Question Paper Name: GATE 2016 Paper

Duration: 180

Total Marks: 100

ABOUT US

PETRODICE Academy is a NEW Educational Institution in India that provides comprehensive test preparatory services to students preparing for GATE in Petroleum Engineering (PE). The Institute is in HYDERABAD and it provides various services from Classroom Program to Test series. We have a very humble Beginning starting in 2019 with All India Test Series with a vision to provide Quality Questions to GATE Aspirants. With this Test Series we started to make a difference in the way Students think and approach Problems. The Success of our Students was inspiring and their faith in PETRODICE Test Series was a catalyst for our venturing into areas beyond test series. It is this faith that prompted us to embark on a mission to provide a comprehensive program taking care of all aspects of the GATE Preparation. We with our urge and compelling desire for perfection and our Students Hard work will enable us and our students to achieve our goals together.
We are committed to provide finest service to the best of our ability in order to help the students, in pursuit of excellence and achieve their goals.

Website: - http://www.petrodice.com/

Facebook: - https://www.facebook.com/Petrodice4u/?modal=admin_todo_tour

Twitter: - https://twitter.com/petrodice4u/status/1168918849867132928

Youtube:-https://www.youtube.com/channel/UCMSjPSTy3iwkXU9loFM9MFQ?view_as=subscriber

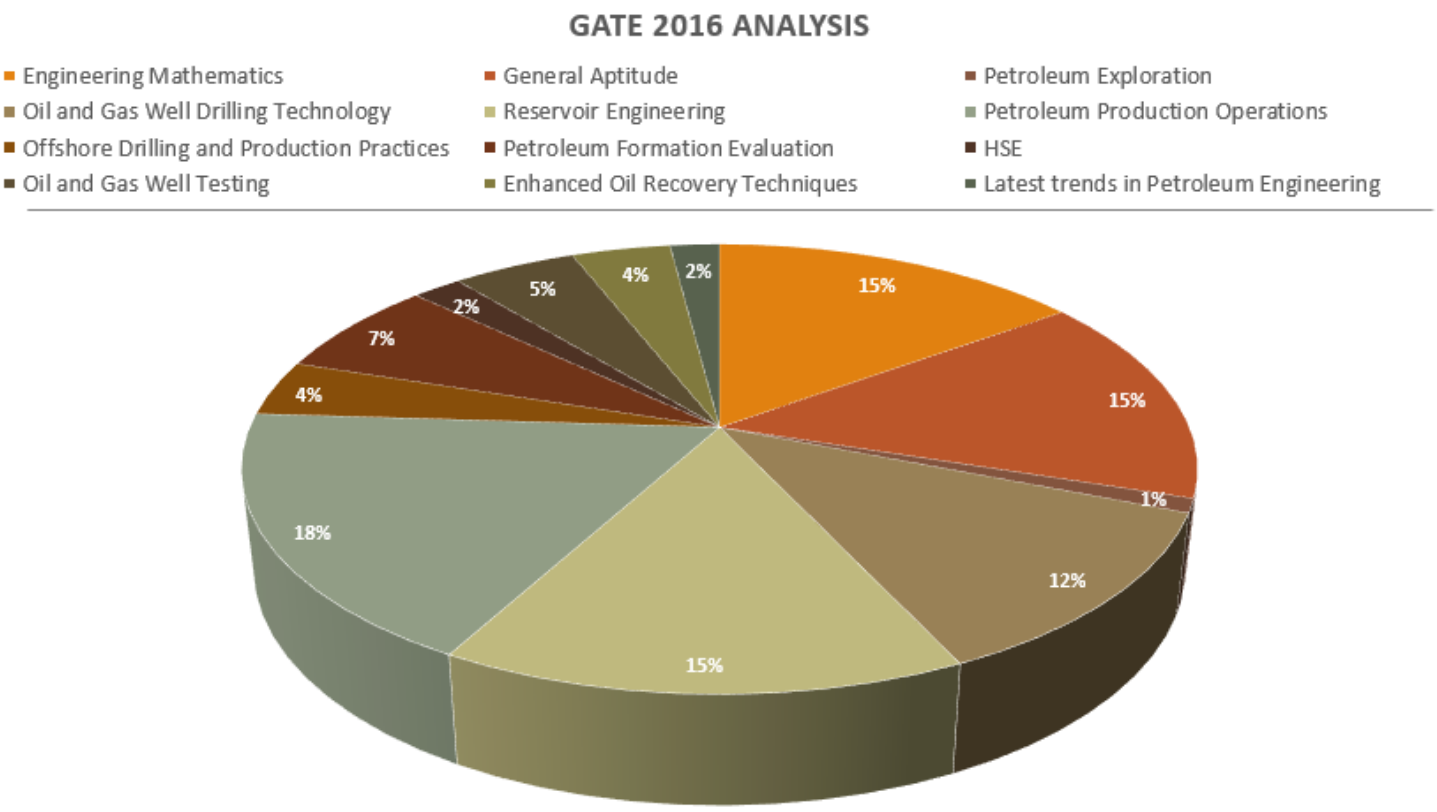
Android: - https://play.google.com/store/apps/details?id=conductexam.petrodice

Telegram: - https://t.me/petrodice

Gate 2016

The Gate 2016 is conducted by Indian Institute of Science (IISc) Bangalore,This is the first year the Petroleum Engineering is introduced in GATE. In this Paper the maximum marks is from Petroleum Production Operations.

Organizing Institute	IISc Bangalore
Number of Candidates Registered	2774
Number of Candidates Appeared	2326
Air 1st Rank Marks (out of 100)	83
General/EWS Qualifying Marks (out of 100)	40
OBC Qualifying Marks (out of 100)	36
SC/ST Qualifying Marks (out of 100)	26.69



SUBJECT	Number of Questions		Total Marks
	1 Mark	2 Mark	
Engineering Mathematics	5	5	15
General Aptitude	5	5	15
Petroleum Exploration	1	0	1
Oil and Gas Well Drilling Technology	2	5	12
Reservoir Engineering	3	6	15
Petroleum Production Operations	2	8	18
Offshore Drilling and Production Practices	2	1	4
Petroleum Formation Evaluation	3	2	7
HSE	2	0	2
Oil and Gas Well Testing	1	2	5
Enhanced Oil Recovery Techniques	2	1	4
Latest trends in Petroleum Engineering	2	0	2
TOTAL	30	35	100

Gate 2016 Question Paper

Q.1 An apple costs Rs. 10. An onion costs Rs. 8.
Select the most suitable sentence with respect to grammar and usage.
(A) The price of an apple is greater than an onion.
(B) The price of an apple is more than onion.
(C) The price of an apple is greater than that of an onion.
(D) Apples are more costlier than onions.

Q.2 The Buddha said, "Holding on to anger is like grasping a hot coal with the intent of throwing it at
someone else; you are the one who gets burnt."
Select the word below which is closest in meaning to the word underlined above.
(A) burning
(B) igniting
(C) clutching
(D) flinging

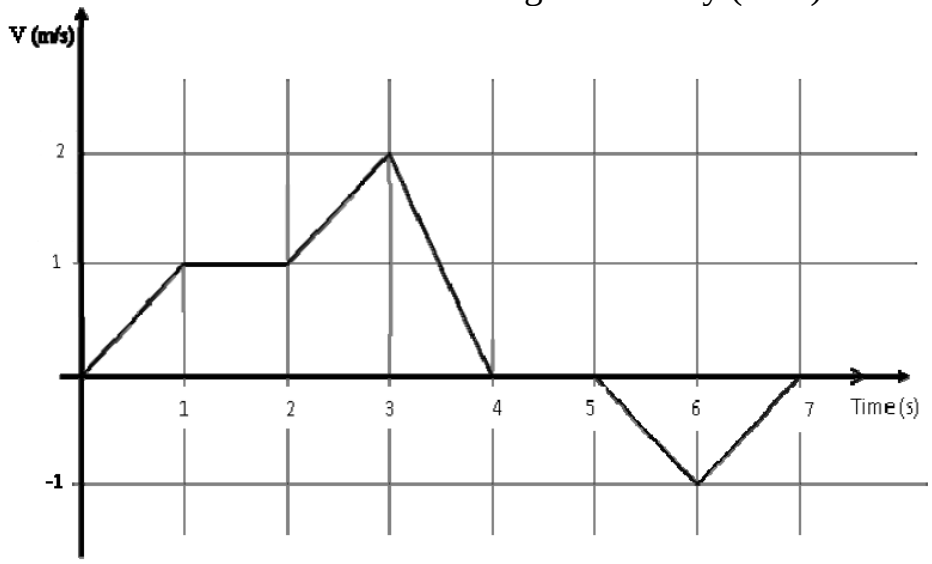
Q.3 M has a son Q and a daughter R. He has no other children. E is the mother of P and daughter-in law
of M. How is P related to M?
(A) P is the son-in-law of M.
(B) P is the grandchild of M.
(C) P is the daughter-in law of M.
(D) P is the grandfather of M.

Q.4 The number that least fits this set: (324, 441, 97 and 64) is _____.
(A) 324
(B) 441
(C) 97
(D) 64

Q.5 It takes 10 s and 15 s, respectively, for two trains travelling at different constant speeds to
completely pass a telegraph post. The length of the first train is 120 m and that of the second train is
150 m. The magnitude of the difference in the speeds of the two trains (in m/s) is _____.
(A) 2.0
(B) 10.0
(C) 12.0

(D) 22.0

Q.6 The velocity V of a vehicle along a straight line is measured in m/s and plotted as shown with respect to time in seconds. At the end of the 7 seconds, how much will the odometer reading increase by (in m)?



(A) 0
(B) 3
(C) 4
(D) 5

Q.7. The overwhelming number of people infected with rabies in India has been flagged by the World Health Organization as a source of concern. It is estimated that inoculating 70% of pets and stray dogs against rabies can lead to a significant reduction in the number of people infected with rabies.
Which of the following can be logically inferred from the above sentences?
(A) The number of people in India infected with rabies is high.
(B) The number of people in other parts of the world who are infected with rabies is low.
(C) Rabies can be eradicated in India by vaccinating 70% of stray dogs.
(D) Stray dogs are the main source of rabies worldwide.

Q.8. A flat is shared by four first year undergraduate students. They agreed to allow the oldest of them to enjoy some extra space in the flat. Manu is two months older than Sravan, who is three months younger than Trideep. Pavan is one month older than Sravan. Who should occupy the extra space in the flat?
(A) Manu
(B) Sravan
(C) Trideep
(D) Pavan

Q.9. Find the area bounded by the lines 3x+2y=14, 2x-3y=5 in the first quadrant.
(A) 14.95
(B) 15.25
(C) 15.70
(D) 20.35

Q.10. A straight line is fit to a data set (ln x, y). This line intercepts the abscissa at ln x = 0.1 and has a slope of −0.02. What is the value of y at x = 5 from the fit?
(A) −0.030
(B) −0.014
(C) 0.014
(D) 0.030

Q.11. The value of $\lim_{x\to 0}\left(\frac{e^x-1}{\sin x}\right)$ is equal to

Q.12. The function f (x) = $\frac{1}{1+|x|}$ is
(A) continuous and differentiable.
(B) continuous but not differentiable.
(C) not continuous but differentiable.
(D) not continuous and not differentiable.

