Contents

AWS Elastic Beanstalk

🌱 Beginner-Level Answers

1. **What is Elastic Beanstalk?**
   → A fully managed PaaS service that lets you deploy, manage, and scale applications without managing infrastructure.
2. **Features of Elastic Beanstalk?**
   → Auto-scaling, load balancing, health monitoring, app versioning, multi-language support, integration with AWS services.
3. **Supported platforms?**
   → Java, .NET, Node.js, PHP, Python, Ruby, Go, Docker.
4. **EB vs EC2?**
   → EB manages infrastructure for you, while EC2 requires manual provisioning and configuration.
5. **What is an environment?**
   → A collection of AWS resources (EC2, ELB, Auto Scaling, RDS, etc.) created to run your app.
6. **Web vs Worker env?**
   → Web: handles HTTP requests via a load balancer.
   → Worker: handles background jobs via SQS.
7. **Scaling in EB?**
   → Uses Auto Scaling groups to automatically add/remove EC2 instances based on demand.
8. **Load balancing in EB?**
   → Integrates with Elastic Load Balancer (ALB/CLB) for traffic distribution.
9. **Deployment models?**
   → All-at-once, Rolling, Rolling with additional batch, Immutable, Traffic splitting.
10. **Docker in EB?**
    → Yes, supports single and multi-container Docker deployments.

🌿 Intermediate-Level Answers

11. **Versioning & Rollbacks?**
    → Each deployment is versioned, and you can quickly roll back to a stable version.
12. **.ebextensions?**
    → Config files that let you customize EC2 instances, install packages, or change settings.
13. **Environment variables?**
    → Can be set via console, EB CLI, or config files to pass app configs securely.
14. **Deployment policies?**
    → All-at-once (fast, downtime), Rolling (zero downtime), Immutable (new instances), Traffic splitting (canary testing).

15. **HTTPS in EB?**
    → Upload SSL cert to ELB or ALB and configure listener rules.

16. **Logging & Monitoring?**
    → Logs available via EB console or CloudWatch; health metrics integrated with CloudWatch.

17. **RDS integration?**
    → Can be provisioned inside EB env (tightly coupled) or externally (recommended for prod).

18. **Single Instance vs Load Balanced?**
    → Single instance = cheap, dev/test. Load balanced = HA production setup.

19. **Deploy via CLI/CI-CD?**
    → Use EB CLI, CodePipeline, or GitHub Actions/Jenkins for automation.

20. **CloudWatch integration?**
    → Collects metrics (CPU, latency, request count) and alarms for scaling/alerts.

🌳 **Advanced-Level Answers**

21. **Blue/Green deployments?**
    → Deploy new version in a separate env, test, then swap CNAME with production env.

22. **EB vs ECS vs EKS?**
    → EB = PaaS, ECS = container orchestration, EKS = Kubernetes management.

23. **Customize EC2 in EB?**
    → Use .ebextensions or custom AMIs to install software/configs.

24. **Multi-container Docker?**
    → Supported via Dockerrun.aws.json or Docker Compose.

25. **Securing EB env?**
    → Use security groups, IAM roles, HTTPS, private VPC subnets, and encryption.

26. **VPC integration?**
    → Deploy EB in custom VPC for private networking and compliance.

27. **High availability?**
    → Multi-AZ deployments with Auto Scaling and ELB.

28. **Limitations?**
    → Limited infra control, slower updates, not ideal for highly customized apps.

29. **CI/CD integration?**
    → Supports CodePipeline, Jenkins, GitHub Actions for automated builds and deployments.

30. **EB vs Lambda/ECS/EKS?**
    → EB = simple web apps, Lambda = serverless, ECS/EKS = containerized workloads.

🌟 **Expert / Scenario Answers**

31. **High latency troubleshooting?**
    → Check CloudWatch metrics, scale instances, enable caching, review DB connections.
32. **Deployment fails health check?**
    → Roll back to previous version, check logs, fix app/config errors.
33. **Multi-region DR?**
    → Deploy EB in multiple regions, use Route53 failover routing.
34. **Zero-downtime deployments?**
    → Use rolling or traffic-splitting deployments, or Blue/Green strategy.
35. **Cost optimization?**
    → Use Spot instances for dev, right-size instances, externalize RDS, auto-scaling.
36. **On-prem to EB migration?**
    → Containerize or package app, deploy via EB CLI or console.
37. **Centralized logs?**
    → Stream EB logs to CloudWatch Logs or S3.
38. **Custom scaling rules?**
    → Configure scaling policies based on CPU, request count, or custom CloudWatch metrics.
39. **Securing sensitive configs?**
    → Store in SSM Parameter Store or Secrets Manager, reference via EB environment variables.
40. **EB vs CloudFormation?**
    → EB = deploy apps quickly, CF = full infra as code for complex environments.

EC2

Beginner-Level Answers

1. **What is Amazon EC2?**
   → Elastic Compute Cloud (EC2) is a virtual server in the cloud that provides scalable compute capacity.

2. **Instance families?**
   → General Purpose (t/m), Compute Optimized (c), Memory Optimized (r/x/z), Storage Optimized (i/d/h), Accelerated Computing (p/g/f).

3. **On-Demand vs Reserved vs Spot?**
   → On-Demand: pay-as-you-go.
   → Reserved: 1/3-year commitment, cheaper.
   → Spot: unused capacity, very cheap, but can be interrupted.

4. **t2, m5, c5, r5 differences?**
   → t2: burstable, low-cost.
   → m5: balanced.
   → c5: compute-heavy.
   → r5: memory-heavy.

5. **Amazon Machine Image (AMI)?**
   → A pre-configured template (OS + software) used to launch EC2 instances.

6. **EBS-backed vs Instance Store?**
   → EBS-backed = persistent storage.
   → Instance Store = temporary storage, lost on stop/terminate.

7. **Security Group?**
   → Virtual firewall controlling inbound/outbound traffic to instances.

8. **Elastic IP?**
   → Static, public IPv4 address that you can remap between EC2 instances.

9. **Connect to EC2?**
   → Use SSH (Linux) or RDP (Windows) with key pairs or Systems Manager Session Manager.

10. **EC2 Auto Recovery?**
    → Automatically recovers an instance if hardware or host fails, without user action.

🌿 **Intermediate-Level Answers**

11. **Scaling EC2?**
    → Use Auto Scaling groups to add/remove instances based on demand.

12. **Vertical vs Horizontal scaling?**
    → Vertical: increase instance size.
    → Horizontal: add more instances behind a load balancer.

13. **Security Groups vs NACLs?**
    → SG = stateful, applied to instances.
    → NACL = stateless, applied at subnet level.

14. **Placement Groups?**
    → Cluster (low latency), Spread (instances across hardware), Partition (large distributed workloads).

15. **Attach/detach EBS volumes?**
    → Possible without stopping instance, except root volume (needs stop/start for detach).

16. **gp3 vs io2?**
    → gp3: general purpose, balanced price/performance.
    → io2: high IOPS, critical databases.

17. **Instance metadata & user data?**
    → Metadata = info about instance (IP, ID, IAM).
    → User data = bootstrap scripts run at launch.

18. **ELB integration with EC2?**
    → ELB distributes traffic across EC2 instances in different AZs.

19. **Data security on EC2?**
    → Encrypt EBS volumes, use HTTPS, and secure with IAM roles.

20. **IAM integration with EC2?**
    → Attach IAM roles to EC2 for secure access to AWS services (no hard-coded keys).

🌳 **Advanced-Level Answers**

21. **Hibernate vs Stop/Start?**
    → Hibernate saves RAM state to disk, Stop just shuts down (RAM cleared).

22. **Spot Fleet?**
    → A collection of Spot + On-Demand instances managed for lowest cost.

23. **Dedicated Host vs Instance?**
    → Host = physical server dedicated to you.
    → Instance = runs on shared hardware.

24. **Cost optimization?**
    → Use Reserved Instances, Spot Instances, right-sizing, and auto-scaling.

25. **High availability in EC2?**
    → Deploy in Multi-AZ, use load balancers, Auto Scaling groups.

26. **Performance monitoring?**
    → CloudWatch metrics (CPU, memory, I/O), VPC Flow Logs, EC2 logs.

27. **Nitro instances?**
    → AWS hypervisor tech with better performance, security, and bare-metal support.

28. **Encrypting EBS volumes?**
    → Enable EBS encryption (AES-256) at creation, or copy to encrypted volume.

29. **Scaling EC2 vs ECS/EKS?**
    → EC2: scale VMs. ECS/EKS: scale containers.

30. **Patching EC2 at scale?**
    → Use Systems Manager Patch Manager or automation scripts.

