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# **NCEES PE-Civil-WRE**

**1227 PE Civil Water Resources and Environmental**



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## Question: 1

An environmental engineer is assessing the impact of a sewage treatment plant on a nearby stream. If the plant discharges effluent with a biochemical oxygen demand (BOD) of 200 mg/L and the stream's flow is 3 m<sup>3</sup>/s, what is the total BOD load entering the stream from the plant in kilograms per day?

- A. 51,840 kg/day
- B. 21,880 kg/day
- C. 45,320 kg/day
- D. 65,000 kg/day

**Answer: A**

Explanation:

The BOD load can be calculated as:

$$\text{BOD Load} = \text{Concentration} \times \text{Flow Rate} \times \text{Time}$$

Convert mg/L to kg/m<sup>3</sup>:

$$\text{Concentration} = 200 \text{ mg/L} = 0.2 \text{ kg/m}^3$$

Thus,

$$\text{BOD Load} = 0.2 \text{ kg/m}^3 \times 3 \text{ m}^3/\text{s} \times 86,400 \text{ s} = 51,840 \text{ kg/day}$$

## Question: 2

A groundwater engineer is evaluating the effects of a contaminant plume in a confined aquifer. If the hydraulic conductivity is 20 m/day and the contaminant concentration decreases from 1,000 µg/L to 100 µg/L over a distance of 50 m, what is the attenuation factor?

- A. 0.1
- B. 0.5
- C. 0.7
- D. 10.0

**Answer: D**

Explanation:

The attenuation factor is calculated as:

$$\text{Attenuation Factor} = \frac{C_1}{C_2} = \frac{1000 \mu\text{g/L}}{100 \mu\text{g/L}} = 10$$

### Question: 3

A civil engineer is assessing the effect of urban runoff on a stream's DO levels. If the stream's DO was 8 mg/L before the runoff event and dropped to 5 mg/L after, what is the percentage change in DO?

- A. 20%
- B. 25%
- C. 37%
- D. 35%

**Answer: C**

Explanation:

The percentage change in DO is calculated as:

$$\text{Percentage Change} = \frac{\text{Initial DO} - \text{Final DO}}{\text{Initial DO}} \times 100$$

Thus,

$$\text{Percentage Change} = \frac{8 - 5}{8} \times 100 = 37.5\%$$

### Question: 4

An environmental scientist is evaluating the impact of nutrients on a lake's water quality. If the lake has a volume of 1,000,000 m<sup>3</sup> and the total phosphorus concentration is 0.2 mg/L, what is the total phosphorus load in kilograms?

- A. 0.2 kg
- B. 2 kg
- C. 20 kg
- D. 200 kg

**Answer: D**

Explanation:

The total phosphorus load can be calculated as:

$$\text{Load} = \text{Concentration} \times \text{Volume}$$

Convert concentration to  $\text{kg/m}^3$ :

$$\text{Concentration} = 0.2 \text{ mg/L} = 0.0002 \text{ kg/m}^3$$

Thus,

$$\text{Load} = 0.0002 \text{ kg/m}^3 \times 1,000,000 \text{ m}^3 = 200 \text{ kg}$$

### Question: 5

A groundwater model indicates that a well is experiencing a drawdown of 5 m after 12 hours of continuous pumping. If the well has a radius of 0.1 m and the aquifer has a hydraulic conductivity of 10 m/day, what is the estimated specific yield of the aquifer?

- A. 0.01
- B. 0.05
- C. 0.1
- D. 0.15

**Answer: B**

Explanation:

The specific yield can be calculated using the relationship:

$$\text{Specific Yield} = \frac{\text{Drawdown}}{\text{Time}} \times \frac{1}{\text{Hydraulic Conductivity}}$$

Thus,

$$\text{Specific Yield} = \frac{5 \text{ m}}{12 \times 3600 \text{ s}} \times \frac{1}{10 \text{ m/day}} = 0.05$$

### Question: 6

A hydrogeologist is evaluating a confined aquifer that has a hydraulic conductivity of 25 m/day and a thickness of 30 m. If the aquifer is being recharged at a rate of 0.1 m/year, what is the estimated sustainable yield of the aquifer over an area of 2 hectares?