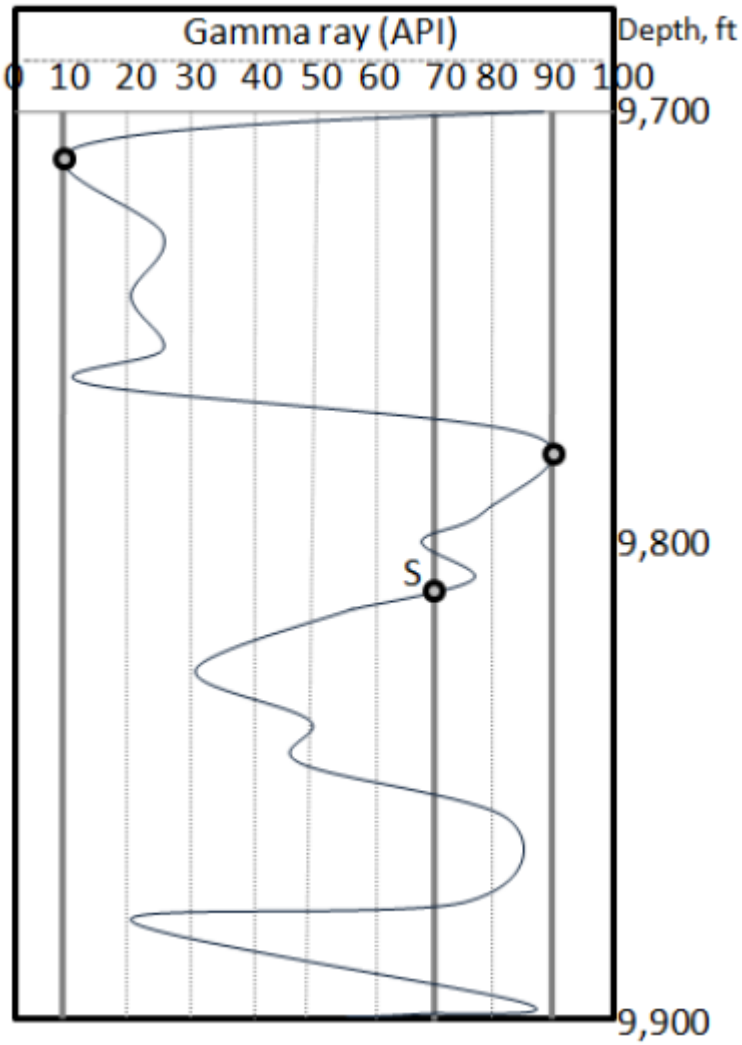
Q.13. The value of the definite integral $\int_1^e (\ln x)\, dx$ is equal to _____.

Q.14. For a complex number Z = $\left(\frac{1}{2}+\frac{\sqrt{3}}{2}i\right)$, the value of Z^6 is
(A) - $\left(\frac{1}{2}+\frac{\sqrt{3}}{2}i\right)$
(B) –1
(C) $\left(\frac{1}{2}-\frac{\sqrt{3}}{2}i\right)$
(D) 1

Q.15. The Laplace transform of the function e^{-2t} is
(A) $\frac{1}{2s}$
(B) $\frac{2}{s}$
(C) $\frac{1}{s+2}$
(D) e^{-2s}

Q.16. Which of the following is preferred fast neutron source in neutron logging?
(A) Americium-Beryllium
(B) Radium-Beryllium
(C) Deuterium-Tritium
(D) Thorium-Beryllium

Q.17. Using the gamma ray log given in the figure, the shaliness index for point S is _____%.

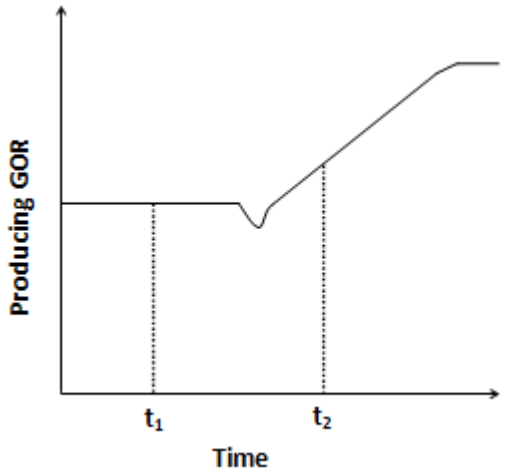


Q.18. Identify the logging device that is based on the concept of longitudinal and transverse relaxation
times.
(A) Thermal neutron decay
(B) Induced gamma ray spectroscopy
(C) Neutron
(D) Nuclear Magnetic Resonance (NMR)

Q.19. The three main stages of evolution of organic matter in sediments are Catagenesis (C), Diagenesis (D) and Metagenesis (M). Their chronological order is
(A) D - C - M
(B) C - D - M
(C) D - M - C
(D) C - M – D

Q.20. For a kick off operation, a directional well has to be drilled for an arc-length of 2500 ft to achieve an inclination of 50°.
The radius of curvature will be _____ ft.

Q.21. The figure shows the producing gas oil ratio (GOR) behaviour with time for an oil reservoir under primary production. At initial reservoir condition, Pb is the bubble point pressure of the crude oil. PR(t) represents the reservoir pressure at time 't'. Which of the following statements is **TRUE**?



(A) PR(t1) > Pb, PR(t2) > Pb
(B) PR(t1) > Pb, PR(t2) < Pb
(C) PR(t1) < Pb, PR(t2) > Pb
(D) PR(t1) < Pb, PR(t2) < Pb

Q.22. A core, with a length of 10 cm, breadth of 4 cm and width of 4 cm, weighs 282.4 g in its dry form. The core is then saturated 100% with brine of density 1.1 g/cm3. The brine saturated core weighs 300 g. The porosity of this core sample is _____%.

Q.23. A hydraulic line of a subsurface safety valve has a fluid of specific gravity 1.2 to operate the valve. The valve closing pressure is 1,200 psia and the recommended safety margin is 200 psia.
The maximum depth at which the valve can be positioned is_____ ft.

Q.24. A sucker rod pump unit is designated by C-228D-200-74. Here, 'D' represents
(A) double reduction gear box.
(B) diameter of sucker rod.
(C) diameter of plunger.
(D) stroke length.

Q.25. The three translational motions for a floating vessel are
(A) Roll-Pitch-Yaw.
(B) Heave-Pitch-Sway.
(C) Surge-Sway-Heave.
(D) Roll-Sway-Heave.

Q.26. Jack-up rigs are typically used for off-shore drilling when the water depth is in the range
(A) < 25 ft
(B) 50 - 500 ft
(C) 1000 - 2000 ft
(D) > 2000 ft

Q.27. Interference tests can be used for
I. determining communication between two or more wells.
II. mature oil wells having skin damage.
III. determining permeability in tested wells.
IV. providing inputs for secondary and tertiary oil recovery methods
(A) only I and II
(B) only I, II and IV
(C) only II, III and IV
(D) I, II, III and IV

Q.28. For an effective hydraulically-fractured well, the skin factor would **GENERALLY** be
(A) negative.
(B) positive.
(C) zero.
(D) indeterminate.

Q.29. The maximum discharge limit of oil and grease in a marine coastal area as per Environmental
(protection) Rules, 1986 in India is
(A) 0.1 mg/L.
(B) 20 mg/L.
(C) 500 mg/L.

(D) 4000 mg/L.

Q.30. Which of the following gases is **NOT** responsible for global warming?
(A) Carbon dioxide
(B) Methane
(C) Water vapour
(D) Nitrogen

Q.31. In an oil reservoir flooded with water, the volumetric sweep efficiency is 70%. The connate water saturation in the reservoir is 0.4 and the residual oil saturation for the water flood is 0.3.
The overall efficiency of the reservoir is _____ %.

Q.32. Identify the pair of **CORRECT** statements for surfactant-micellar-polymer flooding.
I. It reduces interfacial tension between crude oil and water.
II. It influences mobility ratio unfavorably.
III. It improves microscopic displacement efficiency.
IV. It increases isothermal compressibility of the crude oil.
(A) I& II
(B) I& III
(C) III& IV
(D) II& IV

Q.33. Gas hydrate forms at
(A) low pressure and low temperature conditions.
(B) low pressure and high temperature conditions.
(C) high pressure and low temperature conditions.
(D) high pressure and high temperature conditions.

Q.34. Production of coal bed methane (CBM) is based on
(A) distillation.
(B) underground coal gasification.
(C) desorption.
(D) coal liquefaction.

Q.35. The divergence of the velocity field V = (x2 + y) i + (z − 2xy) j + (xy) k at (1, 1, 1) is
_____.

Q.36. For a function f(x), the values of the function in the interval [0, 1] are given in the table below.

x	f(x)
0.0	1.0
0.2	1.24
0.4	1.56
0.6	1.96
0.8	2.44
1.0	3.0

The value of the integral $\int_0^1 f\ (x)\ dx$ according to the trapezoidal rule is _____.

Q.37. A box has a total of ten identical sized balls. Seven of these balls are black in colour and the rest
three are red. Three balls are picked from the box one after another without replacement.
The probability that two of the balls are black and one is red is equal to _____.

Q.38. Consider the matrix, M = $\begin{bmatrix} 5 & 3 \\ 3 & 5 \end{bmatrix}$. The normalized eigen-vector corresponding to the smallest
eigen-value of the matrix M is

(A) $\begin{pmatrix} \frac{\sqrt{3}}{2} \\ \frac{1}{2} \end{pmatrix}$

(B) $\begin{pmatrix} \frac{\sqrt{3}}{2} \\ -\frac{1}{2} \end{pmatrix}$

(C) $\begin{pmatrix} \frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} \end{pmatrix}$

(D) $\begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix}$

Q.39. For the differential equation

$$x^2 \frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = 0$$

the general solution is
(A) $y = C\,x + Ce^{x}$
(B) $y = C \sin x + C \cos x$
(C) $y = C\,e^{x} + C\,e^{-x}$
(D) $y = C\,x^2 + C\,x$

Q.40. The porosities of cubic and hexagonal packings, respectively, are
(A) 47.6% and 25.9%.
(B) 39.5% and 29.5%.
(C) 47.6% and 39.5%.
(D) 39.5% and 25.9%.

Q.41. In sonic logging, the sonic velocities in the formation and drilling mud are 50,000 ft/s and 500 ft/s, respectively.
The critical angle is ____ radians.

Q.42. A section of a clean sandstone reservoir was logged and found to have a porosity of 10%. The
cementation (m) and saturation (n) exponents are equal to 2. The constant 'a' in Archie's saturation
equation is 1. The formation water resistivity is 0.036 ohm-meter and the formation resistivity is 10
ohm-meter.
The water saturation in the reservoir is_____%.

Q.43. Match the entries in Group 1 with those in Group 2

Group 1	**Group 2**
P. Blow Out Preventer	I. Horizontal well problem
Q. Diamond bit	II. Reverse ballooning
R. Tubing elongation	III. Well control
S. Eccentricity	IV. Crown
	V. Ballooning

(A) P-III, Q-IV, R-V, S-II
(B) P-V, Q-IV, R-I, S-II
(C) P-III, Q-IV, R-II, S-I
(D) P-IV, Q-III, R-V, S-I

Q.44. One thousand sacks of cement are required for cementing a protection casing of setting depth of
12,000 ft (top float collar) and annular capacity of 0.40 ft3 per linear ft. The cementing truck has a
mixing capacity of 20 sacks per min. A 1.15 ft3/cycle capacity rig mud pump having an 18 inch
stroke and a 6 ½ inch liner operating at 60 rpm with 90% efficiency is used for the cementing job.
The total cementing time is _____ min.

