Question Bank

1. Differential pressure head measured by mercury oil differential manometer (specific gravity of oil is 0.9) equivalent to a 600 mm difference of mercury levels will nearly be

(a) 7.62 m of oil (b) 76.2 m of oil
(c) 7.34 m of oil (d) 8.47 m of oil

2. A block of aluminium having mass of 12 kg is suspended by a wire and lowered until sumbereged into a tank containing oil of relative density 0.8. Taking the relative density of aluminium as 2.4, the tension in the wire will be (take g = 10 m/s^2)

(a) 12000 N (b) 800 N
(c) 120 N (d) 80 N

3. A rectangular tank of square cross-section is having its height equal to twice the length of any side at the base. If the tank is filled up with a liquid, the ratio of the total hydrostatic force on any vertical wall to that at the bottom is

(a) 2.0 (b) 1.5
(c) 1.0 (d) 0.5

4. The shear stress developed in a lubricating oil, of viscosity 9.81 poise, filled between two parallel plates 1 cm apart and moving with relative velocity of 2 m/s is

(a) 20 N/m^2 (b) 196.2 N/m^2
(c) 29.62 N/m^2 (d) 40 N/m^2

5. A glas tube with a 90° bend is open at both the ends. It is inserted into a flowing stream of oil, S = 0.90, so that one opening is direct upstream and the other is directed upward. Oil inside the tube is 50 mm higher than the surface of flowing oil. The velocity measured by the tube is, early,

(a) 0.89 m/s (b) 0.99 m/s
(c) 1.40 m/s (d) 1.90 m/s

6. The pressure drop in a 100 mm diameter horizontal pipe is 50 kPa over a length of 10 m. The shear stress at the pipe wall is

(a) 0.25 kPa (b) 0.125 kPa
(c) 0.50 kPa (d) 25.0 kPa

7. A barge 30 m long and 10 m wide has a draft of 3 m when floating with its sides in vertical position. If its centre of gravity is 2.5 m above the bottom, the nearest value of metacentric height is

(a) 3.28 m (b) 2.78 m
(c) 1.78 m (d) zero

8. A cylindrical vessel having its height equal to its diameter is filled with liquid and moved horizontally at an acceleration equal to acceleration due to gravity. The ratio of the liquid left in the vessel to the liquid at static equilibrium condition is

(a) 0.2 (b) 0.4
(c) 0.5 (d) 0.75

9. Match List-I (Types of flow) with List-II (Basic idal flows) and select the correct answer using the codes given below the lists:

List-I

A. Flow over a stationary cylinder
B. Flow over a half rankine body
C. Flow over a rotating body
D. Flow over a rankine oval

List-II

1. Source + sink + uniform flow
2. Doublekt + uniform flow
3. Source + uniform flow
4. Doublet + free vortex + uniform flow

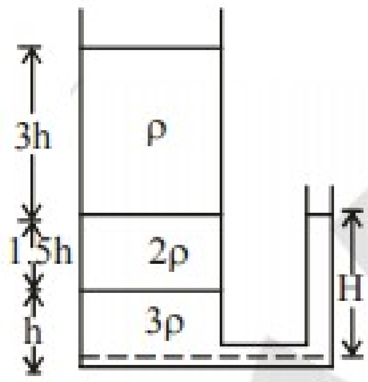
Codes:

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

10. A right circular cylinder is filled with a liquid upto its top level. It is rotated about its vertical axis at such a speed that half the liquid spills out, then the pressure at the point of intersection of the axis and bottom surface

(a) is same as before rotation
(b) is half of the value before rotation
(c) is quarter of the value before rotation
(d) is equal to the atmospheric pressure

11. Three immiscible liquids of specific densities ρ, 2ρ and 3ρ are kept in a jar. The height of the liquids in the jar and at the piezometer fitted to the bottom of the jar are as shown in the figure below.



The ratio H/h is.
(a) 4 (b) 3.5
(c) 3 (d) 2.5

12. The convective acceleration of fluid in the x-direction is given by

(a) $u\frac{\partial u}{\partial x}+v\frac{\partial v}{\partial y}+w\frac{\partial w}{\partial z}$

(b) $\frac{\partial u}{\partial t}+\frac{\partial v}{\partial t}+\frac{\partial w}{\partial t}$

(c) $u\frac{\partial u}{\partial x}+u\frac{\partial v}{\partial y}+u\frac{\partial w}{\partial z}$

(d) $u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}+w\frac{\partial u}{\partial z}$

13. Match List-I with List-II and select the correct answer using the codes givne below the lists:

List-I
A. Stoke's law
B. Bluff body
C. Streamline body
D. Karman vortex street

List-II
1. Strouhal number
2. Creeping motion
3. Pressure drag
4. Skin friction drag

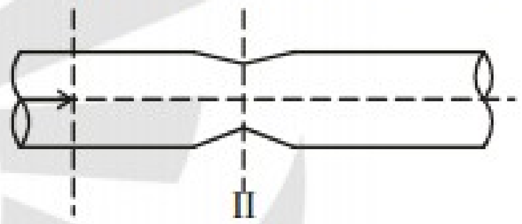
Codes:

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

14. The stream function in a 2-dimensional flow field is given by $\psi = xy$. The potential function is

(a) $\frac{x^2+y^2}{2}$ (b) $\frac{x^2-y^2}{2}$
(c) xy (d) $x^2y + y^2x$

15. At location-I of a horizontal line, the fluid pressure head is 32 cm and velocity head is 4cm. The reduction in area at location-II is such that the pressure head drops down to zero.



