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# UNIVERSITI SAINS MALAYSIA

Second Semester Examination  
2012/2013 Academic Session

June 2013

## EBS 418/3 – Petroleum Engineering [Kejuruteraan Polimer]

Duration : 3 hours  
[Masa : 3 jam]

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Please ensure that this examination paper contains TWENTY-ONE printed pages and ONE page APPENDIX (Objective Answer Sheet) before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi DUA PULUH SATU muka surat beserta SATU muka surat LAMPIRAN (Kertas Jawapan Objektif) yang bercetak sebelum anda memulakan peperiksaan ini.]

This examination paper is made up of three sections:

**Question number 1 (PART A):** 60 objective questions (answer all questions on the objective answer sheet as provided in the Attachment). Detach the answer sheet to be handed in along with other answer scripts.

**Questions number 2, 3 (PART B):** 2 subjective questions and answer any 1 (one) of them.

**Questions number 4, 5 (PART C):** 2 subjective questions and answer any 1 (one) of them.

[Kertas peperiksaan ini terdiri daripada tiga bahagian:

**Soalan nombor 1 (BAHAGIAN A):** 60 soalan objektif (jawab semua soalan di atas kertas jawapan objektif yang disediakan di Lampiran). Ceraikan kertas jawapan ini untuk dikemukakan bersama dengan kertas jawapan yang lain.

**Soalan nombor 2, 3 (BAHAGIAN B):** 2 soalan subjektif dan jawab mana-mana 1 (satu) soalan.

**Soalan nombor 4, 5 (BAHAGIAN C):** 2 soalan subjektif dan jawab mana-mana 1 (satu) soalan.]

The answers to all questions must start on a new page.

[Mulakan jawapan anda untuk semua soalan pada muka surat yang baru.]

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

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

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

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

**PART A / BAHAGIAN A**

Attempt all questions in Question 1 (on the answer sheet in Appendix 1)  
and any other two subjective questions.

*Jawab semua soalan dalam Soalan 1 (di atas kertas jawapan di Lampiran 1)  
dan mana-mana dua soalan subjektif yang lain.*

1. 1.1 Petroleum engineering is .....

- A. is a field of engineering concerned with the processing and refining of petroleum produced from the wells.
- B. is a field of engineering concerned with the activities related to the production of hydrocarbons, which can either be crude oil or natural gas.
- C. the upstream sector of the oil and gas industry whereby particular emphasis is made on the processing and refining of crude oil and natural gas.
- D. the application of petroleum geology and geophysics in finding the most economical oil and gas reservoir.

1.2 Which of the following statements are true for the oil industry?

- I. Geologists have yet to agree completely on the origin and accumulation of petroleum.
  - II. Geophysicists have no tool which searches directly for oil.
  - III. Petroleum engineers are still leaving unrecoverable oil in the ground.
  - IV. Chemists and chemical engineers must still evaluate crude oils on the basis of empirical tests rather than by precise analyses.
- A. I only
  - B. I and IV
  - C. I, III and IV
  - D. All are true

1.3 Reservoir engineers .....

- A. manage the technical aspects of drilling exploratory, production and injection wells.
- B. work to optimize production of oil and gas via proper well placement, production rates and enhanced oil recovery techniques.

1.1 *Kejuruteraan Petroleum ialah ... ..*

- A. satu bidang kejuruteraan yang berkenaan dengan pemprosesan dan penapisan petroleum yang dikeluarkan daripada telaga.
- B. satu bidang kejuruteraan berkenaan dengan kegiatan-kegiatan yang berkaitan dengan pengeluaran hidrokarbon, sama ada minyak mentah atau gas asli.
- C. sektor hulu dalam industri minyak dan gas di mana penekanan dibuat kepada pemprosesan dan penapisan minyak mentah dan gas asli.
- D. Penggunaan geologi petroleum dan geofiziks dalam mencari reserbor minyak dan gas yang paling ekonomik.

1.2 *Kenyataan berikut yang manakah yang benar?*

- I. Ahli-ahli kajibumi masih belum bersetuju sepenuhnya tentang asal dan pengumpulan petroleum.
- II. Ahli geofizik tidak mempunyai alat yang boleh mencari minyak secara terus.
- III. Jurutera petroleum masih meninggalkan minyak yang tidak boleh diperolehi dalam bumi.
- IV. Ahli kimia dan jurutera kimia masih terpaksa menilai minyak mentah berdasarkan kepada ujian-ujian empirik daripada analisa yang tepat.

- A. I sahaja
- B. I dan IV
- C. I, III dan IV
- D. Semua benar

1.3 *Jurutera reservoir .....*

- A. mengurus aspek teknikal bagi penggerudian dalam penjelajahan, pengeluaran dan telaga-telaga suntikan.
- B. bekerja untuk pengoptimumkan pengeluaran minyak dan gas melalui perletakan telaga yang betul, kadar pengeluaran dan teknik-teknik mempertingkatkan perolehan.

- C. manage the interface between the reservoir and the well, including perforations, sand control, downhole flow control, and downhole monitoring equipment; evaluate artificial lift methods; and also select surface equipment that separates the produced fluids (oil, natural gas and water).
- D. work in production installations for the optimization of oil and gas production.
- 1.4 The continental shelf that contains the oil producing basin in the Malaysian Peninsula is the .....
- A. Trengganu basin  
B. East coast basin  
C. Malay basin  
D. Kelantan-Thailand basin
- 1.5 All foreign and private companies in Malaysia must operate through ..... with Petronas.
- A. concession method  
B. a royalty programme  
C. joint venture programme  
D. production sharing contract
- 1.6 In 1978 it was calculated that Malaysian oil reserve would last for 14 years. Why is it until now Malaysia is still producing oil?
- A. The reserve was wrongly calculated.  
B. Malaysia had insufficient professionals to serve the petroleum industry then.  
C. New discovery of oil field in offshore Terengganu.  
D. New production technology and discovery of new oil fields.
- 1.7 Volume of oil is expressed in barrel or bbl, what is 1 bbl equivalent to?
- A. 5.615 cu ft  
B. 5.165 cu ft  
C. 6.516 cu ft  
D. 6.165 cu ft
- C. *Mengurus muka perantaraan antara reserbor dan telaga, termasuk penebukan, kawalan pasir, kawalan aliran dalam lubang, dan peralatan pemantauan dalam lubang, menilai kaedah-kaedah angkat buatan; dan juga memilih peralatan permukaan yang mengasingkan bendalir pengeluaran (minyak, gas asli dan air).*
- D. *Bekerja di kawasan pemasangan pengeluaran bagi pengoptimuman pengeluaran minyak dan gas asli.*
- 1.4 *Pentas benua yang mengandungi lembangan yang mengeluarkan minyak di Semenanjung Malaysia ialah .....*
- A. *Lembangan Terengganu.*  
B. *Lembangan Pantai Timur*  
C. *Lembangan Melayu*  
D. *Lembangan Kelantan-Thailand*
- 1.5 *Semua syarikat asing dan persendirian di Malaysia dimestikan menjalankan kegiatan melalui ..... dengan Petronas.*
- A. *kaedah konsessi*  
B. *program royalty*  
C. *program usahasama*  
D. *kontrak perkonsian pengeluaran*
- 1.6 *Pada tahun 1978, telah dibuat pengiraan bahawa rizab minyak di Malaysia akan bertahan sehingga 14 tahun. Kenapakah sehingga sekarang kita masih mengeluarkan minyak?*
- A. *Kesilapan pengiraan rizab*  
B. *Pada masa itu Malaysia tidak mempunyai ahli profesional yang cukup untuk berkhidmat dalam industri petroleum.*  
C. *Perjumpaan lapangan minyak yang baru di lepas pantai Terengganu.*  
D. *Teknologi pengeluaran yang baru dan perjumpaan lapangan-lapangan minyak yang baru.*
- 1.7 *Isipadu minyak disebut dalam bentuk tong atau bbl, apakah 1 bbl bersamaan dengan?*
- A. *5.615 kaki padu*  
B. *5.165 kaki padu*  
C. *6.516 kaki padu*  
D. *6.165 kaki padu*

