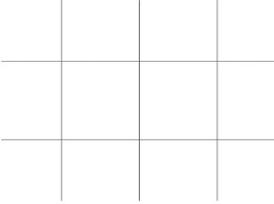




FE 

chemical
practice exam

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About NCEES

NCEES is a nonprofit organization made up of the U.S. engineering and surveying licensing boards in all 50 states, U.S. territories, and the District of Columbia. We develop and score the exams used for engineering and surveying licensure in the United States. NCEES also promotes professional mobility through its services for licensees and its member boards.

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Exam Format

The FE exam contains 110 questions and is administered year-round via computer at approved Pearson VUE test centers. A 6-hour appointment time includes a tutorial, the exam, and a break. You'll have 5 hours and 20 minutes to complete the actual exam.

In addition to traditional multiple-choice questions with one correct answer, the FE exam uses common alternative item types such as

- Multiple correct options—allows multiple choices to be correct
- Point and click—requires examinees to click on part of a graphic to answer
- Drag and drop—requires examinees to click on and drag items to match, sort, rank, or label
- Fill in the blank—provides a space for examinees to enter a response to the question

To familiarize yourself with the format, style, and navigation of a computer-based exam, view the demo on ncees.org/ExamPrep.

Examinee Guide

The *NCEES Examinee Guide* is the official guide to policies and procedures for all NCEES exams. During exam registration and again on exam day, examinees must agree to abide by the conditions in the *Examinee Guide*, which includes the CBT Examinee Rules and Agreement. You can download the *Examinee Guide* at ncees.org/exams. It is your responsibility to make sure you have the current version.

Scoring and reporting

Exam results for computer-based exams are typically available 7–10 days after you take the exam. You will receive an email notification from NCEES with instructions to view your results in your MyNCEES account. All results are reported as pass or fail.

Updates on exam content and procedures

Visit us at ncees.org/exams for updates on everything exam-related, including specifications, exam-day policies, scoring, and corrections to published exam preparation materials. This is also where you will register for the exam and find additional steps you should follow in your state to be approved for the exam.



PRACTICE EXAM

FE CHEMICAL PRACTICE EXAM

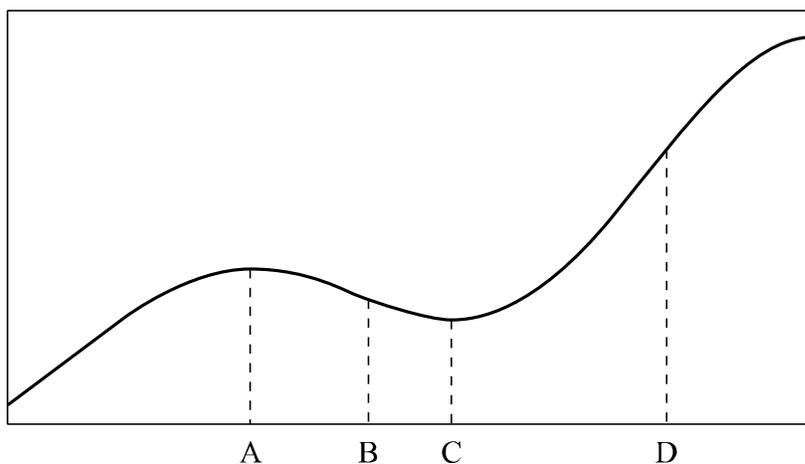
4. A lab technician is preparing a chemical standard and has the following laboratory equipment and glassware.

Volumetric flask	100 ml \pm 0.1 ml
Analytical balance	100 g \pm 0.001 g
Glass pipette	1 ml \pm 0.01 ml

The technician first weighs out 10 g of solids and dissolves them in 100 ml of water. Then the technician dilutes 1 ml of the solution to 100 ml using best laboratory practices. What is the number of significant figures of the molarity of the final solution?

