

# CKS Exam Questions and Answers

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## Question 1: Falco Runtime Security Detection

**Weight:** 7% | **Domain:** Monitoring, Logging & Runtime Security | **Difficulty:** Medium

### Question

Three deployments exist in namespace `apps`: `nvidia-gpu`, `cpu`, and `ollama`. Pods from one of these deployments are accessing `/dev/mem`, causing memory issues on the node.

### Task:

1. Use Falco to identify which pod is accessing `/dev/mem`
2. Scale the related deployment to 0 replicas
3. Save findings:
  - Pod name to: `/opt/course/01/pod-name.txt`
  - Falco alert line to: `/opt/course/01/falco-alert.txt`

### Answer

```
# Find which node the apps pods are running on
kubectl get pods -n apps -o wide

# SSH to that node and check Falco logs
ssh <node-name> journalctl -u falco --no-pager | grep -i mem

# Scale down the offending deployment (ollama)
kubectl scale deployment ollama -n apps --replicas=0

# Save findings
mkdir -p /opt/course/01
kubectl get pods -n apps -l app=ollama -o
jsonpath='{.items[0].metadata.name}' > /opt/course/01/pod-name.txt
echo "<timestamp> Notice Read sensitive device /dev/mem by
container=ollama pod=ollama-xxxxx" > /opt/course/01/falco-alert.txt
```

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## Question 2: Worker Node Kubernetes Upgrade

**Weight:** 5% | **Domain:** Cluster Hardening | **Difficulty:** Medium

### Question

A worker node named `node-01` is running kubelet version 1.34.0. The control plane is already at version 1.34.1.

**Task:** Upgrade the worker node to version 1.34.1

**Save:**

- Pre-upgrade version: `/opt/course/02/node-version-before.txt`
- Post-upgrade version: `/opt/course/02/node-version-after.txt`

Answer

```
# Save current version (from controlplane)
kubectl get nodes <worker-node> -o
jsonpath='{.status.nodeInfo.kubeletVersion}' > /opt/course/02/node-
version-before.txt

# SSH to worker node
ssh <worker-node>

# Update apt and check the kubeadm package
sudo apt update
sudo apt-cache madison kubeadm

# Check the current kubeadm package afterwards
sudo dpkg -l | grep kubeadm

# Upgrade kubeadm
sudo apt-mark unhold kubeadm && \
sudo apt-get update && sudo apt-get install -y kubeadm='1.34.1-1.1' && \
sudo apt-mark hold kubeadm

# Upgrade node configuration
sudo kubeadm upgrade node

# From controlplane (new terminal) - drain the node
kubectl drain <node-name> --ignore-daemonsets --delete-emptydir-data --
force

# Back on worker node - upgrade kubelet and kubectl
sudo apt-mark unhold kubelet kubectl && \
sudo apt-get update && sudo apt-get install -y kubelet='1.34.1-1.1'
kubectl='1.34.1-1.1' && \
sudo apt-mark hold kubelet kubectl

# Restart kubelet
sudo systemctl daemon-reload
sudo systemctl restart kubelet
exit

# From controlplane - uncordon
kubectl uncordon <worker-node>

# Save post-upgrade version
kubectl get nodes <worker-node> -o
jsonpath='{.status.nodeInfo.kubeletVersion}' > /opt/course/02/node-
version-after.txt
```

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## Question 3: Ingress with TLS

**Weight:** 5% | **Domain:** Cluster Setup | **Difficulty:** Easy

## Question

A TLS secret named `tls-secret` exists in namespace `secure-app`. A service named `secure-service` is running on port 80.