The ratio of velocities at location-II to that at location-I is
(a) 3 (b) 2.5
(c) 2 (d) 1.5

16. The critical depth of a rectangualr channel of width 4.0 m for a ischarge of 12 m^3/s is nearrly
(a) 300 mm (b) 30 nn
(c) 0.972 m (d) 0.674 m

17. For maximum transmission of power through a pipeline with total head h, the head lost due torfriction h_f is given by
(a) 0.1H (b) GH/3
(c) H/2 (d) 2H/3

18. Two pipelines of equal length and with diameters of 15 cm and 10 cm are in parallel and connect two reservoirs. The difference in water levels in the reservoirs is 3 m. If the friction is assumed to be equal, the ratio of the discharge due to the larger diameter pipe to that of the smaller diameter pipe is, nearly,
(a) 3.375 (b) 2.756
(c) 2.25 (d) 1.5

19. In a fully-developed turbulent pipe flow, assuming 1/7th power law, the ratio of tiem mean velocity at the centre of the pipe to the average velocity of the flow is

(a) 2.0 (b) 1.5
(c) 1.22 (d) 0.817

20. Laminar developed flow at an average velocity of 5 m/s occurs in a pipe of 10 cm radius. the velocity at 5 cm radius is

(a) 7.5 m/s (b) 10 m/s
(c) 2.5 m/s (d) 5 m/s

21. The velocity distribution in the boundary layer is given as $\frac{u}{U_\infty} = \frac{y}{\delta}$, where u is the velocity at a distance y from the boundary, U_∞ is the fre stream velocity and δ is the boundary layer thickness at a certain distance from the leading edge of plate. The ratio of displacement thickness to momentum thickness is

(a) 5 (b) 4
(c) 3 (d) 2

22. For the velocity profile $\frac{u}{U_\infty} = \eta$, the momentum thickness of a laminar boundary layer on a flat plate at a distance of 1m from leading edge for air (kinematic viscosity = 2×10^{-5} m^2/s) flowing at a free stram velocity of 2 m/s is given by

(a) 3.16 mm (b) 2.1 mm
(c) 3.16 m (d) 2.1 m

23. According to blasius law, the local skin friction coeffiicient in the boundary layer over a flat plate is given by

(a) $\frac{0.332}{\sqrt{Re}}$ (b) $\frac{0.664}{\sqrt{Re}}$

(c) $\frac{0.647}{\sqrt{Re}}$ (d) $\frac{1.328}{\sqrt{Re}}$

24. Match List-I (Dimensionless numbers) with List-II (Definition as the ratio of) and select the correct answer using the codes givne below the lists:

List-I

A. Reynolds number
B. Froude number
C. Weber number
C. Mach number

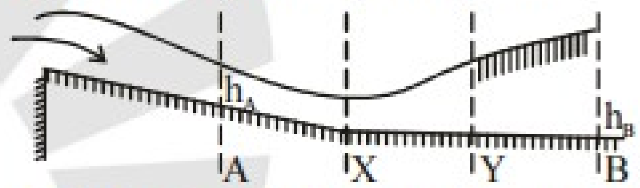
List-II

1. Inertia force and elastic force
2. Inertia force and surface tension force
3. Inertia force and gravity force
4. Inertia force and viscous froce

Codes:

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

25. An open channel flow encounters a hydraulic jump as shown in the figure below.



The following fluid flow conditiosn are observed between A and B:

1. Critical depth
2. Steady non-uniform flow.
3. Unsteady non-uniform flow
4. Steady uniform flow

the correct sequence of the flow conditiosn in the direction of flwo is

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

226. Consider the following statements pertaiing to a centrifugal pump:

1. the manometric head is the head developed by pump.
2. The suction pipe has, generraly, larger diameter as compared to the discharge pipe.
3. The suction pipe is provided with a foot valve and a strainer.
4. The delivery pipe is provided with a foot valve and a strainer.

Which of these statements are correct?

