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PE: Petroleum Engineering

GA - General Aptitude

Q1 - Q5 carry one mark each.

Q.No. 1 He is known for his unscrupulous ways. He always sheds_____tears to deceive people.

(A) fox's
(B) crocodile's
(C) crocodile
(D) fox

Q.No. 2 Jofra Archer, the England fast bowler, is_____than accurate.

(A) more fast
(B) faster
(C) less fast
(D) more faster

Q.No. 3 Select the word that fits the analogy:

Build : Building :: Grow : _____

(A) Grown
(B) Grew
(C) Growth
(D) Growed

Q.No. 4 I do not think you know the case well enough to have opinions. Having said that, I agree with your other point.
What does the phrase "having said that" mean in the given text?

(A) as opposed to what I have said
(B) despite what I have said
(C) in addition to what I have said
(D) contrary to what I have said

Q.No. 5 Define $[x]$ as the greatest integer less than or equal to x, for each $x \in (-\infty, \infty)$. If $y = [x]$, then area under y for $x \in [1,4]$ is _____.

(A) 1
(B) 3
(C) 4
(D) 6

Q6 - Q10 carry two marks each.

Q.No. 6 Crowd funding deals with mobilisation of funds for a project from a large number of people, who would be willing to invest smaller amounts through web-based platforms in the project.

Based on the above paragraph, which of the following is correct about crowd funding?

(A) Funds raised through unwilling contributions on web-based platforms.
(B) Funds raised through large contributions on web-based platforms.
(C) Funds raised through coerced contributions on web-based platforms.
(D) Funds raised through voluntary contributions on web-based platforms.

Q.No. 7 P, Q, R and S are to be uniquely coded using α and β. If P is coded as αα and Q as αβ, then R and S, respectively, can be coded as _____.

(A) βα and αβ
(B) ββ and αα
(C) αβ and ββ
(D) βα and ββ

Q.No. 8 The sum of the first n terms in the sequence 8, 88, 888, 8888, … is_____.

(A) $\frac{81}{80}(10^n - 1) + \frac{9}{8}n$
(B) $\frac{81}{80}(10^n - 1) - \frac{9}{8}n$

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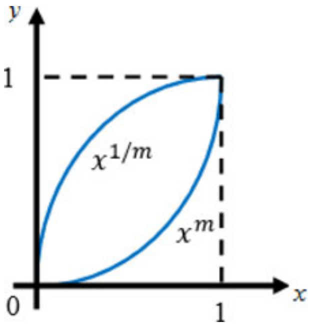
(C) $\frac{80}{81}(10^n - 1) + \frac{8}{9}n$

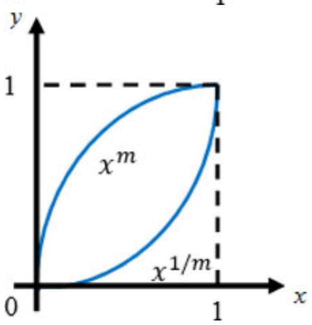
(D) $\frac{80}{81}(10^n - 1) - \frac{8}{9}n$

Q.No. 9 Select the graph that schematically represents BOTH $y = x^m$ and $y = x^{1/m}$ properly in the interval $0 \le x \le 1$, for integer values of m, where $m > 1$.

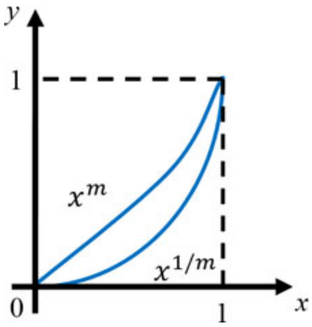
(A)



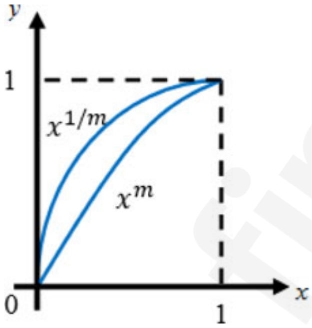
(B)



(C)



(D)



Q.No. 10

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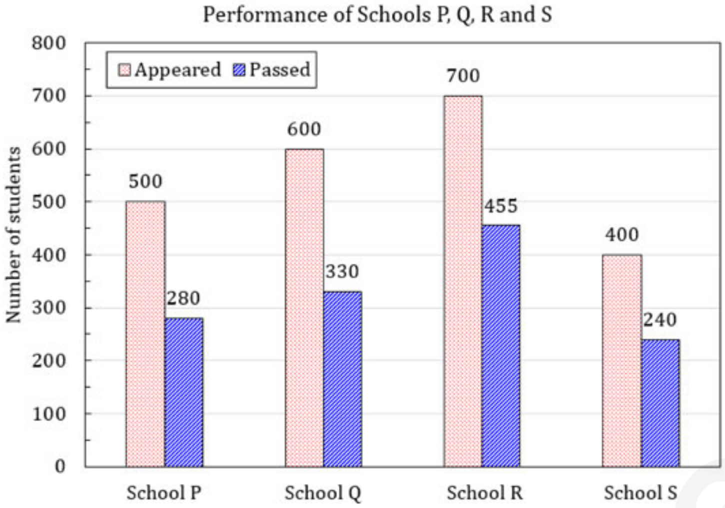
The bar graph shows the data of the students who appeared and passed in an examination for four schools P, Q, R and S. The average of success rates (in percentage) of these four schools is ______.