Q.45. It is desired to increase the density of 200 bbl of 10 ppg mud to 12 ppg mud using API Barite of
density 35 ppg. The final volume is not limited.
[1 bbl = 42 gallons]
The amount of API Barite required is _____ lbm.

Q.46. Using the High Pressure High Temperature (HPHT) filter press data given below, the estimated
API filtration loss is _____ cm3.
Data given:

Time (min)	Filtrate volume (cm3)
1.0	6.5
7.5	14.0

Q.47. A Differential Liberation Experiment (DLE) and a Constant Composition Expansion (CCE)/Flash liberation experiment were performed in a laboratory for a crude oil to find the formation volume factor (Bo) and the dissolved gas oil ratio (Rs). The pressure stages for both experiments were kept the same. At a pressure less than the bubble point pressure of the crude oil, which of the following statements is **TRUE**?
(A) Bo (CCE) > Bo (DLE), Rs (CCE) > Rs (DLE)
(B) Bo (CCE) > Bo (DLE), Rs (CCE) < Rs (DLE)
(C) Bo (CCE) < Bo (DLE), Rs (CCE) > Rs (DLE)
(D) Bo (CCE) < Bo (DLE), Rs (CCE) < Rs (DLE)

Q.48. The production of a gas well was found to decline exponentially. The observed production rate on 1st January, 2014 was 0.6×10^{10} SCF/month and on 1st January, 2015, it was 0.4×10^{10} SCF/month.
The economic production limit for the well is estimated to be 0.002×10^{10} SCF/month.
The remaining reserves for the well as on 1st January, 2015 were _____ $\times$ **10^{10}** SCF.

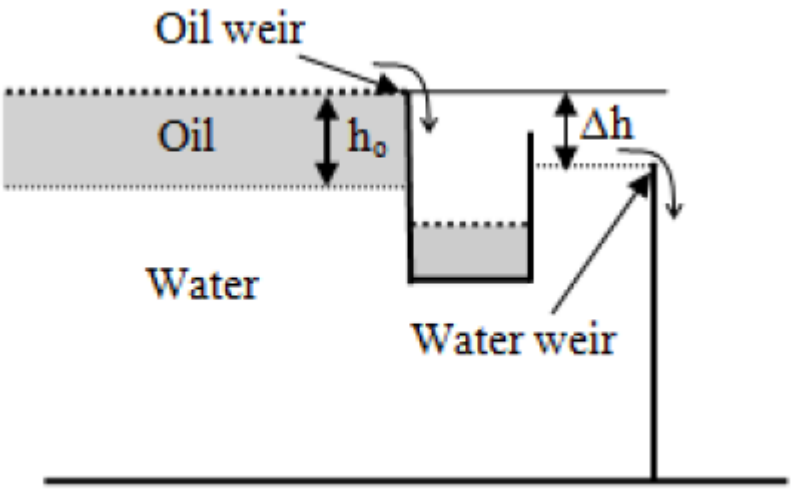
Q.49 A 30 ft thick gas reservoir has an area of 3,000 acres (1 acre = 43,560 ft2). The porosity of the
reservoir is 15% and the connate water saturation is 20%. Initial reservoir pressure and temperature
are 2,600 psig and 150°F (= 610°R), respectively. The compressibility factor (Z) at initial
conditions is 0.82. The gas in the reservoir can be produced till it attains the final pressure of
1,000 psig (Z = 0.88) under isothermal conditions.
The gas recovery factor is _____ %.

Q.50 Brine is used to measure the absolute permeability of a core plug. The rock sample is 4 cm long and its cross-sectional area is 4 cm2. The brine has a viscosity of 2 cp and is flowing at a constant rate of 0.5 cm3/s under a 4 atm pressure differential.
The absolute permeability is _____ Darcy.

Q.51 An oil well is drilled to cover a circular drainage area of radius 700 ft. The well is completed with a 7 inch production casing. Assume reservoir pressure of 1000 psig, permeability of 50 md, pay zone thickness of 20 ft, oil viscosity of 3 cp and oil formation volume factor of 1.25 reservoir-bbl/STB.
For a flowing bottom-hole pressure of 500 psig, the primary production rate is _____ STB/day.

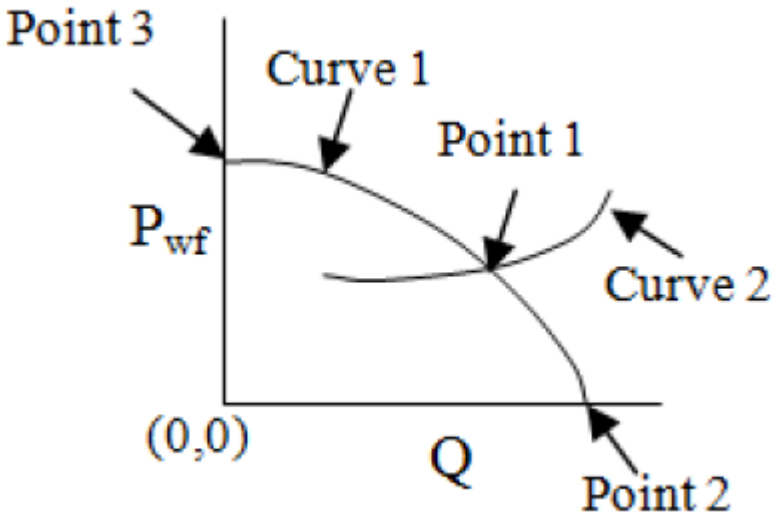
Q.52 An Electric Submersible Pump (ESP) is installed at a depth of 1000 ft from the surface. The ESP
gives 20 ft water head per stage. The wellhead requires 100 psi pressure.
Minimum number of stages of the ESP required for this well is _____.

Q.53. The schematic figure shows a two-phase horizontal separator designed for an oil and water system. The oil specific gravity is 0.8. The oil pad height is ho. The vertical distance between the oil and the water weirs (Δh) at steady state is



(A) 0.2 ho
(B) 0.8 ho
(C) 1.0 ho
(D) 1.2 ho

Q.54. The vertical lift performance (VLP) and the inflow performance relationship (IPR) curves are used to find the production operating conditions. If Pwf is the flowing bottom-hole pressure and Q is the oil flow rate, select the **CORRECT** statement.



(A) Point 3 is absolute open flow, Curve 1 is VLP curve.
(B) Point 2 is at reservoir pressure, Curve 2 is VLP curve.
(C) Point 1 is operating condition, Curve 2 is IPR curve.
(D) Point 2 is absolute open flow, Curve 1 is IPR curve.

Q.55. A ground station has a pump, which delivers a head of 1,000 m water. It is pumping oil of specific gravity 0.8 into a horizontal pipe of diameter 0.5 m with an average velocity of 2 m/s. The
efficiency of the pump is 80%. Density of water is 1,000 kg/m3 and acceleration due to gravity is 9.8 m/s2. The power required to operate the pump is _____ Mega Watts.

Q.56. For a floating vessel, match the **CORRECT** pairs from Group 1 and Group 2 among the options given below. (B = Centre of buoyancy; G = Centre of gravity and M = Metacentre)

Group 1	**Group 2**
P. M is above G	I. Stable equilibrium condition
Q. M is below G	II. Critically stable condition
R. M is coinciding with G	III. Unstable condition
S. B is below G	

(A) P-II, Q-III, R-I and S-II
(B) P-I, Q-III, R-II and S-I
(C) P-III, Q-I, R-II and S-III
(D) P-I, Q-II, R-III and S-I

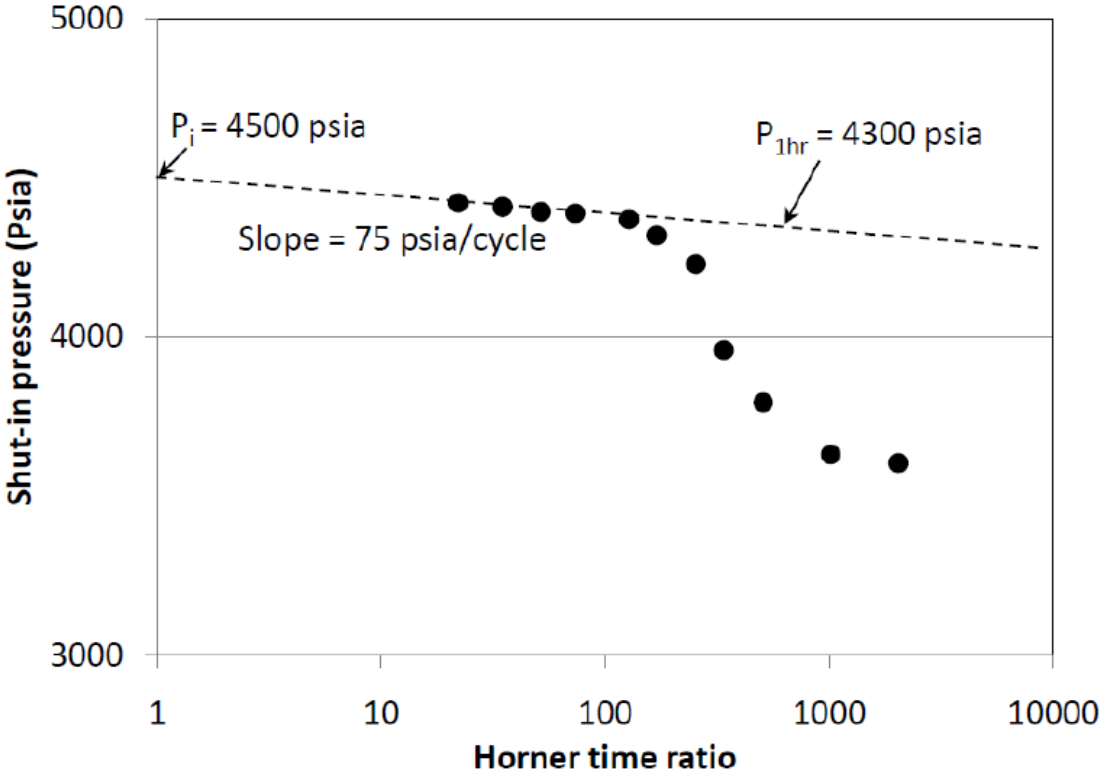
Q.57. Match the following

Group 1	**Group 2**
P. Master valve	I. Drill stem testing tool
Q. Breather valve	II. Heater-treater
R. Tester valve	III. Christmas tree
S. Dump valve	IV. Positive displacement motor
	V. Storage tank

(A) P-III, Q-V, R-II and S-I
(B) P-III, Q-V, R-I and S-IV
(C) P-II, Q-III, R-I and S-V
(D) P-I, Q-III, R-II and S-IV

Q.58. A 50 ft thick reservoir has a porosity (φ) of 20% and a total isothermal compressibility (Ct) of
2.4×10-5 psi-1. The oil in the reservoir has a viscosity 0.75 cp and formation volume factor of
1.25 reservoir-bbl/STB. A pressure build-up test is carried out on a well of radius 0.50 ft in the

reservoir which was producing at 500 STB/day for 500 hours. The flowing bottom-hole pressure at
the start of build-up test ($\Delta t = 0$) was found to be 3,535 psia. The schematic of the pressure build-up
data is shown in the figure.
The skin factor is _____.



