

## 5.56 Hydraulics

- 229.** For smooth turbulent flow, the friction factor varies as
- $N_R$
  - $\sqrt{N_R}$
  - $N_R^{-1/2}$
  - $N_R^{1/4}$
- 230.** In a jet pump
- energy of high pressure fluid is converted into low pressure fluid
  - energy of high velocity stream is converted into pressure energy
  - kinetic energy of fluid is regained as potential energy
  - potential energy of fluid is converted into rotational energy
- 231.** A Froude number of 2 indicates a
- weak jump
  - medium jump
  - strong jump
  - very strong jump
- 232.** The horizontal component of force on a curved surface is equal to the
- weight of liquid vertically above the curved surface
  - weight of liquid retained by the curved surface
  - product of pressure at its centroid and area
  - force on a projection of the curved surface into a vertical plane
- 233.** Pumping device for supplying water to boiler does not have moving parts is
- single stage centrifugal pump
  - multistage centrifugal pump
  - steam injector
  - simplex pump
- 234.** The ratio  $\eta = \frac{\rho}{\left(\frac{du}{dy}\right)}$  for turbulent flow is
- physical property of the fluid
  - dependent upon flow and density
  - viscosity divided by the density
  - independent of the nature of flow
- 235.** Stanton diagram is a plot of
- Friction factor against Reynolds number
  - Friction factor against log of Reynolds number
  - Log of friction factor against Reynolds number
  - Log of friction factor against log of Reynolds number
- 236.** Bernoulli's equation cannot be applied when the flow is
- rotational
  - turbulent
  - unsteady
  - all of the above
- 237.** For a floating body to be in stable equilibrium, its metacentre should be
- below the centre of gravity
  - below the centre of buoyancy
  - above the centre of buoyancy
  - above the centre of gravity
- 238.** Total pressure on the top of a closed cylindrical vessel of radius  $r$  filled with liquid is proportional to
- $r$
  - $\frac{1}{r}$
  - $\frac{1}{r^2}$
  - $r^2$
- 239.** If  $\rho$  is density of fluid, then pressure of fluid due to water hammer is directly proportional to
- $\rho$
  - $\frac{1}{\sqrt{\rho}}$
  - $\sqrt{\rho}$
  - $\rho^2$
- 240.** The most economical channel section for a given cross sectional area is one for which has maximum
- velocity
  - discharge
  - depth
  - wetted perimeter
- 241.** A hydrometer is used to determine
- relative humidity
  - buoyant force
  - specific gravity of liquids
  - viscosity of liquids
- 242.** Relation between gauge pressure  $p$  inside a liquid droplet (i.e. difference of pressure between inside and outside of a liquid drop) of diameter  $d$  and surface tension  $\sigma$  is
- $\rho = pd$
  - $\rho = \pi pd$
  - $\rho = \frac{pd}{\pi}$
  - $\rho = \frac{pd}{4}$
- 243.** For a floating body to be in equilibrium
- metacentre should be above c.g.
  - centre of buoyancy and c.g. must lie on the same vertical plane
  - a righting couple should be formed
  - all of the above
- 244.** Pressure in Pascals at a depth of 1 m below the free surface of a body of water will be equal to
- 1 Pa
  - 98.1 Pa
  - 981 Pa
  - 9810 Pa
- 245.** At the centre line of a pipe flowing under pressure where the velocity gradient is zero, the shear stress will be
- minimum
  - maximum
  - zero
  - could be any value

- 246.** A streamline
- (a) occurs on all types of flows
  - (b) is the line along geometrical centre of the flow
  - (c) is the line of equal velocity in a flow
  - (d) is fixed in space flow
- 247.** Surge wave is an example of
- (a) steady uniform flow
  - (b) steady non-uniform flow
  - (c) unsteady uniform flow
  - (d) unsteady non-uniform flow
- 248.** In laminar flow through a pipe, discharge varies
- (a) linearly as the viscosity
  - (b) linearly as pipe diameter
  - (c) inversely as the viscosity
  - (d) linearly as the pressure drop
- 249.** The terminal velocity of a small sphere settling in a viscous fluid varies as the
- (a) inverse of the diameter
  - (b) inverse of square of the diameter
  - (c) fluid viscosity
  - (d) inverse of the fluid viscosity
- 250.** A control volume refers to
- (a) a closed system
  - (b) a specified mass
  - (c) an isolated system
  - (d) a fixed region in space
- 251.** When the Reynolds number is less than 500, the flow is said to be laminar for
- (a) pipe flow
  - (b) flow between parallel plates
  - (c) free surface flow
  - (d) all of the above
- 252.** For pumping viscous oil, the pump used is
- (a) centrifugal pump      (b) reciprocating pump
  - (c) turbine pump      (d) none of these
- 253.** A draft tube converts
- (a) pressure energy into kinetic energy
  - (b) velocity head into potential head
  - (c) potential head into pressure head
  - (d) kinetic energy into mechanical energy
- 254.** Broadly speaking, water is
- (a) 10 times more compressible than steel
  - (b) 80 time more compressible than steel
  - (c) 80 times less compressible than steel
  - (d) 800 times less compressible than steel
- 255.** On an immersed body in a flowing fluid the lift force is
- (a) due to buoyant force
  - (b) always in the opposite direction to gravity
  - (c) due to wake phenomenon
  - (d) the dynamic fluid-force component normal to approach velocity
- 256.** For a fluid, the shear stress was found to be directly proportional to the rate of angular deformation. The fluid is classified as
- (a) Newtonian                (b) Non-Newtonian
  - (c) Dilatant fluid            (d) Thixotropic
- 257.** A streamline is a line
- (a) which is normal to the velocity vector at every point
  - (b) which represents lines of constant velocity potential
  - (c) which is normal to the lines of constant stream function
  - (d) which is tangential to the velocity vector everywhere at a given instant
- 258.** 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
- 259.** 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) less than and greater
- 260.** In a fluid flow, the time of constant piezometric head passes through two points which have the same
- (a) elevation
  - (b) pressure
  - (c) velocity
  - (d) velocity potential
- 261.** A hydraulic coupling belongs to the category of
- (a) power absorbing machines
  - (b) power developing machines
  - (c) energy generating machines
  - (d) energy transfer machines.

