DPP – 3

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/82

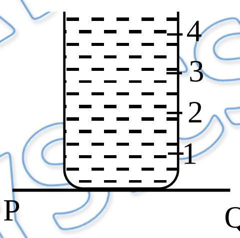
Video Solution on YouTube:- https://youtu.be/dtbAn-lu34Q

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/20

Q 1. Water is flowing through a tube of non uniform cross section. If the radii of the tube at the entrance and exit are in the ratio 3 : 2, then the ratio of velocity of liquid entering and leaving the tube is-
(a) 1 : 1 (b) 4 : 9 (c) 9 : 4 (d) 8 : 27

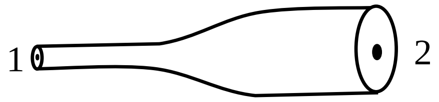
Q 2. A tank is filled with water to a height H. A hole is punched in one of the walls at a depth h below the water surface. Then the distance x from the foot of the wall at which the stream strikes the floor is –
(a) $2\sqrt{Hh}$ (b) $\sqrt{2(H-h)H}$
(c) $2\sqrt{(H-h)h}$ (d) $2h\left(\frac{H-h}{H}\right)$

Q 3. A cylindrical vessel of 90cm height is kept filled upto the brim. It has four holes 1, 2 , 3, 4 which are respectively at heights of 20cm, 30cm, 40cm and 50cm from the horizontal floor P, Q. The water falling at the maximum horizontal distance from the vessel comes from –



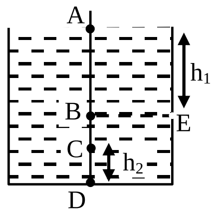
(a) hole number 4 (b) hole number 3
(c) hole number 2 (d) hole number 1

Q 4. Figure shows a section of tube of varying cross section area. Let A_1, v_1, ρ_1 respectively be cross-sectional area, velocity of fluid (an ideal gas) and density of liquid at 1 and corresponding value at '2' be A_2, v_2 & ρ_2 respectively. Assuming temperature at point 1 and 2 to be same –



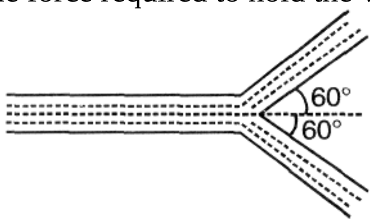
(a) $A_1v_1 < A_2 v_2$ (b) $A_1v_1 = A_2v_2$
(c) $A_1v_1\rho_1 = A_2v_2\rho_2$ (d) $v_1 = v_2$

Q 5. A incompressible and non–viscous liquid of density 'ρ' is kept in a cylindrical container having a opening at 'E'. Then –



(a) $P_B - P_A = h_1\rho g$ (b) $P_D - P_C = h_2\rho g$
(c) $P_B > P_E$ (d) $P_A = P_E$

Q 6. Fresh water issues from the nozzle with a velocity of 20 m/sec at the rate of 0.03 m^3/sec and is split into two equal streams by the fixed vane and deflected through 60° as shown in figure. The force required to hold the vane on place is

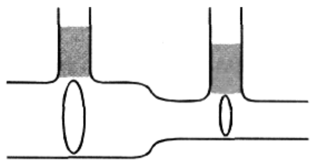


((a) 300 N towards right (b) 300 N towards left
(c) 600 N towards right (d) 600 N towards left

Q 7. A tennis ball receives a top spin when struck by a rocket and describe a curved trajectory. The top spin implies that the rotating motion of the surface of the ball is in the direction of the translating motion of the ball. Then pressure on the top surface is (w.r.t. Bottom surface)

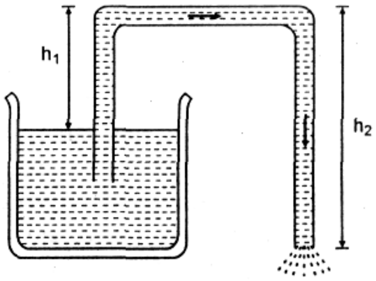
(a)Lower (b)Higher (c)Same (d)Depends on other factors

