Chapter 1

Fluid Mechanics and Hydraulic Machines

1. Pascal-second is the unit of
   a) pressure
   b) kinematic viscosity
   c) dynamic viscosity
   d) surface tension

2. An ideal fluid is
   a) one which obeys Newton's law of viscosity
   b) frictionless and incompressible
   c) very viscous
   d) frictionless and compressible

3. The unit of kinematic viscosity is
   a) gm/cm-sec^2
   b) dyne-sec/cm^2
   c) gm/cm^2-sec
   d) cm^2/sec

*4. If the dynamic viscosity of a fluid is 0.5 poise and specific gravity is 0.5, then the kinematic viscosity of that fluid in stokes is
   a) 0.25
   b) 0.50
   c) 1.0
   d) none of the above

*5. The viscosity of a gas
   a) decreases with increase in temperature
   b) increases with increase in temperature
   c) is independent of temperature
   d) is independent of pressure for very high pressure intensities

6. Newton's law of viscosity relates to the
   a) intensity of pressure and rate of angular deformation
   b) shear stress and rate of angular deformation
   c) shear stress, viscosity and temperature
   d) viscosity and rate of angular deformation

7. The rise of liquid of specific weight γ in a capillary tube of radius r is given by

   a) $\frac{\sigma}{2r\gamma}$ b) $\frac{2\sigma}{r}$

   c) $\frac{2\sigma}{r\gamma}$ d) $\frac{\gamma\sigma}{2r}$

   where σ is the surface tension of the liquid

*8. The intensity of pressure developed by surface tension of 0.075 N/m in a droplet of water of 0.075 mm diameter is
   a) 0.8 N/cm^2 b) 0.6 N/cm^2
   c) 0.4 N/cm^2 d) 400 N/cm^2

9. Surface tension of water
   a) increases with decrease in temperature
   b) decreases with decrease in temperature
   c) is independent of temperature
   d) none of above

10. One kilo-Pascal is equivalent to
   a) 1 N/mm^2 b) 1000 N/m^2
   c) 1000 N/mm^2 d) 1000 N/cm^2

11. If a liquid has greater cohesion than adhesion with the solid, then the liquid in the capillary tube will
   a) rise with concave surface upward
   b) rise with convex surface upward
   c) depress with concave surface upward
   d) depress with convex surface upward

* See **Appendix B** for explanations to the answers given in **Appendix A**.

12. Examine the following four statements:
(i) surface tension is due to cohesion only.
(ii) capillarity is due to adhesion only.
(iii) surface tension is due to both cohesion and adhesion.
(iv) capillarity is due to both cohesion and adhesion.
Which of the above statements are True?
a) (i) and (ii) b) (ii) and (iii)
c) (i) and (iv) d) only (iv)

*13. Pressure of 200 kPa is equivalent to a head of x metres of carbon tetrachloride of relative density 1.59, where x is equal to
a) 11.62 b) 11.92
c) 12.82 d) 13.12

14. For a vertical semicircular plate, submerged in a homogenous liquid with its diameter 'd' at the free surface, the depth of centre of pressure from the free surface is
a) $\frac{3\pi d}{32}$ b) $\frac{3d}{2\pi}$
c) $\frac{4d}{3\pi}$ d) $\frac{3\pi d}{16}$

15. The pressure intensity is same in all directions at a point
a) only when fluid is frictionless and incompressible
b) only when fluid is frictionless and is at rest
c) only when fluid is frictionless
d) when there is no relative motion of one fluid layer relative to other

16. An open tank contains 1 m deep water with 50 cm depth of oil of specific gravity 0.8 above it. The intensity of pressure at the bottom of tank will be
a) 4 kN/m^2 b) 10 kN/m^2
c) 12 kN/m^2 d) 14 kN/m^2

17. The position of centre of pressure on a plane surface immersed vertically in a static mass of fluid is
a) at the centroid of the submerged area
b) always above the centroid of the area
c) always below the centroid of the area
d) none of the above

*18. A vertical triangular area with vertex downward and altitude 'h' has its base lying on the free surface of a liquid. The centre of pressure below the free surface is at a distance
a) $\frac{h}{4}$ b) $\frac{h}{3}$
c) $\frac{h}{2}$ d) $\frac{2h}{3}$ [ES 99]

19. The total pressure on a plane surface inclined at an angle θ with the horizontal is equal to
a) pA b) $pA \sin\theta$
c) $pA \cos\theta$ d) $pA \tan\theta$
where p is pressure intensity at centroid of area and A is area of plane surface.

*20. A vertical rectangular plane surface is submerged in water such that its top and bottom surfaces are 1.5 m and 6.0 m respectively below the free surface. The position of centre of pressure below the free surface will be at a distance of
a) 3.75 m b) 4.0 m
c) 4.2 m d) 4.5 m

21. Centre of buoyancy always
a) coincides with the centre of gravity
b) coincides with the centroid of the volume of fluid displaced
c) remains above the centre of gravity
d) remains below the centre of gravity

22. If the weight of a body immersed in a fluid exceeds the buoyant force, then the body will
a) rise until its weight equals the buoyant force
b) tend to move downward and it may finally sink
c) float
d) none of the above

23. Metacentric height for small values of angle of heel is the distance between the
a) centre of gravity and centre of buoyancy
b) centre of gravity and metacentre
c) centre of buoyancy and metacentre
d) free surface and centre of buoyancy

*24. A floating body is said to be in a state of stable equilibrium
a) when its metacentric height is zero
b) when the metacentre is above the centre of gravity
c) when the metacentre is below the centre of gravity
d) only when its centre of gravity is below its centre of buoyancy [CS95]

*25. The increase in metacentric height
(i) increases stability
(ii) decreases stability
(iii) increases comfort for passengers
(iv) decreases comfort for passengers
The correct answer is
a) (i) and (iii) b) (i) and (iv)
c) (i) and (iii) d) (ii) and (iv)

*26. A rectangular block 2 m long, 1 m wide and 1 m deep floats in water, the depth of immersion being 0.5 m. If water weighs 10 kN/m^3, then the weight of the block is
a) 5 kN b) l0 kN
c) 15 kN d) 20 kN

27. The point in the immersed body through which the resultant pressure of the liquid may be taken to act is known as
a) centre of gravity
b) centre of buoyancy
c) centre of pressure
d) metacentre

28. If a vessel containing liquid moves downward with a constant acceleration equal to 'g', then
a) the pressure throughout the liquid mass is atmospheric
b) there will be vacuum in the liquid
c) the pressure in the liquid mass is greater than hydrostatic pressure
d) none of the above

29. When a liquid rotates at a constant angular velocity about a vertical axis as a rigid body, the pressure intensity varies
a) linearly with radial distance
b) as the square of the radial distance
c) inversely as the square of the radial distance
d) inversely as the radial distance

30. An open cubical tank of 2 m side is filled with water. If the tank is rotated with an acceleration such that half of the water spills out, then the acceleration is equal to
a) $g/3$ b) $g/2$
c) $2g/3$ d) g

31. A right circular cylinder open at the top is filled with liquid and rotated about its vertical axis at such a speed that half the liquid spills out, then the pressure intensity at the centre of bottom is
a) zero
b) one-fourth its value when cylinder was full
c) one-half its value when cylinder was full
d) cannot be predicted from the given data [CS 93, ES 97]

32. The horizontal component of force on a curved surface is equal to the
a) product of pressure intensity at its centroid and area
b) force on a vertical projection of the curved surface
c) weight of liquid vertically above the curved surface
d) force on the horizontal projection of the curved surface

33. A closed tank containing water is moving in a horizontal direction along a straight line at a constant speed. The tank also contains a steel ball and a bubble of air. If the tank is decelerated horizontally, then
(i) the ball will move to the front
(ii) the bubble will move to the front
(iii) the ball will move to the rear
(iv) the bubble will move to the rear
Find out which of the above statements are correct?
a) (i) and (ii) b) (i) and (iv)
c) (ii) and (iii) d) (iii) and (iv)

34. The eddy viscosity for turbulent flow is
a) a function of temperature only
b) a physical property of the fluid.
c) dependent on the flow
d) independent of the flow

35. Flow at constant rate through a tapering pipe is
(i) steady flow
(ii) uniform flow
(iii) unsteady flow
(iv) nonuniform flow
The correct answer is
a) (i) and (ii) b) (i) and (iv)
c) (ii) and (iii) d) (ii) and (iv)

*36. In a two dimensional incompressible steady flow around an airfoil, the streamlines are 2 cm apart at a great distance from the airfoil, where the velocity is 30 m/sec. The velocity near the airfoil, where the stream lines are 1.5 cm apart, is
a) 22.5 m/sec b) 33 m/sec
c) 40 m/sec d) 90 m/sec

37. The equation $\frac{p}{w}+\frac{v^2}{2g}+z=$ constant is based on the following assumptions regarding the flow of fluid:
a) steady, frictionless, incompressible and along a streamline
b) steady, frictionless, uniform and along a streamline
c) steady, incompressible, uniform and along a streamline
d) steady, frictionless, incompressible and uniform

38. When the velocity distribution is uniform over the cross-section, the correction factor for momentum is
a) 0 b) 1
c) 4/3 d) 2

39. Least possible value of correction factor for
(i) kinetic energy is zero
(ii) kinetic energy is 1
(iii) momentum is zero
(iv) momentum is 1
The correct statements are
a) (i) and (iii) b) (ii) and (iii)
c) (i) and (iv) d) (ii) and (iv)

*40. If the velocity is zero over half of the cross-sectional area and is uniform over the remaining half, then the momentum correction factor is
a) 1 b) 4/3
c) 2 d) 4

*41. If velocity is zero over l/3rd of a cross-section and is uniform over remaining 2/3rd of the cross-section, then the correction factor for kinetic energy is
a) 4/3 b) 3/2
c) 9/4 d) 27/8

42. The continuity equation
$\rho_1 V_1 A_1 = \rho_2 V_2 A_2$
is based on the following assumption regarding flow of fluid
a) steady flow
b) uniform flow
c) incompressible flow
d) frictionless flow
where ρ_1 and ρ_2 are mass densities.

43. In the most general form of Bernoulli's equation $\frac{p}{w}+\frac{v^2}{2g}+z=$ constant, each term represents
a) energy per unit mass
b) energy per unit weight
c) energy per unit volume
d) none of the above

*44. Which of the following velocity potentials satisfies continuity equation?
a) $x^2 y$ b) $x^2 - y^2$
c) $\cos x$ d) $x^2 + y^2$

*45. The magnitude of the component of velocity at point (1, 1) for a stream function $\psi = x^2 - y^2$ is equal to
a) 2 b) $2\sqrt{2}$
c) 4 d) $4\sqrt{2}$

46. The motion of air mass in a tornado is a
a) free vortex motion
b) forced vortex motion
c) free vortex at centre and forced vortex outside
d) forced vortex at centre and free vortex outside

47. In a forced vortex motion, the velocity of flow is
a) directly proportional to its radial distance from axis of rotation

b) inversely proportional to its radial distance from the axis of rotation
c) inversely proportional to the square of its radial distance from the axis of rotation
d) directly proportional to the square of its radial distance from the axis of rotation

48. Streamlines and pathlines always coincide in case of
a) steady flow b) laminar flow
c) uniform flow d) turbulent flow

49. The kinetic energy correction factor is
(a) applied to continuity equation
(b) expressed as $\frac{1}{A}\int_A \left(\frac{v}{V}\right)^2 dA$
(c) expressed as $\frac{1}{A}\int_A \left(\frac{v}{V}\right)^3 dA$
(d) expressed as $\frac{1}{A}\int_A \left(\frac{v}{V}\right) dA$

50. The momentum correction factor for the velocity distribution shown in Fig. 1.1 is

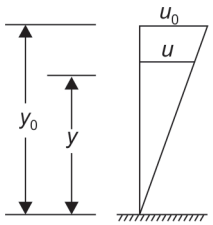


Fig. 1.1

a) 1/3 b) 1
c) 4/3 d) 2

51. Equation of continuity is based on the principle of conservation of
a) mass
b) energy
c) momentum
d) none of the above

52. In steady flow of a fluid, the total acceleration of any fluid particle
a) can be zero
b) is never zero
c) is always zero
d) is independent of coordinates

53. The pitot tube is used to measure
a) velocity at stagnation point
b) stagnation pressure
c) static pressure
d) dynamic pressure

54. Hot wire anemometer is used to measure
a) discharge
b) velocity of gas
c) pressure intensity of gas
d) pressure intensity of liquid

*55. The theoretical value of coefficient of contraction of a sharp edged orifice is
a) 0.611 b) 0.85
c) 0.98 d) 1.00

56. Which of the following is used to measure the discharge?
a) Current meter
b) Venturimeter
c) Pitot tube
d) Hotwire anemometer

57. The pitot static tube measures
a) stagnation pressure
b) static pressure
c) dynamic pressure
d) difference in total and dynamic pressure

*58. A fluid jet discharging from a 4 cm diameter orifice has a diameter 3 cm at its vena contracta. If the coefficient of velocity is 0.98, the coefficient of discharge for the orifice will be
a) $0.98 \times (0.75)^2$
b) $\frac{(0.75)^2}{0.98}$
c) $0.98 \times (133)^2$
d) $\frac{0.98}{(1.33)^2}$

59. The energy loss in orifice flow is given by
a) $H(1 - w^2)$ b) $H(w^2 - 1)$
c) $H\left(1 - \frac{1}{w^2}\right)$ d) $H\left(\frac{1}{w^2} - 1\right)$
where w is coefficient of velocity and H is head on orifice.

60. Select the incorrect statement.
a) the pressure intensity at vena contracta is atmospheric.
b) contraction is least at vena contracta.
c) streamlines are parallel throughout the jet at vena contracta.
d) coefficient of contraction is always less than one.

61. Size of a venturimeter is specified by
a) pipe diameter
b) throat diameter
c) angle of diverging section
d) both pipe diameter as well as throat diameter

62. Due to each end contraction, the discharge of rectangular sharp crested weir is reduced by
a) 5% b) 10%
c) 15% d) 20%

63. The discharge through a V-notch varies as
a) $H^{1/2}$ b) $H^{3/2}$
c) $H^{5/2}$ d) $H^{5/4}$
where H is head.

64. Which of the following is an incorrect statement?
a) coefficient of contraction of a venturimeter is unity.
b) flow nozzle is cheaper than venturimeter but has higher energy loss.
c) discharge is independent of orientation of venturimeter whether it is horizontal, vertical or inclined.
d) none of the above statement is correct.

*65. Coefficient of velocity of venturimeter
a) is independent of Reynolds number
b) decreases with higher Reynolds number
c) is equal to the coefficient of discharge of venturimeter
d) none of the above

66. The pressure at the summit of a syphon is
a) equal to atmospheric pressure
b) less than atmospheric pressure
c) more than atmospheric pressure
d) none of the above

67. $\Delta\psi$ between two streamlines represents
a) velocity b) discharge
c) head d) pressure

68. Coefficient of velocity for Borda's mouthpiece running full is
a) 0.611 b) 0.707
c) 0.855 d) 1.00

69. Coefficient of discharge for a totally submerged orifice as compared to that for an orifice discharging free is
a) slightly less b) slightly more
c) nearly half d) equal

70. The major loss of energy in long pipes is due to
a) sudden enlargement
b) sudden contraction
c) gradual contraction or enlargement
d) friction

71. Coefficient of contraction for an external cylindrical mouthpiece is
a) 1.00 b) 0.855
c) 0.711 d) 0.611

72. Which of the following has highest coefficient of discharge?
a) sharp edged orifice
b) venturimeter
c) Borda's mouthpiece running full
d) Cipolletti weir

73. In a Sutro weir, the discharge is proportional to
a) $H^{1/2}$ b) $H^{3/2}$
c) H^{52} d) H
where H is head.

74. The discharge over a broad crested weir is maximum when the depth of flow is
a) $H/3$ b) $H/2$
c) $2H/5$ d) $2H/3$
where H is the available head.

75. The discharge through a Cipolletti weir is given by
a) $\frac{2}{3}C_d\sqrt{2g}LH^{3/2}$
b) $\frac{8}{15}C_d\sqrt{2g}\tan\frac{\theta}{2}H^5$

c) $\frac{2}{3}C_d\sqrt{2g}(L-0.2H)H^{3/2}$

d) $\frac{2}{3}C_d\sqrt{2g}LH^{5/2}$

where symbols have their usual meanings.

*76. The equation $\tau = -\frac{dp}{dl}\cdot\frac{r}{2}$ for flow through circular tubes, where τ is shear stress at distance r from centre, is applicable for

a) laminar flow only
b) turbulent flow only
c) critical flow
d) both laminar and turbulent flows

77. The ratio of maximum velocity to average velocity for steady flow between fixed parallel plates is

a) $\frac{2}{3}$ b) $\frac{4}{3}$
c) $\frac{3}{2}$ d) 2

78. Which of the following statements is correct?

a) lower critical Reynolds number is of no practical significance in pipe flow problems.
b) upper critical Reynolds number is significant in pipe flow problems.
c) lower critical Reynolds number has the value 2000 in pipe flow.
d) upper critical Reynolds number is the number at which turbulent flow changes to laminar flow.

*79. For a sphere of radius 15 cm moving with a uniform velocity of 2 m/sec through a liquid of specific gravity 0.9 and dynamic viscosity 0.8 poise, the Reynolds number will be

a) 300 b) 337.5
c) 600 d) 6750

80. The shear stress distribution for a fluid flowing in between the parallel plates, both at rest, is

a) constant over the cross-section
b) parabolic distribution across the section
c) zero at the mid plane and varies linearly with distance from mid plane
d) zero at plates and increases linearly to midpoint

81. If x is the distance from leading edge, then the boundary layer thickness in laminar flow varies as

a) $x^{1/2}$ b) $x^{4/3}$
c) $x^{3/5}$ d) $x^{1/7}$ [CS 93]

82. Stanton diagram is a

a) log-log plot of friction factor against Reynolds number
b) log-log plot of relative roughness against Reynolds number
c) semi-log plot of friction factor against Reynolds number
d) semi-log plot of friction factor against relative roughness

83. The depth 'd' below the free surface at which the point velocity is equal to the average velocity of flow for a uniform laminar flow with a free surface, will be

a) 0.423 D b) 0.577 D
c) 0.223 D d) 0.707 D

where D is the depth of flow.

84. The boundary layer thickness in turbulent flow varies as

a) $x^{1/7}$ b) $x^{1/2}$
c) $x^{4/5}$ d) $x^{3/5}$ [ES 93]

where x is the distance from leading edge.

*85. The distance y from pipe boundary, at which the point velocity is equal to average velocity for turbulent flow, is

a) 0.223 R b) 0.423 R
c) 0.577 R d) 0.707 R

where R is radius of pipe.

