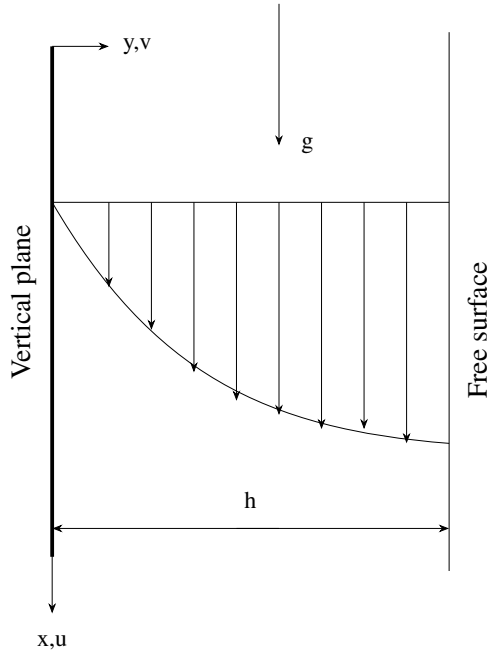


- 27) The hydraulic diameter for a circular pipe of radius R is [2024-XE]
- a) $0.5R$
 - b) R
 - c) $2R$
 - d) $4R$
- 28) For incompressible, laminar, fully-developed flow through a circular pipe, Darcy friction factor and Fanning friction factor are represented as f and C_f , respectively. Which one of the following options is correct? [2024-XE]
- a) $f = 0.25C_f$
 - b) $f = 0.5C_f$
 - c) $f = 2C_f$
 - d) $f = 4C_f$
- 29) For an immersed neutrally buoyant body to be in stable equilibrium, the center of gravity of the body is directly [2024-XE]
- a) above the metacenter.
 - b) below the metacenter.
 - c) above the center of buoyancy.
 - d) below the center of buoyancy.
- 30) The absolute pressure in a chamber is measured as 400 mm Hg at a location where the atmospheric pressure is 700 mm Hg. A vacuum gauge connected to the chamber reads _____ mm Hg (answer in integer) [2024-XE]

- 31) A thin film of incompressible, Newtonian liquid (density ρ , viscosity μ) with a uniform thickness (h) is flowing down on a vertical plate. The flow is driven by gravity (g) alone. Assume zero shear stress condition at the free surface. [2024-XE]



The maximum velocity is given by

- a) $\frac{1}{2\mu}\rho gh^2$
 - b) $\frac{1}{4\mu}\rho gh^2$
 - c) $\frac{1}{\mu}\rho gh^2$
 - d) $\frac{1}{8\mu}\rho gh^2$
- 32) A one-eighth scale model of a car is to be tested in a wind tunnel. If the air velocity over the car is $16 \frac{m}{s}$, what should be the air velocity ($\text{in } \frac{m}{s}$) in the wind tunnel in order to achieve similarity between the model and the prototype? [2024-XE]
- a) 2
 - b) 16

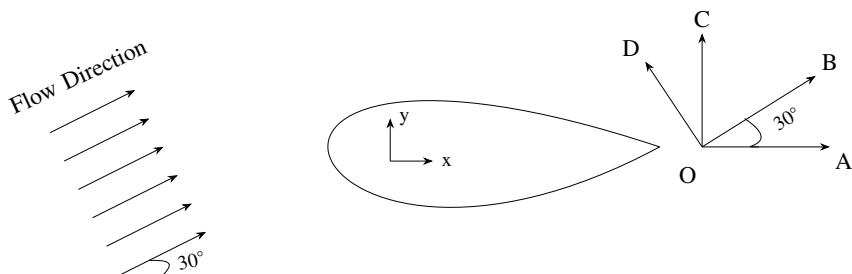
c) 64

d) 128

33) A set of basic dimensions, mass, length, and time are represented by M , L , and T respectively. What will be the dimensions of pressure in $M-L-T$ system? [2024-XE]

