*** Examination ***

Hydraulic Design of Liquid or Water Piping Systems

Select the best answer to the following questions

1. If water flows through pipe of constant inside diameter with negligible heat loss or gain,
   (a) its velocity is proportional to the square of its flow rate
   (b) its velocity is proportional to its flow rate
   (c) its velocity is proportional to the square root of its flow rate
   (d) none of the above

2. If oil at a density of 45 lb/CF flowing through a circular pipe with a inside diameter of 3.026" at 75 gpm, its pipe velocity is

   (a) 0.3 fps
   (b) 3.3 fps
   (c) 13.3 fps
   (d) 133.0 fps

3. If oil at a density of 45 lb/CF flowing through a pipe of inside diameter of 3.026" at 75 gpm, its velocity head is

   (a) 0.053 psi
   (b) 0.17'
   (c) all of the above
   (d) none of the above

4. If oil at a density of 45 lb/CF flowing in a piping increasing an elevation of 20 feet from inlet to outlet,

   (a) its static head loss is 20 feet
   (b) its static pressure loss is 20X45/144 = 6.25 psi
   (c) its static head is 60 feet at the high elevation if its static head is 40 feet at the low elevation.
   (d) all of the above.

5. A liquid flowing through a pipe at a density of 50 lb/CF resulting a total frictional pressure drop of 75 psi

   (a) the dynamic head loss is 75 psi
   (b) the dynamic head loss is 216 ft
   (c) the total pressure drop is 75 psi if there is no static head loss
   (d) all of the above

6. Which of the following fluid parameters may not be used directly to calculate the Reynolds number without appropriate adjustment other than unit conversions?

   (a) fluid's density at the flowing condition
   (b) fluid's viscosity at the flowing condition
   (c) fluid's velocity at the flowing condition
   (d) fluid's density at the standard condition (for example, 1 atm & 60^{o}F)

7. Reynolds number for in-plant liquid piping or cross-country liquid pipe line is most likely

   (a) less than 2,000
   (b) In between 2,200 and 4,000
   (c) less than 4,000
   (d) greater than 10,000

8. Water flowing at 100 gpm, 62 lb/CF, 1 cP in a 3.026" ID pipe, the Reynolds number is

   (a) 1,672
   (b) 13,000
   (c) 104,000
   (d) 2,050,000

9. Water flowing at 100 gpm, 62 lb/CF, 1 cP in a 3.026" ID pipe, Darcy's friction factor according to Moody's chart can **not** be

   (a) 0.004
   (b) 0.016
   (c) practically >0.1
   (d) all of the above

10. Water flowing at 100 gpm, 62 lb/CF, 1 cP in a 3.026" ID commercial steel pipe with an use of absolute roughness of 0.005 inches, the calculated Darcy friction factor by Moody's chart is

    (a) 0.004
    (b) 0.013
    (c) 0.023
    (d) 0.044

11. Water flowing at 100 gpm, 62 lb/CF, 1 cP in a 3.026" ID commercial steel pipe of 100 feet long with an absolute roughness of 0.005 inches, the calculated frictional pressure drop is

    (a) 0.12 psi
    (b) 0.6 psi
    (c) 1.2 psi
    (d) 12.0 psi

12. A diesel piping system is exhibiting 82 psi frictional pressure drop at 200 psig inlet pressure. If this flow system flows the same diesel at 100 psig inlet pressure, the anticipated new frictional pressure drop would be

    (a) still going to be approximately 82 psi
    (b) increased to approximately to 164 psi
    (c) decreased to approximately to 41 psi
    (d) undetermined with the given information

13. A liquid is flowing in turbulent flow through a pipe run in a typical in-plant piping at 3 ft/sec with 20 psi frictional pressure drop. If the velocity is increased to 6 ft/sec, assuming everything else stays constant, then the corresponding frictional pressure drop can be anticipated to be in the order of

    (a) $20X(6/3)^{1/2}$ = 28 psi
    (b) $20X(6/3)$ = 40 psi
    (c) $20X(6/3)^{2}$ = 80 psi
    (d) $20X(6/3)^{5/2}$ =113 psi

