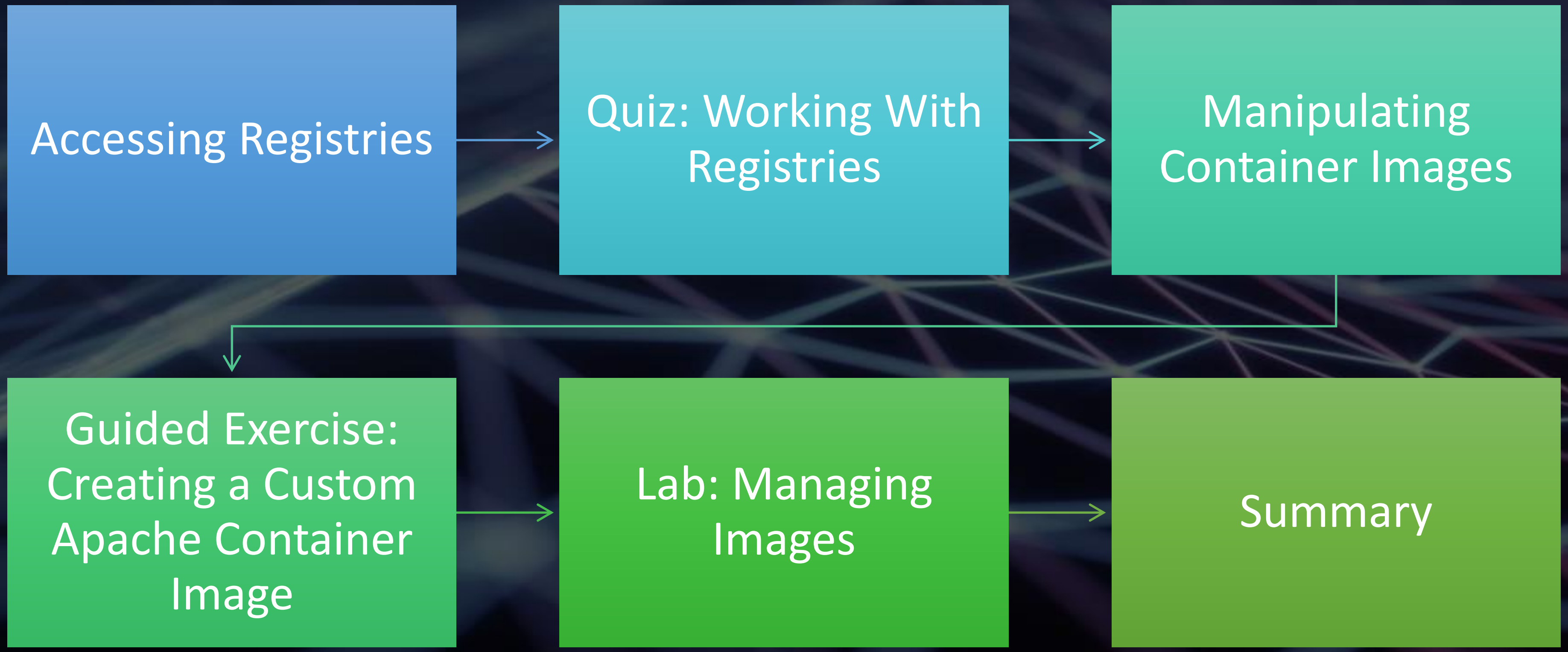
Managing Container Images

Chapter objectives



Accessing Registries

Quiz: Working With Registries

Manipulating Container Images

Guided Exercise: Creating a Custom Apache Container Image

Lab: Managing Images

Summary

Accessing Registries

After completing this section, you will be able to:

Search and pull

- images from remote registries

List advantages of

- using certified public registry

Customize the configuration to

- access alternative container image registries.

List downloaded images

- from a registry to the local file system.

Manage

- tags to pull tagged images.

Public Registries

- Containing container images to download
- Store and distribute images
- Podman can search images from public or private registries
- Example of public registries:
  - Red Hat Container Catalog
  - Quay.io
  - Docker Hub
  - Google Container Registry
  - and etc

Red Hat Container Catalog

- Trusted Source: All container images comprise sources known and trusted by Red Hat.
- Original dependencies: None of the container packages have been tampered with, and only include known libraries.
- Vulnerability-free: Container images are free of known vulnerabilities in the platform components or layers.
- Runtime protection: All applications in container images run as non-root users, minimizing the exposure surface to malicious or faulty applications.
- Red Hat Enterprise Linux (RHEL) compatible: Container images are compatible with all RHEL platforms, from bare metal to cloud.
- Red Hat support: Red Hat commercially supports the complete stack.

QUAY.io

- Public registry managed by Red Hat team
- Server-side image building
- Automatic scanning for known vulnerabilities
- Offers live upload by Image creator
- Fine-grained access controls with namespace

Private Registries

- Company privacy and secret protection.
- Legal restrictions and laws.
- Avoidance of publishing images in development.
- Total control about their image's placement, distribution and usage.

Configuring Registries in Podman

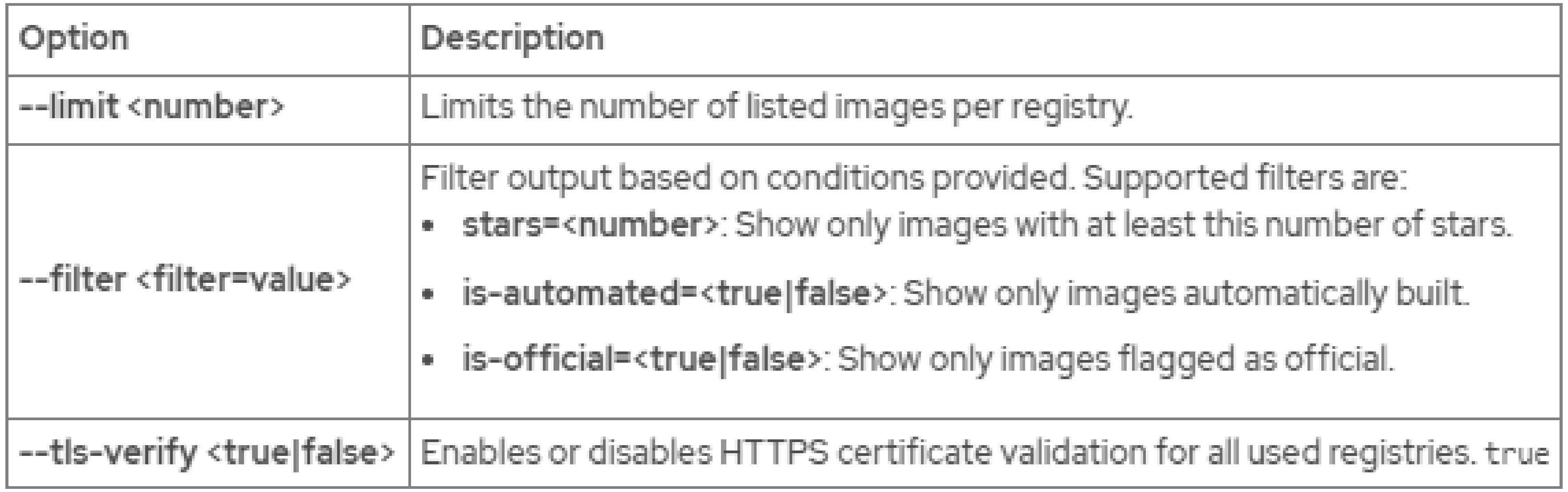
- Update /etc/containers/registries.conf

```
$vi /etc/containers/registries.conf

…output omitted…

[registries.search]

registries = [“registry.access.redhat.com”, “quay.io”, “docker.io”]


[registries.insecure]

registries = [“localhost:5000”]
```

Accessing Registries

- Searching for Images in Registries

```
$ sudo podman search [OPTIONS] <term>
```

