EN00 – Pre-Instructional Survey

Name: _____   Date: _____

1. At 433 degrees F, a type J thermocouple with a 32 degree F reference junction will produce an output in millivolts that is most nearly to:

   a. 9.04
   b. 10.51
   c. 12.05
   d. 17.79

2. The flow of water in a 6-inch pipe is measured with an orifice plate and differential pressure transmitter. At a flow rate of 200 GPM, the differential pressure is 35 inches of water. At a flow rate of 312 GPM, the differential pressure will be approximately equal to:

   a. 16.4 " wc
   b. 32.5" wc
   c. 85.4" wc
   d. 100" wc

3. A tank level is measured using a differential pressure transmitter and a bubbler tube. The tank is vented to atmosphere. The bubbler tube is 1 foot from the bottom of the tank and the tank wall is 20 feet high. A 0-10 psig differential pressure gauge, accurate to .25 per cent of full scale is connected to the bubbler tube connection at the high side of the transmitter. The low pressure side is connected to the tank top. With the tank containing liquid with a specific gravity of 1.1 and the level in the tank at 16 feet, the gauge reading in pounds per square inch (psi) is most nearly equal to:

   a. 4.8
   b. 9.35
   c. 13
   d. 7.1

4. Which of the following practices is important in routing optic cable?

   a. Laying cable in trays with high-horsepower motor wiring should be avoided.
   b. Conduit fittings that require small radius bends should be avoided.
   c. Overhead runs on messenger wires should be limited to 75 feet.
   d. Underground fiber optic runs must be covered with concrete.

5.	Compared to a control loop with no dead time (pure time delay), a control loop with an appreciable dead time tends to require:

a.	Less proportional gain and less integral action
b.	More proportional gain and less integral action
c.	More proportional gain and more integral action
d.	Less proportional gain and more integral action

6.	The definition and classification of hazardous areas for the purpose of wiring and electrical equipment is found in codes published by:

a.	National Fire Protection Association
b.	ISA-The Instrumentation, Systems and Automation Society
c.	Electric Power Research Institute
d.	Occupational Safety and Health Administration

7.	Given the following data for liquid flow:

Flow rate – 0 to 200 gpm
Water at 125 degrees F and 75 psia
Pipe Size – 4 inch schedule 40

The orifice bore for a pressure differential range of 100 inches of water is most nearly equal to:

a.	2.33 inches
b.	3.5 inches
c.	1.5 inches
d.	.75 inches

8.	A control valve is to be sized for the following conditions:

Liquid flow, 50 GPM, specific gravity = .81, inlet pressure of 240 psig, with a pressure drop of 10 psi. The required flow coefficient for the valve will most nearly be:

a.	10.4
b.	14.2
c.	22
d.	35.5

9. A control valve is to be sized for the following conditions:

   Saturated steam at a maximum flow rate of 30,000 pounds per hour and an upstream pressure of 40 psia. P2 will be 30 psia according to the flow sheet and physical piping arrangement. The required flow coefficient for the valve will most nearly be:

   a. 260
   b. 540
   c. 760
   d. 198

10. The control algorithm for a flow control loop is under consideration. It is determined that the flow must be maintained near set point with little or no offset and the signal will be rapid response and noisy. The best choice of control modes for this loop will be:

    a. Proportional Mode
    b. Integral plus Derivative
    c. Proportional plus Integral
    d. Proportional plus Integral plus Derivative

11. According to ISA Standard S5.1, Instrumentation Symbols and Identification, the terms "record" or "recording" can apply to which of the following:

    I.   Graphical data in a strip or circular chart
    II. A table of numerical data in a computer memory
    III. A listing of alarms by a control computer

    a. I and II
    b. II and III
    c. I and III
    d. I, II, and III

12. An orifice plate is to be used to measure the flow of water in a 4 inch, schedule 40 line. The flow rate is specified as 0 – 200 GPM at a pressure of 75 psia and a temperature of 125 degrees F. If a differential pressure of 100 inches of water is used for the primary element, the orifice bore will most nearly equal to:

    a. 3.5 inches
    b. 1.4 inches
    c. 2.3 inches
    d. 0.9 inches

13. A SIL 1 interlock has an RRF of 42.76. The target RRF is 75. How can you increase the RRF to meet or exceed the target RRF?

    a. Add more field sensors.
    b. Add dual solenoids to the one and only one block valve
    c. Double the testing frequency
    d. None of the above.

