Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: PRINCIPLES OF RESERVOIR ENGINEERING
Semester: VII
Programme: BTECH GSE
Time: 03 hrs. **Max. Marks: 100**
Instructions: All questions are compulsory. There is no overall choice. However, internal choice has been provided. You have to attempt only one of the alternatives in all such questions.

SECTION A

S. No.		Marks	CO
1	Given the following gas: <table><tr><td>Component</td><td>Weight fraction</td></tr><tr><td>C1</td><td>0.65</td></tr><tr><td>C2</td><td>0.15</td></tr><tr><td>C3</td><td>0.10</td></tr><tr><td>n-C4</td><td>0.06</td></tr><tr><td>n-C5</td><td>0.04</td></tr></table>Calculate: a. Mole fraction of the gas b. Apparent molecular weight c. Specific gravity d. Specific volume at 300 psia and 120°F by assuming an ideal gas behaviour.	**4**	**CO1**
2	A typical pressure-temperature phase diagram of an oil reservoir is characterised by quality lines that are closely spaced near the dew point curve. Define the properties of reservoir along with the liquid shrinkage curve.	**4**	**CO3**
3	Diagrammatically represent the process of flash and differential liberation tests.	**4**	**CO3**
4	Under which flowing condition the following equation is validated dp/dr= 0 at the boundary condition. Justify the answer.	**4**	**CO2**
5	"When a wetting and a non wetting phase flow together in a reservoir rock, each phase follows separate and distinct paths." Justify how the presence of one phase effects the fluid flow in porous and permeable media with the help of a graph.	**4**	**C02**

SECTION B

6	Calculate the average permeability of a formation that consists of four beds in series, assuming:	**10**	**CO2**

<table>
<tr><td></td><td>a. Linear system
b. Radial system with rw=0.3ft and re=1,450 ft.

<table>
<tr><th>Bed</th><th>Length of bed (ft)</th><th>Permeability (mD)</th></tr>
<tr><td>1</td><td>400</td><td>70</td></tr>
<tr><td>2</td><td>250</td><td>400</td></tr>
<tr><td>3</td><td>300</td><td>100</td></tr>
<tr><td>4</td><td>500</td><td>60</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>7</td><td>Define the following terms
i. OFVF
ii. Gas solubility
iii. Effective porosity
iv. Surface tension interfacial tension
v. Cricondenbar temperature
vi. Connate water saturation
vii. Wettability
viii. Free water level
ix. Bubble point pressure
x. Sub capillary pores</td><td>10</td><td>CO4</td></tr>
<tr><td>8</td><td>An oil well in the Nameless Field is producing at a stabilized rate of 600 STB/day at a stabilized bottom-hole flowing pressure of 1800 psi. Analysis of the pressure buildup test data indicates that the pay zone is characterized by a permeability of 120 md and a uniform thickness of 25ft. The well drains an area of approximately 40 acres. The following additional data is available:
rw = 0.25 ft A = 40 acres
Bo = 1.25 bbl/STB μo = 2.5 cp
Calculate the pressure profile (distribution) and list the pressure drop across 1 ft intervals from rw to 1.25 ft, 4 to 5 ft, 19 to 20 ft, 99 to 100 ft, and 744 to 745 ft.

OR
Describe the basic assumptions behind Decline Curve Analysis. Explain the types of rate decline behavior with appropriate relationship curves.</td><td>10</td><td>CO4</td></tr>
<tr><td>9</td><td>During a PVT experiment a crude oil sample was placed in a variable volume cell and its initial bubble point pressure was determined. The pressure in the cell was then decreased in 3 steps and the volume of liquid and gases were recorded. After recording the value at each pressure the gas was purged out of the cell but all of the liquid retained. The temperature was kept constant at 15°C. The following data were recorded:
<table>
<tr><th>Pressure (kpa)</th><th>Volume of liquid (ml)</th><th>Volume of gas released(ml)</th><th>z-factor</th></tr>
<tr><td>30000</td><td>189.75</td><td>0</td><td></td></tr>
<tr><td>20000</td><td>170.35</td><td>24.97</td><td>0.886</td></tr>
<tr><td>10000</td><td>159.85</td><td>35.35</td><td>0.932</td></tr>
<tr><td>101.325</td><td>147.83</td><td>3981.35</td><td>1</td></tr>
</table></td><td>10</td><td>C03</td></tr>
</table>

a. Calculate OFVF at 30000kpa, 20000kpa and 10000kpa.
b. Calculate solution GOR at 30000kpa, 20000kpa and 10000kpa.
c. Calculate TFVF at 20000 kpa.

SECTION-C

10

Treating the reservoir pore as an idealized container derive the volumetric balance expression which occurs naturally during the productive life of a reservoir. Determine the relative magnitude of each of the driving mechanisms and its contribution to the production in a combination drive mechanism.

OR

A combination-drive reservoir contains 10 MMSTB of oil initially in place. The ratio of the original gas-cap volume to the original oil volume, i.e., m, is estimated as 0.25. The initial reservoir pressure is 3000 psia at 150°F. The reservoir produced 1 MMSTB of oil, 1100 MMscf of 0.8 specific gravity gas, and 50,000 STB of water by the time the reservoir pressure dropped to 2800 psi. The following PVT is available:

	3000 psi	2800 psi
Bo, bbl/STB	1.58	1.48
Rs, scf/STB	1040	850
Bg, bbl/scf	0.0008	0.00092
Bt, bbl/STB	1.58	1.655
Bw, bbl/STB	1	1

The following data are also available:
$S_{wi} = 0.20$ $c_w = 1.5\times10^{-6}\ psi^{-1}$ $c_f = 1\times10^{-6}\ psi^{-1}$
Calculate:
a. Cumulative water influx
b. Net water influx
c. Primary driving indexes at 2800 psi

20 **CO5**

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The following production data are available from a dry gas field:

Qt (MMscf/day)	Gp (MMscf)
320	16,000
336	32000
304	48000
309	96000
272	160000
248	240000
208	304000
197	352000
184	368000
176	384000
184	400000

Estimate
(a) The future cumulative gas production when the gas flow rate reaches

20 **CO6**

	80 MMscf/day (b) *Extra* time to reach 80 MMscf/day		