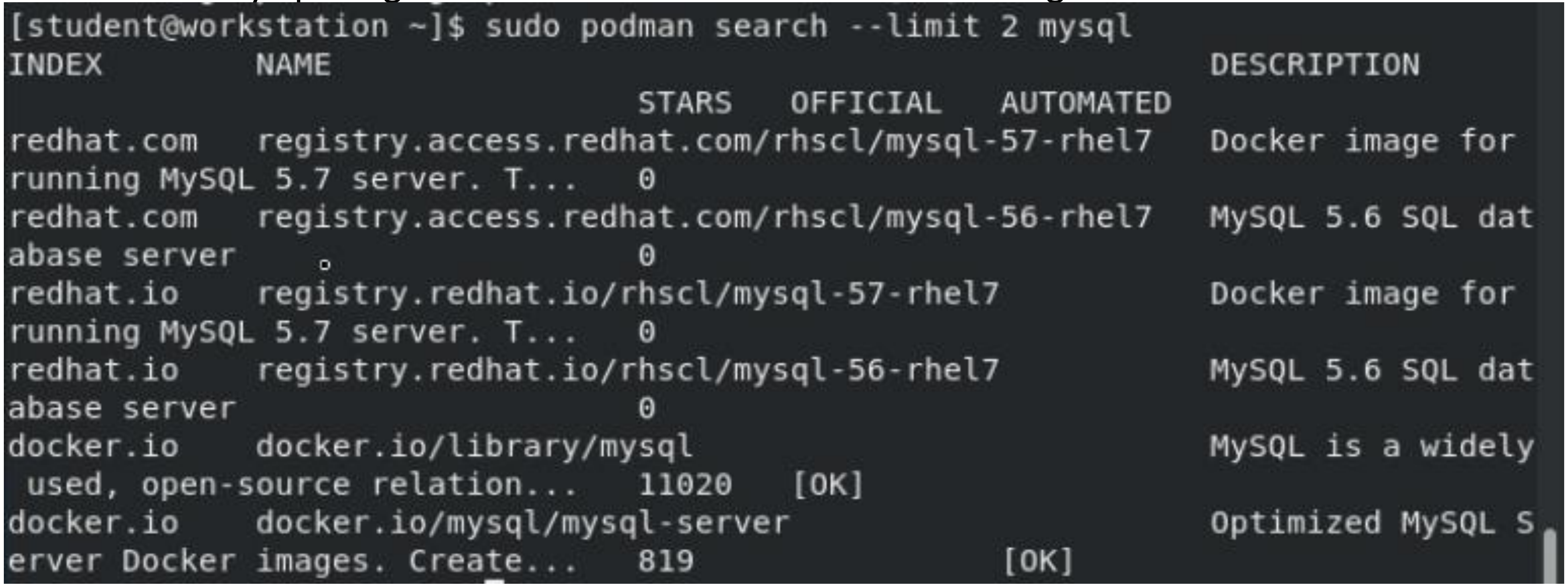


Option	Description
--limit <number>	Limits the number of listed images per registry.
--filter <filter=value>	Filter output based on conditions provided. Supported filters are: • **stars=<number>**: Show only images with at least this number of stars. • **is-automated=<true|false>**: Show only images automatically built. • **is-official=<true|false>**: Show only images flagged as official.
--tls-verify <true|false>	Enables or disables HTTPS certificate validation for all used registries. `true`

- TERM refers to name of image, application, software and etc
  - Example: mysql, sql, apache, apache:2.4

Search for images using --limit

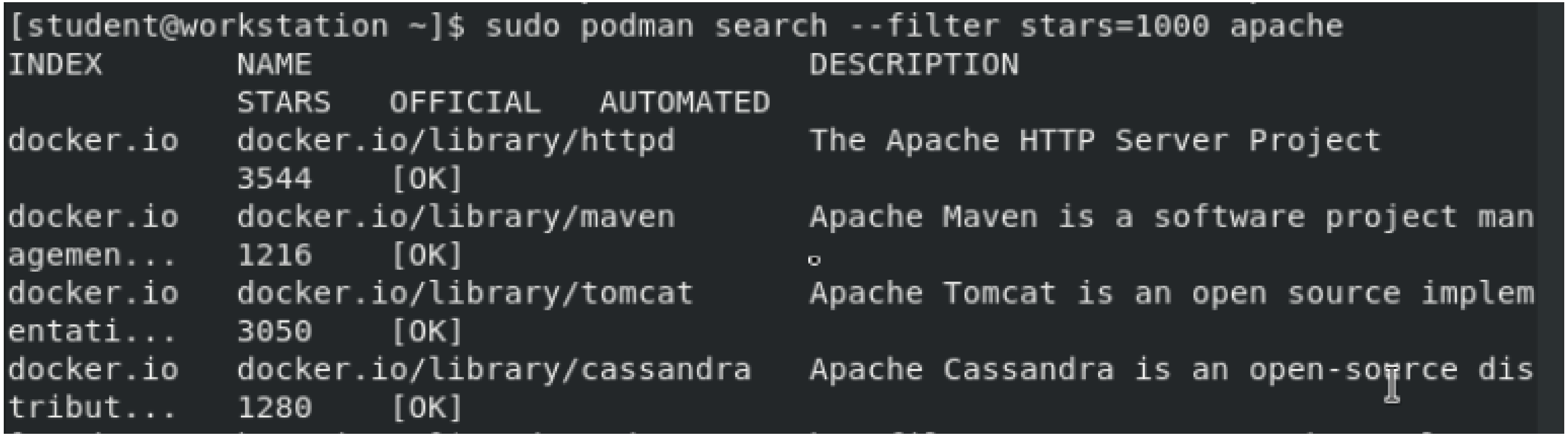
- Search for mysql images but limit to first 2 entries for each registries



```
[student@workstation ~]$ sudo podman search --limit 2 mysql
INDEX       NAME                                            DESCRIPTION
                                   STARS   OFFICIAL   AUTOMATED
redhat.com  registry.access.redhat.com/rhscl/mysql-57-rhel7   Docker image for
running MySQL 5.7 server. T...   0
redhat.com  registry.access.redhat.com/rhscl/mysql-56-rhel7   MySQL 5.6 SQL dat
abase server                     0
redhat.io   registry.redhat.io/rhscl/mysql-57-rhel7           Docker image for
running MySQL 5.7 server. T...   0
redhat.io   registry.redhat.io/rhscl/mysql-56-rhel7           MySQL 5.6 SQL dat
abase server                     0
docker.io   docker.io/library/mysql                           MySQL is a widely
 used, open-source relation...   11020   [OK]
docker.io   docker.io/mysql/mysql-server                      Optimized MySQL S
erver Docker images. Create...   819                [OK]
```

Search for images using --filter

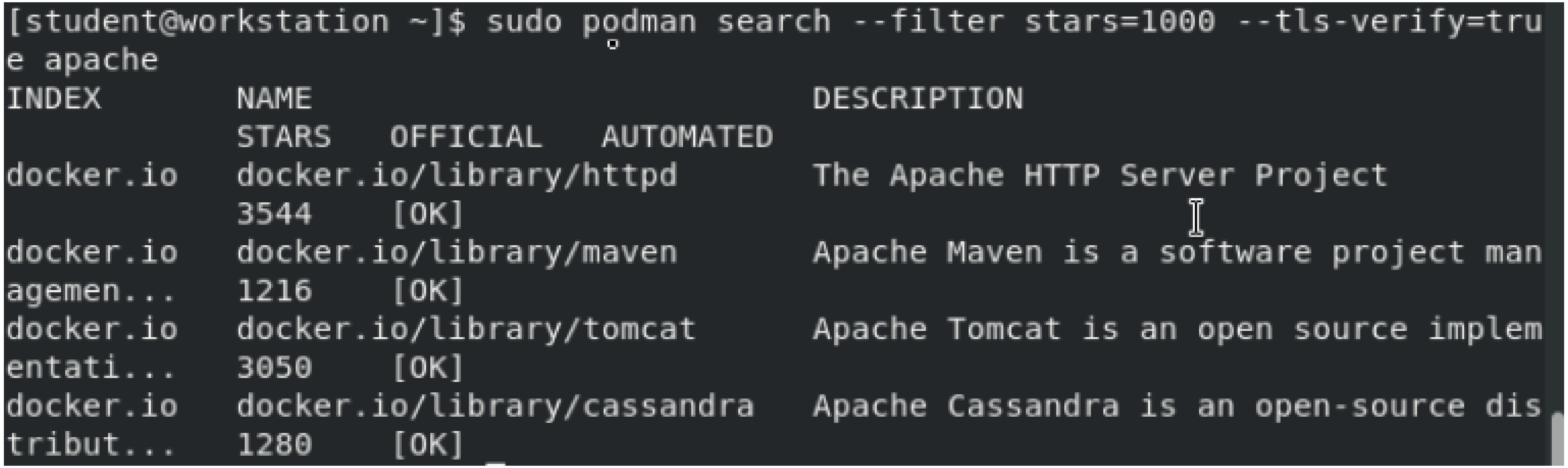
- Search for apache images with 1000 and above stars



```
[student@workstation ~]$ sudo podman search --filter stars=1000 apache
INDEX        NAME                           DESCRIPTION
             STARS   OFFICIAL   AUTOMATED
docker.io    docker.io/library/httpd        The Apache HTTP Server Project
             3544    [OK]
docker.io    docker.io/library/maven        Apache Maven is a software project man
agemen...    1216    [OK]
docker.io    docker.io/library/tomcat       Apache Tomcat is an open source implem
entati...    3050    [OK]
docker.io    docker.io/library/cassandra    Apache Cassandra is an open-source dis
tribut...    1280    [OK]
```