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

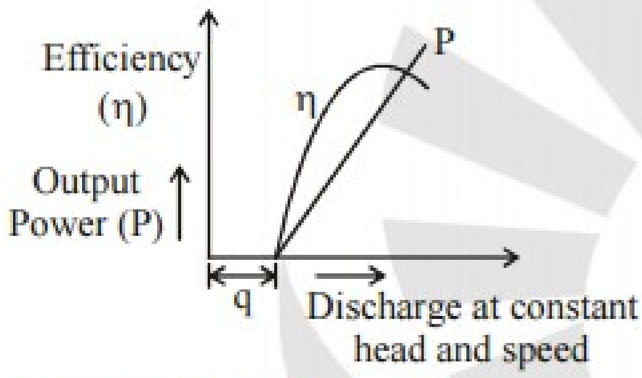
227. If a reciprocating pump having a mechanical efficiency of 80% delivers water at the rate of 80 kg/s with a head of 30 m, the brake power of the pump is

(a) 29.4 kW (b) 20.8 kW
(c) 15.4 kW (d) 10.8 kW

28. The maximum number of jets generally employed in an impulse turbine without jet interference

(a) 4 (b) 6
(c) 8 (d) 12

29. For a water turbine, running at constant head and speed, the operating characteristic curves in the givne figure shown that upto a certain discharge 'q' both output power and efficiency remain zero.



The discharge 'q' is required to

(a) overcoem initial inertia
(b) overcoem initial friction
(c) keep the hydraulic circuit full
(d) keep the turbine running at no load

30. A ship with hull length of 100 m is to run with a speed of 10 m/s. For dynamic simialrity, the velocity for a 1 : 25 model of the ship in a towing tank should be

(a) 2 m/s (b) 10 m/s
(c) 20 m/s (d) 25 m/s

31. A standard 90° V-notch weir is used to measure discharge. The discharge is Q_1 for a height H_1 above the sill and Q_2 is the discharge for a height H_2. If $\frac{H_2}{H_1}$ is 4, then $\frac{Q_2}{Q_1}$ is

(a) 32 (b) $16\sqrt{2}$
(c) 16 (d) 8

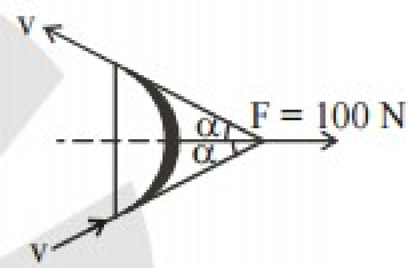
32. Consider the specific speed range of the following types of turbines:

1. Francis
2. Kaplan
3. Pelton

The sequence of their specific speed in increasing order is

(a) 1, 2, 3 (b) 3, 1, 2
(c) 3, 2, 1 (d) 2, 3, 1

33. A symmetrical stationary vane experiences a force F of 100 N as shown in the figure below, when the mass flow rate of water over the vane is 5 kg/s with a velocity 'v' of 20 m/s without friction.



The angle α of the vane is

(a) zero (b) 30°
(c) 45° (d) 60°

34. In a fluid coupling, the torque transmitted is 50 kN-m, when the speed of the driving and driven shaft is 900 rpm and 720 rpm respectively. teh efficiency of the fluid coupling will be

(a) 20% (b) 25%
(c) 80% (d) 90%

35. Consider the following statements regarding the fluid coupling:

1. Efficiency increases with increase in speed ratio.
2. Neglecting friction the output torque is equal to input troque.
3. At the same input speed, higher slip requires higher input torque.

Which of these statements are correct?

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

36. The level of runner exit is 5 m above the tail race, and atmosheric pressure is 10.3 m. The pressure at the exit of the runner for a divergent draft tube ccna be

(a) 5 m (b) 5.3 m
(c) 10 m (d) 10.3 m

37. Consider the following statements:

A surge tank provided on the penstock connected to a water turbine

1. helps in reducing the water hammer.
2. stores extra water when not needed.
3. provides increased demand of water.

Which of these statements are correct?

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

38. The gross head on a trubine is 300 m. The length of penstock supplying water from reservoir to the turbine is 400 m. the diameter of the penstock is 1 m and velocity of water through penstock is 5 m/s. If coefficient of friction is 0.0098, the net head on the turbine would be, nearly

(a) 310 m (b) 295 m
(c) 200 m (d) 150 m

39. In fluid machinery, the relationship between saturation temeprature and pressure decides the process of

(a) flow separation (b) turbulent mixing
(c) cavitation (d) water hammer

40. A hydraulic coupling transmits 1 kW of power at an input speed of 200 rpm, with a slip of 2%. If the input speed is changed to 400 rpm, the power transmitted with the same slip is

(a) 2 kW (b) 1/2 kW
(c) 4 kW (d) 8 kW

DIRECTIONS:

The following items consists of two statment; one labelled as 'Assertion (A)' and the other as 'Reason (R)'. You are to examine these two statements carefully and select the answers to these items 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

41. A capillary tube is inserted in mercury kept in an open container.

Assertion (A): The mercury level inside the tube shall rise above the level of mercury outside.

Reason (R): The cohesive force between the molecules of mercury is greater than the adhesive force between mercury and glass.

42. **Asserion (A):** In a pipe line, the nature of the fluid flow depends entirely on the velocity.