(A) 58.5 %
(B) 58.8 %
(C) 59.0 %
(D) 59.3 %

PE: Petroleum Engineering

Q1 - Q25 carry one mark each.

Q.No. 1 Consider a vector field, $\boldsymbol{A} = 3xz\hat{\boldsymbol{\imath}} + 2xy\hat{\boldsymbol{\jmath}} - yz\hat{\boldsymbol{k}}$, where, $\hat{\boldsymbol{\imath}}$, $\hat{\boldsymbol{\jmath}}$, and $\hat{\boldsymbol{k}}$ are the unit vectors along the $x, y,$ and z directions, respectively. The divergence of $\boldsymbol{A}$ at the point (1, 1, 1) is equal to

(A) 0
(B) 2
(C) 3
(D) 4

Q.No. 2 Inverse Laplace transform of the function, $F(s) = \frac{1}{s^2+s}$, is given by

(A) $1 - e^t$
(B) $1 + e^t$
(C) $1 - e^{-t}$
(D) $1 + e^{-t}$

Q.No. 3 The solution of the differential equation, $\frac{dy}{dx} + \frac{y}{x} = x$, $(x \neq 0)$ with the condition $y = 1$ at $x = 1$, is given by

(A) $y = \frac{2}{3x^2} + \frac{x}{3}$
(B) $y = \frac{x}{2} + \frac{1}{2x}$
(C) $y = \frac{2}{3} + \frac{x}{3}$
(D) $y = \frac{2}{3x} + \frac{x^2}{3}$

Q.No. 4 Two complex numbers are given as, $z_1 = e^{i\theta_1}$ and $z_2 = e^{i\theta_2}$, where, $i = \sqrt{-1}$, and θ_1 and θ_2 are the principal arguments. Given, $\theta_1 \neq \theta_2$ and $|\theta_1 - \theta_2| \neq \pi$.

If $m = \sqrt{(\cos\theta_1 + \cos\theta_2)^2 + (\sin\theta_1 + \sin\theta_2)^2}$, which one of the following conditions is correct?

(A) $2 < m < 3$
(B) $0 < m < 2$
(C) $m = 2$

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(D) $m = 0$

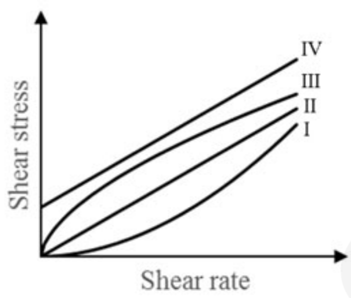
Q.No. 5 Match the following

P. Gauss-Seidel method	I. Interpolation
Q. Forward Newton-Gauss method	II. Non-linear differential equation
R. Runge-Kutta method	III. Linear algebraic equation

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

Q.No. 6 Shear stress versus shear rate plots for four different fluids are given in the Figure.

Which curve represents a pseudoplastic fluid?



(A) I
(B) II
(C) III
(D) IV

Q.No. 7 Which one of the following is **NOT** a desired function of a hydraulic fracturing fluid additive?

(A) Oxygen scavenging to prevent attack on polymers.
(B) Increasing viscosity of fracturing fluid during flow back.
(C) Work as a bactericide.
(D) Work as a surfactant to facilitate post treatment clean-up.

Q.No. 8 Formation damage could be a result of

(i) scale formation near the wellbore

(ii) coke formation due to in-situ combustion

(iii) precipitation of asphaltene

(iv) condensate banking

Which one of the following options is correct ?

(A) (i) and (iv) only
(B) (i) and (iii) only
(C) (i), (ii), and (iii) only
(D) (i), (ii), (iii), and (iv)

Q.No. 9

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Which of the following statement(s) about gas and water coning in the reservoir is/are correct?

(i) Gas and water coning is characterized by downward movement of water and upward movement of gas near the producing wellbore.

