Chapter 2
End-of-chapter quiz questions

1. For fluids, movement through the process occurs due to . . .
   a. An elevation drop from upstream to downstream
   b. A pressure drop from upstream to downstream
   c. A pressure drop from downstream to upstream
   d. None of the above

2. For fluids, the pressure may be increased . . . .
   a. At strategic points in the process
   b. Using pumps
   c. Using Compressors
   d. All of the above

3. For compressible fluids, the pressure may be increased . . .
   a. Through entrainment
   b. Using pumps
   c. Using blowers
   d. All of the above

4. For solids . . . .
   a. Movement is less challenging than for fluids
   b. Are moved solely using gravity
   c. Must be physically moved
   d. Are never pumped

5. For solids . . .
   a. Movement is more challenging than for fluids
   b. May be moved using a conveyor
   c. May be moved using gravity
   d. All of the above

6. For solids . . . .
   a. Movement is less challenging than for fluids
   b. May be moved by fluidization
   c. Cannot be moved using a gas
   d. Are never pumped

7. In commercial-scale processes heat transfer . . .
   a. Is most commonly performed indirectly
   b. Fired heaters are the most common way to heat
   c. Refrigeration loops are the most common way to cool
   d. All of the above

8. In commercial-scale processes heat transfer . . .
    a. Is most commonly performed indirectly
    b. Steam is the most common way to heat
    c. Water are the most common way to cool
    d. All of the above

9. Electric resistance heating . . . .
    a. Is commonly used in large scale systems
    b. Is commonly used in small scale systems
    c. Uses the resistance of the process fluid for heating
    d. All of the above

10. A common separation technique is . . .
    a. Separation by polarity
    b. Separation by adsorption
    c. Separation by leaching
    d. All of the above

11. The following parameters are usually the most important for chemical reactions:
    a. Concentration of one of the reactants, vapor pressure, temperature
    b. The ratio of reactants, vapor pressure, presence of a catalyst
    c. The ratio of reactants, residence time, temperature
    d. The concentration of one of the reactants, reaction pressure, number of reaction products

12. Manipulating the movement of materials in a process . . . .
    a. Can be accomplished using an adjustable throttle
    b. Can be accomplished in many ways
    c. Is the same for solids as for fluids
    d. Is accomplished by adjusting a dependent variable

13. Manipulating the movement of materials in a process . . . .
    a. Can be accomplished by changing the opening of a choke point in a pipe
    b. Can be accomplished by changing the pressure drop of a fluid
    c. Is accomplished by adjusting an independent variable
    d. All of the above

14. For fluids, the most common independent variable is . . .
    a. A throttling control valve
    b. A control valve
    c. Accomplished by changing the choke point in a pipe
    d. All of the above

15. For fluids, the most common independent variable is . . .
    a. A change in the speed of a pump or compressor
    b. A control valve
    c. The flow rate through a pipe
    d. All of the above

16. The following are independent variables in a process . . .
    a. Control valve, motor speed, conveyor speed
    b. Flow rate, temperature, motor speed
    c. Control valve, electrical current to a motor, electrical current to a conveyor
    d. Flow rate, pressure drop, temperature

17. The following are independent variables in a process . . .
    a. Flow rate, temperature, motor speed
    b. Control valve, motor speed, conveyor speed
    c. Flow rate, pressure drop, temperature
    d. Control valve, fraction of time electrical current is sent to a heater, electrical current to a conveyor

18. The following are independent variables in a process . . .
    a. Control valve, motor speed, conveyor speed
    b. Control valve, resistant in the electrical circuit of a motor, fraction of time electrical current is sent to a heater
    c. Flow rate, pressure drop, temperature
    d. Flow rate, temperature, motor speed

19. Dependent variables . . .
    a. Are also known as control variables
    b. Manipulate the process
    c. Measure the effect of changes from independent variables
    d. Control the flow rate in a pipe

20. Dependent variables . . .
    a. Are also known as control variables
    b. Manipulate the process
    c. Are also known as measurement variables
    d. All of the above

21. Dependent variables . . . .
    a. Are also known as measurement variables
    b. Include flow rate, pressure, and temperature
    c. May be coupled to independent variables
    d. All of the above

22. In a well-designed control system . . . .
    a. One dependent variable is coupled with each independent variable
    b. Dependent variables are selected that are insensitive to independent variable changes
    c. There are no independent variables, only dependent ones
    d. There are no dependent variables, only independent ones

23. The most common control strategy is . . .
    a. Fundamental building block control
    b. Manipulate dependent variables and measure the impact
    c. Single input/single output feedback control
    d. Measurement control

24. The most common control strategy is . . .
    a. Feedforward control
    b. Manipulate dependent variables and measure the impact
    c. Feedback control
    d. On/off control