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- 262.** The cavitation and pitting can be prevented by creating which one of the following conditions?
- Reducing the pressure head
  - Reducing the velocity head
  - Increasing the elevation head
  - Reducing the piezometric head.
- 263.** Double hemispherical buckets are used on
- Kaplan turbine      (b) Francis turbine
  - Propeller turbine    (d) Pelton wheel
- 264.** A tapered draft tube as compared to a cylindrical draft tube
- prevents hammer blow and surges.
  - responds better to load fluctuations
  - converts more of kinetic head into pressure head.
  - prevents cavitation even under reduced discharges.
- 265.** In the Sutro weir, the rate of flow for all flows above the rectangular base of width  $W$  and depth ' $a$ ' is proportional to the head
- above the crest
  - above the rectangular box
  - above a datum  $a/3$  above the crest
  - $\frac{2a}{3}$  above the crest
- 266.** 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
- 250 minutes      (b) 50 minutes
  - 6250 minutes     (d) 2 minutes
- 267.** All other conditions and parameters remaining the same, water hammer pressure can be reduced by
- using pipe of greater diameter
  - using pipe of greater wall thickness
  - using a more elastic pipe
  - increasing the velocity of pressure wave
- 268.** In a gradually varied flow, if  $\frac{dy}{dx}$  is positive, then  $\frac{dE}{dx}$  will be
- always zero      (b) positive if  $y > y_e$
  - negative if  $y > y_e$     (d) always negative
- 269.** The flow of water in wash hand basin when it is being emptied through a central opening, is an example of
- free vortex      (b) forced vortex
  - rotational vortex    (d) Rankine vortex
- 270.** Though Manning's formula is dimensionally non-homogenous it is commonly used in practice because
- it is a simple form
  - it was derived from extensive field data
  - it can be made dimensionally homogeneous
  - it can be related to Chezy's coefficient or Darcy-Weisbach's friction factor.
- 271.** With increasing ageing of pipes, the proportion between the maximum velocity and mean velocity
- initially decreases and then increases
  - initially increases and then decreases
  - decreases
  - increases
- 272.** Before passage of a surge, the depth and velocity of flow at a section are 1.8m 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
- + 1.8 m/s      (b) - 2.7 m/s
  - + 3.6 m/s      (d) - 4.5 m/s
- 273.** Which one of the following pairs relating to flumes carrying open channel flow is correctly matched?
- |                         |  |
|-------------------------|--|
| (a) Non-modular flume   | flow is unaffected by drowning                       |
| (b) Venturi flume       | Standing wave forms at the throat                    |
| (c) Venturi flume       | flow at the throat is at less than critical velocity |
| (d) Standing wave flume | hump is not provided at the throat                   |
- 274.** 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) $\sqrt{\frac{x^2}{2YH}}$ |
- 275.** 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
- 7501.5 kg      (b) 7622.5 kg
  - 7812.5 kg      (d) 7916.5 kg
- 276.** A ocean liner 250 metre long has a maximum speed of 15 m/s. The towing speed of a model 10 metres long, to simulate the wave resistance should be
- 15 m/s      (b) 3 m/s
  - 5 m/s      (d) 0.5 m/s
- 277.** The number of parameters needed to express the function  $F(A, V, t, v, L) = 0$  are
- 5      (b) 4
  - 3      (d) 2