*86. If a sphere of diameter 1 cm falls in castor oil of kinematic viscosity 10 stokes, with a terminal velocity of 1.5 cm/sec, the coefficient of drag on the sphere is

a) less than 1
b) between 1 and 100

c) 160
d) 200

*87. In case of an airfoil, the separation of flow occurs
a) at the extreme rear of body
b) at the extreme front of body
c) midway between rear and front of body
d) anywhere between rear and front of body depending upon Reynolds number

88. When an ideal fluid flows past a sphere
a) highest intensity of pressure occurs around the circumference at right angles to flow
b) lowest pressure intensity occurs at front stagnation point
c) lowest pressure intensity occurs at rear stagnation point
d) total drag is zero

89. With the same cross-sectional area and immersed in same turbulent flow, the largest total drag will be on
a) a circular disc of plate held normal to flow
b) a sphere
c) a cylinder
d) a streamlined body

90. In which of the following the friction drag is generally larger than pressure drag?
a) a circular disc or plate held normal to flow
b) a sphere
c) a cylinder
d) an airfoil

91. For hydrodynamically smooth boundary, the friction coefficient for turbulent flow is
a) constant
b) dependent only on Reynolds number
c) a function of Reynolds number and relative roughness
d) dependent on relative roughness only

92. The value of friction factor 'f' for smooth pipes for Reynolds number 10^6 is approximately equal to
a) 0.1 b) 0.01
c) 0.001 d) 0.0001

*93. For laminar flow in a pipe of circular cross-section, the Darcy's friction factor f is
a) directly proportional to Reynolds number and independent of pipe wall roughness
b) directly proportional to pipe wall roughness and independent of Reynolds number
c) inversely proportional to Reynolds number and indpendent of pipe wall roughness
d) inversely proportional to Reynolds number and directly proportional to pipe wall roughness

94. Separation of flow occurs when
a) the pressure intensity reaches a minimum
b) the cross-section of a channel is reduced
c) the boundary layer comes to rest
d) all of the above

95. The loss of energy due to sudden enlargement is given by
a) $\frac{v_2^2}{2g}\left(\frac{A_2}{A_1}-1\right)^2$ b) $\left(\frac{v_1 - v_2}{2g}\right)^2$
c) $\frac{v_1^2 - v_2^2}{2g}$ d) $\frac{v_1^2}{2g}\left(1-\frac{A_2}{A_1}\right)^2$

where A_1, v_1 are area of cross-section and velocity at entry and A_2, v_2, are area of cross-section and velocity at exit.

[CS 93,96,98]

96. The ratio of average velocity to maximum velocity for steady laminar flow in circular pipes is
a) 1/2 b) 2/3
c) 3/2 d) 2

*97. The distance from pipe boundary at which the turbulent shear stress is one-third the wall shear stress, is
a) 1/3 R b) 1/2 R
c) 2/3 R d) 3/4 R

where R is the radius of pipe.

*98. The discharge of a liquid of kinematic viscosity 4 cm^2/sec through a 8 cm diameter pipe is 3200π cm^3/sec. The type of flow expected is
a) laminar flow
b) transition flow
c) turbulent flow
d) not predictable from the given data

99. The Prandtl mixing length is
a) zero at the pipe wall
b) maximum at the pipe wall
c) independent of shear stress
d) none of the above

100. The velocity distribution for laminar flow through a circular tube
a) is constant over the cross-section
b) varies linearly from zero at walls to maximum at centre
c) varies parabolically with maximum at the centre
d) none of the above

*101. A fluid of kinematic viscosity 0.4 cm^2/sec flows through a 8 cm diameter pipe. The maximum velocity for laminar flow will be
a) less than 1 m/sec
b) 1 m/sec
c) 1.5 m/sec
d) 2 m/sec

102. The losses are more in
a) laminar flow b) transition flow
c) turbulent flow d) critical flow

103. The wake
a) always occurs before a separation point
b) always occurs after a separation point
c) is a region of high pressure intensity
d) none of the above

104. The maximum thickness of boundary layer in a pipe of radius r is
a) 0 b) $r/2$
c) r d) $2r$

*105. The hydraulic grade line is
a) always above the centre line of pipe
b) never above the energy grade line
c) always sloping downward in the direction of flow
d) all of the above

106. Two pipe systems are said to be equivalent when
a) head loss and discharge are same in two systems
b) length of pipe and discharge are same in two systems
c) friction factor and length are same in two systems
d) length and diameter are same in two systems [CS 93]

*107. In series-pipe problems
a) the head loss is same through each pipe
b) the discharge is same through each pipe
c) a trial solution is not necessary
d) the discharge through each pipe is added to obtain total discharge

108. Select the correct statement.
a) the absolute roughness of a pipe decreases with time.
b) a pipe becomes smooth after using for long time.
c) the friction factor decreases with time.
d) the absolute roughness increases with time.

*109. A valve is suddenly closed in a water main in which the velocity is 1 m/sec and velocity of pressure wave is 981 m/sec. The inertia head at the valve will be
a) 1 m
b) 10 m
c) 100 m
d) none of the above

110. The speed of a pressure wave through a pipe depends upon
a) the length of pipe
b) the viscosity of fluid
c) the bulk modulus for the fluid
d) the original head

111. If the speed of pressure wave is v_0 and pipe length is L, rapid closure occurs when time of closure is

a) less than $\frac{2L}{v_0}$

b) greater than $\frac{2L}{v_0}$

c) less than $\frac{L}{v_0}$

d) zero

*112. When time of closure $t_c = L/v_0$ (where L is length of pipe and v_0 is speed of pressure wave), the portion of pipe length subjected to maximum head is

a) $L/4$ b) $L/3$
c) $L/2$ d) L

113. If the elevation of hydraulic grade line at the junction of three pipes is above the elevation of reservoirs B and C and below reservoir A, then the direction of flow will be

a) from reservoir A to reservoirs B and C
b) from reservoir B to reservoirs C and A
c) from reservoir C to reservoirs A and B
d) unpredictable

114. If there are n pipes of same diameter d laid in parallel in place of a single pipe of diameter D, then

a) $d = \frac{D}{n^{2/5}}$ b) $D = \frac{d}{n^{2/5}}$
c) $d = \frac{D}{n^{2/3}}$ d) $d = \frac{D}{n^{1/5}}$

*115. The length of a pipe is 1 km and its diameter is 20 cm. If the diameter of an equivalent pipe is 40 cm, then its length is

a) 32 km b) 20 km
c) 8 km d) 4 km

*116. Two pipes of same length and diameters d and $2d$ respectively are connected in series. The diameter of an equivalent pipe of same length is

a) less than d
b) between d and 1.5 d
c) between 1.5 d and $2d$
d) greater than $2d$

117. The horse power transmitted through a pipe is maximum when the ratio of loss of head due to friction and total head supplied is

a) 1/3 b) 1/4
c) 1/2 d) 2/3

118. The boundary layer thickness at a distance of 1 m from the leading edge of a flat plate, kept at zero angle of incidence to the flow direction, is 0.1 cm. The velocity outside the boundary layer is 25 m/sec. The boundary layer thickness at a distance of 4 m is

a) 0.40 cm b) 0.20 cm
c) 0.10 cm d) 0.05 cm

assume that boundary layer is entirely laminar.

119. Drag force is a function of

(i) projected area of the body
(ii) mass density of the fluid
(iii) velocity of the body

The correct answer is

a) (i) and (ii) b) (i) and (iii)
c) (ii) and (iii) d) (i), (ii) and (iii)

120. The correct relationship among displacement thickness d, momentum thickness m and energy thickness e is

a) $d > m > e$ b) $d > e > m$
c) $e > m > d$ d) $e > d > m$

121. For laminar flow in circular pipes, the Darcy's friction factor f is equal to

a) 16/Re
b) 32/Re
c) 64/Re
d) none of the above

where Re is Reynolds number.

122. Surge wave in a rectangular channel is an example of

(i) steady flow
(ii) unsteady flow
(iii) uniform flow
(iv) nonuniform flow

The correct answer is

a) (i) and (iii) b) (ii) and (iii)
c) (i) and (iv) d) (ii) and (iv)

123. The best hydraulic channel cross-section is the one which has a

a) minimum roughness coefficient
b) least cost
c) maximum area for a given flow
d) minimum wetted perimeter

124. Which is the best hydraulic section of the following open channel cross-sections?
a) rectangle b) triangle
c) trapezoidal d) semicircle

125. Hydraulic jump is a
(i) steady flow
(ii) uniform flow
(iii) unsteady flow
(iv) nonuniform flow

The correct answer is
a) (i) and (ii) b) (i) and (iv)
c) (ii) and (iii) d) (iii) and (iv)

126. The hydraulic jump always occurs from
a) below critical depth to above critical depth
b) above critical depth to below critical depth
c) below critical depth to above normal depth
d) above normal depth to below normal depth

127. In a gradually varied flow
a) the slopes of energy grade line, hydraulic grade line and bottom of the channel are same
b) the slopes of energy grade line and hydraulic grade line are same but slope of the bottom of channel is different
c) the slopes of hydraulic grade line and bottom of channel are same but slope of energy grade line is different
d) the slope of energy grade line, hydraulic grade line and bottom of channel are all different.

*128. The flow in channels is considered to be in transitional state if the Reynolds number is
a) less than 500
b) between 500 and 2000
c) between 2000 and 4000
d) greater than 4000

*129. The Froude number is defined as

$$F = \frac{v}{\sqrt{gD}}$$

where v is the mean velocity of flow, g is acceleration due to gravity and D is
a) depth of flow
b) hydraulic depth
c) hydraulic mean depth
d) all of the above

130. For shooting flow the Froude number is
a) zero b) less than one
c) one d) greater than one

131. For uniform flow in a channel
a) the total energy line, water surface and bottom of channel are all horizontal
b) the total energy line and water surface are horizontal but bottom of channel is inclined
c) the total energy line, hydraulic gradient line and bottom of channel are all parallel
d) water surface and bottom of channel are parallel to each other but energy grade line is not parallel to them

132. The Chezy's coefficient
a) is dimensionless
b) has the dimension of velocity
c) has the dimension of discharge
d) has the dimension $L^{1/2}\ T^{1}$

*133. If 'f' is the friction factor, then the Chezy's coefficient is proportional to
a) f b) $\sqrt{f}$
c) $\frac{1}{f}$ d) $\frac{1}{\sqrt{f}}$

134. The relationship between Manning's co-efficient n and Chezy's coefficient c is given by
a) $c = \frac{R^{2/3}}{n}$ b) $c = \frac{R^{1/6}}{n}$
c) $c = \frac{R^{1/3}}{n}$ d) $c = \frac{R^{1/4}}{n}$

where R is the hydraulic mean depth.

*135. The depth of flow for maximum velocity in a circular channel section with diameter equal to 1.5 m is

a) 0.75 m b) 1.065 m
c) 1.215 m d) 1.425 m

*136. For maximum discharge in a circular channel section, the ratio of the depth of flow to that of diameter of the channel is
a) 0.30 b) 0.50
c) 0.81 d) 0.95

137. A triangular channel section is most economical when each of its sloping sides is inclined to the vertical at an angle of
a) 30° b) 45°
c) 60° d) 75°

*138. For a trapezoidal channel section to be most economical, its hydraulic radius must be equal to
a) $\frac{y}{4}$ b) $\frac{y}{2}$
c) $\frac{y}{2\sqrt{2}}$ d) $\frac{y}{3\sqrt{2}}$
where y is the depth of flow.

*139. The critical state of flow through a channel section may be defined as the state of flow at which the
a) specific energy is maximum for a given discharge
b) specific force is maximum for a given discharge
c) discharge is maximum for a given specific force
d) discharge is minimum for a given specific energy

*140. The critical state of flow in a non-rectangular channel is expressed by
a) $y_c = \left(\frac{q^2}{g}\right)^{1/3}$ b) $\frac{Q^2}{g} = \frac{A^3}{T}$
c) $\frac{Q^3}{g} = \frac{A^2}{T}$ d) $\frac{Q^2}{g} = \frac{A}{T^3}$
[CS 96]

*141. The critical depth of flow in a most economical triangular channel section for a discharge of 1 m^3/sec is given by
a) $\left(\frac{1}{9.8}\right)^{1/5}$ metre
b) $\left(\frac{1}{9.8}\right)^{1/3}$ metre
c) $\left(\frac{1}{4.9}\right)^{1/5}$ metre
d) $\left(\frac{1}{4.9}\right)^{1/3}$ metre

*142. For a given specific energy E, the critical depth y_c for a rectangular channel is given by
a) $y_c = \frac{3}{2}E$ b) $y_c = \frac{2}{3}E$
c) $y_c = \frac{4}{5}E$ d) $y_c = \frac{3}{4}E$

*143. For the same specific force, the two depths at which a given discharge can occur are called
a) alternate depths
b) normal depths
c) critical depths
d) conjugate depths

144. The most common device for measuring discharge through channels is
a) venturi flume
b) current meter
c) pitot tube
d) all the above

*145. If the specific energy at the upstream section of a rectangular channel is 3 m and minimum specific energy is 2.5 m, the maximum height of jump without causing afflux will be
a) 0.50 m b) 1.20 m
c) 2.50 m d) 5.50 m

*146. In a 2 m wide rectangular channel uniform flow occurs at a depth of 2 m, the velocity of flow being $\sqrt{2g}$ m/sec. The height of jump which can be raised without causing afflux will be
a) 0 b) 1 m
c) 2 m d) 3 m

147. When the slope of bottom of a channel rises in the direction of flow, it is called
a) critical slope b) mild slope
c) steep slope d) adverse slope

148. For any channel section, the specific energy increases with
(i) increase in depth of subcritical flow
(ii) increase in depth of supercritical flow
(iii) decrease in depth of subcritical flow
(iv) decrease in depth of supercritical flow
The correct answer is
a) (i) and (ii) b) (i) and (iv)
c) (ii) and (iii) d) (iii) and (iv)

149. Flow through a venturi flume is maximum when the depth at the throat is
a) half
b) one-third
c) two-third
d) equal to the total energy of flow

150. For the slope of bottom of a channel to be mild, the normal depth should be
a) greater than critical depth
b) equal to critical depth
c) less than critical depth
d) imaginary

151. Supercritical flow can occur in a
a) channel with a mild slope
b) channel with a steep slope
c) a horizontal channel
d) all the above

152. Analysis of a surge in open channels is carried out by using
(i) Navier Stoke's equation
(ii) energy equation
(iii) continuity equation
(iv) momentum equation
The correct answer is
a) only (i) is correct
b) both (ii) and (iii) are correct
c) both (iii) and (iv) are correct
d) (ii), (iii) and (iv) are correct

*153. The critical velocity for a flow of q m^3sec/m width of a wide rectangular channel is given by
a) $\left(\frac{q^2}{g}\right)^{1/3}$ b) $(qg)^{1/3}$
c) $\sqrt{qg}$ d) none of the above

154. The mild slope profile M_2 occurs for depth
a) above normal but below critical
b) above critical but below normal
c) below normal and below critical
d) above normal and above critical

*155. For a steep slope profile S_1, the type of flow will be
a) supercritical b) critical
c) subcritical d) normal

*156. In case of flow through a triangular channel as shown in Fig. 1.2, the Froude number is given by

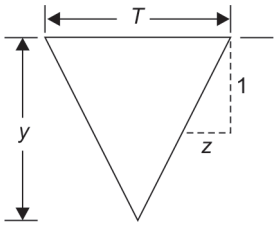


Fig. 1.2

a) $\frac{V}{\sqrt{gy}}$
b) $\frac{V}{\sqrt{gy/2}}$
c) $\frac{V}{\sqrt{gy/3}}$
d) $\frac{V(1+z^2)^{1/4}}{\sqrt{gyz^2}}$

157. If F_r is the Froude number for a flow in a triangular channel, then the Froude number for same velocity and same depth of flow in rectangular channel will be
(a) F_r (b) $\frac{F_r}{\sqrt{2}}$
(c) $\sqrt{2}F_r$ d) $\frac{F_r}{\sqrt{3}}$

158. The flow profile under the gate as shown in Fig. 1.3. is classified as .....

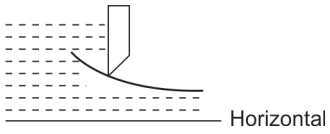


Fig. 1.3

a) M_2 b) H_1
c) H_2 d) H_3

[GATE 96]

*159. Which of the following Froude number range indicates a weak jump?
a) 1.0 to 1.7 b) 1.7 to 2.5
c) 2.5 to 4.5 d) 4.5 to 9.0

160. The speed of an elementary wave in still liquid at depth y is given by
a) $\sqrt{gy/3}$ b) $\sqrt{gy/2}$
c) $\sqrt{gy}$ d) $\sqrt{2gy}$

*161. If the depth of flow in a channel is 1 m and velocity of flow is 2 m/sec. then the velocity with which an elementary wave can travel upstream is
a) 1.132 m/sec b) 2 m/sec
c) 3.132 m/sec d) 5.132 m/sec

[CS 93]

*162. The height of hydraulic jump is equal to
a) initial depth
b) sequent depth
c) difference in alternating depths
d) difference in conjugate depths

*163. If the conjugate depths before and after the jump are 0.5 m and 2.5 m respectively, then the loss of energy in the hydraulic jump will be
a) 0.8 m b) 1.6 m
c) 3.2 m d) 6.4 m

*164. The specific energy in m kg/kg for the flow expressed by V = 2.22 m/sec and y = 1 m is
a) 1.25 b) 2.22
c) 3.22 d) 4.22

165. The value of Froude number can be
a) less than 1 b) equal to 1
c) greater than 1 d) all the above

166. The pressure coefficient is the ratio of pressure forces to
a) gravity forces
b) viscous forces
c) inertial forces
d) none of the above

167. Select the nondimensional parameter of the following
a) specific weight
b) Manning's coefficient
c) angular velocity
d) specific gravity

*168. Which of the following is not a non-dimensional parameter?
a) Froude number
b) Darcy-Weisbach friction factor
c) Chezy's coefficient
d) Mach number

169. The dimensions of pressure gradient dp/dx in a fluid are
a) $M^{-1} L^{-1} T^{-2}$ b) $M^{-1} L^{-3} T^{-2}$
c) $M^{1} L^{-2} T^{-2}$ d) $M^{1} L^{-3} T^{-2}$

170. Which of the following quantities is dimensionless?
a) $\frac{\rho F}{\mu}$ b) $\frac{\mu^2 \rho}{F}$
c) $\frac{\rho F}{\mu^2}$ d) $\frac{\mu}{\rho^2 F}$

where F is force, ρ is density and μ is dynamic viscosity and the dimensions of dynamic viscosity are $M^1L^{-1}T^{-1}$.

*171. Froude number is the ratio of inertia force to
a) viscous force
b) surface tension force
c) gravity force
d) compressive force

172. If the physical quantities involved in a fluid flow phenomenon are discharge Q, diameter D, acceleration due to gravity g, dynamic viscosity μ and density ρ, then the number of π parameters needed to express the function $F(Q, D, g, \mu, \rho) = 0$ are
a) 2 b) 3
c) 4 d) 5

*173. In a 1 : 100 scale model of a harbour, the time which will correspond to the prototype tidal period of 12 hours will be
a) 0.12 hour b) 1.2 hours
c) 12 hours d) 120 hours

174. If the resistance R to the motion of a sphere through a fluid is a function of the density ρ, viscosity η of the fluid, radius r and velocity v of the sphere, the number of π-parameters needed to express the function $F(R, \rho, \eta, r, v) = 0$ is
a) 2 b) 3
c) 4 d) 5

175. The dimensions of surface tension are
a) M^1L^{-1} b) $M^1L^1T^{-2}$
c) $M^1L^0T^{-2}$ d) F^1T^{-2}

176. Which of the following is a dimensionally homogeneous equation?
a) $V = \frac{1}{n} R^{2/3} S^{1/2}$ (Manning's equation)
b) $V = C\sqrt{RS}$ (Chezy's equation)
c) $\rho = \frac{32\mu VL}{D^2}$ (laminar flow in pipes)
d) $N_S = \frac{N\sqrt{P}}{H^{5/4}}$ (specific speed of a turbine)

177. Apart from inertia force, which of the following forces is most important in motion of submarines under water?
a) viscous force
b) gravity force
c) compressive force
d) surface tension force

178. In which of the following situations, the viscous force is not important?
a) flow of incompressible fluids in closed pipes
b) motion of aeroplanes
c) capillary waves in channels
d) resistance to motion of a ship

179. The ratio of volume flow rates in two dynamical similar systems governed by Froude modelling is equal to (assume $g_r = 1$)
a) $L_r^{1/2}$ b) $L_r^{3/2}$
c) $L_r^{5/2}$ d) $L_r^{7/2}$
where L_r is length scale ratio.

