

Sample Questions with Answers

Blockchain

Generated on March 11, 2026 at 4:00 PM

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Question 1:

Explain blockchain technology with a simple example of how blocks are connected.

[ANSWER] Answer & Explanation:

Blockchain is a distributed digital ledger that stores data in blocks linked together using cryptographic hashes.

Basic Structure:

Block 1 (Genesis):
- Data: "Alice sends 10 coins to Bob"
- Hash: 0x1a2b3c...
- Previous Hash: 0x000000...

Block 2:
- Data: "Bob sends 5 coins to Charlie"
- Hash: 0x4d5e6f...
- Previous Hash: 0x1a2b3c... (Block 1 hash)

Key Properties:

- Immutable** - Changing any block breaks the chain
- Decentralized** - No single point of control
- Transparent** - All transactions are visible
- Secure** - Cryptographically protected

Simple Example:

Imagine a notebook shared among friends where:

- Each page (block) contains transaction records
- Every page references the previous page number (hash)
- If someone tries to modify an old page, everyone notices because the page numbers do not match
- Everyone has a copy, so no single person can cheat

This creates an unbreakable chain of records that everyone can trust without needing a central authority.

Question 2:

Explain cryptocurrency and its key differences from traditional digital payments.

[ANSWER] Answer & Explanation:

Cryptocurrency is digital money that uses cryptography for security and operates on blockchain networks without central authority.

Traditional Digital Money (Bank Transfer):

- Alice → Bank → Bob
- Bank verifies Alice has \$100
- Bank deducts \$100 from Alice
- Bank adds \$100 to Bob
- Bank maintains central ledger

Cryptocurrency Transaction:

- Alice → Blockchain Network → Bob
- Alice signs transaction with private key
- Network nodes verify signature and balance
- Transaction added to blockchain
- No central authority needed

Key Differences:

Aspect	Traditional Digital	Cryptocurrency
Control	Central bank/authority	Decentralized network
Verification	Bank validates	Network consensus
Reversibility	Can be reversed	Irreversible
Privacy	Bank knows all details	Pseudonymous
Availability	Business hours 24/7/365	Borders Geographic restrictions Global
Fees	Bank fees Network fees	Network fees

Example Cryptocurrencies:

- Bitcoin (BTC)** - Digital gold, store of value
- Ethereum (ETH)** - Smart contract platform
- Litecoin (LTC)** - Faster Bitcoin alternative

Benefits: No intermediaries, global access, programmable money, censorship resistance

Question 3:

Explain the process of creating and verifying digital signatures with an example.

[ANSWER] Answer & Explanation:

Digital signatures use public-key cryptography to prove transaction authenticity without revealing private keys.

Key Generation Process:

- Generate random private key (256-bit number)
Private Key: $d = 0x1234567890abcdef\dots$
- Calculate public key using elliptic curve
Public Key: $Q = d \times G$ (where G is generator point)
 $Q = (x, y)$ coordinates on curve
- Create wallet address from public key
Address = Hash(Public Key)

Transaction Signing Process:

- Create transaction
 $tx = \{$ from: "1A1zP1eP5QGefi2DMPTfTL5SLmv7DivfNa", to: "1BvBMSEYstWetqTFn5Au4m4GFg7xJaNVN2", amount: 0.5, fee: 0.001 $\}$
- Hash transaction data
 $txHash = SHA256(tx) = 0xabc123\dots$
- Sign with private key
signature = sign(txHash, privateKey)
- Broadcast transaction + signature

Verification Process:

- Receive transaction + signature
- Hash transaction data
- Verify signature using public key
`if (verify(signature, txHash, publicKey) == true) { transaction_valid = true } else { transaction_invalid = true }`

Security Properties:

- Authentication** - Proves sender identity
- Non-repudiation** - Sender cannot deny signing
- Integrity** - Detects any data tampering
- Unforgeable** - Cannot create valid signature without private key

Real-world Analogy: Like a handwritten signature, but mathematically impossible to forge and can be verified by anyone.

Question 4:

Explain how blockchain wallets work and the difference between hot and cold wallets.