Q.59. During a production test in an oil reservoir, the oil production rate is 200 STB/day. The producing gas oil ratio (GOR) is 800 SCF/STB and dissolved GOR is 200 SCF/STB. The formation volume factor of gas is 0.01 ft3/SCF and the formation volume factor of oil is 1.2 reservoir-bbl/STB.
The down-hole GOR is _____ ft3/reservoir-bbl.

Q.60. A productivity test was conducted on a single-phase crude oil well. The well is capable of
producing 100 STB/day at a flowing bottom-hole pressure of 1000 psig. The 24-hour shut-in static
pressure is found to be 1500 psig.
The maximum oil flow rate (Qmax) is_____ STB/day.

Q.61. An oil well of wellbore radius 0.5 ft is shown to develop a skin due to formation damage. The
damaged zone radius is 2.25 ft around the well. The formation permeability is 300 md and the
permeability of the damaged zone is 100 md.

The effective well bore radius for this well is_____ft.

Q.62 A producing well has a shut-in tubing pressure of 3,950 psig for crude oil of specific gravity 0.69. [1 g/cm3 = 8.33 ppg]
The kill fluid density for a workover job at 11,600 ft (TVD) is _____ ppg.

Q.63. For a water-flood operation in a one-dimensional reservoir, the following data are given.
Porosity, $\phi = 0.25$; Cross-sectional area, A = 25,000 ft2; Horizontal distance between the vertical
production and injection well = 600 ft; Water injection rate, iw = 900 bbl/day; Slope of fractional
flow curve at shock front water saturation = 1.97; Water formation volume factor = 1.0 bbl/STB.
[1 bbl = 5.615 ft3]
The cumulative water volume injected at breakthrough is _____ $\times 10^5$ bbl.

Q.64 A heavy oil reservoir is being flooded with a line drive (assume one-dimensional flooding). The
fractional flow of water is found to be 0.75 bbl/bbl at water saturation (SW) of 60%. A polymer
solution with twice the viscosity of water is used as displacing phase. Assume the relative
permeability curves for water flooding and polymer flooding are the same.
The fractional flow of polymer solution at a saturation of 60% is _____bbl/bbl.

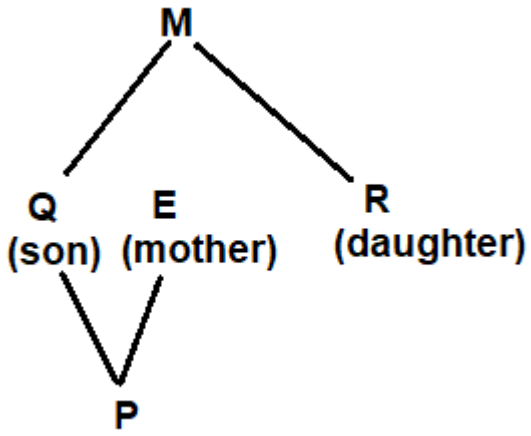
Q.65. Which of the following is the MOST COMMON cause for a fishing job?
(A) Differential sticking
(B) Use of oil based mud
(C) Lost circulation
(D) Well kick

Gate 2016 Question paper Answer and Solutions

Q.1 An apple costs Rs. 10. An onion costs Rs. 8.
Select the most suitable sentence with respect to grammar and usage.
(A) The price of an apple is greater than an onion.
(B) The price of an apple is more than onion.
(C) The price of an apple is greater than that of an onion.
(D) Apples are more costlier than onions.
Ans:C

Q.2 The Buddha said, "Holding on to anger is like grasping a hot coal with the intent of throwing it at
someone else; you are the one who gets burnt."
Select the word below which is closest in meaning to the word underlined above.
(A) burning
(B) igniting
(C) clutching
(D) flinging
Ans: C

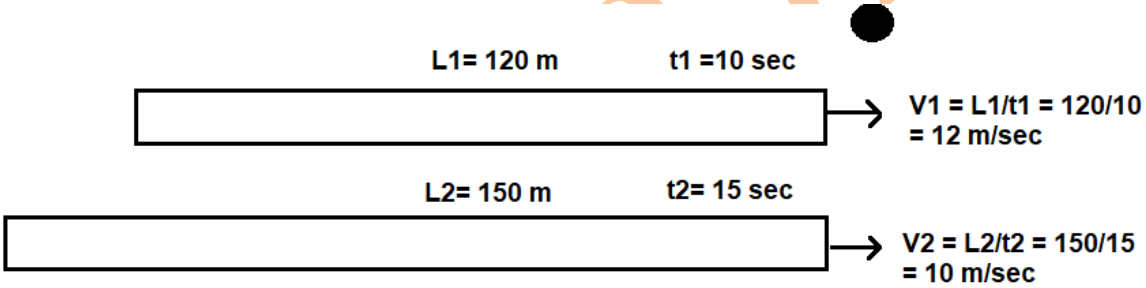
Q.3 M has a son Q and a daughter R. He has no other children. E is the mother of P and daughter-in law
of M. How is P related to M?
(A) P is the son-in-law of M.
(B) P is the grandchild of M.
(C) P is the daughter-in law of M.
(D) P is the grandfather of M.
Ans:B



Q.4 The number that least fits this set: (324, 441, 97 and 64) is _____.

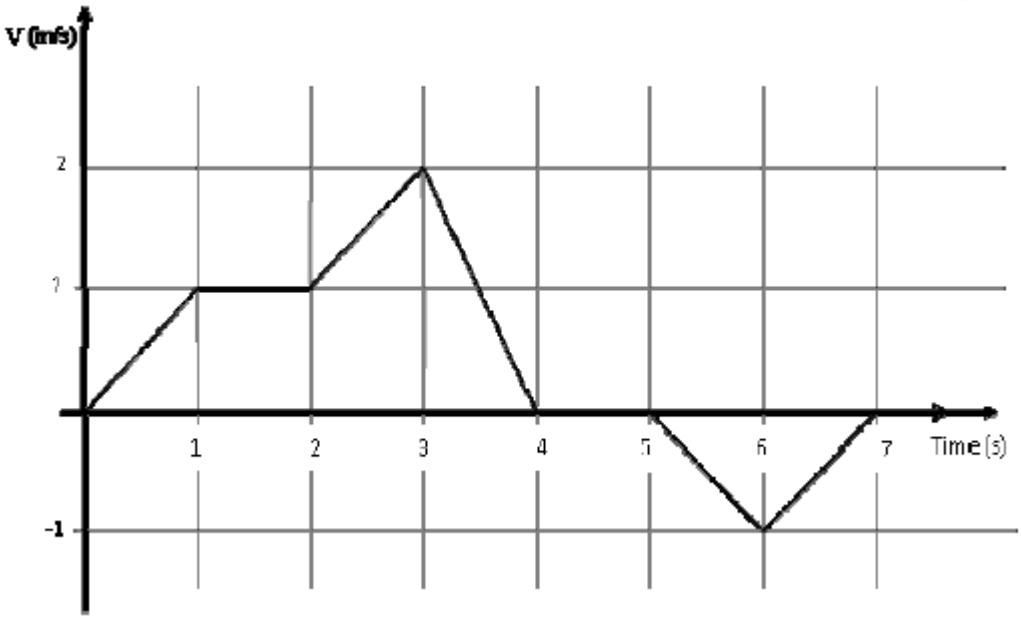
(A) 324
(B) 441
(C) 97
(D) 64
Ans:C
Because 97 is the only oddest number Present among them.

Q.5 It takes 10 s and 15 s, respectively, for two trains travelling at different constant speeds to
completely pass a telegraph post. The length of the first train is 120 m and that of the second train is
150 m. The magnitude of the difference in the speeds of the two trains (in m/s) is _____.
(A) 2.0
(B) 10.0
(C) 12.0
(D) 22.0
Ans:A



V1 – V2 = 12 -10 = 2m/sec

Q.6 The velocity V of a vehicle along a straight line is measured in m/s and plotted as shown with respect to time in seconds. At the end of the 7 seconds, how much will the odometer reading increase by (in m)?



(A) 0
(B) 3
(C) 4
(D) 5
Ans:D
It is the Positive Area under the graph
Area under the graph = 0.5 + 1+ 1.5 + 1 + 0.5 + 0.5
= 5

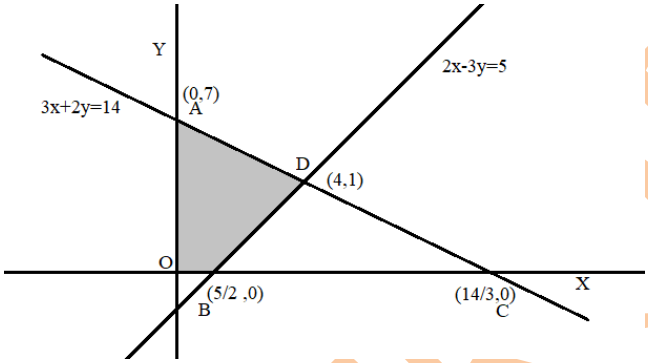
Q.7. The overwhelming number of people infected with rabies in India has been flagged by the World Health Organization as a source of concern. It is estimated that inoculating 70% of pets and stray dogs against rabies can lead to a significant reduction in the number of people infected with rabies.
Which of the following can be logically inferred from the above sentences?
(A) The number of people in India infected with rabies is high.
(B) The number of people in other parts of the world who are infected with rabies is low.
(C) Rabies can be eradicated in India by vaccinating 70% of stray dogs.
(D) Stray dogs are the main source of rabies worldwide.
Ans:A

Q.8. A flat is shared by four first year undergraduate students. They agreed to allow the oldest of them to enjoy some extra space in the flat. Manu is two months older than Sravan, who is three months younger than Trideep. Pavan is one month older than Sravan. Who should occupy the extra space in the flat?
(A) Manu
(B) Sravan
(C) Trideep

(D) Pavan
Ans:C

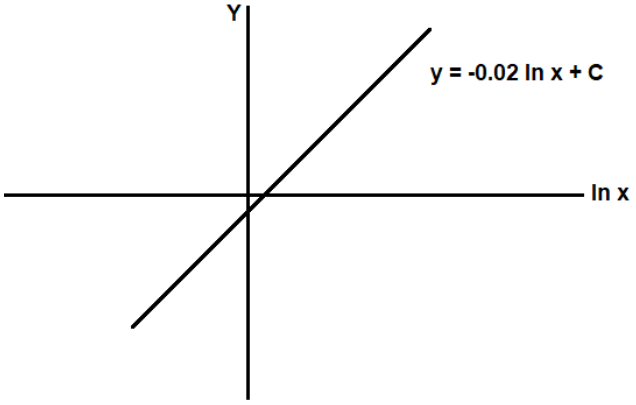
Manu = Sravan + 2 months
Trideep = Sravan + 3 months
Pavan = sravan + 1 month.