- A. 2000  $\text{m}^3/\text{yr}$
- B. 1500  $\text{m}^3/\text{yr}$
- C. 1600  $\text{m}^3/\text{yr}$
- D. 1700  $\text{m}^3/\text{yr}$

**Answer: A**

Explanation:

$$\text{Sustainable Yield} = \text{Recharge Rate} \times \text{Area}$$

Convert the recharge rate to meters:

$$\text{Recharge Rate} = 0.1 \text{ m/yr}$$

Convert area to square meters:

$$\text{Area} = 2 \text{ hectares} = 20,000 \text{ m}^2$$

Thus,

$$\text{Sustainable Yield} = 0.1 \text{ m/yr} \times 20,000 \text{ m}^2 = 2,000 \text{ m}^3/\text{yr}$$

### Question: 7

An engineer is analyzing groundwater flow through a heterogeneous aquifer. The hydraulic gradient in one section of the aquifer is measured at 0.03, and the hydraulic conductivity is 12 m/day. What is the groundwater flow velocity in that section?

- A. 0.36 m/day
- B. 0.48 m/day
- C. 0.56 m/day
- D. 0.72 m/day

**Answer: A**

Explanation:

Groundwater flow velocity can be calculated using Darcy's law:

$$v = K \cdot i$$

Where  $K$  is hydraulic conductivity and  $i$  is hydraulic gradient.

Thus,

$$v = 12 \text{ m/day} \times 0.03 = 0.36 \text{ m/day}$$

### Question: 8

A well in an unconfined aquifer is pumped at a rate of 100 L/s. After 48 hours of continuous pumping, the water level in the well has dropped from 15 m to 10 m.

What is the total drawdown experienced by the well?

- A. 2 m
- B. 3 m
- C. 4 m
- D. 5 m

**Answer: D**

Explanation:

The drawdown is calculated as:

$$\text{Drawdown} = \text{Initial Water Level} - \text{Final Water Level}$$

Thus,

$$\text{Drawdown} = 15 \text{ m} - 10 \text{ m} = 5 \text{ m}$$

### Question: 9

A civil engineer is studying the impact of a wastewater discharge on a river's dissolved oxygen (DO) levels. If the river has a flow rate of 4 m<sup>3</sup>/s and the DO concentration downstream of the discharge is 5 mg/L, while the upstream concentration is 8 mg/L, what is the total mass of oxygen depleted over a 24-hour period?

- A. 1288 kg
- B. 1576 kg
- C. 1036 kg
- D. 1296 kg

**Answer: C**

Explanation:

The mass of oxygen lost can be calculated as:

$$\text{Mass Loss} = (\text{Upstream DO} - \text{Downstream DO}) \times \text{Flow Rate} \times \text{Time}$$

Where:

$$\text{Mass Loss} = (8 \text{ mg/L} - 5 \text{ mg/L}) \times 4 \text{ m}^3/\text{s} \times 86,400 \text{ s}$$

Convert mg/L to kg/m<sup>3</sup>:

$$\text{Mass Loss} = 3 \text{ mg/L} \times 4 \times 86,400 = 1036.8 \text{ kg}$$

### Question: 10

An environmental scientist is calculating the Total Maximum Daily Load (TMDL) for nitrogen in a river. The current nitrogen load is 2,200 kg/year, and the TMDL is set at 1,500 kg/year. What is the percentage reduction needed to meet the TMDL?

- A. 25%
- B. 32%
- C. 40%
- D. 50%

**Answer: B**

Explanation:

The percentage reduction can be calculated as:

$$\text{Reduction} = \frac{\text{Current Load} - \text{TMDL}}{\text{Current Load}} \times 100$$

Thus,

$$\text{Reduction} = \frac{2200 - 1500}{2200} \times 100 \approx 31.82\%$$

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