- 1.8 Crude oil density is expressed in degree API. What is its relationship to specific gravity?
- A.  $^{\circ}\text{API} = (141.5/\gamma) - 131.5$   
 B.  $^{\circ}\text{API} = (141.5/\gamma) + 131.5$   
 C.  $^{\circ}\text{API} = (\gamma/141.5) - 31.5$   
 D.  $^{\circ}\text{API} = (131.5/\gamma) - 141.5$
- 1.9 An oil with with a gravity of  $30^{\circ}\text{API}$  has a specific gravity of .....
- A. 0.767                      C. 0.876  
 B. 0.747                      D. 0.872
- 1.10 Most of the opinions state that oil and gas is derived from .....
- A. sandstone  
 B. the sea  
 C. organic material  
 D. limestone
- 1.11 A rock with 25% porosity is composed of .....
- A. 25% water and 75% oil  
 B. 75% water and 25% oil  
 C. 75% open space and 25% rock  
 D. 75% rock and 25% open space
- 1.12 What is wild cat well?
- A. Oil or gas well drilled without taking into consideration the local geological study  
 B. It is a well initially drilled with a minimum of information.  
 C. Oil or gas well drilled wildly.  
 D. The name originated when a cat was used to locate the oil well.
- 1.13 Most natural gas consist predominantly of ....., the percentage of which may be as high as 98%.
- A. methane  
 B. ethane  
 C. butane  
 D. methane and ethane
- 1.8 Ketumpatan minyak mentah disebut dalam darjah API. Apakah hubungannya dengan gravity tentu?
- A.  $^{\circ}\text{API} = (141.5/\gamma) - 131.5$   
 B.  $^{\circ}\text{API} = (141.5/\gamma) + 131.5$   
 C.  $^{\circ}\text{API} = (\gamma/141.5) - 31.5$   
 D.  $^{\circ}\text{API} = (131.5/\gamma) - 141.5$
- 1.9 Minyak dengan graviti  $30^{\circ}\text{API}$  mempunyai graviti tentu .....
- A. 0.767                      C. 0.876  
 B. 0.747                      D. 0.872
- 1.10 Kebanyakan pendapat menyatakan minyak dan gas terjadi daripada .....
- A. batu pasir  
 B. lautan  
 C. bahan organik  
 D. batu kapur
- 1.11 Suatu batuan yang mempunyai keliangan 25% terdiri daripada .....
- A. 25% air dan 75% minyak  
 B. 75% air dan 25% minyak  
 C. 75% ruang terbuka dan 25% batuan.  
 D. 75% batuan dan 25% ruang terbuka
- 1.12 Apakah telaga "wild cat"?
- A. Telaga minyak atau gas yang digerudi tanpa mengambilkira kajian geologi setempat.  
 B. Ia adalah telaga yang asalnya digerudi dengan maklumat yang minimum.  
 C. Telaga minyak atau gas yang digerudi secara liar.  
 D. Nama ini berasal apabila kucing pernah digunakan dahulu untuk mengesan telaga minyak.
- 1.13 Kebanyakan gas asli mengandungi ..... dengan banyaknya, peratusannya boleh mencecah setinggi 98%.
- A. metana  
 B. etana  
 C. butane  
 D. metana dan etana

1.14 ..... is dissolved in the oil under the initial reservoir pressure and temperature.

- A. Methane      C. Natural gas  
B. Solution gas      D. Butane

1.14 ..... terlarut dalam minyak di bawah tekanan dan suhu asal reserbor.

- A. Metana      C. Gas asli  
B. Gas larutan      D. Butana

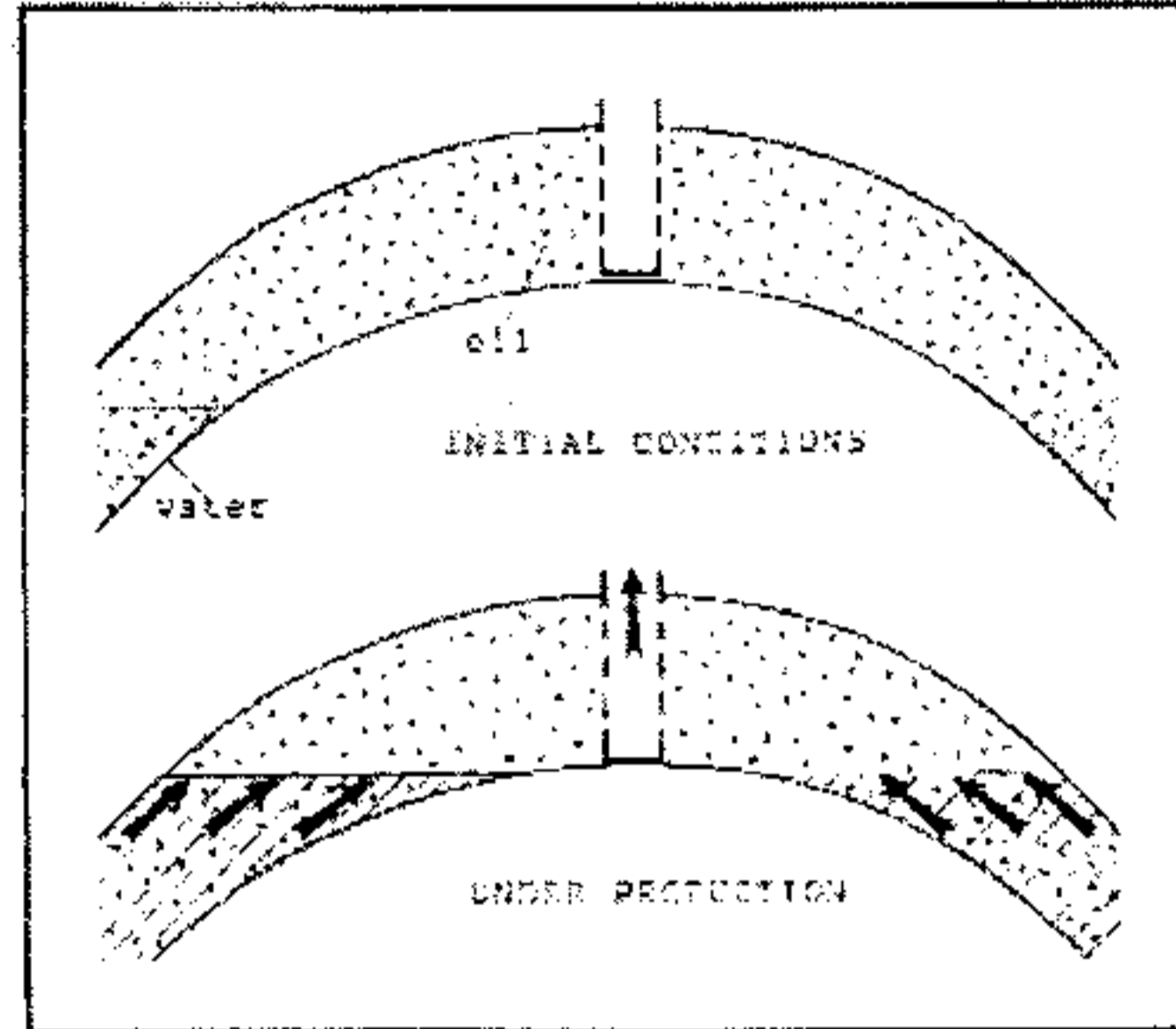


Figure 1

Rajah 1

1.15 From Figure 1, what is the type of reservoir drive?

- A. Water drive reservoir  
B. Gas cap drive reservoir  
C. Gravity drainage drive reservoir  
D. Combination drive reservoir

1.15 Daripada Rajah 1, apakah jenis pacuan reserbor?

- A. Reserbor pacuan air  
B. Reserbor pacuan tukup gas  
C. Reserbor pacuan saliran graviti  
D. Reserbor pacuan campuran

1.16. A gas cap is free gas trapped in the top of the structure above the oil leg. When there is a gas cap, the reservoir is at .....

