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

PRACTICE QUESTIONS

Saudi Council of Engineers

PE004

Practice of Engineering (PE) - Water Resources Environment

EDITION

Demo

QUESTIONS

9

FORMAT

Limited Edition PDF

Before you begin

What this is

9 practice questions for Saudi Council of Engineers **PE004**, 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, **PE004**
- 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 catchment has an area of 50 km². A storm produces a uniform rainfall excess of 20 mm over a duration of 2 hours. Using the Rational Method with a runoff coefficient $C = 0.5$, what is the peak discharge (m³/s)?

- ☒ A 69.4 m³/s
- ☐ B 138.9 m³/s
- ☐ C 250.0 m³/s
- ☐ D 555.6 m³/s

ANSWER **A**

WHY The Rational Method formula is $Q = CiA/3.6$, where C is dimensionless, i is rainfall intensity in mm/hr, and A is area in km², giving Q in m³/s. With $C = 0.5$, $i = 20 \text{ mm} / 2 \text{ hr} = 10 \text{ mm/hr}$, and $A = 50 \text{ km}^2$: $Q = (0.5 \times 10 \times 50) / 3.6 = 250 / 3.6 \approx 69.44 \text{ m}^3/\text{s}$. Option A is correct.

QUESTION 2

SINGLE CHOICE

Water flows at a depth of 2 m in a wide rectangular channel with a Manning's roughness coefficient $n = 0.025$ and a bed slope of 0.001. What is the average velocity of flow using Manning's equation?

- ☐ A 0.89 m/s
- ☐ B 1.26 m/s
- ☒ C 1.99 m/s
- ☐ D 2.52 m/s

ANSWER **C**

WHY For a wide rectangular channel, the hydraulic radius $R \approx \text{depth } y = 2 \text{ m}$. Manning's equation: $V = (1/n) R^{2/3} S^{1/2} = (1/0.025) \times (2)^{2/3} \times (0.001)^{1/2}$. Computing: $(2)^{2/3} \approx 1.587$, $(0.001)^{1/2} = 0.0316$, so $V = 40 \times 1.587 \times 0.0316 \approx 2.00 \text{ m/s}$. Option C is correct.

QUESTION 3

SINGLE CHOICE

In the activated sludge process, which operating parameter is most directly controlled to maintain the proper balance between substrate availability and microbial population?

- ☒ **A Food-to-Microorganism ratio (F/M)**
- ☐ B Dissolved oxygen saturation concentration
- ☐ C Influent pH only
- ☐ D Effluent turbidity

ANSWER A

WHY The Food-to-Microorganism (F/M) ratio is the primary operating parameter used to control the metabolic state and treatment efficiency of the activated sludge process. It directly reflects the balance between substrate (food) loading and the biomass concentration. Dissolved oxygen is controlled but is a consequence/means rather than the direct balance parameter; pH and effluent turbidity are not the primary balancing parameters.

QUESTION 4

SINGLE CHOICE

A water distribution network is analyzed using the Hardy-Cross method. The method requires which of the following conditions to be satisfied at each loop?

- ☒ **A The algebraic sum of head losses around the loop equals zero, assuming a sign convention based on flow direction**
- ☐ B The sum of pipe diameters in each loop equals the sum of pipe lengths
- ☐ C The pressure at each node is equal to the elevation plus atmospheric pressure
- ☐ D All pipes in the loop must have the same Hazen-Williams coefficient

ANSWER A

WHY The Hardy-Cross iterative method balances flows in a pipe network by ensuring that the algebraic sum of head losses around each closed loop equals zero — using a consistent sign convention where clockwise and counterclockwise flows carry opposite signs. The other statements are not part of the Hardy-Cross assumptions.

QUESTION 5

SINGLE CHOICE

Which of the following assumptions is fundamental to the derivation of the Dupuit-Forchheimer equation for unconfined aquifer flow?

- ☒ **A** Flow lines are horizontal and equipotential lines are vertical, with hydraulic gradient equal to the slope of the water table
- ☐ **B** The aquifer is isotropic but the flow is strictly three-dimensional
- ☐ **C** The water table is strictly horizontal with no gradient at any point
- ☐ **D** Darcy's law is invalid within the saturated zone

ANSWER A

WHY The Dupuit-Forchheimer assumptions for unconfined flow are: (1) hydraulic gradient equals the slope of the free water table, (2) flow lines are horizontal and equipotentials are vertical, and (3) the aquifer is homogeneous and isotropic. These simplify the Laplace equation and yield the standard unconfined flow equations.

QUESTION 6

SINGLE CHOICE

In a rectangular channel, critical depth occurs when the specific energy is at its minimum value for a given discharge. Which of the following expressions correctly gives the critical depth y_c for a rectangular channel carrying discharge Q per unit width q ?

- ☒ **A** $y_c = (q^2/g)^{1/3}$
- ☐ **B** $y_c = q^2/g$
- ☐ **C** $y_c = (q/g)^{1/2}$
- ☐ **D** $y_c = g/q^2$

ANSWER A

WHY For a rectangular channel, critical depth is obtained from the condition Froude number = 1, giving $y_c = (q^2/g)^{1/3}$, where q is the discharge per unit width. This is the standard result used in open-channel hydraulics.

QUESTION 7

SINGLE CHOICE

In primary wastewater treatment, the typical removal efficiency for total suspended solids (TSS) and biochemical oxygen demand (BOD) in a well-designed primary clarifier is approximately:

- ☒ **A** 50–70% TSS and 25–40% BOD
- ☐ **B** 90–95% TSS and 85–95% BOD
- ☐ **C** 10–20% TSS and 5–10% BOD
- ☐ **D** 100% TSS and 100% BOD

ANSWER A

WHY A well-designed primary clarifier typically removes 50–70% of total suspended solids and 25–40% of biochemical oxygen demand through plain sedimentation. Higher removals (90%+) require secondary biological treatment; minimal removals indicate an underperforming clarifier.

QUESTION 8

SINGLE CHOICE

The biochemical oxygen demand (BOD) test is conducted by incubating a diluted sample at a specified temperature for a standard duration. The standard conditions used in the BOD5 test are:

- ☒ **A** 20°C for 5 days in the dark
- ☐ **B** 25°C for 3 days in the light
- ☐ **C** 30°C for 7 days in the dark
- ☐ **D** 15°C for 10 days in the light

ANSWER A

WHY The standard BOD5 test incubates the diluted sample at 20°C for 5 days in the dark to prevent photosynthetic oxygen production. These standardized conditions allow comparison of results across laboratories and are the basis for typical BOD5 reporting.

QUESTION 9

SINGLE CHOICE

A drainage catchment with a time of concentration of 30 minutes receives rainfall at an intensity of 50 mm/hr for the first 15 minutes and 25 mm/hr for the next 15 minutes. What is the average rainfall intensity used in the rational method?

- ☐ A 25.0 mm/hr
- ☒ B 37.5 mm/hr
- ☐ C 50.0 mm/hr
- ☐ D 42.5 mm/hr

ANSWER B

WHY The rational method uses the average rainfall intensity over a duration equal to or greater than the time of concentration. The total rainfall depth is $(50 \times 0.25) + (25 \times 0.25) = 12.5 + 6.25 = 18.75$ mm over a 30-minute duration (0.5 hr). The average intensity is $18.75 / 0.5 = 37.5$ mm/hr.