IBM Professional Certification Program

STUDY GUIDE SERIES

Exam C1000-179

Fundamentals of Quantum Computing Using Qiskit v2.X Developer

IBM Professional Certification Program

Purpose of Exam Objectives

When an exam is developed, Subject Matter Experts work together to define the role the certified individual will fill. They define the tasks and knowledge that an individual would need to successfully perform this job role for the product or solution. This creates the foundation for the objectives and measurement criteria, which form the basis of the certification exam. Question writers then use these objectives to develop exam questions.

It is recommended that you review these objectives and ask yourself the following questions:

- Do you know how to complete the task in the objective?
- Do you know why that task needs to be done?
- Do you know what will happen if you do it incorrectly?

If you are not familiar with a task, go through the objective, perform that task in your own environment and read more information on the task. Use the Study Resource reference links below and search for the topic of the task. Review the documentation that you find until you can answer 'yes' to the above questions If there is an objective on a task, there is a high likelihood that you WILL see a question about it on the actual exam. Review the recommended learning designed to prepare you to take the certification exam.

After reviewing the objectives in this guide and completing your own research, take the assessment exam. While the assessment exam does not indicate which specific questions were answered incorrectly, it does indicate overall performance by section. This is a good indicator of preparedness or if further preparation is warranted.

Study Resources

There are many different resources you may choose to use to become proficient in Qiskit. Below are a few great overall resources to explore for all around knowledge and understanding of Qiskit, quantum computing, and using IBM's systems to achieve novel results.

- IBM Quantum Learning
- The IBM Quantum Blog
- Qiskit YouTube
- IBM Quantum Composer

Below is a high-level list of resources to help when you are preparing for the certification exam. This list is not exhaustive and meant to help you should you need more information on topics listed below in the Study Guide. Use the high-level reference links and search for the topic of the task.

Detailed Exam Objectives

Section 1: Perform quantum operations

This section accounts for approximately 16% of the exam.

TASK 1.1: Define Pauli Operators

REFERENCES:

https://quantum.cloud.ibm.com/docs/en/api/qiskit/qiskit.quantum_info.Pauli

TASK 1.2: Apply quantum operations

REFERENCES:

https://quantum.cloud.ibm.com/docs/en/api/qiskit/circuit_library

https://quantum.cloud.ibm.com/docs/en/api/qiskit/qiskit.circuit.QuantumCircuit

Section 2: Visualize quantum circuits, measurements, and states

This section accounts for approximately 11% of the exam.

TASK 2.1: Visualize quantum circuits

REFERENCES:

https://quantum.cloud.ibm.com/docs/en/guides/visualize-circuits

TASK 2.2: Visualize quantum measurements

REFERENCES:

https://quantum.cloud.ibm.com/docs/en/guides/classical-feedforward-and-control-flow

https://quantum.cloud.ibm.com/docs/en/api/qiskit/visualization

https://quantum.cloud.ibm.com/docs/en/api/qiskit/qiskit.visualization.plot_gate_map

TASK 2.3: Visualize quantum states

REFERENCES:

https://quantum.cloud.ibm.com/docs/en/api/qiskit/qiskit.visualization.plot_bloch_multivector

https://quantum.cloud.ibm.com/docs/en/api/qiskit/qiskit.visualization.plot_state_qsphere

Section 3: Create quantum circuits

This section accounts for approximately 18% of the exam.

TASK 3.1: Construct dynamic circuits

REFERENCES:
https://quantum.cloud.ibm.com/docs/en/guides/classical-feedforward-and-control-flow

TASK 3.2: Construct parameterized circuits

REFERENCES:
https://quantum.cloud.ibm.com/docs/en/api/qiskit/qiskit.circuit.Parameter
https://quantum.cloud.ibm.com/docs/en/api/qiskit/qiskit.circuit.QuantumCircuit
https://quantum.cloud.ibm.com/docs/en/api/qiskit/qiskit.circuit.ParameterExpression

TASK 3.3: Transpile and optimize circuits

REFERENCES:
https://quantum.cloud.ibm.com/docs/en/guides/transpiler-stages
https://quantum.cloud.ibm.com/docs/en/guides/transpile-with-pass-managers
https://quantum.cloud.ibm.com/docs/en/api/qiskit/transpiler_passes

TASK 3.4: Construct basic quantum circuits

REFERENCES:
https://quantum.cloud.ibm.com/docs/en/api/qiskit/circuit
https://quantum.cloud.ibm.com/docs/en/api/qiskit/qiskit.circuit.QuantumCircuit

Section 4: Run quantum circuits

This section accounts for approximately 15% of the exam.