- A. reservoir pressure  
B. gas pressure  
C. bubble point pressure  
D. oil pressure

1.16. Tukup gas adalah gas bebas yang terperangkap di bahagian atau suatu struktur di atas daripada kaki minyak. Apabila terdapat tukup gas, reserbor di dalam .....

- A. tekanan reserbor  
B. tekanan gas  
C. tekanan takat gelembung  
D. tekanan minyak

1.17 ..... is a light hydrocarbon liquid formed by condensation of petroleum compounds that were in the gaseous phase under initial reservoir conditions. It is highly volatile and from clear to a light yellow in colour.

- A. Condensate      C. Propane  
B. Gasoline      D. Butane

1.17 ..... ialah cecair hidrokarbon ringan yang terbentuk melalui pemeluwapan sebatian petroleum yang dalam fasa gas apabila di bawah keadaan reserbor asal. Ia terlalu mudah menjadi wap dan berwarna cerah hingga kekuningan.

- A. Peluwap      C. Propana  
B. Gasolin      D. Butana

1.18 What is formation volume factor?

- I. It is a ratio of volume of gas and oil produced.  
II. It is a ratio of the volume of oil and gas produced.

1.18 Apakah faktor isipadu formasi?

- I. Ia adalah nisbah isipadu gas dan minyak yang dikeluarkan.  
II. Ia adalah nisbah isipadu minyak dan gas yang dikeluarkan.

- III. In the case of oil, it is the ratio of the space occupied by a barrel of oil at reservoir conditions to the space occupied by a stock barrel (STB) of the oil.
- IV. The value of formation volume factor is greater than 1.
- A. I and IV  
B. I and III  
C. III and IV  
D. IV only
- 1.19 The following problems may arise due to abnormal pressure.
- I. Kicks and blowouts.  
II. Differential pressure pipe sticking.  
III. Lost circulation resulting from high mud weights.  
IV. Heaving shale
- A. I and III  
B. I, II and III  
C. III and IV  
D. All of the above
- 1.20 In the rotary method of oil well drilling, the hole is drilled by a rotating bit to which a downward force is applied. How does this downward force applied?
- A. By pushing with a machine on the drilling rig.  
B. By the weight of the drill pipes.  
C. By pushing with the crown block on the drilling rig.  
D. By exerting a downward force by the toolpusher.
- 1.21 Most of the drill cuttings from the drilling fluid are separated on the surface using .....
- A. desander  
B. desilter  
C. shale shaker  
D. degasser
- III. Bagi kes minyak, ialah nisbah ruang yang diisi dengan satu tong minyak pada keadaan reservoir kepada ruang yang diisi dengan satu tong stok (STB) minyak.
- IV. Nilai factor isipadu formasi bernilai lebih daripada 1.
- A. I dan IV  
B. I dan III  
C. III dan IV  
D. IV sahaja
- 1.19 Masalah-masalah berikut boleh timbul disebabkan tekanan luar biasa.
- I. Tendangan dan sembur liar.  
II. Paip melekat oleh tekanan beza.  
III. Kehilangan edaran disebabkan oleh berat lumpur yang tinggi.  
V. Syal mengembang
- A. I dan III  
B. I, II dan III  
C. III dan IV  
D. Semua di atas
- 1.20 Dalam kaedah putaran bagi penggerudian telaga minyak, lubang digerudi oleh bit berputar ke atas mana satu daya ke bawah dikenakan. Bagaimanakah daya ke bawah ini dikenakan?
- A. Oleh daya tolak dengan suatu mesin di atas rig penggerudian.  
B. Oleh berat paip gerudi.  
C. Oleh daya tolak dengan blok atas di atas rig penggerudian.  
D. Oleh tekanan daya ke bawah oleh toolpusher.
- 1.21 Kebanyakan rincisan gerudi daripada bendalir gerudi dasingkan di permukaan dengan menggunakan .....
- A. penyahpasir  
B. penyahlodak  
C. pengoncang syal  
D. penyahgas

The following statement is for question number 1.22 to 1.24.

A drilling rig has eight lines strung through the travelling block. A hook load of 240,000 lb is being hoisted at a velocity of 50 feet/min.

1.22 Calculate the velocity of the line being spooled at the drawworks?

- A. 50 feet/min      C. 450 feet/min  
B. 500 feet/min    D. 400 feet/min

1.23 Calculate the line pulled at the drawworks assuming frictional losses of 2% per working line.

- A. 36,000 lb      C. 26,667 lb  
B. 30,000 lb      D. 34,286 lb

1.24 Calculate the horsepower of the drawworks.

- A. 300 HP      C. 433 HP  
B. 454 HP      D. 545 HP

1.25 What type of cement used in casing cementing?

- A. Concrete  
B. Shotcrete  
C. Casing cement  
D. Portland cement

1.26 Prior to any cementing operation of the casing string, the cement is tested .....

- A. for its compressive strength.  
B. to find out its compatibility with the casing.  
C. in determining the volume required and determining the additives required to make sure it is compatible the formation behind the casing  
D. to determine the time available for pumping before the cement begins to set compressive strength.

1.27 A common method for repairing the faulty primary casing jobs or performing remedial operations on the hole is .....

- A. primary cementing.  
B. multi-stage cementing  
C. squeeze cementing  
D. secondary cementing

*Kenyataan berikut adalah untuk soalan 1.22 hingga 1.24*

*Satu rig penggerudian mempunyai lapan talian melalui satu blok bergerak. Daya cangkuk 240,000 lb ditarik ke atas pada halaju 50 kaki/min.*

1.22 *Kira halaju talian dipuntal di gelendong?*

- A. 50 kaki/min      C. 450 kaki/min  
B. 500 kai/min      D. 400 kaki/min

1.23 *Kira tarikan talian di gelendong dengan andaian kehilangan oleh geseran sebanyak 2% per talian yang bekerja.*

- A. 36,000 lb      C. 26,667 lb  
B. 30,000 lb      D. 34,286 lb

1.24 *Kira kuasa kuda bagi gelendong.*

- A. 300 KK      C. 433 KK  
B. 454 KK      D. 545 KK

1.25 *Apakah jenis simen yang digunakan dalam penyimenan selongsong?*

- A. Konkrit  
B. Syotkrit  
C. Simen selongsong  
D. Simen Portland

1.26 *Sebelum apa-apa operasi penyimenan talian selongsong, simen diuji .....*

- A. untuk kekuatan mampatannya.  
B. untuk mendapatkan kesesuaiannya dengan selongsong.  
C. dalam menentukan isipadu yang diperlukan dan menentukan bahan campuran yang diperlukan bagi memastikan ianya bersesuaian dengan formasi di belakang selongsong.  
D. bagi menentukan masa yang ada untuk pengepaman sebelum simen mula mengeras dengan kekuatan mampatan.

