Part (c)
Part i: Comprehensive Unit Test Cases (22 points)

Constructor Testing

Canonical Constructor (private): `Sensor(int reading, boolean valid)`

Test ID	Inputs	Description	Expected Result
TC1	reading = 100, valid = true	Normal positive reading, valid sensor	Sensor created with reading=100, valid=true, label=""
TC2	reading = 0, valid = true	Boundary: zero reading, valid sensor	Sensor created with reading=0, valid=true, label=""
TC3	reading = -50, valid = true	Negative reading, valid sensor	Sensor created with reading=-50, valid=true, label=""
TC4	reading = Integer.MAX_VALUE, valid = true	Edge: maximum integer value	Sensor created with reading=2147483647, valid=true, label=""
TC5	reading = Integer.MIN_VALUE, valid = true	Edge: minimum integer value	Sensor created with reading=-2147483648, valid=true, label=""
TC6	reading = 100, valid = false	Normal reading, invalid sensor	Sensor created with reading=100, valid=false, label=""
TC7	reading = 0, valid = false	Zero reading, invalid sensor	Sensor created with reading=0, valid=false, label=""

Constructor: `Sensor(int reading, String label)`

Test ID	Inputs	Description	Expected Result
TC8	reading = 100, label = "ABC"	Normal case: valid 3-char label	reading=100, valid=true, label="ABC"
TC9	reading = 50, label = "XY"	Normal case: 2-char label	reading=50, valid=true, label="XY"

TC10	reading = 25, label = "A"	Boundary: 1-char label	reading=25, valid=true, label="A"
TC11	reading = 75, label = ""	Boundary: empty string label	reading=75, valid=true, label=""
TC12	reading = 0, label = "ABC"	Boundary: zero reading with valid label	reading=0, valid=true, label="ABC"
TC13	reading = -100, label = "NEG"	Negative reading with valid label	reading=-100, valid=true, label="NEG"
TC14	reading = 100, label = null	Invalid: null label	reading=100, valid=false, label=""
TC15	reading = Integer.MAX_VALUE, label = "MAX"	Edge: maximum reading with label	reading=2147483647, valid=true, label="MAX"
TC16	reading = Integer.MIN_VALUE, label = "MIN"	Edge: minimum reading with label	reading=-2147483648, valid=true, label="MIN"
TC17	reading = 100, label = "ABCD"	Label exceeds 3 characters	reading=100, valid=true, label="ABC" (truncated)
TC18	reading = 100, label = "ABCDEFGHIJ"	Label significantly exceeds 3 characters	reading=100, valid=true, label="ABC" (truncated)

Constructor: `Sensor(boolean valid, int reading)`

Test ID	Inputs	Description	Expected Result
TC19	valid = true, reading = 100	Normal case: valid sensor with positive reading	reading=100, valid=true, label=""
TC20	valid = true, reading = 0	Boundary: valid sensor with zero reading	reading=0, valid=true, label=""
TC21	valid = true, reading = -50	Valid sensor with negative reading	reading=-50, valid=true, label=""

TC22	valid = false, reading = 100	Invalid sensor with positive reading	reading=0, valid=false, label=""
TC23	valid = false, reading = -100	Invalid sensor with negative reading	reading=0, valid=false, label=""
TC24	valid = false, reading = 0	Invalid sensor with zero reading	reading=0, valid=false, label=""
TC25	valid = true, reading = Integer.MAX_VALUE	Edge: valid sensor with max reading	reading=2147483647, valid=true, label=""
TC26	valid = true, reading = Integer.MIN_VALUE	Edge: valid sensor with min reading	reading=-2147483648, valid=true, label=""
TC27	valid = false, reading = Integer.MAX_VALUE	Invalid sensor ignores max reading	reading=0, valid=false, label=""

Constructor: `Sensor()` (No-arg constructor)

Test ID	Inputs	Description	Expected Result
TC28	(none)	Default constructor	reading=0, valid=false, label=""

Setter Method Testing

Method: `setLabel(String label)`

Test ID	Inputs	Description	Expected Result
TC29	label = "ABC"	Normal case: valid 3-char label	label="ABC", valid unchanged
TC30	label = "XY"	Normal case: 2-char label	label="XY", valid unchanged
TC31	label = "A"	Boundary: 1-char label	label="A", valid unchanged
TC32	label = ""	Boundary: empty string	label="", valid should become false (isValid returns false)
TC33	label = "ABCD"	Boundary: 4-char label (just over limit)	label="ABC", valid unchanged

TC34	label = "ABCDEFGHIJ"	Label significantly exceeds 3 characters	label="ABC", valid unchanged
TC35	label = "123"	Numeric characters in label	label="123", valid unchanged
TC36	label = "A1X"	Alphanumeric label	label="A1X", valid unchanged
TC37	label = " "	Three spaces	label=" ", valid unchanged
TC38	label = "\t\n\r"	Special whitespace characters	label truncated to first 3, valid unchanged
TC39	label = null	Invalid: null reference	Should handle gracefully; current code will throw NullPointerException
TC40	Sensor created with valid=false, then setLabel("ABC")	Setting label on invalid sensor	label="ABC", but isValid() still considers the valid flag

Method: `setReading(int reading)`

Test ID	Inputs	Description	Expected Result
TC41	reading = 100	Normal positive reading	reading=100
TC42	reading = 0	Boundary: zero reading	reading=0
TC43	reading = -50	Negative reading (comment says "must be > 0")	reading=-50 (code doesn't enforce comment)
TC44	reading = 1	Boundary: minimum expected positive	reading=1
TC45	reading = Integer.MAX_VALUE	Edge: maximum integer	reading=2147483647
TC46	reading = Integer.MIN_VALUE	Edge: minimum integer	reading=-2147483648
TC47	reading = -1	Boundary: just below zero	reading=-1 (code doesn't validate)

Additional Integration Testing

Test ID	Inputs	Description	Expected Result
TC48	Create with Sensor(100, "ABC"), call isValid()	Test isValid with proper initialization	isValid() returns true
TC49	Create with Sensor(), call isValid()	Test isValid with default constructor	isValid() returns false (label length is 0)
TC50	Create with Sensor(100, "ABC"), setLabel(""), call isValid()	Valid sensor becomes invalid via empty label	isValid() returns false
TC51	Create with Sensor(100, null), call isValid()	Sensor with null label	isValid() returns false (valid=false, label="")
TC52	Create with Sensor(false, 100), call isValid()	Invalid sensor regardless of label	isValid() returns false
TC53	Create with Sensor(true, 100), call getLabel()	Get label from constructor with no label param	getLabel() returns ""