a) $ML^{-1}T^{-2}$ b) MLT^{-2} c) MLT^{-1} d) $ML^{-1}T^{-1}$

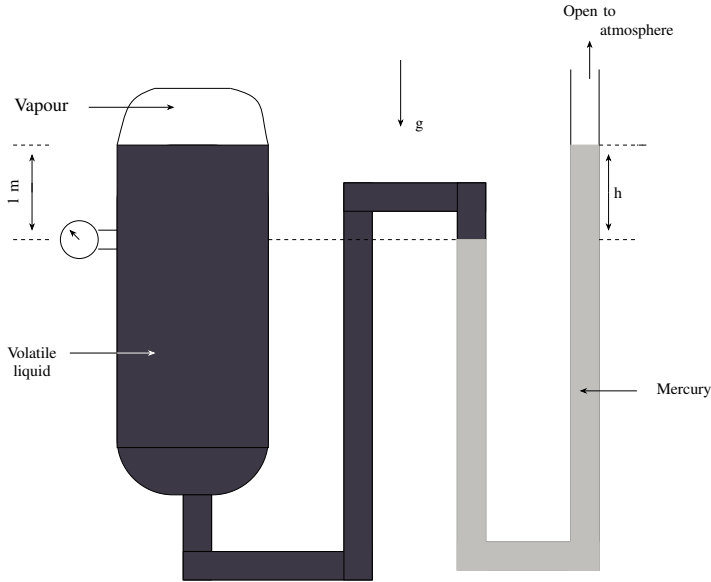
34) Consider a fluid flow around an airfoil as shown in figure.



The directions of drag force and lift force, respectively are along [2024-XE]

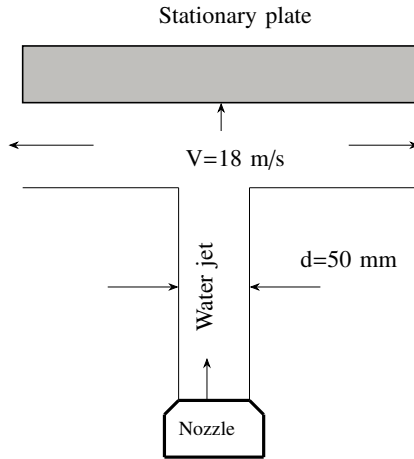
a) OA and OC b) OA and OD c) OB and OC d) OB and OD

- 35) A vessel which contains a volatile liquid and its vapor is connected with a mercury manometer as shown in figure. Both the liquid and vapor phases are at equilibrium. The vapor pressure and density of the volatile liquid are 107.6 kPa and $700 \frac{\text{kg}}{\text{m}^3}$, respectively. The density of the mercury is $13600 \frac{\text{kg}}{\text{m}^3}$. Acceleration due to gravity (g) is $10 \frac{\text{m}}{\text{s}^2}$ and atmospheric pressure is 101 kPa . Hydrostatic pressure created by the weight of the vapor is neglected.



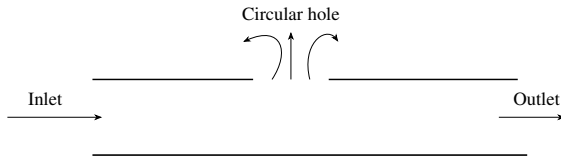
The height, h , (in m, rounded off to two decimal places) of the mercury column in figure is _____. [2024-XE]

- 36) The velocity in a one-dimensional flow is given by $u(x) = \frac{a}{(b-x)^2} \frac{\text{m}}{\text{s}}$, where $a = 8 \frac{\text{m}}{\text{s}^2}$ and $b = 4\text{ m}$. The acceleration (in $\frac{\text{m}}{\text{s}^2}$, answer in integer) at $x = 2\text{ m}$ is _____. [2024-XE]
- 37) Consider two parallel plates separated by a distance of 1 cm filled with a Newtonian fluid of viscosity $10^{-3}\text{ Pa}\cdot\text{s}$. The top plate is moving with a velocity of $1 \frac{\text{m}}{\text{s}}$ whereas the bottom plate is stationary. The shear stress (in Pa, rounded off to one decimal) on the top plate is _____. [2024-XE]
- 38) A circular water jet of diameter 50 mm impinges with a velocity of $18 \frac{\text{m}}{\text{s}}$ normal to a plate. The density of water is $1000 \frac{\text{kg}}{\text{m}^3}$ and gravity force is neglected.



The magnitude of net force (in N, rounded off to two decimal places) imparted by the jet on the stationary plate is _____. [2024-XE]

- 39) Consider the steady, incompressible flow of water in a horizontal pipe of constant diameter 1 m with an inlet velocity of $12\frac{\text{m}}{\text{s}}$.



As shown in the figure, water is lost through a circular hole of diameter 0.6 m at the rate of $4.53\frac{\text{m}^3}{\text{s}}$. The outlet velocity (in $\frac{\text{m}}{\text{s}}$, rounded off to two decimal places) of water in the pipe is _____. [2024-XE]