1.27 *Kaedah biasa bagi membaiki kerosakan pada selongsong primer atau bagi menjalankan operasi pembaikan ke atas lubang ialah .....*

- A. Penyimenan primer.  
B. Penyimenan berperingkat.  
C. Penyimenan himpit.  
D. Penyimenan sekunder.

- 1.28 On an oil platform, more than 40 wells can be grouped together. The wells will fan out from the platform into the reservoir by means of .....
- straight drilling
  - horizontal drilling
  - directional drilling
  - knuckle joint drilling bit
- 1.29 The magnetic compass is widely used in making well surveys in determining the path of the well drilled. Another method is by the use of .....
- topographical map
  - gyroscope
  - Electronic compass
  - satellite positioning
- 1.28 Di atas satu pelantar minyak, lebih 40 telaga boleh dikumpulkan bersama. Telaga-telaga akan digerudi keluar daripada pelantar ke dalam reserbor dengan cara .....
- penggerudian tegak
  - penggerudian mendatar
  - penggerudian berarah
  - bit sambungan buku jari
- 1.29 Kompas magnet digunakan dengan meluas dalam kerja ukur telaga bagi menentukan laluan telaga yang digerudi. Kaedah lain ialah dengan menggunakan.....
- peta topografi
  - giroskop
  - kompas elektronik
  - penempatan satelit



Figure 2  
Rajah 2

- 1.30 Figure 2 is the Spar platform which is a floating platform installed for a deep sea oil exploitation in Malaysia. The depth is about 4,400 feet. Which oil field is it?
- |          |          |
|----------|----------|
| A. Tapis | C. Kikeh |
| B. Pulau | D. Kakap |
- 1.31 Wild cats are drilled offshore usually by using .....
- Tender assisted rigs
  - Semisubmersible
  - drilling rigs
  - drillships
- 1.30 Rajah 2 ialah pelantar Spar iaitu sebuah plantar terapung yang dipasang untuk eksploitasi minyak di lautan dalam. Kedalaman laut lebih kurang 4,400 kaki. Lapangan minyak yang manakah ini?
- |          |          |
|----------|----------|
| A. Tapis | C. Kikeh |
| B. Pulau | D. Kakap |
- 1.31 Telaga liar kebiasaannya digerudi di kawasan lepas pantai dengan menggunakan .....
- tender assisted rigs
  - semisubmersible
  - rig penggerudian
  - kapal gerudi



- 1.32 What is the main purpose of drilling fluid?
- To protect the casing against corrosion.
  - To counterbalance the formation pressure.
  - To make the drilling faster.
  - To lessen formation damage.
- 1.33 In drilling a ..... is always attached at the top of conductor pipe.
- blow out preventer stack
  - kelly bushing
  - rotary table
  - kelly
- 1.34 Mud balance is used in determining .....
- to measure the mud weight.
  - to weigh the mud added in the drilling fluid
  - to weigh the mud before drilling commences.
  - to weigh the mud before spudding.
- 1.35 When a pipe or casing is lowered down into the well, the mud in the hole will support or bouy some of the pipe weight. The upthrust or buoyant force is equal to .....
- the mud weight.
  - the weight of the mud displaced by the pipe or casing.
  - the hydrostatic head created by the drilling mud.
  - the weight of the pipe.
- 1.36 Formation damage is referred to change in ..... around the borehole that results from drilling activities and well completion.
- porosity
  - permeability
  - formation lithology
  - formation characteristics
- 1.32 Apakah kegunaan utama bendalir penggerudian?
- Untuk melindungi selongsong daripada kakisan.
  - Untuk mengimbangi tekanan formasi.
  - Untuk membuat penggerudian lebih pantas.
  - Untuk mengurangkan kerosakan formasi.
- 1.33 Dalam penggerudian satu ..... selalu bersambung di atas paip pandu.
- tindan pencegah semburan liar
  - sesendal kelly
  - meja putar
  - kelly
- 1.34 Alat timbang lumpur digunakan untuk menentukan .....
- untuk mengukur berat lumpur
  - untuk menimbang lumpur yang dicampurkan kepada bendalir penggerudian.
  - untuk menimbang lumpur sebelum penggerudian bermula.
  - untuk menimbang lumpur sebelum penggerudian kali pertama.
- 1.35 Apabila suatu paip atau selongsong diturunkan ke dalam telaga, lumpur di dalam lubang akan mengampu atau mengapung sebahagian daripada berat paip. Daya tolakan-atas atau daya pengapungan bersamaan dengan .....
- berat lumpur
  - berat lumpur yang disesarkan oleh paip atau selongsong.
  - urus hidrostatik dihasilkan oleh lumpur penggerudian.
  - berat paip
- 1.36 Kerosakan formasi merujuk kepada pertukaran ..... di sekeliling lubang gerudi yang dihasilkan daripada kegiatan penggerudian dan pelengkapan telaga.
- keliangan
  - kebolehtelapan
  - litologi formasi
  - sifat formasi

