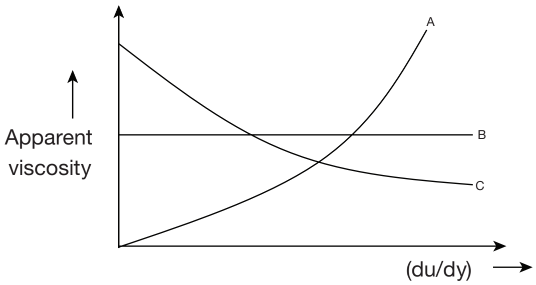
Fluid Mechanics Test 3

Number of Questions: 25 **Time:60 min.**

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Match the following curves (A, B, C) given in the figure with the List (1, 2, 3) given below.



List:

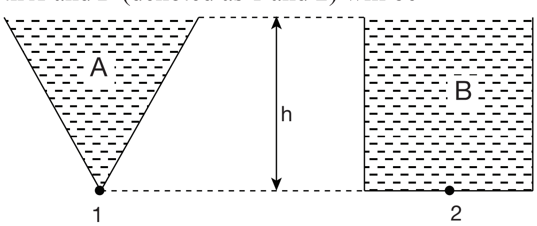
1. Pseudo-plastic fluid
2. Newtonian fluid
3. Dilatent fluid

(A) $A-1, B-2, C-3$ (B) $A-3, B-2, C-1$
(C) $A-1, B-3, C-2$ (D) $A-2, B-3, C-1$

2. What is the surface tension (N/m) if the difference in pressure is 288 N/m^2 across a water drop of diameter 0.001 m?

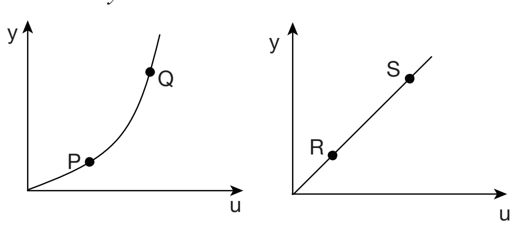
(A) 0.072 (B) 0.288
(C) 0.036 (D) 0.144

3. There are two containers A and B filled with water shown in the figure. The pressure (P) at the bottom of both A and B (denoted as 1 and 2) will be



(A) $P_1 > P_2$ (B) $P_1 < P_2$
(C) $P_1 = P_2$ (D) Cannot be determined

4. For a viscous flow of an incompressible fluid over a fixed plate, variations of velocity of fluid layer (u) with the distance 'y' from the fixed surface are as shown.



For same coefficient of friction, the CORRECT order of shear stress at P, Q, R, S will be

(A) $\tau_P < \tau_Q; \tau_R < \tau_S$ (B) $\tau_P > \tau_Q; \tau_R > \tau_S$
(C) $\tau_P < \tau_Q; \tau_R = \tau_S$ (D) $\tau_P > \tau_Q; \tau_R = \tau_S$

5. A Pitot static tube is used to measure velocity of water using a differential gauge which contains a manometric fluid of relative density 1.6. If the velocity of the water is 1.4 m/s and the coefficient of the tube may be assumed to be 1, then the deflection of the gauge fluid (in mm) will be

(A) 173.4 (B) 183.5
(C) 166.5 (D) 162.3

6. Pseudoplastic is a fluid for which

(A) Dynamic viscosity increases with the time for which shearing forces are applied.
(B) Newton's law of viscosity holds good.
(C) Dynamic viscosity decreases as the rate of shear increases.
(D) Dynamic viscosity increases as the rate of shear increases.

7. Consider the following statements:

The metacentric height of a floating body depends

(1) on the second moment of water-line area.
(2) on the distance between the metacentre and the centre of gravity.
(3) directly on the shape of its water-line area.
(4) on the volume of liquid displaced by the body

Which of these statements are CORRECT?

