



Roll No.																			
----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**PRESIDENCY UNIVERSITY  
BENGALURU**

**SCHOOL OF ENGINEERING**

**TEST 1**

**Sem & AY:** Odd Sem. 2019-20

**Date:** 27.09.2019

**Course Code:** PET 218

**Time:** 02:30PM to 03:30PM

**Course Name:** Petroleum Geology

**Max Marks:** 40

**Program & Sem:** B.Tech.(PET) & III

**Weightage:** 20%

---

**Instructions:**

- (i) Read the questions correctly and answer accordingly.
  - (ii) Question paper consists of 3 parts.
  - (iii) To the point answer will be appreciated.
- 

**Part A [Memory Recall Questions]**

**Answer both the Questions. Each Question carries six marks.**

**(2Qx6M=12M)**

1. Fill in the blank with appropriate word.

[6M]

(C.O.NO. 1) [Knowledge]

- i. Polar Radius of the Earth is \_\_\_\_\_ km.
- ii. \_\_\_\_\_ Science is also known as Geology.
- iii. \_\_\_\_\_ is a branch dealing with the physical, chemical and optical properties of the minerals present within the rocks.
- iv. The word 'solar' is derived from Latin word \_\_\_\_\_ means sun.
- v. \_\_\_\_\_ is at a distance of 1.5 AU from the sun.
- vi. Mercury, Venus, Earth and Mars are called \_\_\_\_\_ Planets.

2. Choose the correct answer.

(C.O.NO. 1) [Knowledge]

- i. \_\_\_\_\_ explains the geometry of different landforms.
  - (a) Geotectonics
  - (b) Geomorphology
  - (c) Physical Geology
  - (d) Hydrology
- ii. Earth's axis of rotation is inclined by \_\_\_\_\_ to the orbital plane.
  - (a) 23° 26'22"
  - (b) 23° 26'23"
  - (c) 23° 26'21"
  - (d) 23° 25'21"

- iii. \_\_\_\_\_ Layer protects life by absorbing dangerous ultra violet rays in Sun's energy.
- |                       |           |
|-----------------------|-----------|
| (a) Air               | (b) Ozone |
| (c) Geomagnetic field | (d) Water |
- iv. The earth completes a full rotation around the sun in \_\_\_\_\_ days, called its Annual Motion.
- |            |            |
|------------|------------|
| (a) 364.25 | (b) 365.25 |
| (c) 364.26 | (d) 365.26 |
- v. As the sun is situated at one focal point of the earth's elliptic orbit, its distance from the earth becomes variable in a year. When the earth comes nearest to the sun called \_\_\_\_\_.
- |                |                         |
|----------------|-------------------------|
| (a) Perihelion | (b) Precession          |
| (c) Aphelion   | (d) Rotational Velocity |
- vi. \_\_\_\_\_ Trench is the highest distortion in oceanic portion of the earth.
- |                |                |
|----------------|----------------|
| (a) Diamantina | (b) Mariana    |
| (c) Tonga      | (d) Philippine |

### Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries six marks.

(4Qx6M=24M)

3. Explain why the entire system of solid earth, hydrosphere, atmosphere, and biosphere is regarded nearly as a closed system. Briefly describe hydrosphere and biosphere. [2M + 4M]  
(C.O.NO. 1) [Comprehension]
4. Why the structure and composition of the constituent matters of the earth yet not studied directly? Explain how the velocity and paths of seismic wave study helped us understanding internal structure of the earth. [2M + 4M]  
(C.O.NO. 1) [Comprehension]
5. What are consequences of tectonic plate movements? Explain 'Mantle Convection' as one the reasons behind tectonic plate movements. [2M + 4M]  
(C.O.NO. 1) [Comprehension]
6. Explain 'Erosion'. Write at least four points for comparing 'Weathering' and 'Erosion'. Explain 'Denudation' with schematic diagram. [2M + 2M + 2M]  
(C.O.NO. 2) [Comprehension]

### Part C [Problem Solving Questions]

Answer the Question. The Question carries four marks.

(1Qx4M=4M)

7. It is observed that, in general, the rate of erosion (down-cutting) decreases and width of the river increases from the source to mouth of the rivers. Explain the possible reason(s) behind it. [4M]  
(C.O.NO. 2) [Comprehension]



## SCHOOL OF ENGINEERING

**Semester:** III

**Date:** 27-09-2019

**Course Code:** PET 218

**Time:** 02:30 PM – 03:30 PM

**Course Name:** Petroleum Geology

**Max Marks:** 40

**Program & Sem:** B.Tech. PET & III

**Weightage:** 20%

### Extract of question distribution [outcome wise & level wise]

Q. No.	CO No.	Unit / Module Number / Unit / Module Title	Memory Recall Type [Marks allotted] Bloom's Levels	Thought Provoking Type [Marks allotted] Bloom's Levels	Problem Solving Type [Marks allotted]	Total Marks
			K	C	C	
1	1 (15%)	Unit – I: Introduction to Geology	6			6
2	1 (15%)	Unit – I: Introduction to Geology	6			6
3	1 (15%)	Unit – I: Introduction to Geology		6		6
4	1 (15%)	Unit – I: Introduction to Geology		6		6
5	1 (15%)	Unit – I: Introduction to Geology		6		6
6	2 (15%)	Unit – I: Introduction to Geology		6		6
7	2 (10%)	Unit – I: Introduction to Geology			4	4
	Total Marks		40			40

K = Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60% of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I here certify that All the questions are set as per the above lines Dr Suman  
Paul

## Annexure- II: Format of Answer Scheme



### SCHOOL OF ENGINEERING

#### SOLUTION

Semester: III

Course Code: PET 218

Course Name: Petroleum Geology

Program & Sem: B.Tech. PET & III

Date: 27-09-2019

Time: 02:30 PM – 03:30 PM

Max Marks: 40

Weightage: 20%

#### Part A

(2Q x 6M = 12 Marks)