Age order
Trideep > Manu > Pavan > Sravan
Q.9. Find the area bounded by the lines 3x+2y=14, 2x-3y=5 in the first quadrant.
(A) 14.95
(B) 15.25
(C) 15.70
(D) 20.35
Ans:B



Required Area is the shaded area
Area of AOBD = Area of AOC – Area of DBC
Area of AOC = $\frac{1}{2}$ x 7 x $\frac{14}{3}$ = $\frac{49}{3}$
Area of DBC = $\frac{1}{2}$ x 1 x ($\frac{14}{3}$ - $\frac{5}{2}$) = $\frac{13}{12}$
Area of AOBD = Area of AOC – Area of DBC
= $\frac{49}{3}$ - $\frac{13}{12}$
= 15.25

Q.10. A straight line is fit to a data set (ln x, y). This line intercepts the abscissa at ln x = 0.1 and has a slope of −0.02. What is the value of y at x = 5 from the fit?
(A) −0.030
(B) −0.014
(C) 0.014
(D) 0.030
Ans:A



y = -0.02 ln x + C
At lnx = 0.1 y = 0
C = 0.002
y = -0.02 ln x + 0.002
= -0.02 xln5 + 0.002
= - 0.030

Q.11. The value of $\lim_{x\to 0}\left(\frac{e^x-1}{\sin x}\right)$ is equal to
Ans:1
Exp:
$\lim_{x\to 0}\left(\frac{e^x-1}{\sin x}\right) = \frac{0}{0}\ (Indeterminate\ form)$
Applying L' Hospital rule
$\lim_{x\to 0}\left(\frac{e^x-1}{\sin x}\right) = \lim_{x\to 0}\left(\frac{e^x}{\cos x}\right) = 1$

Q.12. The function f (x) = $\frac{1}{1+|x|}$ is
(A) continuous and differentiable.
(B) continuous but not differentiable.
(C) not continuous but differentiable.
(D) not continuous and not differentiable.
Ans: B
Exp:
$F^1(x) = -2\,\frac{1}{(1+|x|)^2}\,\frac{|x|}{x}$ is not differentiable at x = 0
Q.13. The value of the definite integral $\int_1^e (\ln x)\,dx$ is equal to _____.
Ans: 1
Exp:
$\int_1^e (\ln x)\,dx = \int_1^e (\ln x)\,x^1\,dx = x \ln x\,]_1^e - \int_1^e (x)\,(\ln x)^1\,dx = e - e + 1 = 1$

Q.14. For a complex number Z = $\left(\frac{1}{2}+\frac{\sqrt{3}}{2}i\right)$, the value of Z^6 is

(A) - $\left(\frac{1}{2}+\frac{\sqrt{3}}{2}i\right)$

(B) –1

(C) $\left(\frac{1}{2}-\frac{\sqrt{3}}{2}i\right)$

(D) 1

Ans:D

Exp:

Z = Cosθ + i sinθ = $e^{i\theta}$ (where θ = 60°)

$Z^6 = (e^{i\theta})^6 = e^{i6\theta}$

= Cos6θ + i sin6θ

= Cos 360 + i sin 360

= 1

Q.15. The Laplace transform of the function e^{-2t} is

(A) $\frac{1}{2s}$

(B) $\frac{2}{s}$

(C) $\frac{1}{s+2}$

(D) e^{-2s}

Ans:C

Exp:

L $(e^{-at}) = \frac{1}{s+a}$

L $(e^{-2t}) = \frac{1}{s+2}$

Q.16. Which of the following is preferred fast neutron source in neutron logging?

(A) Americium-Beryllium

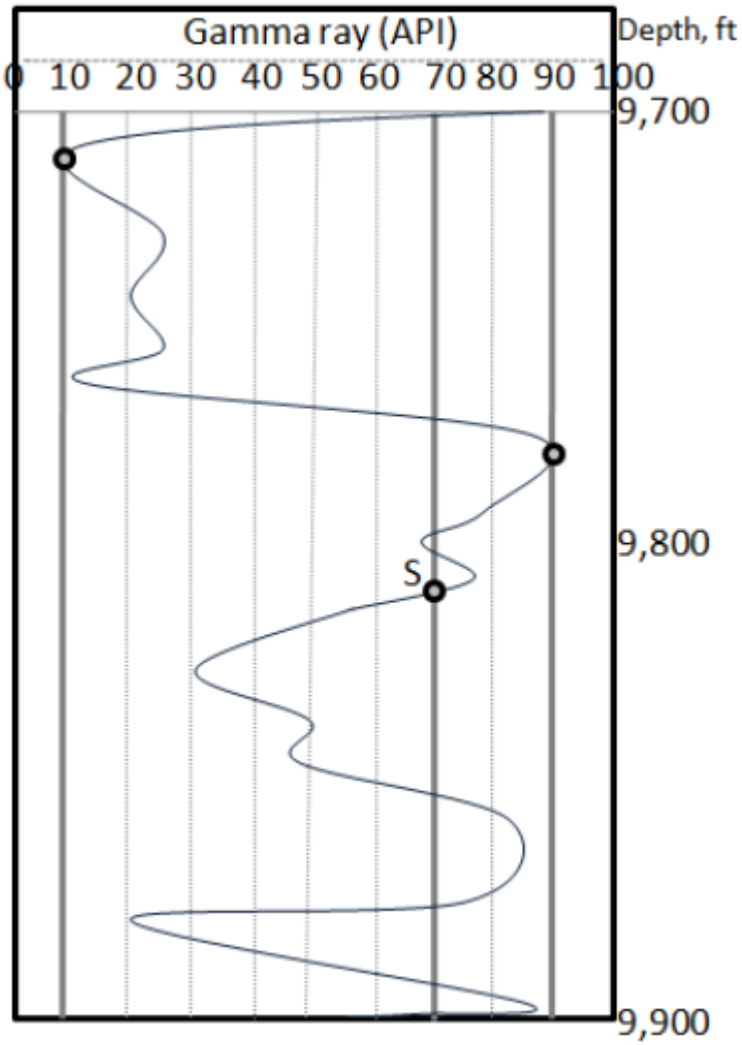
(B) Radium-Beryllium

(C) Deuterium-Tritium

(D) Thorium-Beryllium

Ans:A

Q.17. Using the gamma ray log given in the figure, the shaliness index for point S is _____%.



Ans:75
Exp:
Shale Index = $\frac{GRlog-GRmin}{GRmax-GRmin} = \frac{70-10}{90-10} = \frac{60}{80} = 0.75 = 75\%$

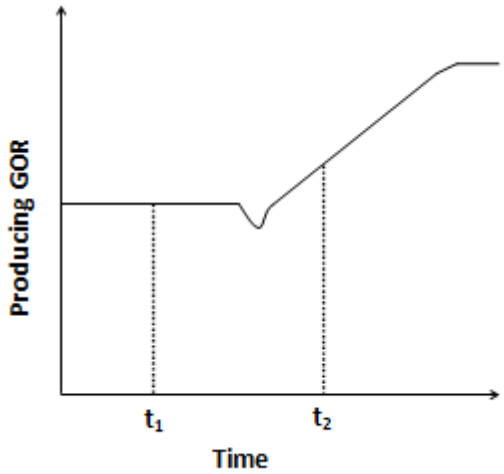
Q.18. Identify the logging device that is based on the concept of longitudinal and transverse relaxation
times.
(A) Thermal neutron decay
(B) Induced gamma ray spectroscopy
(C) Neutron
(D) Nuclear Magnetic Resonance (NMR)
Ans:D

Q.19. The three main stages of evolution of organic matter in sediments are Catagenesis (C), Diagenesis (D) and Metagenesis (M). Their chronological order is
(A) D - C - M
(B) C - D - M

(C) D - M - C
(D) C - M – D
Ans:A

Q.20. For a kick off operation, a directional well has to be drilled for an arc-length of 2500 ft to achieve an inclination of 50°.
The radius of curvature will be _____ ft.
Ans:2865
Exp:
R = $\frac{18000}{\pi\emptyset}$
Where
ϕ is Build up rate angle/100ft
$\phi = \frac{50^o}{2500\ ft} = \frac{2^o}{100\ ft}$
R = $\frac{18000}{\pi\emptyset} = \frac{18000}{\pi\ x\ 2}$ = 2864.7889 ft

Q.21. The figure shows the producing gas oil ratio (GOR) behaviour with time for an oil reservoir under primary production. At initial reservoir condition, Pb is the bubble point pressure of the crude oil. PR(t) represents the reservoir pressure at time 't'. Which of the following statements is **TRUE**?



(A) PR(t1) > Pb, PR(t2) > Pb
(B) PR(t1) > Pb, PR(t2) < Pb
(C) PR(t1) < Pb, PR(t2) > Pb
(D) PR(t1) < Pb, PR(t2) < Pb
Ans:B
Exp:
the Graph is a Solution gas Drive of Producing GOR.

Q.22. A core, with a length of 10 cm, breadth of 4 cm and width of 4 cm, weighs 282.4 g in its dry form. The core is then saturated 100% with brine of density 1.1 g/cm3. The brine saturated core weighs 300 g. The porosity of this core sample is _____%.
Ans:10
Exp:
Volume of core = 10 x 4 x 4 = 160 cc
Weight of dry core = 282.4 grams
Weight of saturated core = 300 grams
Weight of saturated fluid = 300 – 282.4 = 17.6 grams
Volume of saturated fluid = $\frac{\text{Weight of saturated fluid}}{density\ of\ fluid} = \frac{17.6\ gm}{1.1\ gm/cc}$ = 16 cc
Porosity of the core = $\frac{\text{Volume of saturated fluid}}{\text{Volume of core}} = \frac{16}{160}$ = 0.1 = 10%

Q.23. A hydraulic line of a subsurface safety valve has a fluid of specific gravity 1.2 to operate the valve. The valve closing pressure is 1,200 psia and the recommended safety margin is 200 psia.
The maximum depth at which the valve can be positioned is_____ ft.
Ans:1923.85
Exp:
Hydraullic pressure in the hydraulic line + Safety margin = Valve closing pressure
0.052 x 1.2 x 8.33 x H + 200 = 1200
H = 1923.85ft

Q.24. A sucker rod pump unit is designated by C-228D-200-74. Here, 'D' represents
(A) double reduction gear box.
(B) diameter of sucker rod.
(C) diameter of plunger.
(D) stroke length.
Ans:A

Q.25. The three translational motions for a floating vessel are
(A) Roll-Pitch-Yaw.
(B) Heave-Pitch-Sway.
(C) Surge-Sway-Heave.
(D) Roll-Sway-Heave.
Ans:C

Q.26. Jack-up rigs are typically used for off-shore drilling when the water depth is in the range
(A) < 25 ft

(B) 50 - 500 ft
(C) 1000 - 2000 ft
(D) > 2000 ft
Ans:B

Q.27. Interference tests can be used for
I. determining communication between two or more wells.
II. mature oil wells having skin damage.
III. determining permeability in tested wells.
IV. providing inputs for secondary and tertiary oil recovery methods
(A) only I and II
(B) only I, II and IV
(C) only II, III and IV
(D) I, II, III and IV
Ans:D

Q.28. For an effective hydraulically-fractured well, the skin factor would **GENERALLY** be
(A) negative.
(B) positive.
(C) zero.
(D) indeterminate.
Ans:A

Q.29. The maximum discharge limit of oil and grease in a marine coastal area as per Environmental
(protection) Rules, 1986 in India is
(A) 0.1 mg/L.
(B) 20 mg/L.
(C) 500 mg/L.
(D) 4000 mg/L.
Ans:B

Q.30. Which of the following gases is **NOT** responsible for global warming?
(A) Carbon dioxide
(B) Methane
(C) Water vapour
(D) Nitrogen
Ans:D

Q.31. In an oil reservoir flooded with water, the volumetric sweep efficiency is 70%. The connate water saturation in the reservoir is 0.4 and the residual oil saturation for the water flood is 0.3.