180. Which of the following could be a π-parameter of the function $\phi(F, V, \rho, \mu, L) = 0$ when V, ρ and L are taken as repeating variables?
a) $\frac{VL\mu^2}{\rho}$ b) $\frac{F^2}{V^2\rho L}$
c) $\frac{F}{\rho L^2 V^2}$ d) $\frac{VL\rho}{\sqrt{\mu}}$

*181. The condition for complete similarity to exist between model and prototype, where both gravity and viscous forces are important, is
a) $\mu_r = L_r^{3/2}$ b) $\mu_r = L_r^{5/2}$
c) $\mu_r = L_r^{1/2}$ d) $\mu_r = L_r^{2/3}$
where μ_r is kinematic viscosity ratio and L_r is length scale ratio.

*182. A ship's model of scale 1:100 had a wave resistance of 1 kg at its design speed. The corresponding wave resistance in prototype will be
a) 100 kg b) 10000 kg
c) 1000000 kg d) 1000 kg

183. In which of the following situations, the inertia force would not be important?
a) flow over a spillway crest
b) flow through an open channel transition
c) flow through a long capillary tube
d) all the above

184. For the resistance to motion of a ship's model through water, the basic similitude criteria is
(i) Reynold's Law
(ii) Froude's Law
(iii) Weber's Law
The correct answer is
a) only (i) is correct
b) only (ii) is correct
c) both (i) and (ii) are correct
d) both (i) and (iii) are correct

185. The causes of cavitation are
a) high suction lift and low pump speed
b) low suction lift and high pump speed
c) high suction lift and high pump speed
d) low suction lift and low pump speed

186. The cavitation parameter is given by

a) $\frac{p - p_v}{0.5\rho V^2}$ b) $\frac{p_v - p}{0.5\rho V^2}$

c) $\frac{p_a - p}{0.5\rho V^2}$ d) $\frac{p - p_a}{0.5\rho V^2}$

where p is the absolute pressure of the point of consideration, p_a is atmosphere pressure, p_v is vapour pressure of liquid, ρ is the density of the liquid and V is the velocity.

187. An impulse turbine
a) always operates submerged
b) makes use of a draft tube
c) operates by initial complete conversion to kinetic energy
d) converts pressure head into velocity throughout the vanes [GATE 94]

188. Water turbines may be put in the decreasing order of specific speeds as
a) propeller turbine, reaction turbine, impulse turbine
b) Pelton wheel, Francis turbine, Kaplan turbine
c) reaction turbine, impulse turbine, propeller turbine
d) none of the above [GATE 88]

189. At a rated capacity of 44 cumecs, a centrifugal pump develops 36 m of head when operating at 1450 rpm. Its specific speed is
a) 654 b) 509
c) 700 d) 90 [GATE 96]

190. A Francis turbine under a head of 25 m produces 2000 kW at a speed of 250 rpm. Its specific speed is
a) 50 b) 100
c) 150 d) 200

191. Two geometrically similar units are homologous if they have
a) same Reynolds number
b) same Froude number
c) same efficiency
d) similar streamlines

192. A reaction type turbine discharges 10 cumecs under a head of 8 m with an overall efficiency of 85%. The power developed is
a) 667 kW b) 680 kW
c) 800 kW d) 867 kW

193. Consider the following statements:
(i) an impulse turbine is ideal for high head development.
(ii) speed ratio of a reaction turbine is in the range of 0.6 to 0.9.
(iii) the specific speed of a Kaplan turbine is in the range of 50 to 150 m.

Of these statements
a) only (i) is correct
b) (i) and (ii) are correct
c) (i) and (iii) are correct
d) (i), (ii) and (iii) are correct

194. Consider the following statements:
(i) a reciprocating pump does not need priming.
(ii) a centrifugal pump can run at high speed.
(iii) a centrifugal pump has high maintenance cost as compared to reciprocating pump.

Out of these statements
a) only (i) is correct
b) (i) and (ii) are correct
c) (i) and (iii) are correct
d) (i), (ii) and (iii) are correct

195. Pumps may be put in the increasing order of specific speeds as
a) centrifugal pumps, mixed flow pumps, axial flow pumps
b) centrifugal pumps, axial flow pumps, mixed flow pumps
c) mixed flow pumps, axial flow pumps, centrifugal pumps
d) mixed flow pumps, centrifugal pumps, axial flow pumps

*196. The specific speed of a turbine is defined as the speed of a unit of such a size that it
a) delivers unit discharge at unit head
b) delivers unit discharge at unit power
c) produces unit power for unit head
d) none of the above

197. Water enters a turbine steadily at the rate of 100 litres per second with a pressure of

3×10^5 N/m^2 and a velocity of 100 m/s. It leaves the turbine with a pressure of 10^5 N/m^2 and a velocity of 50 m/sec. If no losses occur, the power produced by the turbine is

a) 20 kW b) 375 kW
c) 395 kW d) 770 kW

[GATE 98]

198. An isentropic process is always
a) reversible and isothermal
b) irreversible and adiabatic
c) frictionless and adiabatic
d) frictionless and isothermal

*199. Which of the following equations are used to develop Rayleigh lines?
a) momentum and energy
b) energy and continuity
c) momentum and continuity
d) momentum, energy and continuity

200. Match the following for isentropic flow of air

	List I		List II
A.	critical pressure ratio	1.	0.833
B.	critical temperature ratio	2.	0.528
C.	critical density ratio	3.	0.634

Select the correct answer using the codes given below.

Codes:

a)	A	B	C
	1	3	2
b)	A	B	C
	2	1	3
c)	A	B	C
	3	1	2
d)	A	B	C
	2	3	1

201. A normal shock wave
a) is reversible
b) is isentropic
c) occurs when the approaching flow is supersonic
d) occurs when the approaching flow is subsonic

202. Match List I with List II and select the correct answer using the codes given below the lists.

	List I		List II
A.	subsonic flow through a converging duct	1.	velocity increases and pressure decreases
B.	subsonic flow through a diverging duct	2.	velocity increases and density decreases
C.	supersonic flow through a converging duct	3.	density increases and velocity decreases
D.	supersonic flow through a diverging duct	4.	velocity decreases and pressure, density, temperature increase

Codes:

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

203. In steady, isothermal flow in long pipelines, the significant value of Mach number for determining trends in flow properties is

a) $\sqrt{k}$ b) $1/\sqrt{k}$
c) k d) $1/k$

204. A perfect gas at 27 °C is heated at constant pressure till its volume is doubled. The final temperature of the gas is

a) 54°C b) 327°C
c) 600°C d) 654°C

[GATE 96]

*205. The number of revolutions of a current meter in 50 seconds were found to be 12 and 30 corresponding to the velocities of 0.25 and 0.46 m/sec respectively. What velocity (in m/sec.) would be indicated by 50 revolutions of the current meter in one minute?

a) 0.42 b) 0.50
c) 0.60 d) 0.73

[GATE 99]

*206. A hydraulic turbine has a discharge of 5 m^3/sec, when operating under a head of 20 m with a speed of 500 rpm. If it is to operate under a head of 15 m, for the same discharge, the rotational speed in rpm will approximately be

a) 433 b) 403
c) 627 d) 388

[GATE 99]

*207. A fluid is a substance that

a) is essentially incompressible
b) has a viscosity that always decreases with temperature
c) can not remain at rest when subjected to a shearing stress
d) can not be subjected to shear forces

208. The viscosity of a fluid varies with

a) pressure
b) density
c) temperature
d) temperature and pressure

209. The locus of elevations that water will rise in a series of pitot tubes is called

a) the energy grade line
b) the hydraulic grade line
c) the pressure head
d) the velocity head

210. For a developed turbulent flow in a horizontal pipe, the pressure gradient

a) is zero
b) is constant
c) varies linearly with distance
d) varies exponentially with distance

211. A dimensionless combination of surface tension σ, density ρ, diameter D and velocity V is

a) $\sigma D/\rho V$ b) $\sigma D^2/\rho V$
c) $\sigma/\rho V^2 D$ d) $\sigma D/\rho V^2$

212. The velocity potential function for a source varies with distance r as

a) $\frac{1}{r}$ b) $\frac{1}{r^2}$
c) c^r d) $\ln r$

213. A streamlined body is defined as a body about which

a) the flow is laminar
b) the flow is along the stream lines
c) the flow separation is suppressed
d) the drag is zero [GATE 87]

214. If the velocity distribution is rectangular, the kinetic energy correction factor is

a) greater than zero but less than unity
b) less than zero
c) equal to zero
d) equal to unity [GATE 90]

215. At room temperature, the dynamic and kinematic viscosity of water

a) are both greater than that of air
b) are both less than that of air
c) are respectively greater than and less than that of air
d) are respectively less than and greater than that of air

[ES 93]

216. One end of a two dimensional water tank has the shape of a quadrant of a circle of radius 2 m. When the tank is full, the vertical component of the force per unit length on the curved surface will be

a) 250 π kgf b) 1000 π kgf
c) 4000 kgf d) 3000 kgf

[ES 93]

*217. The mean velocities at two ends of a streamtube 10 cm apart are 2.5 m/s and 3 m/s. The convectional tangential acceleration mid-way is

a) zero
b) 0.5 m/s^2
c) 13.75 m/s^2
d) not determinable [ES 93]

218. Which one of the following velocity fields represents a possible fluid flow?

a) $u = x$; $v = y$
b) $u = x^2$; $v = y^2$
c) $u = xy$; $v = x^2\, y^2$
d) $u = x$;$v = -y$ [ES 93]

219. A cylindrical vessel with a constant plane area of 1 m^2 is rotated about its vertical axis such that the liquid inside the vessel is about to spill. If the height of the vessel is 2 m and the height of the paraboloid is 1m, then the volume (in m^3) of the liquid in the vessel will be
a) 2 b) 1.5
c) 1.0 d) 0.5 [ES 93]

220. When a particular discharge is flowing in a horizontal pipe, a mercury-water U-tube manometer connected to the entrance and throat of a venturimeter fitted in the pipe recorded a deflection of 25 cm. If the same discharge flowed through the same pipe kept at an inclination of 45° to the horizontal, then the corresponding deflection by the U-tube manometer will be
a) $25\sqrt{2}$ cm b) $25/\sqrt{2}$ cm
c) 25/2 cm d) 25 cm
[ES 93]

221. An open rectangular wagon 5 m long is filled with water to a level 0.5 m below the open top. The maximum acceleration (in m/s^2) at which it can be speeded up without spilling the water is nearly
a) 0.98 b) 1.96
c) 4.9 d) 9.8 [ES 93]

222. Which of the following rules are used in choosing the repeating variables in dimensional analysis?
1. repeating variables should include the dependent variables.
2. repeating variables should contain all primary units used in describing the variables in the problem.
3. repeating variables should combine among themselves.
4. repeating variables should not contain the dependent variables.

Select the correct answer using the codes given below.
Codes:
a) 1 and 2 b) 2 and 3
c) 2 and 4 d) 3 and 4
[ES 93]

*223. A harbour model has a horizontal scale of 1/150 and a vertical scale of 1/60. The interval between successive high tides in the model will be nearly
a) 90 min b) 40 min
c) 15 min d) 5 hours
[ES 93]

*224. In a laminar flow through a circular pipe of diameter 20 cm, the maximum velocity is found to be 1 m/s. The velocity at a radial distance of 5 cm from the axis of the pipe will be
a) 0.25 m/s b) 0.50 m/s
c) 0.75 m/s d) 1.0 m/s
[ES 93]

225. If a multijet Pelton turbine has 'n' number of jets, then its specific speed is directly proportional to
a) n^0 b) $n^{1/2}$
c) $n^{3/4}$ d) n [ES 93]

*226. An aeroplane having a wing span of 16 m and chord of 2.5 m weighs 11 tonnes. If it gets airborne at a velocity of 300 kmph, then the coefficient of lift is nearly
a) 0.0004 b) 0.0006
c) 0.4 d) 0.6 [ES 93]

227. The Hardy Cross method of hydraulic analysis of pipe networks, besides satisfying the continuity and energy principles, must also satisfy the condition that the
a) algebraic sum of the head losses around any closed loop is zero
b) flow into any junction equals the outflow from it
c) flow in each pipe has head loss according to Darcy-Weisbach or any other pipe head loss equation
d) momentum principle is followed
[ES 93]

228. A liquid of density ρ and bulk modulus K flows with a mean velocity V in a long rigid

pipe of diameter D. A sudden closure of a valve at the end of the pipe produces a maximum water hammer head h_w, which is equal to

a) $\frac{V\sqrt{\rho}}{g\sqrt{K}}$ b) $\frac{V\sqrt{K}}{g\sqrt{\rho}}$

c) $\frac{V\sqrt{g}}{\rho\sqrt{K}}$ d) $\frac{V\rho}{\sqrt{gK}}$

[ES 93]

229. Given that,
S_0 = slope of the channel bottom,
S_e = slope of the energy line,
F = Froude number,
the equation of gradually varied flow is expressed as

a) $\frac{dy}{dx} = \frac{S_0 - S_e}{1 + F^2}$ b) $\frac{dy}{dx} = \frac{S_0 - S_e}{1 - F^2}$

c) $\frac{dy}{dx} = \frac{S_0 + S_e}{1 + F^2}$ d) $\frac{dy}{dx} = \frac{S_0 + S_e}{1 - F^2}$

[ES 93]

230. Match List I with List II and select the correct answer using the codes given below the lists: (y_0 = normal depth, y_c = critical depth and y = depth of gradually varied flow)

List I (Flow regimes for gradually varied flow)	List II (Type of gradually varied flow profile)
A. $y_c > y_0 > y$	1. C_1
B. $y_c < y_0 < y$	2. M_1
C. $y_0 > y > y_c$	3. S_3
D. $y > y_c > y_0$	4. M_2
	5. S_1

Codes:

a)	A	B	C	D
	1	2	3	4
b)	A	B	C	D
	3	4	5	2
c)	A	B	C	D
	3	2	4	5
d)	A	B	C	D
	5	4	3	1

[ES 93]

*231. A discharge of 3.0 m^3/s flows in a canal, 2 m wide, at a depth of 1.2 m. If the width of the canal is reduced to 1.5 m by a canal transition, then neglecting losses, the depth of flow after the contraction will be

a) 1.12 m b) 1.20 m
c) 1.28 m d) 1.60 m

[ES 93]

232. If u and v are the components of velocity in the x and y directions of a flow given by $u = ax + by$; $v = cx + dy$,
then the condition to be satisfied is

a) $a + c = 0$
b) $b + d = 0$
c) $a + b + c + d = 0$
d) $a + d = 0$ [ES 94]

*233. At a point on a streamline, the velocity is 3 m/s and the radius of curvature is 9 m. If the rate of increase of velocity along the streamline at this point is 1/3 m/s, then the total acceleration at this point would be

a) 1 m/s^2 b) 3 m/s^2
c) 1/3 m/s^2 d) $\sqrt{2}$ m/s^2

[ES 94]

234. Match List I with List II and select the correct answer below the lists.

	List I		List II
A.	rotational flow	1.	a fluid motion in which streamlines are concentric circles
B.	vortex flow	2.	the fluid particles moving in concentric circles may not rotate about their mass centre
C.	free vortex	3.	the fluid particles moving in concentric circles may rotate

D. forced vortex		4. flow near a curved solid boundary	

Codes:

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

[ES 94]

235. In a Sutro weir, the rate of flow for all flows above the rectangular base of width W and depth 'a' is proportional to the head
a) above the crest
b) above the rectangular box
c) above a datum $a/3$ above the crest
d) $\frac{2a}{3}$ above the crest [ES 94]

*236. A model of reservoir is emptied in 10 minutes. If the model scale is 1:25, the time taken by the prototype to empty itself, would be
a) 250 minutes b) 50 minutes
c) 6250 minutes d) 2 minutes
[ES 94]

237. The relationship $\frac{dp}{dx} = \frac{d\tau}{dy}$ is valid for
a) irrotational flow
b) nonuniform flow
c) uniform flow
d) unsteady flow
[ES 94]

238. Which of the following statements are correct in respect of steady laminar flow through a circular pipe?
(1) shear stress is zero at the centre.
(2) discharge varies directly with viscosity of the fluid flowing.
(3) velocity is maximum at the centre.
(4) hydraulic gradient varies directly with the velocity.

Select the correct answer using the codes given below.

Codes:
a) (1), (2) and (4)
b) (l), (3) and (4)
c) (1) and (3)
d) (3) and (4) [ES 94]

239. Match List I with List II and select the correct answer using the codes given below the lists.

List I		List II	
A.	boundary layer thickness	1.	distance from the boundary where velocity is 99% of uniform velocity
B.	displacement thickness	2.	distance from the boundary by which the main flow can be assumed to be shifted
C.	laminar boundary layer	3.	distance from the boundary wherefrom the flow ceases to be laminar
D.	turbulent boundary layer	4.	region near the boundary where viscous stress is also present

Codes:

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

[ES 94]

240. In a compressible flow, the area of flow, the velocity of flow and the mass density are denoted by a, v and m respectively. At a particular section, the differential form of the continuity equation is given by
a) $\frac{da}{a} = \frac{dv}{v} + \frac{dm}{m}$

b) $\frac{da}{a} = \frac{dv}{v} - \frac{dm}{m}$

c) $\frac{da}{a} = -\frac{dv}{v} + \frac{dm}{m}$

d) $\frac{da}{a} = -\frac{dv}{v} - \frac{dm}{m}$ [ES 94]

241. Given that K = a coefficient, v = mean velocity, f = Darcy-Weisbach friction factor and D = diameter of the pipe, if the head loss in a pipe bend is given by $h_L = Kv^2/2g$, then the equivalent length of the pipe is

a) KD/f b) Kf/D
c) f/KD d) Df/K

[ES 94]

242. When no external energy is imposed, which of the following statements would be true?

(1) energy line always falls in the direction of flow.
(2) hydraulic gradient line never rises in the direction of flow.
(3) specific energy may increase or decrease in the direction of flow.
(4) energy line and hydraulic gradient line can cross each other.