(A) 1 and 2 (B) 2 and 3
(C) 3 and 4 (D) 1 and 4

8. Match List-I (properties of fluids) with List-II (Definition/Results) and select the correct answer using the codes given below the lists:

List-I	List-II
P. Ideal fluid	1. Viscosity does not vary with rate of deformation.
Q. Newtonian fluid	2. Fluid of zero viscosity.
R. μ/ ρ	3. Dynamic viscosity
S. Mercury in glass	4. Capillary depression
	5. Kinematic viscosity
	6. Capillary rise

Codes:-

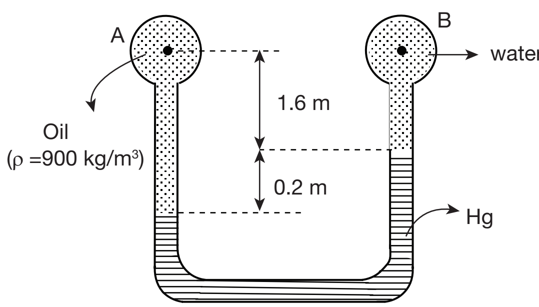
	P	Q	R	S		P	Q	R	S
(A)	1	2	3	4	(B)	1	2	4	6
(C)	2	1	5	4	(D)	2	1	3	6

9. If the surface tension of water-air interface is 0.08 N/m, the gauge pressure (N/m^2) inside a rain drop of 0.8 mm diameter will be

(A) 200 (B) 292
(C) 800 (D) 400

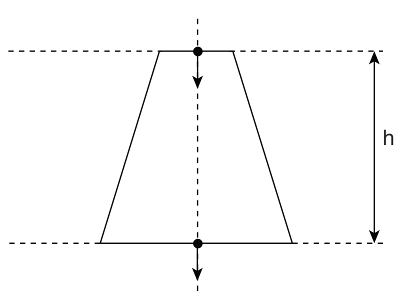
10. A pontoon of 10000 kN displacement is floating in water. A weight of 200 kN is moved through a distance of 8 m across the deck of pontoon, which tilts the pontoon through an angle of 4°. The meta centric height of the pontoon will be
(A) 1.788 m (B) 2.288 m
(C) 1.291 m (D) 2.413 m

11. Two pipelines, one filled with an oil of density 900 kg/m^3 and other with water are connected to a manometer as shown. By what amount of pressure, in the water pipe, should we increase without changing oil pressure so that the level of the mercury becomes same in both the limbs of the manometer.



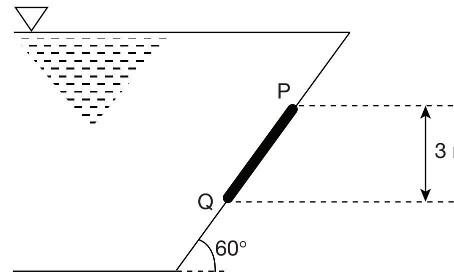
(A) 2.53 kPa (B) 17 kPa
(C) 24.82 kPa (D) 21.2 kPa

12. A liquid flows downward through a tapered vertical portion of a pipe. At inlet and exit of the pipe, the pressure is atmospheric. If for a vertical height 'h' the velocity becomes one-fifth times, then the ratio of 'h' to the velocity head at exit will be



(A) 24 (B) 26
(C) –24 (D) –26

13. An inclined gate PQ stops the water flow from a reservoir container as shown in the figure. Pressure at P and Q are ρg meters and 4ρg meters respectively. The vertical distance of the center of pressure from the free surface will be



(A) 2 m (B) 2.8 m
(C) 1.4 m (D) 2.3 m

14. Water is flowing through an inclined venturimeter of inlet diameter of 30 cm and throat size of 15 cm. The difference between the main and throat pressure measured by an inverted liquid manometer with the liquid of density 700 kg/m^3 gives a reading of 26 cm. If the loss of head between the main, and the throat is 0.2 times of kinetic energy of main then the discharge of water flowing through the venturimeter (in litres/sec) will be
(A) 27.82 (B) 32.41
(C) 20.32 (D) 22.73

15. A piece of plastic of volume 10 m^3 and specific gravity of 0.88 floats on the surface of an oil of specific gravity 1.408. The portion of the body which is submerged in the liquid will be (in m^3)
(A) 10 (B) 6.25
(C) 8.34 (D) 7.24

16. A 2 m diameter open cylindrical tank is filled with water upto depth of 2 m. The height of the tank is 3 m. The tank is rotated about the vertical centre line of cylinder so that the water just spills out of the cylinder. The gauge pressure at the bottom of tank, 0.6 m away from axis of rotation (in kPa) will be
(A) 19.83 (B) 15.81
(C) 14.72 (D) 16.87