Reason (R): Reynolds number depends on the velocity, diameter of the pipe and kinematic viscosity of the fluid.

43. **Assertion (A):** A kaplan turbine is an axial flow reaction turbine with its vanes fixed to the hub.

Reason (R): Water flows parallel to the axis of rotation of the turbine and a part of the pressure energy gets converted to kinetic energy during its flow through the vanes.

44. In the phenomenon of cavitation, the characteristic fluid property involved is

(a) surface tension
(b) viscosity
(c) bulk modulus of elasticity
(d) vapour pressure

45. The capillary rise at 20°C in clean glass tube of 1 mm diameter containing water is kapproximately

(a) 15 mm (b) 50 mm
(c) 20 mm (d) 30 mm

46. Match List-I (Type of fluid) with List-II (Variation of shear stress) and select the correct answer using the codes given below the lists:

List-I

A. Ideal fluid
B. Newtonain fluid
C. Non-newtonian fluid
D. Bingham plastic

List-II

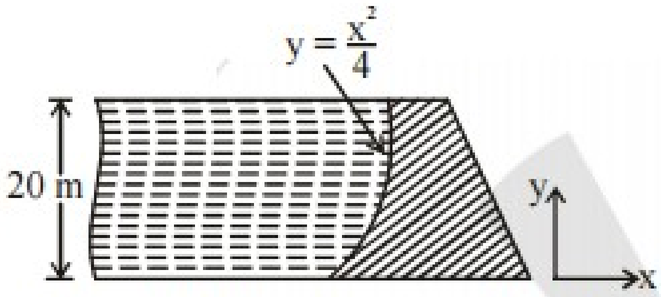
1. Shear stress varies linearly with the rate of strain
2. Shear stress does not vary linearly with the rate of strain
3. Fluid behaves like a solid until a minimum yield stress beyond which it exhibits a linear relationship between shear stress and the rate of strain

4. Shear stress is zero

Codes:

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

47. A dam is having a curved surface as shown in the figure below.



The height of the water retained by the dam is 20 m, density of water is 1000 kg/m^3. Assuming g as 9.81 m/s^2, the horizontal force acting on the dam per unit length is

(a) 1.962×10^2 N (b) 2×10^5 N

(c) 1.962×10^6 N (d) 3.924 × × 10^6 N

48. Match List-I (Stability) and List-II (Conditions) and select the correct answer using the codes givne below the lsits:

List-I

A. Stable equilibrium of a floating body

B. Stable equilibrium of a submerged body

C. Unstable equilibrium of a floating body

D. Unstable equilibrium of a sumberged body

List-II

1. Cente of buoyancy belwo the centre of gravity
2. Metacentre above the centre of gravity
3. Centre of buoyancy above the centre of gravity
4. Metacentre below the centre of gravity

Codes:

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

49. The drag force exerted by a fluid on a body immersed in the fluid is due to

(a) pressure and viscous forces

(b) pressure and gravity forces

(c) pressure and surface tension forces

(d) viscous and gravity forces

50. The hydraulic mean depth (where A = area and P = wetted perimeter) is given by

(a) $\frac{P}{A}$ (b) $\frac{P^2}{A}$

(c) $\frac{A}{P}$ (d) $\sqrt{\frac{A}{P}}$

❑❑❑

ANSWERS AND EXPLANATIONS

1. ***Ans.* (d)**

$13.6 \times 0.6 = 0.9 \times h$

$\therefore \quad h = 9.06$ m of oil

2. ***Ans.* (d)**

Volume of Aluminium

$$V_{Al} = \frac{12}{2.4}$$

$$T + F_B = mg$$

Buoyancy force

$$= \rho v_{Al} \cdot g = 0.8 \times \frac{12}{2.4} \times 10$$

$$= 40N$$

Now,

$$T + 40 = 120$$

$\therefore \quad T = 80N$

3. ***Ans.* (c)**

F_1 = force on vertical wall

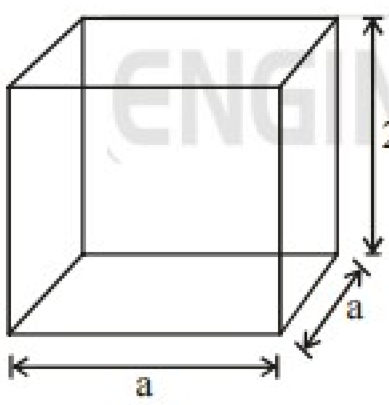
$$= \gamma \times 2a \times a \times a$$