25. In feedback control,
    a. An adjustment is made to an independent variable, then the impact is tested by measuring a dependent variable
    b. An adjustment is made to a control variable, then the impact is tested by reading a measurement variable
    c. The measurement of a dependent variable is compared to standard and the difference is used to make an adjustment to a control variable
    d. All of the above

26. The main objective of a liquid knockout drum is . . .
    a. To minimize the amount of liquid entrained in a gas phase stream
    b. Minimize the amount of gas that leaves from the bottom outlet of the drum
    c. Minimize the pressure lost across this unit operation
    d. Keep the pressure in the vessel below the drum bursting pressure

27. Which of the following is Not an objective for a liquid knockout drum:
    a. Maximize the amount of liquid produced in the drum
    b. Minimize the amount of liquid entrained in a gas phase stream
    c. Minimize the pressure lost across this unit operation
    d. Keep the pressure in the vessel below the drum bursting pressure

28. How can we insure that minimal gas flows out of the bottom of a liquid knockout drum?
    a. Maintain adequate pressure in the vessel
    b. Minimize the pressure in the vessel

c. Maintain a liquid level in the drum
d. None of the above

29. If the liquid outlet pressure from a knockout drum is insufficient . . . .
    a. A compressor can be installed on the outlet line
    b. The pressure in the drum must be raised
    c. A pump can be installed in the bottoms outlet line
    d. The control valve can be adjusted to reduce the pressure drop

30. The portion of the feedback control loop that determines what adjustment should be made to the independent variable is known as the:
    a. The dependent variable
    b. The control valve
    c. The controller
    d. The measurement variable

31. The desired value used in a control loop . . .
    a. Is known as the setpoint
    b. Is known as the standard
    c. Is the desired value of the measurement variable
    d. All of the above

32. The desired value used in a control loop . . .
    a. Is known as the adjustment
    b. Is known as the standard
    c. Is known as the output
    d. All of the above

33. The desired value used in a control loop . . .
    a. Is known as the setpoint
    b. Is known as the output
    c. Is the desired value of the independent variable
    d. All of the above

34. The desired value used in a control loop . . .
    a. Is known as the measurement
    b. Is known as the output
    c. Is the desired value of the dependent variable
    d. All of the above

35. Measurement error is:
    a. The difference between the setpoint and the value of the measurement variable

b. The difference between the standard and the value of the output variable
c. Calculated by comparing the independent variable to the setpoint
d. None of the above

36. Measurement error is:
    a. The difference between the setpoint and the value of the measurement variable
    b. The difference between the standard and the value of the dependent variable
    c. Used to calculate the controller output
    d. All of the above

37. In a coupled control system . . .
    a. The actions of one dependent variable have an immediate impact on a separate dependent variable
    b. The actions of one independent variable have an immediate impact on the dependent variable of a separate independent variable's control loop
    c. Control loops are stable and handle disturbances well
    d. The actions of one dependent variable have an immediate impact on the dependent variable of a separate independent variable's control loop

38. In decoupled control schemes . . .
    a. The actions of one dependent variable have an immediate impact on a separate dependent variable
    b. The actions of one independent variable have an immediate impact on the dependent variable of a separate independent variable's control loop
    c. Control loops are stable and handle disturbances well
    d. The actions of one dependent variable have an immediate impact on the dependent variable of a separate independent variable's control loop

39. A disturbance variable . . . .
    a. Does not affect the operation of the unit operation being controlled
    b. Is not included in the feedback control loops associated with the unit operation being controlled
    c. Is a controlled variable
    d. Measures upsets in the unit operation due to the control loops employed

40. A disturbance variable . . . .
    a. Affects the operation of the unit operation being controlled
    b. Is not included in the feedback control loops associated with the unit operation being controlled
    c. Is not a controlled variable
    d. All of the above

41. A disturbance variable . . . .
    a. Does not affect the operation of the unit operation being controlled
    b. Is included in the feedback control loops associated with the unit operation being controlled
    c. Is an independent variable
    d. All of the above

41. Feedforward control . . .
    a. Is also known as open loop control
    b. Uses the measurement of a dependent variable
    c. Is the same as feedback control
    d. Manipulates an independent disturbance variable in the control loop

42. Feedforward control . . .
    a. Is also known as disturbed loop control
    b. Uses the measurement of an independent variable
    c. Is the same as feedback control
    d. Manipulates an independent disturbance variable in the control loop

43. Feedforward control . . .
    a. Is also known as disturbed loop control
    b. Uses the measurement of a dependent variable
    c. Manipulates an independent disturbance variable in the control loop
    d. None of the above

44. Feedforward control . . .
    a. Is used to anticipate changes to a unit operation
    b. Controls the actions of an independent disturbance variable
    c. Is also known as disturbance loop control
    d. None of the above