- A. 1
- B. 2
- C. 3
- D. 4

5. Match the curve properties to the correct locations on the curve shown below.



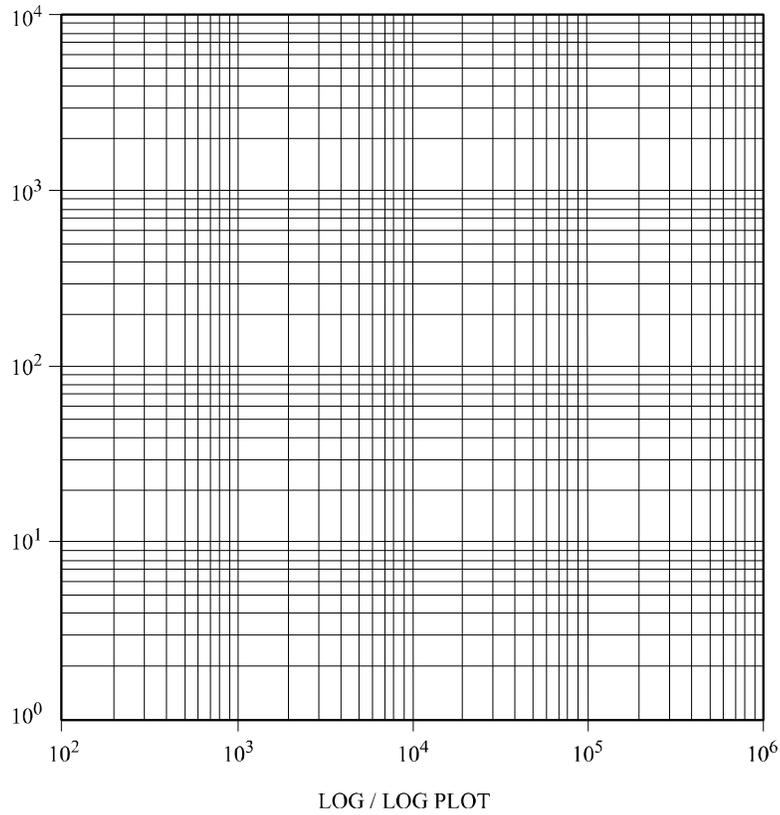
	Points	Properties
A.	<input type="checkbox"/> <input type="checkbox"/>	$f' = 0$
B.	<input type="checkbox"/>	$f'' = 0$
C.	<input type="checkbox"/> <input type="checkbox"/>	$f'' < 0$
D.	<input type="checkbox"/>	$f'' > 0$

FE CHEMICAL PRACTICE EXAM

6. Plot the point on the log/log graph given below:

$$X = 80,000$$

$$Y = 7,000$$

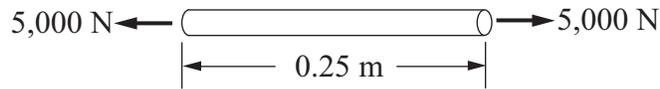


7. You have a fair coin that you toss ten times. The probability of getting exactly four heads in ten tosses is most nearly:

- A. 0.1
- B. 0.2
- C. 0.4
- D. 0.5

FE CHEMICAL PRACTICE EXAM

15. A 0.25-m steel rod with a cross-sectional area of $1,250 \text{ mm}^2$ and a modulus of elasticity E of 200 GPa is subjected to a 5,000-N force as shown below. The elongation of the rod (μm) is most nearly:



- A. 2.4
- B. 4.4
- C. 5.0
- D. 9.6
16. In general, a metal with high hardness will also have which of the following characteristics?
Select **all** that apply.
- A. Good formability
- B. Strong intermolecular bonding
- C. High tensile strength
- D. High yield strength
- E. High oxygen permeability
- F. High abrasion/scratch resistance
17. If an aluminum crimp connector were used to connect a copper wire to a battery, what would most likely happen?
- A. Only the copper wire will corrode.
- B. Only the aluminum connector will corrode.
- C. Both will corrode.
- D. Nothing

FE CHEMICAL PRACTICE EXAM

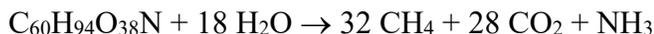
18. Glass is said to be an amorphous material. This means that it:
- A. has a high melting point
 - B. is a supercooled vapor
 - C. has large cubic crystals
 - D. has no apparent crystal structure
19. Five columns—C1, C2, C3, C4, and C5—are labeled below in the Periodic Table of Elements. Select the columns that contain an element that could have either a +3 or –3 charge?