$$= 2a^3\gamma$$

F_2 = force at the bottom

$$= \gamma \times a \times a \times 2a = 2a^3\gamma$$

$$\therefore \quad \frac{F_1}{F_2} = 1$$



4. ***Ans.* (b)**

$$\tau = \mu \frac{du}{dy}$$

$$= 0.981 \times \frac{2}{10^{-2}} = 196.2 N/m^2$$

5. ***Ans.* (b)**

$$\frac{v^2}{2g} = h$$

$$\therefore \quad v = \sqrt{2 \times 9.81 \times 0.05}$$

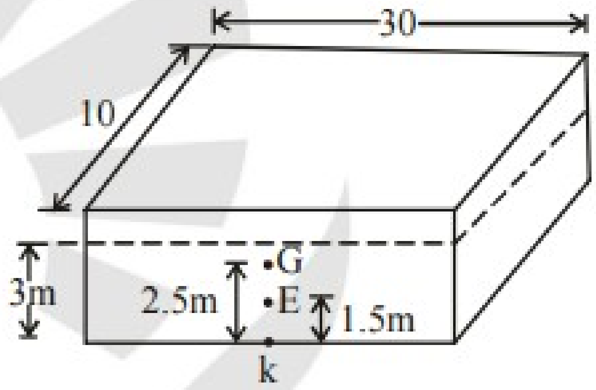
$$v = 0.99 \text{ m/s}$$

6. ***Ans.* (b)**

$$\tau = \left(\frac{dP}{dx}\right)\left(\frac{R}{2}\right)$$

$$= \frac{50 \times 1000 \times 50 \times 10^{-3}}{10 \times 2} = 0.125 KPa$$

7. ***Ans.* (c)**



$$BM = \frac{I}{\nabla} = \frac{(30)\frac{(10)^3}{12}}{30 \times 10 \times 3} = 2.778m$$

Where

I = least moment of inertia

and Δ = displacement

KB = 3/2 = 1.5 m

KM = KB + BM

= 2.778 + 1.5 = 4.278 m

GM = KM – KG

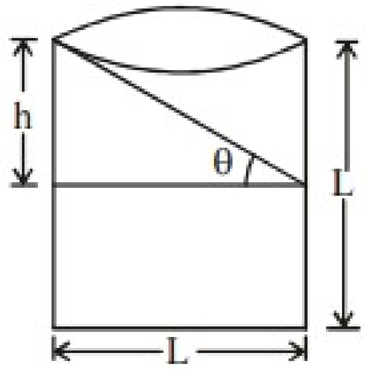
= 4.278 – 2.5 = 1.778 m

$\cong 1.78m$

8. ***Ans.* (c)**

$$\tan\theta = \frac{g}{g+g} = \frac{1}{2}$$

$$\therefore \quad \frac{h}{L} = \frac{1}{2} = 0.5$$



9. ***Ans.* (d)**

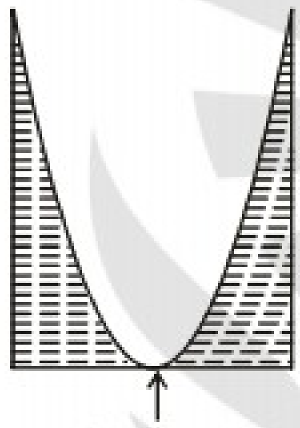
(a) Flow over a statinary cylinder → dublet + unifrm flw

(b) Flow over a half Rankine body → source + uniform flow

(c) Flow over a rotating body → Doublet + free vortex + uniform flow

(d) Flow over a Rankine oval → source + sink + uniform flow

10. ***Ans.* (d)**



11. ***Ans.* (c)**

$$3h \times \rho + 1.5h \times 2\rho + h \times 3\rho - H \times 3\rho = 0$$

$$\therefore \frac{h}{H} = 0$$

12. ***Ans.* (d)**

$$a_x = u\frac{dy}{dx} + v\frac{du}{dy} + \omega\frac{du}{dz} + \frac{du}{dt}$$

Where $\frac{du}{dt}$ = Local or temporal acceleration

Remaining terms are called "convective acceleration".

13. ***Ans.* (a)**

Bluff body : A bluff body is one in which the length in the flow direction is close to or equal to the length perpendicular to the flow direction. This results in a unique characteristics, that skin friction drag is much lower then pressure drag.

Stoke's law : Creeping flow also known as stokes flow is a type of fluid flow where advective inertial forces are small compared with viscous forces. For this Reynolds number is very low i.e., $R_e << 1$. For this type of flow the inertial forces are assumed to be negligible and the Navier-stokes equation simplify to give the stokes equation.