Select the correct answer using the codes given below.
Codes:

a) (1) and (2) b) (2) and (3)
c) (3) and (4) d) (l) and (3)

[ES 94]

243. The specific energy 'E' in a critical flow at depth y_c occurring in a triangular channel is given by

a) $E = 1.25\, y_c$ b) $E = 1.5\, y_c$
c) $E = 1.75\, y_c$ d) $E = 2\, y_c$

[ES 94]

244. In a gradually varied flow, if $\frac{dy}{dx}$ is positive, then $\frac{dE}{dx}$ will be

a) always zero
b) positive if $y > y_c$
c) negative if $y > y_c$
d) always negative [ES 94]

245. Which one of the following is the correct representation of the sequence of surface profiles if the channel slope changes from mild to steep?

a) M_1, S_1 b) M_3, S_2
c) M_2, S_3 d) M_2, S_2

[ES 94]

246. An irrigation canal has a steady discharge Q at a section where a cross-regulation (gated) is provided for control purposes. If the gate of the regulator, which is normally fully open, is suddenly lowered down to a half open position, then a rapidly varied unsteady flow results. In such a case, it would take the form of a

a) +ve surge moving u/s and a –ve surge moving d/s
b) +ve surge moving d/s and a –ve surge moving u/s
c) +ve surge moving u/s and a +ve surge moving d/s
d) –ve surge moving u/s and a –ve surge moving d/s [ES 93]

*247. A 10 cm high rocket containing liquid fuel of specific gravity 1.2 lifts off at an acceleration of 5 g. The pressure on the bottom plate of the rocket, at lift-off is

a) 6.7 kg/cm^2 b) 7.2 kg/cm^2
c) 8.4 kg/cm^2 d) 8.9 kg/cm^2

[ES 95]

248. Match List 1 with List II and select the correct answer using the codes given below the lists.

	List I		List II
A.	stream-lines	1.	tracing of motion of any one fluid particle
B.	streak lines	2.	tracing of motion of different fluid particles
C.	path lines	3.	identification of location number of fluid particle
D.	equipotential lines	4.	orthogonal to streak lines
		5.	location of equal piezometric heads

Codes:

a)	A	B	C	D
	2	3	4	5
b)	A	B	C	D
	3	2	1	4
c)	A	B	C	D
	1	2	4	3
d)	A	B	C	D
	2	3	1	5

[ES 95]

249. As the depth of immersion of a vertical plane surface increases, the location of pressure
   a) comes closer to the centre of gravity of the area
   b) moves apart from the centre of gravity of the area
   c) ultimately coincides with the centre of gravity of the area
   d) remains unaffected [ES 95]

250. If the discharge is Q, in a pipe fitted with an end-cap nozzle discharging a jet of water with velocity V and hitting normally a plate which is moving with a velocity $V/2$ towards the nozzle, then the jet would hit the plate with a discharge of
   a) 0.5 Q b) Q
   c) 1.5 Q d) 2Q [ES 95]

251. Consider the following parameters related to fluid flow.
   (1) Vorticity
   (2) Velocity potential
   (3) Stream function
   Among these, those which exist both in rotational flows and irrotational flows would include
   a) (1) and (2)
   b) (2) and (3)
   c) (1) and (3)
   d) (1), (2) and (3)

   [ES 95]

252. The flow of water in a wash basin when it is being emptied through a central opening is an example of
   a) free vortex
   b) forced vortex
   c) rotational vortex
   d) Rankine vortex [ES 95]

253. In a fluid flow, the time of constant piezometric head passes through two points which have the same
   a) elevation
   b) pressure
   c) velocity potential
   d) velocity [ES 95]

254. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Nondimensional numbers)	List II (Application)
A. Mach number	1. waves in an ocean
B. Thoma number	2. launching of rockets
C. Reynolds number	3. cavitation phenomenon
D. Weber number	4. capillary flow in soil
	5. motion of a submarine

Codes:

a)	A	B	C	D
	1	3	5	2
b)	A	B	C	D
	2	3	5	4
c)	A	B	C	D
	3	2	4	1
d)	A	B	C	D
	2	1	3	4

[ES 95]

255. An error of 0.5% in the measurement of head in a V-notch causes an error of
   a) 0.5% in the discharge
   b) 1.0% in the discharge
   c) 1.25% in the discharge
   d) 1.5% in the discharge [ES 95]

*256. A sphere of certain diameter, when towed submerged under water, experiences a drag force of 4 N at a velocity of 1.5 m/s. If another sphere of twice the diameter of the sphere referred to above, is towed with

the same velocity in water, the drag force experienced by this sphere will be

a) 8N b) 16 N
c) 24 N d) 32 N [ES 95]

257. Which of the following conditions would entail a greater energy dissipation in turbulent flow?

(1) smaller eddy size
(2) lower viscosity
(3) large intensity of turbulence

Select the correct answer using the codes given below.

Codes:

a) (1), (2) and (3)
b) (1) and (3)
c) (2) and (3)
d) (1) and (2) [ES 95]

258. Shear velocity is

a) a nondimensional quantity
b) a fictitious quantity
c) velocity of fluid at the edge of laminar sublayer
d) the velocity of fluid at the edge of roughness element [ES 95]

259. Three reservoirs A,B and C are interconnected by pipes as shown in Fig. 1.4. Water surface elevations in the reservoirs and the piezometric level at the junction D are also indicated in the figure.

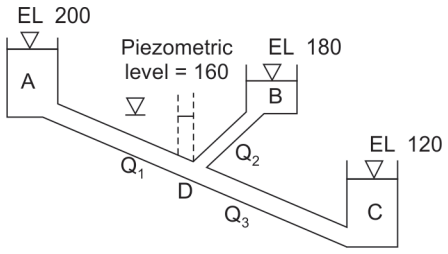


Fig. 1.4

Flows Q_1, Q_2 and Q_3 are related as

a) $Q_1 + Q_2 = Q_3$
b) $Q_1 - Q_2 = Q_3$
c) $Q_2 - Q_1 = Q_3$
d) $Q_1 + Q_2 + Q_3 = 0$ [ES 95]

260. Consider the following statements:
A horizontal pipe reduces from 10 cm to 5 cm in diameter. If the pressure head at 10 cm section is 10 metres and velocity head is 1 m, then the

(1) total head at any point is 11 m
(2) pressure head at the 5 cm section is negative
(3) discharge varies proportionate to the diameter
(4) datum head at all sections is constant

Of these statements

a) (4) alone is correct
b) (1) and (3) are correct
c) (1) (2) and (4) are correct
d) (1), (2), (3) and (4) are correct

[ES 96]

*261. Given $\varphi = 3xy$ and $\psi = \frac{3}{2}(y^2 - x^2)$, the discharge passing between the streamlines through the points (1, 3) and (3, 3) is

a) 2 units b) 4 units
c) 8 units d) 12 units

[ES 96]

*262. A model of a weir made to a horizontal scale of 1/40 and vertical scale of 1/9 discharges 1 l/s. Then the discharge in the prototype is estimated as

a) 1 lps b) 108 lps
c) 1080 lps d) 10800 lps

[ES 96]

263. Laminar flow occurs between extensive stationary plates. The kinetic energy correction factor is nearly

a) 1.0 b) 1.5
c) 2.0 d) 2.3 [ES 96]

*264. In steady laminar flow of a liquid through a circular pipe of internal diameter D, carrying a constant discharge, the hydraulic gradient is inversely proportional to

a) D b) D^2
c) D^4 d) D^5 [ES 96]

*265. The ratio of the coefficient of friction drag in laminar boundary layer compared to that in turbulent boundary layer is proportional to

a) $R_L^{1/2}$ b) $R_L^{1/5}$
c) $R_L^{3/10}$ (d) $R_L^{-3/10}$

[ES 96]

266. The overall drag coefficient of an aircraft of weight W and wing area S is given by

$C_D = a + b\,C^2_L$

where a and b are constants. The maximum drag in horizontal flight will be

a) $W\sqrt{ab}$ b) $2W\sqrt{ab}$
c) $4W\sqrt{ab}$ d) $6W\sqrt{ab}$

[ES 96]

267. For laminar flow between parallel plates separated by a distance $2h$, head loss varies

a) directly as h b) inversely as h
c) directly as h^2 d) inversely as h^3

[ES 96]

268. A penstock is 2000 m long and the velocity of pressure wave in it is 1000 m/s. Water hammer pressure head for instantaneous closure of value at the downstream end of pipe is 60 m. If the valve is closed in 4 secs, then the peak water hammer pressure head is equal to

a) 15 m b) 30 m
c) 60 m d) 120 m [ES 96]

269. In an open channel of wide rectangular section with constant n value, the bed slope is 1.2×10^{-3}, the local friction slope at a section is 1.05×10^{-3}, the local Froude number of the flow is 0.8. The local rate of variation of depth with longitudinal distance along the flow direction is

a) $\dfrac{1.2 - 1.05}{1 - 0.8} \times 10^{-3}$

b) $\dfrac{-1.2 - 1.05}{1 - 0.8} \times 10^{-3}$

c) $\dfrac{1.2 + 1.05}{1 - 0.64} \times 10^{-3}$

d) $\dfrac{1.2 - 1.05}{1 - 0.64} \times 10^{-3}$ [ES 96]

270. Before passage of a surge, the depth and velocity of flow at a section are 1.8 m and 3.72 m/s and after passage, they are 0.6 m and 7.56 m/s respectively. The speed of the surge is

a) + 1.8 m/s b) – 2.7 m/s
c) + 3.6 m/s d) – 4.5 m/s

[ES 96]

*271. A turbine works at 20 m head and 500 rpm speed. Its 1:2 scale model to be tested at a head of 20 m should have a rotational speed of nearly

a) 1000 rpm b) 700 rpm
c) 500 rpm d) 250 rpm

[ES 96]

272. Which one of the following statements regarding reciprocating pump is correct?

a) friction head is mainly responsible for causing cavitation in a reciprocating pump at the beginning of the suction stroke.
b) effect of acceleration pressure on reciprocating pumps appears parabolic and has the maximum effect at the middle of the delivery stroke.
c) air vessel reduces the acceleration head and consequently reduces the effect of friction head also.
d) the maximum permissible suction lift in a double acting reciprocating pump is independent of vapour pressure.

[ES 96]

273. The correct sequence, in the direction of the flow of water for installations in a hydropower plant is

a) reservoir, surge tank, turbine, pen stock
b) reservoir, pen stock, surge tank, turbine
c) reservoir, pen stock, turbine, surge tank
d) reservoir, surge tank, pen stock, turbine

[ES 97]

274. There are four variables, namely, E (volume modulus of elasticity), p (pressure per unit area), g (acceleration due to gravity) and μ (viscosity of water). They are associated with Mach, Euler, Froude and Reynolds numbers, respectively, in the order

a) E, p, μ, g b) p, E, μ, g
c) p, E, g, μ d) E, p, g, μ

[ES 97]

*275 Which one of the following pressure units represents the least pressure?

a) Millibar b) mm of mercury
c) N/mm^2 d) kgf/cm^2

[ES 97]

276. Given that, as flow takes place between two parallel static plates, the velocity midway between the plates is 2 m/s, the Reynolds number is 1200 and the distance between the plates is 10 cm. Which of the following statements are true?

(1) the velocity at the boundary is 1 m/s.
(2) the rate of flow is 0.1 m^3/s width.
(3) the flow is turbulent.
(4) the energy correction factor is 2.0.

Select the correct answer using the codes given below.

Codes:

a) (2) and (3)
b) (2) and (4)
c) (1) and (3)
d) (1), (2), (3) and (4) [ES 97]

277. The displacement thickness of a boundary layer is

a) the distance to the point where $(v/V) = 0.99$
b) the distance where the velocity 'v' is equal to the shear velocity V^*, that is, where $v = V^*$
c) the distance by which the main flow is to be shifted from the boundary to maintain the continuity equation
d) one half the actual thickness of the boundary layer [ES 97]

278. Match List I with List II and select the correct answer using the codes given in the lists.

List I (Flow phenomenon)	List II (Associated equation/ principle)
A. turbulent flow	1. circulation
B. laminar flow	2. momentum integral equation
C. lift on an aerofoil	3. mixing length
D. boundary layer	4. Hagan–Poiseuille equation

Codes:

a) A B C D
   1 4 3 2
b) A B C D
   4 1 2 3
c) A B C D
   3 4 1 2
d) A B C D
   1 2 3 4 [ES 97]

279. For laminar flow in a pipe carrying a given discharge, the height of surface roughness is doubled. In such a case, Darcy-Weisbach friction factor will

a) remain unchanged
b) be halved
c) be doubled
d) increase four-fold [ES 97]

*280. Two small orifices A and B of diameters 1 cm and 2 cm, respectively, are placed on the sides of a tank at depths of h_1 and h_2 below the open liquid surface. If the discharges through A and B are equal, then the ratio of h_1 and h_2 (assuming equal C_d values) will be

a) 16:1 b) 8:1
c) 4:1 d) 2:1 [ES 97]

281. Which of the following conditions will be satisfied by steady irrotational flow?

(1) $\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x} = 0$

(2) $\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y} = 0$

(3) $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$

Select the correct answer using the codes given below.

Codes:

a) (1) and (2)
b) (2) and (3)
c) (1) and (3)
d) (1), (2) and (3) [ES 97]

282. Match List I (Types of turbines) with List II (Ranges of specific speeds in MKS units) and select the correct answer using the codes given below the lists.

	List I		List II
A.	Francis	1.	10–35
B.	Kaplan	2.	35–60
C.	Pelton with one jet	3.	60–300
D.	Pelton with two jets	4.	300–1000

Codes:

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

[ES 98]

*283. The surface tension of water at 20 °C is 75×10^{-3} N/m. The difference in the water surfaces within and outside an open ended capillary tube of 1 mm internal bore, inserted at the water surface, would nearly be

a) 5 mm b) 10 mm
c) 15 mm d) 20 mm

[ES 98]

284. A symmetrical right circular cone of wood floats in fresh water with axis vertical and the apex downmost. The axial height of the cone is l. The submerged portion has a height h, measured upwards from the apex. What would be the height of the centre of buoyancy from the apex?

a) $h/2$ b) $\frac{5}{8}h$
c) $\frac{2}{3}h$ d) $\frac{3}{4}h$ [ES 98]

*285. A rectangular open channel carries a discharge of 15 m^3/s when the depth of flow is 1.5 m and the bed slope is 1:1440. What will be the discharge through the channel at the same depth if the slope would have been 1:1000?

a) 21.6 m^3/s b) 18 m^3/s
c) 14.4 m^3/s d) 12.5 m^3/s

[ES 98]

*286. In steady flow of a compressible fluid through a pipe, the density, area and velocity at a particular section are 1.5 kg/m^3, 0.5 m^2 and 3 m/s, respectively. At another section the density and area are 0.75 kg/m^3 and 1.0 m^2 respectively. What is the velocity at this section?

a) 1.5 m/s b) 3.0 m/s
c) 4.5 m/s d) 6.0 m/s

[ES 98]

287. The coefficient of velocity for an orifice is given by (using usual notations)

a) $\frac{x}{2\sqrt{YH}}$ b) $\frac{2x}{\sqrt{YH}}$
c) $\frac{x}{\sqrt{YH}}$ d) $\sqrt{\frac{x^2}{2YH}}$

[ES 98]

288. The velocity potential ϕ at any point for a two-dimensional steady, irrotational flow in polar coordinates, is given by (with usual notations) $\phi = m\frac{\cos\theta}{r}$

This equation represents a

a) vortex b) sink
c) source d) doublet

[ES 98]

289. A cylindrical vessel of radius 42.31 cm and height 1 m is open at the top. It holds water to half its depth. Which one of the following values approximates the speed at which the cylinder is to be rotated about the vertical axis, so as to make the apex of the paraboloid just reach the centre of the bottom of the vessel?

a) 100 rpm b) 150 rpm
c) 250 rpm d) 300 rpm

[ES 98]

290. Match List I (name of instrument) with List II (variable measured) and select the correct answer using the codes given below the lists.

	List I		List II
A.	hot wire anemometer	1.	boundary shear stress
B.	orifice meter	2.	discharge
C.	pitot tube	3.	mean velocity
D.	preston tube	4.	pressure
		5.	turblence

Codes:

a)	A	B	C	D
	2	3	4	1
b)	A	B	C	D
	5	2	3	4
c)	A	B	C	D
	2	5	1	3
d)	A	B	C	D
	5	2	3	1

[ES 98]

291. Water having kinematic viscosity of 0.01 stoke flows at a velocity of 2 m/sec in a pipe of 15 cm diameter. For dynamic similarity, the velocity of oil of kinematic viscosity 0.03 stoke in a pipe of same diameter will be

a) 0.33 m/sec b) 0.66 m/sec
c) 2 m/sec d) 6 m/sec

[ES 98]

*292. In the model of a highway bridge constructed to a scale of 1:25, the force of water on the pier was measured to be 0.5 kg. The force on the prototype pier will be

a) 7501.5 kg b) 7622.5 kg
c) 7812.5 kg d) 7916.5 kg

[ES 98]

*293. In the stokes experiment of falling sphere, it is found that a sphere of 5 mm diameter falls in a liquid with terminal velocity 20 mm/s giving a drag coefficient of 240. The ratio of specific gravities is 2.85. Which one of the following is the kinematic viscosity of the liquid in stokes?

a) 3.5 b) 10.0
c) 225.0 d) 1000.0

[ES 98]

*294. A ping-pong ball, having a diameter of 3.6 cm and weighing 2.4 g, is served with a horizontal velocity of 10 m/sec and a spin that gives rise to a coefficient of lift of 0.2. Assuming the density of air to be 0.00129 gf/cc, the lift experienced by the ball is nearly

a) 13 gf b) 1.3 gf
c) 0.13 gf d) 0.013 gf

[ES 98]

295. The friction factor (f), in terms of boundary shear stress (τ_0), is given by (ρ = mass density, v = mean velocity)

a) $\frac{2\rho v^2}{\tau_0}$ b) $\frac{\tau_0}{2\rho v^2}$
c) $\frac{2\tau_0}{\rho v^2}$ d) $\frac{\rho v^2}{2\tau_0}$

[ES 98]

296. The loss of head at various pipe fittings is given by the expression $\frac{Kv^2}{2g}$. If values of K were 0.40, 0.90, 1.5 and 2.2, then these would correspond respectively to

a) foot valve of pump, 45° elbow, 90° elbow and close return bend
b) 45° elbow, 90° elbow, foot value of pump and close return bend
c) 90° elbow, foot value of pump, close return bend and 45° elbow
d) foot value of pump, close return bend, 45° elbow and 90° elbow [ES 98]

297. A pipe network consists of a pipe of 60 cm diameter and branches out at a point F into two branches, one of 30 cm diameter and the other of 45 cm diameter. These branch pipes rejoin at a point B. The velocity in the first branch (of 45 cm diameter) is 1.5 m/sec. Which one of the given statements is true?

a) the velocity in the second branch is 1.0 m/sec.
b) the velocity in the second branch is 2.25 m/sec.
c) the velocity in the second branch is 2/3 (=0.667) m/sec.
d) the potential drop between F and B in both branches is the same.

[ES 98]

298. Which of the following statements are true in relation to water hammer phenomenon?
(1) it causes surface erosion in pipes.
(2) the pressure rise is given by ρCU for sudden closure of valve.
(3) it is accompanied by serious cavitation.
(4) the volume modulus of fluid is the relevant fluid property.
(5) it is governed by the Reynolds number of the flow.

Select the correct answer using the codes given below.
Codes:
a) (3) and (5)
b) (2) and (4)
c) (2) and (5)
d) (1), (2), (3) and (4) [ES 98]

299. Which one of the following pairs is not correctly matched? (b = bottom width, y = depth of flow, θ = side slope with vertical)

a)	for least perimeter of rectangular canal section	$b = 2y$
b)	for least perimeter of trapezoidal canal section	$b = 2y(\sec\theta - \tan\theta)$
c)	for critical flow through rectangular canal	$v = gy$
d)	for critical flow through trapezoidal canal	$v = \sqrt{\frac{gy(b + y\tan\theta)}{b + 2y\tan\theta}}$

[ES 98]

300. Match List I (Curves labelled A, B, C and D in Fig. 1.5) with List II (types of fluid) and select the correct answer using the codes given below the lists.