- 278.** Streamlines, pathline and streaklines are virtually identical for  
 (a) Uniform flow      (b) Flow of ideal fluids  
 (c) Steady flow      (d) Non uniform flow
- 279.** In a flow field, the streamlines and equipotential lines  
 (a) are parallel  
 (b) are orthogonal everywhere in the flow field  
 (c) cut at any angle  
 (d) cut orthogonally except at the stagnation points
- 280.** Net force on a control volume due to uniform normal pressure alone  
 (a) shape of the control volume  
 (b) translation and rotation  
 (c) translation and deformation  
 (d) deformation only
- 281.** Existence of velocity potential implies that  
 (a) Fluid is in continuum (b) Fluid is irrotational  
 (c) Fluid is ideal      (d) Fluid is compressible
- 282.** For a fully developed flow through a pipe, the ratio of the maximum velocity to the average velocity is....  
 (a) 1                    (b) 2  
 (c)  $\sqrt{2}$               (d) 4
- 283.** In a pipe flow problem, Reynolds number = 105, Darcy's  $f = 0.0144$ , pipe radius = 0.1 m, average height of roughness = 0.05 mm. The flow in the pipeline is  
 (a) Laminar  
 (b) Smooth turbulent flow (STF)  
 (c) Rough turbulent flow (RTF)  
 (d) Transition from STF to RTF
- 284.** Consider the following statements which relates to different types of water surface profiles. Curve types conform to usual classifications  $y_c$  and  $y_0$  (critical and normal depths)  
 1. Type-3 curves lie between  $y_c$  and  $y_0$ .  
 2. All curves where  $y_c < y_0$  are unaffected upstream from any disturbance.  
 3. All curves where  $y_c > y_0$  are influenced by downstream disturbances.  
 4. All curves approaching the  $y_0$  line approach it asymptotically except for C curve where  $y_c = y_0$ .  
 Which of these statements are correct ?  
 (a) 1, 2, 3 and 4      (b) 1, 3 and 4  
 (c) 2, 3 and 4           (d) 1 and 2
- 285.** The approximate discharge over a 4 m long rectangular weir (with suppressed end contractions) with head over the crest as 0.36 m is  
 (a) 4.2 litres/s        (b)  $2.4 \text{ m}^3/\text{s}$   
 (c) 6.1 litres/s        (d)  $1.6 \text{ m}^3/\text{s}$
- 286.** Flow duration curve is a plot of  
 (a) flow against its time of occurrence in chronological order.  
 (b) flow in ascending order against percentage time in chronological order.  
 (c) flow that equalled or exceeded against percentage time.  
 (d) flow against duration of time for which it is sustained.
- 287.** Pondage in a hydropower station is defined as  
 (a) impounding of considerable amount of excess water during seasons of surplus flow.  
 (b) a regulating body of water in the form of relatively small amount of run-off to regulate flow variation in daily or weekly power requirements.  
 (c) excess run-off to last for years  
 (d) excess run-off for a few hours only
- 288.** The specific speed of a turbine under a head of 150 m to develop 2000 HP while running at 300 r.p.m. is  
 (a) 10 - 35              (b) 35 - 60  
 (c) 60 - 300            (d) 300 - 1000
- 289.** The critical depth of water flowing through a rectangular channel of width 5 m when discharge is  $15 \text{ m}^3/\text{s}$  is  
 (a)  $(2.25)^{1/2} \text{ m}$       (b)  $(1.6)^{1/2} \text{ m}$   
 (c)  $(0.46)^{1/3} \text{ m}$       (d)  $(0.64)^{1/3} \text{ m}$
- 290.** Consider the following statements relating to centrifugal pumps :  
 1. In centrifugal pumps discharge is proportional to speed of the impeller.  
 2. In centrifugal pumps discharge is proportional to the cube of the impeller diameter.  
 3. Specific speed is a criterion for selection of centrifugal pumps.  
 4. Cavitation in centrifugal pumps can be eliminated by avoiding sharp bends, lowering velocity in suction pipe and by lowering temperature.  
 Which of these statements are correct ?  
 (a) 1, 2 and 3            (b) 1, 2 and 4  
 (c) 2, 3 and 4           (d) 1, 3 and 4
- 291.** A solid cylinder of length L, diameter D and specific gravity 0.6 floats in neutral equilibrium in water with its axis vertical. What is the ratio of L to D ?  
 (a)  $\frac{\sqrt{3}}{2}$               (b)  $\frac{2\sqrt{3}}{5}$   
 (c)  $\frac{4}{5\sqrt{3}}$             (d)  $\frac{5}{4\sqrt{3}}$

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- 292.** For a turbulent boundary layer (under zero pressure gradient), the velocity profile is described by the one-fifth power law. What is the ratio of displacement thickness to boundary layer thickness?

$$(a) \frac{1}{7} \quad (b) \frac{1}{6}$$

$$(c) \frac{1}{5} \quad (d) \frac{1}{4}$$

- 293.** Oil ( $\mu = 0.44 \text{ Pa.s}$ ,  $\rho = 888 \text{ kg/m}^3$ ) is filled in the space between two parallel plates which are 18 mm apart. The upper plate is moving at a velocity of 4 m/s. What is the shear stress on the plate?

- 294.** Consider the following statements regarding the conditions to be satisfied for the maximum discharge through a trapezoidal channel section with side slope  $1:n$ , bed width  $b$ , flow depth ' $d$ ' and having a fixed bed slope.

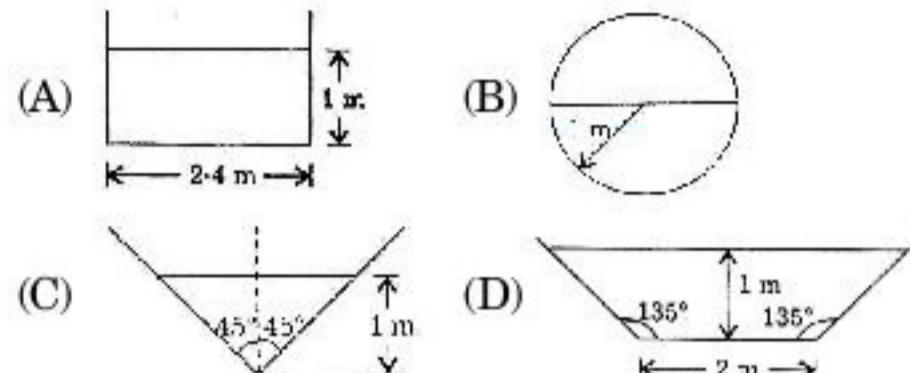
1. Sloping sides should have an angle of  $30^\circ$  with the vertical

2. Hydraulic mean depth equals half the flow depth.

- Length of sloping sides should be equal to twice the bottom width.

Which of the statements given above are correct?

- 295.** Water can flow with 1 m depth in alternatively four channels of different sections as shown below:



Which one of the following sequences shows their hydraulic radii, arranged in descending order?

(a) D-C-B-A.      (b) D-A-C-B  
 (c) A-B-C-D      (d) A-B-D-C

## **EXERCISE - II**

(Questions From Previous SSC CPWD Exams)

2008





3. The net head ( $H$ ) on the turbine is given by

  - (a)  $H = \text{gross head} + \text{head loss due to friction}$
  - (b)  $H = \text{gross head} - \text{head loss due to friction}$
  - (c)  $H = \text{gross head} + \frac{V^2}{2g} - \text{head loss due to friction}$
  - (d) None of the above

4. The loss of pressure head for the laminar flow through pipes varies

  - (a) As the square of the velocity
  - (b) Directly as the velocity
  - (c) As the inverse of the velocity
  - (d) None of the above

2009

5. Pascal's law states that pressure at any point in a fluid at rest has:

- (a) Different magnitude in all directions
- (b) Same magnitude in all direction.
- (c) Zero magnitude in all direction.
- (d) None of the above.

