UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

LASSONDE MINERAL ENGINEERING PROGRAM

FINAL EXAMINATION, APRIL 26, 2001

MIN 310 1H - HYDROCARBON EXPLORATION AND RECOVERY

EXAM TYPE: A

EXAMINER - D.D. MCLEAN

[15]

1. A reef gas pool located in S.W. Ontario, has the following production and pressure history. The pool depth was determined by logs at a mid point interval of 2700 feet. The gas was analysed and had a specific gravity of 0.65. Discovery shut in pressure was recorded at 1200 psia bottom hole.

S.I.B.H.P. psia	CUMM PROD mmcf
1200	0
1000	950
800	1775
600	2600
400	3350

Using the attached graph and chart, calculate the gas in place [GIP] and recovery to an economic limit of 100 psia, B.H.

[10]

2. An oil pool under a 'depletion' type of drive, contains the following reservoir parameters. Calculate the recoverable oil in barrels and the recovery as a percentage of oil in place.

Porosity	= 10%
Water Saturation	= 21%
Init FVF	= 1.30
Final FVF	= 1.03
Abd Gas Saturation	= 26%
Av. Net Pay	= 38 feet
Av. Pool Area	= 150 acres

[8]

3. Describe the various types of underground gas storage reservoirs. What are the principal benefits of gas storage to the LCD'S [local distribution companies]? What is meant be the term 'system load factor' and how does this relate to the economics of pipeline infrastructure?
In respect of a gas storage reservoir, what is meant by the terms 'cushion pressure', 'ultimate reservoir capacity', 'working capacity', and 'delta pressure'? How is delta pressure determined? What are the key parameters that an engineer examines to determine if a reservoir would be a suitable candidate for storage?

[5]

4. When conducting a seismic survey, what is meant by CDP shooting. What is a seismogram and for what purpose is it utilized? Describe the characteristics of each of the principal wave modes generated from a shot point. What are the main interference factors that must be filtered out of final records?

[6]

5. Describe, in detail, the process by which a casing string is cemented in a well during drilling operations. How is the integrity of the cementing ultimately determined? What are the main reasons for setting casing strings in a well?

[6]

6. Describe, in detail, the land survey descriptions for both Western Canada and Ontario, noting the various acreage compositions. How are exploration rights acquired in each jurisdiction and how do the earning rights differ?
What are the principal factors that determine the royalty structures for both oil and gas in Alberta? How does this differ from Ontario?

[6]

7. Why are resource companies and or properties evaluated by the discounted cash flow method? What NPV value is currently used in the marketplace today to evaluate a property on an after tax basis? What is meant by 'Rate of Return' on an investment? When evaluating a property for possible acquisition, certain tax pools as CEE, CDE, and GOGPE most often exist. What are these and how can they benefit a purchaser?

[6]

8. What is meant by 'Farming In' to an oil and gas interest? Describe, in detail, the standard terms of a farm in agreement.

[8]

9. What are the main reservoir conditions determined from well testing? Why do regulatory agencies require certain testing programs? Describe, briefly, the concept of the following tests and why they are undertaken:

    a. Pressure Build Up test
    b. Drill Stem test
    c. Productivity Index test

[8]

10. Describe , in detail, the 'modified isochronal' method of testing a natural gas well. What equipment is used and how is data plotted? What would cause the slope of the curve to be greater than 1.0 or less that 0.5? What is meant by the AOF and how is it determined? Why do regulatory agencies require AOF determinations? What are the back pressure plots used for on an ongoing basis?

[5]

11. What are the four main oil sands areas of Northern Alberta? What are the estimated ultimate recoverable reserves for the oil sands? How did the deposits occur? Describe, generally, the process of converting a mined oil sand to a pipeline product.

[4]

12. What are the 'remaining established reserves' for oil and natural gas in Canada? What were the annual production rates for each in 2000? At these rates, how many years of production remain for the Canadian Established reserves as a whole, and for the Conventional areas in particular?

[3]

13. What are the 2000 world proven reserves of oil and natural gas and annual production of each? How many years remain for world reserves at current production rates?

[10]

14. ANSWER ANY FIVE (5) OF THE FOLLOWING TWELVE (12) QUESTIONS. All have an equal value of two (2) marks.

    (a) What are the principal components of the AFE [approval of funding expenditure] to be costed for partner approval before a well is drilled?

    (b) What is a 'pilot flood'? Why are these designed and undertaken?

    (c) There are a number of applications for directional drilling. Describe the most notable of these.