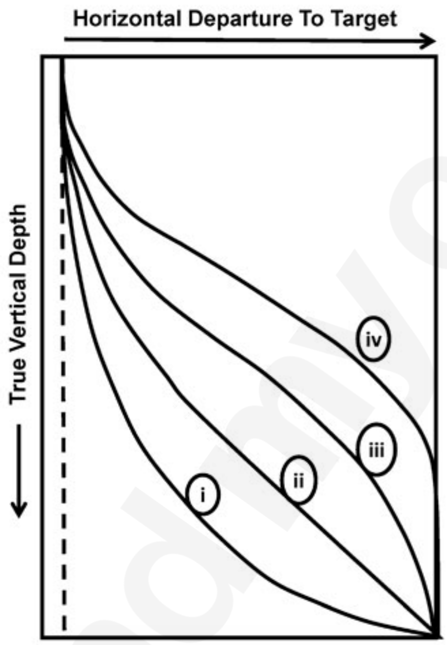
(ii) Gas and water coning is characterized by downward movement of gas and upward movement of water near the producing wellbore.

(iii) Gas and water coning improves the reservoir's oil recovery efficiency.

(iv) Gas and water coning is caused when gravitational forces dominate over viscous forces.

(A) (i) and (iv) only
(B) (ii) only
(C) (ii), (iii), and (iv) only
(D) (iv) only

Q.No. 10 Given the Figure



Which one of the following options represents the correct combination of the trajectory number and the corresponding drilling type?

(A) i → Build and Hold, ii → S-Type, iii → Modified S-Type, iv → Continuous Build
(B) i → Continuous Build, ii → Build and Hold, iii → Modified S-Type, iv → S-Type
(C) i → Continuous Build, ii → S-Type, iii → Modified S-Type, iv → Build and Hold
(D) i → Build and Hold, ii → Modified S-Type, iii → S-Type, iv → Continuous Build

Q.No. 11 A stable geothermal gradient (approx. 25°C/km) in the earth's crust will suddenly increase to a higher gradient value, when

(A) there is excessive erosion or upliftment
(B) there is excessive subsidence or deposition
(C) there is excessive subsidence and upliftment simultaneously
(D) there is excessive subsidence and erosion simultaneously

Q.No. 12 A drawdown test is conducted at a constant flow rate in an oil well for a reservoir with constant compressibility. Which one of the following is valid for semi steady state condition?

(A) Rate of pressure change at the wellbore is less than that at the boundary.
(B) The effect of the outer boundary of the reservoir is felt at the wellbore.
(C) Reservoir permeability does not affect the wellbore pressure.
(D) Pressure in the reservoir does not change with time.

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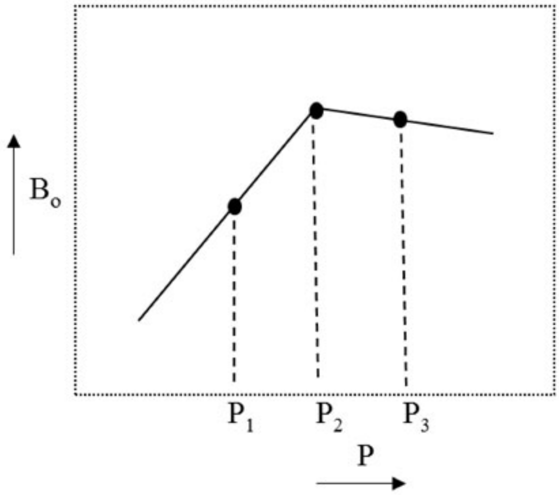
Q.No. 13 Formation volume factor (B_o) versus Pressure (P) plot for an oil is given in the Figure.



Match the following with the corresponding pressure given in the Figure

I. Bubble point

II. Saturated oil

III. Under-saturated oil

(A) I- P_1, II- P_2, III- P_3
(B) I- P_1, II- P_3, III- P_2
(C) I- P_2, II- P_1, III- P_3
(D) I- P_2, II- P_3, III- P_1

Q.No. 14 Which one of the following statements is **NOT** correct?
(A) Flash point of gasoline is lower than that of diesel.
(B) Pour point is the temperature at which oil ceases to flow.
(C) Higher the Diesel Index of a fuel, higher is its cetane number.
(D) Higher the aromatic content of diesel, higher is its aniline point.

Q.No. 15 Which one of the following additives is commonly added to drilling fluids to remove hydrogen sulfide?
(A) Sodium chloride
(B) Calcium chloride
(C) Zinc carbonate
(D) Bentonite

Q.No. 16 Two rigid spherical particles of the same density, with a diameter ratio $D_1 : D_2$ = 1:2, settle freely through a pool of liquid. The terminal settling velocity is given by the Stokes' law. What is the ratio of their terminal settling velocities, $V_1 : V_2$?
(A) 1:2
(B) 2:1
(C) 1:4
(D) 4:1

Q.No. 17 Which one of the following options best represents the correct order of increasing thermal conductivity of the subsurface formations?
(A) Coal < Shale < Dolomite < Evaporite
(B) Evaporite < Shale < Coal < Dolomite
(C) Coal < Shale < Evaporite < Dolomite
(D) Shale < Coal < Evaporite < Dolomite

Q.No. 18

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Which one of the following options is the correct combination of kerogen Type and the source from which it is derived?