The overall efficiency of the reservoir is _____ %.
Ans:35
Exp:
Microscopic displacement efficienct (E_D) = $\frac{Soi-Sor}{Soi}$ = 1 - $\frac{Sor}{Soi}$
Soi = 1 – Swi = 1 – 0.4 = 0.6
Sor = 0.3
Microscopic displacement efficienct (E_D) = $\frac{Soi-Sor}{Soi}$ = 1 - $\frac{0.3}{0.6}$ = 0.5
Overall efficiency = Microscopic displacement efficiency x Volumetric sweep efficiency
= 0.5 x 0.7
= 0.35
= 35 %

Q.32. Identify the pair of **CORRECT** statements for surfactant-micellar-polymer flooding.
I. It reduces interfacial tension between crude oil and water.
II. It influences mobility ratio unfavorably.
III. It improves microscopic displacement efficiency.
IV. It increases isothermal compressibility of the crude oil.
(A) I& II
(B) I& III
(C) III& IV
(D) II& IV
Ans:B

Q.33. Gas hydrate forms at
(A) low pressure and low temperature conditions.
(B) low pressure and high temperature conditions.
(C) high pressure and low temperature conditions.
(D) high pressure and high temperature conditions.
Ans:C

Q.34. Production of coal bed methane (CBM) is based on
(A) distillation.
(B) underground coal gasification.
(C) desorption.
(D) coal liquefaction.
Ans:C

Q.35. The divergence of the velocity field V = (x2 + y) i + (z − 2xy) j + (xy) k at (1, 1, 1) is
_____.

Ans:0
Exp:
$\nabla . V = (\frac{\partial}{\partial x} i + \frac{\partial}{\partial y} j + \frac{\partial}{\partial z} k)$. ((x2 + y) i + (z − 2xy) j + (xy) k)
= 2x -2x + 0
= 0
Q.36. For a function f(x), the values of the function in the interval [0, 1] are given in the table below.

x	f(x)
0.0	1.0
0.2	1.24
0.4	1.56
0.6	1.96
0.8	2.44
1.0	3.0

The value of the integral $\int_0^1 f\ (x)\ dx$ according to the trapezoidal rule is _____.
Ans:1.84
Exp:
Appying Trapezoidal rule

$$\int_0^1 f\ (x)\ dx\ = \frac{h}{2}\ (f(0) + 2\ [f(0.2) + f(0.4) + f(0.6) + f(0.8)] + f(1))$$

$$= \frac{0.2}{2}\ (1 + 2\ [1.24 + 1.56 + 1.96 + 2.44] + 3)$$

$$= 1.84$$

Q.37. A box has a total of ten identical sized balls. Seven of these balls are black in colour and the rest
three are red. Three balls are picked from the box one after another without replacement.
The probability that two of the balls are black and one is red is equal to _____.
Ans:0.525
Exp:
P(A) = P(B,B,R) + P (B, R,B) + P(R, B ,B)

$$= \frac{7}{10}\ x\ \frac{6}{9}\ x\ \frac{3}{8} + \frac{7}{10}\ x\ \frac{3}{9}\ x\ \frac{6}{8} + \frac{3}{10}\ x\ \frac{7}{9}\ x\ \frac{6}{8}$$

$$= 3\ x\ \frac{7}{10}\ x\ \frac{6}{9}\ x\ \frac{3}{8}$$

$$= \frac{378}{720}$$

= 0.525

Q.38. Consider the matrix, M = $\begin{bmatrix} 5 & 3 \\ 3 & 5 \end{bmatrix}$. The normalized eigen-vector corresponding to the smallest eigen-value of the matrix M is

(A) $\begin{pmatrix} \frac{\sqrt{3}}{2} \\ \frac{1}{2} \end{pmatrix}$

(B) $\begin{pmatrix} \frac{\sqrt{3}}{2} \\ -\frac{1}{2} \end{pmatrix}$

(C) $\begin{pmatrix} \frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} \end{pmatrix}$

(D) $\begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix}$

Ans:C

Exp:

M – λI = 0

$Det\ of \begin{bmatrix} 5-\lambda & 3 \\ 3 & 5-\lambda \end{bmatrix} = 0.$

$(5-\lambda)^2 - 9 = 0$

$\lambda - 5 = \pm 3$

$\lambda = 8,2$

normalized eigen-vector corresponding to the smallest eigen-value of the matrix M

$\begin{bmatrix} 5-2 & 3 \\ 3 & 5-2 \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix} = 0$

$\begin{bmatrix} 3 & 3 \\ 3 & 3 \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix} = 0$

X + Y = 0

$\frac{X}{1} = \frac{Y}{-1}$

The normalized eigen vector is

$\begin{pmatrix} \frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} \end{pmatrix}$

Q.39. For the differential equation

$$x^2\frac{d^2y}{dx^2}-2x\frac{dy}{dx}+2y=0$$

the general solution is

(A) $y = C\,x + Ce^x$

(B) $y = C \sin x + C \cos x$

(C) $y = C\,e^x + C\,e^{-x}$

(D) $y = C\,x^2 + C\,x$

Ans:D

Exp:

let Z =ln x

$$x^2\frac{d^2y}{dx^2}-2x\frac{dy}{dx}+2y=0$$

The above can be written as

D (D-1) y – 2 Dy + 2y = 0

where

D = $\frac{d}{dz}$

$(D^2 - D - 2D + 2)\,y = 0$

$(D^2 - 3D + 2)\,y = 0$

(D-1(D-2)y =0

The Solution of the equation

y = C1 e^z + C2 e^{2z}

y = C1 x + C2 x^2

Q.40. The porosities of cubic and hexagonal packings, respectively, are

(A) 47.6% and 25.9%.

(B) 39.5% and 29.5%.

(C) 47.6% and 39.5%.

(D) 39.5% and 25.9%.

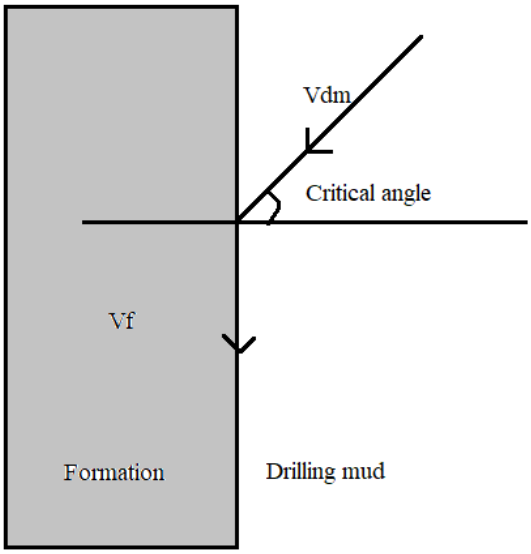
Ans:C

Q.41. In sonic logging, the sonic velocities in the formation and drilling mud are 50,000 ft/s and 500 ft/s, respectively.

The critical angle is ____ radians.

Ans:0.01

Exp:



By snells law

$$\frac{Sin\ C}{Vdm} = \frac{Sin\ 90}{Vf}$$

Sin C = $\frac{Vdm}{Vf} = \frac{500}{50000}$ = 0.01

C= 0.010000Radian

Q.42. A section of a clean sandstone reservoir was logged and found to have a porosity of 10%. The
cementation (m) and saturation (n) exponents are equal to 2. The constant 'a' in Archie's saturation
equation is 1. The formation water resistivity is 0.036 ohm-meter and the formation resistivity is 10
ohm-meter.
The water saturation in the reservoir is_____%.
Ans:60
Exp:

Sw = $\left(\frac{aRw}{Rt\ \emptyset^m}\right)^{1/n}$

Sw = $\left(\frac{1\ x\ 0.036}{10\ \ 0.1^2}\right)^{1/2}$ = 0.6 = 60%

Q.43. Match the entries in Group 1 with those in Group 2

Group 1	Group 2
P. Blow Out Preventer	I. Horizontal well problem
Q. Diamond bit	II. Reverse ballooning
R. Tubing elongation	III. Well control
S. Eccentricity	IV. Crown
	V. Ballooning

(A) P-III, Q-IV, R-V, S-II
(B) P-V, Q-IV, R-I, S-II
(C) P-III, Q-IV, R-II, S-I
(D) P-IV, Q-III, R-V, S-I
Ans:C

Q.44. One thousand sacks of cement are required for cementing a protection casing of setting depth of
12,000 ft (top float collar) and annular capacity of 0.40 ft3 per linear ft. The cementing truck has a
mixing capacity of 20 sacks per min. A 1.15 ft3/cycle capacity rig mud pump having an 18 inch
stroke and a 6 ½ inch liner operating at 60 rpm with 90% efficiency is used for the cementing job.
The total cementing time is _____ min.
Ans:127.294
Exp:
QPump = 1.15 ft3/cycle x 60 rpm x 0.9 = 69 ft3/min
Volume to pump = 0.40 ft3/ft x 12000ft = 4800 ft3.
Time to pump = 4800 ft3/ 69 ft3/min = 69.56 min
Time to mix = 1000/20 = 50 min
Total Cementing time = 50 + 69.56 = 119.565 min

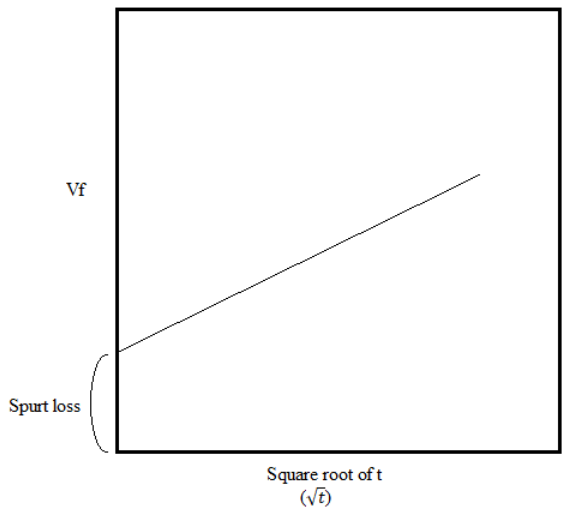
Q.45. It is desired to increase the density of 200 bbl of 10 ppg mud to 12 ppg mud using API Barite of
density 35 ppg. The final volume is not limited.
[1 bbl = 42 gallons]
The amount of API Barite required is _____ lbm.
Ans: 25565.21739
Exp:
V1x ρ1 + V2x ρ2 = Vfx ρf
200bbl x 10 ppg + X x 35ppg = (200+X) x 12
(35-12) X = 2 x 200 = 400
X = 400 / 23 = 17.391bbl = 730.43 gal

Amount of API barite = 35 ppg x 730.43gal
= 25565.21739 lbm

Q.46. Using the High Pressure High Temperature (HPHT) filter press data given below, the estimated
API filtration loss is _____ cm3.
Data given:

Time (min)	Filtrate volume (cm3)
1.0	6.5
7.5	14.0

Ans: 51.64
Exp:
The Voume of mud filtrate ntered the formation is directly proportional to the square root of time



Time (min)	Square root of t	Filtrate volume (cm3)
1.0	1	6.5
7.5	2.74	14.0

$Vf = m\sqrt{t} + C$

$m = \frac{14-6.5}{2.74-1} = 4.310$

$Vf = 4.310\sqrt{t} + C$

$6.5 = 4.310 + C$

$C = 2.189$

$Vf = 4.310\sqrt{t} + 2.189$

spurt loss Vf = 2.189 cm3

The standard API filter press has an area of 45 cm2 and is operated at a pressure of 6.8 atm (100 psig).
The filtrate volume collected in a 30-minute time period is reported as the standard water loss.