    (d) What are the principal categories that classify primary and secondary reserves, noting the degree of risk in each?

(e) Describe the following components of a drilling/producing operation:

-treater
-separator
-kelly bushing
-christmas tree
-elevators
-swivel
-shale shaker
-polished rod

(f) What is meant by pressure maintenance?

(g) What is retrograde condensation?

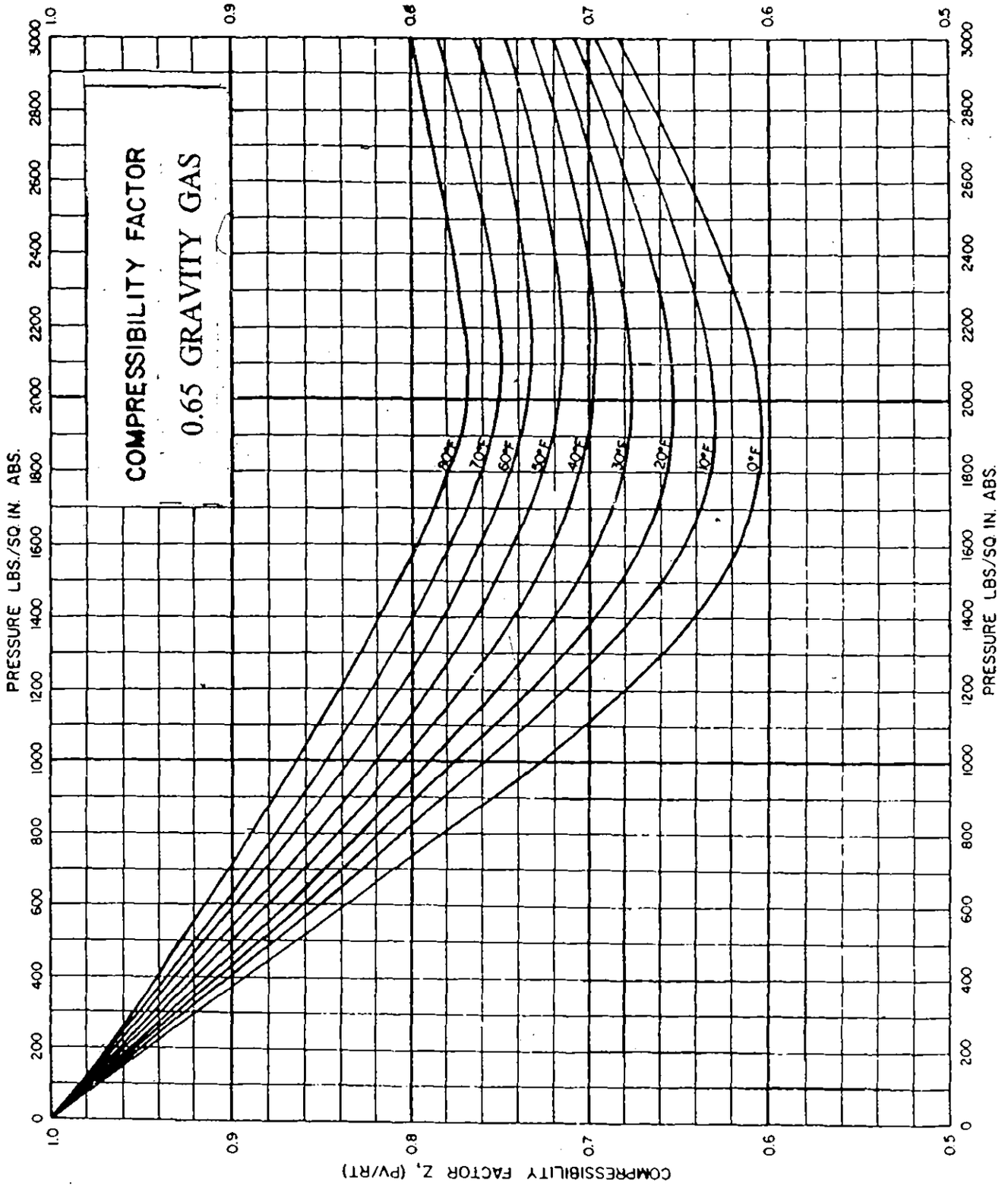
(h) What is meant by 'mobility ratio"?