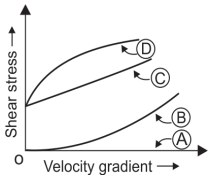
List I	List II
	1. ideal plastic 2. ideal 3. non-Newtonian 4. pseudo-plastic 5. thyxotropic

Fig. 1.5

Codes:

a)	A	B	C	D	
	2	3	1	5	
b)	A	B	C	D	
	3	2	1	5	
c)	A	B	C	D	
	4	2	5	1	
d)	A	B	C	D	
	2	3	5	1	[ES 99]

*301. In the set up shown in Fig. 1.6, assuming the specific weight of water as 10000 N/m^3, the pressure difference between the points A and B will be

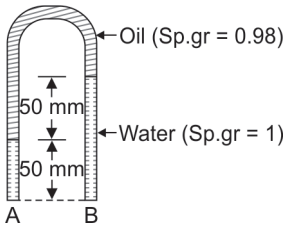


Fig. 1.6

a) 10 N/m^2 b) – 10 N/m^2
c) 20 N/m^2 d) – 20 N/m^2
[ES 99]

302. Consider the following statements:
(1) pumps in series operation allow the head to increase.
(2) pumps in series operation increase the flow rate.
(3) pumps in parallel operation increase the flow rate.
(4) pumps in parallel operation allow the head to increase.

Which of these statements are correct?
a) (1) and (3) b) (1) and (4)
c) (2) and (4) d) (3) and (4)
[ES 99]

303. Which one of the following can be a set of velocity components of a two-dimensional flow?
a) $u = x + y$ and $v = x^2 + y^2$
b) $u = x + y$ and $v = x - y$
c) $u = xy$ and $v = x/y$
d) $u = x^2 + y^2$ and $v = x^2 - y^2$
[ES 99]

304. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Turbine)	List II (Specific speed)
A. pelton	1. 25
B. propeller	2. 75
C. kaplan	3. 500
D. francis	4. 800
	5. 900

Codes:

a)	A	B	C	D
	1	4	5	2
b)	A	B	C	D
	3	4	2	5
c)	A	B	C	D
	4	1	5	3
d)	A	B	C	D
	1	5	4	2

[ES 99]

305. The height of a hydraulic jump in a stilling pool was found to be 10 cm in a model with l_p/l_m =36. The prototype jump height would be
a) 0.6 m
b) 3.6 m
c) 21.6 m
d) indeterminable for want of adequate data [ES 99]

*306. To generate 10000 hp under a head of 81 m while working at a speed of 500 rpm, the turbine of choice would be
a) pelton b) kaplan
c) bulb d) francis
[ES 99]

307. Consider the following statements.
(1) run-of-river plants can be located on any river.
(2) Runaway speed of a turbine is generally 180% of normal speed.
(3) Underground power stations are suited to areas susceptible to land slides.
(4) Higher the specific speed, higher will be the discharge at head.

Which of these statements are correct?
a) (1) and (2) b) (2) and (3)
c) (1) and (4) d) (2) and (4)
[ES 99]

308. A pressure increase of 200 N/cm^2 increases the density of water by 0.1%. The bulk modulus of elasticity of water is equal to
a) 200 GN/m^2 b) 20 GN/m^2
c) 2 GN/m^2 d) 0.2 GN/m^2
[CS 93]

309. A Bourdon gauge measures the pressure at a point relative to
a) the standard atmospheric pressure and not relative to the absolute zero pressure
b) the absolute zero pressure and not relative to the local atmospheric pressure
c) standard atmospheric pressure and not relative to the local atmospheric pressure
d) the local atmospheric pressure and not relative to the standard atmospheric pressure [CS 93]

310. A slab of wood 4 m by 4 m by 1 m (height), specific gravity 0.50 floats in water with 400 kg mass on it. The volume of the slab submerged, in cubic metres, is
a) 1.6 b) 6.4
c) 8.4 d) 10 [CS 93]

*311. Two small circular orifices of diameters d_1 and d_2 respectively are placed on one side of a tank at depths of 25 cm and 1 m below a constant surface of water. If the discharges through the orifices are the same, then the ratio of the diameter d_1 and d_2 will be
a) 1:2 b) $1:\sqrt{2}$
c) 4:1 d) $\sqrt{2}:1$ [CS 93]

312. The streamlines of a flow net are concentric circles. If the velocity at a radius of 0.6 m is 2.7 m/s, the velocity at a radius of 0.9 m will be
a) 3.6 m/s b) 2.7 m/s
c) 1.8 m/s d) 1.2 m/s
[CS 93]

313. The following stream function $\psi = \frac{x^3}{3} - x^2 - xy^2 + y^2$ will represent/ satisfy

a) rotational flow and Laplace equation
b) irrotational flow and Laplace equation
c) irrotational flow and equation of continuity
d) irrotational flow, Laplace equation and equation of continuity [CS 93]

314. Streamlines and equipontential lines
a) can be drawn graphically for viscous flow around any boundary
b) form meshes of perfect squares
c) are orthogonal wherever they meet
d) can be determined mathematically for all boundary conditions [CS 93]

315. The time required to empty a concrete tank through a rectangular weir at the side from a head of 16 cm to 8 cm over the crest was found to be 16 minutes. The time required to empty it further up to the crest will be
a) 16 minutes b) 24 minutes
c) 256 minutes d) infinite
[CS 93]

316. If two geometrically similar models having a scale ratio L_r are operated in a given laboratory at the same Froude number, then all the corresponding accelerations will be in the ratio of
a) $L_r^{1.5}$ b) L_r
c) $L_r^{0.5}$ d) 1 [CS 93]

317. In the distorted model of a river, the horizontal and vertical scale ratios are L_H and L_v respectively. The discharge ratio will be
a) $L_H^{1/2}\ L_V^2$ b) $L_H\ L_V^{3/2}$
c) $L^2{}_H\ L_V^{1/2}$ d) $L^3{}_H\ L_V^{-1/2}$
[CS 93]

318. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Body)	List II (Drag coefficient)
A. aerofoil ($Re > 10^7$)	1. 240
B. sphere (10^4 <Re < 10^5)	2. 1.90
C. flat plate ⊥ flow ($Re > 10^3$)	3. 0.50
D. droplet ($Re \approx 0.1$)	4. 0.003

Codes:

a)	A	B	C	D	
	1	2	3	4	
b)	A	B	C	D	
	4	3	1	2	
c)	A	B	C	D	
	4	3	2	1	
d)	A	B	C	D	
	4	1	3	2	[CS 93]

319. At the same mean velocity, the ratio of head loss per unit length for a sewer pipe flowing full to that for the same pipe flowing half full would be
a) 2.0 b) 1.63
c) 1.0 d) 0.61
[CS 93]

320. The velocity of a pressure wave in water hammer is equal to the velocity of sound in water. Is this statement correct?
a) No, because, the elasticity of the pipe reduces the velocity of the pressure wave
b) No, because, the elasticity of the pipe increases the velocity of the pressure wave
c) Yes, because, the pipe is much more rigid than water
d) Yes, because the pressure disturbances always propagate with the velocity of sound
[CS 93]

321. Consider the following statements regarding specific energy of the flow in an open channel:
(1) there is only one specific energy curve for a given channel.
(2) alternate depths are the depths of flow at which the specific energy is the same.
(3) critical flow occurs when the specific energy is minimum.

Of these statements

a) (1) and (2) are correct
b) (1) and (3) are correct
c) (2) and (3) are correct
d) (1), (2) and (3) are correct [CS 93]

322. Which of the following equations are used for the derivation of the differential equation for water surface profile in open channel flow?

(1) continuity equation
(2) energy equation
(3) momentum equation

Select the correct answer using the codes given below.

Codes:

a) (1), (2) and (3) b) (l) and (3)
c) (2) and (3) d) (l) and (2) [CS 93]

323. S_2 profile can occur at

a) a break in slope from mild to steep
b) a break in slope from steep to mild
c) the downstream of a sluice gate on a steep slope
d) a sudden drop in bed in a steep slope [CS 93]

324. In a standing wave flume, the depth of flow in the throat region

a) should always be larger than the critical depth
b) can be less than the critical depth
c) should be equal to the critical depth
d) is affected by the downstream depth when a jump is formed [CS 93]

325. Match List I with List II and select the correct answer using the codes given below in the lists.

List I (Description)	List II (Property of fluid)
A. property which explains the spherical shape of the drop of a liquid	1. viscosity
B. property which explains the phenomenon of cavitaion in a fluid flow	2. surface tension
C. property which explains the rise of sap in a tree	3. compress-ibility
D. property which explains the flow of a jet of oil in an unbroken stream	4. vapour pressure
	5. capillarity

Codes:

a) A B C D
1 2 4 5
b) A B C D
2 4 5 1
c) A B C D
4 2 5 1
d) A B C D
1 2 3 4 [CS 94]

326. An inclined plate 2 m long and 1 m wide lies with its length inclined at 45° to the surface of water and the nearest edge 1 m below it. If the specific weight of water is 1000 kg/m^3, then the total pressure on the plate (in kg.) is approximately

a) 2000 b) 2500
c) 3000 d) 3420 [CS 94]

327. A rectangular floating body 20 m long is 5 m wide. The water line is 1.5 m above the bottom. If the centre of gravity is 1.8 m from the bottom, then its metacentric height will be approximately

a) 3.3 m b) 1.65 m
c) 0.34 m d) 0.30 m [CS 94]

328. The constant angular velocity at which a liquid rotates in a cylinder about a vertical axis such that the pressure at a point on the axis is the same as at a point 2 m higher at a radius 2 m is

a) 2 g radians/sec
b) g radians /sec
c) $\sqrt{2g}$ radians/sec
d) $\sqrt{g}$ radians/sec [CS 94]

329. Flow net is drawn for a two-dimensional boundary. The velocity of uniform flow at approach is 1.2 m/s. The size of the square is 1.2 cm side. The size of the square at another location in the stream tube is 0.5 cm. The velocity at this point is

a) 1.44 m/s b) 2.4 m/s
c) 2.88 m/s d) 3.4 m/s [CS 94]

330. If the velocity, bulk modulus of elasticity and the mass density of a fluid are denoted by U, K and ρ respectively, then the Mach number is given by

a) $\frac{U\sqrt{K}}{\sqrt{\rho}}$ b) $\frac{U\sqrt{\rho}}{\sqrt{K}}$
c) $\frac{\rho\sqrt{U}}{\sqrt{K}}$ d) $\frac{K\sqrt{U}}{\sqrt{\rho}}$ [CS 94]

331. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Flow problem under study)	List II (Model law)
A. rise of gas bubbles in liquid	1. Euler number
B. flow of gas in a pipe	2. Froude number
C. flow over a spillway dam	3. Mach number
D. flight of supersonic jet	4. Reynolds number
	5. Weber number

Codes:

	A	B	C	D
a)	3	5	4	1
b)	3	4	2	1
c)	5	2	4	3
d)	5	4	2	3

[CS 94]

332. Assuming that the thrust T of a propeller depends on the diameter D, speed of advance V, angular velocity ω, dynamic viscosity μ and mass density ρ, which of the following nondimensional parameters can be derived by dimensional analysis.

(1) $\frac{T}{\rho D^2 V^2}$ (2) $\frac{VD}{\mu}$
(3) $\frac{D\omega}{V}$ (4) $\frac{VD\rho}{\mu}$

Select the correct answer using the codes given below.

Codes:
a) (1), (2) and (3)
b) (2), (3) and (4)
c) (1), (3) and (4)
d) (1), (2) and (4) [CS 94]

*333. A river model is constructed to a horizontal scale of 1:1000 and a vertical scale of 1:100. If the model discharge were 0.1 m^3/s, then the discharge in the river (in m^3/s) would be

a) 10^3 b) 10^4
c) 10^5 d) 10^6 [CS 94]

*334. If δ_1 and δ_2 denote the boundary layer thicknesses at a point distance x from the leading edge on a flat plate when the Reynolds numbers are 100 and 256 respectively, then the ratio of δ_1 to δ_2 will be

a) 0.625
b) 1.6
c) 2.56
d) 4.96 [CS 94]

335. The lift formula is given by lift = $\rho V_0 \Gamma$, where ρ is the density of the fluid, V_0, the free stream velocity and Γ the circulation. Given the following conditions

(1) two-dimensional steady flow
(2) compressible flow
(3) incompressible flow
(4) body of any shape

The lift formula would be valid for condition(s)

a) (1) and (3)
b) (1), (2) and (4)

c) (1), (3) and (4)
d) (4) alone [CS 94]

336. A long pipeline carries water from a river to a city. As part of an augmentation scheme, a similar pipe is added in parallal to the existing pipe for half the total length of the pipeline. The percentage increase in discharge will be
a) 26 b) 50
c) 60 d) 100 [CS 94]

337. Consider the following statements.
In a pipe network
(1) at any junction of a loop, the total inflow is equal to the total outflow
(2) at any junction, loss of head in clockwise branch is equal to the loss of head in anti-clockwise branch
(3) at any junction, head is same
(4) head loss in each loop is the same
Of these statements
a) (1) and (2) are correct
b) (3) and (4) are correct
c) (2) alone is correct
d) (4) alone is correct [CS 94]

*338. A penstock is 3000 metres long. Pressure wave travels in it with a velocity of 1500 m/s. If the turbine gates are closed uniformly and completely in a period of 4.5 seconds, then it is called
a) rapid closure b) slow closure
c) sudden closure d) uniform closure
[CS 94]

339. Water flows uniformly down a 30° slope in a very rough channel at a normal depth of 8 cm. The intensity of bed shear in kgf/m^2 will be about
a) 400 b) 40
c) 20 d) 6.3 [CS 94]

340. The sequent depth ratio in a hydraulic jump formed in a horizontal rectangular channel is 16.48. The Froude number of the super-critical stream is
a) 4.0 b) 8.0
c) 12.0 d) 120 [CS 94]

341. The standard step method of gradually varied flow computations involves the application of
a) differential equation of gradually varied flow
b) continuity and energy equations
c) continuity and momentum equations
d) continuity equation and equation of motion [CS 94]

342. Match List I with List II and select the correct answer using the codes given below the lists.

List I	List II
A. positive surge travelling upstream	1. occurs on upstream of gate that is partly closed suddenly
B. positive surge travelling downstream	2. occurs on downstream of gate that is partly closed suddenly
C. negative surge travelling upstream	3. occurs on upstream of gate that is opened suddenly
D. negative surge travelling downstream	4. occurs on downstream of gate that is opened suddenly

Codes:

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

343. The following statements relate to water surface profiles in gradually varied flow of an open channel.
(1) M_1 and S_1 curves meet y_0 line asymptotically and tend to be horizontal as $y \to \infty$.
(2) M_2 and S_2 curves meet y_0 line normally and y_c line asymptotically.

(3) M_3 and S_3 curves meet y_c line normally and also meet the channel bed normally.

(4) C_1 and C_3 curves will be slightly curved if Chezy's equation is used. Otherwise, they tend to be straight lines.

Of these statements

a) 1 and 3 are correct
b) 1 and 4 are correct
c) 2 and 4 are correct
d) 3 and 4 are correct [CS 94]

344. In a supersonic flow, a diverging passage results in

a) increase in the velocity and pressure
b) increase in the velocity and density
c) decrease in pressure and density
d) decrease in velocity and pressure [CS 94]

345. In a normal shock wave in a one dimensional flow, the

a) velocity, pressure and density increase
b) pressure, density and temperature increase
c) velocity, temperature and density increase
d) pressure, density and momentum per unit time increase [CS 94]

346. A three-dimensional state of stress can be split into the two components, the hydrostatic state and the deviatoric component. Then magnitude of the hydrostatic state pressure is given by

a) $(\sigma_x + \sigma_y + \sigma_z)/3$
b) $(\sigma_x + \sigma_y + \sigma_z)/4$
c) $(\sigma_x + \sigma_y + \sigma_z)/6$
d) $(\sigma_x + \sigma_y + \sigma_z)$ [CS 95]

347. In a two-dimensional incompressible flow, if the fluid velocity components are given by

$$u = x - 4y,\ v = -y - 4x$$

then the stream function ψ is given by

a) $x^2 - xy + 2y^2$ b) $2x^2 + 2xy + y^2$
c) $2x^2 + xy - 2y^2$ d) $2x^2 - xy + 2y^2$ [CS 95]

348. Which of the following equations will be satisfied by irrotational flow of an incompressible fluid?

(1) $\dfrac{\partial u}{\partial x} + \dfrac{\partial v}{\partial y} + \dfrac{\partial w}{\partial z} = 0$

(2) $\dfrac{\partial u}{\partial y} + \dfrac{\partial v}{\partial x} = \dfrac{\partial u}{\partial z} + \dfrac{\partial w}{\partial x} = \dfrac{\partial v}{\partial y} + \dfrac{\partial v}{\partial z} = 0$

(3) $\dfrac{\partial^2 u}{\partial x^2} + \dfrac{\partial^2 v}{\partial y^2} + \dfrac{\partial^2 w}{\partial z^2} = 0$

(4) $\dfrac{\partial v}{\partial x} = \dfrac{\partial u}{\partial y}, \dfrac{\partial y}{\partial z} = \dfrac{\partial w}{\partial x}, \dfrac{\partial v}{\partial z} = \dfrac{\partial w}{\partial y}$

Select the correct answer from the codes given below.

Codes:

a) (3) and (4) b) (l) and (2)
c) (1) and (3) d) (1) and (4) [CS 95]

349. Consider the following statements:

(1) Fluids of low viscosity are all irrotational.
(2) Rotation of the fluid is always associated with shear stress.

Which of the statements given above is/are correct?

a) 1 only b) 2 only
c) Both 1 and 2 d) Neither 1 nor 2 [ES 2008]

350. Given the x-component of the velocity $u = 6xy - 2x^2$, the y-component of the flow v is given by

a) $6y^2 - 4xy$ b) $-6xy + 2x^2$
c) $6x^2 - 2xy$ d) $4xy - 3y^2$ [CS 95]

351. A jet of water issues from a 5 cm diameter nozzle, held vertically upwards, at a velocity of 20 m/sec. If air resistance consumes 10% of the initial energy of the jet, then it would reach a height; above the nozzle, of

a) 18.35 m b) 19.14 m
c) 19.92 m d) 20.00 m [CS 95]

352. The ratio of pressures between two points A and B located respectively at depths 0.5 m and 2 m below a constant level of water in a tank is

a) $1:\sqrt{2}$ b) 1:2
c) 1:4 d) 1:16 [CS 95]

353. A wooden plank (sp. gr. 0.5) 1 m × 1 m × 0.5 m floats in water with 1.5 kN load on it with 1 m × 1 m surface horizontal. The depth of plank lying below water surface shall be
a) 0.178 m b) 0.250 m
c) 0.403 m d) 0.500 m [CS 95]

354. Which of the following assumptions are made in the analysis of jet impinging normally on a moving plate?
(1) friction between jet and plate is neglected.
(2) flow is steady.
(3) momentum of jet is unchanged.
(4) plate moves at a constant velocity.
Choose the correct answer using the codes given below.
Codes:
a) (1), (2) and (4)
b) (1), (2) and (3)
c) (2), (3) and (4)
d) (1), (3) and (4) [CS 95]

355. A Rankine (oval) half body PP is subjected to a two dimensional flow (x, y coordinate directions from origin O) with uniform velocity V, resulting in typical streamlines as shown in Fig. 1.7 by dotted lines.