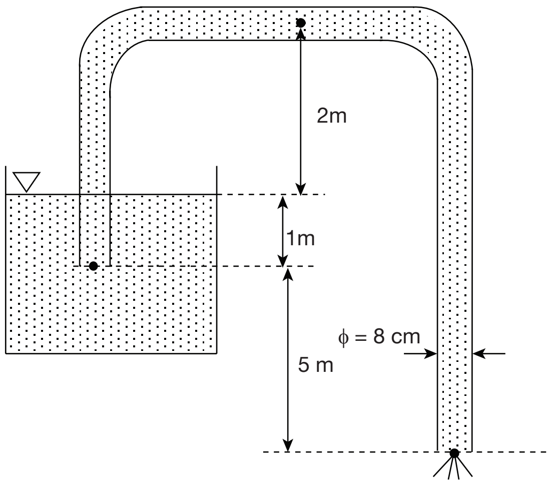
17. A 40 cm diameter pipe, conveying water, branches into two pipes of diameter 20 cm and 15 cm respectively. If the average velocity in the 40 cm diameter pipe and 20 cm diameter pipe are 3.0 m/s and 4.2 m/s respectively then the velocity in 15 cm diameter pipe will be
(A) 11.21 m/s (B) 15.873 m/s
(C) 13.867 m/s (D) 12.363 m/s

18. When the difference of mercury level in a differential U-tube manometer connected to the two tappings of the pitot tube is 100 mm and the coefficient of pitot-tube is 0.98, then the discharge of the flow of water through a pipe of diameter 100 mm will be
(A) 0.0383 m^3/s (B) 0.383 m^3/s
(C) 4.87 m^3/s (D) 0.487 m^3/s

19. The stream function of a two-dimensional flow is $\psi = 5xy + 5$. The flow is

(A) Rotational
(B) Irrotational
(C) Vortex flow
(D) Unsteady pulsating flow

20. A tube is used as siphon to discharge an oil of specific gravity 0.85 from a large open vessel into a drain at atmospheric pressure as shown in the figure. Discharge of oil through the siphon (in m^3/s) will be



(A) 0.1123 (B) 0.01212
(C) 0.5454 (D) 0.05454

21. The velocity field in a fluid medium is given by $\vec{v} = 3xy^2\,\vec{i} + 2xy\,\vec{j} + (2zy + 3t)\,\vec{k}$

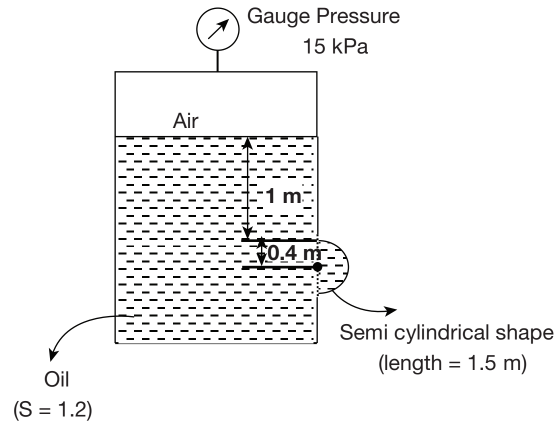
The vorticity of a fluid element at (1, 2, 1) and at $t = 4$ will be

(A) $i - 4\vec{k}$ (B) $2\vec{i} - 8\vec{k}$
(C) $4\vec{i} - \vec{k}$ (D) $\dfrac{\vec{i}}{2} - 2\vec{k}$

22. A cylinder of 0.15 m radius rotates concentrically inside a fixed hollow cylinder of 0.16 m radius. Both the cylinders are 0.3 m long. If a torque of 0.90 N-m is required to maintain an angular velocity of 2π rad/s, then the viscosity of the liquid (in *Pa-s*) which fills the space between the cylinders will be

(A) 0.321 (B) 0.263
(C) 0.211 (D) 0.113

23. Oil of specific gravity 1.2 is filled in a closed container upto a height of 1 m from the protruded semi cylindrical surface as shown in the figure. The resultant of horizontal force and vertical force will be



(A) 38 kN (B) 37 kN
(C) 41 kN (D) 40 kN

24. A velocity field is given by
$\vec{v} = 5x^3\vec{i} - 15x^2 y\vec{j} + t\vec{k}$

Which of the following statement is CORRECT?
(A) Incompressible and Irrotational Flow.
(B) Compressible and Irrotational Flow.
(C) Incompressible and Rotational Flow.
(D) Flow is not possible

25. An inclined tube manometer consists of a vertical cylinder of 35 mm diameter and 5 mm diameter tube. Tube is connected at the bottom of the cylinder and inclined upwards at 15° from the horizontal. The manometer contains oil of relative density 0.785. The open end of the inclined tube is connected to air duct while the top of cylinder is open to atmosphere. If the manometric fluid moves 50 mm up along the inclined tube, then the gauge pressure (in kPa) in the air duct will be
(A) 117.5 (Vaccum) (B) 107.5 (absolute)
(C) 107.5 (Vaccum) (D) 117.5 (absolute)

