MANNY GOMEZ

~~Fail~~ Pass-through #1

1.) A
2.) C
3.) A,B,D
4.) A
5.) A
6.) A,C
7.) B
8.) A,B
9.) D
10.) D
11.) B,C
12.) A
13.) A
14.) A
15.) A
16.) A,C,D
17.) B
18.) C
19.) C
20.) B

IBM Professional Certification Program

Exam C1000 – 112 IBM Certified Associate Developer - Qiskit v0.2X

1. **Which statement will create a quantum circuit with four quantum bits and four classical bits?**

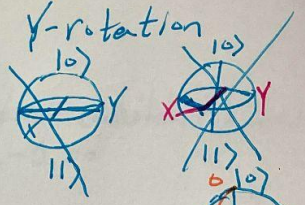
A. `QuantumCircuit(4, 4)`
B. `QuantumCircuit(4)`
C. `QuantumCircuit(QuantumRegister(4, 'qr0'), QuantumRegister(4, 'cr1'))`
D. `QuantumCircuit([4, 4])`

2. **Given this code fragment, what is the probability that a measurement would result in |0> ?**

```
qc = QuantumCircuit(1)
qc.ry(3 * math.pi/4, 0)
```

→ $(3 \cdot \frac{\pi}{4}, 0) = \frac{3\pi}{4}$

Y-rotation



A. 0.8536
B. 0.5
C. 0.1464
D. 1.0

1.)
A.) ✓

B.) Missing the 4 to make a classical register

C.) Doesn't make a classical register

D.) incorrect syntax, no brackets needed for QuantumCircuit

2.)
A.) Looking at where it lands & the fact that we want the probability of |0⟩ & not |1⟩

B.) Not $\pi/2$

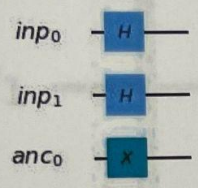
C.) ✓

D.) Not 4π

3. Assuming the fragment below, which three code fragments would produce the circuit illustrated?

```
inp_reg = QuantumRegister(2, name='inp')
ancilla = QuantumRegister(1, name='anc')
qc = QuantumCircuit(inp_reg, ancilla)

# Insert code here
```



A.
```
qc.h(inp_reg)
qc.x(ancilla)
qc.draw()
```

B.
```
qc.h(inp_reg[0:2])
qc.x(ancilla[0])
qc.draw()
```

C.
```
qc.h(inp_reg[0:1])
qc.x(ancilla[0])
qc.draw()
```

D.
```
qc.h(inp_reg[0])
qc.h(inp_reg[1])
qc.x(ancilla[0])
qc.draw()
```

E.
```
qc.h(inp_reg[1])
qc.h(inp_reg[2])
qc.x(ancilla[1])
qc.draw()
```

F.
```
qc.h(inp_reg)
qc.h(inp_reg)
qc.x(ancilla)
qc.draw()
```

Notice B.S. syntax that's tripped me up in the past

A.) ✓

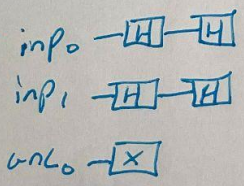
B.) ✓

C.) B.S. syntax wouldn't cover it, 1-1=0

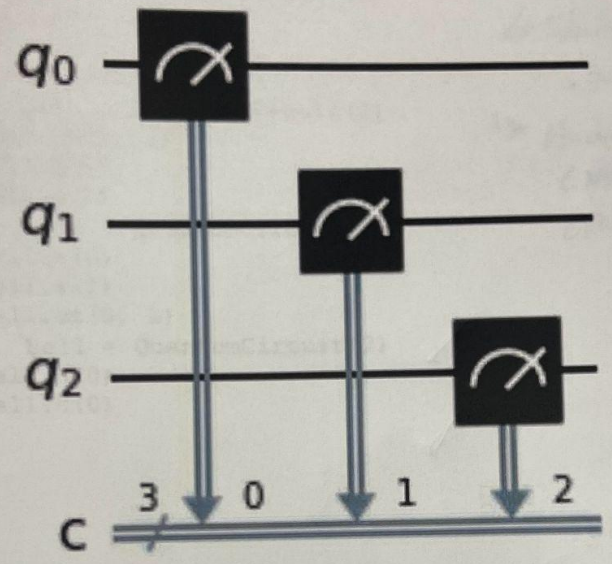
D.) ✓

E) ancilla[1] doesn't exist, we start from the 0th bit

F.) would be



4. **Given an empty QuantumCircuit object, qc, with three qubits and three classical bits, which one of these code fragments would create this circuit?**