Q 8. In the experimental arrangement shown in figure the areas of cross-section of the wide and narrow portions of the tube are 5 cm^2 and 2 cm^2 respectively. The rate of flow of water through the tube is 500 cm^3/sec. The difference of mercury levels in the U-tube is



(a) 0.97 cm (b) 1.93 cm (c) 0.67 cm (d) 4.67 m

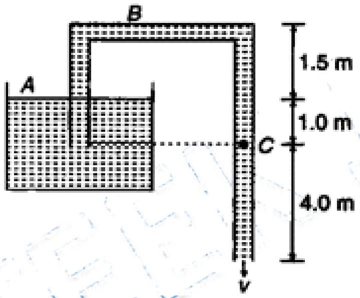
Q 9. Siphon is a device to transfer liquid from a higher level to a lower level. The condition of working of a siphon is:



(a) $h_2 > h_1$
(b) $h_2 = 2\ h_1$
(c) h_1 should be less than the height of corresponding liquid barometer
(d) h_1 should be greater than the height of corresponding liquid barometer

Comprehension (Q.10 to Q.12)

A siphon tube is discharging a liquid of density 900 kg/m^3 as shown in figure. ($P_0 = 1.01 \times 10^5$ N/m^2)

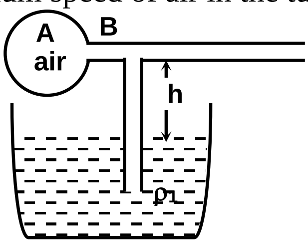


Q 10. The speed of liquid through the siphon is:
(a) 6 m/s (b) 8 m/s (c) 10 m/s (d) 12 m/s

Q 11. Pressure at point B is:
(a) 4.25×10^4 N/m^2 (b) 6.25×10^4 N/m^2
(c) 2.50×10^4 N/m^2 (d) 2.0×10^5 N/m^2

Q 12. Pressure at point C is:
(a) 5.5×10^4 N/m^2 (b) 6.5×10^4 N/m^2
(c) 8.0×10^4 N/m^2 (d) 10.5×10^4 N/m^2

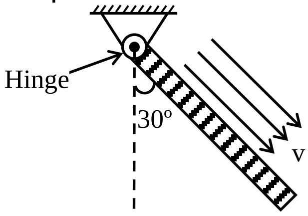
Q 13. The figure shows a model of perfume atomizer. When the bulb A is compressed, air flows through the narrow tube. Consequently, pressure at the position of the vertical tube reduces. The liquid (perfume) rises through the vertical tube and emerges through the end. If the excess pressure applied to the bulb in this process be Δp, then find the minimum speed of air in the tube to lift the perfume



(a) $\sqrt{\frac{2(\Delta p+\rho g h)}{\rho_a}}$ (b) $\sqrt{\frac{(\Delta p+\rho g h)}{\rho_a}}$

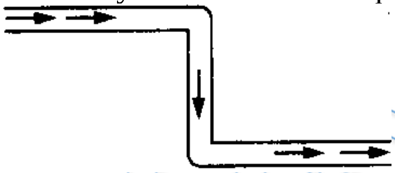
(c) $\sqrt{\frac{(\Delta p+\rho g h)}{2\rho_a}}$ (d) $\sqrt{\frac{(\Delta p+2\rho g h)}{\rho_a}}$

Q 14. A plate of mass m and area A is at rest as shown in figure, by blowing air with velocity v, density of air is ρ –



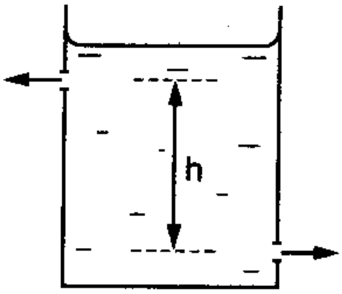
(a) The lift force acting on plate due to air is mg/2
(b) Velocity of air flow is $\sqrt{mg/\rho A}$
(c) Force exerted by hinge on plate is $\sqrt{3}mg$
(d) Torque due to gravity about hinge is zero

