Ministry of Higher Education & Scientific Research **Tikrit University** **College of Engineering** **Chemical Eng. Dept.**	**2026-2025**	**وزارة التعليم العالي والبحث العلمي** **جامعةتكريت** **كلية الهندسة** **قسم الهندسة الكيمياوية**

Subject: Advanced Reactor Design

Q1: For an ideal PFR, the RTD function E(t) is:

A) A delta function
B) A uniform distribution
C) An exponential decay
D) A step function

Q2: In a CSTR, the residence time distribution E(t) is:

A) Delta function
B) Exponential decay
C) Step function
D) Constant

Q3: The mean residence time (τ) in a reactor is calculated from E(t) by:

A) $\tau = \int E(t)\, dt$
B) $\tau = \int t\, E(t)\, dt$
C) $\tau = \int t^2\, E(t)\, dt$
D) $\tau = E(0)$

Q4: In non-ideal flow, dispersion causes the RTD curve to:

A) Narrow
B) Stay the same
C) Widen
D) Disappear

Q5: For ideal CSTR, the conversion can be found using:

A) Plug Flow Equation
B) CSTR Design Equation
C) Levenspiel plot
D) Batch reactor equation

Q6: The early exit of some fluid elements from the reactor is called:

A) Channeling
B) Dead volume
C) Axial dispersion
D) Segregation

Q7: Dead zones in reactors cause the effective volume to:

A) Increase
B) Decrease
C) Stay the same
D) Fluctuate

Q8: In the dispersion model, the dimensionless number that characterizes dispersion is:

A) Reynolds number
B) Peclet number

C) Damkohler number D) Schmidt number

Q9: A high Peclet number (Pe >> 1) indicates:

A) Dominant dispersion B) Plug flow behavior

C) CSTR behavior D) Complete backmixing

Q10: In the dispersion model, axial dispersion is described by which term in the governing equation?

A) Reaction term B) Convective term

C) Diffusive term D) Source term

Q11: If the dispersion coefficient D is 0.02 m²/s, reactor length L = 5 m, and superficial velocity u = 0.5 m/s, calculate the Peclet number (Pe = uL/D):

A) 100 B) 50

C) 125 D) 75

Q12: If the reactor has Pe = 50 and the ideal PFR conversion is 80%, what would the conversion approximately be with dispersion?

A) 79% B) 80%

C) 70% D) 60%

Q13: A single tank in the tanks-in-series model represents:

A) Plug flow B) Complete mixing

C) Partial mixing D) Dead volume

Q14: If a pulse response experiment shows a broad E curve, the reactor behavior is close to:

A) PFR B) CSTR

C) Ideal laminar flow D) Segregated flow

Q15: The rate of surface reaction for a catalytic reaction is generally expressed as:

A) $-r_A = kC_A$ B) $-r_A = kC_A^2$

C) $-r_A = k$ D) $-r_A = k \exp(-Ea/RT)$

Q16: The Thiele modulus (Φ) relates to:

A) Surface reaction only B) Diffusion and reaction resistance

C) Pressure drop D) Adsorption equilibrium

Q17: If $\Phi >> 1$, it indicates:

A) Diffusion limits rate B) Reaction controls

C) Surface area increases conversion D) Temperature is uniform

Q18: A porous catalyst sphere of radius 0.01 m has a diffusion coefficient $D = 1\times10^{-9}$ m²/s and surface reaction rate constant $k = 0.01$ s⁻¹. What is the Thiele modulus Φ?

A) 1 B) 3.16

C) 0.316 D) 10

Q19: If a reaction is highly exothermic in a porous catalyst, internally it may cause:

A) Hot spots B) Cold spots

C) Constant temperature D) Surface deactivation

Q20: In heat effects during reactions, an adiabatic porous catalyst particle may experience:

A) Constant temperature throughout B) Temperature gradient inside the particle

C) No conversion change D) Uniform effectiveness factor

Q21: Given a first-order deactivation with rate $da/dt = -0.1a$, what is the activity after 10 minutes?

A) 0.37 B) 0.5

C) 0.9 D) 0.1

Q22: Deactivation by pore plugging is categorized as:

A) Sintering B) Poisoning

C) Fouling D) Attrition

Q23: If a catalyst has an initial activity of 1.0 and decays to 0.5 in 5 hours under first-order kinetics, what is the decay constant k?

