

Conduits for Water Supply

- Q.1** The type of valve, which is provided on the suction pipe in a tube-well, is
- air relief valve
 - reflux valve
 - pressure relief valve
 - sluice valve
- Q.2** Assertion (A): In gravity conduits, the hydraulic gradient line will coincide with the water surface and will be parallel to the bed of the conduit.
Reason (R): In such a flow, the water is at atmospheric pressure all along and thus there is no pressure term in Bernoulli's equation.
- both A and R are true and R is the correct explanation of A
 - both A and R are true but R is not a correct explanation of A
 - A is true but R is false
 - A is false but R is true
- Q.3** What is the dimension of roughness coefficient, C_{11} ?
- $L^{0.67} T^{-1}$
 - $L^{0.5} T^{-1}$
 - $L^{0.37} T^{-1}$
 - $L^{0.27} T^{-1}$
- Q.4** Normally what is the design period considered for pipelines?
- 50 years
 - 30 years
 - 20 years
 - 60 years
- Q.5** Assertion (A): Cast-iron pipes are generally used for pressure $> 700 \text{ kN/m}^2$.
Reason (R): Cast-iron pipes are most widely used in water supply for trunk as well as distributary mains.
- both A and R are true and R is the correct explanation of A
 - both A and R are true but R is not a correct explanation of A
 - A is true but R is false
 - A is false but R is true
- Q.6** Match List-I (Valves) with List-II (Uses) and select the correct answer using the codes given below the lists:
- List-I
- Sluice valve
 - Check valve
 - Air inlet valve
 - Ball valve
- List-II
- Used where gravity flow is required through pipe line
 - Used to maintain constant level of water
 - Used for reversal of flow
 - Used for isolating
- Codes:
- | | A | B | C | D |
|-----|---|---|---|---|
| (a) | 1 | 3 | 4 | 2 |
| (b) | 4 | 2 | 1 | 3 |
| (c) | 1 | 2 | 4 | 3 |
| (d) | 4 | 3 | 1 | 2 |
- Q.7** A pump discharges 725 l/s at a total head of 22 m . The drive motor delivers 180 kW of power to the pump. At what efficiency is the pump operating?
- 72%
 - 82%
 - 87%
 - 79%
- Q.8** Forces acting on pressure conduits are
- internal pressure of water

2. pressure due to external loads
3. longitudinal temperature stress and longitudinal stress created due to unbalanced pressure at bends
4. flexural stresses produced when pipes are supported on tresilles etc.

Which of these statements are correct?

- (a) Both 1 and 3 (b) Both 1 and 4
(c) 1, 2 and 3 (d) 1, 2, 3 and 4

Q.9 Advantages of using cast iron pipes are

1. moderate in cost and easy to join
2. strong and durable
3. corrosion resistant
4. life upto 100 years

Which of these statements are correct?

- (a) 1, 2 and 3 (b) 1, 3 and 4
(c) 2, 3 and 4 (d) 1, 2, 3 and 4

Q.10 Type of joints that are generally used in cast iron pipes are

1. socket and spigot joint
2. flanged joint
3. mechanical joint
4. flexible joint

Which of these statements are correct?

- (a) Both 1 and 3 (b) Both 2 and 4
(c) 1, 2 and 3 (d) 1, 2, 3 and 4

Q.11 Which is the best sewer material to resist hydrogen sulphide corrosion?

- (a) Glazed stoneware
(b) Glazed earthenware
(c) RCC
(d) Brick masonry

Q.12 Consider the following statements:

The basic difference between water pipes and sewer pipes is

1. in the material used for the pipes
2. in the pressure of the liquid flow
3. in the suspended solids they carry

Which of these statements is/are correct?

- (a) 1 and 3 (b) 1 only
(c) 2 and 3 (d) 1, 2 and 3

Q.13 The internal pressure, to which a water supply pipe is subjected to, is

- (a) Full hydrostatic pressure when water in the pipe is at rest
(b) Pressure head and velocity head in the pipe, when flow at full velocity is taking place
(c) Full hydrostatic pressure when water in the pipe is at rest + water hammer pressure
(d) Pressure head and velocity head in the pipe, when flow at full velocity is taking place + water hammer pressure

Q.14 Match List-I (Pump) with List-II (Requirement) and select the correct answer using the codes given below the lists:

List-I

- A. Multistage centrifugal pump of moderate sized impellers.
B. Axial flow propeller pump
C. Archimedean screw type pump
D. Simple reciprocating pump

List-II

1. Low head and large discharge
2. Low head and low discharge
3. High head and low discharge
4. High head and moderate discharge

Codes:

- | | | | |
|-------|---|---|---|
| A | B | C | D |
| (a) 4 | 1 | 2 | 3 |
| (b) 4 | 3 | 2 | 1 |
| (c) 2 | 1 | 4 | 3 |
| (d) 2 | 3 | 4 | 1 |

Q.15 Consider the following statements related to steel pipes.