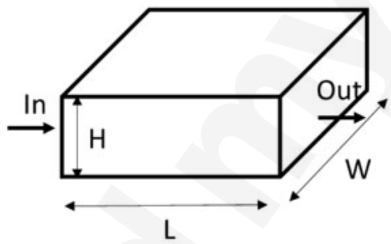
(A) Type I - Lacustrine, Type II - Terrestrial, Type III - Marine, Type IV - Varied
(B) Type I - Lacustrine, Type II - Marine, Type III - Terrestrial, Type IV - Varied
(C) Type I - Lacustrine, Type II - Varied, Type III - Marine, Type IV - Terrestrial
(D) Type I - Marine, Type II - Terrestrial, Type III - Varied, Type IV - Lacustrine

Q.No. 19 The number of power outages in a city in a given time interval is a Poisson random variable with a mean of 2 power outages per month. The Poisson distribution is given by, $P(y) = \frac{e^{-\mu}\mu^{y}}{y!}$.

The probability of exactly 2 power outages in 2 months (rounded off to two decimal places) is ____________.

Q.No. 20 Anhydrous sodium hydroxide is added to 10 litre of water to raise its pH from 7.0 to 9.0. The molar mass of sodium hydroxide is 40 g/mol. Assuming complete dissociation of sodium hydroxide and zero volume change of mixing, the amount of sodium hydroxide added (rounded off to two decimal places) is ________ mg.

Q.No. 21 Consider unidirectional, laminar flow of water through a homogeneous porous media as shown in the Figure. Here, H = 100 m, W = 500 m, L = 500 m, permeability of the porous media is 10^{-12} m^2, and the driving pressure drop (across length L) is 10^6 Pa. Use the viscosity of water as 10^{-3} Pa.s.



At steady state, the volumetric flow rate of water (rounded off to two decimal places) is given by _____________ m^3/s.

Q.No. 22 A dry gas well is producing a gas stream of the following molar composition: 95% methane and 5% carbon dioxide. The molar mass of methane is 16 g/mol and that of carbon dioxide is 44 g/mol. Assuming ideal gas behavior, gas constant R = 8.31 J mol^{-1} K^{-1}, the gas stream density at 10^7 Pa and 350 K (rounded off to one decimal place) is ________ kg/m^3.

Q.No. 23 Consider fluid flow through the annular space between two cylindrical tubes. The outer diameter of the inner tube is 40 mm and the inner diameter of the outer tube is 50 mm. The hydraulic mean diameter for fluid flow calculations (rounded off to one decimal place) is ________ mm.

Q.No. 24

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A build up test was performed on a well after 1000 hours of oil production. During the shut-in period, the Horner's approximation is valid which results in the following equation relating the shut-in well pressure (P_{ws}) to the shut-in time:

$$\frac{2\pi kh}{q\mu}(P_i - P_{ws}) = \frac{1}{2}\ln X + P_D(t_D) - \frac{1}{2}\ln\frac{4t_D}{\gamma}$$

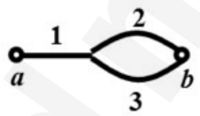
Here, k is the reservoir permeability, h is the reservoir thickness, P_i is the initial reservoir pressure, q is the flow rate during production, μ is the oil viscosity, t_D is the dimensionless production time, $P_D(t_D)$ is the dimensionless pressure at t_D, γ is a constant, and X is dependent on the shut-in time and the production time.

The value of X after 5 hours of shut-in (rounded off to one decimal place) is ________.

Q.No. 25 The initial oil production from an offshore well is 1000 STB/day, which decreased to 960 STB/day in 30 days. Using the 'exponential decline model', the daily production rate after 360 days from the start (rounded off to one decimal place) will be ___________ STB/day.

Q26 - Q55 carry two marks each.

Q.No. 26 An incompressible fluid flows through a network of pipes as shown in the given Figure. The total pressure drop across points ***a*** and ***b*** is 2 kPa. The flow rates (in m^3/s) in sections 1, 2, and 3 are $q_1, q_2,$ and q_3 respectively. The pressure drops (in kPa) are $4q_1, 3q_2,$ and $2q_3$ across sections 1, 2, and 3 respectively.