Answer Keys

1. B	**2.** A	**3.** C	**4.** D	**5.** C	**6.** C	**7.** B	**8.** C	**9.** D	**10.** B
11. C	**12.** C	**13.** B	**14.** D	**15.** B	**16.** D	**17.** C	**18.** A	**19.** B	**20.** D
21. B	**22.** C	**23.** A	**24.** C	**25.** C					

Hints and Explanations

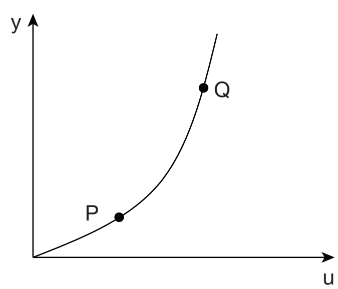
1. **Pseudoplastic fluid:** Apparent viscosity decreases with rate of shear deformation. examples: blood, milk.
Newtonian fluid:- Viscosity is independent of the velocity gradient.
Dilatent fluid:- Apparent viscosity increases with rate of shear deformation. Choice (B)

2. Difference in pressure, $\Delta P = \frac{2T}{R}$

$\therefore \quad 288 = \frac{2 \times T}{0.0005} \Rightarrow T = 0.072$ N/m Choice (A)

3. Pressure at the bottom of the vessel is independent of the shape of the vessel. This is known as hydrostatic paradox given by *D*-Alembert. Choice (C)

4.



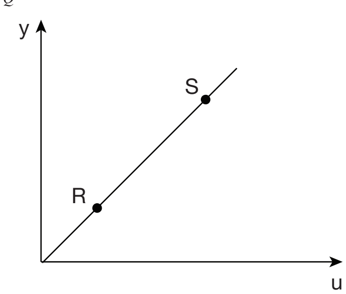
Slope $= \frac{dy}{du}$

Here, $\left(\frac{dy}{du}\right)_Q > \left(\frac{dy}{du}\right)_P$ or $\left(\frac{du}{dy}\right)_P > \left(\frac{du}{dy}\right)_Q$

$\left\{\because \frac{du}{dy} = \frac{1}{\text{slope}} = \frac{1}{dy/du}\right\}$

$\because \quad \tau = \mu \frac{du}{dy}$,

$\therefore \quad \tau_P > \tau_Q$



Here, $\left(\frac{dy}{du}\right)_R = \left(\frac{dy}{du}\right)_S$

$\{\because$ slope is constant$\}$ or $\left(\frac{du}{dy}\right)_R = \left(\frac{du}{dy}\right)_S$

$\therefore \quad \tau_R = \tau_S$ Choice (D)

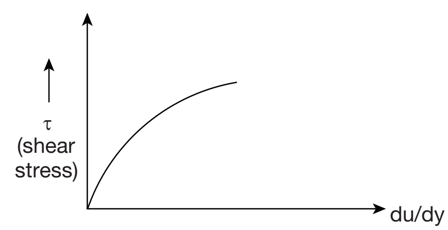
5. Velocity, $V_1 = \sqrt{2gh\left[\frac{S_m}{S_w} - 1\right]}$

h = Manometric deflection
S_m = specific gravity of manometric fluid
S_W = specific gravity of flowing fluid

$\therefore \quad 1.4 = \sqrt{2 \times 9.81 \times h\left[\frac{1.6}{1} - 1\right]}$

$\Rightarrow \quad h = 0.1665$ m or 166.5 mm Choice (C)

6.



Choice (C)

7. Choice (B)

8. Choice (C)

9. Pressure intensity inside a droplet, $P = \frac{4\sigma}{d}$

$\Rightarrow \quad P = \frac{4 \times 0.08}{0.8 \times 10^{-3}} = 400$ N/m^2 Choice (D)

10. Metacentric height $= \frac{w_1 x}{W \tan\theta} = \frac{200 \times 8}{10000 \times \tan 4°}$

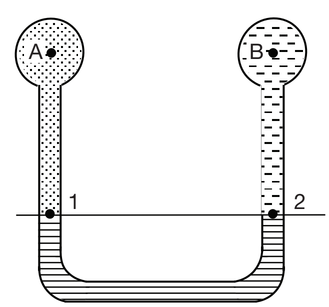
$= 2.288$ m Choice (B)