1. Life is generally taken as 60 years under ordinary conditions.
2. Steel pipes are generally adopted to withstand loads of backfill, traffic, etc.
3. Used as water main passing over bridges and culverts of large span.
4. To protect from higher negative pressures, pipes are coated from inside as well as outside with 1 : 2 cement mortar.

Which of these statements are not correct?

- (a) 1 and 3 (b) 2, 3 and 4
(c) 1 and 2 (d) 1, 2 and 4

Q.16 A steel penstock is 60 cm in diameter has a shell thickness of 1.2 cm. The modulus of

elasticity of pipe shell material is $2.1 \times 10^5 \text{ N/mm}^2$ with a Poisson's ratio of 1/4 and the volume modulus of elasticity of water is $2.1 \times 10^3 \text{ N/mm}^2$. The pipe is designed to discharge water at mean velocity of 2.1 m/s. The water hammer pressure rise caused by sudden closure of valve at the downstream end considering the elasticity of the pipe material is

- (a) $20.03 \times 10^4 \text{ kg/m}^2$ (b) $25.05 \times 10^4 \text{ kg/m}^2$
(c) $22.51 \times 10^4 \text{ kg/m}^2$ (d) $28.94 \times 10^4 \text{ kg/m}^2$

Q.17 Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I

- A. Collar joint
B. Expansion joint
C. Flexible joint
D. Spigot and socket joint

List-II

1. Used to join mains and submains of cast iron, spur-iron or steel.
2. Recommended for the places where the settlement of pipeline may occur.
3. Provided in metal pipelines to take into account the change in pipe length due to temperature variations.
4. Recommended for joining the RCC pipes and asbestos cement pipes.

Codes:

- | | | | |
|-------|---|---|---|
| A | B | C | D |
| (a) 1 | 2 | 3 | 4 |
| (b) 4 | 2 | 3 | 1 |
| (c) 1 | 3 | 2 | 4 |
| (d) 4 | 3 | 2 | 1 |

Q.18 Match the columns most appropriately:

Water pipe material	Average age of pipe
A. Cast iron	1. 75 years
B. Steel	2. 100 years
C. R.C.C.	3. 40 years

- | | | |
|-------|---|---|
| A | B | C |
| (a) 1 | 2 | 3 |
| (b) 1 | 3 | 2 |
| (c) 3 | 2 | 1 |
| (d) 2 | 3 | 1 |

Q.19 By using economical diameter of water mains, the benefit obtained is in terms of

- (a) minimum pumping cost
(b) use of cheapest pipe
(c) minimum cost of pipe and pumping
(d) none of the above benefit is obtained

Q.20 Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I

- A. Anti-siphonage
B. Benching
C. Invert
D. Vent pipe

List-II

1. Protects trap seal from backflow
2. Has sloped floor in inspection chamber
3. Preserves the water seal in traps
4. The lowest point

Codes:

- | | | | |
|-------|---|---|---|
| A | B | C | D |
| (a) 3 | 2 | 4 | 1 |
| (b) 1 | 4 | 2 | 3 |
| (c) 3 | 4 | 2 | 1 |
| (d) 1 | 2 | 4 | 3 |

Q.21 Which of the following are the factors responsible for corrosion?

1. Moisture content
2. pH value
3. Temperature and soil bacteria
4. Oxygen content of the water
5. Composition of pipe material

Select the correct option:

- (a) 1, 2, 4 and 5 (b) 1, 2 and 4
(c) 1, 4 and 5 (d) 1, 2, 3, 4 and 5

Q.22 According to empirical formula given by Lea, the economical diameter of the pumping mains with a discharge of $1.5 \text{ m}^3/\text{s}$ is

- (a) 1.347 m (b) 0.735 m
(c) 1.837 m (d) 1.102 m

Q.23 Given that

Rainfall intensity (R) = 50 mm/h Area (A) = 54 hect and 30% area consists of roof with runoff rate 0.90, 30% area consists of open field with

runoff rate as 0.20, 40% area consists of roads with runoff rate as 0.40.

The storm water flow from catchment area is:

- (a) 4.765 m³/s (b) 6.375 m³/s
(c) 3.675 m³/s (d) 4.985 m³/s

Q.24 The loss for a flow of 1 m³/sec through given. Main with a gate valve wide open having area 0.2 m² is 20 m. The head loss with 75% closed valve ($K = 24.0$) is

- (a) 29 m (b) 26.58 m
(c) 30.58 m (d) 34.58 m

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Answers Conduits for Water Supply

1. (b) 2. (a) 3. (c) 4. (b) 5. (d) 6. (d) 7. (c) 8. (d) 9. (d) 10. (d)
11. (a) 12. (c) 13. (c) 14. (a) 15. (c) 16. (b) 17. (d) 18. (d) 19. (c) 20. (a)
21. (d) 22. (a) 23. (c) 24. (c)

Explanations Conduits for Water Supply

1. (b)
Valve
(i) Air relief valve Discharges air when a main is being filled and to admit air when it is being emptied
(ii) Reflex valve/check valve Prevents back flow. Installed on suction side of the pumping. Also installed on pump discharge to reduce water hammer force on the pump. Also required at inter-connections between polluted water system and potable water system.
(iii) Pressure relief valve To reduce water hammer pressure in pipes, useful in small pipes.
(iv) Sluice valve Used to shut off the supply when ever required, helpful in dividing the water mains into suitable sections.