C1													C4					C5	VIII															
I	C2																	III	IV	V	VI	VII	He											
1 H 1.008	II																	5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180											
3 Li 6.94	4 Be 9.0122																	13 Al 26.982	14 Si 28.085	15 P 30.974	16 S 32.06	17 Cl 35.45	18 Ar 39.948											
11 Na 22.990	12 Mg 24.305																	C3																
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.38	31 Ga 69.723	32 Ge 72.630	33 As 74.922	34 Se 78.971	35 Br 79.904	36 Kr 83.798																	
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.95	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29																	
55 Cs 132.91	56 Ba 137.33	57–71	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)																	
87 Fr (223)	88 Ra (226)	89–103	104 Rf (267)	105 Db (268)	106 Sg (269)	107 Bh (270)	108 Hs (277)	109 Mt (278)	110 Ds (281)	111 Rg (282)	112 Cn (285)	113 Nh (286)	114 Fl (289)	115 Mc (290)	116 Lv (293)	117 Ts (294)	118 Og (294)																	

Lanthanide Series	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.05	71 Lu 174.97
Actinide Series	89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (266)

FE CHEMICAL PRACTICE EXAM

24. The balanced equation and molecular weights for reactants and products in the anaerobic digestion of an organic material are as follows:



Compound	MW
$\text{C}_{60}\text{H}_{94}\text{O}_{38}\text{N}$	1,433
H_2O	18
CH_4	16
CO_2	44
NH_3	17

The weight (lb) of methane produced per 2,000 lb of organic material would be most nearly _____.

25. In the production of wine using yeast, grape juice is fermented in special tanks equipped with pressure relief valves. These valves are used to prevent overpressurization from which one of the following yeast reactions?
- A. The yeast produces oxygen gas from aerobic respiration.
 - B. The yeast produces oxygen gas from anaerobic respiration.
 - C. The yeast produces carbon dioxide during fermentation.
 - D. The yeast could produce both carbon dioxide and oxygen during the fermentation process.
26. Water is warmed from 5°C to 25°C. The specific gravity of the water will:
- A. decrease to 0.997
 - B. increase to 1.003
 - C. increase to 1.017
 - D. not change at all

FE CHEMICAL PRACTICE EXAM

62. The dimensionless Sherwood number, sometimes known as the mass transfer Nusselt number, represents the ratio of convective to diffusive mass transfer.

Match the variables below with the relationship required to determine the Sherwood number.

$$\text{Sh} = \frac{[\quad] \times [\quad]}{[\quad]}$$

Variables

Diffusion Coefficient

Pipe Inner Diameter

Overhead Product Rate

Mass-Transfer Coefficient

Molar-Flux Coefficient

Universal Gas Constant

SOLUTIONS

FE CHEMICAL SOLUTIONS

3. Refer to the Numerical Integration section in the Mathematics chapter of the *FE Reference Handbook*.

$$\text{Area} = \frac{0.5}{2} [0^2 + 2(0.5)^2 + 2(1.0)^2 + 2(1.5)^2 + (2)^2] = 2.75$$

THE CORRECT ANSWER IS: B

4. Volume = 100.1 ml, 4 significant figures
Weight = 100.1 g, 4 significant figures
Pipette = 1.001 ml 4 significant figures

