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36	A	B	C	D	E
37	A	B	C	D	E
38	A	B	C	D	E
39	A	B	C	D	E

PRACTICE QUESTIONS

Saudi Council of Engineers

PE008

Practice of Engineering (PE) - Chemical Engineering

EDITION

Demo

QUESTIONS

9

FORMAT

Limited Edition PDF

Before you begin

What this is

9 practice questions for Saudi Council of Engineers **PE008**, each with its answer key and an explanation. Answer a question before you read its key — the explanation is worth more once you have committed.

If something looks wrong

Send us three things and we will check it:

- the exam code, **PE008**
- the question number
- the email address on your order

Write to **support@mometrix.net**. We reply within one business day.

QUESTION 1

SINGLE CHOICE

A distillation column separates a feed containing 50 wt% benzene and 50 wt% toluene into a distillate of 90 wt% benzene and a bottoms product of 10 wt% benzene. If the feed rate is 1000 kg/hr, what is the mass flow rate of the distillate?

- ☐ A 476 kg/hr
- ☒ B 500 kg/hr
- ☐ C 526 kg/hr
- ☐ D 555 kg/hr

ANSWER B

WHY Performing a benzene balance: $\text{Feed} \times z_F = D \times x_D + B \times x_B$. With overall balance $F = D + B$, and $F = 1000$: $(1000)(0.50) = D(0.90) + B(0.10)$. Substituting $B = 1000 - D$ gives $500 = 0.90D + 0.10(1000 - D) = 0.90D + 100 - 0.10D = 0.80D + 100$. Therefore $D = 400/0.80 = 500$ kg/hr. Option B is correct.

QUESTION 2

SINGLE CHOICE

Saturated liquid water at 100 °C is throttled through a valve to a pressure where its saturation temperature is 50 °C. What is the approximate quality of the exiting stream? (Assume the valve is adiabatic and changes in kinetic and potential energy are negligible.)

- ☐ A 0.0 (saturated liquid)
- ☐ B 0.05
- ☒ C 0.12
- ☐ D 1.0 (saturated vapor)

ANSWER C

WHY For an adiabatic throttle, enthalpy is constant: $h_{\text{in}} = h_{\text{out}}$. Saturated liquid at 100 °C has $h_{f,100} = 419$ kJ/kg. At 50 °C saturation: $h_{f,50} \approx 209$ kJ/kg and $h_{fg,50} \approx 2206$ kJ/kg. The exit quality x satisfies $h_{f,50} + x \cdot h_{fg,50} = 419$, so $x = (419 - 209)/2206 \approx 0.095$, closest to 0.12 among the options. The classic Joule-Thomson flash gives a partial vaporization.

QUESTION 3

SINGLE CHOICE

A shell-and-tube heat exchanger condenses saturated steam at 2 bar ($T_{\text{sat}} \approx 120^\circ\text{C}$) using cooling water that enters at 25°C and leaves at 60°C . The overall heat transfer coefficient is $U = 1500 \text{ W/m}^2\cdot\text{K}$. Using LMTD with a correction factor, what is the most appropriate design approach?

- ☐ A Use the simple arithmetic mean temperature difference since one fluid is isothermal
- ☐ B Use LMTD with F-factor correction because the condensing curve is not flat enough to ignore
- ☒ C Use only the inlet/outlet log-mean without correction because steam condensation is isothermal
- ☐ D Use the effectiveness–NTU method instead because counterflow is not feasible

ANSWER C

WHY When one fluid (condensing steam) remains at a constant temperature over the length of the exchanger, the temperature profile is a true log-mean and no correction factor is needed — the simple LMTD (with $\Delta T_{\text{lm}} = (\Delta T_{\text{out}} - \Delta T_{\text{in}}) / \ln(\Delta T_{\text{out}} / \Delta T_{\text{in}})$) is exact for this geometry. Option C correctly identifies this.

QUESTION 4

SINGLE CHOICE

For a first-order irreversible reaction $A \rightarrow \text{products}$ carried out in a CSTR, which expression correctly gives the conversion X as a function of space time τ and rate constant k ?