Q. No.	Solution	Scheme of Marking	Max. Time required for each Question
1	i. 6378 ii. Earth iii. Petrology iv. Sun v. Jupiter vi. Outer	(1M + 1M + 1M + 1M + 1M + 1M)	4
2	i. (a) ii. (d) iii. (c) iv. (b) v. (c) vi. (b)	(1M + 1M + 1M + 1M + 1M + 1M)	4

#### Part B

(4Q x 6M = 24 Marks)

Q. No.	Solution	Scheme of Marking	Max. Time required for each Question
3	The entire system of solid earth, hydrosphere, atmosphere, and biosphere is expected to be in a steady state because the loss from any members of one system is balanced by addition of other. Only hydrogen and helium are light enough to escape from this system at the uppermost level of atmosphere.  <b>Atmosphere:</b> The air which envelops the earth and extends up to a considerable height from the surface of the earth is called atmosphere. It consists of a mixture of various gases	2M + (2M + 2M)	10

	<p>and is held to the earth by gravitational attraction. This envelope of air is densest at sea level and thins rapidly upwards. The atmosphere constitutes a very insignificant percentage of mass of the earth.</p> <p>Structure of Atmosphere The structure of atmosphere consists of five basic layers:</p> <ul style="list-style-type: none"> <li>(a) Troposphere;</li> <li>(b) Stratosphere;</li> <li>(c) Mesosphere;</li> <li>(d) Ionosphere; and</li> <li>(e) Exosphere.</li> </ul> <p><b>(a) Troposphere:</b> It extends up to a height of 12 km on an average from the surface of the earth. At equator the thickness of the troposphere is the maximum. It is densest of all the layers. It is the locale of all the vital atmospheric processes which create the climatic and weather conditions on the surface of the earth. About half of the mass of air comprising the entire atmosphere is concentrated in this layer. The temperature of air in this layer decreases at the rate of 1°C per 165 meters of height. Tropopause is an undefined region lying between the troposphere and stratosphere and there prevails a constant temperature in this region.</p> <p><b>(b) Stratosphere:</b> In this region air is at rest. It is an isothermal region and is free of clouds, dust and water vapour. It extends up to a height of about 50 kilometers. Its upper strata is rich in ozone which prevents ultraviolet radiation by absorbing them and a very little is filtered through it, which does not harm living organisms.</p> <p><b>(c) Mesosphere:</b> It is a very cold region and extends up to a height of 80 kilometers from the surface of the earth. At a height of 60 kilometers there is an intermediate layer which is known as radio-waves absorbing layer.</p> <p><b>(d) Ionosphere:</b> It is the region of electrically charged of ionized air lying next to mesosphere. It protects us from falling meteorites. It extends up to a height of about 150 kilometers.</p> <p><b>(e) Exosphere:</b> It is the uppermost region of ionosphere and is the fringe of atmosphere. Its boundaries are unknown.</p>		
4	<p>The structure and composition of the constituent matters of the earth yet not studied directly because it is not possible to reach to the core of the earth with the existing technology the temperature increasing rapidly towards the core of the earth.</p> <p>The velocity of seismic waves depends upon the density and rigidity of the medium (rocks of earth's interior) that can be reflecting the nature of the medium. Seismic waves are elastic, i.e. they propagate by means of elastic motion of the particles of the medium. They are divided, accordingly to their nature of propagation into longitudinal wave and transverse wave.</p> <p>In any area, the longitudinal wave is registered first and thus often designated as Primary wave or P-wave (Latin word 'prima' means first) while transverse wave is registered</p>	2M + 4M	10

	<p>subsequently, called Secondary wave or S-wave (Latin word 'secunda' means second).</p> <p>The shelled structure of the earth's interior and the existence of the boundaries between the different shells are marked by abrupt jump or change of velocities of the seismic waves.</p> <p>Waves are also reflected and refracted from these boundaries causing repeated registration of the same wave that had earlier been recorded as direct one. These also indicate the presence of several such disconformities or boundaries below the surface or in other word a layered structure of the earth.</p> <p><b>Comparative study between P-wave and S-wave</b></p> <table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Primary (P) Wave</th> <th style="text-align: left;">Both</th> <th style="text-align: left;">Secondary (S) Wave</th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;"> <ul style="list-style-type: none"> <li>• travels through liquids and solids</li> <li>• pushes and pulls materials as they move through Earth</li> <li>• travel about 8 km per second</li> <li>• cause the first movement you feel in an earthquake</li> </ul> </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> <li>• originate from same focus</li> <li>• begin at same time</li> <li>• can be felt at Earth's surface</li> </ul> </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> <li>• travels through solids only</li> <li>• makes the rocks vibrate up, down, or sideways</li> <li>• travel at about 4.5 km per second</li> <li>• usually cause more building damage</li> </ul> </td> </tr> </tbody> </table>	Primary (P) Wave	Both	Secondary (S) Wave	<ul style="list-style-type: none"> <li>• travels through liquids and solids</li> <li>• pushes and pulls materials as they move through Earth</li> <li>• travel about 8 km per second</li> <li>• cause the first movement you feel in an earthquake</li> </ul>	<ul style="list-style-type: none"> <li>• originate from same focus</li> <li>• begin at same time</li> <li>• can be felt at Earth's surface</li> </ul>	<ul style="list-style-type: none"> <li>• travels through solids only</li> <li>• makes the rocks vibrate up, down, or sideways</li> <li>• travel at about 4.5 km per second</li> <li>• usually cause more building damage</li> </ul>		
Primary (P) Wave	Both	Secondary (S) Wave							
<ul style="list-style-type: none"> <li>• travels through liquids and solids</li> <li>• pushes and pulls materials as they move through Earth</li> <li>• travel about 8 km per second</li> <li>• cause the first movement you feel in an earthquake</li> </ul>	<ul style="list-style-type: none"> <li>• originate from same focus</li> <li>• begin at same time</li> <li>• can be felt at Earth's surface</li> </ul>	<ul style="list-style-type: none"> <li>• travels through solids only</li> <li>• makes the rocks vibrate up, down, or sideways</li> <li>• travel at about 4.5 km per second</li> <li>• usually cause more building damage</li> </ul>							
5	<p><b>Classification of Earthquakes</b></p> <p>Earthquakes are grouped based on their depth of origin, and are described as shallow or intermediate or deeper earthquakes. Earthquakes with a focus depth less than 60 km are called <b>shallow</b> earthquakes. If the depth is greater than 60 km but less than 300 km, they are called <b>intermediate</b> earthquakes. Other which have a focus depth greater than 300 km are called <b>deeper</b> earthquakes.</p> <p>Occurrence of earthquakes at depths greater than 700 km are extremely rare because at greater depths the rocks are very hot and under high pressure so they deform by flowing rather than breaking and faulting.</p> <p><b>Causes of Earthquakes</b></p> <p>These earthquakes occur due to variety of reasons as follows:</p> <ol style="list-style-type: none"> <li>(i) Due to huge water falls;</li> <li>(ii) Due to meteorite impacts;</li> <li>(iii) Due to landslides;</li> <li>(iv) Due to volcanic eruptions;</li> <li>(v) Due to tsunamis</li> <li>(vi) Due to collapse of caves, tunnels etc.;</li> <li>(vii) Due to dams and reservoirs failure.</li> <li>(viii) Due to man-made explosions</li> </ol>	2M + 2M + 2M	10						
6	<p><b>Weathering:</b> Weathering is the total effect of all the various sub-aerial processes that co-operate in bringing about the decay and disintegration of rocks provided that no large-scale removal of the loosen products is involved. The work of rain</p>	2M + 2M + 2M	10						