Q 15. The tube shown is of uniform cross-section. Liquid flows through it at a constant speed in the direction shown by the arrows. The liquid exerts on the tube



(a) a net force to the right (b) a net force to the left
(c) a clockwise torque (d) an anticlockwise torque

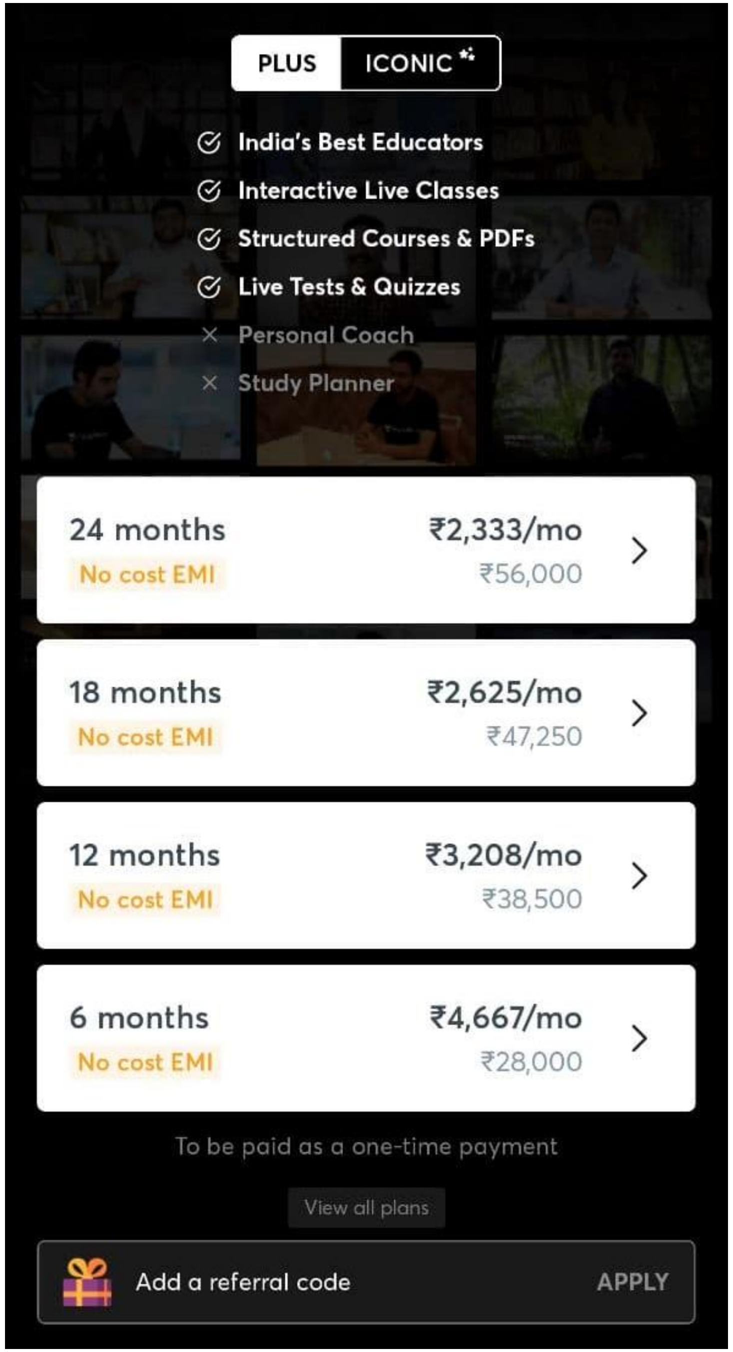
Q 16. There are two identical small holes on the opposite sides of a tank containing a liquid. The tank is open at the top. The difference in height between the two holes is h. As the liquid comes out of the two holes, the tank will experience a net horizontal force proportional to