🌟 **Expert-Level / Scenario Answers**

31. **High CPU utilization?**
    → Scale up instance, add more instances, optimize code, or enable caching.
32. **Low-latency HPC workloads?**
    → Use Cluster Placement Group with high-performance instances.
33. **Migrate on-prem VMs?**
    → Use AWS Application Migration Service (MGN) or VM Import/Export.
34. **Unreachable EC2 instance?**
    → Check SG/NACL, route tables, network ACLs, key pairs, and system logs.
35. **Disaster recovery?**
    → Multi-region replication, AMI backups, EBS snapshots, Route53 failover.
36. **Share AMIs across accounts?**
    → Modify AMI permissions, copy to other regions/accounts.
37. **Zero-downtime patching?**
    → Use rolling updates in Auto Scaling groups with ELB.
38. **Flash sale scaling?**
    → Pre-warm Auto Scaling groups, use Spot+On-Demand mix, add caching.
39. **Secure sensitive credentials?**
    → Use AWS Secrets Manager or SSM Parameter Store, never hard-code.
40. **EC2 vs Lambda vs ECS?**
    → EC2: full control, long-running apps.
    → Lambda: event-driven, serverless.
    → ECS/EKS: containerized workloads.

Load Balancer

🌱 **Beginner-Level**

1. **What is a Load Balancer?**
   Distributes incoming traffic across multiple servers → avoids overload, improves availability.
2. **Types of Load Balancers in AWS?**
   - **ALB** → Layer 7 (HTTP/HTTPS).
   - **NLB** → Layer 4 (TCP/UDP).
   - **GLB** → Security appliances.
   - **CLB** → Old/legacy.
3. **What is ALB?**
   Smart LB at Layer 7 → routes by URL, hostname, headers.
4. **What is NLB?**
   Ultra-fast LB at Layer 4 → handles millions of requests, supports TCP/UDP, gives static IPs.
5. **What is CLB?**
   Old LB, supports basic Layer 4 & 7, less features → not recommended now.
6. **What is GLB?**
   Used for deploying firewalls/security appliances at scale.
7. **What are Target Groups?**
   A collection of targets (EC2, ECS, Lambda) where LB forwards traffic.
8. **What is a Health Check?**
   LB regularly tests targets → sends traffic only to healthy ones.
9. **Horizontal vs Vertical Scaling?**
   - Horizontal = add more servers with LB.
   - Vertical = increase server size.
10. **What is Sticky Session?**
    LB keeps user session on the same backend using cookies.

🌿 **Intermediate-Level**

11. **How does ALB route traffic?**
    Based on URL path, hostnames, headers, query params.
12. **Path vs Host Routing?**

- Path: /api/* → service A.
- Host: api.example.com → service B.

13. **What is SSL Termination?**
    LB decrypts HTTPS → backend gets plain HTTP.

14. **How does NLB give high performance?**
    Works at network layer, directly routes packets → very low latency.
15. **What is Cross-Zone LB?**
    Distributes traffic evenly across AZs → better load balance.
16. **Can ALB support WebSockets?**
    Yes, for real-time apps like chat or games.
17. **Does LB support IPv6?**
    Yes, dual-stack (IPv4 + IPv6).
18. **What is Connection Draining?**
    Waits for existing requests to finish before removing a server.
19. **How is ALB useful for microservices?**
    Routes requests to different services/containers using host/path rules.
20. **ALB vs API Gateway?**

- ALB = routes HTTP traffic.
- API Gateway = full API management (auth, caching, throttling).

🌳 **Advanced-Level**

21. **How does ALB handle sudden traffic spikes?**
    Auto scales automatically (no manual pre-warm like CLB).
22. **What is Idle Timeout?**

- ALB = 60s (configurable).
- NLB = 350s fixed.

23. **How to tune response time?**
    Adjust health check thresholds + deregistration delay.
24. **What if all targets fail health checks?**
    LB returns 503 Service Unavailable.
25. **How to secure LB?**
    Attach **WAF** for filtering (SQLi, XSS, IP blocking, DDoS).
26. **SSL Passthrough vs Termination?**

- Termination = decrypt at LB.
- Passthrough = encrypted till backend.

27. **What is AWS LB Controller in Kubernetes?**
    Auto-creates ALB/NLB for K8s Ingress resources.
28. **What is Weighted Target Group?**
    Send X% traffic to old version, Y% to new → safe rollout.

29. **How does LB help Blue/Green deployments?**
    Switch traffic between target groups (old → new).

30. **What are ALB access logs?**
    Logs stored in S3 → used for debugging, analytics, audits.

🌟 **Expert / Scenarios**

31. **Which LB for TCP + UDP apps?**
    → NLB.

32. **How to reduce latency for global users?**
    → Route 53 latency routing + Global Accelerator + regional LBs.

33. **How to failover with LB + Route 53?**
    → Route 53 health checks → switch to healthy LB/region.

34. **Which LB for millions of requests/sec?**
    → NLB.

35. **How to achieve Zero-downtime deployment?**
    → Use Blue/Green or weighted traffic shifting.

36. **Does NLB support static IPs?**
    → Yes, Elastic IPs per AZ.

37. **How to secure internal apps?**
    → Use Internal LB (private, no public internet access).

38. **How LB works with Auto Scaling?**
    → LB auto-registers new EC2s and removes terminated ones.

39. **Can one target group be attached to multiple LBs?**
    → Yes, multiple LBs can send traffic to same target group.

40. **LB scaling vs Auto Scaling?**

- LB scaling = distributes traffic better.
- Auto Scaling = adds/removes servers.

S3

🌱 **Beginner-Level (Basics)**

1. **What is Amazon S3?**
   Fully managed object storage service to store/retrieve data from anywhere on the internet.
2. **What are Buckets in S3?**
   A container for objects; each bucket has a unique name globally.
3. **What are Objects in S3?**
   Files stored in S3 along with metadata and unique keys.
4. **What is the maximum object size in S3?**
   5 TB (single upload ≤ 5 GB; larger requires multipart upload).
5. **What storage classes are available in S3?**
   Standard, Standard-IA, One Zone-IA, Glacier, Glacier Deep Archive, Intelligent-Tiering.
6. **What is S3 durability and availability?**
   Durability = **11 nines (99.999999999%)**; Availability depends on storage class.
7. **How is data organized in S3?**
   Flat structure (not folders, just prefixes and keys that look like directories).
8. **What is Versioning in S3?**
   Maintains multiple versions of objects, prevents accidental deletes.
9. **Difference between S3 and EBS?**
   - **S3** = object storage (scalable, global).
   - **EBS** = block storage for EC2 instances.
10. **What is S3 Transfer Acceleration?**
    Uses AWS edge locations (CloudFront) to speed up uploads/downloads.

🌿 **Intermediate-Level (Features & Security)**

11. **How does S3 handle data consistency?**
    Strong read-after-write consistency for PUT, DELETE, and overwrite.
12. **Difference between Standard, IA, One Zone-IA, Glacier, Deep Archive?**
    Cost vs retrieval time: Standard (frequent), IA (infrequent), One Zone-IA (cheaper, single AZ), Glacier (archival, minutes), Deep Archive (cheapest, hours).
13. **What is S3 Lifecycle Policy?**
    Rules to automatically transition or expire objects (e.g., move to Glacier after 30 days).
14. **How does Cross-Region Replication (CRR) work in S3?**
    Replicates objects asynchronously from one region to another for DR or latency.
15. **How do you secure an S3 bucket?**

- Block Public Access.
- Use IAM/bucket policies.

- Enable encryption.

16. **Difference between Bucket Policy and IAM Policy?**

- IAM policy = user/role based.
- Bucket policy = directly attached to bucket.

17. **What is Pre-signed URL in S3?**
    Temporary URL to allow time-limited access to objects.

18. **How does S3 Object Lock work?**
    Prevents object deletion for compliance (WORM – Write Once Read Many).

19. **What is S3 Select and Glacier Select?**
    Query subsets of data in objects using SQL (instead of fetching full file).

20. **How does S3 support encryption?**

- SSE-S3 (AWS managed).
- SSE-KMS (AWS KMS keys).
- SSE-C (customer keys).

🌳 **Advanced-Level (Performance, Scaling, Integrations)**

21. **How does S3 scale with high request rates?**
    Scales automatically to handle virtually unlimited requests.

22. **How does Multipart Upload work in S3?**
    Splits large files into parts, uploads in parallel, reassembles on S3 → faster, resilient.

23. **How does S3 handle Event Notifications?**
    Can trigger SNS, SQS, or Lambda when objects are created/deleted.

24. **What is S3 Intelligent-Tiering?**
    Moves objects between frequent and infrequent tiers automatically to reduce cost.