14. A liquid is flowing in turbulent flow through a pipe run in a typical in-plant piping at 39 gpm with 20 psi frictional pressure drop. If the flow rate is increased to 78 gpm, assuming everything else stays constant, then the corresponding frictional pressure drop can be anticipated to be in the order of

    (a) $20X(78/39)^{1/2}$ = 28 psi
    (b) $20X(78/39)$ = 40 psi
    (c) $20X(78/39)^{2}$ = 80 psi
    (d) $20X(78/39)^{5/2}$ =113 psi

15. A liquid is flowing in turbulent flow through a pipe run of 3" inside diameter in a typical in-plant piping at 20 psi frictional pressure drop. If the pipe inside diameter is increased to 4", assuming everything else stays constant, then the corresponding frictional pressure drop can be anticipated to be in the order of

    (a) $20X(3/4)^{-5}$ = 84 psi
    (b) $20X(3/4)^{5}$ = 5 psi
    (c) $20X(3/4)^{2/5}$ = 18 psi
    (d) $20X(3/4)^{2}$ = 11 psi

16. A liquid is flowing in turbulent flow through a pipe run of 100 feet at 3" inside diameter in a typical in-plant piping. If the pipe inside diameter is increased to 4", assuming everything else stays constant, then what can be reasonably anticipated of the equivalent run length to carry the same flow rate at the constant head loss?

    (a) $100X(4/3)^{-5}$ = 25 ft
    (b) $100X(4/3)^{2}$ = 180 ft
    (c) $100X(4/3)^{5/2}$ = 210 ft
    (d) $100X(4/3)^{5}$ = 420 ft

17. A liquid at 50 gpm is flowing turbulent flow through a pipe run of 3" inside diameter in a typical in-plant piping. If the pipe inside diameter is increased to 4", assuming everything else stays constant, then the new flow rate that it can carry can be anticipated to be in the order of

    (a) $50X(4/3)^{-5}$ = 12 gpm
    (b) $50X(4/3)^{2}$ = 90 gpm
    (c) $50X(4/3)^{5/2}$ = 105 gpm
    (d) $50X(4/3)^{5}$ = 210 gpm

18. Aqueous amine solution flows through a pipe circuit with the following equipment in series. Their respective flow resistant coefficient K based on a common pipe diameter are listed below

Equipment	K
Filter	1.5
Heat Exchanger tube side	3.0
Heat Exchanger shell side	2.0

    If this common pipe has a velocity head of 28 psi, then the calculated frictional pressure drop through all these equipment can be estimated to be

    (a) (3.0) X 28 psi
    (b) (1.5 + 3.0 + 2.0) X 28 psi
    (c) (1.5 X 3.0 X 2.0) X 28 psi
    (d) none of the above

19. Hazen-Williams formula

    (a) is an empirical formula for water piping or pipe line hydraulics
    (b) bears some resemblance to the Darcy equation
    (c) requires the use of coefficient C to account for the condition of pipe as the absolute roughness for use in the Darcy type of approach
    (d) all of the above

20. Optimum pipe size is seldom realized in a piping system design because of

    (a) consideration for possible future expansion
    (b) allowing increase of frictional pressure drop over time
    (c) the need to limit the fluid velocity to certain range to help minimize corrosion or erosion
    (d) all of the above

*** EXAM ANSWER SHEET ***

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Fill in one circle for each answer

	a	b	c	d
1	O	O	O	O
2	O	O	O	O
3	O	O	O	O
4	O	O	O	O
5	O	O	O	O
6	O	O	O	O
7	O	O	O	O
8	O	O	O	O
9	O	O	O	O
10	O	O	O	O
11	O	O	O	O
12	O	O	O	O
13	O	O	O	O
14	O	O	O	O
15	O	O	O	O
16	O	O	O	O
17	O	O	O	O
18	O	O	O	O
19	O	O	O	O
20	O	O	O	O

I hereby certify that I have studied the course materials and answered the above question on my own. No other person has helped me complete this exam.

_____ _____

Signature Date

_____ _____ _____

Print Name State Number