UNIVERSITI SAINS MALAYSIA

First Semester Examination
2011/2012 Academic Session

January 2012

EKC 483 – Petroleum & Gas Processing Engineering
[Kejuruteraan Pemprosesan Petroleum & Gas]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of FOUR pages of printed material and TWO pages of Appendix before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi EMPAT muka surat yang bercetak dan DUA muka surat Lampiran sebelum anda memulakan peperiksaan ini.]

Instruction: Answer **ALL** (4) questions.

*[**Arahan:** Jawab **SEMUA** (4) soalan.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.]

Answer ALL questions.
Jawab SEMUA soalan.

1. [a] List out the main properties of crude oil and their implications.
Senaraikan ciri-ciri utama minyak mentah dan implikasinya.
[5 marks/markah]

[b] Gasoline is one of the major fuels for motor vehicle. Discuss the production of gasoline via FCC process in a refinery in order to cope with the market demand.

Gasolin merupakan salah satu daripada bahan api utama bagi kenderaan bermotor. Bincangkan penghasilan gasolin melalui FCC dalam kilang penapisan untuk memenuhi permintaan pasaran. *[7 marks/markah]*

[c] Using the crude oil analysis given in Appendix,
Dengan menggunakan analisis minyak mentah yang diberikan dalam Lampiran:

[i] construct the True Boiling Point and gravity-mid percent curves.
Binakan lengkung Takat Didih Benar dan lengkung peratus tengah graviti.

[ii] find the first two lightest cut product volume % with mid boiling point 250^{o}F and 400^{o}F.
Carikan peratus isipadu bagi dua produk pecahan pertama yang paling ringan dengan takat didih tengah 250^{o}F dan 400^{o}F.
[13 marks/markah]

2. [a] Desalting process is needed before fractionation of the crude oil. Discuss the importance and the process.

Proses penyahgaraman diperlukan sebelum penyulingan minyak mentah. Bincangkan kepentingan dan proses tersebut. *[5 marks/markah]*

[b] What is coking process? Provide the common types of petroleum coke formed during a coking process and their main uses.

Apakah proses pengekokan? Berikan jenis umum kok petroleum yang terbentuk daripada suatu proses pengekokan dan kegunaan utamanya.
[5 marks/markah]

[c] Describe the solvent extraction process to extract vacuum reduced crude to be used as a good quality feed for a FCC unit.

Terangkan proses penyarian pelarut untuk menyari produk bawah unit penyulingan vakum supaya dapat digunakan sebagai bahan suapan berkualiti untuk unit FCC.
[7 marks/markah]

[d] Outline the main goal of catalytic reforming. How this can be achieved through catalytic reforming? Discuss the main reactions taking place during reforming.

Nyatakan objektif utama proses pembentukan semula bermangkin. Bagaimana ini boleh dicapai melalui pembentukan semula bermangkin? Bincangkan tindak balas utama yang berlaku semasa pembentukan semula.

[4 marks/markah]

[e] Discuss the feed characteristic for a hydrocracker. How does it differ from the feed for a catalytic cracker?

Bincangkan ciri-ciri suapan bagi suatu penghidropecah. Bagaimanakah ia berbeza daripada suapan bagi seunit pemecah bermangkin?

[4 marks/markah]

3. [a] Identify whether the natural gas (NG) with composition below is rich or lean, sweet or sour.

Kenalpastikan samada gas asli dengan komposisi di bawah adalah kaya atau kurang, manis atau masam.

Given that 1 Ibmol of gas at standard condition has a volume of 379.49 ft^3.
Diberikan 1 lbmol gas pada keadaan piawai mempunyai isipadu 379.49 kaki^3.

	Mol%	**gal/mol**	**H (MJ/Sm^3)**	**γ**
He	0	0	-	-
N_2	3.2	0	-	-
CO_2	1.7	0	-	-
H_2S	3.3	0	-	-
CH_4	77.1	0	37.7	0.554
C_2H_6	6.6	10.123	66.1	1.038
C_3H_8	3.1	10.428	93.9	1.523
C_4H_{10}	2.0	12.160	121.4	2.007
C_5H_{12}+	3.0	13.721	177.6	2.975

[8 marks/markah]

[b] Calculate the heating value for the gas in MJ/Sm^3. Does it meet the pipeline quality? Explain.
Kirakan nilai pemanasan untuk gas tersebut dalam MJ/Sm^3. Adakah ia memenuhi kualiti paip? Terangkan.

[9 marks/markah]

…4/-

[c] Calculate mol% of air and reduction in methane in order to give consistent burning with minimum W_B of 43.3 MJ/Nm^3 .
Kirakan mol% udara dan pengurangan metana untuk memberi pembakaran yang konsisten dengan W_B minima pada 43.3 MJ/Nm^3.

[8 marks/markah]

4. [a] What is the most preferred method to transport NG over short distance and long distance, respectively? Why?

Apakah kaedah yang paling digemari untuk memindahkan gas asli pada jarak dekat dan jauh masing-masing? Kenapa?

[4 marks/markah]

[b] Explain the differences between peak shaving and baseload.
Terangkan perbezaan antara 'peak shaving' dan 'baseload'.