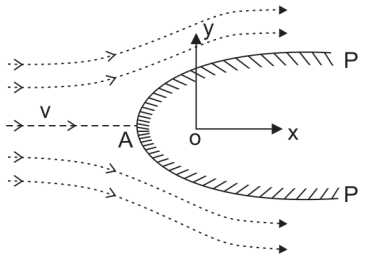


Fig. 1.7

The point A on the body surface is
a) separation point
b) stall point
c) stagnation point
d) point of maximum velocity [CS 95]

356. Match List I with List II and select the correct answer using the codes given below the lists.

	List I		List II
A.	flow over a spillway dam	1.	Euler number
B.	flow through a butterfly valve	2.	Froude number
C.	rise of moisture in the stem of a plant	3.	Mach number
D.	water hammer in a pen stock	4.	Reynolds number
		5.	Weber number

Codes:

a)	A	B	C	D
	2	4	5	3
b)	A	B	C	D
	4	2	3	1
c)	A	B	C	D
	2	3	1	4
d)	A	B	C	D
	5	1	4	2

[CS 95]

357. The head loss in a pipe of diameter d, carrying oil at a flow rate Q over a distance l is h. The pipe is replaced by another with half the diameter, all other things remaining the same. The head loss in this case will be
a) 0.5 h b) 2.0 h
c) 8.0 h d) 32.0 h
[CS 95]

358. Match List I with List II and select the correct answer using the codes given in the the lists.

	List I (Physical quantity)		List II (Dimensional formula)
A.	specific gravity	1.	$[M^0L^2T^{-1}]$
B.	coefficient of viscosity	2.	$[M^0L^0T^0]$
C.	kinematic viscosity	3.	$[ML^{-1}T^{-1}]$
D.	stress	4.	$[ML^{-1}T^{-2}]$

Codes:

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

[CS 95]

359. The discharge per metre width at the foot of a spillway is 10 m^3/s at a velocity of 20 m/s. A perfect free hydraulic jump will occur at the foot of the spillway when the tail water depth is approximately equal to

a) 4.50 m b) 5.00 m
c) 5.50 m d) 6.50 m [CS 95]

360. The differential equation for energy for a reversible adiabatic flow may take the form

a) $dp + d(\rho V^2) = 0$

b) $VdV + c^2 \frac{d\rho}{\rho} = 0$

c) $2VdV + \frac{d\rho}{\rho} = 0$

d) $VdV + \frac{d\rho}{\rho} = 0$ [CS 96]

361. The shear stress in a fluid may be expressed as $\tau = \mu \left(\frac{dv}{dy}\right)^n$, where μ is the viscosity, dv/dy is the velocity gradient and n is constant. The n-values for Newtonian and non-Newtonian fluids will be respectively

a) $n = 1$ and $n > 1$
b) $n < 1$ and $n < 1$
c) $n = 1$ and $n < 1$
d) $n = 1$ and $n \neq 1$ [CS 96]

362. Consider the following statements relating to the stability of floating as well as submerged bodies:

(1) a submerged body is stable when the centre of gravity is below the centre of buoyancy.
(2) a floating body is stable when the centre of gravity is above the centre of buoyancy.
(3) a floating body is stable when the centre of gravity is below the metacentre.
(4) a submerged body is in stable equilibrium when the centre of gravity coincides with the centre of buoyancy.

Of these statements

a) (1), (2) and (3) are correct
b) (2), (3) and (4) are correct
c) (1), (2) and (4) are correct
d) (1), (3) and (4) are correct [CS 96]

363. Match List I with List II and select the correct answer using the codes given below the lists.

	List I		List II
A.	continuity equation	1.	law of conservation of energy
B.	momentum equation	2.	concentric circular streamlines
C.	energy equation	3.	newton's second law of motion
D.	free vortex	4.	law of conservation of mass

Codes:

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

[CS 96]

364. Consider the following statements relating to fluid dynamics:

(1) momentum equation contains only vector quantities.
(2) energy equation involves scalar quantities only.
(3) irrotational flow occurs in real fluid.
(4) in uniform flow, there is no variation of velocity, at a given time, with respect to distance.

Of these statements

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

[CS 96]

365. Figure 1.8 shows the flow net for two dimensional contraction. The size of mesh square at O is 7 mm, and at point A, the mesh size is 3.5 mm.

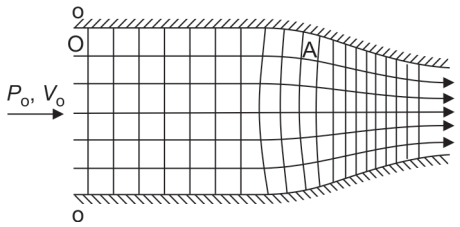


Fig. 1.8

The dimensionless pressure at A, $\frac{\Delta p}{\frac{\rho V_0^2}{2}}$ is equal to

a) 2 b) – 0.75
c) – 3 d) – 4 [CS 96]

366. Match List I with List II and select the correct answer using the codes given below the lists.

	List I		List II
A.	venturi-meter	1.	Flow rate
B.	current meter	2.	Flow velocity
C.	piezometer	3.	Flow pressure

Codes:

a)	A	B	C
	1	2	3
b)	A	B	C
	2	1	3
c)	A	B	C
	3	2	2
d)	A	B	C
	2	3	1

[CS 96]

367. With '*n*' variables and '*m*' fundamental dimensions in a system, which one of the following statements relating to the application of Buckingham's pi theorem is incorrect?

a) with experience, pi terms can be written simply by inspection of variables in a flow system.
b) Buckingham's pi theorem is not directly applicable in compressible flow problem.
c) Buckingham's pi theorem yields dimensionless pi terms given by the difference between the number of variables and the number of fundamental dimensions.
d) Buckingham's pi theorem reduces the number of variables by the number of fundamental dimensions involved.

[CS 96]

368. A hydraulic model of a spillway is constructed with a scale 1:16. If the prototype discharge is 2048 cumec, then the corresponding discharge for which the model should be tested is

a) 1 cumec b) 2 cumec
c) 4 cumec d) 8 cumec

[CS 96]

369. Consider the following statements relating to hydraulic gradient line and energy gradient line:

(1) in the case of a fluid flowing in a pipeline, hydraulic gradient line and energy gradient line may coincide.
(2) the line joining the points representing piezometric heads is known as hydraulic gradient.
(3) in the case of ideal fluid, energy gradient line is always horizontal.
(4) hydraulic gradient line has a downward slope in the case of flow through pipes.

Of these statement

a) (1), (2) and (3) are correct
b) (1), (3) and (4) are correct
c) (2), (3) and (4) are correct
d) (1), (2) and (4) are correct [CS 96]

370. Figure 1.9 shows gradually varied flow in an open channel with a break in bed slope.

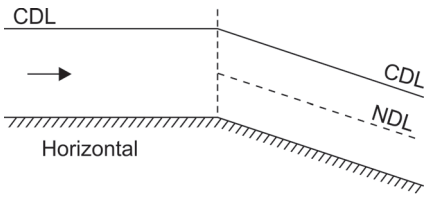


Fig. 1.9

Types of water surface profiles occurring from left to right are

a) H_3, S_3 b) H_2, S_2
c) H_2, M_2 d) H_3, M_2

[CS 96]

371. A hollow cylinder made of wood (sp. gr. = 0.8) has an external diameter of 1.0 m and an internal diameter of 0.6 m. It floats in water with its axis vertical and is in stable equilibrium. This is possible only when the length of the cylinder is equal to or less than

a) 0.72 m b) 0.95 m
c) 1.03 m d) 1.20 m [CS 97]

372. In a horizontally held injection syringe, the piston of 0.2 cm^2 cross-sectional area is pushed at a constant speed of 1.0 cm/s to eject water into the atmosphere through a hypodermic needle of 0.07 mm^2 cross-sectional area while rinsing. Neglecting losses, the force required to move the piston is nearly

a) 6 kg b) 6×10^{-3} kg
c) 6×10^{-5} kg d) 6×10^{-7} kg

[CS 97]

373. If a sluice gate produces a change in the depth of water from 3.0 m to 0.6 m, then the force on the gate is about

a) 9.5 kN/m b) 19.0 kN/m
c) 38.0 kN/m d) 76.0 kN/m

[CS 97]

374. Consider the following types of weirs:

(1) proportional weir
(2) cipolletti weir
(3) parabolic weir
(4) rectangular weir (without end treatment)

All these weirs have varying values exponent in the formula $Q = KH^n$. The correct sequence of these weirs in increasing order of the value of 'n' is

a) (2), (1), (3), (4)
b) (2), (1), (4), (3)
c) (1), (2), (3), (4)
d) (1), (2), (4), (3) [CS 97]

375. A velocity field with no components in the y-and z-directions is given by

$V = 6 + 2xy + t^2$

The acceleration along the x-direction at a point (3,1,2) at time 2, is

a) 8 units
b) 16 units
c) 28 units
d) 36 units

[CS 97]

376. Which one of the following groups constitutes a set of parameters of identical dimensions?

a) velocity potential, stream function, vorticity
b) power, torque, bending moment
c) relative roughness, friction factor, sub-layer thickness
d) rate of angular deformation, velocity gradient, speed in rpm [CS 97]

377. Vorticity in the z-direction is given by

a) $\left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}\right)$ b) $\left(\frac{\partial u}{\partial x} - \frac{\partial v}{\partial y}\right)$

c) $\left(\frac{\partial v}{\partial x} + \frac{\partial u}{\partial y}\right)$ d) $\left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)$

[CS 97]

378. Given that g = acceleration due to gravity and R = hydraulic mean depth, the Darcy-Weisbach friction factor is related to Manning's rugosity coefficient 'n' as

a) $\frac{8gn^2}{R^{1/3}}$ b) $\frac{gn^2}{8R^{1/3}}$

c) $\frac{64ng}{R^{1/3}}$ d) $\frac{R^{1/3}}{8gn^2}$

[CS 97]

379. A surge tank is provided in a hydropower scheme to
a) provide additional storage close to the penstock
b) take care of change of slope, alignment or size of the water conductor
c) reduce the pressures under transient conditions
d) provide convenient overspills
[CS 97]

380. In a reciprocating pump without air vessels, the friction head in the delivery pipe and the acceleration head in the suction pipe respectively are maximum at crank angles
a) 90° and 0°
b) 90° and 90°
c) 0° and 0°
d) 0° and 90°

381. Flow of air can be considered to be incompressible within 1% error if the Mach Number of flow is less than
a) 0.1 b) 0.2
c) 0.4 d) 0.6
[CS 97]

382. Match List I (fluid type) with List II (Example) and select the correct answer using the codes given below the lists.

	List I		List II
A.	newtonian	1.	blood
B.	ideal plastic	2.	printer's ink
C.	thyxotropic	3.	oil paint
D.	pseudo-plastic	4.	water

Codes:

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

[CS 97]

383. In order that a droplet of water at 20°C ($\sigma = 0.0728$ N/m) has an internal pressure 1 kPa greater than that outside it, its diameter should be nearly
a) 0.15 mm b) 0.3 mm
c) 0.6 mm d) 1.2 mm
[CS 97]

384. Glycerine (specific weight 1260 kg/m^3, dynamic viscosity 8.00×10^{-2} kg-sec/m^2) is spread freely to a thickness of 1 mm between a bottom stationary plate and a top moveable plate of 10 cm^2 area. The top plate is to be moved at a uniform speed of 1 m/s. The force to be exerted on the top plate is
a) 1.6 kg b) 0.8 kg
c) 0.16 kg d) 0.08 kg
[CS 97]

385. Consider the following statements relating to some fluid properties:
(1) the variation of kinematic viscosity between liquids and gases is much less than the variation of dynamic viscosity.
(2) surface energy is caused by relative forces of cohesion and adhesion between the fluids.
(3) mercury possesses larger vapour pressure than benzene and hence, benzene is more volatile.
(4) bulk modulus of water is 3,00,000 units and that of gas is 15 units. This indicates that gas is 20,000 times more compressible than water.

Of these statement
a) (1), (2) and (3) are correct
b) (1), (2) and (4) are correct
c) (2), (3) and (4) are correct
d) (1), (3) and (4) are correct
[CS 96]

386. Consider the following statements relating hydrostatic forces on submerged surface:
(1) the pressure centre is always below the centroid of any plane submerged surface that is not horizontal.
(2) total force on a curved surface is the product of the average force and the submerged area.

(3) the magnitude of hydrostatic pressure at a particular depth is a function of the shape of the surface.

(4) the vertical component of force on a body completely submerged in a static reservoir of fluid is equal to the weight of the fluid displaced by the body.

Of these statements

a) (1), (2) and (3) are correct

b) (2), (3) and (4) are correct

c) (1), (3) and (4) are correct

d) (1), (2) and (4) are correct [CS 98]

387. Match List I (phenomena) with List II (equation/ concept involved) and select the correct answer using the codes given below the lists.

	List I		List II
A.	force developed in a pipe bend	1.	continuity equation
B.	pitot static tube	2.	energy equation
C.	flow through smaller passage produces higher velocity	3.	momentum equation
D.	vortex flow	4.	moment of momentum

Codes:

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

[CS 98]

388. Match List I (typical occurrence) with List II (relevant flow condition) and select the correct answer using the codes given below the lists.

	List I		List II
A.	cavitation	1.	absence of fluid velocity
B.	separation	2.	fluid pressure reduces to vapour pressure limit
C.	stagnation point	3.	bluff body in flow
D.	wake	4.	adverse pressure gradient in widening boundaries of flow

Codes:

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

[CS 98]

389. Which one of the following statements is not correct?

a) in free vortex flow, streamlines are concentric spirals and flow continuously circles the origin.

b) in free vortex flow, the flow velocity is in tangential direction only and varies inversely as the distance from the origin.

c) in a free vortex, flow is rotational at the core and irrotational away from it.

d) in a forced vortex, flow is rotational, that is, fluid particles undergo rotation about their mass centre. [CS 98]

390. Consider the following statements:

(1) in a source, equipotential lines are circles.

(2) flownet is a representation of 2-dimensional irrotational flow of incompressible fluid.

(3) boundaries act as limiting equi-potential lines in a flow net.

(4) in uniform flow region, streamlines will be parallel and equidistant.

Of these statements
a) (1), (2) and (3) are correct
b) (1), (2) and (4) are correct
c) (2), (3) and (4) are correct
d) (1), (3) and (4) are correct [CS 98]

391. Match List I with List II and select the correct answer using the codes given below the lists.

	List I		List II
A.	Reynolds number	1.	gravity force
B.	Froude number	2.	surface energy force
C.	Weber number	3.	viscous force
D.	Mach number	4.	elastic force
		5.	shear force

Codes:

a)	A	B	C	D
	1	2	3	4
b)	A	B	C	D
	1	2	4	5
c)	A	B	C	D
	3	1	2	4
d)	A	B	C	D
	1	2	3	5

[CS 98]

392. Which one of the following statements is not correct?
a) in the study of flow between two fixed parallel plates, the flow is assumed two dimensional.
b) in flow between parallel plates, if the distance between the plates and the viscosity remains constant, then the pressure gradient is also constant provided that the flow is steady.
c) velocity distribution for laminar flow between two parallel plates shows that velocity varies directly with pressure gradient.
d) in case of flow between parallel plates, variation of shear is linear. [CS 98]

393. Which one of the following statements is not correct?
a) water hammer occurs in a situation when there is unsteady flow in a pipe.
b) fall of pressure due to decrease in velocity results in the phenomenon of water hammer.
c) propagation of high pressure through elastic media gives rise to water hammer.
d) for water hammer to develop, the valve at the end of a pipeline must be fully closed. [CS 98]

394. Which one of the following pairs of types of flow and situations is not correctly matched?
a) non-uniform flow ... velocity changes magnitude with distance
b) uniform flow ..... flow in a channel bend
c) steady flow ... velocity does not change with time
d) tranquil flow ... Froude number of flow is less than 1 [CS 98]

395. For a circular channel (with r_0 as the radius of the channel) to be efficient,
a) the half subtended angle at the centre with respect to the water level must be 151°10′
b) depth of flow must be 1.88 r_0
c) depth of maximum velocity must be 1.62 r_0
d) the half subtended angle at the centre with respect to the water level must be 90° [CS 98]

396. The loss of energy in a hydraulic jump formed in a rectangular channel is given by (symbols have the usual meanings)
a) $\Delta E = \frac{(y_2 - y_1)^3}{4y_1y_2}$
b) $\Delta E = \frac{vQ(y_2 - y_1)^3}{8y_1y_2}$
c) $\Delta E = \frac{vQ(y_2 - y_1)^3}{75 \times 4y_1y_2} - HP$
(d) $\Delta E = \frac{(y_1 - y_2)^3}{4y_1y_2}$ [CS 98]

397. Which one of the following statements is not correct?
a) specific energy is the total energy above the floor of an open channel.
b) for a given specific energy, two depths exist and these are called alternate depths.
c) velocity of flow is critical at maximum specific energy.
d) critical velocity occurs at Froude number = 1. [CS 98]

398. Which one of the following pairs of situations and types of water surface profiles is not correctly matched?
a) mild slope; flow over free overall: M_2
b) mild slope; flow downstream of a sluice gate: M_1
c) critical slope; flow downstream of a sluice gate: C_3
d) critical slope; flow behind an overflow weir: C_1 [CS 98]

399. Match List I (surface profile) with List II (description of the profile) and select the correct answer using the codes given below the lists.

	List I		List II
A.	M_2	1.	convex upwards; asymptotic to horizontal at d/s end; depth increasing with d/s.
B.	S_3	2.	convex downwards; upstream asympototic to normal depth with depth decreasing in d/s direction
C.	C_1	3.	depth increasing downstream and meeting at an angle to CDL; a curve with an inflexion point
D.	A_3	4.	convex upwards and depth increasing in flow direction asymptotic to NDL at d/s end

Codes:

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

[CS 98]

400. Consider the following fluids:
(1) blood
(2) glycerine
(3) molasses
(4) slurry of clay in water
(5) kerosene
Among these, non-Newtonian fluids would include
a) (2), (4) and (5)
b) (2), (3) and (4)
c) (1), (3) and (4)
d) (1), (4) and (5)

[CS 98]

401. Match List I (units) with List II (dimension) and select the correct answer using the codes given below the lists.

	List I		List II
A.	pressure intensity	1.	$M^0L^0T^0$
B.	horse power	2.	$ML^{-2}T^{-2}$
C.	Reynolds number	3.	$ML^{-2}T^{-3}$
D.	specific weight	4.	$ML^{-1}T^{-2}$

Codes:

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

[CS 99]

402. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Fluid property)	List II (Flow phenomenon)
A. compressibility	1. flow of real fluid past a tiny sphere
B. gravity	2. cavitation
C. viscosity	3. hydraulic jump
D. vapour pressure	4. flight of supersonic aircraft

Codes:

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

[CS 99]

403. A U-tube manometer is used to measure the pressure in an oil pipe A as shown in Fig. 1.10. The specific gravity of oil is 0.8 and that of mercury is 13.6.

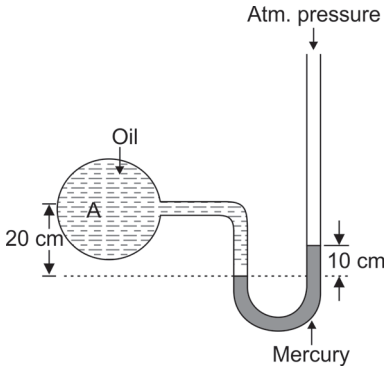


Fig. 1.10

The equivalent gauge pressure is nearly

a) 8.53 kN/m^2 b) 11.76 kN/m^2
c) 13.34 kN/m^2 d) 15.00 kN/m^2 [CS 99]

404. A racing car with a partially filled fuel tank moves in the horizontal direction at a uniform acceleration equal to g. The free surface of the liquid fuel in the tank will assume a slope of

a) 20° b) 30°
c) 45° d) 60° [CS 99]

405. A multi-tube manometer filled with water up to level A, B and C as shown in Fig. 1.11 is rotated about the vertical axis at A.