- 6.** Venturimeter is advantageous because:

  - (a) It has much smaller head loss.
  - (b) Its coefficient of discharge is more than for an orifice meter.
  - (c) Its accuracy is quite good.
  - (d) All the above.

7. The upper surface of weir over which water flows, is known as:

(a) Crest. (b) Sill.  
 (c) Vein. (d) Contrac-

8. The equation  $t = C + S \tan f$  is given by

  - (a) Rankine
  - (b) Coulomb
  - (c) Newton
  - (d) Mohr

2010



2011

- 21.** When the flow in an open channel is gradually varied, the flow is said to be

  - (a) steady uniform flow
  - (b) steady non-uniform flow
  - (c) unsteady uniform flow
  - (d) unsteady non-uniform flow

**22.** Venturimeter is used to

  - (a) measure the velocity of a flowing liquid
  - (b) measure the pressure of a flowing liquid
  - (c) measure the discharge of liquid flowing through a pipe
  - (d) measure the pressure difference of liquid flowing between two points in a pipe line

2012

23. Which one of following is **not** a non-dimensional parameter?

  - (a) Chezy's coefficient
  - (b) Darcy-Weisbach friction factor
  - (c) Froude number
  - (d) Mach number

24. The characteristic of an ideal fluid is

  - (a) One which satisfies continuity equation
  - (b) One which flows with least friction
  - (c) One which obeys Newton's Law of Viscosity
  - (d) Frictionless and incompressible

25. The discharge through a rectangular orifice is given by the expression as indicated below :

$$(a) Q = \frac{2}{3} C_d b \sqrt{2g} (H_2^{1/2} - H_1^{1/2})$$

$$(b) Q = \frac{2}{3} C_d b \sqrt{2g} (H_2^2 - H_1^2)$$

$$(c) Q = \frac{2}{3} C_d b \sqrt{2g} (H_2 - H_1)$$

$$(d) Q = \frac{2}{3} C_d b \sqrt{2g} (H_2^{3/2} - H_1^{3/2})$$

Where the notations have their usual meanings.

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- 26.** In the Bernoulli's equation written as  $\frac{p}{r} + \frac{v^2}{2g} + z =$  constant, each of the term represents energy per unit

  - (a) Weight
  - (b) Length of flow
  - (c) Mass
  - (d) Volume

**27.** The term 'alternate depth' in open channel flow refers to the

  - (a) Depths having the same specific energy for a given discharge
  - (b) Depths before and after the passage of the surge
  - (c) Depths having the same kinetic energy for a given discharge
  - (d) Depths on either side of a hydraulic jump

**28.** The length of a pipe is 1000 m and its diameter is 20 cm. If the diameter of an equivalent pipe is 40 cm, then its length is

  - (a) 4000 m
  - (b) 32000 m
  - (c) 20000 m
  - (d) 8000 m

2013

- 29.** The specific speed for a turbine has the dimensions of

  - $F^{1/2} L^{-3/4} T^{-3/2}$
  - $T^{-1}$
  - $F^{1/2} L^{-5/2} T^{-3/2}$
  - $F L^{-3/4} T^{-3/2}$

**30.** In a two-dimensional flow of fluid, if a velocity potential function  $\phi$  exists which satisfies the relation

$$\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = 0, \text{ then the flow is}$$
  - steady incompressible
  - steady laminar and incompressible
  - irrotational and incompressible
  - turbulent and incompressible

**31.** Reynolds number is the ratio of the inertia force to the

  - surface tension force
  - viscous force
  - gravity force
  - elastic force

**32.** Bulk modulus of fluid is the ratio of

  - shear stress to shear strain
  - increase in volume to the viscosity of fluid
  - increase in pressure to the volumetric strain
  - critical velocity to the velocity of fluid

**33.** In open channel flows, the characteristic length commonly used in defining the Reynolds number is the

- (a) depth of flow
- (b) wetted perimeter
- (c) hydraulic radius
- (d) area/top width

2014

- 34.** Capillary rise is a phenomenon that is attributed to the following property of fluid :  
 (a) vapour pressure      (b) viscosity  
 (c) density                (d) surface tension

**35.** The flow constant 'f' in Darcy Weisbach equation for head loss in piped flows has a unit of :  
 (a) No unit-diversion less  
 (b) m  
 (c) m/sec  
 (d) Kg-m/sec

**36.** For producing electricity, following combination of machines will be required :  
 (a) Electric Motor + Pump  
 (b) Hydraulic Turbine + Generator  
 (c) Hydraulic Turbine + Electric Motor  
 (d) Generator + Pump

**37.** The ratio of normal stress to normal strain within elastic limits is called :  
 (a) Young's Modulus      (b) Shear Modulus  
 (c) Poisson's Ratio       (d) Bulk Modulus

**38.** For subcritical flow, the froude number is :  
 (a) Not equal to one      (b) Less than one  
 (c) Greater than one      (d) Equal to one

**39.** A fluid, which is incompressible and is having no viscosity  
 (a) Ideal fluid              (b) Real fluid  
 (c) Newtonian fluid       (d) Non Newtonian fluid

**40.** Manometer is a device used for measuring  
 (a) Velocity                (b) Pressure  
 (c) Density                (d) Discharge

