***[](http://www.benha-univ.edu.eg/)*Benha University Time: two hours.**

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

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

**Advanced Petrophysics (686G) for Pre-master Students (Applied Geophysics)**

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

**دراسات عليا(تمهيدى جيوفيزياء تطبيقيه)**

**يوم الامتحان: الاثنين**

**تاريخ الامتحان: 5 / 06/ 2017**

**الماده: بتروفيزياء متقدمه (686 ج)**

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

**أستاذ مساعد بقسم الجيولوجيا بكلية العلوم**

**ورقه كامله**

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

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

**Advanced Petrophysics (686G) for Pre-master Students (Applied Geophysics)**

**Question (1) (60 Marks)**

***Answer four questions only of the following*: (15 Mark each)**

1. **Define or explain the concept of the petrophysical analysis?**
2. **What is permeability, by what unit or units do geoscientists commonly quantitatively measure it, and what are the qualitative indications of permeability on logs?**
3. **Define porosity and explain how petrophysists commonly determine it using crossplots?**
4. **What is Rw, and how can you determine it?**
5. **What is “Quicklook Technique”; write on Neutron-Density quicklook technique?**

**Question2. (20Marks)**

**What are the secondary effects (environmental effects), Discuss?**

**BEST WISHES**

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

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

**Advanced Petrophysics (686G) for Pre-master Students (Applied Geophysics)**

**Answer of Question (1) (60 Marks)**

**1-Define or explain the concept of the petrophysical analysis?**

petrophysics is the study of the physical and chemical properties of rocks and their contained fluids.

**2-What is permeability, by what unit or units do geoscientists commonly quantitatively measure it, and what are the qualitative indications of permeability on logs?**

The permeability is a measure of the ease with which a fluid can flow through a rock. It is measured by Darcy or m.darcy.The presence of an SP (positive or negative) opposite a bed indicates permeability. On Caliper log,The existence of mudcake (when the borehole diameter is less than the bit size) is an indication of the infiltration of mud into the formation.

**3-Define porosity and explain how petrophysists commonly determine it using cross plots?**

Porosity is defined as the ratio of the amount of pore space present in a volume of rock to the total volume (pore space plus rock matrix) of that rock.

Cross plots

Graphical x-y plots which predict porosity and lithology on the basis of the location of data points with respect to pure lithology reference data. The plots may also contain data in the z-axis.

### POROSITY CROSSPLOTS:

### A) Using two-mineral technique

### The Neutron-Density crossplot

### The Neutron-Sonic crossplot

### The Sonic-Density crossplot

4-Spectral Density (bulk density and Pe)

### B) Using three-mineral technique

1- M-N crossplot

2- MID crossplot

1. Neutron and Spectral Density
2. Neutron, Density, and Sonic

**4-What is Rw, and how can you determine it?**

Rw is the water resistivity. It can be determined from:

1. SP log
2. Rw FROM A PICKETT PLOT

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1. RW FROM PRODUCTION TESTS, This is the best value of Rw when available.
2. RW FROM DRILL STEM TESTS (DST)
3. RW FROM WATER CATALOGUES: catalogues are compiled by individual companies
4. RW FROM LOCAL KNOWLEDGE: his is usually from the expertise of individuals with experience in a certain area.

**5-What is “Quicklook Technique”, write on Neutron-Density quicklook technique?**

Graphical techniques, usually comparing measurements in a log plot format (usually for Neutron and Density).

The Neutron-Density quicklook technique is a quick way of determining formation lithology. The most important aspect of the technique is determining the relative positions of the neutron and density curves (with respect to each other). While the positions of the curves on the log will vary with changing porosity, the relative positions of the curves will remain fairly constant with lithology.

**Answer of Question2. (20Marks)**

**What are the secondary effects (environmental effects), Discuss?**

GR LOG

Hole size: increasing hole size decreases count rates.

Mud weight: increasing mud weight decreases count rates.

Centering: centering the tool decreases count rates.

Mud type: KCl muds increase potassium count rates in spectral tools; barite-weighted muds affect all count rates.

Logging Speed: In older logs, the logging speed may cause some variation in the response, with logs acquired at a faster speed having somewhat less definition and activity than those acquired at slower speeds.

CALIPER

In highly deviated holes, the caliper mechanism may not be strong enough to support the weight of the logging tool, and may not indicate the actual diameter of the hole.

SONIC LOG

Enlarged borehole, formation fractures, gas in the borehole or formation, or improper centralization can produce signal attenuation resulting in "cycle skipping", or DT spikes to higher values.

DENSITY LOG

Enlarged borehole (>9 inches): RHOB < formation bulk density (DPHI > PHIactual).

NEUTRON LOG

Enlarged borehole: NPHI > PHIact

Mudcake: NPHI < PHIactual

Borehole salinity: NPHI < PHIactual

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Formation salinity: NPHI > PHIactual

Mud weight: NPHI < PHIactual

Pressure: NPHI > PHIactual

Temperature: NPHI < PHIactual

Temperature and pressure have the greatest effects on the the Neutron log.

The Neutron is not as severely affected by rough borehole as the Density log.

INDUCTION LOG

Borehole effects can be large when the formation resistivity is greater than 100 ohm-meters, or if the borehole is large, or if the mud is very conductive. The effect is greater on the medium induction than on the deep induction, especially if the proper standoff is not used.

Bed thickness effects are noticeable when bed thickness is less than eight feet, or when adjacent beds have large resistivity contrasts (e.g., 18 foot thick bed with an apparent resistivity of 30 ohm-m and 1 ohm-m shoulder (shale) beds).

No invasion corrections are needed when the ratio: RILM/RILD < 1.2.

The induction works in non-conducting muds or in air-filled boreholes.

The induction is most effective in fresh muds and low formation resistivities.

LATEROLOG

Borehole size corrections are usually neglected unless the borehole diameter is greater than 12 inches. Bed thickness corrections are small for beds greater than 4 feet thick unless the resistivity contrast is high for the bed resistivity compared to the shoulder bed. No invasion corrections are needed when the ratio: RLLD/RLLS < 1.05. The laterolog must have conducting fluid in the borehole; it will not work in air filled holes or oil based muds.

The laterolog is most effective in salty muds and high formation resistivities.

MICRORESISTIVITY LOG

Micro Laterologs provide good Rxo readings for invasion thicknesses of as little as four inches, but require mudcake corrections for mudcakes larger than 1/4 inch. On the other hand, no mud cake correction is required for the Proximity log unless mudcake thickness is over 3/4 inch or very high Rxo to mudcake resistivity (Rmc) ratios exist. However, the Proximity log has a much larger depth of investigation, and unless flushing has proceeded to 40 inches from the wellbore, one cannot be sure of getting an Rxo reading not affected by the uninvaded rock resistivity. The MSFL tool is a compromise to give reasonable Rxo readings without requiring mudcake correction except for large mudcakes

Rough hole will cause the pad to lose contact with the borehole wall. No corrections can be made to the data to correct for the effect.