Answer the Following questions:

I- Write briefly on the following…………………………. (18 mark)

1- Noises and their types……………………………….(9 mark)

NOISES

Noise on a seismic reflection profile can be defined as the deflection of a seismic trace caused by anything other than energy reflected once from an interface. Noise can be natural, cultural, or induced by the seismic method itself.

- Natural Noise

Seismic receivers (geophones) can be shaken as the result of natural phenomena. The wind shakes trees, bushes, and other objects, causing vibrations of the ground that are recorded by the geophones. Likewise, animals walking near geophones, or water flowing in nearby streams can cause ground vibrations. Wind, rain, and animals can also shake the cables connecting geophones, causing the geophones to vibrate.

- Cultural Noise

Activities of people can contribute to noise. Cars, trucks, trains, as well as people walking near the survey line, cause the ground to rattle. Electrical

power lines cause a magnetic field which can interfere with electrical systems of a seismic survey.

- Noise Induced by Seismic Acquisition and processing

The seismic reflection method attempts to image primary reflections (Figs.). Other seismic events, or phenomena introduced by acquisition or processing, interfere with the primary reflections. Rayleigh waves (also referred to as groundroll, Fig.) appear as low-frequency events cutting across the reflected arrivals. Direct waves, critically refracted waves, and diffractions (energy radiating from a point source) can also arrive at the same time as reflections (Fig.).

Multiple reflections (energy reflected more than once from the same interface) also interfere (Figs.).

Seismic surveys best attenuate noise when survey lines are straight and continuous. Surveys may have to skip or go around areas with buildings, highways, rivers or other obstructions, causing gaps or bends in the recorded data. Noise can also be introduced in the processing of data, through factors like over-migration or poor normal moveout corrections (Fig.).

2- Multiples and their types……………………………….(9 mark)

Multiple Reflection

Primary reflection is a seismic event whose energy has been reflected once. Multiples, in contrast, are events whose energy has been reflected more than once. A goal of seismic data processing is to enhance primary reflections, which are then interpreted as subsurface interfaces.

Multiply reflected seismic energy, or any event in seismic data that has incurred more than one reflection in its travel path. Depending on their time delay from the primary events with which they are associated, multiples are characterized as short-path or peg-leg, implying that they interfere with the primary reflection, or long-path, where they appear as

separate events. Multiples from the water bottom (the interface of the base of water and the rock or sediment beneath it) and the air-water interface are common in marine seismic data, and are suppressed by seismic processing.

a.   Short-path multiple

Multiply-reflected seismic energy with a shorter travel path than long-path multiples. Short-path multiples tend to come from shallow subsurface phenomena or highly cyclical sedimentation and arrive soon after, and sometimes very near, the primary reflections. Short-path multiples are less obvious than most long-path multiples and are less easily removed by seismic processing.

Ghost multiple is a short-path multiple, or a spurious reflection that occurs when seismic energy initially reverberates upward from the shallow subsurface and then is reflected downward, such as at the base of weathering or between sources and receivers and the sea surface.

Peg-leg multiple is a type of short-path multiple, or multiply-reflected seismic energy, having an asymmetric path. Short-path multiples are added to primary reflections, tend to come from shallow subsurface phenomena and highly cyclical deposition, and can be suppressed by seismic processing. In some cases, the period of the peg-leg multiple is so brief that it interferes with primary reflections, and its interference causes a loss of high frequencies in the wavelet.

II- Chose the most accurate answer: ………………………. (15 mark)

1- A seismic survey is conducted in a region with two layers. The top layer is shale, with density 2.0 g/cm3, and seismic velocity of 2900m/s, and the bottom layer is sandstone, with a density of 2.1 g/cm3, and a seismic velocity of 3000m/s. The reflection coefficient will be

a. Positive

b. Negative

c. Zero

2- Which of the following statements about the overall P-wave velocity in sedimentary rocks is not true?

a) Velocity decreases with porosity increases.

b) Velocity increases from sandstone to limestone to dolomite.

c) In the same rock, P-wave velocity is greater, when gas fills the pores, than when oil or water fills them.

d) Velocity increases with age, depth, pressure, or cementation.

3- In three-dimensional seismic data (3D) acquisition.

a) Geophones are placed in a two-dimensional array on the Earth surface.

b) Geophones are placed in a one-dimensional array on the Earth surface.

c) Geophones are placed vertical in the well.

4- In a seismic reflection survey each trace in the processed section …..

a) Is the signal that would be received if the source and receiver were coincident.

b. Is the measured signal from the geophone that is closest to the receiver.

c. Is the signal from the common offset array.

d. Is the signal from a common midpoint array.

5- The acoustic impedance of a medium …………………..

a) is equal to the value of the seismic velocity

b) <u>depends upon the product of density and velocity</u>

c) depends upon the ratio of density and velocity

d) depends upon velocity and bulk modulus

6- In single-beam echo sounders, the travel time is proportional to …..

a) The water depth and the velocity of the ship.

b) The density of the seawater column and the velocity of the ship.

c) <u>The water depth and density of the seawater column.</u>

7- Which of the following is NOT a seismic exploration source?

a) <u>Earthquakes</u>

b) Airgun

c) Explosives

8- A total *seismic trace* can be viewed as the result of convolving:

a) The input seismic signal, convolved with a reflection coefficient time series (resulting from acoustic impedance changes).

b) Reflection coefficient time series (resulting from acoustic impedance changes) and noise superimposed.

c) <u>The input seismic signal, convolved with a reflection coefficient time series (resulting from acoustic impedance changes) and Noise superimposed.</u>

8- What are the units on the y axis of a seismic profile?

a) Time

b) Two way time

c) Depth

9- The ability to see stratigraphic changes (Seismic Resolution and Definition) on seismic profiles depends on:

a) Signal-to-noise ratio and Frequencies.

b) Signal-to-noise ratio, Frequencies and Broad bandwidth (Octave).

c) Frequencies and Broad bandwidth (Octave).

10- The geometry of an array (or *geophone group)* is designed to:

a) Cancel certain unwanted signals.

b) Enhance the reflected events.

c) Cancel certain unwanted signals and enhance the reflected events.

III- Complete the sentences …………………………… (15 mark)

1- A seismic profile (seismic section) is made up of numerous vertical CMP wiggle traces which are displayed in two way time.

2- The geometry of a receiver array (or *geophone group)* is designed to cancel unwanted signals (noise or groundroll).

3- One-dimensional seismic data (1D) applied to determination of sonic velocities of strata penetrated by hole.

4- The Common Midpoint (CMP) method provides redundancy of information that enhances signal-to-noise ratio.

5- The type of noise caused by electrical power lines on a seismic reflection profile is defined as (Cultural Noise).

6- <u>The fold of stack</u> is the number of traces from the CMP gather comprising a stacked trace.

7- The <u>stacking velocity</u> is the velocity that best corrects an event on a CMP gather for normal moveout.

8- <u>Minimum Phase</u> input signal is the result of an explosive source, like *dynamite* on land or *air guns* at sea.

9- <u>Four-dimensional seismic data (4D)</u> is made to determine the changes occurring in the reservoir as a result of hydrocarbon production or injection of water or gas into the reservoir by comparing the repeated datasets.

10- <u>The interval velocity</u> is the average velocity of the material between two interfaces.