14. Which of the following types of valves has the highest gain when the valve is nearly closed?

    a. Quick opening
    b. Equal percentage
    c. Fail open
    d. Linear

15. Which of the following types of control systems is normally programmed in ladder logic?

    a. Programmable logic controllers (PLCs)
    b. Distributed control systems (DCSs)
    c. Single loop digital controllers
    d. Supervisory Control and Data Acquisition (SCADA)

16. What is the resistance of 2000 feet of copper wire (specific resistance = 10.37) given a cross sectional area of 0370 cmil and a wire temperature of 20 degrees C?

    a. 1
    b. 2
    c. 10
    d. 20

17. Which of the following protection techniques is acceptable for equipment located in a Class I, Division 1 area of an industrial facility?

    a. Explosion- proof apparatus and nonincendive equipment
    b. Explosion-proof apparatus and intrinsically safe equipment
    c. Dust ignition proof and nonincendive equipment
    d. General purpose and intrinsically safe equipment

18. To minimize electrical interference when AC power and DC signal wiring meet in a control panel, it is BEST to:

    a. Use a different size wire
    b. Cross the wires at 90 degrees
    c. Run the wires parallel to each other
    d. Twist the AC wires around the DC wires

EN00 – Pre-Instructional Survey Answers

1. Type J Thermocouple Table w/ 32°F Reference.
   The emf @ 430° = 11.96 mV
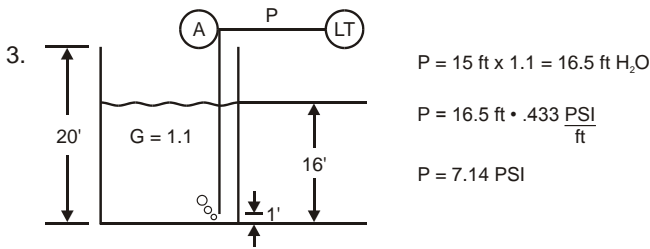   @ 440° = 12.26 mV

   Interpolating: $11.96 + \left(\frac{3}{10}\right)(12.26 - 11.96) = 12.05$ mV

   | Answer is C | 12.05 mV |

2. $\left(\frac{F_1}{F_2}\right) = \sqrt{\frac{\Delta P_1}{\Delta P_2}}$ $\therefore$ $\frac{200}{312} = \sqrt{\frac{35}{X}}$

   $X = \dfrac{35}{\left(\frac{200}{312}\right)^2} = \dfrac{35}{.41} = 85.4"\ H_2O$

   | Answer is C | 85.4" H_2O |

3.

   P = 15 ft x 1.1 = 16.5 ft H_2O

   P = 16.5 ft • .433 $\frac{PSI}{ft}$

   P = 7.14 PSI

   | Answer is D | 7.1 PSI |

4. | Answer is B | Small radius bends |

5. Open Loop Tuning Parameter $K_C = \dfrac{.9\tau}{K_P T_d}$ T_D = Derivative Time

   T_d (Dead Time) $T_D = 3.33\ T_d$ (Minutes/Repeat)

   Smaller gain and less integral action

   | Answer is A |

6. | Answer is A | NFPA produce NEC |

7. $K = \dfrac{Q^2}{[(19.636)(Fa)(C)]^2 h}$ $d = \sqrt[4]{\dfrac{K}{1 + \frac{K}{D^4}}}$