**41.** Capillarity is due to  
 I. surface tension          II. cohesion  
 III. viscosity              IV. vapour pressure  
 V. weight density of liquid  
 (a) II, III                (b) III  
 (c) I                      (d) II, III, V

**42.** Flow of water through a passage under atmospheric pressure is called  
 (a) Pipe flow              (b) Uniform flow  
 (c) Open channel flow    (d) Non-uniform flow

- 43.** The discharge through a V-notch varies  
 (a) proportional to head ( $H$ )  
 (b) inversely proportional to angle  $\theta$   
 (c) proportional to  $H^{5/2}$   
 (d) inversely proportional to  $\tan \theta/2$
- 44.** Which of the following flow constants does **not** have any unit ?  
 (a) Chezy's C  
 (b) Manning's N  
 (c) Both Chezy's C and Manning's N  
 (d) None of the above
- 45.** Each term of the Bernoulli equation represents  
 (a) energy per unit weight  
 (b) energy per unit mass  
 (c) energy per unit volume  
 (d) specific energy
- 46.** Typically, a hydroelectric plant will have following hydraulic machine :  
 (a) Hydraulic Turbine (b) Hydraulic Pump  
 (c) Electric Motor (d) None of the above
- 47.** Darcy – Weisbach equation to calculate the head loss due to friction for flow through pipes is applicable when the flow through the pipe can be  
 (a) laminar only  
 (b) turbulent only  
 (c) both laminar and turbulent  
 (d) subcritical flow

**2015**

- 48.** Francis turbine is  
 (a) a reaction turbine  
 (b) an impulse turbine  
 (c) a tangential flow impulse turbine  
 (d) an axial flow turbine
- 49.** Most economical circular channel gives maximum discharge while  
 (a) flow depth = 0.95 diameter  
 (b) flow velocity high  
 (c) area of flow is full  
 (d) wetted perimeter is least
- 50.** Two pipe systems are said to be equivalent when  
 (a) they carry same discharge  
 (b) they are satisfying Bernoulli's theorem  
 (c) both have same head loss and discharge values  
 (d) they are of same length and having same head loss

- 51.** The specific speed of a pump is defined as the speed of a unit of such a size that it discharges  
 (a) unit discharge at unit power  
 (b) unit work at unit head loss  
 (c) unit discharge at unit head  
 (d) unit volume at unit time
- 52.** The dimensions of Chezy's C is  
 (a) non-dimensional (b)  $L/T$   
 (c)  $LT$  (d)  $[L/T^2]^{1/2}$
- 53.** The velocity distribution for turbulent flow through circular pipes is  
 (a) uniform (b) linear  
 (c) parabolic (d) logarithmic
- 54.** With increase in temperature the viscosity of air and water varies as  
 (a) viscosity of air increases and viscosity of water decreases  
 (b) viscosity of air increases and viscosity of water increases  
 (c) viscosity of air decreases and viscosity of water decreases  
 (d) viscosity of air decreases and viscosity of water increases
- 55.** Harbour model are based on the following law  
 (a) Froude law (b) Reynold's law  
 (c) Stoke's law (d) Euler's law
- 56.** For stability of floating bodies, the metacentre should be  
 (a) above the centre of gravity  
 (b) below the centre of gravity  
 (c) above the centre of buoyancy  
 (d) below the centre of buoyance
- 57.** A vessel containing water of depth  $h$  is accelerated upward with an acceleration of  $\frac{g}{2}$ . The pressure at the bottom of the vessel is  
 (a)  $\gamma h$  (b)  $\frac{\gamma h}{2}$   
 (c)  $2\gamma h$  (d)  $\frac{3}{2}\gamma h$
- 58.** The bulking of sand occurs due to  
 (a) Air in voids  
 (b) Moisture in voids  
 (c) Surface tension  
 (d) Capillary action