THE CORRECT ANSWER IS: D

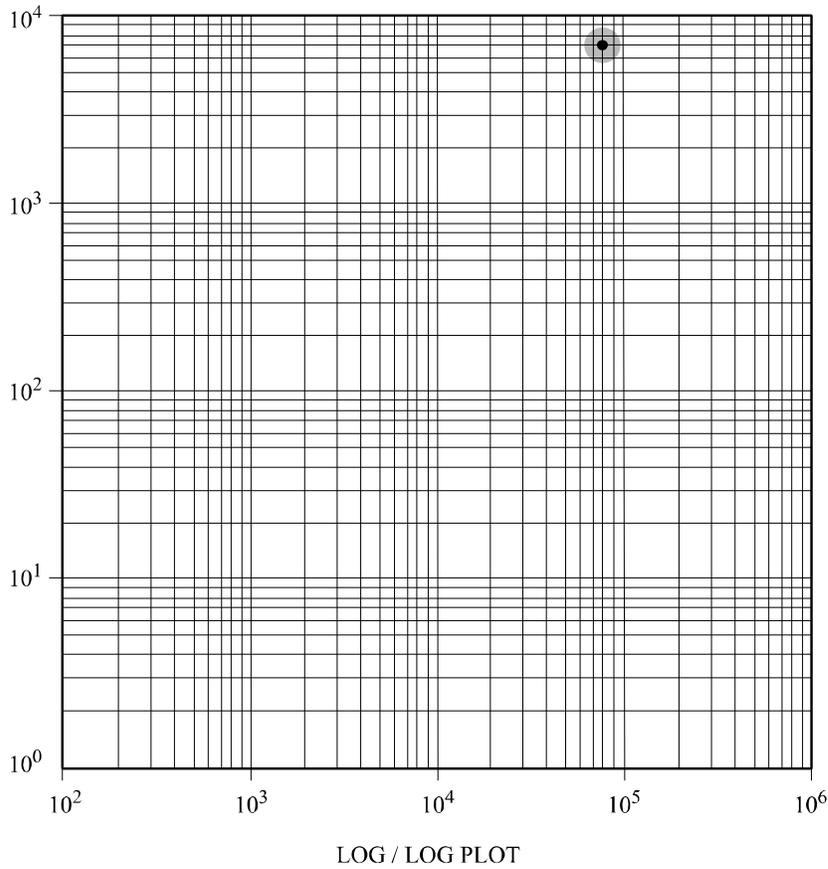
5. Refer to the Differential Calculus section in the Mathematics chapter of the *FE Reference Handbook*.

Point	Location on Curve
$f' = 0$	A, C
$f'' = 0$	B, D
$f'' < 0$	A
$f'' > 0$	C

THE CORRECT ANSWERS ARE SHOWN ABOVE.

FE CHEMICAL SOLUTIONS

6.



THE CORRECT ANSWER IS SHOWN ON THE GRAPH.

7. Refer to the Engineering Probability and Statistics chapter of the *FE Reference Handbook*.

Binomial distribution

$p = 0.5$ (chance of getting a head)

$q = 0.5$ (chance of not getting a head)

$n = 10$ (number of trials)

$x = 4$ (number of heads)

$$P_{10}(4) = \frac{10!}{4!6!} (0.5^4)(0.5^6) = \frac{(10)(9)(8)(7)}{(4)(3)(2)(1)} (0.5)^{10}$$
$$= 0.2051$$

THE CORRECT ANSWER IS: B

FE CHEMICAL SOLUTIONS

14. Refer to the Vectors section in the Mathematics chapter of the *FE Reference Handbook*.

THE CORRECT ANSWER IS: A

15. From the Uniaxial Loading and Deformation section in the Mechanics of Materials chapter of the *FE Reference Handbook*, the uniaxial deformation is:

$$\text{Deformation} = \delta = \frac{PL}{AE} = \frac{(5,000)(0.25)}{(1,250 \times 10^{-6})(200 \times 10^9)} = 5.0 \times 10^{-6} \text{ m} = 5.0 \mu\text{m}$$

THE CORRECT ANSWER IS: C

16. Refer to the Relationship Between Hardness and Tensile Strength section in the Mechanics of Materials chapter of the *FE Reference Handbook*.

By definition, a metal with high hardness has a high tensile and yield strength, as well as strong intermolecular bonding, with high impact, rebound, and scratch resistance strength.

THE CORRECT ANSWERS ARE: B, C, D, AND F

17. Refer to the Corrosion section in the Mechanics of Materials chapter of the *FE Reference Handbook*. Aluminum is anodic relative to copper and therefore will corrode to protect the copper.

THE CORRECT ANSWER IS: B

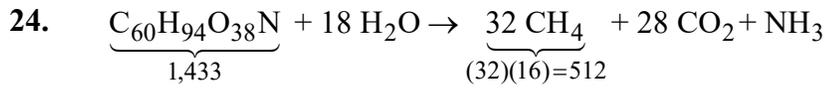
18. Refer to the Amorphous Materials section in the Mechanics of Materials chapter of the *FE Reference Handbook*. By definition, amorphous materials do not have a crystal structure.

THE CORRECT ANSWER IS: D

19. Elements in C3 (iron group) and C4 (boron group) contain elements that could have +3 or -3 charge.

THE CORRECT ANSWERS ARE: C3, C4

FE CHEMICAL SOLUTIONS



$$CH_4 \text{ pounds} = 2,000 \text{ pounds} \left(\frac{512}{1,433} \right) = 714 - 715 \text{ pounds}$$

THE CORRECT ANSWER IS: 714–715

25. The yeast produces alcohol during grape juice fermentation and releases carbon dioxide. The pressure release valves prevent overpressurization of the tanks.