wash and that of wind are both essentially erosional and hence should be excluded. However, the loosened products of weathering under the influence of gravity always have a tendency to fall or slip downwards making their small-scale displacement from their original place but this indeed helps further weathering of rocks with the exposure of fresh rock surface.

In particular, weathering occurs where rocks and minerals come in contact with the atmosphere, surficial water and organic life under conditions that are normal to the surface of the earth. Weathering is the initial stage in the process of denudation. An essential feature of the process is that it affects in-situ rocks; no transportation is involved. The products of rock weathering tend to accumulate in a soft surface layer called regolith.

The regolith grades downward into solid, unaltered rock, known simply as bed rock. Weathering helps erosion but is not a part of it. There can be weathering without erosion and erosion without weathering. There are three types of weathering:

- (a) Physical or Mechanical weathering,
- (b) Chemical weathering and
- (c) Biological weathering.

**Advantages of Weathering:**

- Weathering produces soil which is vital for agriculture and for the production of agricultural crops;
- Weathering makes rocks into porous and permeable which allow the movement of groundwater in case of hard rocks like granites;
- Economic minerals like bauxite deposits are also formed due to weathering;
- Chemical weathering is important in the formation of some ore deposits particularly sulphides.

**Disadvantages of Weathering**

Weathering is not a welcome process, because it reduces the strength, durability and good appearance of rocks;

- Therefore, the weathered rocks are unfit to be at the site of foundation in case of civil structures like dams and bridges;
- Since weathered rocks are characterized by loose characters i.e., strength, durability etc., they become unfit for the formation of road metal or as a building stone;
- Weathered rocks are being weak, therefore unsuitable for tunneling;
- Occurrence of weathered zone in the upstream side creates silting problem in case of reservoirs as the accumulation of rapid silt reduces their reservoir capacity;
- Loose boulders due to weathering along steep slopes may cause landslides.

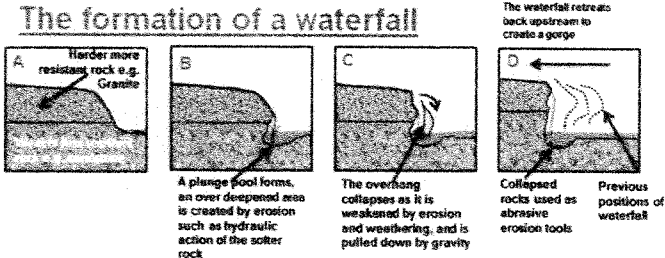
**Denudation:** Weathering and erosion are sometimes misjudged by thinking that they are the same thing or



	<p>somewhat similar. But the fact is weathering and erosion are completely different actions with different mechanism. The similarity between these two actions is that they both are parts of a single process called <b>denudation</b>, lowering of the surface of the earth.</p>		
--	---	--	--

**Part C**

(1Q x 4M = 4 Marks)

Q. No.	Solution	Scheme of Marking	Max. Time required for each Question
7	<p>It is observed that the continuous undercutting finally causes collapse of resistant but unsupported cap rock from the downstream side and that results gradual retreat of the waterfall but towards the upstream side because in most of the cases, when an outcrop of a resistant rock is underlain downstream by a soft rock, the latter is relatively quickly worn out and undercut below the resistant cap-rock forming an initial rapid. Rapids and waterfalls results when there is a sudden increase of gradient of the river. Waterfalls are generated where water descends vertically. Waterfalls are usually created by a change in rock type. As the river moves from hard rock to soft rock, erosion increases creating a waterfall. More down cutting and undercutting of the soft rock, ultimately produces a vertical cliff of tens or hundreds of meter height producing waterfall. The continuous undercutting finally causes collapse of resistant but unsupported cap rock from the downstream side and that results gradual retreat of the waterfall but towards upstream side.</p> <p align="center"><b>The formation of a waterfall</b></p>  <p>The diagram illustrates the formation of a waterfall in four stages:</p> <ul style="list-style-type: none"> <li><b>A:</b> A plunge pool forms, an over deepened area is created by erosion such as hydraulic action of the softer rock.</li> <li><b>B:</b> The overhang collapses as it is weakened by erosion and weathering, and is pulled down by gravity.</li> <li><b>C:</b> Collapsed rocks used as abrasive erosion tools.</li> <li><b>D:</b> The waterfall retreats back upstream to create a gorge.</li> </ul>	4M	10