Search for images using multiple options

- Search for apache images with 1000 and above stars and also its must be TLS verified



```
[student@workstation ~]$ sudo podman search --filter stars=1000 --tls-verify=tru
e apache
INDEX       NAME                         DESCRIPTION
            STARS   OFFICIAL   AUTOMATED
docker.io   docker.io/library/httpd      The Apache HTTP Server Project
            3544    [OK]
docker.io   docker.io/library/maven      Apache Maven is a software project man
agemen...   1216    [OK]
docker.io   docker.io/library/tomcat     Apache Tomcat is an open source implem
entati...   3050    [OK]
docker.io   docker.io/library/cassandra  Apache Cassandra is an open-source dis
tribut...   1280    [OK]
```

Registry HTTP API

- Docker Registry HTTP API v2 specification – docker.io / Quay.io
- Interface to access or interact with remote registries
- Example: To list all repositories available in a registry

```
$ curl -Ls https://myserver/v2/_catalog?

{"repositories":["centos/httpd","do180/custom-httpd","hello-openshift"]}
```

- Example: To list all versions of specific image in a quay.io registry

```
$ curl -Ls https://quay.io/v2/jason.wong76/webserver/tags/list

{“name”:”jason.wong76/webserver”,”tags”:[“1.0”,”2.0”,”3.0”,”latest”,”4.0”]}


$ curl -Ls  https://quay.io/v2/redhattraining/httpd-parent/tags/list

…output omitted…
```

Registry HTTP API

- Make it more readable

```
$ curl -Ls https://quay.io/v2/redhattraining/httpd-parent/tags/list  | python3 -m json.tool
{
    "name": "redhattraining/httpd-parent",
    "tags": [
        "latest",
        "2.4"
    ]
}


$ curl -Ls https://quay.io/v2/jason.wong76/webserver/tags/list | python3 -m json.tool
…output omitted…
```

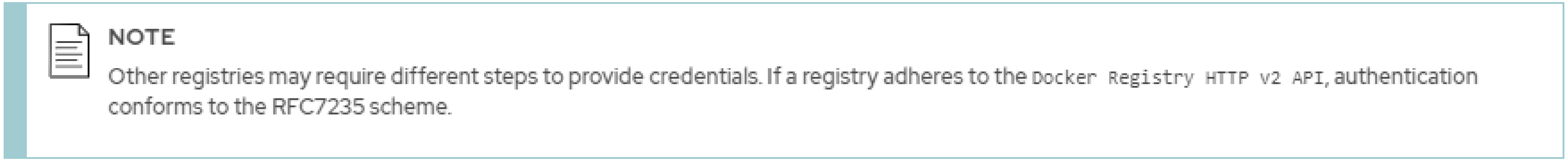
Registry Authentication

- Some registries require access authentication
- Use podman login -u <username> -p <password> <hostname to registry>

```
$ sudo podman login –u username –p password registry.access.redhat.com
```

- Or via API

```
$ curl -u username:password –Ls \
“https://sso.redhat.com/auth/realms/rhcc/protocol/redhat-docker-v2/auth?service=docker-registry”
```



NOTE

Other registries may require different steps to provide credentials. If a registry adheres to the `Docker Registry HTTP v2 API`, authentication conforms to the RFC7235 scheme.

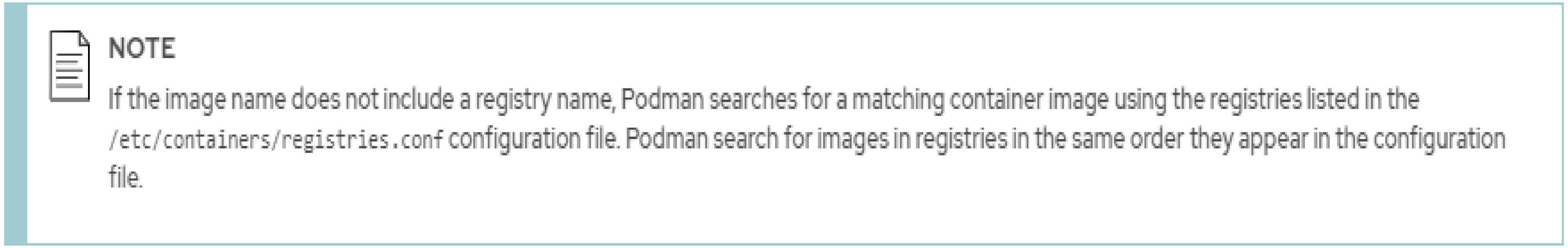
Pulling Images

- The podman pull command syntax

```
$ sudo podman pull [OPTIONS] [REGISTRY[:PORT/]]NAME[:TAG]
```

- Pull an NGINX container from quay.io registry

```
$ sudo podman pull quay.io/bitnami/nginx
```



NOTE

If the image name does not include a registry name, Podman searches for a matching container image using the registries listed in the `/etc/containers/registries.conf` configuration file. Podman search for images in registries in the same order they appear in the configuration file.

Pulling Images with –creds option

- Pull an image from a private repository

```
$read -s password

<enter password to private repo>



$ sudo podman pull --creds jason.wong76:$password quay.io/jason.wong76/webserver:2.0
```

Listing Local Copies of Images

- Downloaded image is stored locally
- Avoids repeating download
- Minimize deployment time
- Custom images built
- Default location:
  - /var/lib/containers/storage/overlay-images
- List all images

```
$ sudo podman images

Or

$ sudo podman image list
```

Image Tags

- Support multiple versions or releases of same image
- Old and new version
- Evaluation and production copy
- Community copy
- Default to latest tag

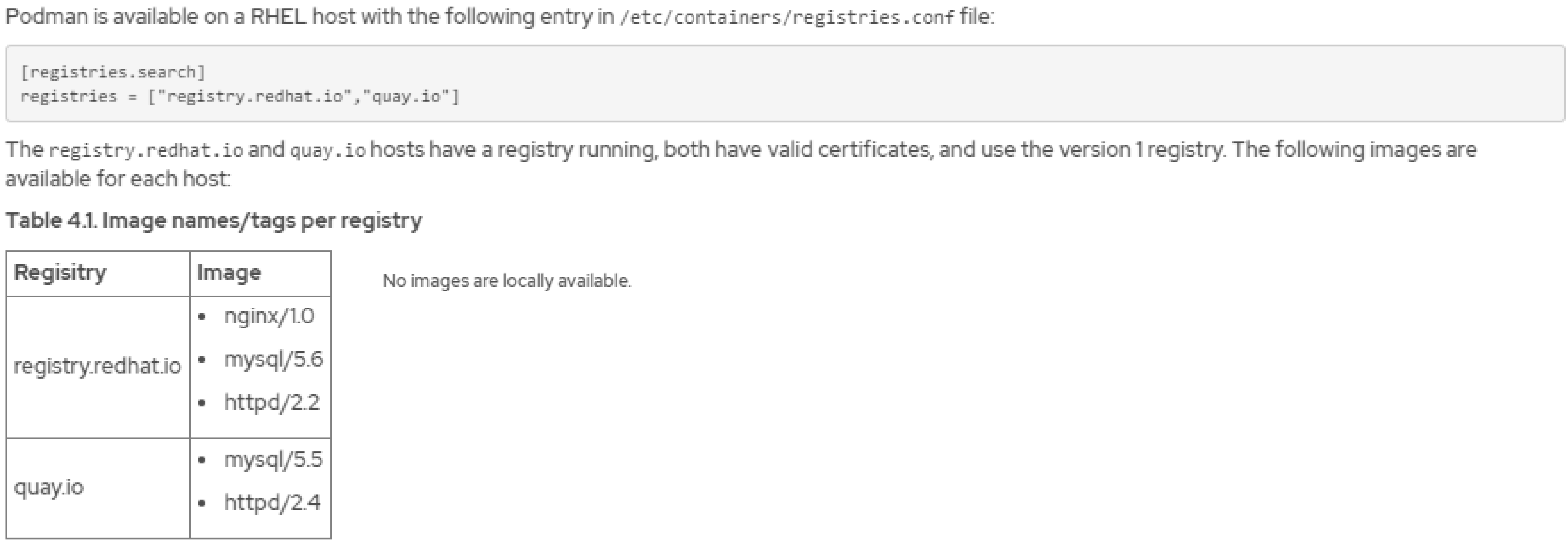
- Example: Pull an image with specific version

```
$ sudo podman pull httpd:2.4
```