V30 = 25.82 cm3
However, since the standard API fi lter press has twice the cross-sectional area of the HP/HT filter press,
HPHT API filter loss = 2 x V30 = 2 x 25.82 = 51.64 cm3

Q.47. A Differential Liberation Experiment (DLE) and a Constant Composition Expansion (CCE)/Flash liberation experiment were performed in a laboratory for a crude oil to find the formation volume factor (Bo) and the dissolved gas oil ratio (Rs). The pressure stages for both experiments were kept the same. At a pressure less than the bubble point pressure of the crude oil, which of the following statements is **TRUE**?
(A) Bo (CCE) > Bo (DLE), Rs (CCE) > Rs (DLE)
(B) Bo (CCE) > Bo (DLE), Rs (CCE) < Rs (DLE)
(C) Bo (CCE) < Bo (DLE), Rs (CCE) > Rs (DLE)
(D) Bo (CCE) < Bo (DLE), Rs (CCE) < Rs (DLE)
Ans:A

Q.48. The production of a gas well was found to decline exponentially. The observed production rate on 1st January, 2014 was 0.6×10^{10} SCF/month and on 1st January, 2015, it was 0.4×10^{10} SCF/month.
The economic production limit for the well is estimated to be 0.002×10^{10} SCF/month.
The remaining reserves for the well as on 1st January, 2015 were _____ $\times$ **10^{10}** SCF.
Ans:11.782
Exp:
$Qt = Qi\ e^{-kt}$
0.4×10^{10} SCF/month = 0.6×10^{10} SCF/month x $e^{-k \times 12}$
$0.4/0.6 = e^{-k \times 12}$
$0.6667 = e^{-k \times 12}$
ln (0.6667) = -k x 12
- 0.405465 = - k x 12
K = 0.03378/month
Cumulative oil produced from 2014 = $\frac{Qi-Qe}{K} = \frac{0.6-0.002}{0.03378} \times 10^{10} = 17.7 \times 10^{10}$ SCF.
Cumulative oil produced from 2014 = $\frac{Qt-Qe}{K} = \frac{0.4-0.002}{0.03378} \times 10^{10} = 11.782 \times 10^{10}$ SCF.
Cumulative oil Produced from 2015 to 2015 = $\frac{Qt-Qe}{K} = \frac{0.6-0.4}{0.03378} \times 10^{10} = 5.92 \times 10^{10}$ SCF.
Remaining Reserves at 2015 is the Producible oil = 11.782×10^{10} SCF.

Q.49 A 30 ft thick gas reservoir has an area of 3,000 acres (1 acre = 43,560 ft2). The porosity of the
reservoir is 15% and the connate water saturation is 20%. Initial reservoir pressure and temperature
are 2,600 psig and 150°F (= 610°R), respectively. The compressibility factor (Z) at initial
conditions is 0.82. The gas in the reservoir can be produced till it attains the final pressure of
1,000 psig (Z = 0.88) under isothermal conditions.
The gas recovery factor is _____ %.
Ans:64.16
Exp:

$$\frac{P}{Z} = \frac{Pi}{Zi}\left(1 - \frac{Gp}{G}\right)$$

$$\frac{1000}{0.88} = \frac{2600}{0.82}\left(1 - \frac{Gp}{G}\right)$$

$$0.3584 = 1 - \frac{Gp}{G}$$

$$\frac{Gp}{G} = 1 - 0.3584 = 0.6416$$

Gas recovery factor = 64.16%

Q.50 Brine is used to measure the absolute permeability of a core plug. The rock sample is 4 cm long and its cross-sectional area is 4 cm2. The brine has a viscosity of 2 cp and is flowing at a constant rate of 0.5 cm3/s under a 4 atm pressure differential.
The absolute permeability is _____ Darcy.
Ans:0.25
Exp:

$$\frac{Q}{A} = \frac{K}{\mu}\frac{\Delta P}{L}$$

$$K = \frac{Q\mu L}{A\,\Delta P} = \frac{0.5\ x\ 2\ x\ 4}{4\ x\ 4} = 0.25 \text{ darcy}$$

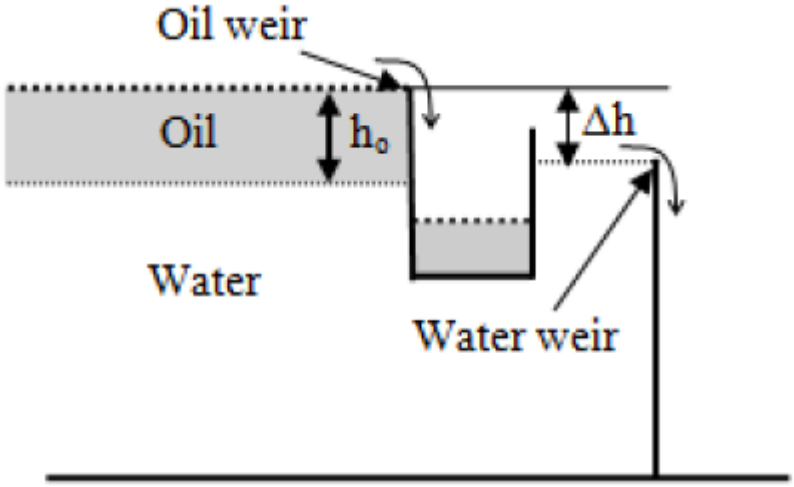
Q.51 An oil well is drilled to cover a circular drainage area of radius 700 ft. The well is completed with a 7 inch production casing. Assume reservoir pressure of 1000 psig, permeability of 50 md, pay zone thickness of 20 ft, oil viscosity of 3 cp and oil formation volume factor of 1.25 reservoir-bbl/STB.
For a flowing bottom-hole pressure of 500 psig, the primary production rate is _____ STB/day.
Ans:121.3234
Exp:

$$Pe - Pwf = 141.2\,\frac{Q\mu Bo}{Kh}\,\ln\left(\frac{re}{rw}\right)$$

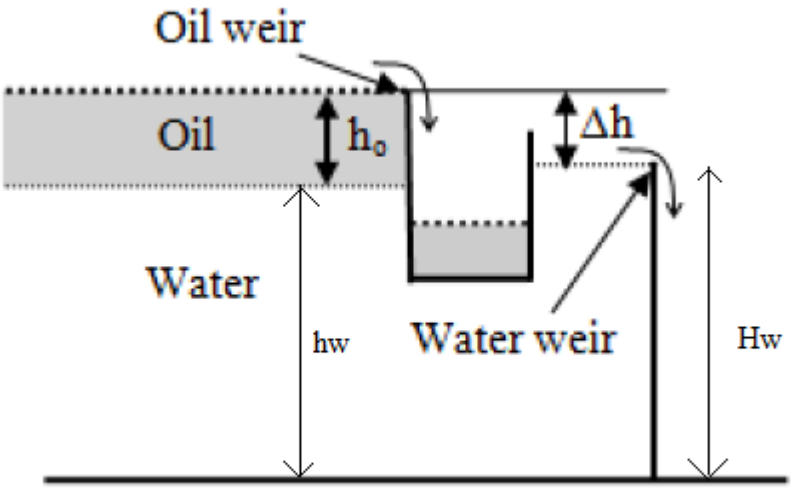
$1000 - 500 = 141.1 \frac{Qx3\ x1.25}{50\ x\ 20} \ln(\frac{700}{3.5}\ x12)$
500 = Q 4.121217
Q = 121.3234 STB/day

Q.52 An Electric Submersible Pump (ESP) is installed at a depth of 1000 ft from the surface. The ESP
gives 20 ft water head per stage. The wellhead requires 100 psi pressure. Minimum number of stages of the ESP required for this well is _____.
Ans:62
Exp:
Total Head = $1000 + \frac{100\ psi}{0.052\ x\ 8.33}$ = 1230.86 ft
Minimum number of stages = 1230.86/20 = 61.5 = 62 stages

Q.53. The schematic figure shows a two-phase horizontal separator designed for an oil and water system. The oil specific gravity is 0.8. The oil pad height is ho. The vertical distance between the oil and the water weirs (Δh) at steady state is

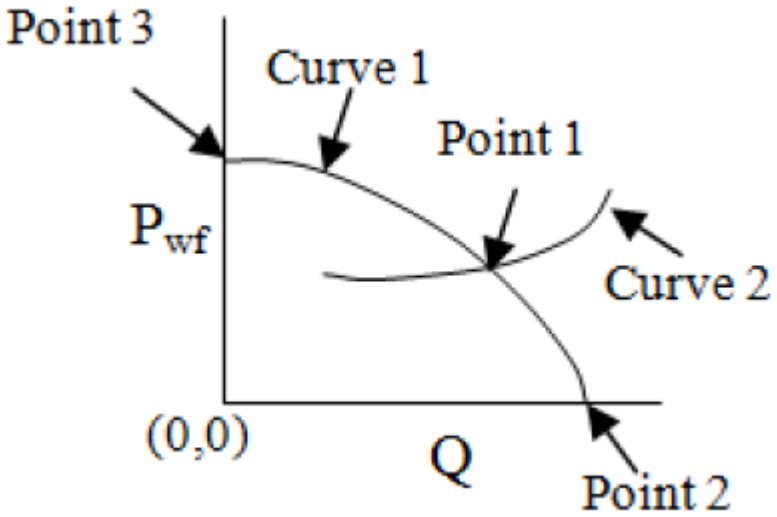


(A) 0.2 ho
(B) 0.8 ho
(C) 1.0 ho
(D) 1.2 ho
Ans:A
Exp:



ho + hw = Hw + Δh ------ 1
Equating Pressure on both sides
ρox g x ho + ρw x g x hw = ρw x g x Hw
ρo x ho + ρw x hw = ρw x Hw
0.8ho + hw = Hw ----- 2
Equating equations 1 and 2
0.8ho + hw = Hw = ho + hw - Δh
0.8ho + hw = ho + hw – Δh
Δh = 0.2 ho

Q.54. The vertical lift performance (VLP) and the inflow performance relationship (IPR) curves are used to find the production operating conditions. If Pwf is the flowing bottom-hole pressure and Q is the oil flow rate, select the **CORRECT** statement.



(A) Point 3 is absolute open flow, Curve 1 is VLP curve.