14. ***Ans.* (b)**

$$\frac{d\psi}{dx} = y = -\frac{d\phi}{dy}, \frac{d\psi}{dy} = x = \frac{d\phi}{dx}$$

$$\therefore \frac{d\phi}{dx} = x \therefore \phi = \frac{x^2}{2} + f(y)$$

$$\text{Now, } \frac{d\phi}{dy} = f'(y) = -y$$

$$\therefore f(y) = -\frac{y^2}{2} \therefore \phi = \frac{x^2 - y^2}{2}$$

15. ***Ans.* (a)**

By Bernoulli's equation

$$\frac{p_1}{\rho g} + \frac{v_1^2}{2g} = \frac{p_2}{\rho g} + \frac{v_2^2}{28}$$

$$\Rightarrow 32 + 4 = 0 + \frac{v_2^2}{2g} \qquad \therefore \frac{v_2^2}{2g} = 36$$

$$\text{Now, } \frac{v_2^2/2g}{v_1^2/2g} = \frac{36}{4} \qquad \therefore \frac{v_2^2}{v_1^2} = 9$$

$$\therefore \frac{v_2}{v_1} = 3$$

16. ***Ans.* (c)**

Critical depth (y_c) for aconstant unit flow q in a rectangular channel occur when the specific energy is minimum and it is given by

$$y_c = \sqrt[3]{\frac{q^2}{g}}$$

$$q = \frac{Q}{L} = \frac{12m^3/s}{4m} = 3\ m^2/s$$

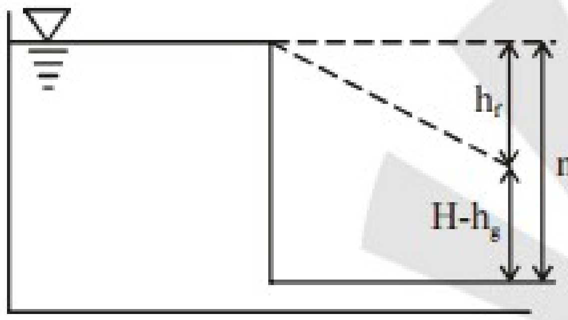
$$y_c = \sqrt[3]{\frac{(3)^2}{9.81}} = 0.972$$

17. ***Ans.* (b)**

Power transmitted by the pipe

$$P = \rho g Q(H - h_f)$$

$$P = \rho g A v\left(H - \frac{fL}{D}.\frac{V^2}{2g}\right)$$



$$= \rho g A\left(Hv - \frac{fL}{D}.\frac{v^3}{2g}\right)$$

for Maximum Power : $\frac{dP}{dv} = 0$

$$\therefore\ H - 3\frac{fL}{D}.\frac{v^2}{2g} = 0$$

$$h_f = \frac{H}{3}$$

18. ***Ans.* (b)**

$$h_f = \frac{fLv^2}{2gD}$$

$$\therefore\quad v \propto \sqrt{D}$$

Now, $\frac{Q_1}{Q_2} = \frac{A_1V_1}{A_2V_2} = \left(\frac{D_1}{D_2}\right)^{5/2} = (1.5)^{5/2}$

19. ***Ans.* (d)**

20. ***Ans.* (a)**

$$U = 2U_{av}\left[1 - \left(\frac{r}{R}\right)^2\right]$$

$$= 2\times5\left[1 - \left(\frac{5}{10}\right)^2\right]$$

$$= 7.5\ m/s$$

21. ***Ans.* (c)**

$$\delta = \int_0^\delta\left(1 - \frac{y}{\delta}\right)dy = \left[y - \frac{y^2}{2\delta}\right]_0^\delta = \frac{\delta}{2}$$

$$\theta = \int_0^\delta\left(1 - \frac{y}{\delta}\right)\left(\frac{y}{\delta}\right)dy = \int_0^\delta\left[\frac{y}{\delta} - \left(\frac{y}{\delta}\right)^2\right]dy$$

$$= \left[\frac{y^2}{2\delta} - \frac{y^2}{3\delta^2}\right]_0^\delta = \frac{\delta}{6}$$

$$\therefore\ H = \frac{\delta^*}{\theta} = 3$$

22. ***Ans.* (b)**

$$Re = \frac{2\times1}{2\times10^{-5}} = 10^5$$

$$\delta = \frac{5\times1}{\sqrt{10^5}} = 0.0158$$

$$\theta = \int_0^\delta\left(1 - \frac{y}{\delta}\right)\frac{y}{\delta}.dy = \frac{\delta}{6}$$

$\therefore\quad d = 2.1$ mm

23. ***Ans.* (b)**

$$C_{fl} = \frac{0.664}{\sqrt{Re_x}}$$

24. ***Ans.* (b)**

Inertia-viscous force ratio → Reynold number
Inertia-Gravity force ratio → froude number
Inertia-Surface tension ratio → weber number
Inertia-elastic force ratio → Mach number

25. ***Ans.* (b)**

26. ***Ans.* (c)**

The head developed by a pump equal to the work done by impeller on water minus the frictional losses between pump inlet and outlet. This head is known as manometric head.

$$H_m = h_{\delta t} + h_f + \frac{V_d^2}{2g}$$

27. ***Ans.*** **(a)**

$$\text{B.P.} = \frac{mgh}{R_m} = \frac{80\times 9.81\times 30}{0.8} = 29.4\,\text{kW}$$

28. ***Ans.*** **(b)**

The maximum number of nozzle used is six while four jet pelton wheel widely preferred.

29. ***Ans.*** **(b)**

The no load discharge 'q' is required to keep the turbine running under no load condition, to overcome the frictional losses.