For a steady-state flow operation, the system of equations for flow rates is given by,

$$\begin{bmatrix} 4 & 3 & 0 \\ 0 & -3 & 2 \\ 0 & \boldsymbol{X} & -1 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix} = \begin{bmatrix} 2 \\ 0 \\ -0.5 \end{bmatrix}$$

The correct option for the numeric value of ***X*** is

(A) -0.50
(B) -1.75
(C) -1.00
(D) -2.00

Q.No. 27 Match the following for Enhanced Oil Recovery operations

(P) Surfactant flooding	(I) Prevent viscous fingering
(Q) Polymer flooding	(II) Decrease oil viscosity
(R) Alkali flooding	(III) Reduce interfacial tension
(S) Steam injection	(IV) Reaction with naphthenic acid

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

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(C) P-III, Q-II, R-IV, S-I

(D) P-III,Q-I, R-II, S-IV

Q.No. 28 An incompressible fluid is flowing through a tube of radius, R and length, L. The shear rate dependence of the fluid viscosity is given by the power law, $\mu = k|\dot{\gamma}|^{n-1}$ where, $\dot{\gamma}$ is the scalar shear rate, k is a constant, and n is the flow behavior index. Assuming the flow to be steady, laminar, and fully developed, the velocity profile inside the tube for a pressure drop of Δp applied across the tube is

(A) $\left(\frac{\Delta p}{2kL}\right)^{\frac{1}{n}}\left(\frac{n}{n+1}\right)R^{\frac{n+1}{n}}\left[1-\left(\frac{r}{R}\right)^{\frac{n+1}{n}}\right]$

(B) $\left(\frac{\Delta p}{2kL}\right)^{\frac{1}{n}}\left(\frac{n+1}{n+2}\right)R^{\frac{n+2}{n+1}}\left[1-\left(\frac{r}{R}\right)^{\frac{n+2}{n+1}}\right]$

(C) $\left(\frac{\Delta p}{2kL}\right)^{\frac{1}{n}}\left(\frac{n}{n+2}\right)R^{\frac{n+2}{n}}\left[1-\left(\frac{r}{R}\right)^{\frac{n+2}{n}}\right]$

(D) $\left(\frac{\Delta p}{8kL}\right)^{n}R^{2}\left[1-\left(\frac{r}{R}\right)^{2n}\right]$

Q.No. 29 The apparent permeability of a core measured using air is K_a, and its absolute permeability measured using an incompressible liquid is K_L. If, P_m is the mean air pressure in the core during permeability measurement, and c is a positive constant linked to the pore geometry, then K_a and K_L are related as

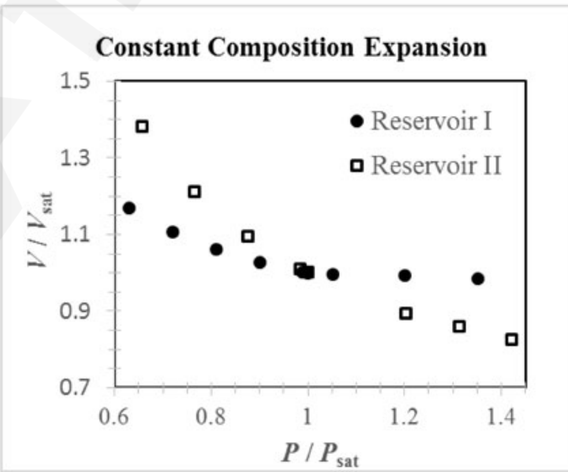
(A) $K_a = 2K_L - c\left(\frac{1}{P_m}\right)$

(B) $K_a^2 = K_L^2 - c(P_m)$

(C) $K_a = K_L + c\left(\frac{1}{P_m}\right)$

(D) $K_a^2 = K_L^2 + c(P_m)$

Q.No. 30 The plot of volume (V) versus pressure (P) for two reservoir fluids (I and II) obtained in a constant composition expansion (CCE) is shown in the Figure. Here, V_{sat} is saturation volume and P_{sat} is saturation pressure. The measurements were carried out at constant temperature (the measured reservoir temperature) throughout the experiment. Which one of the following statements for the type of reservoir is correct?



(A) I is a gas condensate reservoir and II is an oil reservoir.

(B) I is an oil reservoir and II is a gas condensate reserovir.

(C) I is a light oil reservoir and II is a heavy oil reservoir.

(D) I is a dry gas reservoir and II is a gas condensate reserovir.

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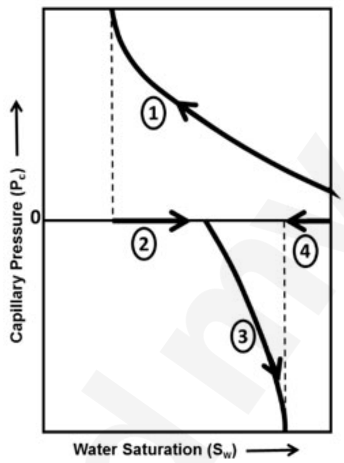
Q.No. 31 The following primary and secondary porosity types are prevalent in the subsurface formations:

1. Interparticle
2. Intraparticle
3. Fracture
4. Solution
5. Bedding plane voids
6. Channel

Which one of the following options represents the correct combination?