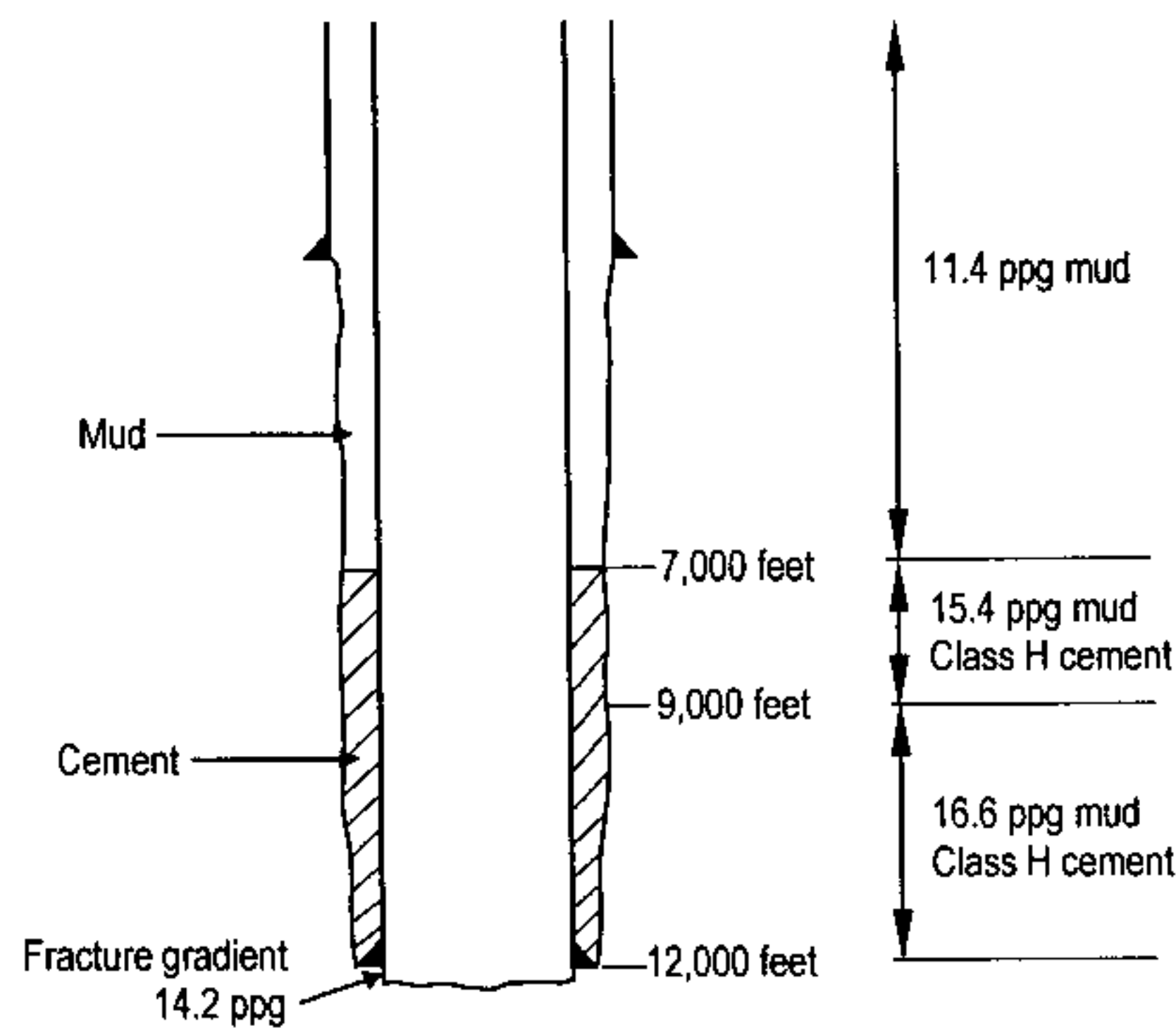


Figure 3

Rajah 3

Figure 3 is for questions no. 1.37 to 1.39 where an intermediate casing string will be cemented as shown.

Rajah 3 untuk soalan 1.37 hinggg 1.39 di mana satu selongsong pertengahan akan disimen seperti tertera dalam Rajah 3.

- 1.37 Convert the pressure at 12,000 feet to an equivalent mud weight.
- A. 7,114 psi      C. 10,358 psi  
B. 8,340 psi      D. 9,027 psi
- 1.38 What is the equivalent mud weight at 12,000 feet depth?
- A. 11.4 lb/gal      C. 14.5 lb/gal  
B. 15.4 ppg      D. 13.36 lb/gal
- 1.39 The fracture gradient of the formation at the bottom of the hole is 14.2 lb/gal. What does that indicate in relation to the equivalent mud weight at 12,000 feet depth?
- A. The equivalent mud weight which is less than 14.2 lb/gal indicates that there is oil within the formation at 12,000 feet.  
B. It indicates that fracture will occur and a kick is expected.  
C. It indicates that the mud weight has to be increased to be greater than 14.2 lb/gal so fracture will occur to enhance oil recovery.  
D. The hydrostatic pressure is less than the fracture gradient. This means that the formation has less or no risk of being fractured.
- 1.37 Tukarkan tekanan pada 12,000 kaki kepada berat lumpur setara.
- A. 7,114 psi      C. 10,358 psi  
B. 8,340 psi      D. 9,027 psi
- 1.38 Apakah berat lumpur setara pada kedalaman 12,000 kaki?
- A. 11.4 lb/gal      C. 14.5 lb/gal  
B. 15.4 ppg      D. 13.36 lb/gal
- 1.39 Kecerunan retakan formasi di dasar lubang ialah 14.2 lb/gal. Apakah yang ditunjukkan, dalam hubungan berat lumpur setara pada kedalaman 12,000 kaki?
- A. Berat lumpur setara yang kurang daripada 14.2 lb/gal menunjukkan bahawa terdapat minyak di dalam formasi di kedalaman 12,000 kaki.  
B. Ia menunjukkan keretakan akan berlaku dan tendangan dijangka.  
C. Ia menunjukkan bahawa berat lumpur perlu ditambah kepada lebih daripada 14.2 lb/gal supaya akan berlaku keretakan untuk mempertingkatkan perolehan minyak.  
D. Tekanan hidrostatik kurang daripada kecerunan retakan. Ini bermakna bahawa formasi mempunyai kurang atau tiada risiko kepada terjadinya keretakan.

- 1.40 The SCF and STB are referred in standard condition. What is the standard condition?
- A. 60°F, 14.7 psi  
 B. 80°F, 14.7 psi  
 C. 60°F, 14.17 psi  
 D. 60°F, 14.3 psi
- 1.41 Which of the following statement is true for drill stem testing?
- A. It is to test the strength of the drill stem.  
 B. It is a mechanical punch  
 C. It is done while drilling is in progress and the drill stem is used in sampling the oil.  
 D. It is to test for the the strength of the production tubing.
- 1.42 Which of the following statements are true for casing and tubing?
- I. A casing string consists of multiple joints of large diameter steel pipe that are screwed together, one joint at a time, as the pipe is run in the hole.  
 II. A tubing string is set in the hole temporarily while casing string is being prepared to run in hole.  
 III. All casing strings are cemented to well bore from bottom until the surface.  
 IV. A tubing string is retrievable, whereas a casing string is permanently set in the well with the annular space between the casing and the hole filled with cement.
- A. I and II                      C. I and III  
 B. I and IV                      D. III and IV
- 1.43 Two types of drilling fluid most commonly used are .....
- I. Water-based mud  
 II. barite-based mud  
 III. Oil-based mud  
 IV. clay-based mud
- A. I and II  
 B. I and III  
 C. I, II and III  
 D. All of the above
- 1.40 SCF dan STB dirujuk dalam keadaan piawai. Apakah keadaan piawai?
- A. 60°F, 14.7 psi  
 B. 80°F, 14.7 psi  
 C. 60°F, 14.17 psi  
 D. 60°F, 14.3 psi
- 1.41 Kenyataan yang manakah yang benar untuk ujian batang gerudi?
- A. Ia adalah ujian kekuatan batang gerudi.  
 B. Ia adalah penebuk mekanikal.  
 C. Ia dilakukan semasa penggerudian dan batang gerudi digunakan untuk persampelan minyak.  
 D. Ia adalah untuk menguji kekuatan tetiub pengeluaran.
- 1.42 Kenyataan yang manakah yang benar untuk selongsong dan tetiub?
- I. Suatu talian selongsong yang mengandungi berbilang sambungan paip keluli bergarispusat besar yang diskru bersama, satu sambungan pada satu masa, sementara paip diturunkan ke dalam lubang.  
 II. Suatu talian tetiub diletakkan dalam lubang, sementara menunggu talian selongsong disediakan untuk diturunkan ke dalam lubang.  
 III. Semua talian selongsong disimen kepada dinding telaga daripada bawah sehingga ke permukaan.  
 IV. Suatu talian tetiub boleh ditarik keluar, manakala talian selongsong diletakkan kekal di dalam lubang dengan ruang annulus antara selongsong dan lubang diisikan dengan simen.
- A. I dan II                      C. I dan III  
 B. I dan IV                      D. III dan IV
- 1.43 Dua jenis bendalir penggerudian yang biasa digunakan ialah .....
- I. Lumpur berdasarkan air  
 II. Lumpur berdasarkan barit  
 III. Lumpur berdasarkan minyak  
 IV. Lumpur berdasarkan tanah liat
- A. I dan II  
 B. I dan III  
 C. I, II dan III  
 D. Semua di atas