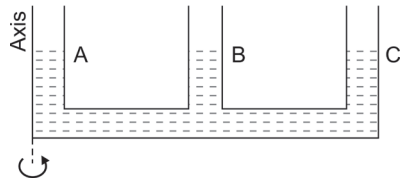


Fig. 1.11

The water levels at A, B and C will all lie on

a) a circle b) an ellipse
c) a hyperbola d) a parabola [CS 99]

406. A circular plate of diameter d is submerged in water vertically, so that the topmost point is just at the water surface. The centre of pressure on the plate will be below the water surface at a depth of

a) $\frac{5d}{8}$ b) $\frac{2d}{3}$
c) $\frac{11d}{16}$ d) $\frac{3d}{4}$ [CS 99]

407. When a ship moving on seawater enters a river and moves inland, it is expected to

a) rise a little
b) sink a little
c) maintain the same level of draft
d) rise or fall depending on whether it is made of wood or steel [CS 99]

408. Match List I with List II and select the correct answer using the codes given below the lists.

	List I		List II
A.	submerged body	1.	force on a curved surface
B.	floating body	2.	moment of intertia

C.	metacentric height	3.	metacentre
D.	buoyancy	4.	force acting vertically up
		5.	centre of buoyancy

Codes:

a)	A	B	C	D	
	5	3	2	1	
b)	A	B	C	D	
	5	3	2	4	
c)	A	B	C	D	
	1	2	3	4	
d)	A	B	C	D	
	1	2	5	4	[CS 99]

409. The velocity components in a 2D flow for an incompressible fluid are given by the equations

$$u = 2xy;\ v = a^2 + x^2 + y^2$$

The flow

a) satisfies irrotationality condition and the continuity equation
b) satisfies irrotationality condition but not the continuity equation
c) does not satisfy the irrotationality condition but satisfies the continuity equation
d) does not satisfy either the irrotationality condition or the continuity equation [CS 99]

410. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Phenomenon)		List II (Condition)	
A.	rotational flow	1.	velocity zero or infinite
B.	irrotational flow	2.	proportional to velocity
C.	singularities	3.	vorticity is zero
D.	streamline spacing	4.	vorticity exists

Codes:

a)	A	B	C	D	
	3	4	1	2	
b)	A	B	C	D	
	4	3	1	2	
c)	A	B	C	D	
	4	3	2	1	
d)	A	B	C	D	
	3	4	2	1	[CS 99]

411. Which one of the following statements on similitude is correct?

a) to achieve dynamic similarity between the model and the prototype, there need not be any geometric similarity.
b) for kinematic similarity between the model and the prototype, the ratios of forces between the model and the prototype should be the same.
c) for dynamic similarity between model and prototype in a compressible flow system, the Weber numbers must be the same.
d) for dynamic similarity between the model and the prototype, the ratio of forces must be the same. [CS 99]

412. The limit of the values of the coefficient of discharge of venturimeter is between

a) 0.60 to 0.75 b) 0.76 to 0.80
c) 0.81 to 0.94 d) 0.95 to 0.99 [CS 99]

413. Match List I with List II and select the correct answer using the codes given below the lists.

	List I		List II
A.	moment of momentum equation	1.	equation to find energy loss in a pipe line having laminar flow
B.	Bernoulli's equation	2.	equation of motion for one-dimensional steady flow of ideal and incompressible fluid
C.	Euler's equation	3.	equation based on conservation of momentum principle applicable to circulatory flows

D.	Hagen-Poiseuille equation	4. three dimensional equation of motion based on principle of conservation of momentum for ideal and incompressible fluid flow

Codes:

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

[CS 99]

414. Which one of the following pairs is correctly matched?

a) prandtl: Flow through channels
b) continuity equation: Law of conservation of energy
c) mixing length: Laminar flow
d) karman vortex street: Flow past a cylinder [CS 99]

415. A pitot tube (coefficient = 1.0) is used to measure the velocity of air of mass density 1.2 kg/m^3. If the head difference in a vertical U-tube filled with water is 12 mm, then the velocity of air (in m/s) will be

a) 10 b) 14
c) 17 d) 20 [CS 99]

416. Match List I with List II for different stages of flow in a pipeline and select the correct answer using the codes given below the lists.

	List I		List II
A.	laminar flow	1.	$f = \frac{0.3164}{(\mathrm{Re})^{0.25}}$
B.	smooth turbulent flow ($\mathrm{Re} < 10^5$)	2.	$\frac{1}{\sqrt{f}} = -0.8 + 2\log\left(\mathrm{Re}\sqrt{f}\right)$
C.	rough turbulent flow	3.	$f = \frac{64}{\mathrm{Re}}$
D.	smooth turbulent flow ($\mathrm{Re} > 10^5$)	4.	$\frac{1}{\sqrt{f}} = 1.74 + 2\log\left(\frac{\mathrm{Re}}{k}\right)$

Codes:

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

[CS 94,99]

417. Consider the following statements in relation to dimensionless numbers:

(1) inertia force is always involved in the expression of any dimensionless number.
(2) Weber number is significant in a flow system where viscous force dominates.
(3) Mach number is significant in a flow system where the flow is of compressible fluid.
(4) Reynolds number is significant where both gravity force and viscous force predominate.

Of these statements

a) (1) and (2) are correct
b) (1) and (3) are correct
c) (2) and (4) are correct
d) (3) and (4) are correct

[CS 99]

418. Separation of boundary layer takes place under

a) positive pressure gradient in the direction of flow
b) negative pressure gradient in the direction of flow

c) zero pressure gradient in the direction of flow
d) very rough surface [CS 96, 99]

Directions: Select your answers for the questions from 419 to 442 using the codes given below.

Codes:

a) *Both A and R are true and R is the correct explanation of A*
b) *Both A and R are true but R is not a correct explanation of A*
c) *A is true but R is false*
d) *A is false but R is true*

419. **Assertion A:** Flow in the boundary layer is always laminar.

Reason R: In turbulent flow on a smooth boundary, a laminar sublayer still exists within the boundary layer. [ES 95]

420. **Assertion A:** Gravity influences the pipe flow.

Reason R: Gravity term (g) appears explicitly in Darcy-Weisbach formula for pipe flow resistance. [ES 94]

421. **Assertion A:** At the critical state of flow, the specific force is a minimum for the given discharge.

Reason R: For a minimum value of the specific force, the first derivative of force with respect to depth should be unity. [ES 95]

422. **Assertion A:** The specific speed of a Pelton wheel is generally much less than that of a reaction turbine.

Reason R: Pelton wheels generally use more than one nozzle and the specific speed is defined for power developed per nozzle. [ES96]

423. **Assertion A:** Pressure intensity in a liquid flow is a form of energy.

Reason R: The pressure gradient is a measure of the rate of energy dissipation in steady uniform flow. [ES 97]

424. **Assertion A:** The following potential function in two-dimensional flow field represents rotational flow $\phi = 2x^2 - 3y^2$

Reason R: For the given function

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} \neq 0$$ [ES 98]

425. **Assertion A:** In Rayleigh's method of dimensional analysis, the dependent variable is written as the function of exponential terms of independent variables.

Reason R: In Rayleigh's method, when the number of independent variable exceeds 3, the exponents of non repeating variables are expressed as the exponents of repeating variables. [ES 98]

426. **Assertion A:** If laminar flow of oil between two points of a given pipeline is doubled, then the power consumption is increased to four times the original power.

Reason R: In laminar flow through circular pipes, head loss varies directly as the discharge. [ES 98]

427. **Assertion A:** In the equation

$$h_f = f \frac{l}{d} \frac{v^3}{2g},$$

for laminar flow through the pipe, the term v (mean velocity of flow) is given by

$$v = \frac{(p_1 - p_2) r^2}{8 \mu l}$$

Reason R: The term 'f' (friction factor) in the above equation equals $\frac{64}{\text{Re}}$, where Re is the Reynold's number [ES 98]

428. **Assertion A:** Water flows through a pipe connecting two reservoirs. The line joining the water surface levels in the reservoirs is the hydraulic gradient

Reason R: There will be no negative gauge pressure anywhere in the pipeline, as long as the pipeline lies below the hydraulic gradient. [ES 99]

429. **Assertion A:** Irrotational flow exists when the net rotation of the fluid about its mass centre is zero.

Reason R: There is always a possibility of rotation in ideal fluid and therefore, ideal fluids can not have irrotational flow. [CS 96]

430. **Assertion A:** The inlet velocity triangle for a Pelton turbine is a straight line

Reason R: For a Pelton turbine, the vane angle at inlet is 180°. [ES 99]

431. **Assertion A:** Total energy of flow decreases in the direction of flow.

Reason (R): The specific energy may decrease, increase or remain constant. [ES 2009]

432. **Assertion A:** The movement of two blocks of wood wetted with hot glue requires greater and greater effort as the glue is drying up.

Reason R: Viscosity of liquids varies inversely with temperature. [CS 94]

433. **Assertion A:** There is no flow in the direction perpendicular to a streamline at any point on it.

Reason R: Streamline consists of a number of infinitesimally small segments such that all of them lie along the directions of velocity vectors of fluid particles at those segments. [CS 95]

434. **Assertion A:** Continuity equation must hold good in a pipe network system.

Reason R: In a pipe network analysis, the flow into any junction must be equal to the flow out of the junction. [CS 96]

435. **Assertion A:** Bernoulli's equation is applicable to any point in the flow field provided the flow is steady and irrotational.

Reason R: The integration of Euler's equation of motion to derive Bernoulli's equation involves the assumptions that velocity potential exists and that the flow conditions do not change with time at any point. [ES 18]

436. **Assertion A:** The boundary layer thickness decreases as the distance from the leading edge increases.

Reason R: Greater is the kinematic viscosity of the fluid, greater is the boundary layer thickness. [ES 22]

437. **Assertion A:** The discharge (Q) through a triangular weir is given by

$$Q = \frac{8}{15} C_d \sqrt{2g}\, h^{5/2} \tan\left(\frac{\theta}{2}\right)$$

where C_d is the coefficient of discharge, h is the head of flow, θ is the apex angle of the weir and g is the acceleration due to gravity.

Reason R: The cross-sectional area of flow in a triangular weir is $h^2 \tan(\theta/2)$ and average velocity is $\frac{8}{15} C_d \sqrt{2gh}$ [CS 97]

438. **Assertion A:** When both gravitational and viscous forces are predominant in a flow scale ratio can be chosen at will.

Reason R: With both gravitational and viscous forces being predominant, scale ratio depends upon kinematic viscosity of the fluids. [CS 97]

439. **Assertion A:** Any discharge will flow as critical in a wide rectangular channel whose bed slope is 1 in C^2/g

Reason R: The critical depth of flow through a wide rectangular channel is $(q^2/g)^{1/3}$. [CS97]

440. **Assertion A:** Loss of head at a sudden expansion in a pipe is greater than that at a sudden contraction.

Reason R: Flow in a sudden expansion tends to be irrotational. [CS 98]

441. **Assertion A:** The kinematic viscosity of both air and water decreases as the temperature increases.

Reason R: The kinematic viscosity of liquids and gases at a given pressure is a function of temperature [CS 99]

442. **Assertion A:** Energy is lost in sudden contraction in a pipeline.

Reason R: If the flow is now reversed, energy can be gained at the transition which acts as an expansion [CS 99]

443. For a steady incompressible laminar flow between two infinite parallel stationary plates, the shear stress variation is
a) linear with zero value at the plates
b) linear with zero value at the center
c) quadratic with zero value at the plates
d) quadratic with zero value at the center
[GATE 17]

444. A 1 m wide rectangular channel has a bed slope of 0.0016 and the Manning's roughness coefficient is 0.04. Uniform flow takes place in the channel at a flow depth of 0.5 m. At a particular section, gradually varied flow (GVF) is observed and the flow depth is measured as 0.6 m. The GVF profile at that section is classified as
a) S_1 b) S_2
c) M_1 d) M_2 [GATE 17]

445. In a 5 m wide rectangular channel, the velocity u distribution in the vertical direction y is given by $u = 1.25y^{1/6}$. The distance y is measured from the channel bed. If the flow depth is 2 m, the discharge per unit width of the channel is
a) 2.40 $m^3/s/m$
b) 2.80 $m^3/s/m$
c) 3.27 $m^3/s/m$
d) 12.02 $m^3/s/m$ [GATE 18]

446. In a rectangular channel, the ratio of the velocity head to the flow depth for critical flow condition, is
a) 2/3 b) 2
c) 1/2 d) 3/2 [GATE 19]

447. Velocity of flow is proportional to the first power of hydraulic gradient in Darcy's law. The law is applicable to
a) laminar flow in porous media
b) transitional flow in porous media
c) turbulent flow in porous media
d) laminar as well as turbulent flow in porous media [GATE 20]

448. If water is flowing at the same depth in most hydraulically efficient triangular and rectangular channel sections then the ratio of hydraulic radius of triangular section to that of rectangular section is
a) $\sqrt{2}$ b) $1/\sqrt{2}$
c) 1 d) 2 [GATE 21]

*449. A rectangular open channel of 6 m width is carrying a discharge of 20 m^3/s. Consider the acceleration due to gravity as 9.81 m/s^2 and assume water as incompressible and inviscid. The depth of flow in the channel at which the specific energy of the flowing water is minimum for the given discharge will then be
a) 3.18 m b) 1.04 m
c) 2.5 m d) 0.82 m
[GATE 21]

450. The ratio of the momentum correction factor to the energy correction factor for a laminar flow in a pipe is
a) 1 b) 2/3
c) 1/2 d) 3/2
[GATE 21]

451. A rectangular channel with gradually varied flow (GVF) has a changing bed slope. If the change is from a steeper slope to a steep slope, the resulting GVF profile is
a) S_3
b) S_1
c) S_2
d) either S_1 or S_2, depending on the magnitude of the slopes [GATE 22]

452. Water is flowing in a horizontal, frictionless, rectangular channel. A smooth hump is built on the channel floor at a section and its height is gradually increased to reach choked condition in the channel. The depth of water at this section is y_2 and that at its upstream section is y_1 . Consider the following statement(s) for the choked and unchoked conditions in the channel.
(1) in choked condition, y_1 decreases if the flow is supercritical and increases if the flow is subcritical.
(2) in choked condition, y_2 is equal to the critical depth if the flow is supercritical or subcritical.
(3) in unchoked condition, y_1 remains unaffected when the flow is supercritical or subcritical.

(4) in choked condition, y_1 increases if the flow is supercritical and decreases if the flow is subcritical.

The correct statement(s) is/are

a) 1 and 2 only
b) 1 and 3 only
c) 1, 2 and 3 only
d) 2, 3 and 4 only [GATE 22]

453. Which of the following statements are correct?

(1) depression of mercury in a capillary tube is dependent on density and surface tension.
(2) modelling of flow-induced drag on a ship is done invoking both of Froude number and Reynolds number.
(3) flow of a fluid in a narrow pipe is related to both Reynolds number and Cauchy number.
(4) formation and collapse of a soap bubble is analyzed through employing surface tension and external pressure.
(5) flow over the downstream slope of an ogee spillway can be affected by surface tension.

Select the correct answer using the codes given below:

a) 1, 2 and 4 only
b) 1, 3 and 5 only
c) 2, 3 and 4 only
d) 3, 4 and 5 only [ES 17]

454. Which of the following factors are non-dimensional?

(1) C in Chezy's equation
(2) 11.6 as a measure of the sublayer
(3) $H/(N^2D^2)$ employed in comparing performance of pumps
(4) Q^2/D^5 employed in computations in pipe networks
(5) $U\sqrt{gL}$ used in estimating wave-making drag

Select the correct answer using the codes given below:

a) 2 and 5 only
b) 2, 4 and 5 only
c) 1 and 5 only
d) 1, 3 and 4 only [ES 17]

455. A fluid flow field is given by

$U = 2xyi + yzj - (2yz + z^2/2)\,k$

(1) the flow is viscous.
(2) the flow is steady.
(3) the flow is incompressible.
(4) the magnitude of the total velocity vector at a point (1, 4, 3) is nearest to 27 units.

Which of the above statements are correct?

a) 1 and 3 only
b) 1 and 4 only
c) 2 and 3 only
d) 2 and 4 only [ES 17]

456. Consider the following statements regarding flow net:

(1) It helps determine the quantity of seepage.
(2) It helps determine the upward lift below a hydraulic structure.
(3) It is applicable to rotational flow only.

Which of the above statements are correct?

a) 1 and 2 only
b) 1 and 3 only
c) 2 and 3 only
d) 1, 2 and 3 [ES 17]

*457. Hydraulic jump forms in a horizontal rectangular channel carrying a unit discharge of 1.019 m^3/sec/m at a depth of 101.9 mm.

This jump is classified as

a) weak jump
b) oscillating jump
c) steady jump
d) strong jump [ES 17]

*458. A man, 65 kg, descends to the ground with the help of a parachute, 18 kg. The parachute is hemispherical in shape, 2 m diameter. Density of air can be taken as 0.00125 g/cm^3 and its kinematic viscosity as 0.15 stoke. What is the terminal velocity of the parachute?

(Take $C_D = 1.5$ and $g = 1000$ cm/sec^2)

a) 16.6 m/sec
b) 15.8 m/sec
c) 15.0 m/sec
d) 14.1 m/sec [ES 17]

459. In a wide rectangular channel, the normal depth is increased by 20%. This would mean an increase in the discharge of the channel nearly by
a) 20% b) 26%
c) 36% d) 56% [ES 17]

460. At a sluice gate across a rectangular channel, the upstream flow conditions are: depth = 2.0 m; velocity of flow = 1.25 m/sec. The flow conditions at the vena contract just downstream of the gate can be taken as: depth = 0.44 m; velocity of flow = 5.68 m/sec. What is the total thrust on the gate on its upstream face (to the nearest 10 units)?
a) 770 kgf b) 800 kgf
c) 825 kgf d) 870 kg
[ES 17]

461. Consider the following statements regarding a turbine:
(1) specific speed plays an important role in the selection of the type of turbine.
(2) an increase in specific speed of the turbine is accompanied by higher maximum efficiency.
(3) the runner of too high specific speed with high available head increases the cost of the turbine on account of the high mechanical strength required.

Which of the above statements are correct?
a) 1, 2 and 3
b) 1 and 2 only
c) 1 and 3 only
d) 2 and 3 only [ES 17]

462. In a hydraulic machine, the moment of momentum of water is reduced by 15915 N.m, when the machine is rotating at 600 rpm. The power developed is
a) 1000 kW
b) 1500 kW
c) 2000 kW
d) 2500 kW [ES 17]

463. Consider the following statements:
(1) surge tanks are not substitutes for forebays.
(2) pumped storage power plants are a boon to power generation.
(3) water hammer in penstocks is not dangerous.
(4) kaplan turbines are used in low head power plants.

Which of the above statements are correct?
a) 2 and 4 only
b) 1 and 4 only
c) 2 and 3 only
d) 1 and 3 only [ES 17]

464. A glass tube of 2.5 mm internal diameter is immersed in oil of mass density 940 kg/m^3 to a depth of 9 mm. If a pressure of 148 N/m^2 is needed to form a bubble which is just released.