**Task:** Create an Ingress named `secure-ingress` that:

- Uses TLS secret `tls-secret`
- Redirects HTTP to HTTPS
- Routes traffic for `secure.example.com` to `secure-service:80`

**Save:** `/opt/course/03/ingress.yaml`

## Answer

```
# Check the ingress-nginx controller is installed and running
k -n ingress-nginx get pods

# Generate the Ingress manifest using kubectl
kubectl -n secure-app create ingress secure-ingress \
  --class=nginx \
  --rule="secure.example.com/*=secure-service:80,tls=tls-secret" \
  --annotation="nginx.ingress.kubernetes.io/ssl-redirect=true" \
  --dry-run=client -o yaml | tee /opt/course/03/ingress.yaml

# Apply it
kubectl apply -f /opt/course/03/ingress.yaml
```

**Or manually create the YAML:**

```
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: secure-ingress
  namespace: secure-app
  annotations:
    nginx.ingress.kubernetes.io/ssl-redirect: "true"
spec:
  ingressClassName: nginx
  tls:
  - hosts:
    - secure.example.com
    secretName: tls-secret
  rules:
  - host: secure.example.com
    http:
      paths:
      - path: /
        pathType: Prefix
        backend:
          service:
            name: secure-service
            port:
              number: 80
```

```
kubectl apply -f /opt/course/03/ingress.yaml
```

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## Question 4: SBOM Generation

**Weight:** 4% | **Domain:** Supply Chain Security | **Difficulty:** Easy

### Question

Generate an SBOM for the container image `nginx:1.25-`

`alpine@sha256:721fa00bc549df26b3e67cc558ff176112d4ba69847537766f3c28e171d180e7`

### Task:

1. Save SBOM to: `/opt/course/04/sbom.spdx`
2. Query for SSL packages, save to: `/opt/course/04/ssl-packages.txt`
3. Find `libcrypto3` version, save to: `/opt/course/04/libcrypto-version.txt`

### Answer

```
mkdir -p /opt/course/04

# Generate SBOM
bom generate -o /opt/course/04/sbom.spdx --image nginx:1.25-
alpine@sha256:721fa00bc549df26b3e67cc558ff176112d4ba69847537766f3c28e171d1
80e7

# Query for SSL packages
# ⚠ IMPORTANT: The --fields argument MUST be quoted: --fields
'name,version'
# Without quotes, bash interprets the comma as a command separator!
bom document query /opt/course/04/sbom.spdx 'name:ssl' --fields
'name,version' > /opt/course/04/ssl-packages.txt
bom document query /opt/course/04/sbom.spdx 'name:openssl' --fields
'name,version' >> /opt/course/04/ssl-packages.txt

# Get libcrypto3 version
bom document query /opt/course/04/sbom.spdx 'name:libcrypto3' --fields
'name,version' > /opt/course/04/libcrypto-version.txt
```

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## Question 5: Create TLS Secret

**Weight:** 2% | **Domain:** Cluster Setup | **Difficulty:** Very Easy

### Question

Create a TLS secret using provided certificate and key files.

#### Requirements:

- Certificate: `/opt/course/05/tls.crt`
- Key: `/opt/course/05/tls.key`
- Secret name: `my-tls-secret`
- Namespace: `secure-ns`

**Save command to:** `/opt/course/05/create-secret.txt`

### Answer

```
kubectl create secret tls my-tls-secret \  
  --cert=/opt/course/05/tls.crt \  
  --key=/opt/course/05/tls.key \  
  -n secure-ns  
  
echo "kubectl create secret tls my-tls-secret --  
cert=/opt/course/05/tls.crt --key=/opt/course/05/tls.key -n secure-ns" >  
/opt/course/05/create-secret.txt
```

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## Question 6: Docker Daemon Hardening

**Weight:** 5% | **Domain:** System Hardening | **Difficulty:** Medium

### Question

SSH to the cluster node and secure the Docker daemon:

1. Remove user `developer` from the `docker` group
2. Set `/var/run/docker.sock` group ownership to `root`
3. Remove any TCP listener configuration
4. Restart Docker daemon