Roll No.																				
----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**PRESIDENCY UNIVERSITY  
BENGALURU**

**SCHOOL OF ENGINEERING**

**TEST – 2**

**Sem & AY:** Odd Sem 2019-20

**Course Code:** PET 218

**Course Name:** PETROLEUM GEOLOGY

**Program & Sem:** B.Tech. (PET) & III

**Date:** 16.11.2019

**Time:** 2:30 PM to 3:30 PM

**Max Marks:** 40

**Weightage:** 20%

**Instructions:**

- (i) Read the questions correctly and answer accordingly.
- (ii) Question paper consists of 3 parts.
- (iii) To the point answer will be appreciated.

**Part A [Memory Recall Questions]**

**Answer all the Questions. Each Sub Question carries one marks.**

**(2Q=14M)**

1. Fill in the blank with appropriate word. [7M](C.O.N.O.3 & C.O.N.O.4) [Knowledge]
  - i. The word 'Petroleum' is derived from Greek work '\_\_\_\_\_'.  
ii. To get oil and natural gas are usually found together in the \_\_\_\_\_ of the earth.  
iii. Source rocks are considered as one of the necessary elements of working \_\_\_\_\_ system.  
iv. Organic material cannot decay too much as it has to keep its \_\_\_\_\_ to generate petroleum.  
v. The amount of Total Organic Carbon is measured by Total \_\_\_\_\_ Technique.  
vi. \_\_\_\_\_ is a well-defined vertical salinity gradient in ocean or other saline water.  
vii. The fuels that come from the remains of living things are called \_\_\_\_\_ fuels.
2. Choose the correct answer. [7M] (C.O.N.O.3 & C.O.N.O.4) [Knowledge]
  - i. \_\_\_\_\_ - an abrupt temperature gradient in a body of water such as a lake, marked by a layer above and below which the water is at different temperatures.  
(a) Thermocline (b) Pycnocline  
(c) Halocline (d) Syncline
  - ii. \_\_\_\_\_ is the solid form of hydrocarbon.  
(a) Crude Oil (b) Asphalt  
(c) Methane (d) Propane
  - iii. Mixture of methane, ethane and propane is known as \_\_\_\_\_.  
(a) LPG (b) LNG  
(c) CNG (d) PNG

- iv. The essential elements of a petroleum system include \_\_\_\_\_.  
 (a) Source Rock (b) Reservoir Rock  
 (c) Cap Rock (d) All the elements mentioned before
- v. The accumulation of vast quantities of living organisms requires ample \_\_\_\_\_ supply.  
 (a) CO<sub>2</sub> (b) O<sub>2</sub>  
 (c) H<sub>2</sub> (d) SO<sub>2</sub>
- vi. \_\_\_\_\_ are formed from terrestrial plant material that has been decomposed by bacterial and fungi under oxic or sub-oxic conditions: they tend to generate mostly gas with associated light oils when thermally cracked during deep burial.  
 (a) Type I Source Rocks (b) Type II Source Rocks  
 (c) Type III Source Rocks (d) Type IV Source Rocks
- vii. \_\_\_\_\_ bed acts as the reservoir rock for shale gas reservoirs.  
 (a) Dolomite (b) Sandstone  
 (c) Limestone (d) Shale

### Part B [Thought Provoking Questions]

**Answer all the Questions. Each Question carries six marks. (3Qx6M=18M)**

3. Why do we find petroleum only in the crust of the earth? Briefly describe the process of petroleum generation with suitable diagram. [2M+4M]  
 (C.O.N.O.3) [Comprehension]
4. Why don't we consider all the shale formations as the source for hydrocarbon generation? What happens to all the organic matter as it gets buried? [2M+4M]  
 (C.O.N.O.4) [Comprehension]
5. Describe the fundamental property of rock that helps us identifying effective reservoir rock. Explain the principal factors that control porosity. [2M+4M]  
 (C.O.N.O.1) [Comprehension]

### Part C [Problem Solving Questions]

**Answer the Question. The Question carries eight marks. (1Qx8M=8M)**

6. In conventional petroleum reservoir, mostly shale and sandstone rocks are considered as source rock and reservoir rock respectively. It is known that all of the components of petroleum system are formed in marine environments. Therefore, petroleum systems should be identified only in offshore areas (marine condition). But we have identified many petroleum systems in onshore (on land) areas also. What could be the reason behind this? Explain your view scientifically and logically from geological point of view with suitable diagram. [2M+6M]  
 (C.O.N.O.4) [Comprehension]



## SCHOOL OF ENGINEERING

**Semester:** III

**Course Code:** PET 218

**Course Name:** Petroleum Geology

**Program & Sem:** B.Tech. PET & III

**Date:** 16-11-2019

**Time:** 02:30 PM – 03:30 PM

**Max Marks:** 40

**Weightage:** 20%

### Extract of question distribution [outcome wise & level wise]

Q. No.	CO No.	Unit / Module Number / Unit / Module Title	Memory Recall Type	Thought Provoking Type	Problem Solving Type	Total Marks
			[Marks allotted] Bloom's Levels	[Marks allotted] Bloom's Levels	[Marks allotted]	
			K	C	C	
1	3 (10%)	Unit II: Introduction to Petroleum Geology	4			7
	4 (7.50%)	Unit III: Source, Reservoir and Cap Rocks	3			
2	3 (7.50%)	Unit II: Introduction to Petroleum Geology	3			7
	4 (10%)	Unit III: Source, Reservoir and Cap Rocks	4			
3	4 (15%)	Unit III: Source, Reservoir and Cap Rocks		6		6
4	4 (15%)	Unit III: Source, Reservoir and Cap Rocks		6		6
5	4 (15%)	Unit III: Source, Reservoir and Cap Rocks		6		6
6	4 (20%)	Unit III: Source, Reservoir and Cap Rocks			8	8
	<b>Total Marks</b>		<b>14</b>	<b>18</b>	<b>8</b>	<b>40</b>

K = Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60% of the questions must be such that even a below average students must be able to attempt, about 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I here certify that all the questions are set as per the above lines - Dr Suman Paul





# SCHOOL OF ENGINEERING

## SOLUTION

Semester: III

Course Code: PET 218

Course Name: Petroleum Geology

Program & Sem: B.Tech. PET & III

Date: 16-11-2019

Time: 02:30 PM – 03:30 PM

Max Marks: 40

Weightage: 20%

### Part A

(2Q x 7M = 14 Marks)

Q. No.	Solution	Scheme of Marking	Max. Time required for each Question
1	i. Petra-oleum ii. Crust iii. petroleum iv. carbon v. Pyrolysis vi. Halocline vii. fossil	$(1M + 1M + 1M + 1M + 1M + 1M + 1M)$	5
2	i. (a) ii. (b) iii. (b) iv. (d) v. (b) vi. (c) vii. (d)	$(1M + 1M + 1M + 1M + 1M + 1M + 1M)$	5

### Part B

(3Q x 6M = 18 Marks)

Q. No.	Solution	Scheme of Marking	Max. Time required for each Question
3	<p>Petroleum is found only in the crust of the earth because the word petroleum is derived from Green word 'Petra-oleum' which means 'Rock-oil' and all the rocks are found within the crust. Petroleum is found in sedimentary rocks.</p> <p>Process of Petroleum Generation:</p>	2M + 4M	10





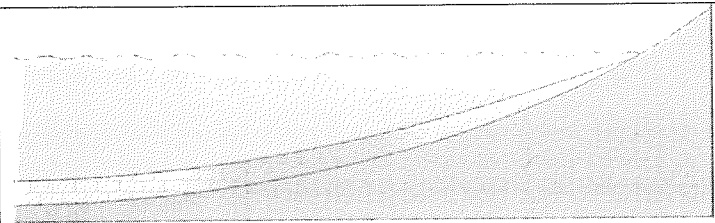
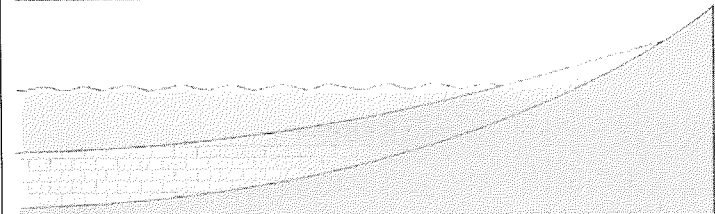
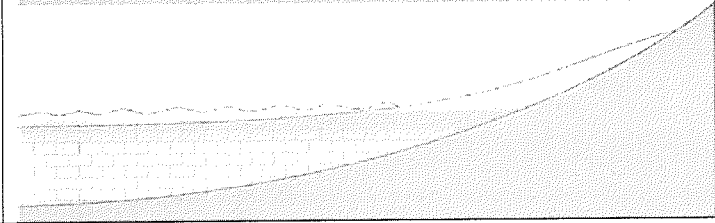
4	<p>We do not consider all the shale formations as the source for hydrocarbon generation because all shale formations does not contain organic matter.</p> <p>Due to continuous process of burial, the increase in pressure and temperature converts the organic matter converted into oil and gas. Three major processes like Diagenesis, Catagenesis and Metagenesis takes place during this conversion.</p> <p>(1) Diagenesis: Shallow subsurface phenomenon that includes biogenic decay (bacteria) and abiotic reactions. Products include Kerogen (the solid remaining) methane, carbon dioxide (bicarbonate at most pH), water, H<sub>2</sub>S. The major change to the solid is that its oxygen content is reduced, but the hydrogen/carbon ratio isn't changed greatly.</p> <p>(2) Catagenesis: Continued burial process where fluid hydrocarbons is released from the solid matter. Initially liquids, and later at higher temperatures gas. The hydrogen/carbon ratio decreases, but the O/C ratio doesn't change much.</p> <p>(3) Metagenesis: Continued burial process where pressure (P) and temperature (T) approaches metamorphic values. Largely methane expelled at these T and P. The H/C ratio continues to decline in the solid as the fluid H/C ratio increase. Remaining product is graphite.</p>	2M + 4M	10
5	<p>Permeability is the fundamental property of rock that helps us identifying effective reservoir rock. A measure of the ease with which a fluid (or gas) flows through connecting pore spaces of reservoir rock is called permeability. This natural plumbing system conducts fluids toward the borehole and is very important in predicting the rate of production from a reservoir.</p> <p>Permeability depends largely on –</p> <p>(1) Size of pore openings  (2) Degree and size of pore connectivity  (3) Degree and type of cementing material between rock grains</p> <p>The principal factors that control porosity are</p> <ol style="list-style-type: none"> <li>1. Grain or Particle Size</li> <li>2. Grain and Particle Shape</li> <li>3. Method of Deposition</li> <li>4. Effects of Compaction</li> </ol>	2M + 4M	10

### Part C

(1Q x 8M = 8 Marks)

Q. No.	Solution	Scheme of Marking	Max. Time required for each Question
6	<p>The petroleum systems that we identified in land (onshore) today were probably formed in marine environment (offshore condition) million years back. This happens due to marine regression. Marine regression is a geological process occurring when areas of submerged seafloor are exposed above the sea level.</p>	2M + 6M	15







Roll No

**PRESIDENCY UNIVERSITY  
BENGALURU**

**SCHOOL OF ENGINEERING**

**END TERM FINAL EXAMINATION**

**Semester:** Odd Semester: 2019 - 20

**Course Code:** PET 218

**Course Name:** PETROLEUM GEOLOGY

**Program & Sem:** B.Tech.(PET) & III

**Date:** 23 December 2019

**Time:** 1:00 PM to 4:00 PM

**Max Marks:** 80

**Weightage:** 40%

**Instructions:**

- (i) Read the questions carefully and answer accordingly.
- (ii) Question paper consists of 3 parts.
- (iii) To the point answer will be appreciated.