THE CORRECT ANSWER IS: C

26. Refer to specific volumes on the steam tables in the *FE Reference Handbook*.

Density at 25°C is $1/0.001003 = 997$.
Density at 5°C is $1/0.001000 = 1,000$.
 $997/1,000 = 0.997$

THE CORRECT ANSWER IS: A

27. Refer to the Fluid Flow Characterization section in the Fluid Mechanics section of the *FE Reference Handbook*.

$$Re = vD/\nu = (0.52 \text{ m/s}) \times (1.25 \text{ cm}) / (0.000001306 \text{ m}^2/\text{s}) (100 \text{ cm/m}) = 4,977 \text{ or } \sim 5,000$$

ν = kinematic viscosity, which for water at 10°C is $0.000001306 \text{ m}^2/\text{s}$, as shown on the Properties of Water table (SI) in the Fluid Mechanics chapter of the *FE Reference Handbook*.

The Reynolds number for this water flow is $\sim 5,000$, which would be considered transitional flow.

$Re < 2,100$ is laminar; $2,100 < Re < 10,000$ is transitional; and $Re > 10,000$ is turbulent.

THE CORRECT ANSWER IS: B

FE CHEMICAL SOLUTIONS

39. Refer to the Steady-Flow Systems section in the Thermodynamics chapter of the *FE Reference Handbook*.

Flow through an insulated valve closely follows a throttling process. A throttling process is at constant enthalpy.

THE CORRECT ANSWER IS: B

40. Refer to the Thermodynamics chapter of the *FE Reference Handbook*. The definition of relative humidity is $\phi = P_v/P_g = \text{vapor pressure/saturation pressure}$

THE CORRECT ANSWER IS: B

FE CHEMICAL SOLUTIONS

57. Refer to the Transient Conduction Using Lumped Capacitance Model section in the Heat Transfer chapter of the *FE Reference Handbook*.

$$\begin{aligned}\dot{Q} &= \dot{m}C_p\Delta T \\ &= 7,500 \frac{\text{kg}}{\text{min}} \times 1.007 \frac{\text{kJ}}{\text{kg}\cdot\text{K}} \times (90 - 10) \text{ K} \times 1,000 \frac{\text{J}}{\text{kJ}} \times \frac{\text{min}}{60 \text{ sec}} \\ &= 1.01 \times 10^7 \text{ W}\end{aligned}$$