### Save:

- Socket permissions before: `/opt/course/06/socket-before.txt`
- Socket permissions after: `/opt/course/06/socket-after.txt`
- daemon.json content: `/opt/course/06/daemon.json`

### Answer

```
ssh <worker-node>

# Save current permissions
ls -la /var/run/docker.sock > /opt/course/06/socket-before.txt

# Remove user from docker group
sudo gpasswd -d developer docker

# Configure Docker daemon
echo '{"group": "root"}' | sudo tee /etc/docker/daemon.json

# Save daemon.json
sudo cp /etc/docker/daemon.json /opt/course/06/daemon.json

# Restart Docker
sudo systemctl restart docker

# Save new permissions
ls -la /var/run/docker.sock > /opt/course/06/socket-after.txt

exit

kubectl get nodes
```

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## Question 7: Network Policy

**Weight:** 7% | **Domain:** Cluster Setup | **Difficulty:** Medium-Hard

### Question

Create two NetworkPolicies:

1. `deny-all-ingress` in `prod` namespace - deny ALL ingress traffic
2. `allow-from-prod` in `data` namespace - allow ingress ONLY from pods in `prod` namespace with label `env: prod`

**Save:**

- `/opt/course/07/deny-all-ingress.yaml`
- `/opt/course/07/allow-from-prod.yaml`

### Answer

**deny-all-ingress.yaml:**

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: deny-all-ingress
  namespace: prod
spec:
  podSelector: {}
  policyTypes:
  - Ingress
```

**allow-from-prod.yaml:**

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-from-prod
  namespace: data
spec:
  podSelector: {}
  policyTypes:
  - Ingress
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          env: prod
      podSelector:
        matchLabels:
          env: prod
```

```
kubectl apply -f /opt/course/07/deny-all-ingress.yaml
kubectl apply -f /opt/course/07/allow-from-prod.yaml
```

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## Question 8: ServiceAccount Token with Projected Volume

**Weight:** 5% | **Domain:** Cluster Hardening | **Difficulty:** Medium

### Question

ServiceAccount `backend-sa` and Deployment `backend-deploy` exist in namespace `secure`.

**Task:**

1. Disable automatic token mounting on the ServiceAccount

2. Manually mount the token using a projected volume with:

- expirationSeconds: 3600
- path: token
- Mount at: `/var/run/secrets/kubernetes.io/serviceaccount`

**Save:**

- `/opt/course/08/serviceaccount.yaml`
- `/opt/course/08/deployment.yaml`

**Answer**

**serviceaccount.yaml:**

```
apiVersion: v1
kind: ServiceAccount
metadata:
  name: backend-sa
  namespace: secure
automountServiceAccountToken: false
```

**deployment.yaml:**

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: backend-deploy
  namespace: secure
spec:
  replicas: 1
  selector:
    matchLabels:
      app: backend
  template:
    metadata:
      labels:
        app: backend
    spec:
      serviceAccountName: backend-sa
      containers:
        - name: backend
          image: nginx:1.25-alpine
          ports:
            - containerPort: 80
          volumeMounts:
            - name: token
              mountPath: /var/run/secrets/kubernetes.io/serviceaccount
              readOnly: true
      volumes:
        - name: token
          projected:
            sources:
              - serviceAccountToken:
                  expirationSeconds: 3600
                  path: token
```

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## Question 9: Configure Kubernetes Auditing

**Weight:** 7% | **Domain:** Monitoring, Logging and Runtime Security | **Difficulty:** Medium-Hard

### Question

Configure the kube-apiserver to enable auditing:

1. Create audit policy at `/etc/kubernetes/audit/policy.yaml`:

- Log `secrets` at `Metadata` level
- Log `configmaps` at `Metadata` level
- Log `namespaces` at `RequestResponse` level

## 2. Configure API server with:

- `--audit-policy-file=/etc/kubernetes/audit/policy.yaml`
- `--audit-log-path=/var/log/kubernetes/audit/audit.log`
- `--audit-log-maxage=2`
- `--audit-log-maxbackup=10`

**Save:** `/opt/course/09/audit-policy.yaml`

Answer

**audit-policy.yaml:**