25. **What happens when you delete a bucket with versioning enabled?**
    Deletes only the *current* version; older versions remain unless permanently deleted.

26. **How do you optimize costs in S3?**
    Use lifecycle rules, Intelligent-Tiering, Glacier, delete old versions, enable storage class analysis.

27. **What are S3 Access Points?**
    Simplify access management by creating unique access endpoints with specific permissions.

28. **How does VPC Endpoint for S3 work?**
    Allows private S3 access without using public internet.

29. **How does S3 ensure durability of 11 9s?**
    Replicates data across multiple facilities and devices automatically.

30. **Difference between Cross-Region Replication (CRR) and Same-Region Replication (SRR)?**

- CRR = copies across AWS regions.
- SRR = copies within same region for compliance/audit.

🌞 **Expert / Scenario-Based Questions**

31. **Your S3 bucket is public by mistake — how do you fix it?**
    Block Public Access, remove bucket ACLs, tighten bucket policies.
32. **How would you share large files securely with external users?**
    Generate pre-signed URLs with expiry.
33. **How do you host a static website on S3?**
    Enable static website hosting on bucket, upload files, use Route 53/CloudFront for domain/CDN.
34. **Your S3 bill is too high — what steps will you take?**
    Analyze usage, enable lifecycle rules, move infrequent data to Glacier, remove unused versions.
35. **How do you implement disaster recovery with S3?**
    Enable CRR, versioning, and store backups in multiple regions.
36. **How do you integrate S3 with CloudFront?**
    Use S3 as origin → CloudFront caches content globally → faster delivery.
37. **How does S3 handle strong read-after-write consistency?**
    Immediately reflects new PUTs and DELETEs across all requests.
38. **Can you restrict access to S3 only from a specific VPC or IP range?**
    Yes, using VPC Endpoint policies or bucket policies with condition aws:SourceIp.
39. **How would you migrate PBs of on-prem data to S3 efficiently?**
    Use AWS Snowball, DataSync, or Storage Gateway.
40. **What are common security risks with S3 and how to prevent them?**

- Risk: Public buckets, misconfigured policies.
- Solution: Block public access, IAM least privilege, encryption, CloudTrail logging.

RDS

🌱 **Beginner-Level (Basics)**

1. **What is Amazon RDS?**
   Managed relational database service for MySQL, PostgreSQL, MariaDB, Oracle, and SQL Server.

2. **What are the benefits of using RDS?**
   Automated backups, patching, monitoring, scaling, high availability, and less admin overhead.
3. **What is a DB Instance in RDS?**
   The basic building block in RDS – an isolated database environment running on AWS.
4. **What engines are supported by RDS?**
   MySQL, PostgreSQL, MariaDB, Oracle, SQL Server, and Amazon Aurora.
5. **What is the difference between RDS and Aurora?**
   Aurora is AWS-built, MySQL/Postgres compatible, faster, highly available, and auto-scales storage.
6. **How does RDS handle backups?**
   Automated daily backups + user-initiated snapshots.
7. **What is Multi-AZ deployment in RDS?**
   Provides high availability by automatically replicating DB synchronously to a standby in another AZ.
8. **What are Read Replicas in RDS?**
   Asynchronous copies of the primary DB for read scaling and offloading queries.
9. **How do you connect to an RDS instance?**
   Using DB endpoint + port via client tools (e.g., MySQL Workbench, psql).
10. **What is the max storage supported in RDS?**
    Up to **64 TB** (depends on engine and instance type).

🌿 **Intermediate-Level (Features & Scaling)**

11. **Difference between Multi-AZ and Read Replica?**

- Multi-AZ = high availability (failover).
- Read Replica = read scaling (performance).

12. **How does RDS handle patching and upgrades?**
    Can be scheduled in a maintenance window, or applied manually.
13. **How does RDS provide high availability?**
    Multi-AZ replication + automated failover.
14. **How do you scale an RDS database?**

- Vertical: increase instance size.
- Horizontal: add Read Replicas.

15. **What are DB Parameter Groups in RDS?**
    Configuration templates for database engine settings.
16. **How does RDS ensure security?**
    IAM, VPC isolation, security groups, encryption at rest (KMS) and in transit (SSL).

17. **How are RDS backups stored?**
    Stored in S3, managed automatically by AWS.
18. **What is RDS Performance Insights?**
    Monitoring feature to analyze query performance and bottlenecks.
19. **What is RDS Enhanced Monitoring?**
    Provides OS-level metrics like CPU, memory, disk, processes.
20. **How does RDS handle automated failover?**
    In Multi-AZ, failover occurs automatically to the standby instance if primary fails.

🌳 **Advanced-Level (Optimization & DR)**

21. **How does RDS replication work?**
    Asynchronous (read replicas) or synchronous (Multi-AZ).
22. **How do you migrate data into RDS?**

- AWS DMS.
- Native engine tools (mysqldump, pg_dump).
- Snapshot restore.

23. **How does RDS handle disaster recovery?**
    Automated backups, cross-region read replicas, and snapshot copy.
24. **What is RDS Proxy?**
    Fully managed DB proxy that improves scalability and connection management.
25. **How do you optimize RDS performance?**
    Use read replicas, caching (ElastiCache), indexes, tuning parameter groups, scaling instance size.
26. **How does Aurora differ from standard RDS engines?**
    Aurora auto-scales storage, faster replication (millisecond latency), and is fault-tolerant by design.
27. **How do you encrypt RDS databases?**
    Enable encryption at creation (KMS); in-transit via SSL/TLS.
28. **Can you stop/start an RDS instance?**
    Yes, supported for non-Aurora DBs (up to 7 days stopped).
29. **What is the difference between RDS and DynamoDB?**

- RDS = relational, SQL queries, fixed schema.
- DynamoDB = NoSQL, key-value/document, highly scalable.

30. **How does Aurora handle replication?**
    Replicates six copies of data across 3 AZs, auto-heals storage failures.

🌟 Expert / Scenario-Based Questions

31. **Your RDS performance is slow — what steps will you take?**
    Check Performance Insights, scale instance, add read replicas, tune queries/indexes, use caching.
32. **How do you enable cross-region DR for RDS?**
    Create cross-region read replicas or copy snapshots to another region.
33. **What happens if the primary DB in Multi-AZ fails?**
    Failover automatically promotes standby as new primary with minimal downtime.
34. **How do you secure RDS from public access?**
    Place in private subnet, restrict SGs, enforce IAM/KMS encryption.
35. **Your RDS instance is reaching storage limit — what to do?**
    Enable auto-scaling for storage or manually increase allocated storage.
36. **How do you reduce costs in RDS?**
    Use reserved instances, stop dev/test DBs, right-size instances, use Aurora Serverless.
37. **How does Aurora Serverless work?**
    Scales compute up/down automatically based on load, billed per second of usage.
38. **How do you monitor and troubleshoot RDS?**
    CloudWatch metrics, Performance Insights, Enhanced Monitoring, DB logs.
39. **What is Amazon RDS Global Database (Aurora)?**
    A single Aurora DB spanning multiple regions for low-latency global reads and DR.
40. **How do you implement compliance (HIPAA/GDPR) in RDS?**
    Use encryption, auditing, logging, Multi-AZ, secure access, compliance-enabled regions.

Lambda

🌱 Beginner-Level (Basics)

1. **What is AWS Lambda?**
   A serverless compute service that runs code without provisioning servers.
2. **What languages does Lambda support?**
   Node.js, Python, Java, Go, .NET, Ruby, custom runtimes via API.

3. **What are the main benefits of Lambda?**
   Auto-scaling, pay-per-use, no server management, quick deployments.
4. **How is Lambda priced?**
   Based on request count + execution duration (GB-seconds).
5. **What is the maximum execution timeout?**
   15 minutes per function invocation.
6. **What is the max memory and CPU allocation?**
   Memory: 128 MB – 10 GB. CPU is proportional to memory.
7. **What is an Event Source in Lambda?**
   A service (like S3, API Gateway, DynamoDB, SQS) that triggers Lambda.
8. **Can Lambda run on a schedule?**
   Yes, using CloudWatch Events or EventBridge.
9. **What are Lambda Layers?**
   Reusable code or libraries shared across functions.
10. **Difference between Lambda and EC2?**
    EC2 = servers you manage. Lambda = serverless, event-driven.