THE CORRECT ANSWER IS: A

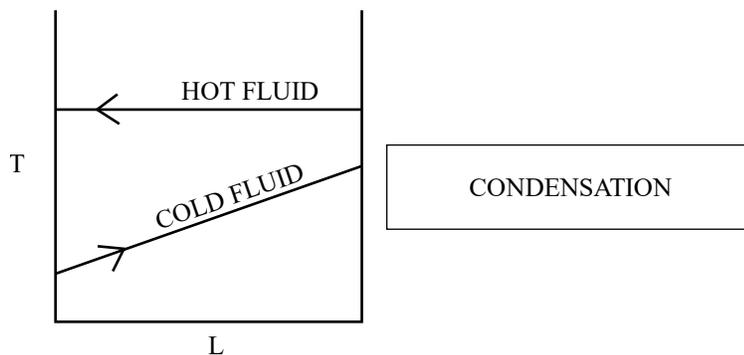
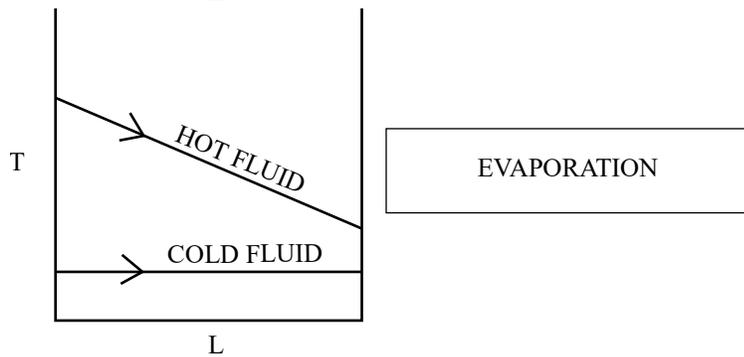
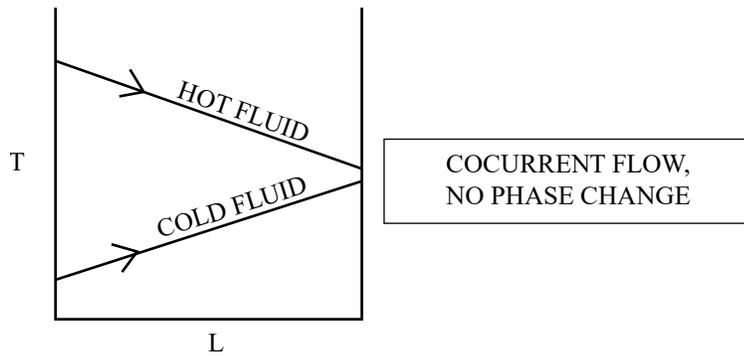
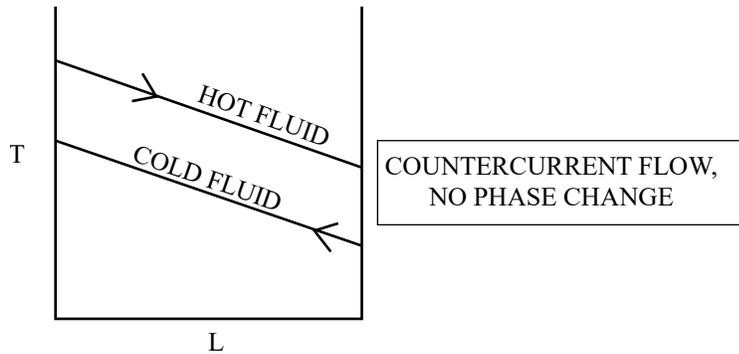
58. Refer to the Noncircular Ducts section in the Heat Transfer chapter of the *FE Reference Handbook*.

$$\begin{aligned}D_H &= \frac{4A}{P} = \frac{(4)(a)(b)}{2a + 2b} = \frac{2ab}{a + b} \\ D_H &= \frac{(2)(10 \text{ mm})(4 \text{ mm})}{10 \text{ mm} + 4 \text{ mm}} = \frac{80 \text{ mm}^2}{14 \text{ mm}} = 5.7 \text{ mm}\end{aligned}$$

THE CORRECT ANSWER IS: A

FE CHEMICAL SOLUTIONS

59. TEMPERATURE PROFILES



FE CHEMICAL SOLUTIONS

62. The Dimensionless Group equation (Sherwood) is given in the Chemical Engineering chapter of the *FE Reference Handbook*.

$$[\text{Sh}] = [] = \frac{[k][L]}{D} = \frac{[k][L]}{[L^2/t]} = \frac{[k]}{[L/t]}$$

$$[k] = [] [L/t] = [L/t] = [\text{Linear Velocity}]$$

$$\text{Sh} = \frac{[\text{Mass-Transfer Coefficient}] \times [\text{Pipe Inner Diameter}]}{[\text{Diffusion Coefficient}]}$$

Or

$$\text{Sh} = \frac{[\text{Pipe Inner Diameter}] \times [\text{Mass-Transfer Coefficient}]}{[\text{Diffusion Coefficient}]}$$

THE CORRECT ANSWERS ARE SHOWN ABOVE.

63. Refer to the Vapor-Liquid Equilibrium (VLE) Diagram in the Chemical Engineering chapter of the *FE Reference Handbook*.

8 trays + reboiler (from McCabe-Thiele diagram)

THE CORRECT ANSWER IS: C

64. Refer to the distillation unit diagram in the Murphree Plate Efficiency section in the Chemical Engineering chapter of the *FE Reference Handbook*.

Feed = bottoms + distillate = 100 kg/hr

From diagram, mole fraction of A in the feed is 47%.

Balance on A gives

$$47 = 0.97 D + 0.04 B$$

since $B = 100 - D$

$$\text{then } D = \frac{43}{93} = 46.2$$

$$\text{and } B = 100 - 46.2 = 53.8$$

THE CORRECT ANSWER IS: C