- 1.44 A well is being drilled in a salt-water basin with a pressure gradient of 0.465 psi/ft to a depth of 11,000 feet. What is the mud weight required in drilling this well?
- A. 8.94 ppg                      C. 8.33 ppg  
B. 9.84 ppg                      D. 9.00 ppg
- 1.45 Which of the following statements are true?
- I. Stuck pipe can occur after drilling has been halted for a rig breakdown, while running a directional survey or when conducting other non-drilling operation.  
II. The drill pipe may stick to the wall of the hole due to formation of filter cake or a layer of wet mud solids on the wall of the hole.  
III. Lost circulation of drilling fluid can occur in several types of formation, including high permeable formation, fractured formations and cavernous zones.  
IV. Heaving or sloughing hole occurs when shales enter the wellbore after the section has been penetrated by the bit. To solve this problem, drilling is suspended and the hole is conditioned (by letting the mud in circulation for a period of time.
- A. I and II  
B. I, II and III  
C. I and III  
D. All of the above
- 1.46 The specific gravity of bentonite is 2.65. What is the specific gravity of barite?
- A. 7.1                              C. 5.0  
B. 4.2                              D. 4.2 g/cm<sup>3</sup>
- 1.47 Calculate the internal yield (burst) pressure for 26.40 lb/ft, N-80 grade, 7.625 inch pipe. Assume it has a wall thickness of 0.328 inch. Use the API minimum wall thickness factor of 0.875.
- A. 6,022 psi                      C. 6,000 psi  
B. 6,538 psi                      D. 6,500 psi
- 1.44 Satu telaga sedang digerudi dalam lembangan air masin dengan kecerunan tekanan 0.465 psi/kaki pada kedalaman 11,000 kaki. Apakah berat lumpur diperlukan dalam penggerudian telaga ini.
- A. 8.94 ppg                      C. 8.33 ppg  
B. 9.84 ppg                      D. 9.00 ppg
- 1.45 Kenyataan berikut yang manakah yang benar?
- I. Paip tersangkut boleh berlaku setelah penggerudian dihentikan kerana kerosakan rig, semasa menjalankan ukur berarah atau semasa menjalankan kegiatan bukan-gerudi yang lain.  
II. Paip gerudi boleh melekat di dinding lubang kerana terbentuknya kek turas atau satu lapisan pepejal lumpur basah di dinding lubang.  
III. Kehilangan edaran bendalir penggerudian boleh berlaku dalam beberapa jenis formasi, termasuk formasi berkebolehtelapan tinggi, formasi retak dan kawasan berongga.  
IV. Lubang mengembang atau runtuh berlaku apabila syal memasuki lubang gerudi setelah bahagian ini digerudi oleh bit. Untuk menyelesaikan masalah ini, penggerudian diberhentikan sementara dan lubang dikondisikan (dengan membiarkan lumpur berkitaran bagi sesuatu tempoh)
- A. I dan II  
B. I, II dan III  
C. I dan III  
D. Semua di atas
- 1.46 Graviti tentu bentonite ialah 2.65. Apakah graviti tentu barit?
- A. 7.1                              C. 5.0  
B. 4.2                              D. 4.2 g/cm<sup>3</sup>
- 1.47 Kira tekanan alahan (pecah) dalaman bagi paip 26.40 lb/kaki, gred N-80, 7.625 inci. Andaikan ketebalan dinding 0.328 inci. Gunakan faktor ketebalan dinding minimum API bersamaan 0.875.
- A. 6,022 psi                      C. 6,000 psi  
B. 6,538 psi                      D. 6,500 psi

- 1.48 When a drilling well fails to find any zone of interest, it is declared a dry hole and .....
- A. install a Christmas tree for future usage.  
B. permanently plugged and abandoned by placing several cement plugs in the hole.  
C. left as it is and let nature do the rest.  
D. fill the hole with drilling mud and close the well by steel plug.
- 1.49 The casing and the cement behind it is perforated by using ..... for preparation of pay zone for production.
- A. mechanical punch  
B. electrical drill  
C. electrical punch  
D. shaped charges
- 1.50 What is main purpose of surface casing?
- A. To protect unconsolidated surface material and any zone of potable water.  
B. To protect the pay zone from being damaged  
C. To protect the drill string from being corroded.  
D. To protect the Christmas tree from the corroding fluid within the crude oil.
- 1.51 This method gives the density of rock and indirectly the rock types may be known.
- A. Gamma ray logging  
B. electrical logging  
C. SP logging  
D. mud logging
- 1.52 Oil saturation in the pay zone may be known from .....
- A. conventional coring  
B. side wall coring  
C. neutron logging  
D. production testing
- 1.48 Apabila satu telaga yang sedang menggerudi gagal menjumpai mana-mana zon yang menarik minat, ia diisytiharkan lubang kering dan .....
- A. dipasang pohon krismas untuk kegunaan masa hadapan.  
B. disumbatkan secara kekal dan ditinggalkan dengan meletakkan beberapa beberapa penutup simen di dalam lubang.  
C. ditinggalkan seadanya dan membiarkan alam semulajadi melakukan selebihnya.  
D. lubang diisi dengan lumpur penggerudian dan telaga ditutup dengan penutup keluli.
- 1.49 Selongsong dan simen dibelakangnya ditebuk dengan menggunakan ..... bagi penyediaan zon bayar untuk pengeluaran.
- A. penebuk mekanikal  
B. penggerudi elektrik  
C. penggerudi elektrik  
D. cas tetuang
- 1.50 Apakah tujuan utama selongsong permukaan?
- A. Untuk melindungi bahan permukaan yang tidak kuat dan mana-mana zon air bersih.  
B. Untuk melindungi zon bayar daripada dirosakkan.  
C. Untuk melindungi talian penggerudian daripada dikakis.  
D. Untuk melindungi pohon krismas daripada bendalir mengkakis di dalam minyak mentah.
- 1.51 Kaedah ini memberi ketumpatan batuan dan secara tak lansung jenis batuan boleh diketahui.
- A. Pengelogan gamma  
B. Pengelogan elektrik  
C. Pengelogan SP  
D. Pengelogan lumpur
- 1.52 Ketepuan minyak dalam zon bayar boleh diketahui daripada .....
- A. teras konvensional.  
B. teras dinding sisi  
C. pengelogan neutron  
D. ujian pengeluaran

- 1.53 For general calculation, the overburden stress gradient is often assumed to be .....
- A. 1.0 psi/ft  
B. 0.433 psi/ft  
C. 0.465 psi/ft  
D. 0.5 psi/ft
- 1.54 A well is going to be drilled to a depth of 15,000 feet. Entry into an abnormal pressure zone at 10,000 feet is due to undercompaction. Calculate the formation pressure at 15,000 feet. Use the normal assumption for the fluid pressure gradient and the overburden stress gradient.
- A. 6,975 psi      C. 15,000 psi  
B. 9,650 psi      D. 10,988 psi
- 1.55 A flowing well must overcome the following obstacles:
- I. Reservoir friction  
II. Hydrostatic head from the fluid column in the tubing  
III. Tubing pressure  
IV. Surface facilities pressure
- A. II and III  
B. II, III and IV  
C. III only  
D. All of the above
- 1.56 ..... is an artificial lift in oil production, that made up of a walking beam that gives the reciprocating movement, which the rod goes up and down, activating the pump.
- A. Centrifugal pump  
B. Surface pump  
C. Sucker rod pumps  
D. Mud pump
- 1.57 For oil field that contains a lot of gas, gas lift method is employed as an artificial lift for oil production. Gas lift valves are installed on the ..... at specific intervals and all these valves are submerged below the oil level in the well.
- A. production tubing  
B. production casing  
C. drilling pipe  
D. pay zones
- 1.53 Untuk pengiraan am, kecerunan tegasan beban atas kebiasaannya diandaikan bersamaan dengan .....
- A. 1.0 psi/kaki  
B. 0.433 psi/kaki  
C. 0.465 psi/kaki  
D. 0.5 psi/kaki
- 1.54 Satu telaga akan digerudi dikedalaman 15,000 kaki. Kemasukkan kepada zon tekanan luar biasa pada 10,000 kaki disebabkan kurang pepadatan. Kira tekanan formasi pada 15,000 kaki. Guanakan andaian biasa bagi kecerunan tekanan bendalir dan kecerunan tegasan beban atas.
- A. 6,975 psi      C. 15,000 psi  
B. 9,650 psi      D. 10,988 psi
- 1.55 Telaga yang sedang mengalir terpaksa mengatasi halangan-halangan berikut:
- I. geseran reserbor  
II. turus hidrostatik daripada kolum bendalir dalam tetiub.  
III. Tekanan daripada tetiub  
IV. Tekanan perlengkapan permukaan
- A. II dan III  
B. II, III dan IV  
C. III sahaja  
D. Semua di atas
- 1.56 ..... ialah angkat buatan dalam pengeluaran minyak, yang terdiri daripada rasuk berjalan yang memberi pergerakan salingan, di mana rod bergerak ke atas dan ke bawah, mengerakkan pam.
- A. Pam empar  
B. Pam permukaan  
C. Pam rod penyedut  
D. Pam lumpur
- 1.57 Bagi lapangan minyak yang mengandungi banyak gas, kaedah angkat gas digunakan sebagai angkat buatan bagi pengeluaran minyak. Injap-injap angkat gas dipasang di ..... di jeda-jeda tertentu dan semua injap-injap ini tenggelam di bawah paras minyak di dalam telaga.
- A. tetiub pengeluaran  
B. selongsong pengeluaran  
C. paip penggerudian  
D. zon bayar