11. From the given figure,

$\frac{P_A}{\rho g} + [(1.6 + 0.2) \times 0.9] - (0.2 \times 13.6) - 1.6 = \frac{P_B}{\rho g}$

$\therefore \quad \frac{P_A - P_B}{\rho g} = 2.7$ m of water

Now,



Here $P_1 = P_2$

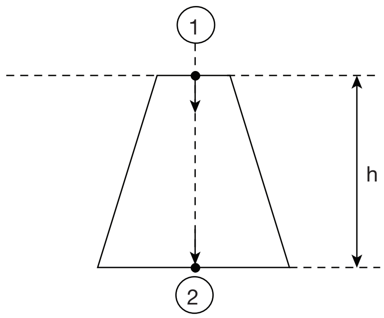
$\therefore \quad \frac{P_A}{\rho g} + 1.7 \times 0.9 = \frac{(P_B + \Delta P)}{\rho g} + 1.7$

Now $\frac{P_A - P_B}{\rho g} - \frac{\Delta P}{\rho g} = 1.7 - (1.7 \times 0.9)$

$\Rightarrow \quad -\dfrac{\Delta P}{\rho g} = 0.17 - 2.7$

or $\Delta P = 24.82$ kPa. Choice (C)

12. Applying Bernoulli's equation between inlet (1) and exit (2) of the pipe.



$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2$$

Now $P_1 = P_2$

$\therefore \quad \dfrac{V_1^2}{2g} + h = \dfrac{V_2^2}{2g}$

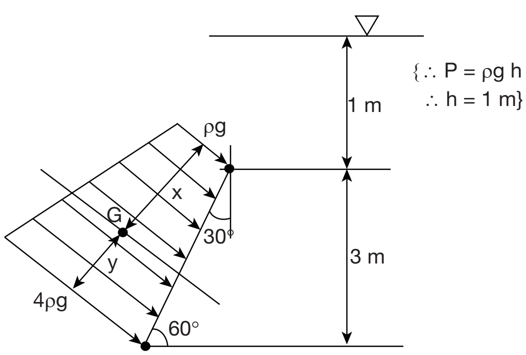
Now, $V_1 = 5\,V_2$ [Given]

$\therefore \quad \dfrac{(5v_2)^2}{2g} + h = \dfrac{V_2^2}{2g}$

$\Rightarrow \quad \dfrac{25v_2^2}{2g} + h = \dfrac{V_2^2}{2g}$

$\therefore \quad h = -24\dfrac{V_2^2}{2g}$ or $\dfrac{h}{\frac{v_2^2}{2g}} = -24$ Choice (C)

13. We know that, center of pressure is the centroid of the pressure diagram.

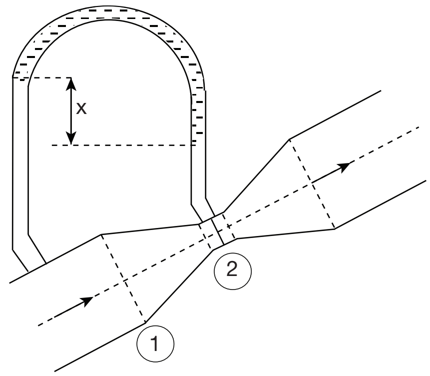


$$y = \frac{[(2\times\rho g) + 4\rho g]}{[\rho g + 4\rho g]} + \frac{3}{(\cos 30°)} = 1.38564\,\text{m}$$

Now $x = \dfrac{3}{\cos 30°} - 1.38564 = 2.07846$ m

$\therefore \quad y_{cp}$ from free surface = 2.07846 Cos 30° + 1 = 2.8 m Choice (B)

14.



Difference of pressure head at section 1 – 2

$$h = \left[\frac{P_1}{\rho g} + z_1\right] - \left[\frac{P_2}{\rho g} + z_2\right] = x\left[1 - \frac{S_l}{S_w}\right]$$

$\therefore \quad h = 0.26 \times \left[1 - \dfrac{0.7}{1}\right] = 0.078\,\text{m}$

Applying Bernoulli's equation between 1 – 2

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2 + h_L$$

$\Rightarrow \quad \left[\dfrac{P_1}{\rho g} + z_1\right] - \left[\dfrac{P_2}{\rho g} + z_2\right] = \dfrac{V_2^2 - V_1^2}{2g}\left[\dfrac{V_1^2}{2g} \times 0.2\right]$

$\Rightarrow \quad h = 0.078 = \dfrac{V_2^2}{2g} - \dfrac{V_1^2}{2g} - 0.2\dfrac{V_1^2}{2g}$