- Example: Pull an image with latest version from specific registry

```
$ sudo podman pull quay.io/redhattraining/httpd-parent:latest
```

Quiz 1



Podman is available on a RHEL host with the following entry in `/etc/containers/registries.conf` file:

```
[registries.search]
registries = ["registry.redhat.io","quay.io"]
```

The `registry.redhat.io` and `quay.io` hosts have a registry running, both have valid certificates, and use the version 1 registry. The following images are available for each host:

Table 4.1. Image names/tags per registry

Regisitry	Image
registry.redhat.io	• nginx/1.0 • mysql/5.6 • httpd/2.2
quay.io	• mysql/5.5 • httpd/2.4

No images are locally available.

Which two commands display mysql images available for download from registry.redhat.io? (Choose two.)

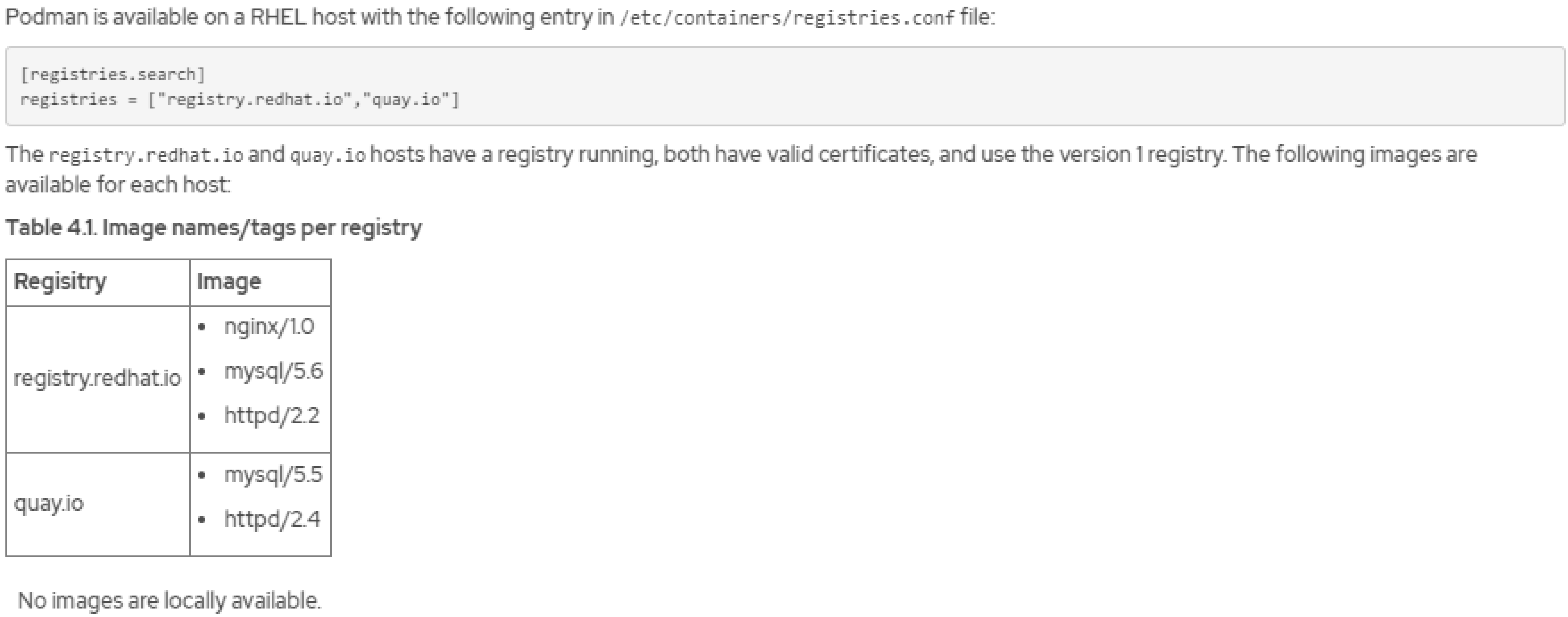
a) podman search registry.redhat.io/mysql

b) podman images

c) podman pull mysql

d) podman search mysql

Quiz 1



Podman is available on a RHEL host with the following entry in `/etc/containers/registries.conf` file:

```
[registries.search]
registries = ["registry.redhat.io","quay.io"]
```

The `registry.redhat.io` and `quay.io` hosts have a registry running, both have valid certificates, and use the version 1 registry. The following images are available for each host:

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registry.redhat.io	nginx/1.0 mysql/5.6 httpd/2.2
quay.io	mysql/5.5 httpd/2.4

No images are locally available.

Which two commands display mysql images available for download from registry.redhat.io? (Choose two.)

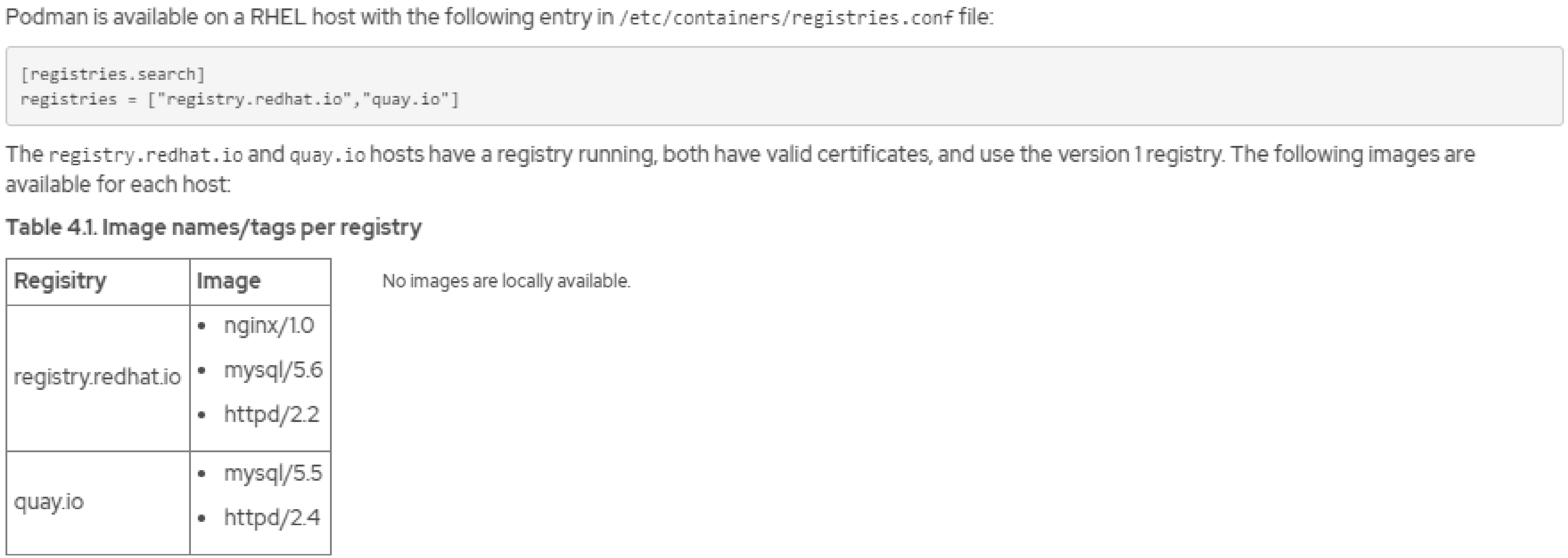
a) podman search registry.redhat.io/mysql

b) podman images

c) podman pull mysql

d) podman search mysql

Quiz 2



Podman is available on a RHEL host with the following entry in `/etc/containers/registries.conf` file:

```
[registries.search]
registries = ["registry.redhat.io","quay.io"]
```

The `registry.redhat.io` and `quay.io` hosts have a registry running, both have valid certificates, and use the version 1 registry. The following images are available for each host:

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Regisitry	Image
registry.redhat.io	• nginx/1.0 • mysql/5.6 • httpd/2.2
quay.io	• mysql/5.5 • httpd/2.4

No images are locally available.