[4 marks/markah]

[c] Provide the schematic of peak shaving facility and explain.
Berikan rajah skematik kemudahan 'peak shaving' dan terangkan.

[7 marks/markah]

[d] Provide the schematic for baseload plant and explain.
Berikan rajah skematik untuk loji 'baseload' dan terangkan.

[10 marks/markah]

- oooOooo –

Appendix

CRUDE PETROLEUM ANALYSIS
Sample 62066

GENERAL CHARACTERISTIC

Gravity, specific, 0.871
Gravity, API, 31.0
Sulfur %, 0.15
Nitrogen, wt % 0.02
Colour, green black

DISTILLATION DATA

Stage 1- Distillation at atmospheric pressure 745 mm Hg

Fraction no.	Cut temp. ^{o}F	Percent	Sp. Gr. 60/60 ^{o}F
1	122	-	-
2	167	1.1	0.748
3	212	1.8	0.753
4	257	1.7	0.757
5	302	2.7	0.770
6	347	3.4	0.789
7	392	5.1	0.813
8	437	5.9	0.829
9	482	9.8	0.846
10	527	10.7	0.860

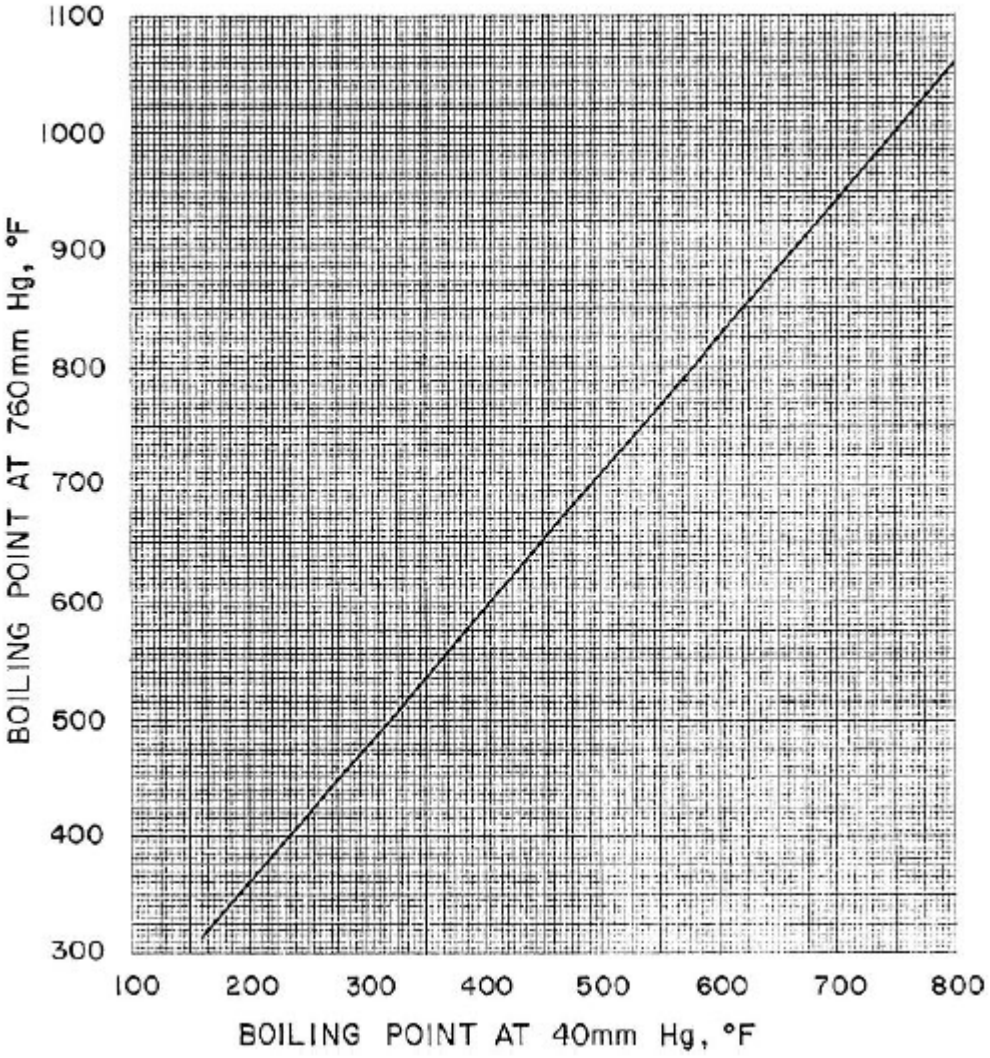
Stage 2 – Distillation continued at 40 mmHg

11	392	4.4	0.871
12	437	8.7	0.880
13	482	6.7	0.891
14	527	5.9	0.904
15	572	6.6	0.910
Residuum	-	23.0	0.942

Carbon residue, Conradsom: Residuum, 4.3 %; crude 1.1 %

Note: API = [141.5/specific gravity (60^{o}F)] - 131.5

…2/-



Boiling point at 760 mmHg versus boiling point at 40 mmHg.