$\therefore \quad V_2^2 - 1.2V_1^2 = 1.53036$ $\rightarrow$ (1)

Now $A_1\,V_1 = A_2\,V_2$

$\Rightarrow \quad \dfrac{\pi}{4}\,(30)^2 \times V_1 = \dfrac{\pi}{4} \times (15)^2 \times V_2$

or $4V_1 = V_2$ $\rightarrow$ (2)

From equation (1) and (2) we get

$(4\,V_1)^2 - 1.2\,V_1^2 = 1.53036$

$\Rightarrow \quad V_1 = 0.321563$ m/s

$\therefore \quad$ Discharge rate, $Q = A_1\,V_1 = \dfrac{\pi}{4} \times 0.3^2 \times 0.321563$

$\Rightarrow \quad Q = 0.02273\ \text{m}^3/\text{sec} = 22.73$ liters/sec

Choice (D)

15. Weight of plastic = weight of water displaced

$\therefore \quad \rho_p \times g \times V_P = \rho_o \times g \times V_o$

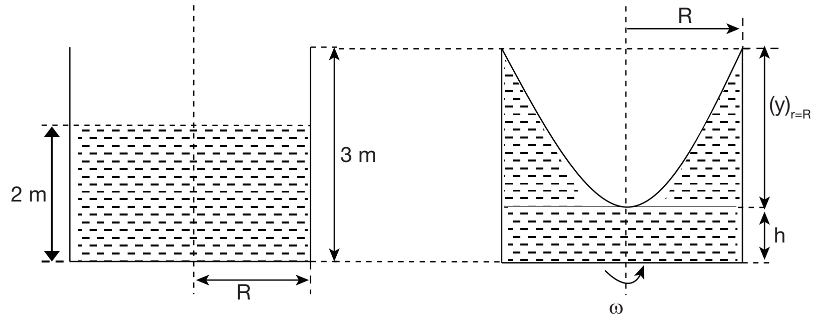
Here V_o = Displaced volume of oil due to the submerged plastic volume.

V_P = Total plastic volume

$0.88 \times 1000 \times g \times 10 = 1.408 \times 1000 \times g \times V_o$

$\Rightarrow \quad V_o = 6.25\ \text{m}^3$ Choice (B)

16.



$(y)_{r=R} = \frac{\omega^2 R^2}{2g}$

Now, since no water spills out, therefore

Initial volume of water = Final volume of water

$\pi R^2 \times (2) = \pi R^2 h + \frac{1}{2}[\pi R^2](y)_{r=R}$

Now $(y)_{r=R} + h = 3$ m or $(y)_{r=R} = (3 - h)$ m

$\therefore \quad \pi \times (1)^2 \times 2 = \pi \times (1)^2 \times h + \frac{1}{2}[\pi \times 1^2] \times (3 - h)$

$\therefore \quad h = 1$ m

$\therefore \quad (y)_{r=R} = 3 - 1 = 2$ m

Now $(y)_{r=R} = \frac{\omega^2 R^2}{2g} \Rightarrow \omega = \sqrt{\frac{2 \times 2 \times 9.81}{1^2}}$

$\Rightarrow \quad \omega = 6.264$ rad/sec

$(y)_{r=0.6m} = \frac{\omega^2 \times (0.6)^2}{2g} = \frac{6.264^2 \times 0.6^2}{2 \times 9.81}$

$\Rightarrow \quad (y)_{r=0.6m} = 0.72$ m

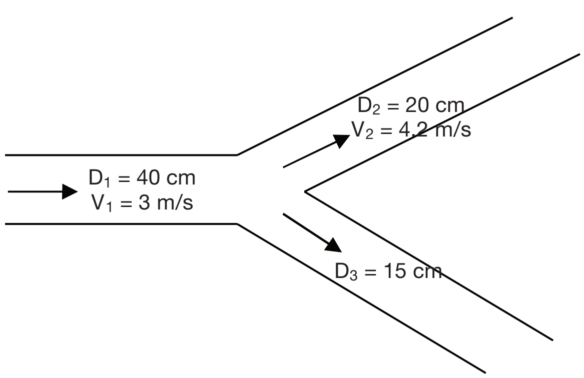
$\therefore$ Pressure at the bottom of tank, P will be

$P = \rho g \times [(y)_{r=0.6} + h]$

$= 1000 \times 9.81 \times [0.72 + 1] = 16.8732$ kPa

Choice (D)

17.