- 1.58 There are three types of wells that produce gas, these are:
- I. Oil wells
  - II. Gas well
  - III. Condensate well
  - IV. Injection well
- A. I and II
  - B. IV only
  - C. I, II and III
  - D. II only
- 1.59 The crude oil from the formation will flow into the well through the production tubing, the Christmas tree and to the first pressure vessel that is known as .....
- A. separator
  - B. crude oil processor
  - C. crude oil fragmentation
  - D. crude oil tank
- 1.60 Natural gas is also produced .....
- A. from a refinery.
  - B. after crude oil is treated in the oil refinery.
  - C. with the crude oil from the reservoir.
  - D. after the gas is treated at the oil refinery.
- 1.58 Terdapat tiga jenis telaga yang mengeluarkan gas, ini adalah:
- I. telaga minyak
  - II. telaga gas
  - III. telaga peluwap
  - IV. telaga suntikan
- A. I dan II
  - B. IV sahaja
  - C. I, II dan III
  - D. II sahaja
- 1.59 Minyak mentah daripada formasi akan mengalir ke dalam telaga melalui tetiub pengeluaran, pohon krismas dan kepada kebuk tekanan yang pertama yang dikenali sebagai .....
- A. pemisah
  - B. pemproses minyak mentah
  - C. fragmentasi minyak mentah
  - D. tanki minyak mentah
- 1.60 Gas asli juga dikeluarkan.....
- A. daripada kilang penapis.
  - B. selepas minyak mentah dirawat di kilang penapis minyak.
  - C. bersama dengan minyak mentah daripada reserbor.
  - D. Selepas gas dirawat di kilang penapis minyak.

(50 marks/markah)

Formula for reference

$$P = 0.004V^2$$

$$F_d = ((n+2)/n) W$$

$$HP = (WV_h/33,000) \times 1/e$$

$$P = 0.465D_b + 1.0(D_1 - D_b) \text{ psi/ft}$$

$$W_L = (W_{pe} L) + e_w$$

$$A_p = 0.29W_{pe} \text{ square inches}$$

$$P_B = 0.875 (2Y_p t / OD)$$

$$P_Y = 0.7854 (OD^2 - ID^2) YP$$

**PART B / BAHAGIAN B**

**This section consists of 2 (two) questions. You are required to answer any 1 (one) of them.**

*Bahagian ini mengandungi 2 (dua) soalan. Anda diperlukan menjawab mana-mana (2) dua soalan.*

2. The commerciality magnitude for the accumulation of crude oil and gas to be formed and preserved depends on a number of geological conditions of one particular area. Discuss the conditions required for that such magnitude with the help of sketches.

*Magnitud kebolehpasaran untuk pengumpulan minyak mentah dan gas akan terbentuk dan dipelihara bergantung kepada beberapa keadaan geologi satu kawasan tertentu. Bincangkan syarat-syarat yang diperlukan bagi magnitud itu dengan bantuan lakaran.*

(100 marks/markah)

3. Permeability and porosity are essential consideration to make a productive crude oil and gas well. Present the general forms of the relationships between permeability and porosity. Is the permeability anisotropic parameter? How the occurrences of clay minerals influence the permeability, discussion should be based on the location of clay minerals and type of clay minerals.

*Kebolehtelapan dan keliangan adalah pertimbangan yang penting untuk membuat minyak mentah dan gas yang produktif. Hadir bentuk umum hubungan antara kebolehtelapan dan keliangan. Adakah parameter kebolehtelapan anisotropik? Bagaimana kejadian mineral tanah liat mempengaruhi kebolehtelapan, perbincangan harus berdasarkan lokasi mineral tanah liat dan jenis mineral tanah liat.*

(100 marks/markah)



**PART B / BAHAGIAN B**

This section consists of 2 (two) questions. You are required to answer any 1 (one) of them.

*Bahagian ini mengandungi 2 (dua) soalan. Anda diperlukan menjawab mana-mana (2) dua soalan.*

4. [a] Natural gas is an important source of energy used worldwide.

*Gas asli ialah satu sumber tenaga yang penting digunakan serata dunia.*

- (i) Recommend a simple definition of what natural gas is and list three possible types of natural gas occurrence.

*Syorkan satu definisi mudah bagi gas asli dan senaraikan tiga jenis kejadian gas asli yang mungkin.*

(10 marks/markah)

- (ii) With the aid of a table, categorize the two compound types found in a typical natural gas. For each compound type, distinguish two compounds present, and state the percentage availability for each in a typical natural gas.

*Dengan bantuan jadual, kategorikan dua jenis kompaun yang didapati pada gas asli tipikal. Bagi setiap jenis kompaun, bezakan dua kompaun yang hadir, dan nyatakan peratusan ketersediaan bagi setiap satunya dalam gas asli tipikal.*

(10 marks/markah)

- (iii) There are a number of important properties of natural gas. Identify five of these properties, and discuss briefly the definition and mathematical representation of each property.

*Terdapat beberapa ciri penting gas asli. Kenalpasti lima dari ciri-ciri ini dan bincangkan dengan ringkas definisi dan perwakilan matematik bagi setiap ciri.*

(20 marks/markah)

- [b] Explain in brief why natural gas processing needs to be done. Consequently, categorize five of the products obtained from natural gas processing and each of their uses.

*Terangkan secara ringkas mengapa pemprosesan gas asli perlu dilakukan. Seterusnya, berikan lima kategori produk yang diperolehi dari pemprosesan gas asli, serta kegunaan tiap produk tersebut.*

(20 marks/markah)

- [c] Generalize the three aims of the Claus process. With the aid of a diagram, explain the two steps of the Claus process in detail. For each step, relate the possible theoretical concept, and the yield. Finally, explain two advantages of this process to the environment.

*Berikan tiga tujuan proses Claus secara am. Dengan bantuan rajah, terangkan dua langkah proses Claus dengan lengkap. Bagi setiap langkah, nyatakan konsep teoretikal yang terlibat dan hasilnya. Akhir sekali, terangkan dua kelebihan proses ini kepada alam sekitar.*

(40 marks/markah)

5. [a] Explain four aims of a surface oil production facility.