A) 0.1386 hr⁻¹ B) 0.05 hr⁻¹

C) 0.2 hr⁻¹ D) 0.01 hr⁻¹

Q24: The activity of a catalyst drops from 1.0 to 0.606 in 5 minutes. What is the deactivation rate constant assuming first-order decay?

A) 0.1 min^{-1} B) 0.2 min^{-1}

C) 0.05 min^{-1} D) 0.3 min^{-1}

Q25: For an endothermic reaction, increasing the temperature will:

A) Decrease the reaction rate B) Increase both rate and equilibrium conversion

C) Decrease equilibrium conversion D) Have no effect

Q26: When a high liquid holdup is required in a reactor for gas liquid reaction, use ------- column.

A) Packed B) Bubble

C) Slurry D) Spray

Q27: / The point of intersection of energy balance and material balance curves for exothermic irreversible reactions, wherein instability is witnessed is stated as ____.

A) Extinction point B) Ignition point

C) Hot spot point D) Reaction runaway

Q28: /

The average residence time of the CSTR from the tracer using the following data

Time, min	0	5	10	15	20	25	30	35
Concentration, mol/m^3	0	84.9	141.5	141.5	113.3	56.6	28.3	0

and the concentration of the tracer was measured at the outlet of the reactor with the volume is 2 m^3 and the flow at the outlet is 7.2m^3/h. Then the residence time is:

A) 15 B) 8

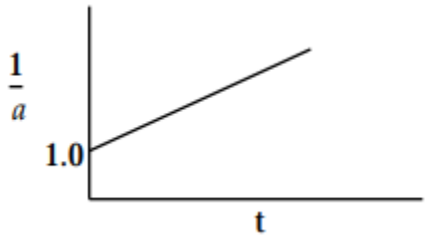
C) 22 D) 35

Q29: /An solution initially contains a catalytic amount of an enzyme with K_M = 1.5 mM, 0.25 M of substrate, and no product. After 45 seconds, the solution contains 25 µM of product. Find V_{max} and the concentration of product after 2.0 minutes. This problem is based on Michaelis Menten Model.

A) Vmax=33.3 µM/min, [P]=66.6 µM B) Vmax=20.8 µM/min, [P]=72.5 µM

C) Vmax=42.9 µM/min, [P]=15.8 µM D) Vmax=53.23 µM/min, [P]=92.3 µM

Q30: The following plot of activity as a function of time was obtained?



What type of decay would best describe to data?

a) Poisoning
b) Sintering
c) Coking
d) None of the above

Good Luck

Subject : Advanced Thermodynamics

Q1 : From Antoine: $\ln P^{sat} = A - \frac{B}{T-C}$, compute P_1^{sat} $at\ T = 318.15K$ for: A = 16.59158, B = 3643.31, C = 33.424

A. 41.3
B. 44.5
C. 48.0
D. 50.6

Q2 : Which of the following affects the chemical reaction equilibrium?

A. Catalyst
B. Temperature
C. Mixing speed
D. Reactor material

Q3 : What is the reaction coordinate (ε) used to describe?

A. Temperature of reaction
B. Rate of reaction
C. Progress of the reaction
D. Pressure of the system

Q4 : What is the general criterion for chemical reaction equilibrium?

A. $\sum ni\mu i$ = constant
B. $\sum vi\mu i = 0$
C. $G = \sum vi\mu i$
D. $d\varepsilon = 0$

Q5 : What does the equilibrium constant (K) depend on?

A. Pressure
B. Temperature
C. Concentration
D. Volume

Q6 : Which of the following is a consequence of a positive ΔH° for a reaction?

A. K decreases with temperature
B. K increases with temperature
C. K is independent of temperature
D. ΔG° increases

Q7 : If ΔG° < 0 for a reaction, what can be said about the equilibrium constant K?

A. K > 1 B. K = 0

C. K < 1 D. K = 1

Q8 : The stoichiometric number for a product is:

A. Always zero B. Always negative

C. Always positive D. Sometimes negative

Q9 : The standard state for a gas is defined as:

A. Gas at 25°C and 1 atm B. Gas at 1 bar behaving ideally

C. Gas at 100°C and 1 bar D. Gas at any pressure but ideal

Q10 : For the reaction:

$\mathbf{CH_4 + H_2O \rightarrow CO + 3H_2}$,

Given the initial moles: 2 mol CH_4 , 1 mol H_2O, 1 mol CO, 4 mol H_2 , and $\varepsilon = 0.5$, what is the mole fraction of CO?

