UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2008/2009

November 2008

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

Duration : 3 hours
[Masa : 3 jam]

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

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

Instructions: Answer **FOUR** (4) questions. Answer **TWO** (2) questions from Section A. Answer **TWO** (2) questions from Section B.

*[**Arahan:** Jawab **EMPAT** (4) soalan. Jawab **DUA** (2) soalan dari Bahagian A. Jawab **DUA** (2) soalan dari Bahagian B.]*

You may answer the question either in Bahasa Malaysia or in English.

[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

Section A : Answer any TWO questions.
Bahagian A : Jawab mana-mana DUA soalan.

1. [a] Define each of the following:
Takrifkan setiap yang berikut:

[i] API gravity
Graviti API

[ii] Carbon residue
Baki karbon

[iii] Asphaltene
Asfaltena

[iv] Naphthene
Naftena

[v] Aromatic
Aromatik

[5 marks/markah]

[b] [i] Discuss briefly the basic refinery operations in a conventional petroleum refinery.
Bincangkan secara ringkas operasi asas dalam sebuah kilang penapis petroleum lazim.

[5 marks/markah]

[ii] List the products of crude distillation.
Senaraikan produk-produk penyulingan minyak mentah.

[3 marks/markah]

[c] [i] Discuss briefly the delayed coking process.
Bincangkan secara ringkas proses pengkokan terlengah.

[7 marks/markah]

[ii] Give the common types of petroleum coke and their main uses.
Berikan jenis-jenis kok petroleum yang biasa dan kegunaan utamanya.

[5 marks/markah]

2. [a] The following ASTM laboratory data were obtained for light oil cut. Convert these ASTM data to True Boiling Point (TBP) data.
Data makmal ASTM yang berikut diperolehi bagi pecahan minyak ringan. Tukarkan data ASTM ini kepada data takat didih sebenar.

Vol. % *Isipadu %*	IBP *Takat didih mula*	10	30	50	70	90	FBP *Takat didih akhir*
ASTM Temperature, °F *Suhu ASTM, °F*	424	453	484	502	504	536	570

[5 marks/markah]

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[b] Using the crude oil analysis given in Appendix, construct the True Boiling Point curve and gravity-mid percent curve.

Gunakan analisa minyak mentah yang diberi di Lampiran, binakan Lengkung Takat Didih Sebenar dan lengkung graviti-peratus tengah.

[10 marks/markah]

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

Bincangkan ciri suapan bagi sebuah pemecah bermangkin. Bagaimana ia berbeza dengan ciri suapan bagi sebuah reaktor penghidropecahan?

[5 marks/markah]

[d] Briefly discuss the Fluid Catalytic Cracking (FCC) process.

Bincangkan secara ringkas proses Pemecahan Bermangkin Bendalir.

[5 marks/markah]

3. [a] Sketch an ebullated bed reactor and briefly discuss its advantages in the processing of heavy stock.

Lakarkan sebuah reaktor lapisan ebulasi dan bincangkan secara ringkas kelebihan reaktor ini dalam pemprosesan stok berat.

[8 marks/markah]

[b] Discuss the effect of the operating variables: temperature, hydrogen partial pressure and space velocity in the hydrotreating process.

Bincangkan kesan operasi pembolehubah: suhu, tekanan separa hidrogen dan halaju ruang dalam proses penghidrorawatan.

[4 marks/markah]

[c] Outline the main goal of catalytic reforming and the common catalyst used in a catalytic reformer. Outline the major chemical reactions occur in a catalytic reformer during an operation.

Bincangkan matlamat utama proses bentuk semula bermangkin dan pemangkin yang biasa digunakan dalam reaktor bentuk semula bermangkin. Jelaskan tindakbalas-tindakbalas kimia utama yang berlaku dalam sebuah reaktor bentuk semula bermangkin semasa beroperasi.

[8 marks/markah]

[d] Explain the operations of a typical semi-regenerative catalytic reformer unit based on Figure Q.3.[d].

Jelaskan pengendalian suatu unit reaktor bentuk semula bermangkin kitar-jana separuh berdasarkan Rajah S.3.[d].