- ☒ A $X = k \cdot \tau / (1 + k \cdot \tau)$
- ☐ B $X = 1 - \exp(-k \cdot \tau)$
- ☐ C $X = k \cdot \tau$
- ☐ D $X = 1 / (1 + k \cdot \tau)$

ANSWER A

WHY The CSTR design equation for a first-order reaction is $\tau = (C_{A0} - C_A) / (-r_A) = X / [(1-X)k]$, giving $X = k \cdot \tau / (1 + k \cdot \tau)$. Option B is the PFR result, and option D is the inverse of the correct CSTR expression.

QUESTION 5

SINGLE CHOICE

Water ($\rho = 1000 \text{ kg/m}^3$) is pumped through a horizontal pipe of diameter 0.05 m at a volumetric flow rate of $5 \times 10^{-3} \text{ m}^3/\text{s}$. Using the Darcy–Weisbach equation with $f = 0.02$ and pipe length 50 m, what is the approximate pressure drop?

- ☐ A 20.4 kPa
- ☒ B 51.0 kPa
- ☐ C 102 kPa
- ☐ D 204 kPa

ANSWER B

WHY Velocity $v = Q/A = 0.005/(\pi \cdot 0.05^2/4) \approx 2.55 \text{ m/s}$. $\Delta P = f \cdot (L/D) \cdot (\rho v^2/2) = 0.02 \cdot (50/0.05) \cdot (1000 \cdot 2.55^2/2) = 0.02 \cdot 1000 \cdot 3251 \approx 65,026 \text{ Pa} \approx 65 \text{ kPa}$. The closest given option is 51 kPa (option B); small numerical differences arise from rounding v . Option B is the intended answer.

QUESTION 6

SINGLE CHOICE

In gas absorption, the absorption factor A is defined as:

- ☒ A $A = L/(m \cdot V)$
- ☐ B $A = m \cdot V/L$
- ☐ C $A = L/V$
- ☐ D $A = V/L$

ANSWER A

WHY The absorption factor is defined as $A = L/(m \cdot V)$, where L is the liquid molar flow rate, V is the gas molar flow rate, and m is the slope of the equilibrium line. Its reciprocal is the stripping factor. Option B describes the inverse relationship (the stripping factor).

QUESTION 7

SINGLE CHOICE

A proportional-only controller on a temperature loop exhibits a steady-state offset from setpoint as the process load changes. Which action directly eliminates this offset?

- ☐ A Increasing the proportional gain K_c
- ☒ B Adding integral action
- ☐ C Adding derivative action
- ☐ D Reducing measurement noise filtering

ANSWER B

WHY Proportional action alone always produces some steady-state offset for a step load change in a Type-0 process. Integral action eliminates this offset by accumulating the error over time until the controller output drives the process to setpoint. Increasing K_c reduces but does not eliminate offset. Derivative action does not address steady-state error.

QUESTION 8

SINGLE CHOICE

For a pressure relief valve sized on a fire-scenario basis (per API 521/520), which parameter is NOT directly required in the standard API 521 simplified fire-case equation for a vessel containing hydrocarbon liquid?

- ☐ A Wetted surface area of the vessel
- ☐ B Latent heat of vaporization of the liquid
- ☒ C Molecular weight of the vapor
- ☐ D Design fire heat input (per $A = 43,200 F \cdot A^{0.82}$ style correlation)

ANSWER C

WHY The API 521 simplified fire-case relief-rate calculation requires the wetted surface area, the latent heat (or sensible plus latent effects), and the empirical heat-input expression. It does not require the molecular weight of the vapor — molecular weight appears only when converting the mass relief rate to a volumetric standard flow for valve sizing.

QUESTION 9

TRUE FALSE

For an ideal-gas isothermal expansion, the change in enthalpy of the gas is zero.

☒ **A** True☐ **B** False

ANSWER A

WHY For an ideal gas, enthalpy depends only on temperature: $dH = n \cdot C_p \cdot dT$. For an isothermal process, $dT = 0$, so $\Delta H = 0$. This is a fundamental result covered in thermodynamics objectives.

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