According to continuity equation

$Q_1 = Q_2 + Q_3 \Rightarrow A_1 V_1 = A_2 V_2 + A_3 V_3$

$\Rightarrow \quad D_1^2 \times V_1 = (D_2^2 \times V_2) + (D_3^2 \times V_3)$

$\Rightarrow \quad (0.4^2 \times 3) = (0.2^2 \times 4.2) + (0.15^2 \times V_3)$

$\Rightarrow \quad V_3 = 13.867$ m/s

Choice (C)

18. Difference of pressure head, $h = x\left[\frac{S_g}{S_w} - 1\right]$

$\Rightarrow \quad h = 0.1\left[\frac{13.6}{1} - 1\right] = 1.26\text{ m}$

$\therefore$ Velocity of flow, $V = C_V \sqrt{2gh}$

$\Rightarrow \quad V = 0.98 \times \sqrt{2 \times 9.81 \times 1.26} = 4.8726$ m/s

and Discharge, $Q = AV = \frac{\pi}{4} \times 0.1^2 \times 4.8726$

$\Rightarrow \quad Q = 0.0382693$ m³/s

Choice (A)

19. $\Psi = 5xy + 5$

$\frac{\partial \Psi}{\partial x} = 5y = v$ and $\frac{\partial \Psi}{\partial y} = -5x = -u$

Rotational component along z-axis

$\omega_z = \frac{1}{2}\left[\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right] = 0$

and $\omega_x = \omega_y = 0$

$\therefore$ Flow is irrotational.

Choice (B)

20. Applying Bernoulli's equation between points 1 and D.

$\frac{P_{atm}}{\rho g} + \frac{V_1^2}{2g} + 6 = \frac{P_D}{\rho g} + \frac{V_D^2}{2g} + 0$

$\because \quad P_D = P_{atm}$ and $V_1 <<< V_D$

$\therefore \quad 6 = \frac{V_D^2}{2g} \Rightarrow V_D = \sqrt{2 \times 9.81 \times 6}$

$\Rightarrow \quad V_D = 10.85$ m/s

Discharge, $Q = A_1 V_1 = \frac{\pi}{4} \times 0.08^2 \times 10.85$

$\Rightarrow \quad Q = 0.05454$ m³/sec

Choice (D)

21. Rotational velocity vector, $\vec{\omega}$

$$\vec{\omega} = \frac{1}{2}(\nabla \times \vec{\Delta}) = \frac{1}{2}\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ u & v & w \end{vmatrix}$$

$$\Rightarrow \quad \vec{\omega} = \frac{\vec{i}}{2}\left[\frac{\partial w}{\partial y} - \frac{\partial v}{\partial z}\right] + \frac{\vec{j}}{2}\left[\frac{\partial u}{\partial z} - \frac{\partial w}{\partial x}\right] + \frac{\vec{k}}{2}\left[\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right]$$

$$\Rightarrow \quad \vec{\omega} = \vec{i}\,\frac{1}{2}\left[\frac{\partial}{\partial y}(2zy+3t) - \frac{\partial}{\partial z}(2xy)\right] + \vec{j}\,\frac{1}{2}\left[\frac{\partial}{\partial z}(3xy)^2 - \frac{\partial}{\partial x}(2zy+3t) + \vec{k}\,\frac{1}{2}\left[\frac{\partial}{\partial x}(2xy) - \frac{\partial}{\partial y}(3xy^2)\right]\right]$$

$\therefore \quad \omega = z\vec{i} + (y - 3xy)\vec{k}$

At (1, 2, 1) and $t = 4$

$\vec{\omega} = \vec{i} - 4\vec{k}$

Vortivity $\vec{\Omega} = 2\vec{\omega} \Rightarrow \vec{\Omega} = 2(\vec{i} - 4\vec{k})$

$\Rightarrow \quad \vec{\Omega} = 2\vec{i} - 8\vec{k}$ Choice (B)

22. Torque applied = Resisting torque by the fluid = (shear stress) × (surface area) × (radius)

Hence, at any radial location r from the axis of rotation

$0.9 = \tau[2\pi r \times 0.3]r \Rightarrow \tau = \dfrac{0.47746}{r^2}$

Now $\tau = -\mu\dfrac{dv}{dr} \Rightarrow \dfrac{dv}{dr} = \dfrac{-0.47746}{\mu r^2}$

$$\Rightarrow \quad \int_{V_{outer}}^{V_{inner}} dV = \frac{0.47746}{\mu}\int_{0.16}^{0.15} -\frac{dr}{r^2}$$