A. 0.125 B. 0.167

C. 0.150 D. 0.187

Q11 : Given: $\mathbf{H_2O \rightarrow H_2 + \frac{1}{2} O_2}$, and n_0 = 1 mol H_2O, what is the mole fraction of O_2 at $\varepsilon = 0.2$?

A. 0.041 B. 0.071

C. 0.091 D. 0.102

Q12 : For $\mathbf{CO + H_2O \rightleftharpoons CO_2 + H_2}$ at 1100 K, if K = 1 and initial moles of CO and H_2O are 1 mol each, what is the value of ε at equilibrium?

A. 0.25 B. 0.50

C. 0.75 D. 1.00

Q13 : If $\Delta G° = -8378$ J/mol at 298.15 K, what is the equilibrium constant K?

A. 8.4 B. 15.1

C. 29.4 D. 45.2

Q14 : If K = 2 at 300 K and ΔH° = –40,000 J/mol, what is K at 350 K?

A. 1.10 B. 0.58

C. 0.26 D. 3.25

Q15 : For **A + B ⇌ C + D**, with K = 4, starting from 1 mol each of A and B, what is the extent of reaction (ε) at equilibrium?

A. 0.50 B. 0.66

C. 0.75 D. 1.00

Q16 : For **A ⇌ B + C**, if 1 mol A is present initially, K = 10, and P = 2 bar, find ε (assume ideal gas)

A. 0.50 B. 0.64

C. 0.73 D. 0.82

Q17: For $CH_4 + H_2O \rightleftharpoons CO + 3H_2$, if ε = 0.5 and initial moles = 8, what is the total number of moles at equilibrium?

A. 8.5 B. 9.0

C. 9.5 D. 10.0

Q18 : What is a necessary condition for a binary liquid mixture to remain as a single phase at constant T and P?

A. ΔG of mixing is negative B. First derivative of ΔG is zero

C. Second derivative of ΔG is negative D. Second derivative of ΔG is positive

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Q19 : In phase equilibrium, what is the requirement for chemical potential μi?

A. μi must be zero B. μi must be equal in all phases

C. μi must be minimized

D. μi must be greater in vapor

Q20 : Which statement best describes an azeotrope?

A. A point where x1 = 0.5

B. A constant boiling mixture where x1 = y1

C. A mixture with negative deviation from Raoult's law

D. A mixture of solids and liquids

Q21 : Which of the following contributes to positive deviation from ideal solution behavior?

A. Strong intermolecular forces

B. Hydrogen bonding

C. Weak interaction between unlike molecules

D. Identical molecular sizes

Q22 : What type of equilibrium exists in a partially miscible binary system forming two liquid phases?

A. VLE

B. SLE

C. LLE

D. VLLE

Q23: Which criterion is required for the stability of a single liquid phase?

A. $\frac{d^2G}{dx_1^2} < 0$

B. $\frac{d^2G}{dx_1^2} > 0$

C. $\frac{dG}{dx_1} = 0$

D. $\frac{dS}{dx_1} > 0$

Q24 : What does the UNIQUAC model primarily estimate?

A. Reaction rates

B. Fugacity coefficients

C. Activity coefficients in liquid phase

D. Enthalpy of vaporization

Q25: The parameter A in $G^E/RT = Ax_1x_2$ affects:

A. Pressure only

B. Stability of single-phase system

C. Vapor pressure

D. Triple point

Q26 : **Given A = 2.48, estimate equilibrium compositions using symmetry.**

A. $x1\alpha = 0.15$ B. $x1\alpha = 0.25$

C. x1α = 0.35 D. x1α = 0.45

Q27 : **If $G^E/RT = Ax_1x_2$ and x1 = 0.4, x2 = 0.6, and A = 3, calculate GE/RT.**

A. 0.6 B. 0.72

C. 0.5 D. 0.85

Q28 : **If γ1α = 10, γ1β = 1, x1β = 0.8, find x1α.**

A. 0.1 B. 0.08

C. 0.05 D. 0.02

Q29 : **For complete immiscibility, what is P* if $P_1^{sat} = 70kPa, P_2^{sat} = 30kPa$?**

A. 100 kPa B. 90 kPa

C. 80 kPa D. 110 kPa

Q30 : **Given γ1 = 2.5, P1sat = 80 kPa, x1 = 0.5, calculate partial pressure of component 1.**

A. 100 kPa B. 80 kPa

C. 120 kPa D. 70 kPa

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Engineering Analysis

Q1: What is the order of the differential equation given by dy/dx+4y=sinx

A. 0.5 B. 1

C. 2 D. 0

Q2 $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$ **is the condition of _____ differentiation.**

A. Partial B. Successive

C. Exact D. Total

Q3: Which oh the folowing is not a type of differential equation?

