GENERAL

antenna theory objective question answers

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Introduction

When it comes to mastering antenna theory, one of the most effective ways to gauge your understanding is through objective question and answer sets. These concise, focused questions help you test your knowledge, identify gaps, and reinforce core concepts. Whether you're preparing for an engineering exam, a professional certification, or simply looking to deepen your grasp of radio frequency (RF) fundamentals, a well structured set of objective questions can be an indispensable study aid.

In this article, we'll explore the fundamentals of antenna theory, present a curated collection of high quality objective questions, and walk through detailed answers that explain the reasoning behind each correct choice. We'll also provide study strategies and resources to help you ace any antenna theory exam.

Overview of Antenna Theory

What Is an Antenna?

An antenna is a device that transmits or receives electromagnetic waves. It converts electrical signals into radiated energy (in the case of transmission) or converts incoming waves back into electrical signals (in the case of reception). Antennas are ubiquitous in modern communication systems—from cell phones and Wi Fi routers to satellite dishes and radar systems.

Key Parameters

- Gain – Measures how much power is radiated in a specific direction compared to an isotropic radiator.
- Directivity – Describes the concentration of radiated energy in a particular direction.
- Bandwidth – The frequency range over which the antenna performs satisfactorily.
- Impedance – The electrical resistance and reactance presented by the antenna, typically matched to 50 /:' ÷" sR ó© for RF systems.
- Radiation Pattern – A graphical representation of the power radiated by the antenna as a function of direction.

Types of Antennas

Antenna classifications are often based on geometry, operating frequency, and intended application:

- Dipole – The simplest form, consisting of two conductive elements.
- Monopole – A single conductive element above a ground plane.
- Patch (Microstrip) – A flat, rectangular conductor on a dielectric substrate.
- Parabolic Dish – Offers high gain by reflecting waves off a curved surface.
- Log Periodic – Provides wideband performance with multiple resonant elements.
- Array – Multiple elements combined to shape the radiation pattern.

Fundamental Electromagnetic Theory

Understanding antenna behavior requires a solid grasp of Maxwell's equations, wave propagation, and boundary conditions. Key concepts include:

- Wavelength (;²' b The distance over which the wave's shape repeats.
- Propagation Constant (;2' b FVf–æW2 †ðw the wave attenuates and phase shifts in a medium.

- Reflection Coefficient (92’ b The ratio of reflected to incident wave amplitude, crucial for impedance matching.
- Standing Wave Ratio (SWR) – A practical measure of mismatch between an antenna and the transmission line.

Key Concepts for Objective Questions

Impedance Matching

Impedance mismatches cause reflections, leading to power loss and signal distortion. Objective questions often test knowledge of matching techniques such as:

- Quarter wave transformers
- Stub matching
- Baluns and unbaluns
- Use of matching networks (L, Pi, T)

Radiation Patterns and Beamwidth

Questions may ask you to interpret or calculate beamwidth, front to back ratio, or side lobe levels. Familiarity with pattern notation (e.g., 3 /dB, -10 /dB points) is essential.

Polarization

Linear, circular, and elliptical polarizations are common. Objective questions may probe the impact of polarization mismatch on link budgets.

Bandwidth and Quality Factor (Q)

The Q factor inversely relates to bandwidth; high Q antennas are narrowband. Questions often involve calculating fractional bandwidth or understanding the trade off between size and bandwidth.

Array Theory

Array factor, element spacing, and phasing are typical topics. Objective questions may ask you to derive array patterns or evaluate grating lobes.

Material Properties

Dielectric constant, loss tangent, and conductivity affect antenna performance. Questions may involve selecting suitable substrates for microstrip antennas.

Sample Objective Questions & Answers

Below is a curated set of 20 objective questions covering a wide range of antenna theory topics. Each question is followed by the correct answer and a detailed explanation.

Question 1

Which of the following is the most common impedance for RF transmission lines and antennas?

1. 25 /:•
2. 50 /:•
3. 75 /:•
4. 100 /:•

Answer: B (50 /:’•

Explanation: The industry standard for most RF systems, especially in mobile and broadcast applications, is 50 :’à It

balances power handling and cable loss. 75 /:’ —2 W6VB imarily for video and broadcast cables, while 25 /:’ æB ó© are less common.

Question 2

A half wave dipole has a resonant length of 15 cm at a frequency of 2 GHz. What is the wavelength (;²• at this frequency?