30. ***Ans.*** **(a)**

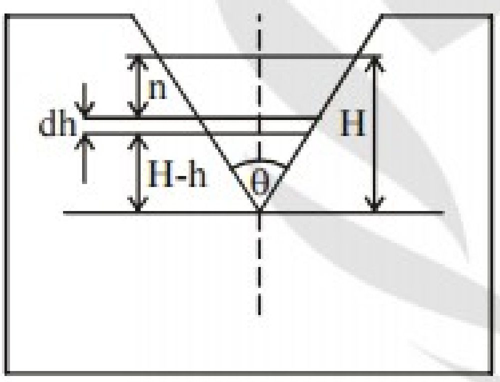
Since the model is tested at a velocity hence the similarity is based on Froude model law, according to which

$$\left(\frac{V}{\sqrt{gL}}\right)_m = \left(\frac{V}{\sqrt{gL}}\right)_P$$

$$V_m = V_P\sqrt{\left(\frac{L_m}{L_P}\right)} = 10\sqrt{\frac{1}{25}}$$

$\therefore \quad V_m = 2$ m/s

31. ***Ans.*** **(a)**



$$dQ = \sqrt{2gh}.dA$$

$$= \sqrt{2gh}.(b.dh)$$

$$\tan\frac{\theta}{2} = \frac{b/2}{(H-h)}$$

$$\Rightarrow \quad b = 2(H-h)\tan\frac{\theta}{2}$$

$$dQ = 2(H-h)\tan\frac{\theta}{2}\sqrt{2gh}.dh$$

$$Q = \int dQ = \frac{8}{15}\sqrt{2g}\tan\frac{\theta}{2}H^{5/2}$$

$$\frac{Q_2}{Q_1} = \left(\frac{H_2}{H_1}\right)^{5/2} = 4^{5/2} = 32$$

32. ***Ans.*** **(b)**

Characteristics of Pelton wheel

(i) Impulse turbine

(ii) High head turbine (300 – 2000 m)

(iii) Low specific discharge turbine

(iv) Axial flow turbine

(v) Low specific speed turbine (4 – 70 rpm)

Characteristics of Francis turbine

(i) Reaction turbine

(ii) Medium head turbine (30 – 500 m)

(iii) Medium specific discharge

(iv) Radial flow turbine, but modern francis turbine are mixed flow turbine

(v) Medium specific speed turbine (60m – 400 rpm)

Characteristics of Kaplan turbine

(i) Reaction turbine

(ii) Low head turbine (2m – 70 m)

(iii) High specific discharge

(iv) Axial flow

(v) High specific speed (300 – 1100) rpm

33. ***Ans.*** **(d)**

$$100 = 5 \times 20 \cos\alpha \times 2$$

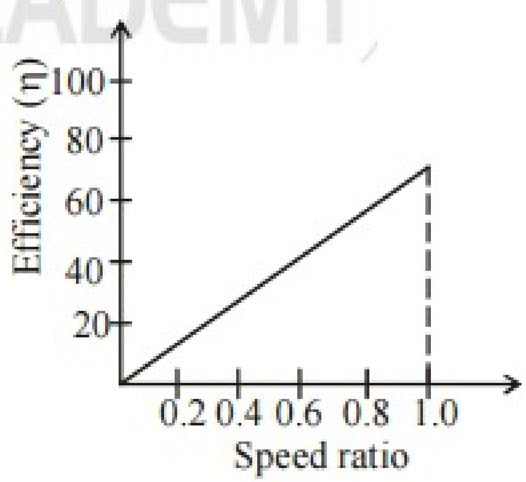
$$\cos\alpha = 1/2$$

$$\therefore \quad \alpha = 60°$$

34. ***Ans.*** **(c)**

$$\text{Efficiency } (\eta) = \frac{H_2}{N_1} = \frac{720}{900} = 0.80$$

35. ***Ans.*** **(a)**



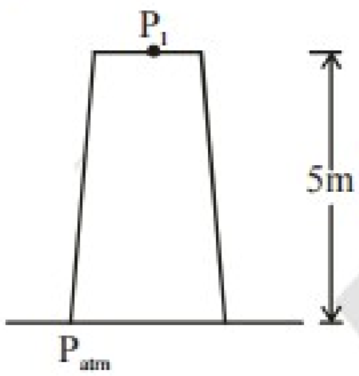
Efficiency-speed ratio curve for a fluid coupling.

The efficiency of fluid coupling is large, usually in excess of 94 percent. A typical efficiency

versus speed ratio curve for a fluid coupling isshown in figure. The efficiency of the fluid coupling starts at zero and increases uniformly with the speed ratio unitl η = 95 percent and then reduces to zero.

As the torque transmitted increases, the slip increases and the efficiency drops.