```
apiVersion: audit.k8s.io/v1
kind: Policy
rules:
  - level: Metadata
    resources:
      - group: ""
        resources: ["secrets"]

  - level: Metadata
    resources:
      - group: ""
        resources: ["configmaps"]

  - level: RequestResponse
    resources:
      - group: ""
        resources: ["namespaces"]

  - level: Metadata
    omitStages:
      - RequestReceived
```

```
sudo mkdir -p /etc/kubernetes/audit
sudo mkdir -p /var/log/kubernetes/audit

# Save audit policy
cat << 'POLICY' | sudo tee /etc/kubernetes/audit/policy.yaml
apiVersion: audit.k8s.io/v1
kind: Policy
rules:
  - level: Metadata
    resources:
      - group: ""
        resources: ["secrets"]
  - level: Metadata
    resources:
      - group: ""
        resources: ["configmaps"]
  - level: RequestResponse
    resources:
      - group: ""
        resources: ["namespaces"]
  - level: Metadata
    omitStages:
      - RequestReceived
POLICY

# Edit kube-apiserver manifest and add:
# Flags:
#   - --audit-policy-file=/etc/kubernetes/audit/policy.yaml
#   - --audit-log-path=/var/log/kubernetes/audit/audit.log
#   - --audit-log-maxage=2
#   - --audit-log-maxbackup=10
#
# volumeMounts:
#   - mountPath: /etc/kubernetes/audit
#     name: audit-policy
#     readOnly: true
#   - mountPath: /var/log/kubernetes/audit
#     name: audit-log
#
# volumes:
#   - hostPath:
#       path: /etc/kubernetes/audit
#       type: DirectoryOrCreate
#     name: audit-policy
#   - hostPath:
#       path: /var/log/kubernetes/audit
#       type: DirectoryOrCreate
#     name: audit-log
```

## Question 10: ImagePolicyWebhook Admission Controller

**Weight:** 7% | **Domain:** Supply Chain Security | **Difficulty:** Medium-Hard

### Question

Enable the ImagePolicyWebhook admission controller:

1. Add `ImagePolicyWebhook` to `--enable-admission-plugins`
2. Set `--admission-control-config-file`
3. Set `defaultAllow` to `false`
4. Set webhook server URL to: `https://image-policy-webhook.default.svc:443/image_policy`

**Save:**

- `/opt/course/10/admission-config.yaml`
- `/opt/course/10/kubeconfig.yaml`

### Answer

**admission\_config.yaml:**

```
apiVersion: apiserver.config.k8s.io/v1
kind: AdmissionConfiguration
plugins:
- name: ImagePolicyWebhook
  configuration:
    imagePolicy:
      kubeConfigFile: /etc/kubernetes/epconfig/kubeconfig.yaml
      allowTTL: 50
      denyTTL: 50
      retryBackoff: 500
      defaultAllow: false
```

**kubeconfig.yaml:**

```
apiVersion: v1
kind: Config
clusters:
- name: image-policy-webhook
  cluster:
    server: https://image-policy-webhook.default.svc:443/image_policy
    certificate-authority: /etc/kubernetes/epconfig/webhook-ca.crt
users:
- name: api-server
  user:
    client-certificate: /etc/kubernetes/epconfig/client.crt
    client-key: /etc/kubernetes/epconfig/client.key
contexts:
- name: default
  context:
    cluster: image-policy-webhook
    user: api-server
current-context: default
```

#### API server manifest changes:

```
# Add to --enable-admission-plugins:
- --enable-admission-plugins=NodeRestriction,ImagePolicyWebhook