[5 marks/markah]

...4/-

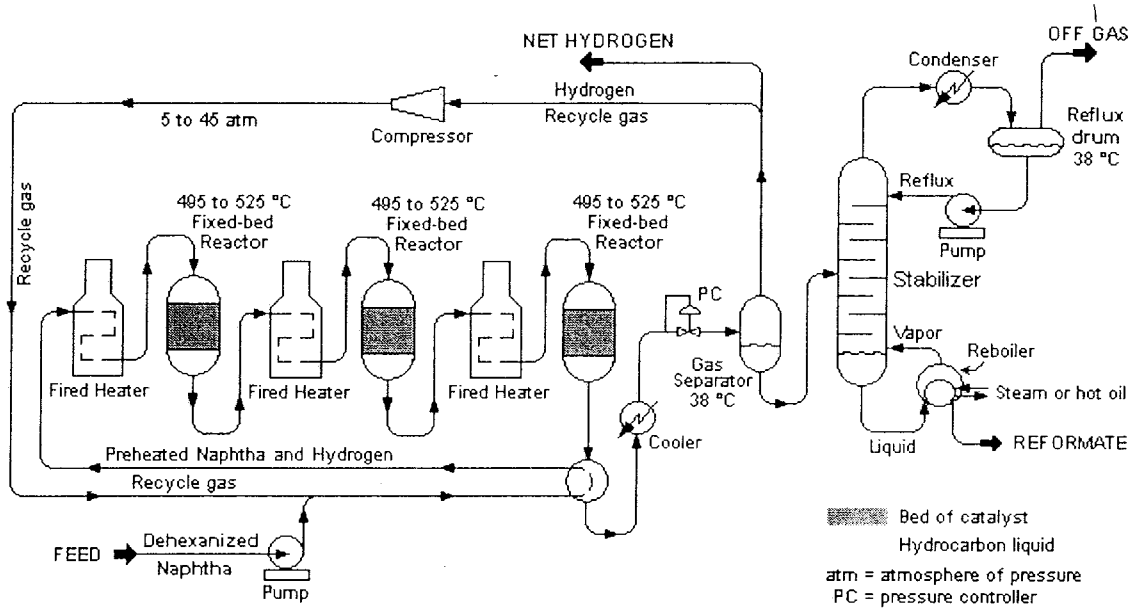

Figure Q.3.[d].
Rajah S.3.[d].

Section B : Answer any TWO questions.
Bahagian B : Jawab mana-mana DUA soalan.

4. [a] What are the principal reasons for the removal of water from natural gas for long-distance transmission?

Apakah sebab-sebab utama penyingkiran air daripada gas asli bagi penghantaran jarak jauh?

[4 marks/markah]

[b] What are the parameters that should be evaluated and considered in the design of a system for gas field processing?

Apakah parameter-parameter yang harus dinilai dan dipertimbangkan dalam rekabentuk sistem pemprosesan medan gas?

[6 marks/markah]

[c] The price of crude oil in the international market is going high. Thus searching for alternative fuel is very much needed in the near future. Identify two alternative fuels that are being studied. What factors will affect their development as alternative fuels?

Harga minyak mentah di pasaran antarabangsa sedang meningkat naik. Maka pencarian bahanapi alternatif adalah amat diperlukan untuk masa terdekat. Kenalpastikan dua bahanapi yang sedang dikaji. Apakah faktor-faktor yang akan mempengaruhi pembangunan mereka sebagai bahanapi alternatif?

[5 marks/markah]

...5/-

[d] At depropanizing tower with all the overhead product condensing, the condensing temperature is 80°F and the overhead product has an analysis of the following:

Di sebuah menara penyahpropanaan dengan kesemua produk atasnya memeluwap, jika suhu pemeluwapan ialah 80°F dan produk atas mempunyai analisis yang berikut:

Component *Komponen*	Mole % *% mol*
C_2	3.0
C_3	95.0
iC_4	2.0

Determine the tower operating pressure. Assume this pressure is 10 psi greater than the accumulator pressure.

Tentukan tekanan operasi menara. Andaikan tekanan ini ialah 10 psi lebih tinggi daripada tekanan penumpuk.

[10 marks/markah]

5. [a] When a gas enters a plant, nearly always there is a large vessel, separator, through which the gas passes.

Apabila suatu gas memasuki sebuah loji, gas tersebut biasanya melalui sebuah bekas besar, iaitu sebuah pemisah.

[i] What is the function of the separators?

Apakah fungsi pemisah tersebut?

[4 marks/markah]

[ii] What are the different types of separators? State the mechanism of separation for each type of separator.

Apakah jenis-jenis pemisah? Nyatakan mekanisma pemisahan bagi setiap jenis pemisah.

[6 marks/markah]

[b] Is the presence of liquid hydrocarbons in natural gas desirable or undesirable? Explain why.

Adakah kehadiran hidrokarbon cecair dalam gas asli diingini ataupun tidak? Terangkan kenapa.