Which command is used to list all available image tags for the httpd container image?

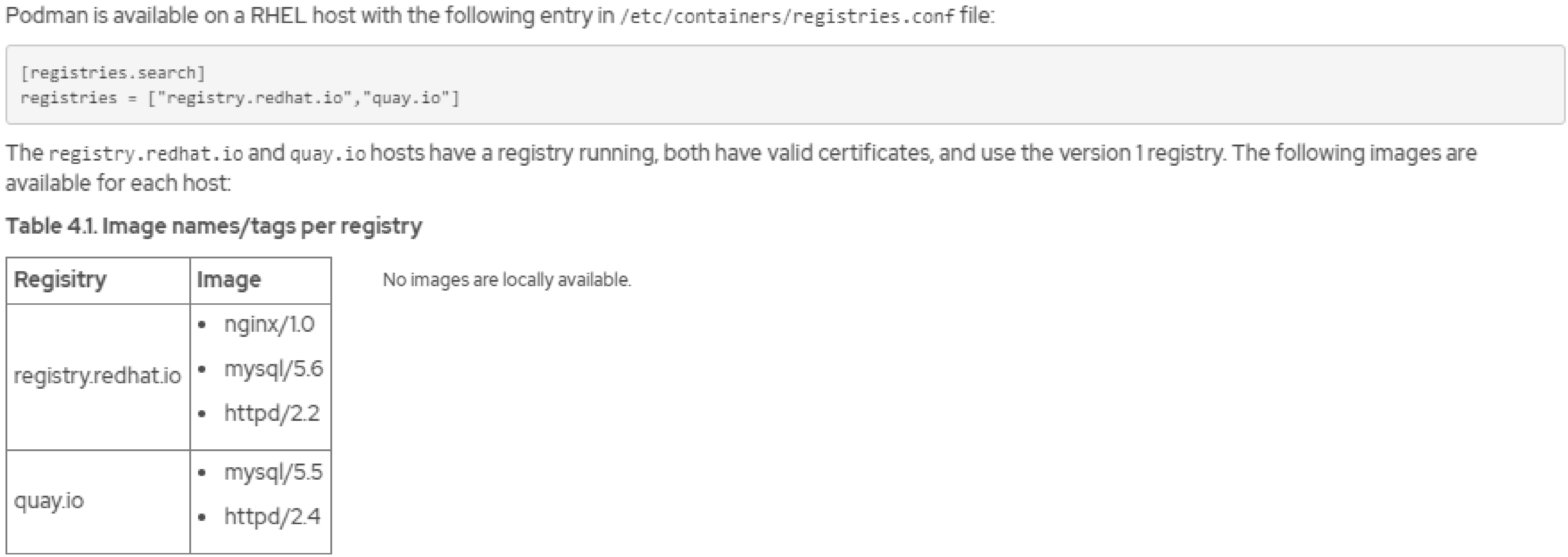
a) podman search httpd

b) podman images httpd

c) podman pull --all-tags=true httpd

d) There is no podman command available to search for tags.

Quiz 2



Podman is available on a RHEL host with the following entry in `/etc/containers/registries.conf` file:

```
[registries.search]
registries = ["registry.redhat.io","quay.io"]
```

The `registry.redhat.io` and `quay.io` hosts have a registry running, both have valid certificates, and use the version 1 registry. The following images are available for each host:

Table 4.1. Image names/tags per registry

Regisitry	Image
registry.redhat.io	nginx/1.0 mysql/5.6 httpd/2.2
quay.io	mysql/5.5 httpd/2.4

No images are locally available.

Which command is used to list all available image tags for the httpd container image?

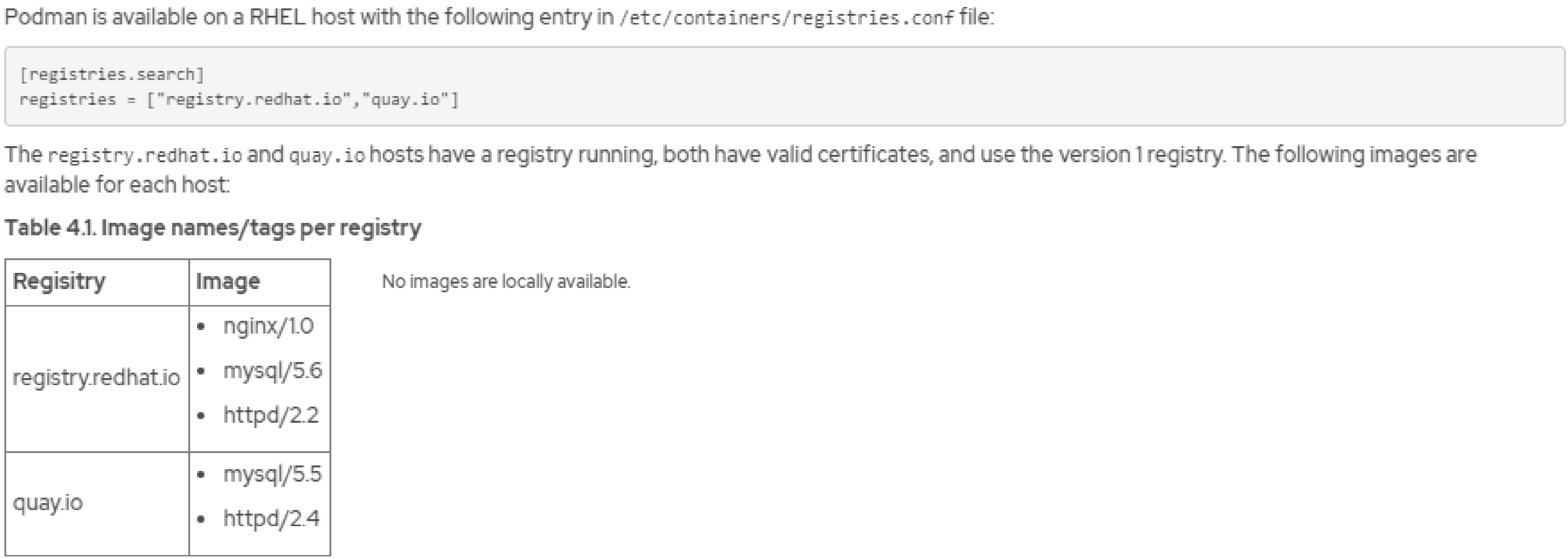
a) podman search httpd

b) podman images httpd

c) podman pull --all-tags=true httpd

d) There is no podman command available to search for tags.

Quiz 3



Podman is available on a RHEL host with the following entry in `/etc/containers/registries.conf` file:

```
[registries.search]
registries = ["registry.redhat.io","quay.io"]
```

The `registry.redhat.io` and `quay.io` hosts have a registry running, both have valid certificates, and use the version 1 registry. The following images are available for each host:

Table 4.1. Image names/tags per registry

Regisitry	Image
registry.redhat.io	• nginx/1.0 • mysql/5.6 • httpd/2.2
quay.io	• mysql/5.5 • httpd/2.4

No images are locally available.

Which two commands pull the httpd image with the 2.2 tag? (Choose two.)