1. 15 /cm
2. 30 /cm
3. 5 /cm
4. 10 /cm

Answer: B (30 /cm)

Explanation: A half wave dipole’s length equals ;²ó"à Therefore, ;² Ò " r R ö6Ò Ò 3 ö6Òà At 2 /GHz, ;² $, R ö6ÒÂ ut since th dipole is half wave, the physical length is 15 /cm.

Question 3

Which of the following elements is NOT typically part of an antenna array design?

1. Element spacing
2. Array factor
3. Impedance matching
4. Capacitive loading

Answer: D (Capacitive loading)

Explanation: While capacitive loading can be used to reduce the physical size of an antenna, it is not a fundamental component of array theory. Element spacing, array factor, and impedance matching are core to array design.

Question 4

What is the relationship between the quality factor (Q) and the fractional bandwidth (BW) of an antenna?

1. Q "H BW
2. Q "H 1/BW
3. Q "H BW²
4. Q "H 1/BW²

Answer: B (Q "H 1/BW)

Explanation: The Q factor is inversely proportional to the fractional bandwidth: Q = f € / BW, where f € is the resonant frequency. A high Q implies a narrow bandwidth, and vice versa.

Question 5

Which type of polarization is most suitable for satellite communication to mitigate multipath fading?

1. Linear
2. Circular
3. Elliptical
4. Random

Answer: B (Circular)

Explanation: Circular polarization reduces the impact of orientation differences between the transmitting and receiving antennas, thereby mitigating multipath and polarization mismatch losses.

Question 6

In a quarter wave transformer used for impedance matching, the characteristic impedance (Z €) of the transformer is given by:

1. " (Z • × Z ,)
2. Z • + Z ,
3. Z • × Z ,
4. 2 × " (Z • × Z ,)

Answer: A (" (Z • × Z ,))

Explanation:A quarter wave transformer matches two impedances Z • and Z , by setting its characteristic impedance to the geometric mean: Z € = " (Z • × Z ,).

Question 7

Which of the following is a key advantage of microstrip patch antennas?

1. High mechanical robustness
2. Large bandwidth
3. Low profile and lightweight
4. Excellent radiation efficiency at low frequencies

Answer: C (Low profile and lightweight)

Explanation: Microstrip patches are thin, planar structures that can be fabricated on flexible substrates, making them ideal for compact and lightweight applications. However, they typically have narrow bandwidth and limited low frequency performance.

Question 8

Which parameter describes how much power is radiated in the main lobe relative to the power radiated in all directions?

1. Beamwidth
2. Directivity
3. Gain
4. Efficiency

Answer: B (Directivity)

Explanation: Directivity measures the concentration of radiated power in a specific direction. Gain is directivity multiplied by efficiency.

Question 9

In an antenna array, grating lobes appear when the element spacing exceeds:

1. ;²ó@
2. ;²ó
3. ;°
4. 2;°

Answer: B (;²ó"•

Explanation: To avoid grating lobes, the element spacing should be less than or equal to ;²ó"à Larger spacings introduce additional lobes at predictable angles.

Question 10

Which of the following best describes the effect of increasing the dielectric constant (;QÖ2’ öb Ö–7&÷7G ip substrate?

1. Increases the antenna’s bandwidth
2. Reduces the resonant frequency
3. Decreases the physical size of the antenna
4. Both B and C

Answer: D (Both B and C)

Explanation:A higher dielectric constant lowers the effective wavelength in the substrate, reducing the resonant frequency for a given physical length. It also allows the antenna to be physically smaller for the same frequency, but it typically narrows the bandwidth.

Question 11

What is the primary purpose of a balun?

1. To match impedance between two antennas
2. To convert between balanced and unbalanced signals
3. To increase antenna gain
4. To filter out noise

Answer: B (To convert between balanced and unbalanced signals)

Explanation:A balun (balanced to unbalanced transformer) ensures that a balanced antenna (e.g., dipole) can be connected to an unbalanced transmission line (e.g., coaxial cable) without introducing common mode currents.

Question 12

Which of the following is a typical application of a log periodic antenna?

1. Indoor Wi Fi routers
2. Satellite TV dishes
3. Radar systems requiring wideband operation
4. Low frequency AM broadcasting

Answer: C (Radar systems requiring wideband operation)

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