🌿 **Intermediate-Level (Core Features)**

11. **How does Lambda handle scaling?**
    Automatically creates new instances per request (concurrent execution).
12. **What is a Cold Start in Lambda?**
    Delay when a new container is initialized for the first time.
13. **How do you reduce cold start time?**
    Use Provisioned Concurrency, keep functions lightweight.
14. **How does Lambda integrate with S3 / DynamoDB / Kinesis?**
    Lambda triggers automatically when new data/events occur.
15. **What is the max deployment package size?**
    50 MB (compressed), 250 MB (uncompressed).
16. **How do you secure Lambda functions?**
    IAM roles, VPC isolation, environment variable encryption (KMS).
17. **How do you manage environment variables?**
    Stored securely, can be encrypted with AWS KMS.
18. **What are DLQs in Lambda?**
    Dead Letter Queues (SQS/SNS) capture failed async executions.
19. **What is Lambda@Edge?**
    Runs Lambda functions at CloudFront edge locations for low-latency.
20. **Difference between sync vs async invocation?**

- Sync: waits for response (API Gateway).
- Async: queues event, retries automatically (S3, SNS).

🌳 Advanced-Level (Performance & Architecture)

21. **How does concurrency work in Lambda?**
    Each function scales with concurrent executions. Default limit = 1000.
22. **What is Provisioned Concurrency?**
    Pre-warms Lambda containers to avoid cold starts.
23. **How to monitor Lambda performance?**
    CloudWatch metrics, X-Ray tracing, Logs.
24. **How to debug Lambda failures?**
    Check CloudWatch logs, use DLQs, enable X-Ray.
25. **How do you handle large dependencies?**
    Use Layers, container images (up to 10 GB).
26. **What are Lambda Destinations?**
    Route success/failure results to SQS, SNS, EventBridge, Lambda.
27. **How to connect Lambda to VPC resources?**
    Assign VPC, subnet, and security group to the Lambda.
28. **How to optimize cost in Lambda-heavy apps?**
    Optimize memory, reduce execution time, use Step Functions for orchestration.
29. **How do you integrate Lambda with Step Functions?**
    Step Functions manage workflows by chaining multiple Lambdas.
30. **When not to use Lambda?**
    For long-running, compute-heavy, or low-latency workloads.

🌟 Expert / Scenario-Based

31. **How would you design a serverless API with Lambda?**
    Use API Gateway + Lambda + DynamoDB/RDS + IAM auth.
32. **Your Lambda is timing out — how to fix it?**
    Increase timeout, optimize code, place inside VPC for DB access.
33. **How do you process millions of S3 file uploads efficiently?**
    Trigger Lambda → push to SQS/Kinesis → batch processing.
34. **How do you ensure idempotency in Lambda executions?**
    Use unique request IDs, DynamoDB conditional writes, or SQS deduplication.
35. **What happens if a Lambda processing SQS message fails?**
    Retries, then message goes to DLQ.

36. **How to secure sensitive data in Lambda?**
    Use AWS Secrets Manager or KMS-encrypted environment variables.
37. **How would you migrate a monolithic app to Lambda?**
    Break into microservices/functions + API Gateway + Step Functions.
38. **How does Lambda handle retries in async calls?**
    Retries twice with exponential backoff before sending to DLQ.
39. **How do you design a real-time stream processor?**
    Kinesis → Lambda → store in DynamoDB/S3 → trigger further processing.
40. **How to troubleshoot Lambda performance bottlenecks?**
    Use X-Ray traces, CloudWatch metrics, optimize code, tune memory.

API Gateway

🌱 **Beginner-Level (Basics)**

1. **What is API Gateway?**
   A fully managed service to create, publish, secure, and monitor APIs at scale.
2. **What types of APIs does API Gateway support?**
   REST APIs, HTTP APIs, and WebSocket APIs.

3. **How is API Gateway priced?**
   Pay-per-call model: requests, data transfer out, and optional caching.
4. **What is the difference between REST API and HTTP API in API Gateway?**
   REST API = feature-rich (caching, usage plans). HTTP API = cheaper, faster, lightweight.
5. **What is an API Gateway stage?**
   A named reference (like dev, test, prod) with unique configurations and endpoints.
6. **What is a resource and method in API Gateway?**
   Resource = endpoint (e.g., /users). Method = HTTP operation (GET, POST, etc.).
7. **What are usage plans in API Gateway?**
   Throttling + quotas applied to API keys for rate limiting.
8. **How does API Gateway integrate with Lambda?**
   Invokes Lambda as backend for handling requests.
9. **What is caching in API Gateway?**
   Stores responses at the edge for faster performance and reduced backend load.
10. **How does API Gateway provide security?**
    Supports IAM auth, Cognito user pools, and custom Lambda authorizers.

🌿 **Intermediate-Level (Core Features)**

11. **How does throttling work in API Gateway?**
    Limits requests per second per stage/method to protect backend.
12. **What is the difference between regional, edge-optimized, and private endpoints?**

- Regional = direct regional access.
- Edge-optimized = via CloudFront for global access.
- Private = VPC-only access.

13. **What is a Lambda Authorizer?**
    A Lambda function that validates tokens (JWT, OAuth, custom headers).
14. **What is request/response transformation in API Gateway?**
    Modify request/response payloads using mapping templates (Velocity Template Language).
15. **What is integration type in API Gateway?**
    Specifies backend: Lambda, HTTP endpoint, AWS service proxy, or Mock integration.
16. **How do you enable monitoring for API Gateway?**
    Use CloudWatch metrics, logs, and X-Ray for tracing.
17. **What is stage variable in API Gateway?**
    Key-value pairs used to configure endpoints dynamically (e.g., Lambda ARN per stage).
18. **What are API Gateway quotas?**
    Limits total requests per day/week/month to control API usage.

19. **How to handle cross-origin requests (CORS)?**
    Enable CORS in API Gateway with correct headers (Access-Control-Allow-*).

20. **What are Gateway Responses?**
    Custom error responses for unauthorized, throttled, or failed requests.

🌳 **Advanced-Level (Performance & Architecture)**

21. **How does API Gateway scale with traffic?**
    Fully managed, scales automatically to handle millions of requests.

22. **What is WAF integration with API Gateway?**
    Protects APIs against threats like SQL injection and XSS.

23. **How do you optimize API Gateway performance?**
    Use caching, enable compression, choose HTTP APIs for simple workloads.

24. **What is the payload size limit in API Gateway?**
    Max 10 MB for request/response payload.

25. **What is mutual TLS in API Gateway?**
    Client certificate-based authentication for secure API access.

26. **How do you implement rate limiting for specific users?**
    Use API Keys + Usage Plans with per-user limits.

27. **What is the difference between synchronous vs asynchronous API calls?**
    Sync: Immediate response (HTTP APIs). Async: Event-driven via Lambda + SQS/SNS.

28. **How do you secure APIs for private VPC access?**
    Use VPC links with private integrations or private endpoints.

29. **How to migrate from REST API to HTTP API?**
    Re-create endpoints, test compatibility, shift traffic gradually.

30. **When should you use WebSocket APIs in API Gateway?**
    For real-time, bidirectional communication (e.g., chat, live updates).

🌞 **Expert / Scenario-Based**

31. **How would you design a secure public API with API Gateway?**
    API Gateway + WAF + Lambda Authorizer + Cognito for authentication.

32. **How do you handle versioning in API Gateway?**
    Use stages (v1, v2) or separate resources for different API versions.

33. **Your API Gateway returns 429 errors — what's happening?**
    Requests are throttled due to exceeding limits; increase quotas or optimize.

34. **How do you protect backend from overload when traffic spikes?**
    Use throttling, caching, and SQS decoupling behind API Gateway.

35. **How would you implement request validation in API Gateway?**
    Define request models and enable validation at API Gateway level.
36. **How do you secure sensitive data in API requests?**
    Use HTTPS/TLS, encrypt payloads, and integrate with KMS.
37. **How do you debug failed API requests?**
    Enable CloudWatch logs, trace with X-Ray, inspect Gateway Responses.
38. **How would you expose an internal service only to your apps?**
    Use private API Gateway with VPC endpoints.
39. **How to handle long-running requests with API Gateway + Lambda?**
    Offload work to SQS/EventBridge and return async acknowledgment.
40. **How do you design a multi-region API setup?**
    Deploy regional APIs, use Route 53 for latency-based routing, enable failover.

SNS (Simple Network Service)

🌱 Beginner-Level (Basics)

1. **What is Amazon SNS?**
   A fully managed pub/sub messaging service that delivers messages to subscribers.
2. **What are the main components of SNS?**
   Topics (channels) and Subscriptions (endpoints like SQS, Lambda, Email, SMS, HTTP).