Where,
 V is velocity with dimension $[LT^{-1}]$
 L has dimension $[L]$
 S is slope of energy line which is dimensionless
So, $[LT^{-1}] = C_H [L^{0.63}]$
 $\Rightarrow C_H = [L^{0.37} T^{-1}]$

5. (d)
Cast-iron pipes are not used for pressure > 700 kN/m²

7. (c)
Efficiency of pump,

$$\eta = \frac{\gamma_w QH}{P} \times 100\%$$

Where, $\gamma_w = 9.81 \text{ kN/m}^3$
 $Q = 725 \text{ l/s} = 0.725 \text{ m}^3/\text{sec}$
 $H = 22 \text{ m}$
 $P = 180 \text{ kW}$

$$\text{So, } \eta = \frac{9.81 \times 0.725 \times 22}{180} \times 100 = 86.93\% \approx 87\%$$

10. (d)
Type of joints generally used in cast iron pipes.
(i) Socket and spigot joints
(ii) Flanged joint

- (iii) Mechanical joint
(iv) Flexible joint
(v) Expansion joint

11. (a)
Glazed stoneware or vitrified clay pipes have the advantage of being highly resistant to sulphide corrosion.

12. (c)
Cast iron pipes can be used for both water pipes and sewer pipes. However the basic difference is pressure flow in water pipe and suspended solids carried in sewer pipe.

13. (c)
The internal pressure within a pipe is caused by the water head to which the pipe can be subjected and the additional transient pressures. The maximum internal pressure under worst circumstance is sum of full static pressure and the water hammer pressure.

15. (c)
Life of steel pipes is generally taken as 40 years under ordinary conditions. Steel pipes are not adapted to withstand external loads of backfill, traffic, etc; while a partial vacuum caused by emptying of the pipe may cause collapse or distortions, if not designed properly.

16. (b)
Velocity of pressure wave generated,

$$C = 1433 \times \frac{1}{\sqrt{1 + \frac{E_p d}{E_t}}} \\ = \frac{1433}{\sqrt{1 + \frac{2.1 \times 10^5 \times 60}{2.1 \times 10^5 \times 1.2}}} \\ = 1170.04 \text{ ms}^{-1}$$

$$H_{\text{max}} = \frac{CV_0}{g} = \frac{1170.04 \times 2.1}{9.81}$$

$$\Rightarrow H_{\text{max}} = 250.47 \text{ m}$$

Water hammer pressure

$$P = \rho H_{\text{max}} = 1000 \times 250.47 \\ = 25.05 \times 10^4 \text{ kg/m}^2$$

19. (c)
If pipe diameter > Economical diameter then
• less cost of Pumping
• high cost of pipe material
If pipe diameter < economical diameter then
• less cost of pipe material
• high cost of pumping

20. (a)
The bottom of sewer pipe is called invert and top is called crown.
In a manhole, the bottom part prepared by concreting is called benching. It has sloped floor. It facilitates the entry of sewage into the main sewer.

22. (a)
The empirical formula given by Lea, relating the diameter and the discharge is

$$D = 0.97 \text{ to } 1.22 \sqrt{Q}$$

Where, D = Economical diameter (in metres)
 Q = Discharge to be pumped in (m³/s)
Here, $Q = 1.5 \text{ m}^3/\text{s}$

$$\text{So, } D = 0.97 \sqrt{1.5} \text{ to } 1.22 \sqrt{1.5} \\ = 1.188 \text{ m}^3/\text{s to } 1.494 \text{ m}^3/\text{s}$$

23. (c)
Runoff rate
$$= \frac{0.30 \times 0.9 + 0.30 \times 0.20 + 0.40 \times 0.40}{0.3 + 0.3 + 0.40} \\ = 0.49$$

Storm water flow,
$$Q = \frac{\text{AIR}}{360} = \frac{54 \times 0.49 \times 50}{360} = 3.675 \text{ m}^3/\text{sec}$$

24. (c)
$$V = \frac{Q}{A} = \frac{1}{0.2} = 5 \text{ m/s}$$

$$h_L = h_0 + \frac{KV^2}{2g} = 20 + 24 \times \frac{(5)^2}{2 \times 9.81} = 30.58 \text{ m}$$

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