**Part A [Memory Recall Questions]**

**Answer all the Questions. Each Question carries 5 marks.**

**(6Qx5M=30M)**

1. Define different elements of 'Hydrosphere'.  
[5M] (C.O.No.1) [Knowledge]
2. (a) Why was the Continental Drift Hypothesis of Wegener rejected?  
(b) How the Subduction Process related with Plate Tectonics?  
[2M+3M] (C.O.No.2) [Knowledge]
3. Name at least three essential elements and two processes associated with any Petroleum Systems.  
[5M] (C.O.No.3) [Knowledge]
4. List the reservoir parameters used for formation evaluation using well log data.  
[5M] (C.O.No.4) [Knowledge]
5. (a) Define Primary Migration and Secondary migration.  
(b) What are the two major obstacles needed to be overcome in developing models of primary migration?  
[3M+2M] (C.O.No.5) [Knowledge]
6. (a) Define 'Sedimentary Basin'.  
(b) List at least two Category I, two Category II and two Category III Sedimentary Basins of India.  
[2M+3M] (C.O.No.6) [Knowledge]

### Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 10 marks.

(3Qx10M=30M)

7. (a) Can all the shale formations be considered as the source for hydrocarbon generation? Justify your answer.  
(b) Source rocks are classified from the types of Kerogen that they contain, which in turn governs the type of hydrocarbons that will be generated. Classify the Source Rock based on their hydrocarbon potentiality.  
[3M+7M] (C.O.No.4) [Comprehension]
8. (a) Why the 'Migration Loss' takes place in petroleum reservoir?  
(b) Is the migration loss play any significant role in petroleum drilling?  
(c) Explain the differences between primary Migration and Secondary Migration.  
[2M+3M+5M] (C.O.No.5) [Comprehension]
9. (a) What are the necessary conditions needed to be fulfilled for formation of sedimentary basins?  
(b) How are the Sedimentary Basins of India categorized? Explain your answer.  
[5M+5M] (C.O.No.6) [Comprehension]

### Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries 10 marks.

(2Qx10M=20M)

10. Porosity of any rock formation can be influenced by many factors. Explain at least five factors that influence porosity of any formation.  
(C.O.No.4) [Comprehension]
11. Continents break up and drift apart to create ocean basins as much as 500 km wide, which can subsequently close again as ocean-floor crust is subducted in trenches. The opening and closing of an ocean basin can be explained by a cycle. Name the cycle that explains opening and closing of ocean basins and explain that cycle elaborately with proper schematic diagram.  
(C.O.No.6) [Comprehension]



## SCHOOL OF ENGINEERING

### END TERM FINAL EXAMINATION

#### Extract of question distribution [Outcome wise & Level wise]


Q. No.	C.O. No. (% age of C.O.)	Unit / Module Number / Unit / Module Title	Memory Recall Type [30 Marks] Knowledge Level	Thought Provoking Type [30 Marks] Comprehension Level	Problem Solving Type [20 Marks] Comprehension Level	Total Marks
			K	C	C	
1	CO1	Unit I: Introduction to Geology	5			5
2	CO2	Unit I: Introduction to Geology	5			5
3	CO3	Unit II: Introduction to Petroleum Geology	5			5
4	CO4	Unit III: Source, Reservoir and Cap Rocks	5			5
5	CO5	Unit IV: Migration, Accumulation and Entrapment	5			5
6	CO6	Unit V: Sedimentary Basins	5			5
7	CO4	Unit III: Source, Reservoir and Cap Rocks		10		10
8	CO5	Unit IV: Migration, Accumulation and Entrapment		10		10
9	CO6	Unit V: Sedimentary Basins		10		10
10	CO4	Unit III: Source, Reservoir and Cap Rocks			10	10
11	CO6	Unit V: Sedimentary Basins			10	10
<b>Total Marks</b>			30	30	20	80

K = Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60% of the questions must be such that even a below average students must be able to attempt, about 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

  
 12/12/19

Reviewer Comment:

# Format of Answer Scheme



## SCHOOL OF ENGINEERING

### SOLUTION

Semester: Odd Semester: 2019 - 20

Course Code: PET 218

Course Name: Petroleum Geology

Program & Sem: B. Tech. PET & 3<sup>rd</sup>

Date: 23 Dec 2019

Time: 01:00 PM – 04:00 PM

Max Marks: 80

Weightage: 40%

#### Part A

(6Q x 5M = 30Marks)