3. **What protocols are supported by SNS?**
   HTTP/S, Email, SMS, SQS, Lambda, Mobile Push.
4. **What is the difference between SNS and SQS?**
   SNS = pub/sub push model, SQS = queue pull model.
5. **What is a topic in SNS?**
   A communication channel where publishers send messages that are delivered to subscribers.
6. **What is a subscription in SNS?**
   An endpoint that receives messages published to a topic.
7. **How does SNS ensure durability?**
   Stores messages across multiple AZs for high availability and fault tolerance.
8. **How is SNS priced?**
   Based on requests, data transfer, and SMS/email delivery charges.
9. **Can SNS trigger Lambda?**
   Yes, SNS can invoke Lambda directly as a subscriber.
10. **Difference between Standard vs FIFO topics in SNS?**
    Standard = high throughput, best-effort ordering. FIFO = strict ordering, exactly-once delivery.

🌿 **Intermediate-Level (Core Features)**

11. **What is message filtering in SNS?**
    Allows subscribers to receive only specific messages using filter policies.
12. **What are message attributes in SNS?**
    Metadata attached to messages for filtering or processing.
13. **How does SNS ensure message delivery?**
    Retries with exponential backoff for failed endpoints.
14. **How do you secure SNS topics?**
    IAM policies, topic policies, encryption (KMS), VPC endpoints.
15. **What is the maximum message size in SNS?**
    256 KB per message.
16. **How does SNS integrate with SQS?**
    SNS can fan out messages to multiple SQS queues for decoupled processing.
17. **What are delivery retries in SNS?**
    SNS retries for HTTP/S endpoints with exponential backoff if delivery fails.
18. **How can you encrypt SNS messages?**
    At-rest using KMS, in-transit using TLS.

19. **How to monitor SNS activity?**
    CloudWatch metrics (NumberOfMessagesPublished, DeliveryAttempts, FailedNotifications).

20. **What are DLQs in SNS?**
    Dead Letter Queues (SQS) to store undelivered messages for analysis.

🌳 **Advanced-Level (Performance & Architecture)**

21. **How does SNS handle scaling?**
    Fully managed, automatically scales to millions of messages per second.

22. **When would you choose FIFO SNS over Standard SNS?**
    When message ordering and exactly-once delivery are critical (e.g., financial apps).

23. **How to prevent duplicate messages in SNS?**
    Use FIFO topics with deduplication IDs.

24. **How to design fan-out architecture with SNS?**
    One SNS topic publishes messages to multiple SQS queues, Lambdas, or endpoints.

25. **How to secure SNS in private environments?**
    Use VPC endpoints (PrivateLink) for internal access.

26. **What is the delivery status feature in SNS?**
    Provides feedback about delivery success/failure for SMS/HTTP endpoints.

27. **How to reduce costs in SNS-heavy systems?**
    Use message filtering, avoid unnecessary fan-out, compress large payloads.

28. **What are SNS mobile push notifications?**
    SNS integrates with APNS, FCM, ADM to send push notifications to devices.

29. **How does SNS integrate with EventBridge?**
    SNS can act as a source for EventBridge, enabling event-driven workflows.

30. **How do you guarantee ordering when using SNS + SQS?**
    Use FIFO SNS topics with FIFO SQS queues.

🌟 **Expert / Scenario-Based**

31. **How would you build a global notification system with SNS?**
    Use SNS topics in multiple regions + cross-region subscriptions + CloudFront/Route 53 for routing.

32. **Your SMS delivery fails in SNS — how do you debug?**
    Check CloudWatch delivery status logs, verify phone carrier, inspect message limits.

33. **How would you send alerts to both email and Slack via SNS?**
    Use an SNS topic with multiple subscriptions: email + Lambda (to push to Slack).

34. **How do you ensure secure message delivery for financial data?**
    Use KMS encryption + HTTPS endpoints + strict IAM topic policies.
35. **How do you implement retry and error handling with SNS → Lambda?**
    Use DLQs for undelivered messages + CloudWatch alarms for monitoring.
36. **How to handle millions of IoT messages with SNS?**
    SNS → multiple SQS queues → consumer applications for scalable processing.
37. **What happens if a subscriber endpoint is down?**
    SNS retries with exponential backoff; if still undelivered, message goes to DLQ.
38. **How to use SNS for real-time notifications in a chat app?**
    Publish messages to an SNS topic → WebSocket/HTTP subscribers for real-time delivery.
39. **How would you migrate from polling-based architecture to SNS?**
    Replace polling with push-based SNS → subscribers (Lambda, SQS).
40. **When not to use SNS?**
    When you need message persistence, long delays, or complex workflows (use SQS/Step Functions instead).

SES(Simple Email Service)

🌱 **Beginner-Level (Basics)**

1. **What is Amazon SES?**
   A cloud-based, scalable, cost-effective service for sending and receiving emails securely.

2. **What are common use cases for SES?**
   Marketing emails, transactional emails (order confirmations, OTPs), and bulk campaigns.
3. **What protocols does SES support?**
   SMTP interface and AWS SDK/API.
4. **What is the difference between SES and SNS?**
   SES = sending/receiving emails, SNS = messaging/notifications to multiple channels.
5. **How does SES pricing work?**
   Pay per email sent/received and for attachments; first 62,000 emails/month are free if sent from EC2.
6. **What is the sending limit in SES?**
   Defined by the account's SES quota (daily sending quota + maximum send rate).
7. **What is a verified identity in SES?**
   An email address or domain you verify before sending emails to prevent spoofing.
8. **What is the difference between sandbox and production mode in SES?**
   Sandbox = restricted sending (only verified addresses). Production = unrestricted sending.
9. **What regions support SES?**
   Not all AWS regions support SES; must choose a supported region.
10. **Can SES receive emails?**
    Yes, SES can both send and receive emails with inbound rules.

🌿 **Intermediate-Level (Core Features)**

11. **What is DKIM in SES?**
    DomainKeys Identified Mail — used to sign emails for authentication and prevent spoofing.
12. **What is SPF in SES?**
    Sender Policy Framework — specifies which servers are allowed to send emails for your domain.
13. **How does SES handle bounces and complaints?**
    Provides feedback via SNS topics for bounce, complaint, or delivery notifications.
14. **What are configuration sets in SES?**
    Rules that let you track or control email sending (e.g., logging, monitoring, routing).
15. **What is the difference between hard bounce and soft bounce?**
    Hard = permanent failure (invalid address). Soft = temporary failure (mailbox full, server issue).
16. **How to secure SES?**
    Use IAM policies, verified domains, DKIM, SPF, and TLS for email sending.

17. **How does SES integrate with Lambda?**
    SES can trigger Lambda on receiving inbound emails for processing workflows.
18. **What is email feedback forwarding in SES?**
    Option to forward bounce/complaint messages to the sender's email address.
19. **How to monitor SES activity?**
    CloudWatch metrics (Send, Bounce, Complaint, Delivery rates) and SNS notifications.
20. **What is reputation dashboard in SES?**
    A dashboard showing bounce rates, complaint rates, and blacklist status.

🌳 **Advanced-Level (Performance & Architecture)**

21. **How does SES ensure high deliverability?**
    Uses domain authentication (SPF, DKIM, DMARC), IP warm-up, and reputation monitoring.
22. **What is DMARC in SES?**
    Domain-based Message Authentication, Reporting & Conformance — prevents spoofing and phishing.
23. **What is dedicated IP in SES?**
    An IP address reserved for your account to improve deliverability and sender reputation.
24. **What is IP warm-up in SES?**
    Gradual increase in sending volume from new IPs to build a good reputation.
25. **How does SES handle throttling?**
    SES enforces sending quotas; exceeding them leads to throttling errors.
26. **What are email templates in SES?**
    Predefined HTML/text templates for transactional or marketing emails.
27. **What is suppression list in SES?**
    A list of addresses that permanently bounced to avoid resending to them.
28. **What is the max email size in SES?**
    40 MB (including attachments).
29. **How does SES integrate with S3?**
    Incoming emails can be stored in S3 for archiving or further processing.
30. **How do you handle high-volume sending with SES?**
    Use configuration sets, dedicated IPs, and SNS monitoring for feedback loops.

🌞 **Expert / Scenario-Based**

31. **How would you design a system to send millions of emails per day?**
    Use SES with dedicated IPs, IP warm-up, SQS buffering, and monitoring via SNS + CloudWatch.

32. **Your emails are going to spam — how do you fix it?**
    Enable DKIM/SPF/DMARC, warm up IPs, improve email content quality, monitor complaint rates.
33. **How would you build an OTP/email verification system using SES?**
    Use SES API + Lambda to send OTPs and verify against user input.
34. **How do you track open and click rates in SES?**
    Use configuration sets with event publishing to CloudWatch, Kinesis, or S3.
35. **How do you build an inbound email processing system?**
    SES inbound → S3 → Lambda → process/store in DB.
36. **How would you separate marketing and transactional emails?**
    Use different configuration sets, domains, or dedicated IP pools.
37. **How to ensure compliance with GDPR/anti-spam laws in SES?**
    Get user consent, provide unsubscribe links, and manage suppression lists.
38. **How to implement multi-region email sending with SES?**
    Use SES in multiple supported regions + Route 53 failover for redundancy.
39. **How would you integrate SES with CRM systems?**
    Connect SES with Lambda/SQS for processing, then update CRM via APIs.
40. **When not to use SES?**
    When you need advanced marketing automation (use tools like Pinpoint or third-party providers).