**ANSWERS****EXERCISE - I**

<b>1.</b> (a)	<b>2.</b> (b)	<b>3.</b> (c)	<b>4.</b> (d)	<b>5.</b> (a)	<b>6.</b> (d)	<b>7.</b> (d)	<b>8.</b> (d)	<b>9.</b> (c)	<b>10.</b> (a)
<b>11.</b> (c)	<b>12.</b> (d)	<b>13.</b> (a)	<b>14.</b> (b)	<b>15.</b> (d)	<b>16.</b> (c)	<b>17.</b> (d)	<b>18.</b> (d)	<b>19.</b> (d)	<b>20.</b> (a)
<b>21.</b> (a)	<b>22.</b> (d)	<b>23.</b> (a)	<b>24.</b> (a)	<b>25.</b> (d)	<b>26.</b> (c)	<b>27.</b> (c)	<b>28.</b> (b)	<b>29.</b> (b)	<b>30.</b> (d)
<b>31.</b> (c)	<b>32.</b> (d)	<b>33.</b> (a)	<b>34.</b> (a)	<b>35.</b> (c)	<b>36.</b> (b)	<b>37.</b> (c)	<b>38.</b> (c)	<b>39.</b> (b)	<b>40.</b> (d)
<b>41.</b> (c)	<b>42.</b> (b)	<b>43.</b> (d)	<b>44.</b> (d)	<b>45.</b> (c)	<b>46.</b> (d)	<b>47.</b> (c)	<b>48.</b> (b)	<b>49.</b> (a)	<b>50.</b> (c)
<b>51.</b> (a)	<b>52.</b> (c)	<b>53.</b> (d)	<b>54.</b> (d)	<b>55.</b> (d)	<b>56.</b> (a)	<b>57.</b> (b)	<b>58.</b> (b)	<b>59.</b> (d)	<b>60.</b> (d)
<b>61.</b> (b)	<b>62.</b> (b)	<b>63.</b> (d)	<b>64.</b> (c)	<b>65.</b> (b)	<b>66.</b> (a)	<b>67.</b> (b)	<b>68.</b> (b)	<b>69.</b> (d)	<b>70.</b> (d)
<b>71.</b> (b)	<b>72.</b> (d)	<b>73.</b> (a)	<b>74.</b> (a)	<b>75.</b> (b)	<b>76.</b> (c)	<b>77.</b> (c)	<b>78.</b> (c)	<b>79.</b> (a)	<b>80.</b> (d)
<b>91.</b> (a)	<b>82.</b> (d)	<b>83.</b> (d)	<b>84.</b> (b)	<b>85.</b> (c)	<b>86.</b> (d)	<b>87.</b> (b)	<b>88.</b> (d)	<b>89.</b> (d)	<b>90.</b> (b)
<b>91.</b> (b)	<b>92.</b> (a)	<b>93.</b> (d)	<b>94.</b> (c)	<b>95.</b> (b)	<b>96.</b> (c)	<b>97.</b> (b)	<b>98.</b> (b)	<b>99.</b> (c)	<b>100.</b> (d)
<b>101.</b> (a)	<b>102.</b> (d)	<b>103.</b> (c)	<b>104.</b> (d)	<b>105.</b> (c)	<b>106.</b> (d)	<b>107.</b> (d)	<b>108.</b> (d)	<b>109.</b> (c)	<b>110.</b> (d)
<b>111.</b> (c)	<b>112.</b> (c)	<b>113.</b> (a)	<b>114.</b> (c)	<b>115.</b> (a)	<b>116.</b> (d)	<b>117.</b> (a)	<b>118.</b> (d)	<b>119.</b> (d)	<b>120.</b> (d)
<b>121.</b> (b)	<b>122.</b> (c)	<b>123.</b> (b)	<b>124.</b> (d)	<b>125.</b> (c)	<b>126.</b> (d)	<b>127.</b> (d)	<b>128.</b> (c)	<b>129.</b> (b)	<b>130.</b> (a)
<b>131.</b> (c)	<b>132.</b> (d)	<b>133.</b> (b)	<b>134.</b> (d)	<b>135.</b> (d)	<b>136.</b> (b)	<b>137.</b> (c)	<b>138.</b> (b)	<b>139.</b> (a)	<b>140.</b> (b)
<b>141.</b> (d)	<b>142.</b> (d)	<b>143.</b> (d)	<b>144.</b> (a)	<b>145.</b> (a)	<b>146.</b> (b)	<b>147.</b> (c)	<b>148.</b> (a)	<b>149.</b> (d)	<b>150.</b> (b)
<b>151.</b> (b)	<b>152.</b> (c)	<b>153.</b> (b)	<b>154.</b> (b)	<b>155.</b> (b)	<b>156.</b> (b)	<b>157.</b> (d)	<b>158.</b> (b)	<b>159.</b> (b)	<b>162.</b> (b)
<b>161.</b> (d)	<b>162.</b> (b)	<b>163.</b> (c)	<b>164.</b> (a)	<b>165.</b> (d)	<b>166.</b> (d)	<b>167.</b> (b)	<b>168.</b> (d)	<b>169.</b> (c)	<b>170.</b> (c)
<b>171.</b> (c)	<b>172.</b> (a)	<b>173.</b> (c)	<b>174.</b> (b)	<b>175.</b> (c)	<b>176.</b> (b)	<b>177.</b> (b)	<b>178.</b> (a)	<b>179.</b> (a)	<b>180.</b> (d)
<b>181.</b> (c)	<b>182.</b> (b)	<b>183.</b> (d)	<b>184.</b> (a)	<b>185.</b> (c)	<b>186.</b> (c)	<b>187.</b> (a)	<b>188.</b> (d)	<b>189.</b> (b)	<b>190.</b> (a)
<b>191.</b> (a)	<b>192.</b> (a)	<b>193.</b> (d)	<b>194.</b> (d)	<b>195.</b> (d)	<b>196.</b> (c)	<b>197.</b> (d)	<b>198.</b> (b)	<b>199.</b> (d)	<b>200.</b> (a)
<b>201.</b> (a)	<b>202.</b> (c)	<b>203.</b> (a)	<b>204.</b> (a)	<b>205.</b> (d)	<b>206.</b> (d)	<b>207.</b> (d)	<b>208.</b> (b)	<b>209.</b> (b)	<b>210.</b> (a)
<b>211.</b> (a)	<b>212.</b> (c)	<b>213.</b> (b)	<b>214.</b> (b)	<b>215.</b> (b)	<b>216.</b> (b)	<b>217.</b> (c)	<b>218.</b> (b)	<b>219.</b> (c)	<b>220.</b> (b)
<b>221.</b> (d)	<b>222.</b> (a)	<b>223.</b> (d)	<b>224.</b> (b)	<b>225.</b> (a)	<b>226.</b> (c)	<b>227.</b> (a)	<b>228.</b> (b)	<b>229.</b> (d)	<b>230.</b> (a)
<b>231.</b> (a)	<b>232.</b> (d)	<b>233.</b> (c)	<b>234.</b> (b)	<b>235.</b> (d)	<b>236.</b> (b)	<b>237.</b> (d)	<b>238.</b> (c)	<b>239.</b> (b)	<b>240.</b> (b)
<b>241.</b> (c)	<b>242.</b> (d)	<b>243.</b> (a)	<b>244.</b> (d)	<b>245.</b> (d)	<b>246.</b> (d)	<b>247.</b> (d)	<b>248.</b> (c)	<b>249.</b> (d)	<b>250.</b> (d)
<b>251.</b> (d)	<b>252.</b> (c)	<b>253.</b> (d)	<b>254.</b> (b)	<b>255.</b> (b)	<b>256.</b> (a)	<b>257.</b> (a)	<b>258.</b> (b)	<b>259.</b> (b)	<b>260.</b> (a)
<b>261.</b> (d)	<b>262.</b> (d)	<b>263.</b> (d)	<b>264.</b> (c)	<b>265.</b> (b)	<b>266.</b> (b)	<b>267.</b> (c)	<b>268.</b> (c)	<b>269.</b> (a)	<b>270.</b> (c)
<b>271.</b> (c)	<b>272.</b> (a)	<b>273.</b> (c)	<b>274.</b> (a)	<b>275.</b> (c)	<b>276.</b> (b)	<b>277.</b> (d)	<b>278.</b> (c)	<b>278.</b> (c)	<b>280.</b> (c)
<b>281.</b> (b)	<b>282.</b> (b)	<b>283.</b> (c)	<b>284.</b> (c)	<b>285.</b> (d)	<b>286.</b> (c)	<b>287.</b> (a)	<b>288.</b> (a)	<b>289.</b> (a)	<b>290.</b> (a)
<b>291.</b> (d)	<b>292.</b> (b)	<b>293.</b> (a)	<b>294.</b> (b)	<b>295.</b> (b)					