A. `qc.measure([0,1,2], [0,1,2])`
B. `qc.measure([0,0], [1,1], [2,2])`
C. `qc.measure_all()`
D. `qc.measure(0,1,2)`

A.) ✓

B.) .measure only takes in 2 arguments

C.) .measure_all() adds in an (unnecessary) additional classical register

D.) .measure only takes in 2 arguments

5. Which code fragment will produce a maximally entangled, or Bell, state?

Bell information:
↳ statevector of .707
↳ Hadamard & then CNOT required to create a bell state

A.
```
bell = QuantumCircuit(2)
bell.h(0)
bell.x(1)
bell.cx(0, 1)
```

B.
```
bell = QuantumCircuit(2)
bell.cx(0, 1)
bell.h(0)
bell.x(1)
```

C.
```
bell = QuantumCircuit(2)
bell.h(0)
bell.x(1)
bell.cz(0, 1)
```

D.
```
bell = QuantumCircuit(2)
bell.h(0)
bell.h(0)
```

A.) ✓

B.) CNOT & then a hadamard is for decoding entangled info

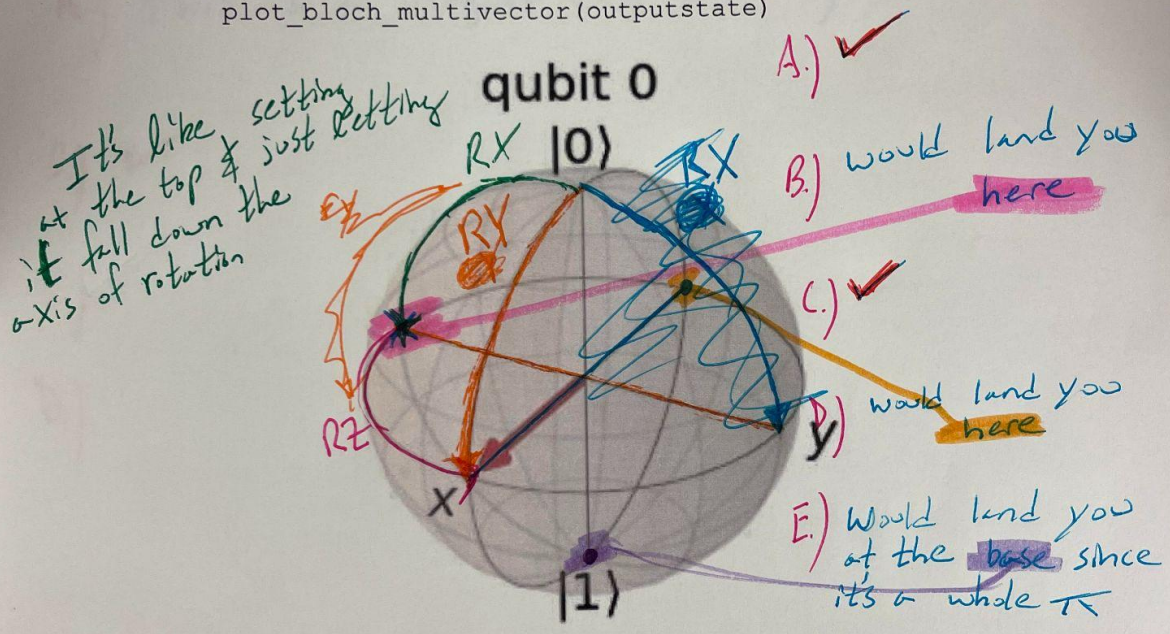
C.) Control z not part of Bell states

D.) 2 Hadamards, criteria not met

6. **Given this code, which two inserted code fragments result in the state vector represented by this Bloch sphere?**

```
qc = QuantumCircuit(1,1)
# Insert code fragment here

simulator = Aer.get_backend('statevector_simulator')
job = execute(qc, simulator)
result = job.result()
outputstate = result.get_statevector(qc)
plot_bloch_multivector(outputstate)
```



A. `qc.h(0)`
B. `qc.rx(math.pi / 2, 0)`
C. `qc.ry(math.pi / 2, 0)`
D. `qc.rx(math.pi / 2, 0)`
`qc.rz(-math.pi / 2, 0)`
E. `qc.ry(math.pi, 0)`

7. **S-gate is a Qiskit phase gate with what value of the phase parameter?**

A. π/4
B. π/2
C. π/8
D. π

A.) This is a T-gate (RZ of π/4)

B.) ✓

C.)

D.)