(A) Primary (1, 2, 3); Secondary (4, 5, 6)
(B) Primary (1, 2, 5); Secondary (3, 4, 6)
(C) Primary (1, 3, 6); Secondary (2, 4, 5)
(D) Primary (2, 4, 6); Secondary (1, 3, 5)

Q.No. 32 In the given Figure, which one of the following options represents the correct combination of drainage and imbibition processes for a water wet rock in the subsurface, as indicated by number 1 to 4?



(A) 1- oil displacing water, 2- spontaneous brine imbibition, 3- water displacing oil, 4- spontaneous oil imbibition
(B) 1- water displacing oil, 2- spontaneous oil imbibition, 3- spontaneous brine imbibition, 4- oil displacing water
(C) 1- spontaneous oil imbibition, 2- spontaneous brine imbibition, 3- water displacing oil, 4- oil displacing water
(D) 1- water displacing oil, 2- spontaneous brine imbibition, 3- oil displacing water, 4- spontaneous oil imbibition

Q.No. 33 The following notations are defined for a porous medium:

φ = porosity,

S_p = surface area of the pore per unit bulk volume of the core,

τ = tortuosity factor for the interconnected porous channel,

C = geometric factor of the pore.

The correct combination for the hydraulic radius (r_h) and absolute permeability (k) of a porous medium is

(A)

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$r_h = \frac{\varphi^3}{S_p}$ and $k = \frac{C\varphi^3}{\tau S_P^2}$

(B) $r_h = \frac{\varphi^2}{S_p}$ and $k = \frac{C\varphi^2}{\tau S_P^2}$

(C) $r_h = \frac{\varphi}{S_p}$ and $k = \frac{C\varphi^3}{\tau S_P^2}$

(D) $r_h = \frac{\varphi}{S_p}$ and $k = \frac{C\varphi^4}{\tau S_P^2}$

Q.No. 34 Match the following

I. Drag bit	P. Hard formation and reduction in trip time
II. Diamond bit	Q. Excessive pressure loss and extra pumping capacity
III. Jet bit	R. Soft and sticky formation

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

Q.No. 35 Select the correct combination of a floating vessel motion in a horizontal plane (P) and a vertical plane (Q)

(A) P: (Surge, Sway, Yaw) and Q: (Heave, Roll, Pitch)
(B) P: (Heave, Roll, Pitch) and Q: (Surge, Sway, Yaw)
(C) P: (Surge, Roll, Pitch) and Q: (Heave, Sway, Yaw)
(D) P: (Surge, Sway, Pitch) and Q: (Heave, Roll, Yaw)

Q.No. 36 The equation $x^3 - 3x - 5 = 0$ is to be solved using the Newton-Raphson method. Starting with an initial guess of 2, the value of x after three iterations (rounded off to three decimal places) is _____.

Q.No. 37 The axis of a cylinder of radius a and length L is along the z-axis with center of the flat surface at (0, 0, 0). An inextensible string of negligible thickness is wound tightly as a right-handed helix around the curved surface of the cylinder. The two ends of the string are at $(a, 0, 0)$ and $(a, 0, L)$.

The parametric equation of the right-handed helix is given by,

$$r(\theta) = [a\cos\theta, a\sin\theta, c\theta],$$

where, r is the position vector and θ is in radian.

Given $a = \frac{2}{\pi}$ cm, $c = \frac{1}{\pi}$ cm, $L = 4$ cm, the total length of the string (rounded off to two decimal places) is ________________ cm.

Q.No. 38

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A data set containing n (= 10) independent measurements (x_i, y_i) is to be fitted by a simple linear regression model. The least square estimates of regression coefficients are obtained and the regression estimate is given by $\hat{y} = \widehat{\beta_0} + \widehat{\beta_1}x$.

$$\widehat{\beta_0} = \frac{\sum_{i=1}^{n} y_i}{n} - \widehat{\beta_1}\frac{\sum_{i=1}^{n} x_i}{n} \text{ and } \widehat{\beta_1} = \frac{\mathrm{Cov}(x,y)}{\mathrm{Var}(x)},$$

where, $\mathrm{Cov}(x, y)$ is the sample covariance and $\mathrm{Var}(x)$ is the sample variance.