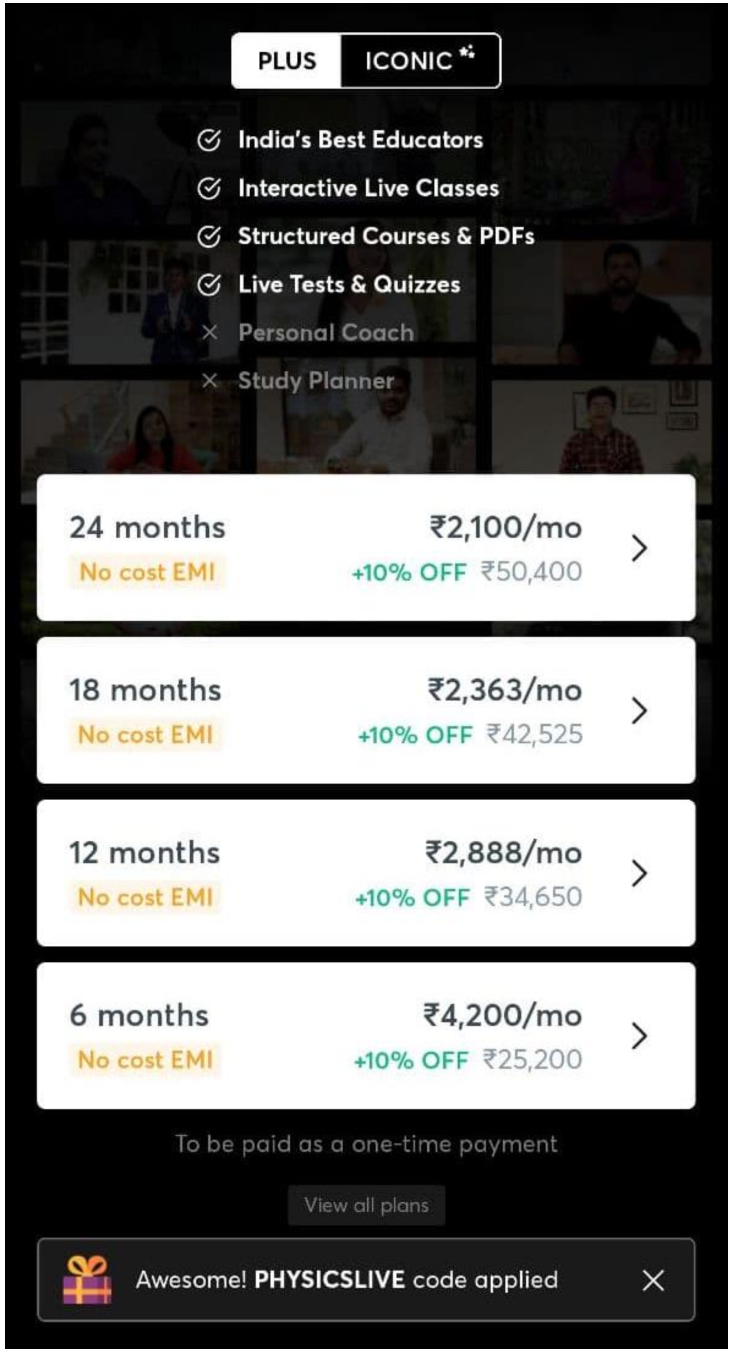
(a) √h (b) h (c) $h^{3/2}$ (d) h^2

Answer Key

Q.1 b	Q.2 c	Q.3 a, b	Q.4 a, c, d	Q.5 b, c, d
Q.6 b	Q.7 b	Q.8 b	Q.9 c	Q.10 c
Q.11 a	Q.12 b	Q.13 a	Q.14 a, b	Q.15 c
Q.16 b				



PHYSICSLIVE



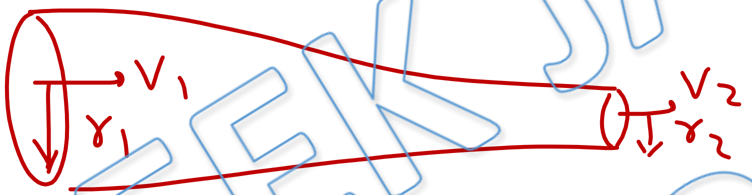
Use code PHYSICSLIVE to get 10% OFF on Unacademy PLUS.