CloudWatch

🌱 **Beginner-Level (Basics)**

1. **What is Amazon CloudWatch?**
   Monitoring and observability service for AWS resources, apps, and services.
2. **What are CloudWatch metrics?**
   Time-ordered data points that represent resource usage/performance.
3. **What are CloudWatch alarms?**
   Trigger actions (SNS, Auto Scaling, etc.) based on metric thresholds.
4. **Difference between CloudWatch Logs vs Metrics?**
   Metrics = numerical time-series data. Logs = raw event/application/system logs.
5. **What is the default retention of CloudWatch metrics?**
   15 months (granularity decreases over time).
6. **What is CloudWatch Agent?**
   Installed on EC2/on-prem servers to collect custom metrics & logs.
7. **What are CloudWatch dashboards?**
   Custom visualizations of metrics across AWS services.
8. **Difference between CloudTrail vs CloudWatch?**
   CloudTrail = API activity/audit logs. CloudWatch = performance/resource monitoring.
9. **Can you monitor on-prem servers with CloudWatch?**
   Yes, using CloudWatch Agent and hybrid monitoring.
10. **How is CloudWatch priced?**
    Based on metrics, dashboards, logs ingested, and custom events.

🌿 **Intermediate-Level (Core Features)**

11. **What is a custom metric in CloudWatch?**
    User-defined metric published via API/agent (e.g., app latency).
12. **What is high-resolution custom metric?**
    Metric with 1-second granularity (vs. standard 1-minute).
13. **What are metric filters in CloudWatch Logs?**
    Extract values from logs and convert them into metrics.
14. **What are CloudWatch Events (EventBridge)?**
    Responds to AWS service events (state changes, schedules, automation).
15. **What is anomaly detection in CloudWatch?**
    Uses ML to detect unusual patterns in metrics automatically.
16. **What is log subscription in CloudWatch?**
    Streams logs to destinations like Lambda, S3, or Kinesis for processing.
17. **What are composite alarms?**
    Alarm that combines multiple alarms into one condition.

18. **What is Contributor Insights in CloudWatch?**
    Identifies top contributors (IPs, users, etc.) to metric trends.
19. **What is cross-account monitoring?**
    CloudWatch can monitor and consolidate metrics from multiple AWS accounts.
20. **How do you secure CloudWatch Logs?**
    Encrypt logs (KMS), restrict access via IAM, and use VPC endpoints.

🌳 **Advanced-Level (Performance & Architecture)**

21. **How do you optimize CloudWatch cost?**
    Reduce retention, use filters, export old logs to S3/Glacier.
22. **How does CloudWatch integrate with Auto Scaling?**
    Alarms trigger scaling policies based on metrics (CPU, traffic).
23. **How do you monitor Lambda with CloudWatch?**
    Lambda automatically pushes logs & metrics (invocations, errors, duration).
24. **What are CloudWatch Embedded Metrics Format (EMF)?**
    JSON structure that logs + metrics together for richer observability.
25. **How do you enable real-time log monitoring?**
    Use metric filters + alarms, or stream logs via subscription filters.
26. **How does CloudWatch integrate with SIEM tools?**
    Export logs to S3/Kinesis → process with 3rd-party SIEM solutions.
27. **What is CloudWatch Logs Insights?**
    Interactive query engine for searching/analyzing log data.
28. **How does CloudWatch differ from Prometheus/Grafana?**
    CloudWatch = AWS-native monitoring. Prometheus/Grafana = open-source, flexible visualization.
29. **How to set up centralized logging across accounts?**
    Use cross-account log aggregation with subscription filters + S3/Kinesis.
30. **How does CloudWatch handle retention vs Glacier?**
    CloudWatch = short-term logs/metrics. Export to S3/Glacier for long-term retention.

🌼 **Expert / Scenario-Based**

31. **How would you troubleshoot high EC2 CPU usage with CloudWatch?**
    Check CPUUtilization metric, correlate with app logs, trigger Auto Scaling if needed.
32. **Your Lambda is failing intermittently — how do you debug?**
    Use CloudWatch Logs + X-Ray traces + metric alarms for failures.
33. **How do you monitor S3 bucket activity with CloudWatch?**
    Enable CloudTrail → send events to CloudWatch → set alarms.

34. **How do you monitor custom business KPIs with CloudWatch?**
    Publish custom metrics (e.g., orders processed/min) → create dashboards & alarms.

35. **How to monitor microservices in EKS with CloudWatch?**
    Install Container Insights, monitor pod/container-level metrics, and analyze logs.

36. **Your CloudWatch costs are very high — how do you fix?**
    Reduce retention, sample logs, filter only needed fields, move archives to S3.

37. **How would you implement alerting for failed login attempts across apps?**
    Send app logs → CloudWatch Logs Insights filter → set alarm → notify via SNS.

38. **How do you use anomaly detection for fraud detection?**
    Enable anomaly detection on transaction metrics to trigger alerts on unusual patterns.

39. **How to design centralized monitoring for 100 AWS accounts?**
    Use CloudWatch cross-account observability + AWS Organizations + dashboards.

40. **When not to use CloudWatch?**
    For very large-scale log analytics or visualization-heavy dashboards → use ELK, Datadog, or Grafana.

CloudFront

🌱 Beginner-Level (Basics)

1. **What is Amazon CloudFront?**
   A global Content Delivery Network (CDN) that caches content at edge locations to deliver low-latency and high transfer speeds.
2. **What are CloudFront edge locations?**
   Data centers worldwide that serve cached content closer to users.
3. **What are origins in CloudFront?**
   The source of content (S3 bucket, EC2, ALB, or on-prem server).
4. **What is a CloudFront distribution?**
   Configuration that tells CloudFront where to fetch and deliver content.
5. **What protocols does CloudFront support?**
   Supports HTTP, HTTPS, WebSockets, and HTTP/2.
6. **How does caching work in CloudFront?**
   Content is cached at edge locations with TTL defined by cache-control headers or behaviors.
7. **What is TTL in CloudFront?**
   Time-to-Live defines how long objects stay cached at edge locations.
8. **What are CloudFront behaviors?**
   Rules that define how CloudFront handles requests (e.g., caching, forwarding headers).
9. **Does CloudFront support dynamic content?**
   Yes, CloudFront can accelerate both static and dynamic content.
10. **How is CloudFront priced?**
    Based on data transfer out, requests, and additional features (WAF, logs, etc.).

🌿 Intermediate-Level (Core Features)

11. **What are signed URLs and signed cookies in CloudFront?**
    Methods to restrict access to private content.
12. **What is Origin Access Identity (OAI)?**
    Special identity that allows CloudFront to access private S3 buckets securely.
13. **What is Origin Access Control (OAC)?**
    Modern replacement for OAI, with better security (signed requests using SigV4).
14. **What are invalidations in CloudFront?**
    Manually remove cached objects before TTL expires.

15. **What is Lambda@Edge?**
    Run custom code at CloudFront edge locations to modify requests/responses.
16. **What is CloudFront Functions?**
    Lightweight JavaScript functions to run at edge with lower cost and faster execution than Lambda@Edge.
17. **What are geo-restrictions in CloudFront?**
    Restrict or allow content delivery based on user location.
18. **What is field-level encryption in CloudFront?**
    Encrypt specific sensitive data (like credit card numbers) at the edge before forwarding.
19. **What is the difference between CloudFront and Global Accelerator?**
    CloudFront = content caching. Global Accelerator = optimizes TCP/UDP traffic routing (no caching).
20. **How does CloudFront integrate with WAF?**
    Protects applications by filtering malicious traffic at the edge before reaching the origin.