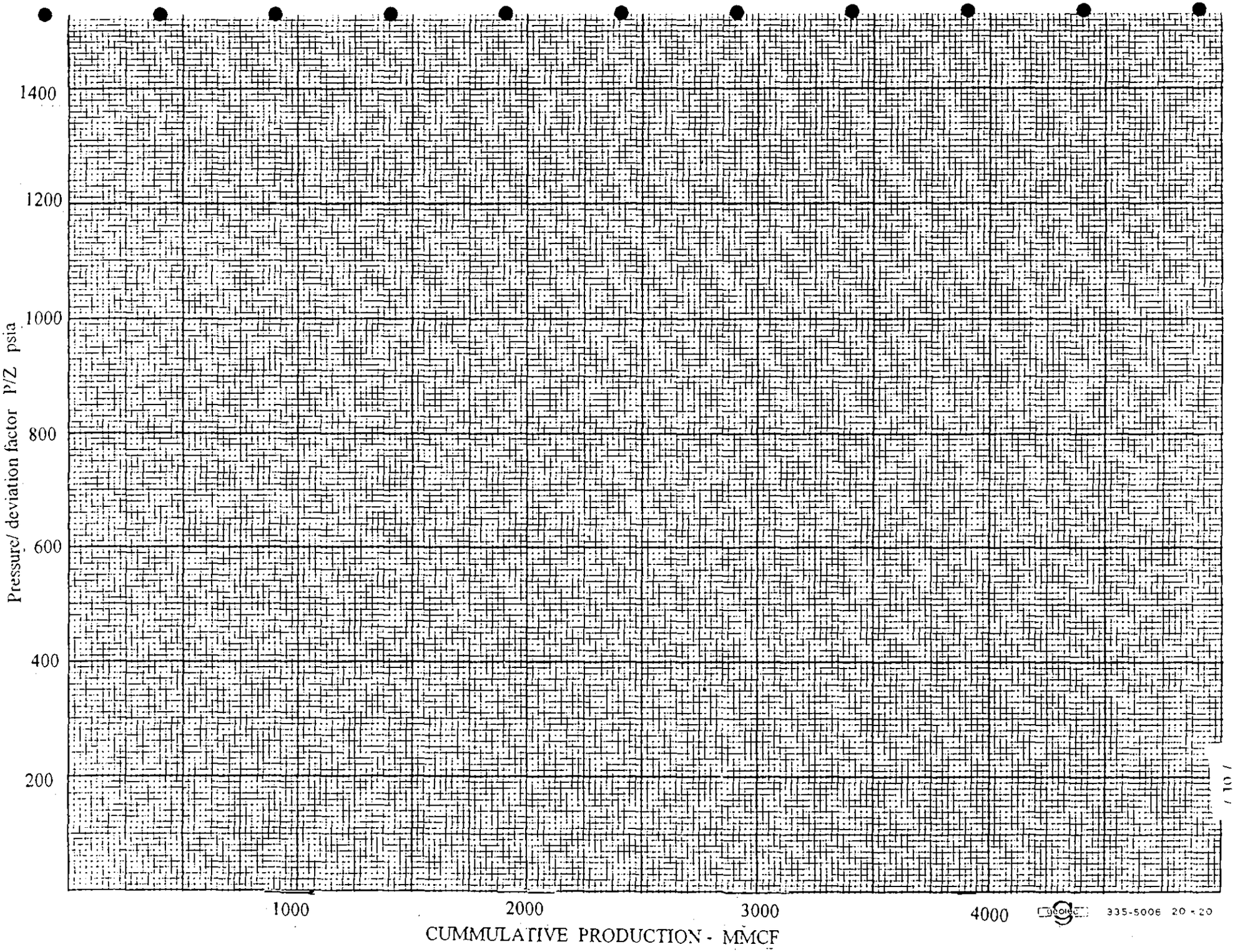
(i) What is the role of polymers in an EOR process?

(j) What is the concept of the MWD process when undertaking a horizontal drilling program?

(k) How are crude oil prices established in Canada?

(l) Before a secondary or tertiary recovery program can proceed, the lands must be unitized. What is meant by this and what are the general terms of reference?


COMPRESSIBILITY FACTOR
0.65 GRAVITY GAS
80°F
70°F
60°F
50°F
40°F
30°F
20°F
10°F
0°F
PRESSURE LBS./SQ IN. ABS.
PRESSURE LBS/SQ IN. ABS.
COMPRESSIBILITY FACTOR Z, (PV/RT)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
1.0
0.9
0.8
0.7
0.6
0.5


1400
1200
1000
800
600
400
200
Pressure/ deviation factor P/Z psia
1000
2000
3000
4000
CUMMULATIVE PRODUCTION - MMCF