TASK 4.1: Demonstrate an understanding of execution modes such as: session with dedicated, priority, and batch mode

1. Sessions
2. Batch

REFERENCES:
https://quantum.cloud.ibm.com/docs/en/guides/execute-on-hardware
https://quantum.cloud.ibm.com/docs/en/guides/execution-modes
https://quantum.cloud.ibm.com/docs/en/guides/choose-execution-mode
https://quantum.cloud.ibm.com/docs/en/guides/run-jobs-batch

TASK 4.2: Demonstrate understanding of how to run quantum circuits with real hardware using Qiskit Runtime primitives and applying broadcasting rules

1. Primitives
2. Broadcasting rules
3. Input / output
4. Jobs

REFERENCES:

https://quantum.cloud.ibm.com/docs/en/guides/execute-on-hardware
https://quantum.cloud.ibm.com/docs/en/guides/primitives
https://quantum.cloud.ibm.com/docs/en/guides/primitive-input-output
https://quantum.cloud.ibm.com/docs/en/guides/run-jobs-session

Section 5: Use the sampler primitive

This section accounts for approximately 12% of the exam.

TASK 5.1: Set sampler primitive options such as dynamical decoupling

REFERENCES:

https://quantum.cloud.ibm.com/docs/en/guides/get-started-with-primitives
https://quantum.cloud.ibm.com/docs/en/api/qiskit-ibm-runtime/options-sampler-options
https://quantum.cloud.ibm.com/docs/en/api/qiskit-ibm-runtime/options-twirling-options
https://quantum.cloud.ibm.com/docs/en/guides/error-mitigation-and-suppression-techniques

TASK 5.2: Understand the theoretical background behind the sampler primitive

REFERENCES:

https://quantum.cloud.ibm.com/docs/en/guides/get-started-with-primitives
https://quantum.cloud.ibm.com/docs/en/api/qiskit-ibm-runtime/sampler-v2
https://quantum.cloud.ibm.com/docs/en/migration-guides/v2-primitives

Section 6: Use the estimator primitive

This section accounts for approximately 12% of the exam.

TASK 6.1: Set estimator primitive options (such as resilience levels)

REFERENCES:

https://quantum.cloud.ibm.com/docs/en/api/qiskit-ibm-runtime/options-estimator-options
https://quantum.cloud.ibm.com/docs/en/api/qiskit-ibm-runtime/options-twirling-options
https://quantum.cloud.ibm.com/docs/en/api/qiskit-ibm-runtime/options-resilience-options-v2
https://quantum.cloud.ibm.com/docs/en/api/qiskit-ibm-runtime/options-zne-options

TASK 6.2: Understand the theoretical background behind the estimator primitive

REFERENCES:
https://quantum.cloud.ibm.com/docs/en/guides/primitives
https://quantum.cloud.ibm.com/docs/en/guides/error-mitigation-and-suppression-techniques

Section 7: Retrieve and analyze the results of quantum circuits

This section accounts for approximately 10% of the exam.

TASK 7.1: Retrieve previous experiment results (session/Qiskit Runtime)

REFERENCES:
https://quantum.cloud.ibm.com/docs/en/api/qiskit/qiskit.primitives.SamplerPubResult
https://quantum.cloud.ibm.com/docs/en/guides/save-jobs
https://quantum.cloud.ibm.com/docs/en/api/qiskit-ibm-runtime/runtime-job
https://quantum.cloud.ibm.com/docs/en/api/qiskit/qiskit.primitives.BasePrimitiveJob

TASK 7.2: Monitor jobs

REFERENCES:
https://quantum.cloud.ibm.com/docs/en/api/qiskit/providers
https://quantum.cloud.ibm.com/docs/en/api/qiskit/qiskit.providers.JobStatus
https://quantum.cloud.ibm.com/docs/en/api/qiskit-ibm-runtime/session

Section 8: Operate with OpenQASM

This section accounts for approximately 6% of the exam.

TASK 8.1: Structure types in OpenQASM 3 programs

REFERENCES:
https://openqasm.com/versions/3.0/language/types.html

TASK 8.2: Interpret OpenQASM semantics

REFERENCES:
https://quantum.cloud.ibm.com/docs/en/api/qiskit/qasm3

TASK 8.3: Interoperate different versions of OpenQASM with Qiskit

REFERENCES:
https://quantum.cloud.ibm.com/docs/en/guides/interoperate-qiskit-qasm3

TASK 8.4: Interact with the Qiskit IBM Runtime REST API

REFERENCES:
https://quantum.cloud.ibm.com/docs/en/api/qiskit-runtime-rest

Next Steps

1. Take the assessment test for ***Fundamentals of Quantum Computing Using Qiskit v2.X Developer***
2. If you pass the assessment exam, visit https://home.pearsonvue.com/ibm to schedule your testing sessions.
3. If you failed the assessment exam, review how you did by section. Focus attention on the sections where you need improvement. Keep in mind that you can take the assessment exam as many times as you would like ($30 per exam); however, you will still receive the same questions only in a different order.