*Terangkan empat tujuan sebuah kemudahan penghasilan minyak daratan.*

(10 marks/markah)

- [b] Water content in crude oil may vary from 1% to 90%, and purchasers will only accept a range of 0.2% to 3% water in the crude oil. It is difficult to separate water from crude oil when both form an emulsion.

*Kandungan air di dalam minyak mentah mungkin berbeza dari 1% hingga 90%, dan pembeli hanya akan menerima julat 0.2% hingga 3% air di dalam minyak mentah. Ianya agak sulit untuk mengasingkan air dari minyak mentah, terutamanya apabila kedua-duanya membentuk emulsi.*

- (i) Explain the most common way to treat crude oil-water emulsions.

*Terangkan cara yang paling lazim untuk merawat emulsi minyak mentah-air.*

(5 marks/markah)

- (ii) Explain the four benefits obtained if this most common way is used to treat crude oil-water emulsions.

*Terangkan empat kelebihan yang diperolehi sekiranya cara yang paling lazim ini digunakan untuk merawat emulsi minyak mentah-air.*

(20 marks/markah)

- [c] A petroleum refining facility or an oil refinery is an important downstream section of the petroleum industry. It is here that crude oil is processed into more usable products.

*Sebuah kawasan kemudahan penapisan petroleum atau sebuah loji penapisan minyak ialah satu bahagian hiliran yang penting dalam industri petroleum. Di sini, minyak mentah akan diproses menjadi produk yang lebih berguna.*

- (i) Identify the first processing unit in a typical petroleum refining facility.

*Kenal pasti unit pemprosesan yang pertama dalam sebuah kawasan kemudahan penapisan petroleum yang tipikal.*

(5 marks/markah)

- (ii) Describe the on-goings in this first processing unit.

*Gambarkan apa yang berlaku di dalam unit pemprosesan pertama ini.*

(10 marks/markah)

- (iii) List five possible products from this processing unit and identify the next processing unit for each of them.

*Senaraikan lima produk yang mungkin daripada unit pemprosesan ini dan kenal pasti unit pemprosesan seterusnya untuk setiap produk tersebut.*

(10 marks/markah)

- [d] Corrosion is a known major issue in petroleum refineries.

*Kakisan telah diketahui sebagai isu utama dalam loji penapisan minyak.*

- (i) List four major types of corrosion found in petroleum refineries and identify the cause of corrosion for each.

*Senaraikan empat jenis utama kakisan yang dijumpai di dalam loji penapisan minyak dan kenal pasti sebab kakisan tiap-taip satunya.*

(10 marks/markah)

- (ii) Choose what you think being the most widely-used criteria in predicting corrosion in oil and gas environment. Sketch a graph that relates this most widely used criteria to number of corrosive incidents.

*Pilih apa yang anda rasa sebagai kriteria yang luas diguna pakai dalam meramal kakisan dalam persekitaran minyak dan gas asli. Lakarkan sebuah graf yang menghubungkan kriteria tersebut dengan jumlah insiden kakisan.*

(10 marks/markah)

- (iii) Discuss four corrosion minimizing efforts that is applied in the petroleum environment.

*Bincangkan empat usaha meminimalkan kakisan yang digunakan dalam arena petroleum.*

(20 marks/markah)

UNIVERSITI SAINS MALAYSIA  
SECOND SEMESTER EXAMINATION 2012/2013  
PEPERIKSAAN SEMESTER KEDUA 2012/2013

**EBS 418/3**  
**PETROLEUM ENGINEERING**  
*KEJURUTERAAN PETROLEUM*

OBJECTIVE QUESTIONS ANSWER SHEET

Examination Index Number :

*Angka Giliran Peperiksaan:*

(in words):

*(dalam perkataan):*

.....  
.....

Blacken the correct answer using a suitable pencil.

*Hitamkan jawapan yang betul dengan menggunakan pensel yang sesuai*

- |      |     |     |     |     |      |     |     |     |     |      |     |     |     |     |
|------|-----|-----|-----|-----|------|-----|-----|-----|-----|------|-----|-----|-----|-----|
| 1.1  | =A= | =B= | =C= | =D= | 1.21 | =A= | =B= | =C= | =D= | 1.41 | =A= | =B= | =C= | =D= |
| 1.2  | =A= | =B= | =C= | =D= | 1.22 | =A= | =B= | =C= | =D= | 1.42 | =A= | =B= | =C= | =D= |
| 1.3  | =A= | =B= | =C= | =D= | 1.23 | =A= | =B= | =C= | =D= | 1.43 | =A= | =B= | =C= | =D= |
| 1.4  | =A= | =B= | =C= | =D= | 1.24 | =A= | =B= | =C= | =D= | 1.44 | =A= | =B= | =C= | =D= |
| 1.5  | =A= | =B= | =C= | =D= | 1.25 | =A= | =B= | =C= | =D= | 1.45 | =A= | =B= | =C= | =D= |
| 1.6  | =A= | =B= | =C= | =D= | 1.26 | =A= | =B= | =C= | =D= | 1.46 | =A= | =B= | =C= | =D= |
| 1.7  | =A= | =B= | =C= | =D= | 1.27 | =A= | =B= | =C= | =D= | 1.47 | =A= | =B= | =C= | =D= |
| 1.8  | =A= | =B= | =C= | =D= | 1.28 | =A= | =B= | =C= | =D= | 1.48 | =A= | =B= | =C= | =D= |
| 1.9  | =A= | =B= | =C= | =D= | 1.29 | =A= | =B= | =C= | =D= | 1.49 | =A= | =B= | =C= | =D= |
| 1.10 | =A= | =B= | =C= | =D= | 1.30 | =A= | =B= | =C= | =D= | 1.50 | =A= | =B= | =C= | =D= |
| 1.11 | =A= | =B= | =C= | =D= | 1.31 | =A= | =B= | =C= | =D= | 1.51 | =A= | =B= | =C= | =D= |
| 1.12 | =A= | =B= | =C= | =D= | 1.32 | =A= | =B= | =C= | =D= | 1.52 | =A= | =B= | =C= | =D= |
| 1.13 | =A= | =B= | =C= | =D= | 1.33 | =A= | =B= | =C= | =D= | 1.53 | =A= | =B= | =C= | =D= |
| 1.14 | =A= | =B= | =C= | =D= | 1.34 | =A= | =B= | =C= | =D= | 1.54 | =A= | =B= | =C= | =D= |
| 1.15 | =A= | =B= | =C= | =D= | 1.35 | =A= | =B= | =C= | =D= | 1.55 | =A= | =B= | =C= | =D= |
| 1.16 | =A= | =B= | =C= | =D= | 1.36 | =A= | =B= | =C= | =D= | 1.56 | =A= | =B= | =C= | =D= |
| 1.17 | =A= | =B= | =C= | =D= | 1.37 | =A= | =B= | =C= | =D= | 1.57 | =A= | =B= | =C= | =D= |
| 1.18 | =A= | =B= | =C= | =D= | 1.38 | =A= | =B= | =C= | =D= | 1.58 | =A= | =B= | =C= | =D= |
| 1.19 | =A= | =B= | =C= | =D= | 1.39 | =A= | =B= | =C= | =D= | 1.59 | =A= | =B= | =C= | =D= |
| 1.20 | =A= | =B= | =C= | =D= | 1.40 | =A= | =B= | =C= | =D= | 1.60 | =A= | =B= | =C= | =D= |