45. Feedforward control . . .
    a. Is often combined with feedback control
    b. Generates an error by comparing a disturbance variable to a setpoint
    c. Generates an error that can be added to the error from a feedback controller
    d. All of the above

46. Feedforward control . . .
    a. Is used instead of feedback control
    b. Generates an error by comparing a disturbance variable to a setpoint
    c. Generates an error that can be added to the error from a feedback controller
    d. Both b and c

47. Feedforward control . . .
    a. Can be combined with feedback control in two different ways

b. Generates an error by comparing a measurement variable to a setpoint
c. Generates an error that can be used as an external setpoint for a feedback controller
d. Both b and c

48. In a ratio controller . . .
    a. The value of a disturbance variable is added to the value of a measurement variable
    b. The ratio of two measurements is used as the input variable which is then compared to a setpoint in the controller
    c. The ratio of two separate outputs is used to adjust an independent variable such as a control valve
    d. All of the above

49. In a ratio controller . . .
    a. The value of a disturbance variable is divided by the value of a measurement variable
    b. The ratio of two disturbance variables is used as the input variable which is then compared to a setpoint in the controller
    c. The ratio of two separate outputs is used to adjust an independent variable such as a control valve
    d. All of the above

50. In a ratio controller . . .
    a. The value of a disturbance variable is divided by the value of a measurement variable
    b. The ratio of two separate outputs is used to adjust an independent variable such as a control valve
    c. The measurement ratio is used as the input variable which is then compared to a setpoint in the controller
    d. All of the above

51. When a level controller is used in a recycle loop . . .
    a. It can be “de-tuned” to reduce process upsets
    b. Must be coupled to a flow controller in order to work correctly
    c. The responsiveness of the level measurement to process upsets causes upsets
    d. All of the above

52. When a level controller is used in a recycle loop . . .
    a. It will smooth out all process upsets
    b. Can be coupled to a flow controller in a cascade to insure smooth drum outlet flow with adequate level control
    c. The responsiveness of the level measurement to process upsets causes upsets
    d. All of the above

53. When a level controller is used in a recycle loop . . .
    a. It can be “de-tuned” to reduce process upsets
    b. Can be coupled to a flow controller in a cascade to insure smooth drum outlet flow with adequate level control
    c. The non-responsiveness of the level measurement helps to smooth out process upsets
    d. All of the above

54. For a cascade control loop to work correctly,
    a. The response dynamics of the master loop must be faster than those of the slave loop
    b. The response dynamics of the slave loop must be faster than those of the master loop
    c. The response dynamics of the master loop must be identical to those of the slave loop
    d. The response dynamics of the master loop should be around 100 times slower than those of the slave loop

55. For a cascade control loop to work correctly,
    a. The response dynamics of the master loop must be slower than those of the slave loop
    b. The response dynamics of the slave loop must be slower than those of the master loop
    c. The response dynamics of the master loop must be identical to those of the slave loop
    d. The response dynamics of the master loop should be around 100 times faster than those of the slave loop

56. For a cascade control loop to work correctly,
    a. The response dynamics of the master loop must be faster than those of the slave loop
    b. The response dynamics of the master loop must be identical to those of the slave loop
    c. The response dynamics of the master loop should be around 10 times slower than those of the slave loop
    d. It must involve unrelated variables

57. For a cascade control loop to work correctly,
    a. The response dynamics of the master loop must be faster than those of the slave loop
    b. The response dynamics of the master loop must be identical to those of the slave loop
    c. The response dynamics of the master loop should be around 10 times faster than those of the slave loop
    d. It must involve inter-dependent variables

58. Feedforward and feedback control loops can be combined by . . . .
    a. Adding the outputs together if the responsiveness of the two loops are similar
    b. Adding the outputs together if the responsiveness of the feedforward loop is much slower than the responsiveness of the feedback loop
    c. Cascading the feedforward as a master and the feedback as a slave loop
    d. Cascading the feedback as the master and feedforward as a slave when the responsiveness of the two loops are similar

59. Feedforward and feedback control loops can be combined by . . . .
    a. Adding the outputs together if the responsiveness of the two loops are dissimilar
    b. Adding the outputs together if the responsiveness of the feedforward loop is much faster than the responsiveness of the feedback loop
    c. Cascading the feedforward as a master and the feedback as a slave loop
    d. Cascading the feedback as the master and feedforward as a slave when the responsiveness of the two loops are similar

60. Feedforward and feedback control loops can be combined by . . . .
    a. Adding the outputs together if the responsiveness of the two loops are dissimilar

b. Adding the outputs together if the responsiveness of the feedforward loop is much slower than the responsiveness of the feedback loop
c. Cascading the feedforward as a slave and the feedback as a master loop when the responsiveness of the feedback loop is much slower than the feedforward loop
d. Cascading the feedback as the master and feedforward as a slave when the responsiveness of the two loops are similar