🌳 **Advanced-Level (Performance & Architecture)**

21. **How does CloudFront handle SSL/TLS?**
    Supports HTTPS with AWS Certificate Manager (ACM) and custom SSL certs.
22. **What is the difference between default and custom SSL certificates?**
    Default = free CloudFront domain cert. Custom = ACM/3rd-party cert for custom domains.
23. **What is origin failover in CloudFront?**
    Provides high availability by routing traffic to a secondary origin if the primary fails.
24. **How do you debug CloudFront issues?**
    Enable logging (standard or real-time logs), use CloudWatch metrics, and trace request IDs.
25. **What is real-time log configuration?**
    Provides near real-time request data to Kinesis/DataStream for monitoring and analytics.
26. **How does CloudFront handle DDoS attacks?**
    Works with AWS Shield + WAF to absorb and filter malicious traffic.
27. **How do you secure CloudFront content delivery?**
    Use HTTPS, OAC/OAI, signed URLs/cookies, geo-restrictions, and WAF.
28. **What is the difference between CloudFront caching policies vs origin request policies?**
    Caching policy = controls cache keys. Origin request policy = controls what headers/query strings go to origin.
29. **What is CloudFront price class?**
    Lets you choose which edge locations serve traffic (cheapest, mid, or all).

30. **What's the difference between CloudFront and S3 Transfer Acceleration?**
    CloudFront = caching + delivery. Transfer Acceleration = speeds up S3 uploads/downloads via edge locations.

🌟 Expert / Scenario-Based

31. **How do you restrict access to private S3 content via CloudFront?**
    Use OAC/OAI + signed URLs/cookies + bucket policies.
32. **How would you handle cache busting in CloudFront?**
    Change object versioning (file name) or use invalidations.
33. **Your users are seeing stale content — how do you fix it?**
    Invalidate cache or lower TTL in caching policies.
34. **How do you serve different content to users in different countries?**
    Use geo-restrictions + Lambda@Edge/CloudFront Functions.
35. **How do you prevent hotlinking with CloudFront?**
    Use signed URLs/cookies or restrict referrer headers.
36. **How do you handle large file distribution with CloudFront?**
    Use multipart uploads, configure range requests, and tune TTL.
37. **How do you deliver low-latency APIs via CloudFront?**
    Use caching policies, enable compression, and accelerate dynamic requests.
38. **How do you secure an e-commerce app served via CloudFront?**
    HTTPS, WAF, Shield, signed cookies/URLs, field-level encryption, and OAC.
39. **How do you debug 403/504 errors in CloudFront?**
    Check OAC/OAI permissions, origin settings, and CloudWatch logs.
40. **When would you not use CloudFront?**
    For purely internal apps with no global traffic (use ALB/VPN instead).

Certificate Manager

🌱 Beginner-Level (Basics)

1. **What is AWS Certificate Manager (ACM)?**
   A service that provisions, manages, and deploys SSL/TLS certificates for AWS resources.
2. **What types of certificates can ACM issue?**
   Public certificates (free from ACM) and private certificates (via ACM Private CA).
3. **Which AWS services integrate directly with ACM?**
   CloudFront, ALB, NLB, API Gateway, Elastic Beanstalk, etc.
4. **How do you request a public certificate in ACM?**
   Through the console/CLI, validated via DNS or email.
5. **Where are ACM certificates stored?**
   Securely managed by AWS, private keys are never exposed.
6. **Do ACM certificates support auto-renewal?**
   Yes, ACM automatically renews public and private certificates before expiration.
7. **What is the difference between DNS validation and email validation in ACM?**
   DNS validation uses CNAME records (preferred); email validation requires approval via domain contact email.
8. **Does ACM support wildcard certificates?**
   Yes, e.g., *.example.com covers all subdomains.
9. **Can ACM certificates be exported?**
   Public ACM certs = ❌ Not exportable. Private CA certs = ✅ Exportable.
10. **What is ACM Private CA?**
    A managed private certificate authority to issue internal certs for apps, devices, or IoT.

🌿 Intermediate-Level (Core Features)

11. **What is the limit of domains in one ACM certificate?**
    Up to 100 domain names (SAN – Subject Alternative Names).
12. **How does ACM integrate with CloudFront?**
    You attach an ACM certificate (issued in us-east-1) to CloudFront for HTTPS.
13. **What regions are ACM certificates available in?**
    Public certs are region-specific except for CloudFront, which requires us-east-1.
14. **How does ACM handle certificate renewal failures?**
    ACM retries multiple times; if DNS/email validation is missing, renewal fails.
15. **What's the difference between ACM and IAM certificates?**
    IAM certs = manually uploaded; ACM certs = managed and auto-renewed.

16. **How does ACM support hybrid environments?**
    By using ACM Private CA + exporting private certs for on-prem use.
17. **What is a certificate chain?**
    Includes root, intermediate, and end-entity certs to establish trust.
18. **What security standard does ACM follow?**
    ACM certs use RSA (2048-bit+) or ECDSA for strong encryption.
19. **What is the difference between public and private ACM certs?**
    Public = trusted by internet browsers, free. Private = internal use via ACM Private CA (paid).
20. **Can ACM issue Extended Validation (EV) certificates?**
    ❌ No, only DV (Domain Validated) certificates are supported.

🌳 **Advanced-Level (Architecture & Troubleshooting)**

21. **How do you enforce HTTPS using ACM?**
    Attach ACM certs to ALB/CloudFront and configure HTTP-to-HTTPS redirects.
22. **How do you migrate certificates from another CA to ACM?**
    Import third-party cert + private key into ACM.
23. **How do you secure an internal API with ACM?**
    Use ACM Private CA, issue private certs, and attach to API Gateway/NLB.
24. **How does ACM integrate with AWS Load Balancers?**
    Certificates are bound to HTTPS listeners on ALB/NLB.
25. **How do you troubleshoot an ACM certificate not showing in CloudFront?**
    Check if the certificate is in us-east-1, DNS validation is complete, and domain names match.
26. **What happens if an ACM certificate expires?**
    HTTPS connections fail; ACM auto-renewal avoids this risk.
27. **How does ACM handle multi-region apps?**
    Certificates must be requested/imported separately in each region (except CloudFront).
28. **How do you revoke a private certificate?**
    Through ACM Private CA CRL (Certificate Revocation List).
29. **How can you monitor ACM certificate health?**
    Use CloudWatch Events and AWS Config rules for certificate expiration alerts.
30. **What's the difference between AWS ACM and Let's Encrypt?**
    Both issue free certs; ACM is AWS-managed with auto-renewal, Let's Encrypt needs manual/automated scripts.

🌟 **Expert / Scenario-Based**

31. **How do you restrict access to an internal web app with ACM?**
    Use ACM Private CA certs + mutual TLS authentication.

32. **How do you handle HTTPS for a multi-domain SaaS app?**
    Use SAN certificates (multiple domains in one cert) or wildcard certs via ACM.

33. **What's your approach if a certificate renewal failed in ACM?**
    Check DNS/email validation records, re-validate, and retry.

34. **How do you enforce client-side encryption with ACM?**
    Use mutual TLS where both server and client present certificates.

35. **How do you support IoT devices with ACM?**
    Issue private certs via ACM Private CA for device authentication.

36. **What's the difference between ACM Private CA and AWS IoT Core certs?**
    ACM Private CA = enterprise-grade CA. IoT Core certs = specific to IoT device authentication.

37. **How do you secure a multi-account setup with ACM?**
    Use ACM Private CA in a central account + share certs via AWS Resource Access Manager (RAM).

38. **How do you integrate ACM with Kubernetes (EKS)?**
    Use AWS Load Balancer Controller with ACM certs for ingress HTTPS.

39. **How do you migrate from IAM certificates to ACM?**
    Export IAM cert → Import into ACM → Re-attach to ALB/CloudFront.

40. **When would you not use ACM?**
    If you need EV certificates or certs outside AWS (not supported natively).

Route53

🌱 Beginner-Level (Basics)

1. **What is Amazon Route 53?**
   A highly available and scalable DNS (Domain Name System) service by AWS.
2. **What are the main functions of Route 53?**
   Domain registration, DNS routing, and health checking.
3. **What is a hosted zone in Route 53?**
   A container for DNS records for a specific domain (public or private).
4. **What DNS record types are supported in Route 53?**
   A, AAAA, CNAME, MX, TXT, NS, Alias, etc.
5. **What is an Alias record in Route 53?**
   A Route 53–specific record that maps to AWS resources (like CloudFront, ALB) without needing an IP.
6. **What is the difference between public and private hosted zones?**
   Public = accessible over the internet. Private = accessible only inside a VPC.
7. **What is TTL (Time to Live) in DNS?**
   The time a DNS resolver caches a record before refreshing.
8. **How does Route 53 provide high availability?**
   Through a global network of DNS servers and health checks.
9. **How do you register a domain in Route 53?**
   Using the domain registration feature directly in the console.
10. **What is health check in Route 53?**
    A monitoring feature to route traffic only to healthy endpoints.