**EXERCISE - II**

<b>1.</b> (b)	<b>2.</b> (d)	<b>3.</b> (b)	<b>4.</b> (b)	<b>5.</b> (b)	<b>6.</b> (d)	<b>7.</b> (a)	<b>8.</b> (b)	<b>9.</b> (a)	<b>10.</b> (a)
<b>11.</b> (b)	<b>12.</b> (d)	<b>13.</b> (a)	<b>14.</b> (b)	<b>15.</b> (d)	<b>16.</b> (c)	<b>17.</b> (a)	<b>18.</b> (b)	<b>19.</b> (b)	<b>20.</b> (c)
<b>21.</b> (b)	<b>22.</b> (c)	<b>23.</b> (a)	<b>24.</b> (d)	<b>25.</b> (d)	<b>26.</b> (c)	<b>27.</b> (a)	<b>28.</b> (b)	<b>29.</b> (a)	<b>30.</b> (c)
<b>31.</b> (b)	<b>32.</b> (c)	<b>33.</b> (c)	<b>34.</b> (d)	<b>35.</b> (a)	<b>36.</b> (c)	<b>37.</b> (a)	<b>38.</b> (b)	<b>39.</b> (a)	<b>40.</b> (b)
<b>41.</b> (c)	<b>42.</b> (c)	<b>43.</b> (c)	<b>44.</b> (b)	<b>45.</b> (a)	<b>46.</b> (a)	<b>47.</b> (c)	<b>48.</b> (a)	<b>49.</b> (d)	<b>50.</b> (c)
<b>51.</b> (c)	<b>52.</b> (d)	<b>53.</b> (d)	<b>54.</b> (a)	<b>55.</b> (a)	<b>56.</b> (a)	<b>57.</b> (d)	<b>58.</b> (b)		

## EXPLANATIONS

### EXERCISE - II

1. Difference in pressure heads

$$\frac{P_A}{w} - \frac{P_B}{w} = x(S_2 - S_1)$$

The manometric liquid is mercury ( $s_2 = 13.6$ ) and the liquid at A or B is water ( $s_1 = 1$ ) then the difference in pressure heads at points A and B is  
 $\therefore x(S_2 - S_1) = 0.20(13.6 - 1) = 2.52$

2.  $R_e \leq 500 \rightarrow$  Flow is Laminar  
 $500 < R_e < 2000 \rightarrow$  Flow is Transitional  
 $R_e \geq 2000 \rightarrow$  Flow is Turbulent

3. **Net Head (H):** Net head or effective head is the actual head available at the inlet of the two work on the turbine.  $H = H_g - h_l$

4. Loss of pressure head for the laminar flow through pipes is given by

$$P_1 - P_2 = \frac{32\mu VL}{D^2}$$

Hence the loss of pressure head for the laminar flow through pipes varies Directly as the velocity.

5. The pressure at any point in a fluid at rest has the same magnitude in all directions.

6. Venturimeter is advantageous because-

- It has much smaller head loss
- Its coefficient of discharge ( $C_d = 0.98$ ) is more than for an orifice meter ( $C_d = 0.68$ )
- Its accuracy is quite good.

7. **Crest** - The highest point in the current of water as it flows over a weir, as measured from the level of the bottom of the weir-notch or of the surface of the dam.

8. The total shear strength of a soil mass  $\tau_f$  is thus given by the Coulomb's equation

$$\tau_f = C + \sigma' \cdot \tan \phi$$

Where,  $\sigma'$  = effective vertical stress

$C$  = cohesion

$\phi$  = angle of internal friction of soil

9. Unconfined compressive strength test is Undrained test.

#### Unconfined compressive strength test (UCS)-

This is a special case of Triaxial test, in which the confining pressure ( $\sigma_3$ ) is zero. The main objective of this test is to determine the Unconfined compressive strength ( $q_u$ ) of cohesive

soil. The **undrained** shear strength due to cohesion for such soils can then be computed as equal to half the unconfined compressive strength. i.e.  $C_u = q_u/2$

10. **Viscosity**- It is that property of a fluid by virtue of which it offers resistance to the movement of one layer of fluid over an adjacent layer.

11. **Steady Flow** a flow in which the velocity, pressure, density, temperature etc. of the fluid at a particular fixed point does not change with time is called steady flow. Otherwise the flow is **Unsteady flow**.