(B) Point 2 is at reservoir pressure, Curve 2 is VLP curve.
(C) Point 1 is operating condition, Curve 2 is IPR curve.
(D) Point 2 is absolute open flow, Curve 1 is IPR curve.
Ans:D

Q.55. A ground station has a pump, which delivers a head of 1,000 m water. It is pumping oil of specific gravity 0.8 into a horizontal pipe of diameter 0.5 m with an average velocity of 2 m/s. The
efficiency of the pump is 80%. Density of water is 1,000 kg/m3 and acceleration due to gravity is 9.8 m/s2. The power required to operate the pump is _____ Mega Watts.
Ans:
Exp:
Power = Force x velocity
Force = P x A = pressure x Area = ρw x g x h x A = 1000 kg/m3 x 9.8 m/sec2 x 1000m x $\frac{\pi}{4}$ 0.5^2
= 1924225.5 kg.m/sec2
Output Power = 1924225.5 N x 2 m/s
= 3848451.0 Jolue/sec
= 3848451.0 W.
= 3.85 MW
Input power = $\frac{Output\ power}{Efficiency}$ = $\frac{3.85\ MW}{0.8}$ =4.8125 MW.

Q.56. For a floating vessel, match the **CORRECT** pairs from Group 1 and Group 2 among the options given below. (B = Centre of buoyancy; G = Centre of gravity and M = Metacentre)

Group 1	**Group 2**
P. M is above G	I. Stable equilibrium condition
Q. M is below G	II. Critically stable condition
R. M is coinciding with G	III. Unstable condition
S. B is below G	

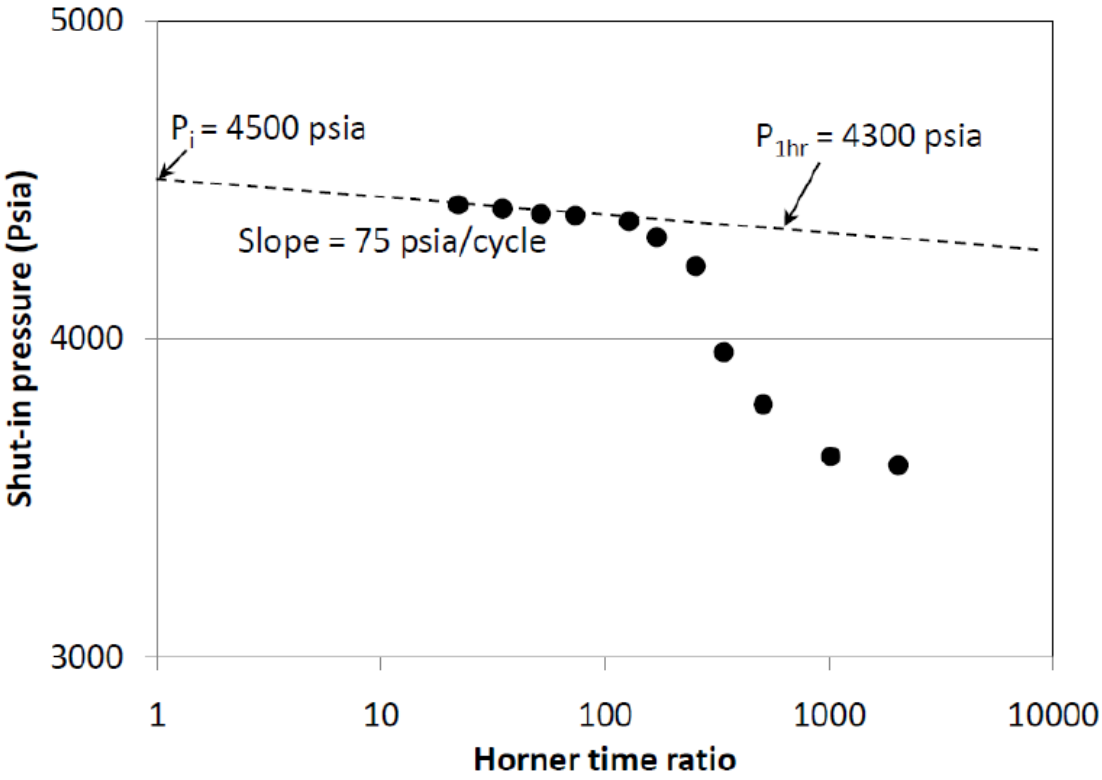
(A) P-II, Q-III, R-I and S-II
(B) P-I, Q-III, R-II and S-I
(C) P-III, Q-I, R-II and S-III
(D) P-I, Q-II, R-III and S-I
Ans:B

Q.57. Match the following

Group 1	Group 2
P. Master valve	I. Drill stem testing tool
Q. Breather valve	II. Heater-treater
R. Tester valve	III. Christmas tree
S. Dump valve	IV. Positive displacement motor
	V. Storage tank

(A) P-III, Q-V, R-II and S-I
(B) P-III, Q-V, R-I and S-IV
(C) P-II, Q-III, R-I and S-V
(D) P-I, Q-III, R-II and S-IV
Ans:B

Q.58. A 50 ft thick reservoir has a porosity (φ) of 20% and a total isothermal compressibility (Ct) of
2.4×10-5 psi-1. The oil in the reservoir has a viscosity 0.75 cp and formation volume factor of
1.25 reservoir-bbl/STB. A pressure build-up test is carried out on a well of radius 0.50 ft in the
reservoir which was producing at 500 STB/day for 500 hours. The flowing bottom-hole pressure at
the start of build-up test ($\Delta t = 0$) was found to be 3,535 psia. The schematic of the pressure build-up
data is shown in the figure.
The skin factor is _____.



Ans:6.77

Exp:

m = 75

$162.6 \frac{Q\mu Bo}{Kh} = 75$

$K = 162.6 \frac{Q\mu Bo}{75\ x\ h} = 162.6 \frac{500\ x\ 0.75\ x\ 1.28}{75\ x\ 50} = 20.8128$ md

$Pi\ 1hr - Pi\ (\Delta t = 0) = 162.6 \frac{Q\mu Bo}{Kh} [\log (\frac{k}{\emptyset \mu Ct\ rw^2}) - 3.23 + 0.87S]$

$4300 - 3535 = 75\ [\log (\frac{20.813}{0.2\ x\ 0.75\ x 2.4\times 10-5\ x\ 0.5^2}) - 3.23 + 0.87S]$

765= 75 [4.134+ 0.87S]

10.2 = 4.134 + 0.87 S

S = 6.7655

Q.59. During a production test in an oil reservoir, the oil production rate is 200 STB/day. The producing gas oil ratio (GOR) is 800 SCF/STB and dissolved GOR is 200 SCF/STB. The formation volume factor of gas is 0.01 ft3/SCF and the formation volume factor of oil is 1.2 reservoir-bbl/STB.

The down-hole GOR is _____ ft3/reservoir-bbl.

Ans:

Exp:

$Rp = Rs + \frac{Qg}{Qo}$

Where

Rp is Producing Gas Oil Ratio

Rs is Solution Gas Oil Ratio

Qg is Surface Free gas rate
Qo is Surface Oil rate

$Rp = Rs + \frac{qg}{qo}\frac{Bo}{Bg}$
Where
qg is downhole free gas rate
qo is downhole oil rate
$\frac{qg}{qo}$ is downhole GOR
Downhole GOR = (Rp - Rs) $\frac{Bg}{Bo}$
= (800 - 200) $\frac{0.01}{1.2}$
= 5

Q.60. A productivity test was conducted on a single-phase crude oil well. The well is capable of
producing 100 STB/day at a flowing bottom-hole pressure of 1000 psig. The 24-hour shut-in static
pressure is found to be 1500 psig.
The maximum oil flow rate (Qmax) is_____ STB/day.
Ans:
Exp:
$J = \frac{Q}{Pr - Pwf}$
Where
J is Productivity index
Q is Flow rate
Pr is reservoir pressure
Pwf is flowing bottom hole pressure
$J = \frac{100}{1500-1000} = 0.2$
Q max = J x Pr = 0.2 x 1500 = 300 STB/day

Q.61. An oil well of wellbore radius 0.5 ft is shown to develop a skin due to formation damage. The
damaged zone radius is 2.25 ft around the well. The formation permeability is 300 md and the
permeability of the damaged zone is 100 md.
The effective well bore radius for this well is_____ft.
Ans:0.0248
Exp:
Effective wellbore radius = wellbore radius x e^{-skin}

Skin = $(\frac{K}{Kskin} - 1)\ \ln\ (\frac{rskin}{rw})$

$= (\frac{300}{100} - 1)\ \ln\ (\frac{2.25}{0.5})$

= 3.008

Effective wellbore radius = wellbore radius x e^{-skin}

= 0.5 x e^{-3}

= 0.0248 ft

Q.62 A producing well has a shut-in tubing pressure of 3,950 psig for crude oil of specific gravity 0.69. [1 g/cm3 = 8.33 ppg]

The kill fluid density for a workover job at 11,600 ft (TVD) is _____ ppg.

Ans: 12.296

Exp:

Bottomhole Pressure = Hydrostatic pressure + Shutin tubing pressure

= 0.052 x 0.69 x 8.33 x 11600 + 3950

= 7417 psi

Kill Mud weight = $\frac{Bottom\ hole\ pressure}{0.052\ x\ TVD} = \frac{7417}{0.052\ x\ 11600}$

= 12.296 ppg

Q.63. For a water-flood operation in a one-dimensional reservoir, the following data are given.

Porosity, ϕ = 0.25; Cross-sectional area, A = 25,000 ft2; Horizontal distance between the vertical

production and injection well = 600 ft; Water injection rate, iw = 900 bbl/day; Slope of fractional

flow curve at shock front water saturation = 1.97; Water formation volume factor = 1.0 bbl/STB.

[1 bbl = 5.615 ft3]

The cumulative water volume injected at breakthrough is _____ × 10^5 bbl.

Ans:3.4

Exp:

Iw x t $(\frac{\partial fw}{\partial Sw})$ = A x ϕ x Xsw

Cumulative water injected = $\frac{\text{A x h x ϕ x L}}{(\frac{\partial fw}{\partial Sw})} = \frac{25000\ ft2\ x\ 0.25\ x\ 600}{1.97}$ = 1903553.3 ft3 = 19.0355 x 10^5 ft3

= 3.39 x 10^5 bbl

Q.64 A heavy oil reservoir is being flooded with a line drive (assume one-dimensional flooding). The

fractional flow of water is found to be 0.75 bbl/bbl at water saturation (SW) of 60%. A polymer

solution with twice the viscosity of water is used as displacing phase. Assume the relative
permeability curves for water flooding and polymer flooding are the same.
The fractional flow of polymer solution at a saturation of 60% is
_____bbl/bbl.

Ans:

Exp:

fw = $\frac{1}{1+\frac{1}{M}}$

M is Mobility ratio

M = $\frac{\lambda w}{\lambda o} = \frac{Krw}{Kro}\ \frac{\mu o}{\mu w}$

Given

μp = 2 μw

Mpolymer- oil = $\frac{Mwater-oil}{2}$

fwater = $\frac{1}{1+\frac{1}{Mwater-oil}}$

0.75 = $\frac{1}{1+\frac{1}{Mwater-oil}}$

$1 + \frac{1}{Mwater-oil} = \frac{4}{3}$

$\frac{1}{Mwater-oil} = \frac{1}{3}$

Mwater-oil = 3

Mpolymer- oil = $\frac{Mwater-oil}{2} = \frac{3}{2}$

fpolymer-oil = $\frac{1}{1+\frac{1}{Mpolymer-oil}}$

$= \frac{1}{1+\frac{2}{3}} = \frac{3}{5} = 0.6$

Q.65. Which of the following is the MOST COMMON cause for a fishing job?

(A) Differential sticking

(B) Use of oil based mud

(C) Lost circulation

(D) Well kick

Ans:A