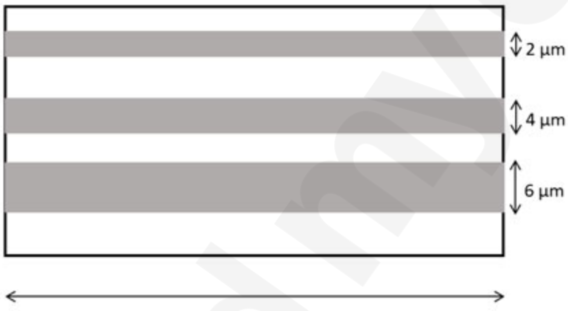
The values are given below:

$$\sum_{i=1}^{10} x_i = 25, \quad \sum_{i=1}^{10} y_i = 37$$

$$\sum_{i=1}^{10} x_i^2 = 108, \quad \sum_{i=1}^{10} y_i^2 = 155, \quad \sum_{i=1}^{10} x_i y_i = 120$$

For the given data set, the unbiased variance for the error $(y_i - \hat{y}_i)$ (rounded off to two decimal places) is __________.

Q.No. 39 A porous medium of 10 cm length is made of three horizontal, cylindrical capillaries of inside diameters 2 μm, 4 μm, and 6 μm as shown in the Figure (not to scale).



Oil is being injected in this porous medium that was initially filled completely with water. The interfacial tension between oil and water is 0.025 N/m. Consider water as the completely wetting phase, i.e., contact angle is 0°. When the pressure drop across the porous medium is 20 kPa, the maximum saturation of oil in the porous medium is 0.643.

When the pressure drop is increased to 30 kPa, the maximum oil saturation (rounded off to two decimal places) will be _______ (in fraction).

Q.No. 40 A unidirectional, immiscible displacement of an oil is carried out with water in a cylindrical reservoir core sample (Buckley-Leverett theory is applicable). The connate water saturation is 0.25. A fractional flow of water (f_w) vs. water saturation (S_w) curve is drawn for the process. A line drawn from a point (S_w = 0.25, f_w = 0) on the fractional flow curve is tangent at the point (S_w = 0.8, f_w = 0.8) on the curve.

The average water saturation $(\overline{S_w})$ in the core at the time of breakthrough (rounded off to two decimal places) is ______ (in fraction).

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Q.No. 41 In a hydrate reservoir, the porosity of the porous medium is 0.3 and the solid hydrate saturation is 0.5. Assume that the permeability (in mD) in a porous medium is given by $k = 1000\frac{\phi_e^2}{1-\phi_e}$, where, ϕ_e is the effective porosity available for the fluids. The permeability of the hydrate bearing porous medium (rounded off to two decimal places) is _______mD.

Q.No. 42 The slip velocity for a gas-liquid flow in a vertical production well is 0.1 m/s. The superficial velocity of each of the phases is 0.1 m/s. The fractional hold-up of the gas phase (rounded off to two decimal places) is _________.

Q.No. 43 A three stage reciprocating compressor is to compress 4 mol/s of methane from 1 bar absolute to 60 bar absolute pressure. The gas temperature is 303 K at the suction. The compression ratio in each stage is equal and the compression is isentropic. The gas behaves as an ideal gas and the ratio of specific heat capacities $\left(\frac{C_p}{C_v}\right)$ is 1.4. Take gas constant, R = 8.31 J mol^{-1} K^{-1}.

The minimum work rate of compression required for the gas (rounded off to two decimal places) is _______kJ/s.

Q.No. 44 In a 1-1 counter flow shell and tube heat exchanger, a liquid process stream (C_p= 2.1 kJ kg^{-1} K^{-1}) is cooled from 430 K to 330 K using water (C_p= 4.2 kJ kg^{-1} K^{-1}) having an inlet temperature of 280 K. The process stream flows on the shell side at a rate of 1 kg/s and the water on the tube side at a rate of 2.5 kg/s. The overall heat transfer coefficient is 600 W m^{-2} K^{-1}. Neglecting the heat loss to the surroundings, the required heat transfer area (rounded off to two decimal places) is _______ m^2.

Q.No. 45 A pre-flush of 15 wt% HCl solution (density = 1070 kg/m^3) is used to dissolve dolomite in a sandstone reservoir. The molecular formula, molar mass, and density of dolomite are $CaMg(CO_3)_2$, 184.3 g/mol, and 2840 kg/m^3, respectively. The molar mass of HCl is 36.5 g/mol.

If the pre-flush has to remove all the dolomite, the volumetric dissolving power of the pre-flush (rounded off to three decimal places) is _______ (m^3 of dolomite/m^3 of 15 wt% HCl solution).

Q.No. 46 A cuboidal wooden block of density 750 kg/m^3, with horizontal dimensions of 2.0 m × 1.0 m and vertical height of 0.8 m, floats in water (density = 1000 kg/m^3). The acceleration due to gravity is 9.81 m/s^2. The distance between center of gravity and metacenter of the block (rounded off to two decimal places) is ________ m.