   $K = \dfrac{(200)^2}{[19.636(1.0)(.61)]^2\,(8.33\ ft)}$

   $K = \dfrac{40,000}{143.5\,(8.33)} = 33.5$

   $\therefore d = \sqrt[4]{\dfrac{33.5}{1 + \frac{33.5}{(4.026)^4}}}$

   d = 2.33"

   | Answer is A | 2.33 |

8. $C_v = Q \sqrt{\dfrac{G_F}{\Delta P}}$ $\Delta P_{ALLOW} = F_L^{\,2} (P_1 - F_F P_V)$

   $C_v = 50 \sqrt{\dfrac{.81}{10}}$ $F_F = .96 - .28 \sqrt{\dfrac{P_V}{P_C}}$

   $C_v = 14.23$

   | Answer is B | 14.2 |

9. $C_v = \dfrac{W}{63.3Y \sqrt{X \, P_F \, \gamma_1}}$ $X = \dfrac{\Delta P}{P_1} = \dfrac{10}{40} = .25$

   $C_v = \dfrac{30,000}{63.3(.87) \sqrt{.25(40)(.095)}}$ $X_T = .85 \, F_L^{\,2} = .85 \, (.85)^2$

   $C_v = 560$ $X_T = .62$

   $C_v = \dfrac{W (1 + .007 \, T_{SH})}{2.1 \sqrt{\Delta P (P1 + P2)}}$ $Y = 1 - \dfrac{X}{3X_T}$

   $C_v = \dfrac{30,000}{2.1 \sqrt{10 (40 + 30)}}$ $Y = 1 - \dfrac{.25}{3(.62)}$

   $C_v = 540$ $Y = .87$

   $\gamma = \dfrac{.095 \, lb}{ft^3}$

   | Answer is B | 540 |

10. Noisy signal eliminates derivative need.
    To get to set point, integral is needed.

    | Answer is C | Proportioned plus Integral |

11. Record or Recording indicates any history of a quantity.

    | Answer is D | I, II, and III |

12. Same as #7

    Computer Run: B = .587
    d = 2.362"

    $S = \dfrac{Q_m \, G_b}{5.667 \, D^2 \sqrt{G_F} \, \sqrt{hm}}$ SPINK

    $S = \dfrac{200(1.0)}{5.667 \, (4.026)^2 \sqrt{.98} \, \sqrt{100}}$

    $S = \dfrac{200}{90.67 \, (.99) \, (10)}$

    $S = .223$ and $B = 585$ $d = BD = .585(4.026)$

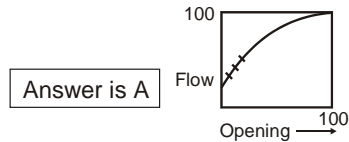 $d = 2.33"$

    | Answer is C | 2.33" |

13. RRF = 42.76 $\longrightarrow$ need RRF = 75

    RRF = $\dfrac{2}{\text{LAMBDAd} * \text{T1}}$

    Doubling the testing frequency, T1, will yield a
    RRF of 85.52

    | Answer is C | Double the testing frequency

14. The Quick opening characteristic will give more
    flow initially as the valve starts to open.

    100

    | Answer is A | Flow

    Opening $\longrightarrow$ 100

15. Programmable Logic Controllers are programmed
    using ladder logic for discrete control.

    | Answer is A |

16. R = $\dfrac{rL}{A}$ A = Cross sectional area (CMil)

    R = $\dfrac{10.37\,(2000)}{10370\ \text{CMil}}$ r = Specific resistance

    R = 2 OHMS   L = Length

    | Answer is B | 2 Ω

17. Class I, Division is gas product which may be present
    at all times. Therefore, explosion proof or intrinsically
    safe devices must be used.

    | Answer is B |

18. If the wires are crossed at 90 degrees the emf interference
    will tend to cancel each other.

    | Answer is B |