8. **Which two code fragments, when inserted into the code below, will produce the statevector shown in the output?**

initialize common for statevectors

```
from qiskit import QuantumCircuit, Aer, execute
from math import sqrt

qc = QuantumCircuit(2)

# Insert fragment here

simulator = Aer.get_backend('statevector_simulator')
result = execute(qc, simulator).result()
statevector = result.get_statevector()
print(statevector)
```

Output:

```
[0.707+0.j  0.+0.j  0.+0.j  0.707+0.j]
```

notice Bell-State characteristic statevector

A. `v = [1/sqrt(2), 0, 0, 1/sqrt(2)]`
`qc.initialize(v,[0,1])`

B. `qc.h(0)`
`qc.cx(0,1)`

C. `v1, v2 = [1,0], [0,1]`
`qc.initialize(v1,0)`
`qc.initialize(v2,1)`

D. `qc.cx(0,1)`
`qc.measure_all()`

E. `qc.h(0)`
`qc.h(1)`
`qc.measure_all()`

A.) ✓

B.) ✓

E.) Incomplete Bell ε

C.) 1001 is not .707 0 0 .707

D.) Incomplete Bell

9. **Which code fragment will produce a multi-qubit gate other than a CNOT ?**

A. `qc.cx(0,1)`
B. `qc.cnot(0,1)`
C. `qc.mct([0],1)`
D. `qc.cz(0,1)`

A.) typical .cx(control, target) syntax
B.) typical .cnot(control, target) syntax
C.) typ'al .mct([0],1) multiple-control syntax (w/ only 1 control for cnot) as opposed to 2 for toffoli
D.) ✓ Control-Z gate ~~rotation~~ ≠ CNOT

10. **Which code fragment will produce a multi-qubit gate other than a Toffoli?**

A. `qc.ccx(0,1,2)`
B. `qc.mct([0,1], 2)`
C.
```
from qiskit.circuit.library import CXGate
ccx = CXGate().control()
qc.append(ccx, [0,1,2])
```
D. `qc.cry(0,1,2)`

Notice .mct bracket syntax for control qubits

11. **Which two options would place a barrier across all qubits to the QuantumCircuit below?**

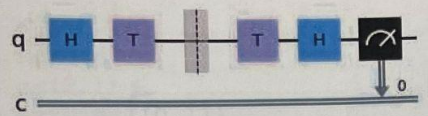
```
qc = QuantumCircuit(3,3)
```

A. `qc.barrier(qc)`
B. `qc.barrier([0,1,2])`
C. `qc.barrier()`
D. `qc.barrier(3)`
E. `qc.barrier_all()`

10.)
A.) .ccx(~~control~~ ~~target~~ 1, ~~control~~ ~~target~~ 2, target) (multiple-control)
B.) .mct ([control 1, control 2], target)
C.)
D.) ✓ Controlled-y-gate rotation ≠ toffoli

11.)
A.) incorrect syntax (unfortunately, I wish it ~~was~~ worked like this)
B.) ✓
C.) ✓
D.) .barrier_all() does not exist, .measure_all() is the only _all() command that exists
E.) only 1 barrier placed

12. **What code fragment codes the equivalent circuit if you remove the barrier in the following QuantumCircuit?**



Notice they may try to trip you up by using equivalents, study the operator glossary for this

A.
```
qc = QuantumCircuit(1,1)
qc.h(0)
qc.s(0)
qc.h(0)
qc.measure(0,0)
```
B.
```
qc = QuantumCircuit(1,1)
qc.measure(0,0)
```
C.
```
qc = QuantumCircuit(1,1)
qc.h(0)
qc.t(0)
qc.tdg(0)
qc.h(0)
qc.measure(0,0)
```
D.
```
qc = QuantumCircuit(1,1)
qc.h(0)
qc.z(0)
qc.h(0)
qc.measure(0,0)
```

A) ✓, 2T's = 1S

B.) wtf just an empty register

C.) T & Tdg cancel, not what we want

D.) Z ≠ 2 T's

13. **Given the following code, what is the depth of the circuit?**

```
qc = QuantumCircuit(2, 2)

qc.h(0)
qc.barrier(0)
qc.cx(0,1)
qc.barrier([0,1])
```

A. 2
B. 3
C. 4
D. 5

Barriers & Snapshots do not count towards circuit depth

A.) ✓

B.)

C.)

D.)