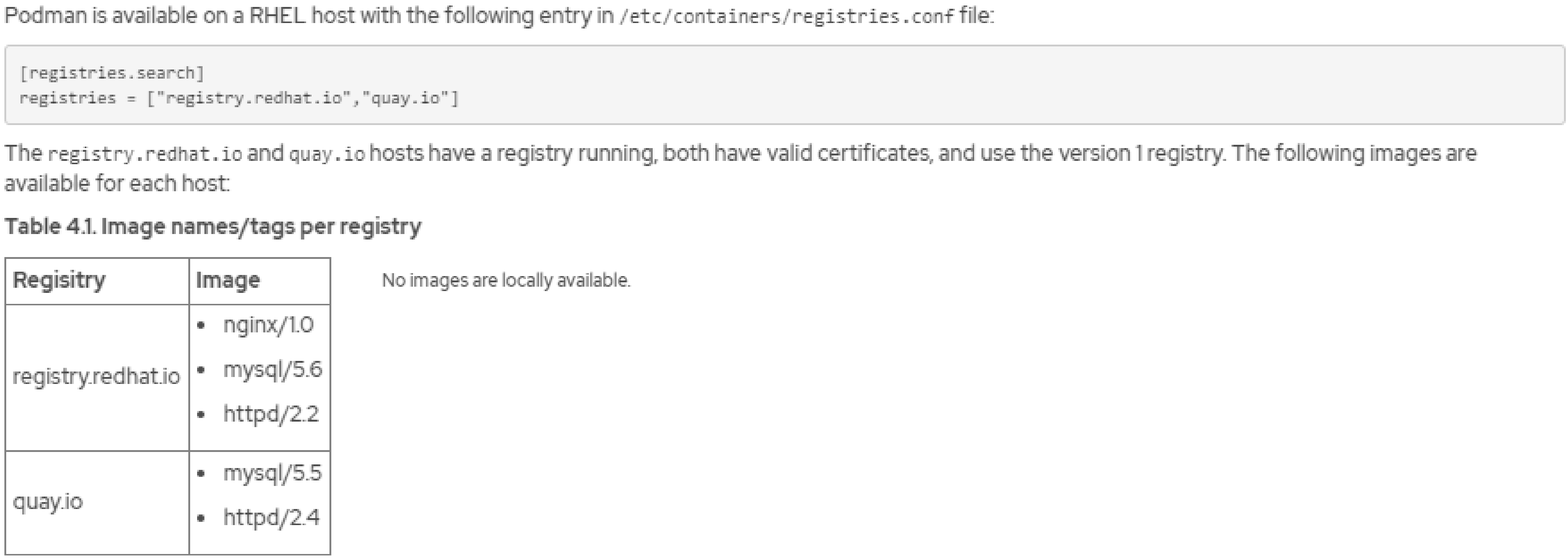
a) podman pull httpd:2.2

b) podman pull httpd:latest

c) podman pull quay.io/httpd

d) podman pull registry.redhat.io/httpd:2.2

Quiz 3



Podman is available on a RHEL host with the following entry in `/etc/containers/registries.conf` file:

```
[registries.search]
registries = ["registry.redhat.io","quay.io"]
```

The `registry.redhat.io` and `quay.io` hosts have a registry running, both have valid certificates, and use the version 1 registry. The following images are available for each host:

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quay.io	• mysql/5.5 • httpd/2.4

No images are locally available.

Which two commands pull the httpd image with the 2.2 tag? (Choose two.)

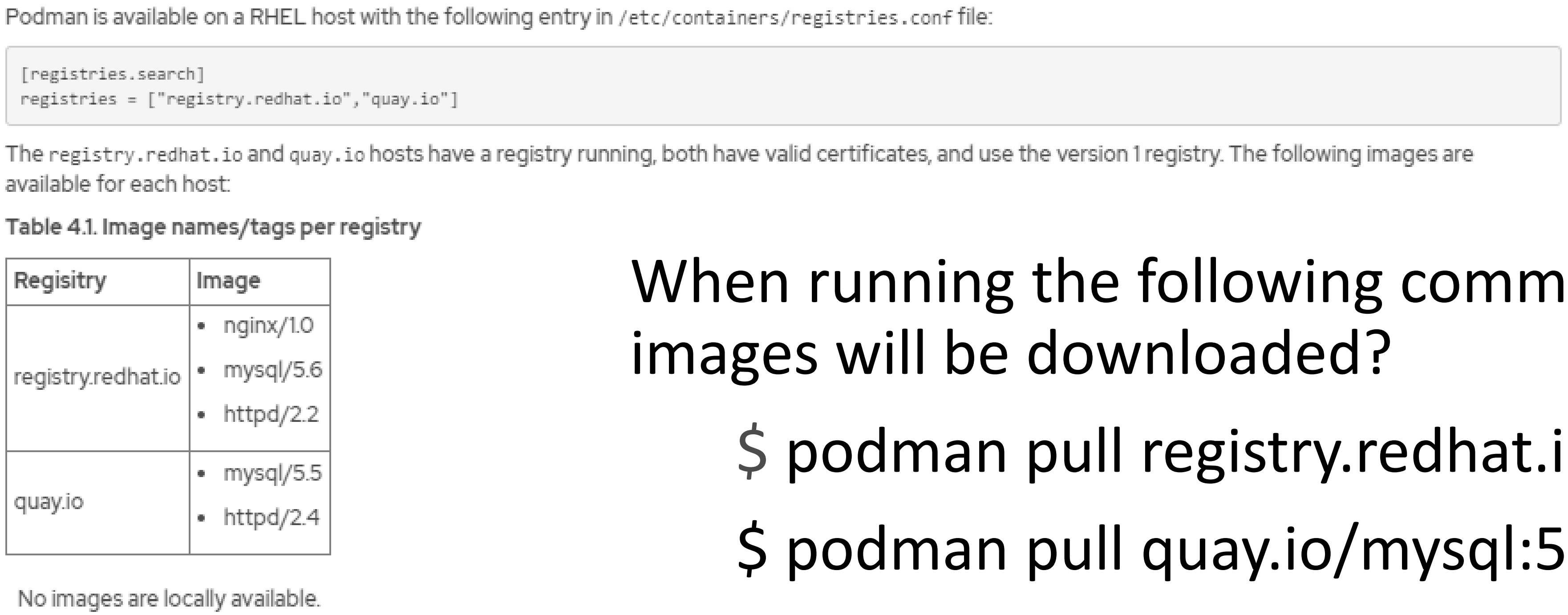
a) podman pull httpd:2.2

b) podman pull httpd:latest

c) podman pull quay.io/httpd

d) podman pull registry.redhat.io/httpd:2.2

Quiz 4



Podman is available on a RHEL host with the following entry in `/etc/containers/registries.conf` file:

```
[registries.search]
registries = ["registry.redhat.io","quay.io"]
```

The `registry.redhat.io` and `quay.io` hosts have a registry running, both have valid certificates, and use the version 1 registry. The following images are available for each host:

Table 4.1. Image names/tags per registry

Regisitry	Image
registry.redhat.io	• nginx/1.0 • mysql/5.6 • httpd/2.2
quay.io	• mysql/5.5 • httpd/2.4

No images are locally available.

When running the following commands, which container images will be downloaded?

```
$ podman pull registry.redhat.io/httpd:2.2
$ podman pull quay.io/mysql:5.6
```