Q. No.	Solution	Scheme of Marking	Max. Time required for each Question
1	<p><b>Hydrosphere:</b></p> <p>The hydrosphere includes all the natural water occurs, i.e.,</p> <p>(i) on the earth surface which occurs within oceans, lakes, rivers and covers about three quarter of the earth surface are called <b>surface water</b>,</p> <p>(ii) below the earth surface (subsurface) which occur in the pore spaces within soil and sand, fissures within rocks are called <b>groundwater</b>, and</p> <p>(iii) as trapped water in the form of <b>ice</b> in the polar zones and in zones of high altitudes.</p> <p>The proportion of water content in different sectors of hydrosphere remains more or less constant due to continuous operation of a natural cycle called hydrologic cycle.</p>	5	10
2	<p>The Continental Drift Hypothesis of Wegener was rejected because the mechanism that Wegener suggested was easily disproved by geologic evidence. The evidence that Wegener needed to support his <b>hypothesis</b> was discovered nearly two decades after his death.</p> <p><b>Subduction</b> is a geological process that takes place at convergent boundaries of tectonic plates where one plate move under another and is forced to sink due to gravity into the mantle. Regions where this process occurs are known as subduction zones.</p>	2 + 3	10
3	<p>The essential elements of a petroleum system include the following:</p> <ul style="list-style-type: none"> <li>• Source rock</li> <li>• Reservoir rock</li> <li>• Seal rock</li> <li>• Overburden rock</li> </ul> <p>Petroleum systems have two processes:</p> <ul style="list-style-type: none"> <li>• Generation–migration–accumulation of hydrocarbons</li> <li>• Trap formation</li> </ul> <p>These essential elements and processes must be correctly placed in time and space so that organic matter included in a source rock can be converted into a petroleum accumulation. A petroleum system exists wherever all these</p>	3 + 2	10

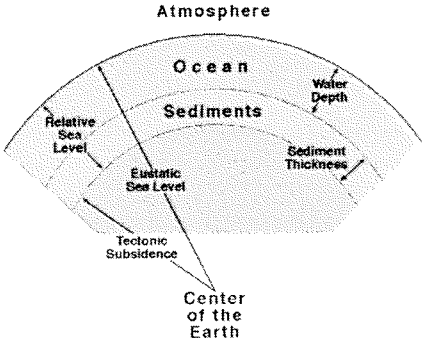


	essential elements and processes are known to occur or are thought to have a reasonable chance or probability to occur.		
4	The reservoir parameters used for formation evaluation using well log data are: (1) Porosity (2) Water Saturation (3) Hydrocarbon Saturation (4) Reservoir Thickness and Area (5) Permeability	5	10
5	<b>Primary Migration:</b> The movement of hydrocarbons out of the source rock into the reservoir rock is called primary migration.  <b>Secondary Migration:</b> The movement of hydrocarbons through the reservoir rock and into a trap is called secondary migration.  The two major obstacles needed to be overcome in developing models of primary migration are: (1) The pore size of deeply buried shales is smaller than most hydrocarbon molecules; and (2) hydrocarbon molecules have very low solubility in water, which fills the pores of the source rocks.	3 + 2	10
6	<b>Sedimentary Basin:</b> A sedimentary basin is a depression of some kind capable of trapping sediment. Subsidence of the upper surface of the crust must take place to form such a depression.  <b>Category I Sedimentary Basins of India:</b> - Cambay - Assam Shelf - Mumbai Offshore - Krishna Godavari - Cauvery - Assam – Arakan Fold Belt - Rajasthan  <b>Category II Sedimentary Basins of India:</b> - Kutch - Mahanadi – NEC - Andaman Nicobar  <b>Category III Sedimentary Basins of India:</b> - Himalayan Foreland - Ganga - Vindhyan - Saurashtra - Kerala – Konkan – Lakshadweep - Bengal	2 + 3	10

### Part B

(3Q x 10M = 30Marks)

Q. No.	Solution	Scheme of Marking	Max. Time required for each Question
7	(a) All the shale formations can't be considered as the source for hydrocarbon generation because all shale formations does not contain organic matter which is the primary requirement for hydrocarbon generation.	3 + 7	20

	<p>(b) Source rocks are classified from the types of Kerogen that they contain, which in turn governs the type of hydrocarbons that will be generated. Classification of Source Rocks based on their hydrocarbon potentiality is provided below:</p> <p><b>Type I Source Rocks</b> are formed from algal remains deposited under anoxic conditions in deep lakes: they tend to generate waxy crude oils when submitted to thermal stress during deep burial.</p> <p><b>Type II Source Rocks</b> are formed from marine planktonic and bacterial remains preserved under anoxic conditions in marine environments: they produce both oil and gas when thermally cracked during deep burial.</p> <p><b>Type III Source Rocks</b> are formed from terrestrial plant material that has been decomposed by bacterial and fungi under oxic or sub-oxic conditions: they tend to generate mostly gas with associated light oils when thermally cracked during deep burial. <b>Most coals and coaly shales are generally Type III Source Rocks.</b></p>		
8	<p><b>Migration Loss:</b> Sometimes a proportion of the hydrocarbons can't move upwards because they are dissolved in the water contained in the rocks they pass through - this is mostly the case with gas or they remain stuck to the rock grain. This phenomenon is known as <b>migration losses</b>.</p> <p>The migration loss may play significant impact in petroleum drilling because possibility of losing maximum portion of petroleum due to this process is high, especially if the oil and gas have a long way to travel. This is why some source rock hydrocarbons will never be suitable for drilling.</p> <p><b>Difference between Primary Migration and Secondary Migration:</b>  <b>Primary migration</b> is the movement of hydrocarbons from source rock to permeable carrier beds. It occurs over relatively short distances and involves complex interactions between petroleum, free and structured pore water, and clay mineral surfaces.</p> <p><b>Secondary migration</b> is the movement of petroleum droplets through water-wet permeable layers until it is trapped in the reservoir. It can occur over long distances.</p>	2 + 3 + 5	20
9	<p>(a) The necessary conditions for Sedimentary Basin Formations are as follows:</p> <ul style="list-style-type: none"> <li>- <b>Accommodation Space:</b> It is the space available for accumulation of sediments in any basin (Figure 1).</li> <li>- <b>Sediment Supply:</b> Sediment supply is dependent on (1) Source of sediments, (2) Topography of the region, (3) Transportation and Deposition processes.</li> </ul> <p>Tectonic subsidence (T) + Eustatic Sea Level rise (E)  = Rate of Sedimentation (S) + Increase in water depth (W)</p>  <p><b>Figure 1:</b> Showing Tectonic subsidence and Eustatic Sea Level change due to change in Rate of sedimentation and Increase water depth.</p>	5 + 5	20