A. Ordinary differential equation B. Successive differential equation

C. Linear differential equation D. Homogenouse differential equation

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Q4: $e^{\int p(x)\,dx}$ **is the formula of :**

A. Power facter B. Integration factor

C. Bernoulli's equation D. None

Q5: **differential equation is called partial differential equation which has independent numbe of varibales**

A. At least one

B. At least two

C. At most one

D. At most two

Q6: What will be the general solution of the differential equation $d^2y/dx^2 = e^{2x}(12 \cos 3x - 5 \sin 3x)$? (here, A and B are integration constant)

A. $y = e^x \sin 3x + Ax + B$

B. $y = e^{2x} \sin 3x + Ax + B$

C. $y = e^{2x} \sin 3x + A$

D. Data inadequate

Q7: To reduce Bernoulli's equation to linear, substitute:

A. $y = v$

B. $y^n = v$

C. $v = y^{(1-n)}$

D. $v = y^n$

Q8: For the equation y'' - 6y' + 9y = 0, the roots of the characteristic equation are

A. r = 3, r = 3

B. r = -3, r = 3

C. r = -3, r = -3

D. r = 3, r = -6

Q9: Which of the following is a fourth-order linear homogeneous equation?

A. y'' + 5y' + 4y = 0

B. y'''' + 3y'' + 2y = 0

C. y'' + y = 0

D. y''' + 2y' = 0

Q10: The general solution of the Euler-Cauchy equation x^2 y'' + 5x y' + 6y = 0 is_____

A. $y = C_1 x^3 + C_2 x^{(-2)}$

B. $y = C_1 x^2 + C_2 x^{(-3)}$

C. $y = C_1 e^{(x)} + C_2 e^{(-x)}$

D. $y = C_1 x^3 + C_2 x^2$

Q11: The equation x^2 y'' + 4x y' + 3y = 0 is an example of:

A. Linear second-order equation

B. Non-linear equation

C. Euler-Cauchy equation

D. Homogeneous equation

Q12: The method of finding power series solutions to a differential equation is most useful near

A. Singular points

B. Regular points

C. Zero

D. Infinity

Q13: The Beta function B(x, y) is related to the Gamma function by:

A. $B(x, y) = \Gamma(x)\Gamma(y)$

B. $B(x, y) = \Gamma(x + y)$

C. $B(x, y) = \Gamma(x)\Gamma(y)/\Gamma(x + y)$

D. $B(x, y) = \Gamma(x)\Gamma(y)/x!$

Q14: The PDE $u_{tt}=c^2u_{xx}$ is classified as:

A. Elliptic

B. Parabolic

C. Hyperbolic

D. None

Q15: In Separation of Variables, for the 1D heat equation $u_t=\alpha^2 u_{xx}$, the spatial part X(x) satisfies:

A. An ODE

B. A PDE

C. An algebraic equation

D. A differential-algebraic equation

Q16: The Laplace equation $u_{xx}+u_{yy}=0$ is solved using separation of variables by assuming:

A. $u(x,y)=X(x)+Y(y)$

B. $u(x,y)=X(x)Y(y)$

C. $u(x,y)=X'(x)Y(y)$

D. $u(x,y)=X(x)-Y(y)$

Q17: The separated ODE for T(t) in the heat equation problem is usually:

A. $T''+\lambda T=0$

B. $T'+\lambda T=0$

C. $T''=\lambda T$

D. $T'=\lambda T$

Q18: The Laplace transform of e^{at} is:

A. 1/s

B. 1/ s-a

C. 1/ s+a

D. s/ s+a

Q19: The Laplace transform of t^n (where n is a positive integer) is_____

A. $1 / s^{n+1}$

B. $n! / s^{n+1}$

C. $1/s^n$

D. $n! / s^n$

Q20: The Laplace transform of $e^{2t}\sin(3t)$ is:

A. $3/(s-2)^2+9$ B. $3/(s+2)^2+9$

C. $3/(s-3)^2+4$ D. $3/(s-3)^2+9$

Q21: The Fourier series of a periodic function f(x)f with period 2π is generally written as:

A. $a_0+\sum(a_n \cos nx + b_n \sin nx)$ B. $a_0+\sum(a_n \sin nx + b_n \cos nx)$

C. $a_0+\sum(a_n \tan nx + b_n \cot nx)$ D. None of these

Q22: For an even function, which Fourier coefficients are zero

A. a_n B. b_n

C. Both a_n and b_n D. None

Q23: If f(x) is a periodic function of period 2L, its Fourier series involves:

A. Cos(nπx/L) and sin (nπx/L) B. Cos(nx) and sin (nx)

C. Cos(2nx) and sin (2nx) D. None

Q24: Fourier coefficient a_0 in the Fourier series $\frac{a_0}{2}+\sum_{n=1}^{\infty}(a_n\cos nx+b_n\sin nx)$ of $f(x)=e^{-x};\ 0\le x\le 2\pi$ and $f(x+2\pi)=f(x)$ is _____

A. $\frac{1}{\pi}\left(1-e^{-2\pi}\right)$ B. $\frac{1}{2\pi}\left(1-e^{2\pi}\right)$

C. $\frac{2}{\pi}\left(e^{-2\pi}-1\right)$ D. $\frac{1}{\pi}\left(1+e^{2\pi}\right)$

Q25: For Half range cosine series of $f(x)=\sin x,\ \ 0\le x\le \pi$ and period is 2π. Fourier series is represented by $\frac{a_0}{2}+\sum_{n=1}^{\infty}a_n\cos nx$, then Fourier coefficient a_0 is_____

A. 4

B. 2

C. $\frac{2}{\pi}$

D. $\frac{4}{\pi}$

Q26: If the Laplace transform of function f(t) is given by s+3/(s+1)(s+2), then f(0) is

A. 32

B. 12

C. 0

D. 1

Q27: Laplace transform of function f(t)=1.5sin(3t-π/2) is

A. $1.5/(s^2+9)$

B. $1.5s/(s^2+9)$

C. **$-1.5s/(s^2+9)$**

D. $s-1.5s/(s^2+9)$

Q28: If $f(x)=\sqrt{2}\sin\frac{x}{2}$ and f(x + 2π) = f(x). Fourier series of f(x) is represented by $\frac{a_0}{2}+\sum(a_n\cos nx+b_n\sin nx)$ then a_0 is_____

A. $\frac{4\sqrt{2}}{\pi}$

B. $\frac{2\sqrt{2}}{\pi}$

C. $-\frac{4\sqrt{2}}{\pi}$

D. $\frac{4\sqrt{3}}{\pi^2}$

Q29: The Fourier series of f(x) = cos(x) is:

A. Only cosine terms

B. Only sine terms

C. Exponential form

D. No terms

Q30: Find the general solution of: $\partial u/\partial x = 3y$

A. u=3yx+f(y)

B. u=3xy+g(x)

C. u=3y+g(x)

D. u=3xy

Good Luck

Examination Committee

Name of Class: Philosophy of Doctor

Subject: Advanced Process Control

Q1/ The state space modeling is used for following systems:

a) Multivariable systems
b) Linear systems
c) Nonlinear system
d) All of the above

Q2/ The system is controllability if the of controllability matrix is:

a) Non-singular
b) Singular
c) Contains dependent column vector
d) None of the above

Q3/ The advantages of decentralized control system are:

a) Use a simple algorithm
b) Easy to understand by operators
c) Use standard control design
d) All of the above

Q4/ The elements of the relative gain array across any row or down any column sum up to:

a) 1
b) 0
c) -1
d) 2

Q5/ The interaction between input and output variables is existing if the relative gain (λ) is:

a) $\lambda = 0$
b) $0 < \lambda < 1$
c) $\lambda = 1$
d) $\lambda = -1$

Q6/ The inner loop in the cascade control method is called:

a) Secondary loop
b) Primary loop
c) Master loop
d) None of the above

1)In fully developed laminar pipe flow, velocity profile is:

A) Uniform
B) Parabolic
C) Linear
D) Constant

2)The mass per unit volume of a fluid is called:

A) Viscosity
B) Density
C) Surface tension
D) Pressure

3)For flow in a pipe, if Reynolds number is 6000, the flow is:

A) Laminar
B) Transitional
C) Turbulent
D) Static

4)In turbulent flow, eddies are:

A) Absent
B) Large and slow
C) Irregular and chaotic
D) Small and regular

5)In an orifice meter, coefficient of discharge is typically around:

A) 0.1
B) 0.2
C) 0.6
D) 1.0

6)The main advantage of a venturi meter is:

A) Cheaper
B) High energy loss
C) Low energy loss
D) Complex construction

7)Discharge measured by an orifice meter is:

A) Directly measured
B) Calculated from pressure drop
C) Measured from area
D) Measured from velocity

8)In a venturi meter, pressure is lowest at:

A) Inlet
B) Throat
C) Outlet
D) Everywhere same

9)The friction factor in laminar flow in a circular pipe is:

A) Re/64
B) 20/Re
C) 64/Re
D) 1/Re

10)In turbulent pipe flow, head loss varies approximately with:

A) Flow rate (Q)
B) Q^2
C) $\sqrt{Q}$
D) 1/Q

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11) Benzene at 20°C has a viscosity of 0.000651 Pa s. What shear stress is required to deform this fluid at a strain rate of 4900 s^{-1}?

A) 3.19 Pa
B) 4.19 Pa
C) 1.19 Pa
D) 0.19 Pa

12) SAE 30 oil at 20°C is sheared between two parallel plates 0.005 in apart with the lower plate fixed and the upper plate moving at 13 ft/s. Compute the shear stress in the oil.

A) 250 lb/ft^2
B) 365 lb/ft^2

C) 287 lb/ft²
D) 155 lb/ft²

13) A 35-cm-by-55-cm block slides on oil (μ = 0.81 Pa s) over a large plane surface. What force is required to drag the block at 3 m/s, if the separating oil film is 0.6 mm thick?

A) 680 N
B) 700 N
C) 740 N
D) 780 N

14) The surface tensions of mercury and water at 60 °C are 0.47 N/m and 0.0662 N/m, respectively. What capillary-height changes will occur in the mercury fluid when it is in contact with air in a glass tube of radius 0.30 mm? Use ɵ = 130° ; γ = 132.3 kN/m³ for mercury.

A) 0 m
B) -1.0152 m
C) -0.0152 m
D)-0.052 m

15) The surface tensions of mercury and water at 60 °C are 0.47 N/m and 0.0662 N/m, respectively. What capillary-height changes will occur in water when it is in contact with air in a glass tube of radius 0.30 mm? Use ɵ = 0° , γ = 9.650 kN/m³.

A) 0.045 m
B) 0.055 m
C) 0.065 m
D) 0.075 m

16) An open tank contains 5.7 m of water (γ =9.79 kN/m³) covered with 2.8 m of kerosene (γ = 8.0 kN/m³). Find the pressure at the interface.

A) 20.4 kPa
B) 22.4 kPa
C) 24.4 kPa
D) 26.4 kPa

17) An open tank contains 5.7 m of water (γ =9.79 kN/m³) covered with 2.8 m of kerosene (γ = 8.0 kN/m³). Find the pressure at the bottom of the tank.

A) 68.2 kPa
B) 78.2 kPa
C) 88.2 kPa
D) 98.2 kPa

18) What is the Reynolds number for a flow of oil (ρ= 1.55 Ib/ ft^3, μ = 0.00200 lb s/ft²) in a 6-in-diameter pipe at a flow rate of 10 ft^3/s?

A) 15554
B) 44001
C) 12110
D) 19749

19) Calculate the specific weight of a liquid having a volume of 6 m^3 and weight of 44 kN.

A) 7.333 kN/m^3
B) 6.224 kN/m^3
C) 7.999 kN/m^3
D) 4.235 kN/m^3

20) A soap bubble 62.5 mm diameter has an internal pressure in excess of the outside pressure of 20 N/m . What is tension in the soap film?

A) 0.055 N/m
B) 1.002 N/m
C) 0.156 N/m
D) 0.334 N/m

21) What do you mean by surface tension? If the pressure difference between the inside and outside of the air bubble of diameter 0.01 mm is 29.2 kPa, what will be the surface tension at air-water interface?