🌿 Intermediate-Level (Core Features)

11. **What are the different routing policies in Route 53?**
    Simple, Weighted, Latency-based, Failover, Geolocation, Geoproximity, and Multi-Value.
12. **What is Weighted Routing in Route 53?**
    Distributes traffic across resources based on percentage weights you assign.
13. **How does Latency-based Routing work?**
    Routes traffic to the region with the lowest network latency for the user.
14. **What is Failover Routing?**
    Routes traffic to a primary resource and fails over to a secondary if the primary is unhealthy.

15. **What is the difference between Geolocation and Geoproximity routing?**
    Geolocation = based on user's location.
    Geoproximity = based on user's location + bias to shift traffic.
16. **What is Multi-Value Answer Routing?**
    Returns multiple healthy IPs in DNS queries for load distribution.
17. **How does Route 53 integrate with CloudFront?**
    By mapping an Alias record from the domain to the CloudFront distribution.
18. **How does Route 53 support hybrid cloud?**
    Via private hosted zones and Route 53 Resolver endpoints to connect on-prem DNS with AWS.
19. **What are Route 53 Resolver rules?**
    Forwarding or conditional DNS rules for cross-VPC and hybrid environments.
20. **Can Route 53 handle DNSSEC?**
    Yes, Route 53 supports DNSSEC signing for domain security.

🌳 **Advanced-Level (Architecture & Troubleshooting)**

21. **How do you design a DR strategy with Route 53?**
    Use Failover Routing + Health checks to switch between primary and secondary regions.
22. **How would you handle Blue-Green deployments with Route 53?**
    Use Weighted Routing to gradually shift traffic between versions.
23. **How can Route 53 improve global app performance?**
    Using Latency-based Routing or Geoproximity routing to direct users to nearest AWS region.
24. **What happens if all records in a Weighted Routing policy fail health checks?**
    Route 53 returns no healthy records (DNS resolution fails).
25. **How do you restrict users from certain countries in Route 53?**
    Use Geolocation routing to allow/deny traffic based on location.
26. **What's the difference between Alias and CNAME in Route 53?**
    Alias works at root domains and is free inside AWS; CNAME doesn't work at root and incurs charges.
27. **How do you achieve multi-region active-active setup with Route 53?**
    Combine Latency-based Routing with health checks across multiple regions.
28. **How does Route 53 achieve SLA of 100% availability?**
    By using a global anycast network of DNS servers with redundancy.
29. **What's the difference between Route 53 and traditional DNS providers?**
    Route 53 integrates with AWS services, supports Alias records, health checks, and advanced routing policies.

30. **How do you troubleshoot if a Route 53 record isn't resolving?**
    Check propagation (TTL), NS delegation, hosted zone setup, and DNS validation.

🌟 Expert / Scenario-Based

31. **How would you migrate DNS from another provider to Route 53?**
    Export existing records, create a hosted zone in Route 53, import records, and update registrar NS.
32. **How do you secure Route 53 DNS records?**
    Enable DNSSEC, restrict IAM permissions, and use AWS CloudTrail for auditing.
33. **How can Route 53 be used in a hybrid DNS setup?**
    Use Route 53 Resolver with inbound/outbound endpoints to forward queries between AWS and on-prem.
34. **How do you route traffic across multiple AWS accounts using Route 53?**
    Share hosted zones via AWS RAM or use cross-account delegation with NS records.
35. **How would you implement GDPR compliance with Route 53?**
    Use Geolocation routing to restrict or redirect EU user traffic to EU-only endpoints.
36. **How would you integrate Route 53 with API Gateway custom domains?**
    Create an Alias record pointing to API Gateway domain name.
37. **How do you monitor Route 53 DNS queries?**
    Enable Route 53 Query Logging with CloudWatch Logs or S3.
38. **How do you protect against DNS spoofing/attacks in Route 53?**
    Enable DNSSEC, use IAM least privilege, and CloudWatch alarms for anomalies.
39. **How do you reduce DNS propagation time in Route 53?**
    Lower the TTL before making changes to records.
40. **When would you not use Route 53?**
    If you need enterprise DNS features like GSLB with advanced traffic steering outside AWS ecosystem.

IAM

🌱 Beginner-Level (Basics)

1. **What is IAM in AWS?**
   IAM is a service that helps securely manage access to AWS services and resources.
2. **What are IAM users?**
   Individual identities with credentials to access AWS resources.
3. **What are IAM groups?**
   Collections of users that share the same permissions.
4. **What are IAM roles?**
   Identities with temporary permissions that can be assumed by users, applications, or AWS services.
5. **What are IAM policies?**
   JSON documents that define permissions (allow/deny actions on resources).
6. **What are the types of policies in IAM?**
   AWS managed, customer managed, and inline policies.
7. **What is the difference between an IAM role and an IAM user?**
   User = permanent identity with credentials. Role = temporary access for trusted entities.
8. **What are IAM identity providers?**
   They allow external users (e.g., via SAML or OIDC) to access AWS using federation.
9. **What is the IAM root user?**
   The account owner with full privileges; should be used minimally with MFA.
10. **What is MFA in IAM?**
    Multi-Factor Authentication adds an extra security layer by requiring a second factor (e.g., OTP).

🌿 Intermediate-Level (Core Features)

11. **What is the principle of least privilege in IAM?**
    Grant only the minimum permissions needed for a task.
12. **How do IAM roles work with EC2?**
    Roles can be attached to EC2 instances so applications can securely access AWS resources without storing credentials.
13. **What are service-linked roles?**
    Roles preconfigured by AWS services to perform actions on your behalf.
14. **What are IAM permissions boundaries?**
    Advanced feature to set the maximum permissions an identity can have.

15. **What are IAM access keys?**
    Credentials (access key ID + secret key) for programmatic AWS access.
16. **What is IAM credential report?**
    A report showing the status of all IAM users, their credentials, and security status.
17. **What are IAM access advisor and IAM access analyzer?**
    Access advisor = shows last-used permissions.
    Access analyzer = identifies unused or risky permissions.
18. **What are inline vs managed policies?**
    Inline = directly attached to one user/role/group.
    Managed = reusable across multiple identities.
19. **How do you restrict access to an S3 bucket using IAM?**
    By attaching IAM policies or resource-based bucket policies with least privilege.
20. **What are resource-based vs identity-based policies?**
    Identity-based = attached to user/role/group.
    Resource-based = attached directly to a resource (e.g., S3 bucket policy).

🌳 **Advanced-Level (Architecture & Scenarios)**

21. **How does IAM integrate with STS (Security Token Service)?**
    STS provides temporary credentials for roles or federated users.
22. **How do you use IAM for cross-account access?**
    Create a role in Account A and allow users from Account B to assume it via trust policies.
23. **What's the difference between trust policy and permission policy?**
    Trust policy = who can assume the role.
    Permission policy = what the role can do once assumed.
24. **How do you secure the IAM root user?**
    Enable MFA, remove access keys, and use it only for account setup.
25. **What is IAM policy evaluation logic (policy evaluation order)?**
    Explicit Deny > Allow > Default Deny (no permission = denied).
26. **How do you enforce password policies in IAM?**
    By setting account-wide password requirements like length, complexity, and rotation.
27. **What is the IAM policy simulator?**
    A tool to test and troubleshoot policy permissions before applying them.
28. **What is identity federation in IAM?**
    Allows external identities (Google, AD, etc.) to access AWS without creating IAM users.
29. **How do you handle IAM scalability in large organizations?**
    Use AWS Organizations with Service Control Policies (SCPs) for central permission management.

30. **How do IAM conditions work in a policy?**
    You can add conditions (e.g., IP address, time, MFA status) for fine-grained control.

🌟 Expert / Scenario-Based

31. **How do you rotate IAM access keys securely?**
    Create a new key, update apps to use it, then deactivate and delete the old key.
32. **How do you implement least privilege across 100s of developers?**
    Use groups, managed policies, SCPs, and Access Analyzer to continuously refine.
33. **How would you audit IAM activities?**
    Use CloudTrail for logging, Config for compliance, and credential reports.
34. **How do you handle IAM in a hybrid environment (on-prem + AWS)?**
    Use federation with Active Directory/SSO (via SAML/OIDC).
35. **How do you implement just-in-time access in IAM?**
    Use STS to grant temporary credentials with limited lifetime.
36. **What is a use case for permission boundaries?**
    To delegate role creation while limiting max permissions a role can grant.
37. **How would you design IAM for a multi-account AWS setup?**
    Use AWS Organizations, SCPs, centralized IAM roles, and cross-account trust.
38. **What are some IAM best practices?**
    Enable MFA, follow least privilege, rotate keys, use roles over long-term keys, monitor with CloudTrail.
39. **How can IAM be used with API Gateway or Lambda?**
    Use IAM roles for execution permissions and IAM auth for securing APIs.
40. **When would you NOT use IAM users?**
    For applications or external access—use roles, STS, or federation instead.