these tools are essentially the same as those for conventional open hole logging tools, in that they are run on electric cable and produce a surface readout.

A production log may be required to measure:

• Flow rates to locate the precise source of production of oil, gas and water.

• Fluid density to determine the type of fluid being produced from an interval.

• Temperature to determine the flowing and shut-in temperature profile of the well.

• The information from production a log is used to:

• Allocate production or injection to reservoirs or intervals in commingled completions.

• Quantify cross flow between intervals.

• Identify sources of excess water or gas production.

• Quantify the amount of water or gas being produced from a particular interval.

• Identify intervals that require stimulation.

• Analyse the success of a stimulation treatment.

• Locate leaks in the casing, tubing or packers.

• Identify flow behind the casing from non-perforated intervals

**Answer of Question 2. (20Marks)**

**\*Write briefly about two only of the following:**

**a- Permeability**

The permeability is a measure of the ease with which a fluid can flow through a rock. In this section *absolute* permeability will be discussed, which is a property of the rock itself and which is independent of the fluids that flow.

**Factors Affecting Permeability**

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Experiments using capillary tube models of the pore space in rocks easily show that the flow rate is higher in wide capillaries than in several narrow ones having the same total flow area permeability is dependent on the radius of the capillaries or pore throats. An increase in the radius of the capillaries will also lead to an increase in the porosity, suggesting that permeability is dependent on the same factors as porosity (i.e. pore throat size, grain size variation), but to a differing degree.

**Permeability Anisotropy**

In most rocks the permeability depends to some extent on the direction of fluid flow. The permeability is usually lowest in the direction perpendicular to the bedding planes due to the following effects:-

• Most rock grains are elongated along one axis, however slightly, and will tend to settle with their long axis approximately horizontal.

• The overburden pressure compacting a sediment acts vertically, and will also tend to make the grains lie with their longest axis horizontal.

• Layers of less permeable sediments, e.g. muds, will be deposited horizontally, and will tend to hinder flow perpendicular to their final orientation in the reservoir.

**b- Gamma Ray logging**

The gamma ray (GR) log is the most commonly used reservoir thickness log. It measures the natural gamma radioactivity of the formation. This property can be used to discriminate between reservoir and non reservoir rock. The natural radiation spectrum can also be analyzed, from which conclusions can be drawn about the detailed mineralogy of the rock. The natural gamma radiation in the formation originates from radioactive decay of potassium, thorium and uranium isotopes. The measurement is made by a scintillation counter, which records the radiation intensity in API units. Most common minerals show distinct levels of natural radiation. This radiation originates mainly from potassium, as this is the most abundant of the three radioactive elements. There is a general trend for reservoir rock to have low radiation levels, whereas shale has a high potassium content and a high level of radioactivity. If all the non-reservoir rock consist of shales (observation from the mudlog), the GR may be used to identify the reservoir intervals.

**c- Sonic log**

The sonic log is the oldest of the porosity logs. It is of only limited use for quantitative porosity determination due to uncertainties in its interpretation. An important application of the tool is to calibrate seismic data, by providing the velocity profile required for time-to-depth conversion. The tool measures the travel time of a sound wave through the formation, by transmitting sound pulses and detecting their arrival at a receiver some distance away on the tool. The measured values of At are displayed on a decreasing linear scale of travel time, in units of microseconds per foot (or per meter). Determining the porosity is analogous to the density log. The measured travel time (Dt log) is assumed to be made up from the matrix and pore fluid travel times

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**Answer of Question 3. (15Marks)**

**What are the objectives of appraisal?**

Appraisal activities are designed to reduce the uncertainty associated with discovery volumes of hydrocarbons. The information to be collected is aimed at answering one or more combinations of the following questions:

• How much oil and gas is there?

• Where is it?

• At what rate and how much in total will it produce?

Appraisal is often trying to narrow the range between the low and high estimates of HCIIP Such appraisal, if successful,**?**