[4 marks/markah]

[c] Natural gas flowing at 2 MMSCFD has a specific gravity of 0.7 and acid gas concentration of 25 ppm. The operating pressure and temperature are 1000 psig and 120°F, respectively. Design an adsorption column containing iron sponge for the removal of acid gas. Given z = 0.86

Gas asli yang mengalir pada 2 MMSCFD mempunyai graviti tentu 0.7 dan kepekatan gas asid 25 ppm. Tekanan dan suhu operasi masing-masing adalah 1000 psig dan 120°F. Rekabentukkan sebuah turus penjerapan yang mengandungi span besi bagi penyingkiran gas asid. Diberi z = 0.86

(MMSCFD=10^6 standard feet per day)
(MMSCFD=10^6 kaki piawai per hari)

[11 marks/markah]

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6. [a] What are the most common dehydration methods used for natural gas processing?

Apakah kaedah-kaedah penyahhidratan yang paling lazim digunakan untuk pemprosesan gas asli?

[3 marks/markah]

[b] [i] List the commercial finished products that are obtained by fractionation of NGL stream and sold in a gas plant.

Senaraikan produk-produk akhir komersil yang diperolehi daripada pemeringkatan aliran NGL dan dijual di sebuah loji gas.

[2 marks/markah]

[ii] Draw the process flow diagram of Natural Gas Liquids (NGL) separation by absorption process used for polishing the gas.

Lukiskan gambarajah aliran proses pemisahan Cecair Gas Asli (NGL) melalui proses penyerapan bagi kegunaan penggilapan gas.

[4 marks/markah]

[iii] What is compressed natural gas (CNG)? Is it environmental friendly fuel?

Apakah gas asli temampat (CNG)? Apakah gas tersebut suatu bahanapi mesra alam?

[2 marks/markah]

[c] There are many methods available to protect natural gas pipeline from corrosion. Briefly describe the cathodic protection method and draw a schematic diagram for the system.

Terdapat banyak kaedah sedia ada bagi melindungi talian paip gas asli daripada kakisan. Huraikan secara ringkas kaedah perlindungan katod dan lukiskan gambarajah skema sistem tersebut.

[5 marks/markah]

[d] The most prominent and common form of underground storage consists of depleted gas reservoirs.

Bentuk simpanan bawah tanah yang paling menonjol dan lazim digunakan terdiri daripada takungan gas tersusut.

[i] Briefly describe the factors that determine whether or not a depleted reservoir will make a suitable storage facility for natural gas.

Huraikan secara ringkas faktor-faktor yang menentukan sama ada takungan tersusut akan menjadi suatu kemudahan simpanan yang sesuai bagi gas asli.

[4 marks/markah]

[ii] Draw a schematic diagram for a depleted reservoir facility.

Lukiskan gambarajah skema bagi suatu kemudahan takungan tersusut.

[5 marks/markah]

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Appendix
Lampiran

CRUDE PETROLEUM ANALYSIS
GENERAL CHARACTERISTIC

Gravity, specific, 0.887	Nitrogen, wt % 0.318
Gravity, API 28.0	Colour, brown black
Sulfur %, 1.41	

DISTILLATION DATA

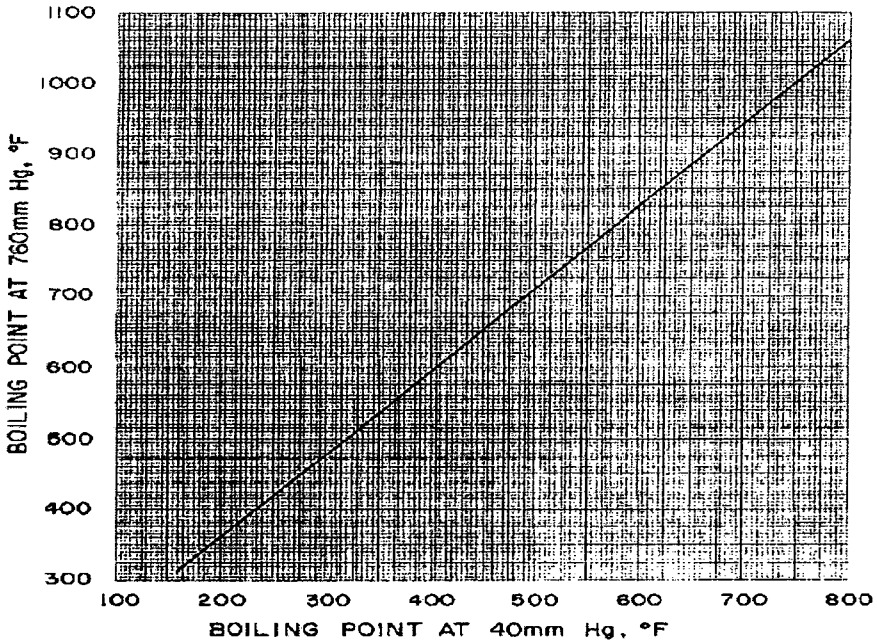
Stage 1- Distillation at atmospheric pressure 745 mm Hg