Hence $V_{\text{inner}} - V_{\text{outer}} = \dfrac{0.47746}{\mu}\left[\dfrac{1}{r}\right]_{0.16}^{0.15}$

Velocity at inner cylinder, $V_{\text{inner}} = \omega\, r_{\text{inner}}$

$\Rightarrow \quad V_{\text{inner}} = 2\pi \times 0.15$

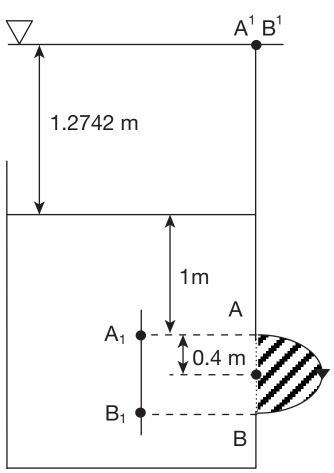
$\therefore \quad [(2\pi \times 0.15) - 0] = \dfrac{0.47746}{\mu} \times \left[\dfrac{1}{0.15} - \dfrac{1}{0.16}\right]$

$\Rightarrow \quad \mu = 0.211$ *Pa-s* Choice (C)

23. Free surface is at a distance 1.27 m from the oil surface.

$\because \quad P = 15$ kPa $= \rho g x$

or $x = \dfrac{15}{1.2 \times 9.81} = 1.2742$ m



Horizontal Force, $F_H = \rho g \bar{x}\ A$

= 1000 × 1.2 × 9.81 × [1.2742 + 1 + 0.4] × 0.8 × 1.5

= 37.776 kN

Vertical Force = (Area under $A - B - A^1\ B^1 - A$) × length × ρ × g

$= \dfrac{\pi \times 0.4^2}{2}$ × 1.5 × 1.2 × 1000 × 9.81 = 4.438 kN

Resultant $= \sqrt{F_H^2 + F_V^2} = \sqrt{37.776^2 + 4.438^2}$

= 38.036 kN Choice (A)

24. For incompressible fluid flow to occur, equation of continuity has to be satisfy.

$\therefore \quad \nabla.\vec{V} = \dfrac{\partial u}{\partial x} + \dfrac{\partial v}{\partial y} + \dfrac{\partial w}{\partial z} = 0$

$\Rightarrow \quad 15x^2 - 15x^2 + 0 = 0$

$\therefore$ Flow is incompressible.

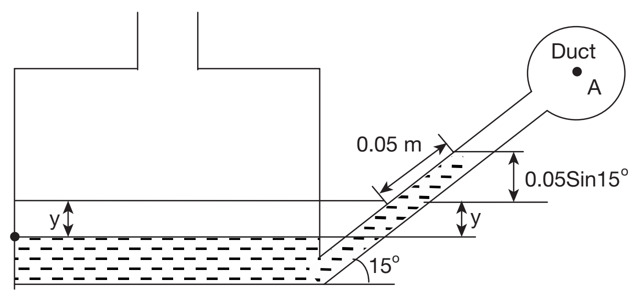
Now for irrotational flow,

$$\omega = \frac{1}{2}\,\text{curl}\,\vec{V} = 0 \Rightarrow \frac{1}{2}\begin{vmatrix} i & j & k \\ \dfrac{\partial}{\partial x} & \dfrac{\partial}{\partial y} & \dfrac{\partial}{\partial z} \\ 5x^3 & -15x^2 y & t \end{vmatrix} = \omega$$

$\Rightarrow \quad \omega = \dfrac{1}{2}i[0] - j[0] + [-30xy] \neq 0$

$\therefore$ It is Rotational flow. Choice (C)

25.



Volume of liquid displaced is same in both cylinder and tube.

$\therefore \quad \dfrac{\pi}{4} \times D^2 \times y = \dfrac{\pi}{4} \times d^2 \times I$

$\Rightarrow \quad y = [0.005^2 \times 0.05]/0.035^2$

$\Rightarrow \quad y = 0.0010204$ m

Now $\dfrac{P_P}{\rho g} - y \times S_{0il} - [0.05 \times \text{Sin}15^o \times S_{0il}] = \dfrac{P_A}{\rho g}$

$\because \quad P_P = 0$ [Gauge Atmospheric]

0 – (0.0010204 × 0.785) – (0.05 × Sin15° × 0.785) $= \dfrac{P_A}{\rho g}$

$\Rightarrow \quad P_A = -107.5$ kPa or $P_A = 107.5$ kPa (Vacuum)

Choice (C)