[ANSWER] Answer & Explanation:

A blockchain wallet does not actually store cryptocurrency - it stores private keys that control access to funds on the blockchain.
How Wallets Work:
Wallet Components:
??? Private Keys (secret, never shared)
??? Public Keys (derived from private keys)
??? Addresses (derived from public keys)
??? Transaction History (queried from blockchain)
Example:
Private Key: 5KJvsngHeMpm884wtkJNzQGACErckhHJBGFsvd3VyK5qMZXj3hS
Public Key:

04678afdb0fe5548271967f1a67130b7105cd6a828e03909a67962e0ea1f61deb649f6bc3f4cef38c4f35504e51ec112de5c384df7ba0b8d578a4c

1BvBMSEYstWetqTFn5Au4m4GFg7xJaNVN2
Wallet Types:
1. Hot Wallets (Connected to Internet):

Web Wallets - MetaMask, MyEtherWallet
Mobile Apps - Trust Wallet, Coinbase Wallet
Desktop Software - Electrum, Exodus

Advantages - Convenient, easy to use
Disadvantages - Vulnerable to hacking
2. Cold Wallets (Offline Storage):

Hardware Wallets - Ledger, Trezor
Paper Wallets - Private keys printed on paper
Air-gapped Computers - Never connected to internet

Advantages - Maximum security
Disadvantages - Less convenient for frequent use
Seed Phrase Example: Mnemonic (12-24 words):

abandon ability able about above absent absorb abstract absurd abuse access accident
This generates:
- Master Private Key
- Hierarchical Deterministic (HD) wallet structure
- Multiple addresses from single seed

Security Best Practices:
- Never share private keys or seed phrases
- Use hardware wallets for large amounts
- Keep multiple backups in secure locations
- Verify addresses before sending transactions
- Use strong passwords and 2FA

Important: "Not your keys, not your coins" - only control funds if you control private keys.



Question 5:

Explain the mining process with a practical example of how miners compete to add blocks.

[ANSWER] Answer & Explanation:

Mining is the process where computers compete to solve mathematical puzzles to validate transactions and secure the blockchain network.
Mining Process Step-by-Step:
Step 1: Collect Transactions
Mempool (pending transactions):
- Alice ? Bob: 2 BTC
- Charlie ? Dave: 1.5 BTC
- Eve ? Frank: 0.8 BTC
- Total fees: 0.05 BTC

Step 2: Create Block Header
Block Header:
- "previousHash": "0000a1b2c3d4e5f6..."
- "merkleRoot": "abc123def456..."
- "timestamp": 1640995200
- "difficulty": "00000000000000000001a..."
- "nonce": 0

Step 3: Mining Competition
Target: Hash must start with 19 zeros
Miners try different nonce values:
Miner A tries nonce = 1:
SHA256(blockHeader) = 1a2b3c4d... ? (does not start with enough zeros)

Miner A tries nonce = 2:
SHA256(blockHeader) = 9f8e7d6c... ?
Miner B tries nonce = 1,847,293:
SHA256(blockHeader) = 00000000000000000001abc... ? WINNER!

Step 4: Broadcast Solution
Winning miner broadcasts:
- Valid block with correct nonce
- Network verifies solution
- Block added to blockchain
- Miner receives reward: 6.25 BTC + 0.05 BTC fees

Why Mining is Necessary:
1. Security: - Makes network attack expensive (need 51% of computing power)
- Cost to attack > potential profit
2. Decentralization: - No central authority decides which transactions are valid
- Distributed consensus through competition

3. Incentivization: - Miners earn rewards for maintaining network
- Economic incentive ensures network operation
4. Fair Distribution: - New coins distributed through work, not favoritism
- Anyone can participate with computing power

Mining Difficulty Adjustment:
Every 2016 blocks (~2 weeks):
- if (actual_time < 2_weeks) {increase_difficulty()} // blocks found too fast
- else if (actual_time > 2_weeks) {decrease_difficulty()} // blocks found too slow

Energy Consumption Trade-off:
High energy use = High security. The electricity cost makes attacks economically unfeasible.

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