12. Bernoulli's equation represents total energy per unit of weight.

$$\frac{P}{w} + \frac{V^2}{2g} + Z = C$$

$$13. i = \frac{G-1}{1+e}, \text{ and } e = \frac{n}{1-n} = \frac{0.3}{1-0.3} = 0.43$$

$$i = \frac{2.5-1}{1+0.43} = 1.0$$

#### 14. The flow in open channel

$R_e \geq 2000 \rightarrow$  Flow is Turbulent

$500 < R_e < 2000 \rightarrow$  Flow is Transitional

$R_e \leq 500 \rightarrow$  Flow is Laminar

15. A fluid is a substance which is capable of flowing, moving or **deforming under the action of shear force** (however small the force may be). If there is no shear force, the fluid will be at rest.

16. Capillary height  $(h_c) = \frac{4\sigma \cos \theta}{wd}$

$$\Rightarrow h_c \propto \frac{1}{d}$$

Hence, If the diameter of a capillary tube is doubled, the capillary rise will be halved.

17. To measure static pressure in a pipe, one uses a pressure guage connected to a Pitot tube.

18. The minor loss due to sudden contraction is due to expansion of flow after sudden contraction.

#### 19. Archimedes's principle

When a body is immersed in a fluid either wholly or partially, it is buoyed or lifted up by a force which is equal to the weight of the fluid displaced by the body.

20. Bernoulli's equation represents total energy per unit of weight.

$$\frac{P}{w} + \frac{V^2}{2g} + Z = C$$

## 5.66 Hydraulics

30. Irrotational and incompressible.

31. Reynolds number =  $\frac{\text{Inertia force}}{\text{Viscous force}}$

32. Bulk modulus (K) =  $\frac{\text{increase in pressure}}{\text{volumetric strain}}$

35.  $f$  = Darcy-Weisbach resistance coefficient has dimensionless  $[M^0 Z^0 T^0]$

36. For producing electricity, following combination of machines will be required Hydraulic turbine + Electric motor.

37. The ratio of normal stress to normal strain within elastic limits is called Young's Modulus.

The ratio of direct stress to volumetric strain within elastic limits is called Bulk Modulus.

The Ratio of shear stress to shear strain within elastic limits is called Modulus of Rigidity.

The ratio of lateral strain to linear strain is called Poisson's ratio.

38. Froude number  $F_r = \sqrt{\frac{F_i}{F_g}} = \frac{V}{\sqrt{gD}}$

Where  $V$  = mean velocity of flow

$D$  = hydraulic depth

- If  $F_r < 1$ , Flow is sub critical or streaming or tranquil. It is a stable type of flow.
- If  $F_r = 1$ , Flow is critical.
- If  $F_r > 1$ , Flow is **super critical** or shooting flow or Torrential flow.

45.  $P - \frac{V^2}{2g} + h = \text{constant}$

48. Francis Turbine is a inward reaction turbine.

49. Most economical circular gives flow depth with 95% of its diameter.

50.  $\frac{L}{D_5} = \frac{L_1}{D_1 5} + \frac{L_2}{D_2 5} + \frac{L_3}{D_3 5}$

Discharge is same

51.  $N_s = \frac{N\sqrt{Q}}{H^{3/4}}$

$Q$  = Discharge,  $H$  = Head

$N_s$  = Specific Speed

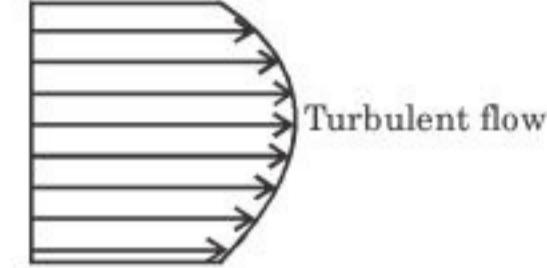
52.  $V = c\sqrt{mi}$

$$V \rightarrow \text{Velocity} = \frac{L}{T} \Rightarrow C = \frac{V}{\sqrt{mi}}$$

$$C = \frac{L}{\sqrt{L}} \Rightarrow \frac{L^{1/2}}{T} = C$$

$m \rightarrow \text{meter}$

53.



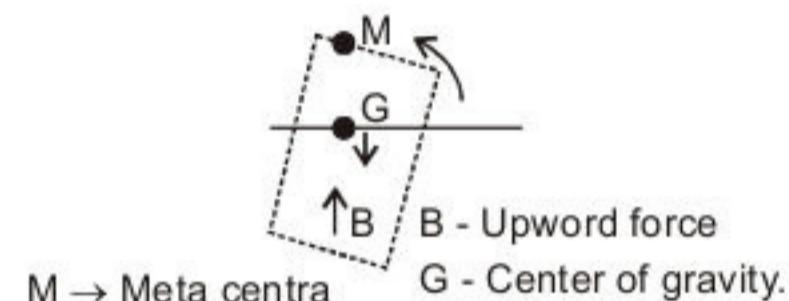
Velocity Profile

54. In Air, viscosity increases with temperature and water  $V \downarrow T \uparrow$ . In Air molecules have high spaced.

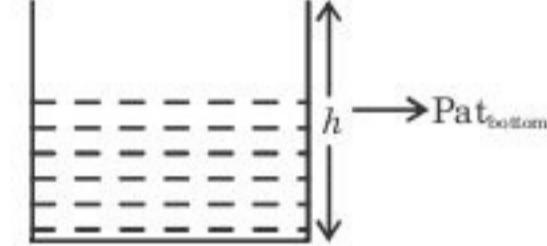
55. It is based on continuum M/C (Mechanism) shipmodes one to other catchment area.

56.

$BM > BG$



57.



$$\rho gh + \rho \frac{g}{2} h = \frac{3}{2} \rho gh$$

58. Bulking of sand occurs due to moisture in voids.

■ ■