Written Solution

DPP-3 Fluid : Equation of Continuity, Bernoulli's Theorem and its applications

By Physicsaholics Team

Q1) Water is flowing through a tube of non uniform cross section. If the radii of the tube at the entrance and exit are in the ratio 3 : 2, then the ratio of velocity of liquid entering and leaving the tube is-



$r_1 : r_2 = 3 : 2$

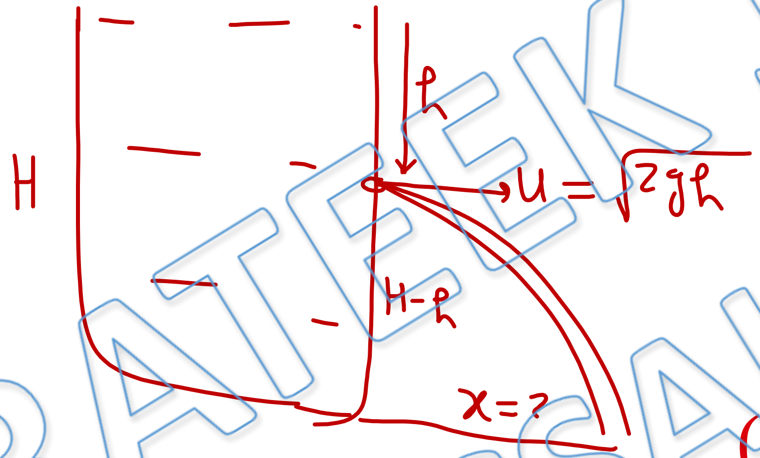
$\Rightarrow A_1 : A_2 = 9 : 4$

(a) 1 : 1 (b) 4 : 9 (c) 9 : 4 (d) 8 : 27

$AV = C \Rightarrow V \propto \frac{1}{A}$

$V_1 : V_2 = A_2 : A_1 = 4 : 9$

Q2) A tank is filled with water to a height H. A hole is punched in one of the walls at a depth h below the water surface. Then the distance x from the foot of the wall at which the stream strikes the floor is –