Fraction no.	Out temp. °F (TBP data)	Percent	Sum percent 60/60°F	Sp. Gr. 60/60 °F
1	122	1.3	1.3	0.648
2	167	1.5	2.8	0.674
3	212	3.3	6.1	0.712
4	257	4.3	10.4	0.739
5	302	4.0	14.4	0.758
6	347	4.1	18.5	0.779
7	392	3.7	22.2	0.798
8	437	4.1	26.3	0.814
9	482	4.8	31.1	0.831
10	527	6.0	37.1	0.848

Stage 2 – Distillation continued at 40 mmHg

11	392	1.1	38.2	0.862
12	437	4.7	42.9	0.873
13	482	4.6	47.5	0.882
14	527	5.3	52.8	0.898
15	572	5.3	58.1	0.911
Residuum	-	40.9	99.0	0.982

Carbon residue, Conradsom: Residuum, 11.4 %; crude 5.2 %



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

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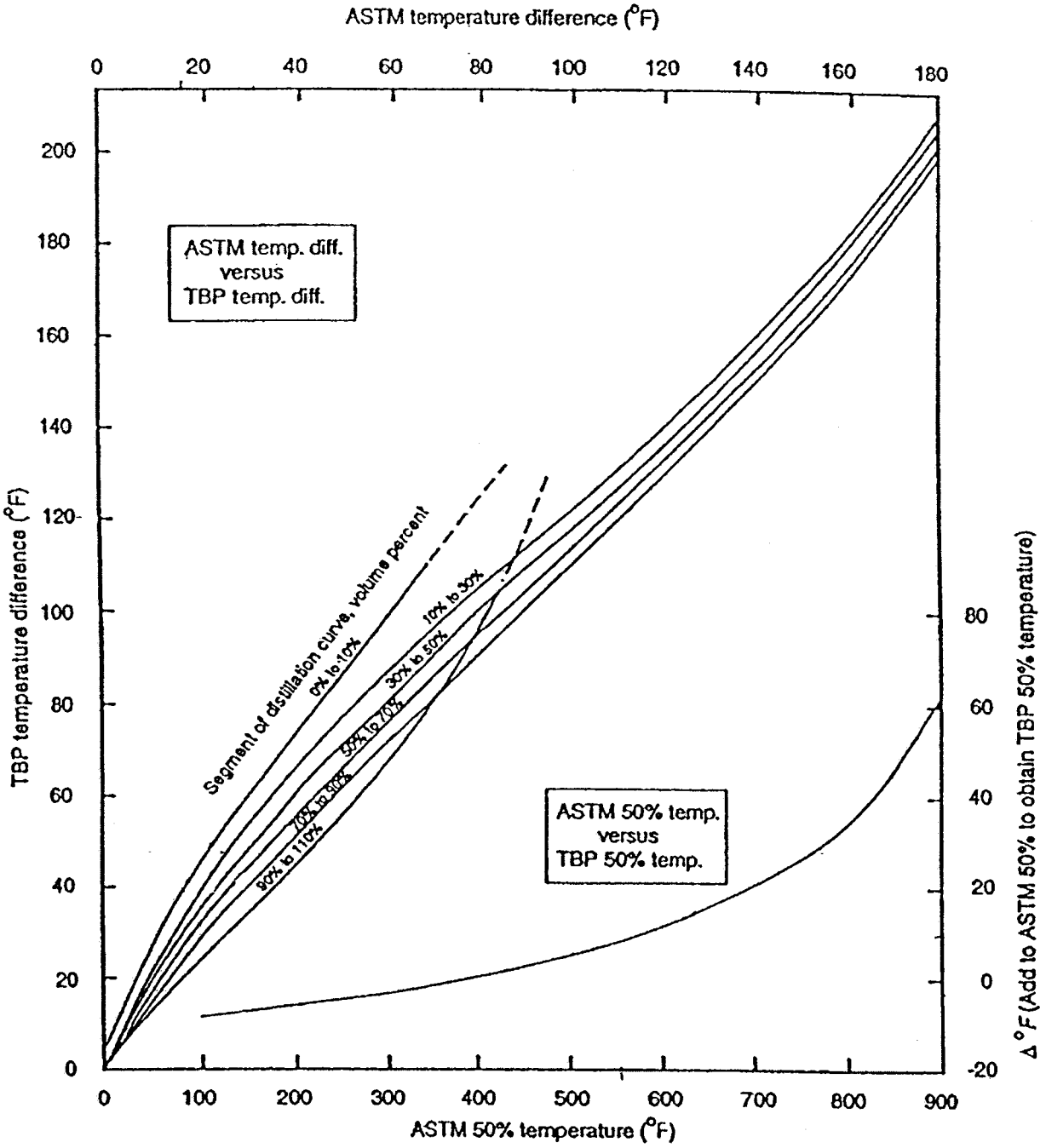