14. Which code snippet would execute a circuit given these parameters?

1) • Measure the circuit 1024 times,
2) • use the QASM simulator,
3) • and use a coupling map that connects three qubits linearly

```
qc = QuantumCircuit(3)

# Insert code fragment here
result = job.result()
```

A.
```
qasm_sim = Aer.get_backend('qasm_simulator')
couple_map = [[0, 1], [1, 2]]
job = execute(qc, backend=qasm_sim, shots=1024,
coupling_map=couple_map)
```

B.
```
qasm_sim = Aer.getBackend('ibmq_simulator')
couple_map = [[0, 1], [0, 2]]
job = execute(qc, loop=1024, coupling_map=couple_map)
```

C.
```
qasm_sim = Aer.get_backend('qasm_simulator')
couple_map = [[0, 1], [1, 2]]
job = execute(qc, backend=qasm_sim, repeat=1024,
coupling_map=couple_map)
```

D.
```
qasm_sim = Aer.get_backend('qasm_simulator')
couple_map = [[0, 1], [1, 2]]
job = execute(backend=qasm_sim, qc, shot=1024,
coupling_map=couple_map)
```

A.) ✓

B.) 'ibmq-simulator' doesn't exist & execute syntax incorrect, 'loop' used instead of 'shots'

C.) 'repeat' used instead of 'shots'

D.) 'shot' used instead of 'shots', incorrect syntax for execute (supposed to be (name, backend, shots, couple~~map~~))

15. Which of these would execute a circuit on a set of qubits which are coupled in a custom way?

```
from qiskit import QuantumCircuit, execute, BasicAer
backend = BasicAer.get_backend('qasm_simulator')
qc = QuantumCircuit(3)

# insert code here
```

A. `execute(qc, backend, shots=1024, coupling_map=[[0,1], [1,2]])`
B. `execute(qc, backend, shots=1024, custom_topology=[[0,1],[2,3]]`
C. `execute(qc, backend, shots=1024, device="qasm_simulator", mode="custom")`
D. `execute(qc, backend, mode="custom")`

16. Which three simulators are available in BasicAer?

A. qasm_simulator
B. basic_qasm_simulator
C. statevector_simulator
D. unitary_simulator
E. quantum_simulator
F. quantum_circuit_simulator

15.)
A.) ✓

B.) 'custom_topology' doesn't exist

C.) mode = "custom" doesn't exist for execute

D.) mode = 'custom' doesn't exist for execute

16.)
A.) ✓

B.)

C.) ✓

D.) ✓

↳ qasm_
statevector_
unitary_

E.)

F.)

17. Which line of code would assign a statevector simulator object to the variable `backend` ?

A. `backend = BasicAer.StatevectorSimulatorPy()`
B. `backend = BasicAer.get_backend('statevector_simulator')`
C. `backend = BasicAer.StatevectorSimulatorPy().name()`
D. `backend = BasicAer.get_back('statevector_simulator')`

18. Which code fragment would yield an operator that represents a single-qubit X gate?

A. `op = Operator.Xop(0)`
B. `op = Operator([[0,1]])`
C. `qc = QuantumCircuit(1)`
`qc.x(0)`
`op = Operator(qc)`
D. `op = Operator([[1,0,0,1]])`

17.)

A.) bad syntax

B.) ✓

C.) bad syntax

D.) .get_back should be .get_backend

18.)

A.) bad syntax

B.) not what we're looking for

C.) ✓

D.) cool statevectors, not an X

19. What would be the fidelity result(s) for these two operators, which differ only by global phase?

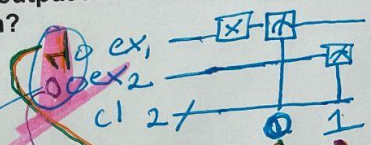
```
op_a = Operator(XGate())
op_b = numpy.exp(1j * 0.5) * Operator(XGate())
```

A. state_fidelity() of 1.0
B. state_fidelity() and average_gate_fidelity() of 1.0
C. average_gate_fidelity() and process_fidelity() of 1.0
D. state_fidelity(), average_gate_fidelity() and process_fidelity() of 1.0

20. Given this code fragment, which output fits most closely with the measurement probability distribution?

```
qc = QuantumCircuit(2, 2)
qc.x(0)
qc.measure([0,1], [0,1])
simulator = Aer.get_backend('qasm_simulator')
result = execute(qc, simulator, shots=1000).result()
counts  = result.get_counts(qc)
print(counts)
```

A. {'00': 1000}
B. {'01': 1000}
C. {'10': 1000}
D. {'11': 1000}



19.)
A) state_fidelity doesn't work w/ operators
B.) state_fidelity doesn't work w/ operators
C.) ✓
D.) state_fidelity doesn't work w/ operators

20.)
A.)
B.) ✓
C.)
D.)