	<p>(b) The Sedimentary Basins of India are categorized as follows on the basis of present prospectively.</p> <p><b>Category - I:</b> The sedimentary basins with proved hydrocarbon reserves and where commercial production has already been started. Example: Cambay, Mumbai Offshore, Krishna-Godavari, etc.</p> <p><b>Category - II:</b> The sedimentary basins with proved occurrence of hydrocarbon but from which no commercial production has been started yet. Example: Kutch, Mahanadi – NEC, etc.</p> <p><b>Category - III:</b> The sedimentary basins with no significant oil and gas shows but which are considered to be prospective on the basis of geology consideration. Example: Ganga, Vindhyan, Saurashtra, etc.</p> <p><b>Category - IV:</b> The sedimentary basins with uncertain prospects which require basic data to be generated for prognosis. It includes the basins which bear an analogy with similar hydrocarbon producing basins in the world and may be prospective. Example: Narmada, Cuddapah, etc.</p>		
--	--	--	--

### Part C

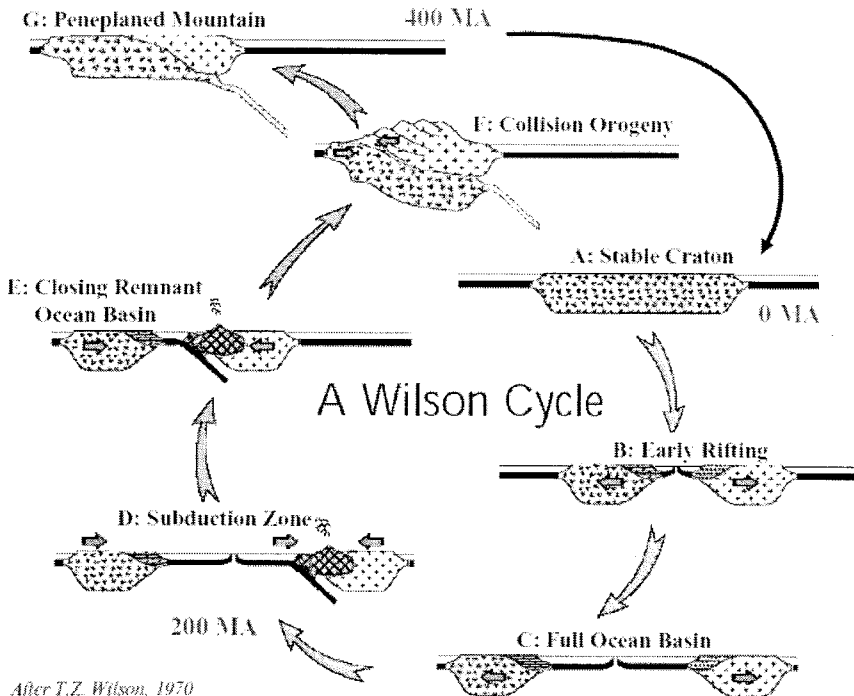
(2Q x 10M = 20Marks)

Q. No.	Solution	Scheme of Marking	Max. Time required for each Question
10	<p>The factors that influence porosity of any formation are as follows:</p> <p><b>1) Grain Shape:</b> Porosity (and possibly permeability) may decrease with sphericity and rounded grains.</p> <p><b>(2) Grain Size:</b> Porosity is theoretically independent of grain size, but there is a general empirical correlation between porosity and permeability. May be caused by increased cementation or because of poorer sorting. Permeability decreases with decreasing grain size because pore throats are smaller and the capillary pressure goes up.</p> <p><b>(3) Packing:</b> Porosity (and permeability) will decrease with tighter packing. Most reservoirs are buried and altered, so packing is generally not an issue- the rocks are already packed.</p> <p><b>(4) Deposition Process:</b> No clear relationship, too many other variables.</p> <p><b>(5) Grain Orientation:</b> controlled primarily by layering in the beds.</p>	10	25
11	<p>The cycle that explains opening and closing of ocean basins is known as 'Wilson Cycle'.</p> <p><b>Wilson Cycles:</b></p> <p>Wilson cycles begin with the formation of rift basins (floored by continental crust), which subsequently evolve into proto-oceanic troughs (partially floored by oceanic crust), and eventually into ocean basins, floored by oceanic crust and bordered by passive continental margins. After tens of millions of years or more, subduction zones develop around the ocean margins and the ocean begins to close. Closure culminates with continental collision and the formation of an orogenic belt (Figure 1).</p> <p>The entire process of basin formation and destruction requires perhaps 50 to 150 million years. The geologic record suggests that there have been many Wilson cycles in the history of each continent. Thus, few sedimentary basins</p>	10	25

remain unchanged with time, or in fixed positions, except perhaps some basins located on cratons well within continental margins.

During the opening phases of a Wilson cycle, tectonic plates are moving apart (by rifting) to form divergent (passive) continental margins. The closing stages of a Wilson cycle are characterized by plates moving toward each other, as oceanic crust is subducted (consumed) in trenches. Continental margins formed during a stage of ocean closing are called convergent (active) margins. During opening or closing of an ocean basin, some parts of plates may slide past each other without either diverging or converging. Such a setting is referred to as a transform margin.

During a Wilson cycle, various kinds of sedimentary basins form in divergent, convergent, and transform settings, as well as in intraplate settings.



After T.Z. Wilson, 1970

**Figure 1: Wilson Cycle.**