36. ***Ans.*** **(b)**



$$\frac{P_1}{\rho g}+\frac{V_1^2}{2g}+z=\frac{P_{atm}}{\rho g}+\frac{V^2}{2g}$$

$$\frac{P_1}{\rho g}+\frac{V_1^2}{2g}+5=10.3$$

$$\frac{P_1}{\rho g}=5.3-\frac{V_1^2}{2g}$$

If $V_1 = 0$, $\frac{P_1}{\rho g}=5.3\text{m}$

37. ***Ans.*** **(d)**

When the load on the generator decreases the governor reduces the rate of flow of water striking the runner in order to maintain the constant speed for the runner. But the sudden reduction of the rate of flow in the penstock may lead to setting up of water hammer in the pipe, which may cause excessive inertia in pipeline due to which the pipe may burst. Two devices viz, deflector and relief valve are thus provided to avoid the sudden reduction of the rate of flow in the penstock. But neither of these devices are of any assistance when the load on the generator increases and the turbine is in need of move water. Thus in order to fulfil both the above noted requirements, in addition to the above noted devices certai nother devices such as surge tank and forebay are usually employed. surge tanks are employed in the care of high and medium head hydropower plants where the penstock is very long, and forebays are suitable for medium and low head-power plants where the length of the penstock is short.

38. ***Ans.*** **(b)**

$$h_f=\frac{fLv^2}{2gD}=\frac{0.0098\times400\times(5)^2}{2\times9.8\times1}$$

h_f = 5m

$\therefore$ H_{net} = 300 – 5 = 295m

39. ***Ans.*** **(c)**

Hydrodynamic cavitation describes the process of vaporization bubble generation and bubble implosion which occur in a flowing liquid as a result of decrease and subsequent increase in pressure. The vaporization will occur only if the pressure drops below the vapour pressure at the corresponding saturation temperature.

40. ***Ans.*** **(*)**

41. ***Ans.*** **(d)**

Assertion is true but reason is false because, for capillary rise adhesive force is greater than the cohesive force.

42. ***Ans.*** **(d)**

In a pipe line, nature of the fluid flow depends entirely on the Reynold number. Which is depends on velocity, diameter of pipe and kinematicd viscosity of the fluid.

43. ***Ans.*** **(a)**

Kaplan turbine are axial flow turbine in which blades (or vanes) attached to a hub or boss are so shaped that water flown axially through the runner. Moving blades acts kile nozzle in which part of pressure head converts into kinetic energy.

44. ***Ans.*** **(d)**

Vapour pressure plays very important role in cavitation.

45. ***Ans.*** **(d)**

At 20°C surface tension of water (contact with air) = 0.0736 N/m

$\therefore$ Capillary rise :

$$h=\frac{4\times0.0736}{9.81\times10^3\times10^{-3}}$$

= 0.030 m = 30 mm

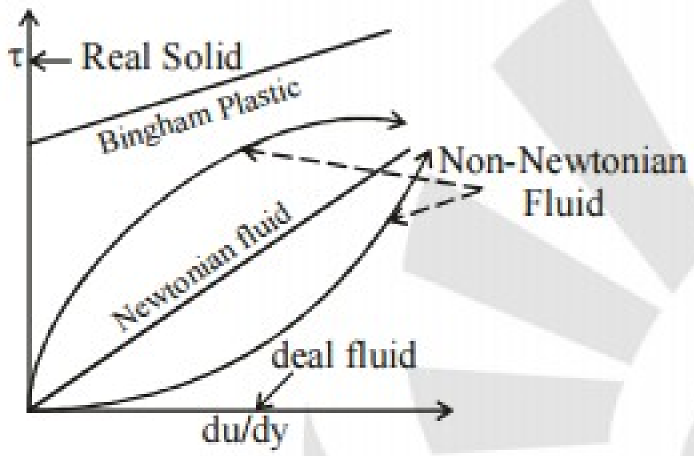
46. ***Ans.* (d)**

$\tau = \mu \frac{du}{dy} \Rightarrow$ Newtonian fluid

$\tau = \mu \left(\frac{du}{dy}\right)^n \Rightarrow$ Non-Newtonian fluid

$\tau = 0 \Rightarrow$ Ideal fluid

$\tau = \text{constant} + \mu\left(\frac{du}{dy}\right) \Rightarrow$ Binghamplastic



47. ***Ans.* (c)**

Horizontal force = $wA\bar{x}$

per unit length = 9.81 × 1000 × 20 × 1 × 10

= 1.982×10^6 N/m

48. ***Ans.* (b)**

(a) Stable equilibrium of floating body : Metacentre above the centre of gravity.

(b) Stable equilibrium of submerged body : Centre of buoyancy above the centre of gravity.

(c) Unstable equilibrium of a body floating : Metacentre below the centre of gravity.

(d) Unstable equilibrium of a submerged body : Centre of buoyancy below the centre of gravity.

49. ***Ans.* (a)**

Viscous forces and pressure forces are responsible for drag forces.

50. ***Ans.* (c)**

$$\text{Hydraulicdepth} = \frac{\text{Surface area}}{\text{wettedperimeter}}$$

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