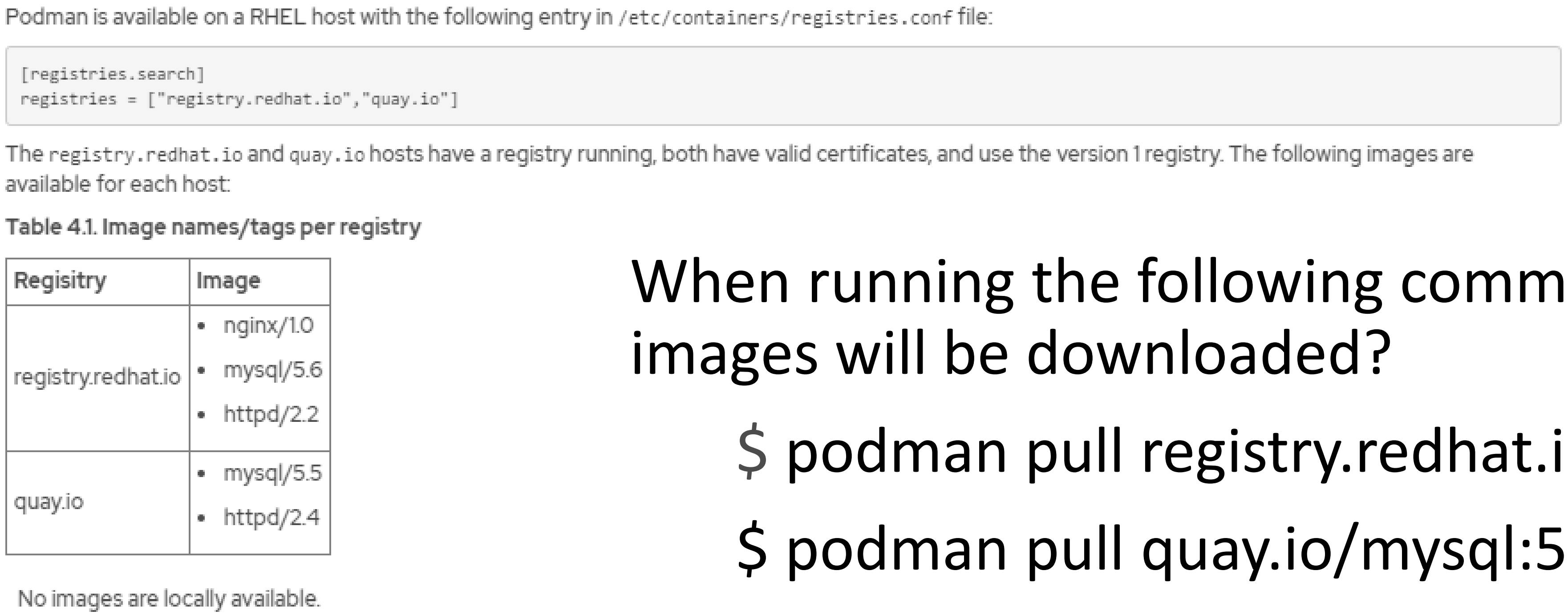
a) quay.io/httpd:2.2
registry.redhat.io/mysql:5.6

b) registry.redhat.io/httpd:2.2
registry.redhat.io/mysql:5.6

c) registry.redhat.io/httpd:2.2
No image will be downloaded for mysql.

d) quay.io/httpd:2.2
No image will be downloaded for mysql.

Quiz 4



Podman is available on a RHEL host with the following entry in /etc/containers/registries.conf file:

```
[registries.search]
registries = ["registry.redhat.io","quay.io"]
```

The registry.redhat.io and quay.io hosts have a registry running, both have valid certificates, and use the version 1 registry. The following images are available for each host:

Table 4.1. Image names/tags per registry

Regisitry	Image
registry.redhat.io	• nginx/1.0 • mysql/5.6 • httpd/2.2
quay.io	• mysql/5.5 • httpd/2.4

No images are locally available.

When running the following commands, which container images will be downloaded?

```
$ podman pull registry.redhat.io/httpd:2.2
$ podman pull quay.io/mysql:5.6
```

a) quay.io/httpd:2.2
registry.redhat.io/mysql:5.6

b) registry.redhat.io/httpd:2.2
registry.redhat.io/mysql:5.6

c) registry.redhat.io/httpd:2.2
No image will be downloaded for mysql.

d) quay.io/httpd:2.2
No image will be downloaded for mysql.

Manipulating Container Images

After completing this section, you will be:

Save and load

- container images to local files.

Delete images

- from the local storage.

Create new container images

- from containers and update image metadata.

Manage image tags

- for distribution purposes.

Saving and Loading Images

- Use podman save command. The syntax:

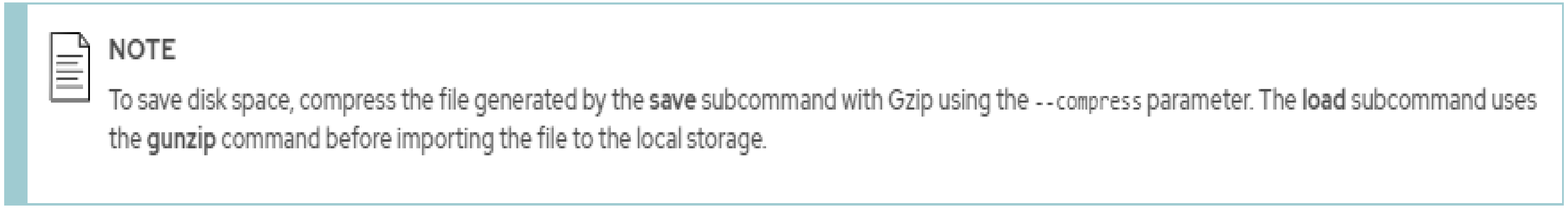
```
$ sudo podman save [-o FILE_NAME] IMAGE_NAME[:tag]
```

- Example: Backup following mysql image to mysql.tar

```
$ sudo podman save  -o mysql.tar registry.access.redhat.com/rhscl/mysql-57-rhel7:5.7
```

- Example: Restore the image

```
$  sudo podman load  -i mysql.tar
```



NOTE

To save disk space, compress the file generated by the **save** subcommand with Gzip using the `--compress` parameter. The **load** subcommand uses the **gunzip** command before importing the file to the local storage.

Delete image

- Use podman rmi command. The syntax:

```
$ sudo podman rmi [OPTIONS] IMAGE [IMAGE…]
```

- Delete operation fails if the image is being used
- Use --force or -f option to force
- Use --all or -a option to remove all locally stored images

```
$ sudo podman rmi -af
```

- Recommended workflow

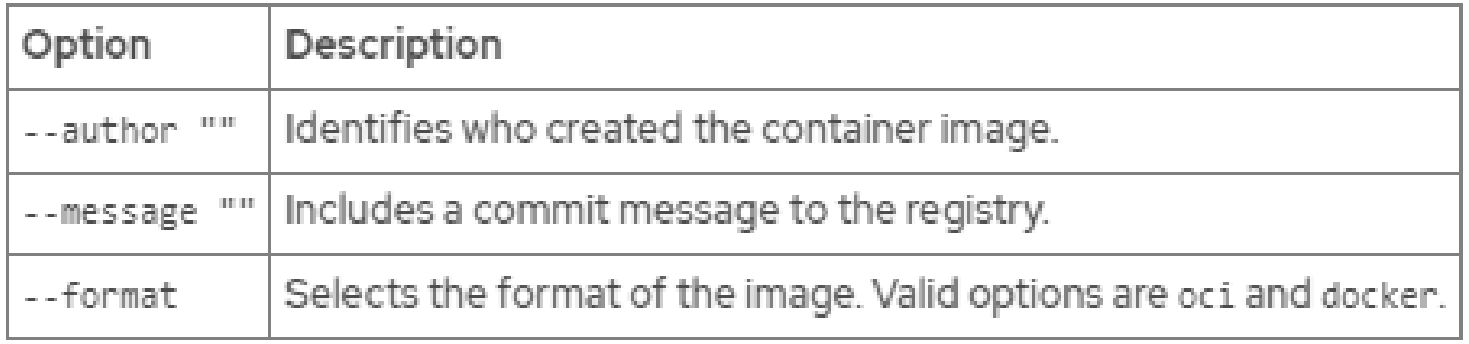
```
$ sudo podman kill -s 9 my-container or sudo podman stop -f my-container

$ sudo podman rm -f my-container

$ sudo podman rmi -f container-image:1.0
```

Saving containers

- Latest configuration
- Use podman commit command: The syntax:

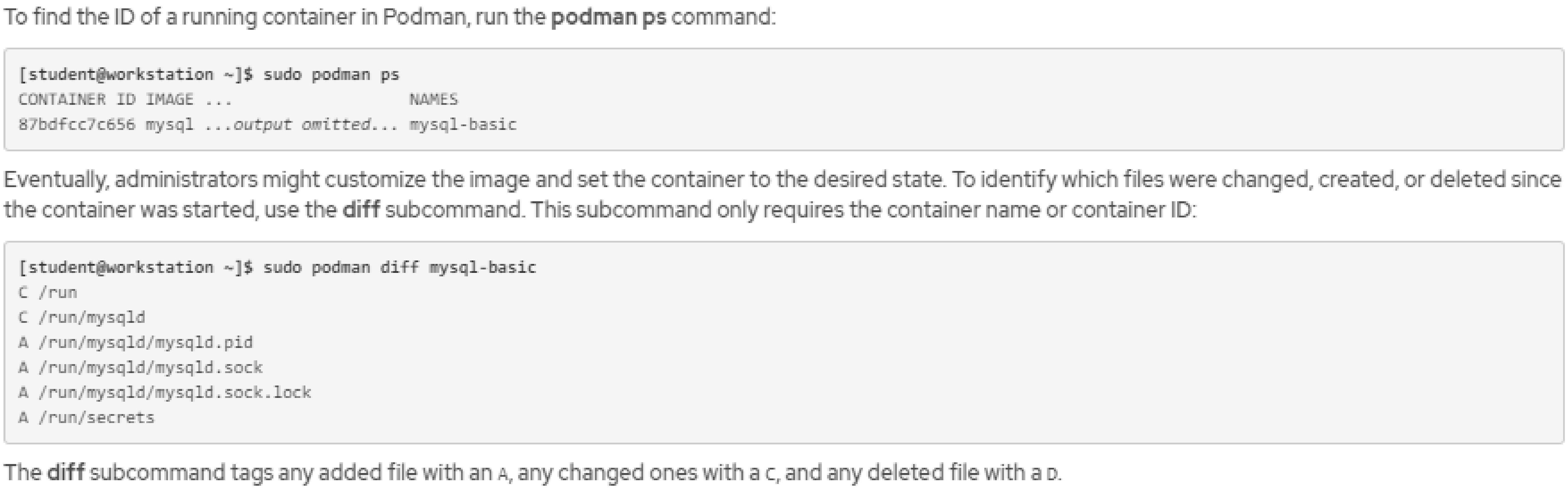
```
$ sudo podman commit [OPTIONS] container  [REGISTRY[:PORT]/IMAGE_NAME[:TAG]
```

- REGISTRY: Public or private registry url
- PORT: Registry's port. Default to 5000
- IMAGE_NAME: Container image name
- TAG: Version of image. Default to latest



Option	Description
`--author ""`	Identifies who created the container image.
`--message ""`	Includes a commit message to the registry.
`--format`	Selects the format of the image. Valid options are `oci` and `docker`.

Saving containers - EXAMPLE



To find the ID of a running container in Podman, run the **podman ps** command:

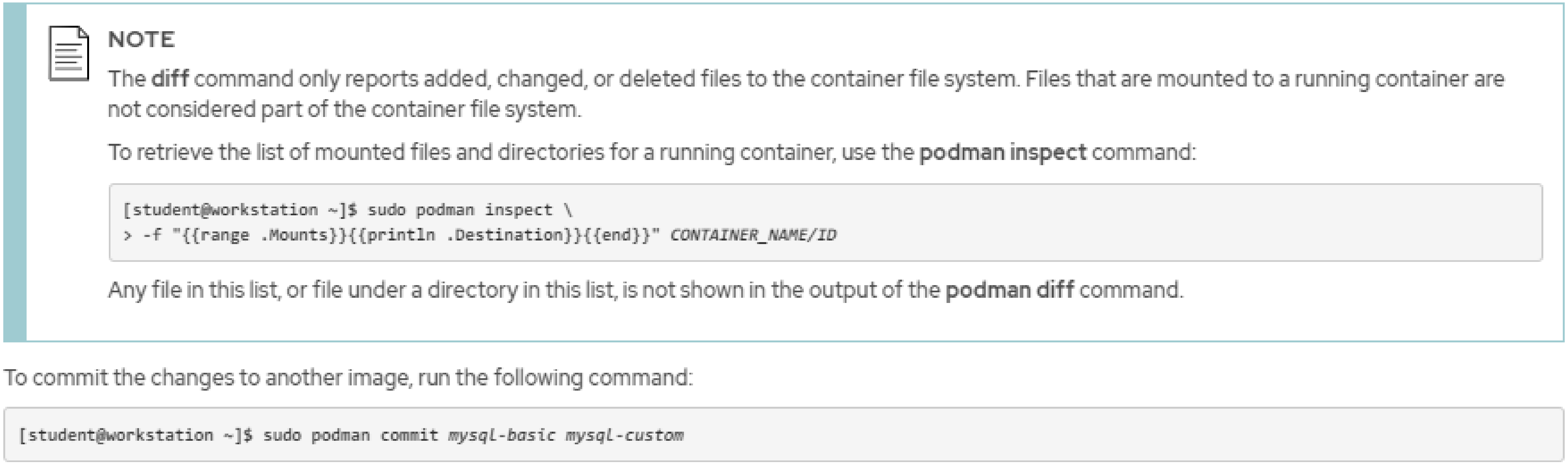
```
[student@workstation ~]$ sudo podman ps
CONTAINER ID IMAGE ...                  NAMES
87bdfcc7c656 mysql ...output omitted... mysql-basic
```

Eventually, administrators might customize the image and set the container to the desired state. To identify which files were changed, created, or deleted since the container was started, use the **diff** subcommand. This subcommand only requires the container name or container ID:

```
[student@workstation ~]$ sudo podman diff mysql-basic
C /run
C /run/mysqld
A /run/mysqld/mysqld.pid
A /run/mysqld/mysqld.sock
A /run/mysqld/mysqld.sock.lock
A /run/secrets
```

The **diff** subcommand tags any added file with an A, any changed ones with a C, and any deleted file with a D.

Saving containers - EXAMPLE



NOTE

The **diff** command only reports added, changed, or deleted files to the container file system. Files that are mounted to a running container are not considered part of the container file system.

To retrieve the list of mounted files and directories for a running container, use the **podman inspect** command:

```
[student@workstation ~]$ sudo podman inspect \
> -f "{{range .Mounts}}{{println .Destination}}{{end}}" CONTAINER_NAME/ID
```

Any file in this list, or file under a directory in this list, is not shown in the output of the **podman diff** command.

To commit the changes to another image, run the following command:

```
[student@workstation ~]$ sudo podman commit mysql-basic mysql-custom
```

Tagging Images

- A project with multiple different version of the same image
- Example: a container image to run with either MySQL or PostgreSQL database
- Use podman tag command. The syntax:

```
$ sudo podman tag [OPTIONS] IMAGE[:TAG] [REGISTRYHOST/][USERNAME/]IMAGE_NAME[:TAG]
```

- Example: Tag a local image named mysql-custom as devops/mysql

```
$ sudo podman tag mysql-custom quay.io/devops/mysql
```

- Example: Similar as above but use different tag name

```
$ sudo podman tag mysql-custom quay.io/devops/mysql:snapshot
```

- Best Practice for Tagging Images
  - Latest tag is used by default
  - Specify a version or functional purpose of the tagged image

List and Remove Tagged Images

- List tagged images

```
$ sudo podman images
```

- Remove the tagged image

```
$ sudo podman rmi devops/mysql:snapshot
```

Publishing Images to Registry

- Images must reside in local storage
- Tagged for identification purposes
- Use podman push command. The syntax:

```
$ sudo podman push [OPTIONS] IMAGE [DESTINATION]
```

- Example 1: Tag and push a local image to remote registry

```
$ sudo podman tag  httpd-parent:latest  my-httpd:snapshot

$ read password

< enter password to quay.io account >

$ sudo podman login -u jason.wong76 -p $password quay.io

$ sudo podman push my-httpd:snapshot  quay.io/jason.wong76/my-httpd:snapshot
```

Publishing Images to Registry

- Example 2: Tag and push a local image to remote registry

```
$ sudo podman tag  httpd-parent:latest  quay.io/jason.wong76/my-httpd:snapshot

$ read password

< enter password to quay.io account >

$ sudo podman push --creds jason.wong76:$password \

> quay.io/jason.wong76/my-httpd:snapshot
```

Guided Exercise: Creating a Custom Apache Container Image

You should be able to:

- Create a custom Apache container image
- Tag an image
- Push the tagged image to Quay.io registry

Chapter Summary

In this chapter, you learned:

- The Red Hat Container Catalog provides tested and certified images at registry.redhat.io.
- Podman provides commands to manage container images both in local storage and as compressed files.
- Podman can interact with remote container registries to search, pull, and push container images.
- Use the podman commit to create an image from a container.
- Image tags are a mechanism to support multiple releases of a container image.