Q.No. 47

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It is desired to determine the radius of investigation (r_{inv}) of a low-permeability and low-pressure gas reservoir which produces under a constant flow rate. Use the following data:

Absolute permeability (k) = 0.01 mD,

Porosity (φ) = 0.05,

Total isothermal compressibility (C_t) = 200×10^{-6} $psia^{-1}$, and

Viscosity (μ) = 0.05 cP.

Assuming transient flow conditions are valid, the radius of investigation (r_{inv}) after 200 hours of gas production (rounded off to one decimal place) is ______ ft.

Q.No. 48 Well stimulation is carried out in a homogeneous formation. The well is stimulated up to a radial distance of 54 inch from the surface of the wellbore. The diameter of the wellbore is 12 inch. The permeability enhancement in the stimulated region is found to be 10 times that of the unstimulated region. Assuming steady-state radial flow, the skin factor after stimulation (rounded off to two decimal places) is ________.

Q.No. 49 A gas reservoir has a permeability of 1.0 mD, which is to be fractured hydraulically to create a 600 m long and 0.30 cm wide fracture of 2×10^5 mD permeability around the center of damage area. The fracture conductivity for the well (rounded off to two decimal places) is ______.

Q.No. 50 A producing oil well with the drainage to wellbore radius ratio of 2981 is found to have a skin factor of 8. Assume steady state operation and negligible pressure drop in the tubing.

The ratio of production rate of the 'damaged' to the 'undamaged' well (rounded off to two decimal places) is______.

Q.No. 51 It is desired to prepare a Class H cement slurry having a density of 2100 kg/m^3 using hematite as an additive. The water requirement for the Class H cement is 20 litre/50 kg cement and that for hematite is 3 litre/1000 kg hematite.

Given:
Density of class H cement = 3125 kg/m^3
Density of hematite = 5000 kg/m^3
Density of water = 1000 kg/m^3
Weight of one sack of cement = 50.0 kg

Assuming zero volume change of mixing, the amount of hematite that should be blended with one sack of cement (rounded off to two decimal places) is __________ kg.

Q.No. 52

find my college

A gas reservoir without aquifer is at 300 bar (absolute) and 90°C. The GIIP (gas initial in place) is 10^7 m^3 (at surface conditions). Neglect formation and water compressibility.

Given:

Surface pressure = 1 bar (absolute)

Surface temperature = 25°C

Gas compressibility factor, Z (at surface condition) = 1

Z (at 300 bar (absolute) and 90°C) = 0.88

Z (at 100 bar (absolute) and 90°C) = 0.83

If the reservoir pressure reduces to 100 bar (absolute) under isothermal conditions, the total volume of gas (at surface conditions) produced from the reservoir (rounded off to two decimal places) is ________ $\times 10^6$ m^3.

Q.No. 53 Given the following data of a shale gas formation:

W_{TOC} (weight fraction of total organic carbon (TOC)) = 0.10

S_{wT} (total water saturation) = 0.25

ρ_{TOC} (density of TOC) = 1.10 g/cm^3

ρ_m (density of matrix) = 2.65 g/cm^3

ρ_g (density of gas) = 0.35 g/cm^3

ρ_w (density of water) = 1.00 g/cm^3

ρ_b (formation bulk density) = 2.00 g/cm^3

Consider that only water and gas are present in the formation and the following equations apply,

$$\rho_b = \frac{\rho_m \times (1-\varphi_T) + \rho_f \times \varphi_T}{1 - W_{TOC} \times \left(1 - \frac{\rho_m}{\rho_{TOC}}\right)}, \quad \rho_b = \left(\frac{\rho_{TOC} \times V_{TOC}}{W_{TOC}}\right) + \varphi_T \times \rho_f$$

Where, ρ_f is the fluid density, φ_T is the total porosity, and V_{TOC} is the volume fraction of TOC.

The volume fraction of TOC (rounded off to two decimal places) is _____.

Q.No. 54 It is desired to drill a deviated well with 'build and hold type' trajectory. The kick-off point is at a vertical depth of 1500 ft from the surface and the rate of build is 2°/100 ft. At a true vertical depth (TVD) of 7500 ft, the net horizontal departure to the target is 2500 ft. The total measured depth is _____ft.

Q.No. 55

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A cylindrical core sample of 4 inch diameter and 20 inch length is obtained from a consolidated reservoir sand. At the reservoir temperature, the formation water resistivity (R_w) is 0.15 ohm-m whereas, the resistance of the core, which is 100% saturated with brine, is 100 ohm. Use the generalized form of the Archie's formula relating Formation Resistivity Factor (F_R) and the porosity (φ). Assume, *a* (tortuosity factor) = 1, and *m* (cementation factor) = 2.

The porosity (in fraction) of the core (rounded off to two decimal places) is _________.