2. Mathematical Methods for EE

Starter Quiz ·

University Electrical Engineering Name: _____ Score: _____

1. $v(t) = 3t^2$ volts. What is the slope dv/dt at t = 2 s, in volts per second?

   _____ V/s

2. What is the modulus of $z = 5 - j12$?

   _____

3. Solve $2x + y = 7$ and $x - y = 2$. What is x?

   _____

4. $dy/dt + 4y = 0$ with $y(0) = 3$. What is y at t = 0.25? Give two decimal places.

   _____

5. Evaluate the Laplace transform of e^{-4t} at s = 1.

   _____

6. At t = T/4, what does the square-wave series $(4/\pi)(1 - 1/3 + 1/5 - \ldots)$ add up to?

   ☐ 1: the bracket converges to $\pi/4$, and $(4/\pi)(\pi/4) = 1$

   ☐ $\pi/4$

   ☐ 0.785, and falling

   ☐ Nothing; the series diverges

7. For Gaussian noise with $\sigma = 2$ mV, a single reading of 5 mV is impossible.

   ☐ True ☐ False

8. $V = 3x^2y$. What is the electric field E at (1, 2)?

   ☐ $(6xy, 3x^2)$

   ☐ (12, 3) V/m

   ☐ $-(6, 3)$ V/m

   ☐ $-(12, 3)$ V/m

9. A current of +2 mA for 1 s followed by −2 mA for 1 s delivers a net charge of 4 mC.

   ☐ True ☐ False

10. Multiplying a phasor by j rotates it by −90°.

    ☐ True ☐ False

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Answers ·

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1. **12 V/s**

   $\frac{d}{dt}3t^2 = 6t$, which is 12 at $t = 2$.

2. **13**

   $\sqrt{5^2 + 12^2} = \sqrt{169} = 13$. The minus sign affects the angle, not the length.

3. **3**

   Add the equations to remove y: $3x = 9$, so $x = 3$ and $y = 1$. Check: $2 \cdot 3 + 1 = 7$.

4. **1.1**

   $y = 3e^{-4t}$, so $y(0.25) = 3e^{-1} \approx 1.10$. With no input, only the homogeneous part remains.

5. **0.2**

   $\mathcal{L}\{e^{-4t}\} = \frac{1}{s+4}$, which is $\frac{1}{5} = 0.2$ at $s = 1$.

6. **1: the bracket converges to $\pi/4$, and $(4/\pi)(\pi/4) = 1$**

   The alternating series of odd reciprocals sums to $\frac{\pi}{4}$; scaled by $\frac{4}{\pi}$ it gives exactly 1, the value the square wave demands there.

7. **False**

   5 mV is 2.5σ. Readings that far out are rare (about 1%) but they do happen.

8. **$-(12, 3)$ V/m**

   $\nabla V = (6xy, 3x^2) = (12, 3)$ at the point, and $\mathbf{E} = -\nabla V = -(12, 3)$.

9. **False**

   Area below the axis subtracts, so the net charge is $2 - 2 = 0$ mC. 4 mC is the total without signs.

10. **False**

    $j = 1\angle 90°$, so multiplying by j adds $+90°$. Multiplying by $-j$ rotates by $-90°$.