# Add flag:
- --admission-control-config-
file=/etc/kubernetes/epconfig/admission_config.yaml

# Add volumeMount:
- mountPath: /etc/kubernetes/epconfig
  name: epconfig
  readOnly: true

# Add volume:
- hostPath:
    path: /etc/kubernetes/epconfig
    type: DirectoryOrCreate
  name: epconfig
```

---

## Question 11: Pod Security Admission

**Weight:** 7% | **Domain:** Minimize Microservice Vulnerabilities | **Difficulty:** Medium

### Question

Namespace `team-blue` has PSA configured with `restricted` level. Some pods don't comply.

**Task:**

1. Use `kubectl label --dry-run=server` to identify violations
2. Delete non-compliant pods
3. Keep compliant pods running

**Save:**

- Warning output: `/opt/course/11/violations.txt`
- Deleted pod names: `/opt/course/11/deleted-pods.txt`
- Command used: `/opt/course/11/command.txt`

**Answer**

```
# Identify violations
kubectl label --dry-run=server --overwrite ns team-blue \
    pod-security.kubernetes.io/enforce=restricted 2>&1 | tee
/opt/course/11/violations.txt

# Save command
echo 'kubectl label --dry-run=server --overwrite ns team-blue pod-
security.kubernetes.io/enforce=restricted' > /opt/course/11/command.txt

# Delete non-compliant pods (based on warning output)
kubectl delete pod hostnetwork-pod -n team-blue
kubectl delete pod root-pod -n team-blue
kubectl delete pod escalation-pod -n team-blue

# Save deleted pods
cat << 'EOF' > /opt/course/11/deleted-pods.txt
hostnetwork-pod
root-pod
escalation-pod
EOF
```

---

## Question 12: Dockerfile and Deployment Security

**Weight:** 7% | **Domain:** Supply Chain Security | **Difficulty:** Medium

### Question

Fix security issues in Dockerfile and Deployment manifest.

**Dockerfile issues:**

- Running as root
- Using `latest` tag
- Using `ADD` instead of `COPY`

**Deployment issues:**

- privileged: true
- allowPrivilegeEscalation: true
- No runAsNonRoot
- No readOnlyRootFilesystem

**Save:**

- /opt/course/12/Dockerfile-fixed
- /opt/course/12/deployment-fixed.yaml

**Answer****Dockerfile-fixed:**

```
FROM nginx:1.25.3-alpine

COPY config.txt /etc/config.txt
COPY index.html /usr/share/nginx/html/

ADD app.tar.gz /app

RUN addgroup -g 1001 appgroup && \
    adduser -u 1001 -G appgroup -D appuser && \
    chown -R appuser:appgroup /usr/share/nginx/html /var/cache/nginx /var/run

USER appuser

EXPOSE 80

CMD ["nginx", "-g", "daemon off;"]
```

**deployment-fixed.yaml:**

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: web-app
  namespace: default
spec:
  replicas: 1
  selector:
    matchLabels:
      app: web-app
  template:
    metadata:
      labels:
        app: web-app
    spec:
      securityContext:
        runAsNonRoot: true
        runAsUser: 1001
        fsGroup: 1001
      containers:
        - name: nginx
          image: nginx:1.25.3-alpine
          ports:
            - containerPort: 80
          securityContext:
            privileged: false
            allowPrivilegeEscalation: false
            readOnlyRootFilesystem: true
            capabilities:
              drop:
                - ALL
          volumeMounts:
            - name: tmp
              mountPath: /tmp
            - name: cache
              mountPath: /var/cache/nginx
            - name: run
              mountPath: /var/run
      volumes:
        - name: tmp
          emptyDir: {}
        - name: cache
          emptyDir: {}
        - name: run
          emptyDir: {}
```

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## Question 13: Kubelet Security Configuration

**Weight:** 5% | **Domain:** Cluster Hardening | **Difficulty:** Medium

## Question

SSH to the worker node and secure `/var/lib/kubelet/config.yaml`:

1. Set `authentication.anonymous.enabled` to `false`
2. Set `authentication.webhook.enabled` to `true`
3. Set `authorization.mode` to `Webhook`
4. Restart kubelet

### Save:

- Before: `/opt/course/13/kubelet-before.yaml`
- After: `/opt/course/13/kubelet-after.yaml`

## Answer

```
ssh <worker-node>

mkdir -p /opt/course/13
sudo cp /var/lib/kubelet/config.yaml /opt/course/13/kubelet-before.yaml

# Edit kubelet config
sudo vi /var/lib/kubelet/config.yaml
```

### Kubelet config changes:

```
authentication:
  anonymous:
    enabled: false
  webhook:
    cacheTTL: 0s
    enabled: true
  x509:
    clientCAFile: /etc/kubernetes/pki/ca.crt
authorization:
  mode: Webhook
  webhook:
    cacheAuthorizedTTL: 0s
    cacheUnauthorizedTTL: 0s
```

```
# Restart kubelet
sudo systemctl daemon-reload
sudo systemctl restart kubelet

# Save config
sudo cp /var/lib/kubelet/config.yaml /opt/course/13/kubelet-after.yaml

exit
kubectl get nodes
```

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## Question 14: Ensure Container Immutability

**Weight:** 7% | **Domain:** Monitoring, Logging and Runtime Security | **Difficulty:** Medium

### Question

Modify Deployment `nginx` in namespace `immutable-ns` to make the container filesystem immutable:

1. Add `readOnlyRootFilesystem: true`
2. Add `emptyDir` volumes for writable paths nginx requires

**Save:** `/opt/course/14/deployment-immutable.yaml`

### Answer

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx
  namespace: immutable-ns
spec:
  replicas: 1
  selector:
    matchLabels:
      app: nginx
  template:
    metadata:
      labels:
        app: nginx
    spec:
      containers:
        - name: nginx
          image: nginx:1.25-alpine
          ports:
            - containerPort: 80
          securityContext:
            readOnlyRootFilesystem: true
          volumeMounts:
            - name: cache
              mountPath: /var/cache/nginx
            - name: run
              mountPath: /var/run
            - name: tmp
              mountPath: /tmp
      volumes:
        - name: cache
          emptyDir: {}
        - name: run
          emptyDir: {}
        - name: tmp
          emptyDir: {}
```

```
kubectl apply -f /opt/course/14/deployment-immutable.yaml
```

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## Question 15: Containerd Security Hardening

**Weight:** 5% | **Domain:** System Hardening | **Difficulty:** Medium

### Question

SSH to the worker node and secure containerd:

1. Remove user `developer` from container-related groups
2. Set `/run/containerd/containerd.sock` group ownership to `root`
3. Remove any TCP listener configuration
4. Restart containerd

**Save:**

- Socket permissions before: `/opt/course/15/socket-before.txt`
- Socket permissions after: `/opt/course/15/socket-after.txt`
- config.toml content: `/opt/course/15/config.toml`
- TCP port proof: `/opt/course/15/netstat-after.txt`

**Answer**

```
ssh <worker-node>

mkdir -p /opt/course/15

# Save current permissions
ls -la /run/containerd/containerd.sock > /opt/course/15/socket-before.txt

# Remove user from containerd group
sudo gpasswd -d developer containerd

# Fix socket ownership
sudo chown root:root /run/containerd/containerd.sock
sudo chmod 660 /run/containerd/containerd.sock

# Remove TCP listener
sudo sed -i '/tcp_address/d' /etc/containerd/config.toml

# Save config
sudo cp /etc/containerd/config.toml /opt/course/15/config.toml

# Restart containerd
sudo systemctl restart containerd

# Save results
ls -la /run/containerd/containerd.sock > /opt/course/15/socket-after.txt
ss -tlnp > /opt/course/15/netstat-after.txt

exit

kubectl get nodes
```