A) 0.073 N/m

B) 1.002 N/m

C) 0.156 N/m

D) 0.334 N/m

22) Determine the minimum size of glass tubing that can be used to measure water level, if the capillary rise in the tube is not to exceed 0.3 mm. Take surface tension of water in contact with air as 0.0735 N/m.

A) 50 mm

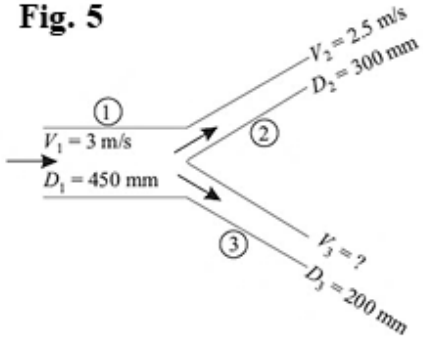
B) 100 mm

C) 150 mm

D) 200 mm

23) In Fig. 5.15, calculate V_3?

Fig. 5



A) 9.55 m/s

B) 9.01 m/s

C) 9.9 m/s

D) 9.11 m/s

24) In a pipe of 90 mm diameter water is flowing with a mean velocity of 2 m/s and at a gauge pressure of 350 kN/m^2. Determine the total head, if the pipe is 8 metres above the datum line. Neglect friction.

A) 10.2 m

B) 25.38 m

C) 31.55 m
D) 43.88 m

25) Determine the difference in datum head (z_2 - z_1) for the pipe in Fig. 6, if the rate of flow through the pipe is 60 litres/sec.

A) 25.47 m
B) 32.24 m
C) 12.12 m
D) 5.11 m

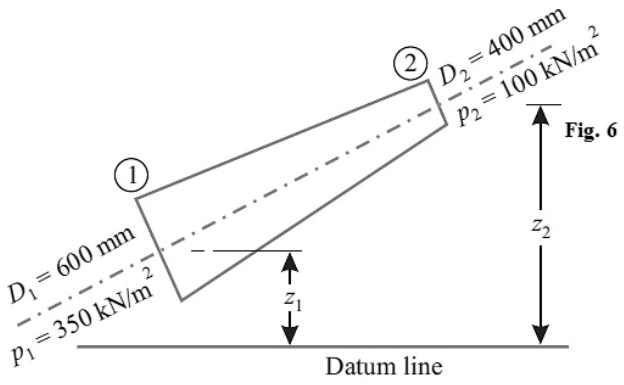


Fig. 6

26) In a smooth inclined pipe of uniform diameter 250 mm, a pressure of 50 kPa was observed at section 1 which was at elevation 10 m. At another section 2 at elevation 12 m, the pressure was 20 kPa and the velocity was 1.25 m/s. Determine the direction of flow and the head loss between these two sections. The fluid in the pipe is water. The density of water at 20°C and 760 mm Hg is 998 kg/m^3.

A) E_1-E_2= 2.001 m
B) E_1-E_2= 1.222 m
C) E_1-E_2= 1.065 m
D) E_1-E_2= 1.001 m

27) An orifice 50mm in diameter is discharging water under a head of 10 meters. If C_d = 0.6 and C_v = 0.97, find the actual discharge of the jet at vena contract.

A) 0.01649 m^3/s
B) 0.1120 m^3/s
C) 0.1556 m^3/s
D) 0.0225 m^3/s

28) An orifice 50mm in diameter is discharging water under a head of 10 meters. If C_d = 0.6 and C_v = 0.97, find the actual velocity of the jet at vena contract.

A) 15.22 m/s
B) 13.58 m/s
C) 22.55 m/s
D) 2.111 m/s

29) The head of water over the center of an orifice of diameter 30 mm is 1.5m. The actual discharge through the orifice is 2.55litres/sec. Find the co-efficient of discharge.

A) 0.612
B) 0.668
C) 0.852
D) 0.933

30) Find the discharge through a rectangular orifice 3.0 m wide and 2.0 m deep fitted to a water tank. The water level in the tank is 4·0 m above the top edge of the orifice. Take C_d= 0.62.

A) 36.78 m^3/s
B) 51.12 m^3/s
C) 13.55 m^3/s
D) 24.55 m^3/s