61. Feedforward and feedback control loops can be combined by . . . .
    a. Adding the outputs together if the responsiveness of the two loops are dissimilar
    b. Adding the outputs together if the responsiveness of the feedforward loop is much slower than the responsiveness of the feedback loop
    c. Cascading the feedforward as a master and the feedback as a slave loop
    d. Cascading the feedback as the master and feedforward as a slave when the responsiveness of the feedforward loop is much faster than the feedback loop

62. When both the disturbance variable and the measurement variable are non-responsive . . .
    a. A third, more responsive, variable related to the measurement variable should be used as the slave
    b. The outputs from the feedforward and feedback controllers should be added together
    c. Both a and b
    d. Neither a or b

63. Most controllers include which of the following alarms:
    a. High
    b. Low
    c. Deviation
    d. All of the above

64. Most controllers include which of the following alarms:
    a. High high
    b. Low low
    c. Deviation
    d. All of the above

65. Most controllers include which of the following alarms:
    a. High high
    b. Low
    c. Development
    d. All of the above

66. Another term for a control operator is . . .
    a. Broad operator
    b. Field operator
    c. Telephone operator
    d. Board operator

67. As much as possible . . .
    a. Alarms should be handled by the control operator

b. Alarms should be handled automatically by the control system
c. Alarms should be ignored
d. Alarms should be disabled

68. The consequences of a highly upset process can include . . .
    a. Injury to personnel
    b. The release of toxic materials
    c. Damage to equipment
    d. All of the above

69. The consequences of a highly upset process can include . . .
    a. Loss of jobs for the operators
    b. The release of flammable materials
    c. Nothing, the control system can handle any contingency
    d. None of the above

70. The safety automation system . . .
    a. Is integrated with the process control system
    b. Is independent of the process control system
    c. Uses the same measurement devices as the process control system
    d. Is an option used only in very hazardous processes

71. The safety automation system . . .
    a. Uses separate measurement devices
    b. Activates when a measurement is far out from normal
    c. Uses separate controllers/control computers
    d. All of the above

72. The safety automation system . . .
    a. Is integrated with the process control system
    b. Uses the same measurement devices as the process control system
    c. Represents a last resort
    d. Is an option used only in very hazardous processes

73. Manual mode . . .
    a. Is independent of the process control system
    b. Uses separate measurement devices from the process control system
    c. Means the control operator overrides the controller output
    d. Is an option used only in very hazardous processes

74. A high-high alarm . . .
    a. Is integrated with the process control system
    b. Is a secondary alarm set above the high level alarm of the process device
    c. Uses the same measurement devices as the process control system
    d. Is an option used only in very hazardous processes

74. A low-low alarm . . .
    a. Is integrated with the process control system

b. Uses the same measurement devices as the process control system
c. Is a secondary alarm set below the high level alarm of the process device
d. Is a secondary alarm set below the low level alarm of the process device

75. An AFO valve . . .
    a. Shuts off when the air fails
    b. Opens when the controller output fails
    c. Shuts off when the measurement device fails to provide an input to the controller
    d. None of the above

76. An AFC valve . . .
    a. Shuts off when the air fails
    b. Opens when the controller output fails
    c. Shuts off when the measurement device fails to provide an input to the controller
    d. None of the above

77. Sequential processes . . .
    a. Is another name for continuous processes
    b. Operate similarly to continuous processes
    c. Require an entirely different control paradigm compared to continuous processes
    d. Cannot be embedded within continuous processes

78. Sequential processes . . .
    a. Is another name for continuous processes
    b. Operate similarly to continuous processes
    c. Use the same control paradigm as continuous processes
    d. Can be embedded within continuous processes

79. Sequential processes . . .
    a. Are distinctly different from continuous processes
    b. Require an entirely different control paradigm compared to continuous processes
    c. Can be embedded within continuous processes
    d. All of the above

80. A sequential logic controller . . .
    a. Is software or firmware that can be configured to change multiple valve positions and/or motor conditions simultaneously
    b. Is another name for a feedback controller
    c. Is another name for a cascade controller
    d. None of the above

81. A sequential logic controller . . .
    a. Is software or firmware that can be configured to change a single valve position and/or motor condition for a given sequence step
    b. Is used to change the process from one set of conditions to another
    c. Is another name for a cascade controller
    d. None of the above

82. A sequential logic controller . . .
    a. Is software or firmware that can be configured to change a single valve position and/or motor condition for a given sequence step
    b. Is another name for a feedback controller
    c. Changes the process conditions based on one or more termination criteria
    d. None of the above

83. To properly specify a control scheme for a batch process . . .
    a. You only need to look at the operational steps of the process
    b. You walk through the process step by step and add the measurement and control variables required for each step
    c. You only need to specify open/close valves and start/stop motor actions
    d. None of the above