What is the surface tension of the oil?
a) 0.041 N/m
b) 0.043 N/m
c) 0.046 N/m
d) 0.050 N/m [ES 18]

*465. A steady, two dimensional, incompressible flow field is represented by $u = x + 3y + 3$ and $v = 2x - y - 8$. In this flow field, the stagnation point is
a) (3, 2) b) (–3, 2)
c) (–3, –2) d) (3, –2) [ES 18]

466. In a siphon, the summit is 5 m above the water level in the tank from which the flow is being discharged. If the head loss from the inlet to the summit is 2.5 m and the velocity head at the summit is 0.5 m, (taking γ = 10 appropriate units) the pressure head at the summit is
a) –80 kPa
b) –3 m of water (abs)
c) 5 m of water (abs)
d) 18 m of water (abs) [ES 18]

*467. The stream function of a doublet with horizontal axis and of strength μ is
a) $\mu\, r/(2\pi)$
b) $\mu \cos\theta/(2\pi r)$
c) $\mu\, r \sin\theta/(2\pi)$
d) $\mu \sin\theta/(2\pi r)$ [ES 18]

468. What is the rotational speed in rpm of a 0.8 m diameter cylindrical container, held with axis vertical, if the fluid contained in it rises to 0.6 m height at the sides and

leaves a circular space 0.3 m diameter on the bottom uncovered?

a) 90.2 rpm
b) 88.4 rpm
c) 86.0 rpm
d) 83.7 rpm [ES 18]

469. In a 90° triangular notch, the error in the estimated discharge for a given head due to an error of 1% in cutting the vertex angle is

a) zero b) 1%
c) π/2% d) π% [ES 18]

470. An open channel is of isosceles triangle shape, with side slopes 1 vertical and *n* horizontal. The ratio of the critical depth to specific energy at critical depth will be

a) 2/3 b) 3/4
c) 4/5 d) 5/6 [ES 18]

471. M_3 profile is indicated by which of the following conditions?

a) $y_0 > y_c > y$
b) $y > y_0 > y_c$
c) $y_c > y_0 > y$
d) $y > y_c > y_0$ [ES 18]

*472. Two identical centrifugal pumps are connected in parallel to a common delivery pipe of a system. The discharge performance curve of each of the pumps is represented by $H = 30 - 80Q^2$. The discharge-head equation of the parallel duplex pump set is

a) $H = 30–80\ Q^2$
b) $H = 15–20\ Q^2$
c) $H = 30–20\ Q^2$
d) $H = 15–80\ Q^2$ [ES 18]

473. Consider the following data relating to performance of a centrifugal pump: speed = 1200 rpm, flow rate = 30 l/s, head = 20 m, and power = 5 kW. If the speed of the pump is increased to 1500 rpm, assuming the efficiency is unaltered, the new flow rate and head, respectively, will be

a) 46.9 l/s and 25.0 m
b) 37.5 l/s and 25.0 m
c) 46.9 l/s and 31.3 m
d) 37.5 l/s and 31.3 m

[ES 18]

474. The work done by a kN of water jet moving with a velocity of 60 m/sec, when it impinges on a series of vanes moving in the same direction with a velocity of 9 m/sec is

a) 60.2 kN m
b) 55.6 kN m
c) 46.8 kN m
d) 45.0 kN m [ES 18]

475. A ship weighs 127 MN. On filling the ship's boats on one side with water weighing 600 kN with the mean distance of the boats from the centre line of the ship being 10 m, the angle of displacement of the plumb line is 2°16'. The metacentric height will be nearly

(Take sin 2°16' = 0.04, cos 2°16' = 0.9992 and tan 2°16' = 0.04)

a) 1.73 m
b) 1.42 m
c) 1.18 m
d) 0.87 m [ES 19]

476. The phenomenon of generation of lift by rotating an object placed in a free stream is known as

a) Coanda effect
b) Magnus effect
c) Scale effect
d) Buoyancy effect

[ES 19]

477. Which of the following assumptions is/are made in the analysis of hydraulic jump?

(1) it is assumed that before and after jump formation the flow is essentially two-dimensional and that the pressure distribution is hydrostatic.
(2) the length of the jump is small so that the losses due to friction on the channel floor are small and hence neglected.
(3) the channel floor is horizontal or the slope is so gentle that the weight component of the water mass comprising the jump is very high.

a) 1 only
b) 2 only
c) 3 only
d) 1, 2 and 3 [ES 19]

478. Water is to be pumped out of a deep well under a total head of 95 m. A number of identical pumps of design speed 1000 rpm and specific speed 900 rpm with a rated capacity of 150 liter/second are available. The number of pumps required will be
a) 1 b) 3
c) 5 d) 7 [ES 19]

479. Consider the following data from a test on Pelton wheel:
Head at the base of the nozzle = 32 m;
Discharge of the nozzle = 0.18 m^3/s
Area of the jet = 7500 mm^2
Power available at the shaft = 44 kW
Mechanical efficiency = 94%
The power lost in the nozzle will be nearly
a) 3.9 kW b) 4.7 kW
c) 3.5 kW d) 2.3 kW
[ES 19]

480. A certain hydropower plant utilizes the flow as it occurs, without any provision for storage. It is premised that a defined minimum dry weather flow is available. Such a plant is classified as
a) Diverted-flow plant
b) Pooled storage plant
c) Base-load plant
d) Run-of-river plant [ES 19]

481. Two turbo-generators, each of capacity 25,000 kW, have been installed at a hydel power station. The load on the hydel plant varies from 15,000 kW to 40,000 kW. The total installed plant capacity and the load factor are nearly
a) 40,000 kW and 68.8%
b) 50,000 kW and 68.8%
c) 40,000 kW and 62.3%
d) 50,000 kW and 62.3% [ES 19]

482. A plate 0.025 mm distant from a fixed plate moves at 60 cm/s and requires a force of 0.2 kgf/m^2 to maintain this speed. The dynamic viscosity of the fluid between the plates will be nearly
a) 9.2×10^{-10} $kgfs/cm^2$
b) 8.3×10^{-10} $kgfs/cm^2$
c) 7.4×10^{-10} $kgfs/cm^2$
d) 6.5×10^{-10} kgf/cm^2 [ES 19]

483. Which of the following are component parts for an oil pressure governor in modern turbines?
(1) servomotor, known as relay cylinder
(2) oil sump
(3) oil pump which is driven by belt connected to turbine main shaft
(4) draft tube
a) 1, 2 and 3 only b) 1, 2 and 4 only
c) 1, 3 and 4 only d) 2, 3 and 4 only
[ES 19]

484. A double-acting reciprocating pump having piston area 0.1 m^2 has a stroke 0.30 m long. The pump is discharging 2.4 m^3 of water per minute at 45 rpm through a height of 10 m. The slip of the pump and power required to drive the pump will be nearly
a) 0.005 m^3/s and 4.8 kW
b) 0.003 m^3/s and 4.8 kW
c) 0.005 m^3/s and 4.4 kW
d) 0.003 m^3/s and 4.4 kW

485. An oil of specific gravity 0.9 contained in a vessel. At a point the height of oil is 40 m and for the density of water = 1000 kg/m^3, the corresponding height of water at the point will be
a) 28 m b) 32 m
c) 36 m d) 40 m [ES 20]

486. A jet propelled aircraft is flying at a speed of 1100 km/hour at $t = 20°C$, $k = 1.4$ and $R = 287$ J/kg. The Mach number at a point on the jet will be nearly
a) 0.3 b) 0.5
c) 0.7 d) 0.9 [ES 20]

487. When the drag force becomes equal to the weight of the body, the acceleration ceases and the net external force acting in the body becomes
a) zero and the body will move at constant speed
b) light and the body will move forward
c) zero and the body will move fast
d) high and the body will move at constant speed [ES 20]

488. Which one of the following statements is correct regarding flow in open channel?
a) the curve for kinetic energy is a parabola
b) the curve for potential energy is a parabola
c) specific energy is asymptotic to the vertical axis
d) at critical depth the specific energy is maximum [ES 20]

489. Which one of the following statement is correct regarding critical state of flow through a channel section?
a) specific energy is minimum for a given discharge
b) specific energy is maximum for a given discharge
c) the Froude number is greater than two
d) the discharge is minimum for a given specific force [ES 20]

490. Which one of the following statements is correct regarding centrifugal pumps?
a) the discharge is fluctuating and pulsating
b) it is used for large discharge through smaller heads
c) the efficiency is low
d) it runs at low speed

491. A hydraulic press has a ram of 300 mm diameter and a plunger of 45 mm diameter. When the force applied at the plunger is 50 N, the weight lifted by the hydraulic press will be nearly
a) 2133 N
b) 2223 N
c) 2316 N
d) 2406 N [ES 20]

492. Hydraulic efficiency of Francis turbine is
a) directly proportional to velocity of whirl at inlet and inversely proportional to net head on turbine
b) directly proportional to velocity of whirl at inlet and net head on turbine
c) inversely proportional to velocity of whirl at inlet and net head on turbine
d) inversely proportional to velocity of whirl at inlet and directly proportional to net head on turbine [ES 20]

493. A network of pipes conveying water to a city has the following specifications. The diameter of a main pipe is 30 cm and it branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the main pipe is 2.5 m/s and the average velocity in the 20 cm pipe is measured as 2 m/s, what is the velocity in the 15 cm pipe?
a) 8.84 m/s b) 7.44 m/s
c) 5.84 m/s d) 6.44 m/s
[ES 21]

*494. A centrifugal pump delivers water against a net head of 14.5 m and a design speed of 1000 r.p.m. The vanes are curved back to an angle of 30° with the periphery. The impeller diameter is 300 mm and the outlet width is 50 mm. What is the tangential velocity of impeller at outlet?
a) 15.7 m/s b) 13.2 m/s
c) 9.7 m/s d) 11.2 m/s
[ES 21]

495. A 7.5 cm diameter jet of water strikes a curved plate at its centre with a velocity of 20 m/s. The curved plate is moving with a velocity of 8 m/s in the direction of the jet. The jet is deflected through an angle of 165°. By assuming the plate as smooth, what is the angle made by the relative velocity at the outlet of the plate?
a) 45° b) 30°
c) 15° d) 0° [ES 21]

*496. A reservoir has a head of 40 m and a channel leading from the reservoir permits a flow rate of 34 m^3/s. If the rotational speed of the rotor is 150 r.p.m., what is the power of the turbine? (take $g = 9.81\ m/s^2$)
a) 14.34 MW b) 13.34 MW
c) 12.34 MW d) 11.34 MW
[ES 21]

497. Two pressure points in a water pipe are connected to a manometer which has the form of an inverted U-tube. The space above the water in the two limbs of the manometer is filled with toluene (specific gravity is 0.875). If the difference of level

of water columns in the two limbs reads 12.0 cm, what is the corresponding difference of pressure? (Take $g = 9.81$ m/s^2)

a) 110.49 N/m^2 b) 128.12 N/m^2
c) 131.34 N/m^2 d) 147.15 N/m^2

[ES 21]

*498. What is the minimum size of glass tube that can be used to measure water level if the capillary rise in the tube is to be restricted to 2 mm? (Take surface tension of water in contact with air as 0.073575 N/m)

a) 1.5 cm b) 1.0 cm
c) 2.5 cm d) 2.0 cm

[ES 21]

499. If pressure head of water is 100 m and specific gravity of kerosene is 0.81, what is the pressure head of kerosene?

a) 123.5 m of kerosene
b) 241.3 m of kerosene
c) 75.1 m of kerosene
d) 52.4 m of kerosene [ES 21]

*500. A 2 m wide tank contains water upto a height of 0.50 m above its base. An immiscible liquid of specific gravity 0.80 is filled on the top of the water upto 1 m height. What is the total pressure force on one side of the tank? (Take density of water as 1000 kg/m^3 and $g = 9.81$ m/s^2)

a) 7.85 kN b) 24.52 kN
c) 10.3 kN d) 18.15 kN

[ES 22]

501. A pipeline of uniformly varying cross-section carries on oil of specific gravity 0.87. The diameter of pipe is 200 mm at end A and 500 mm at end B. The end B is located at 4 m higher than A. What is the loss of head in the pipeline if the pressure reading at A is 9.81 N/cm^2 and B is 5.886 N/cm^2? (take discharge as 200 litres/s and $g = 9.81$ m/s^2)

a) 2.609 m b) 26.09 cm
c) 2.109 m d) 21.09 cm

[ES 22]

502. The water is flowing with a velocity of 1.5 m/s in a pipe of length 2500 m and diameter 500 mm. A valve is provided at the end of the pipe. What is the rise in pressure if the valve is closed in 25 seconds? (Take velocity of pressure wave as 1460 m/s)

a) 15 N/cm^2 b) 1500 N/cm^2
c) 150 N/m^2 d) 15 kN/m^2

[ES 22]

503. Which one of the following statements is correct with respect to Kaplan Turbine?

a) the peripheral velocity at inlet is more than peripheral velocity at outlet.
b) velocity of flow at inlet is more than velocity of flow at outlet.
c) the peripheral velocity at inlet and outlet are equal
d) velocity of flow at outlet is more than velocity of flow at inlet.

[ES 22]

504. The speed of the generator can be maintained constant only if the speed of the turbine runner is constant equal to the one given by equation $N = 60$ f/p and is known as

a) synchronous speed
b) asynchronous speed
c) derived speed
d) measured variable speed [ES 22]

505. Consider the following statements related to negative slip of the reciprocating pump

(1) the actual discharge of a reciprocating pump is more than the theoretical discharge.
(2) the coefficient of discharge will be more than unity.
(3) when the suction pipe is short and delivery pipe is long and pump is running at slow speed, then negative slip of the pump occurs.

Which of the above statements are correct?

a) 1 and 2 only
b) 1 and 3 only
c) 2 and 3 only
d) 1, 2 and 3 [ES 22]

506. A single acting reciprocating pump has a plunger of diameter 250 mm and stroke of 350 mm. If the speed of the pump is 60 rpm and it delivers 16.5 lit/sec of water against

a suction head of 5 m and a delivery head of 20 m, what is the coefficient of discharge?

a) 0.72 b) 0.79
c) 0.86 d) 0.96 [ES 22]

507. Select the correct statement.

a) centrifugal pump converts the mechanical energy into hydraulic energy by means of a centrifugal force.
b) centrifugal pump converts the hydraulic energy into mechanical energy by means of a centrifugal force.
c) reciprocating pump converts the mechanical energy into hydraulic energy by means of a centrifugal force.
d) reciprocating pump converts the hydraulic energy into mechanical energy.

508. For circular cylinders, with Reynolds number greater than 1000, how would the Strouhal number behave?

a) varies as $Re^{1/6}$
b) varies as $Re^{1/4}$
c) almost $\approx 0{\cdot}16$
d) constant at $0{\cdot}21$

[ES 14]

509. Calibration of a current meter for use in channel flow measurement is done in a

a) wind tunnel
b) water tunnel
c) towing tank
d) flume [ES 10]

510. The equations of motion for laminar flow of a real fluid are known as

a) Euler's equations
b) Bernoulli's equations
c) Navier-Stokes equation
d) Hagen-Poiseuille equations

511. In an exponential channel where area (A) is related to the depth (y) as $A = k y^a$ (k and a are constants), the ratio of the minimum specific energy E_c to the critical depth y_c is

a) $1 + 1/a$ b) $1 + 1/2a$
c) $3a/2$ d) $2a$

512. For a rectangular channel, the length of hydraulic jump is about k times the height of the jump. The value of k is

a) 1 to 3 times b) 5 to 7 times
c) 8 to 11 times d) 12 to 15 times

513. The Cippoletti weir is a

a) triangular weir with side slopes in the ratio of 1 vertical to 4 horizontal.
b) triangular weir with side slopes in the ratio of 4 vertical to 1 horizontal.
c) trapezoidal weir with side slopes in the ratio of 1 vertical to 4 horizontal.
d) trapezoidal weir with side slopes in the ratio of 4 vertical to 1 horizontal.

514. In a hydrodynamically smooth surface, the roughness magnitude ε and the laminar sublayer thickness δ' are related as

a) $\varepsilon/\delta' < 1/30$ b) $\varepsilon/\delta' < 0.25$
c) $\varepsilon/\delta' > 1.0$ d) $\varepsilon/\delta' > 6.0$

*515. In a fully turbulent flow through a rough pipe, the friction factor is

a) a function of the Reynolds number only
b) a function of the relative roughness only
c) a function of the Reynolds number and relative roughness
d) neither a function of the Reynolds number nor a function of relative roughness

*516. The total number of possible GVF profiles in open channel are

a) 9 b) 11
c) 12 d) 15

517. Consider the following statements.

Which of the following statements is/are TRUE?

(1) the thickness of a turbulent boundary layer on a flat plate kept parallel to the flow direction is proportional to the square root of the distance from the leading edge
(2) if the streamlines and equipotential lines of a source are interchanged with each other, the resulting flow will be a sink
(3) for a curved surface immersed in a stationary liquid, the vertical component of the force on the curved surface is equal to the weight of the liquid above it

(4) for flow through circular pipes, the momentum correction factor for laminar flow is larger than that for turbulent flow

Which of the statements given above is/are correct?

a) 1 and 3 b) 1 and 4
c) 2 and 3 d) 3 and 4

[GATE 23]

518. Which one of the following is an advantage using a triangular notch over a rectangular notch?

a) ventilation of a triangular notch is necessary
b) the same triangular notch cannot measure a wide range of flows accurately
c) for heavy discharges, a triangular notch gives more accurate results than a rectangular notch.
d) in a given triangular notch, only one reading is required to be taken for the measurement of discharge [ES 23]

519. How does the bulk modulus of elasticity of a fluid change with increasing pressure?

a) it remains constant
b) it decreases with increase in pressure
c) it increases with increase in pressure
d) it becomes zero

[ES 24]

520. Which one of the following heads is defined as

"The head against which a centrifugal pump has to work"?

a) suction head
b) delivery head
c) static head
d) manometric head [ES 24]

521. Consider flow in a long and very wide rectangular open channel. Width of the channel can be considered as infinity compared to the depth of flow. Uniform flow depth is 1.0 m. The bed slope of the channel is 0.0001. The Manning roughness coefficient value is 0.02. Acceleration due to gravity, g can be taken as 9.81 m/s^2.

The critical depth (in m) corresponding to the flow rate resulting from the above conditions is

a) 0.4
b) 0.3
c) 0.6
d) 0.1 [GATE 25]

522. Which one of the following pressure gauges is most accurate device and is used for precision work and calibrating other pressure gauges?

a) Deadweight pressure gauge
b) Diaphragm pressure gauge
c) Bourdon tube pressure gauge
d) Vacuum pressure gauge [ES 25]

523. A double-acting reciprocating pump, running at 40 rpm, is discharging 1.0 m^3 of water per minute. The pump has a stroke of 400 mm. The diameter of piston is 200 mm. The delivery and suction head are 20 m and 5 m respectively. The theoretical discharge for the double-acting pump is

a) $\frac{1.6\pi}{300}\ m^3/s$ b) $\frac{0.8\pi}{300}\ m^3/s$
c) $\frac{2.4\pi}{300}\ m^3/s$ d) $\frac{0.4\pi}{300}\ m^3/s$

[ES 25]

524. What is the discharge through the venturi flume built in a rectangular channel 1 m wide and having its throat width 0.4 m? The upstream head is 0.57 m, measured head in throat is 0.5 m and the value of C_d is 1.

a) 210 L/s b) 230 L/s
c) 250 L/s d) 270 L/s

[ES 25]