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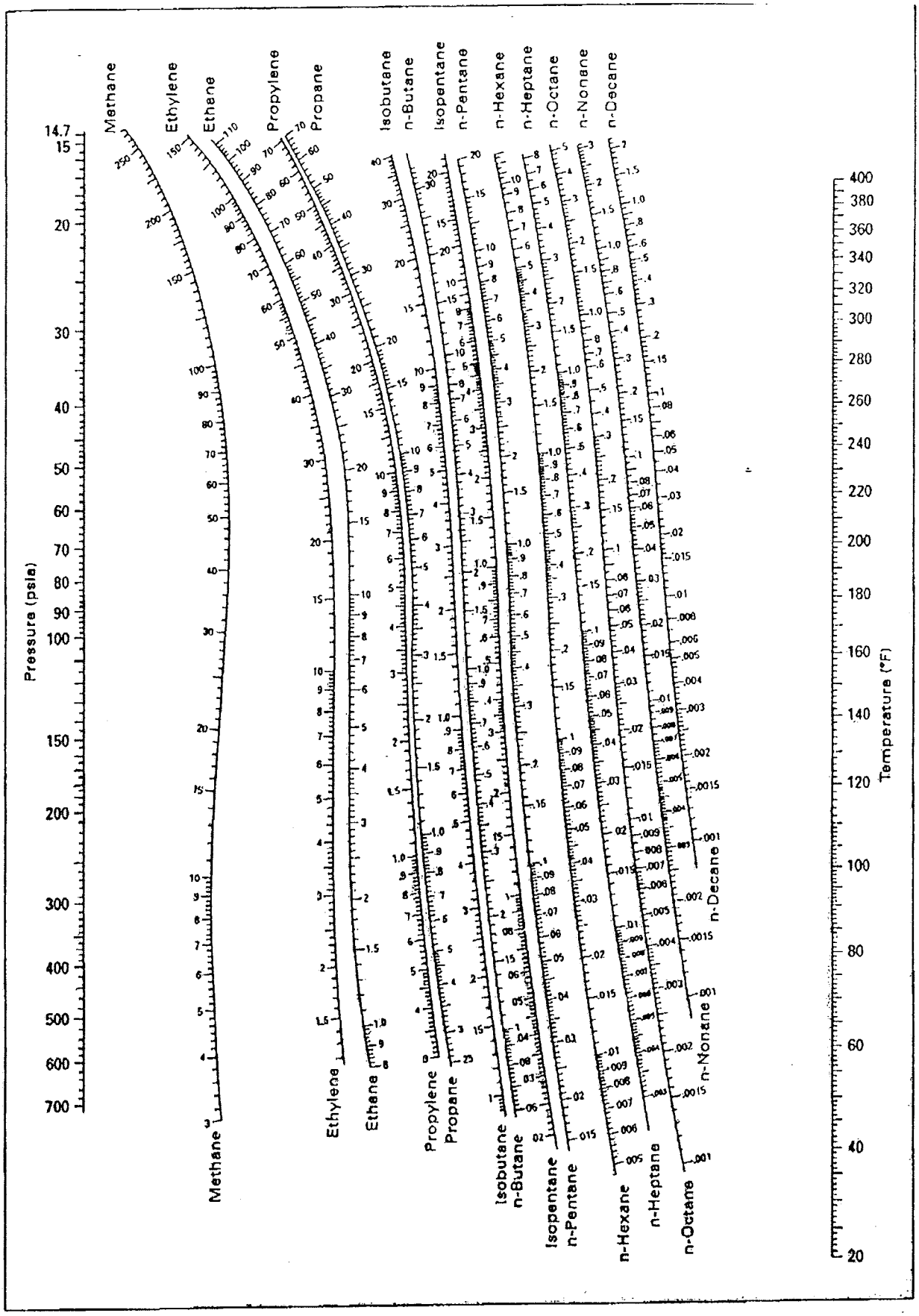

Figure *K*-values for systems of light hydrocarbons. High-temperature range.