(a) $2\sqrt{Hh}$

(b) $\sqrt{2(H-h)H}$

(c) $2\sqrt{(H-h)h}$

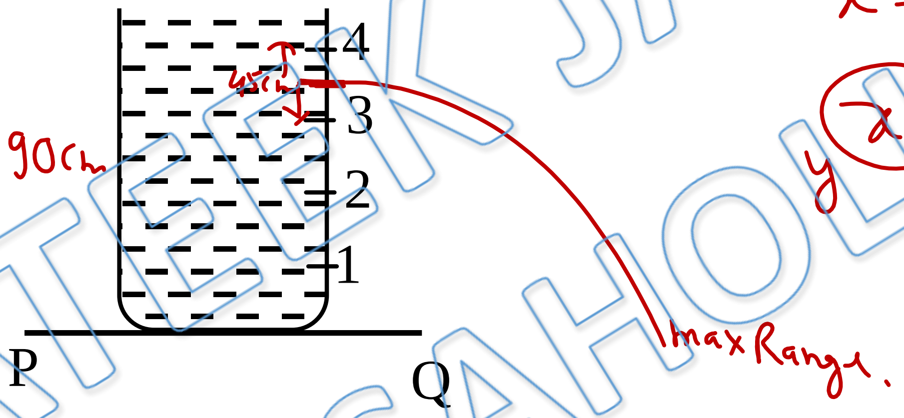
(d) $2h\left(\frac{H-h}{H}\right)$

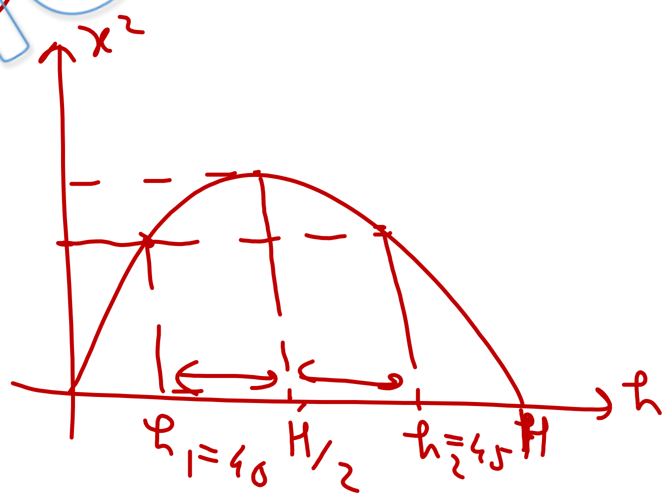
Q3) A cylindrical vessel of 90cm height is kept filled upto the brim. It has four holes 1, 2 , 3, 4 which are respectively at heights of 20cm, 30cm, 40cm and 50cm from the horizontal floor P, Q. The water falling at the maximum horizontal distance from the vessel comes from -

$\frac{H}{2} = 45cm$

$x = \sqrt{4h(H-h)}$

$x^2 = 4Hh - 4h^2$





(a) hole number 4
(b) hole number 3
(c) hole number 2
(d) hole number 1

Q4) Figure shows a section of tube of varying cross section area. Let A_1, v_1, ρ_1 respectively be cross-sectional area, velocity of fluid (an ideal gas) and density of liquid at 1 and corresponding value at '2' be A_2, v_2 & ρ_2 respectively. Assuming temperature at point 1 and 2 to be same –

$v_1 = v_2 = v$ (Since T is same)

(a) $A_1v_1 < A_2v_2$

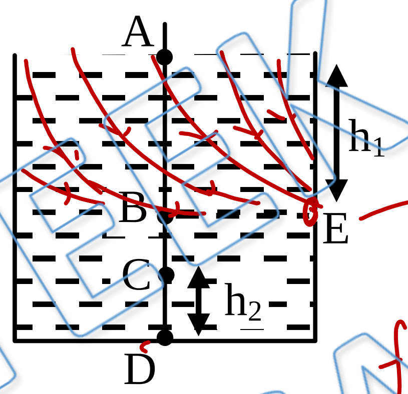
(b) $A_1v_1 = A_2v_2$

(c) $A_1v_1\rho_1 = A_2v_2\rho_2$

(d) $v_1 = v_2$

Eq of Conti

Q5) A incompressible and non–viscous liquid of density ‘ρ’ is kept in a cylindrical container having a opening at ‘E’. Then –



fluid is in motion

(a) $P_B - P_A = h_1\rho g$

fluid is static

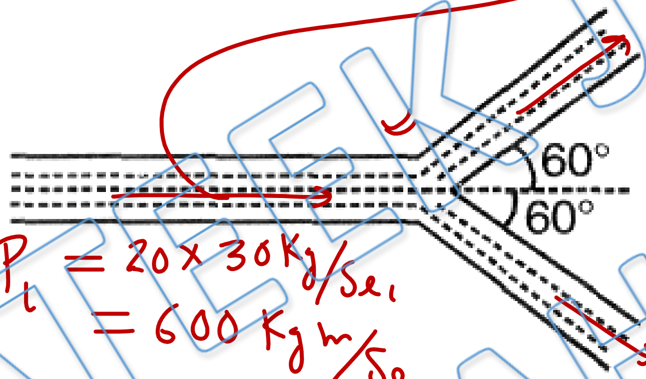
(b) $P_D - P_C = h_2\rho g$

(c) $P_B > P_E$

(d) $P_A = P_E$

$= P_0$

Q6) Fresh water issues from the nozzle with a velocity of 20 m/sec at the rate of 0.03 m^3/sec and is split into two equal streams by the fixed vane and deflected through 60° as shown in figure. The force required to hold the vane on place is



300 Kgm/Sec

300 Kgm/Sec

+ve

$P_i = 20 \times 30$ Kgm/Sec
$= 600$ Kgm/Sec

mass rate of flow
$= .03 \times 10^3$
$= 30$ Kgm/Sec

net momentum of water after divide
$= 2 \times 300 \cos 60$
$= 300$ Kgm/Sec

(a) 300 N towards right
(b) 300 N towards left
(c) 600 N towards right
(d) 600 N towards left

ΔP of water per Sec $= 300 - 600 = -300$

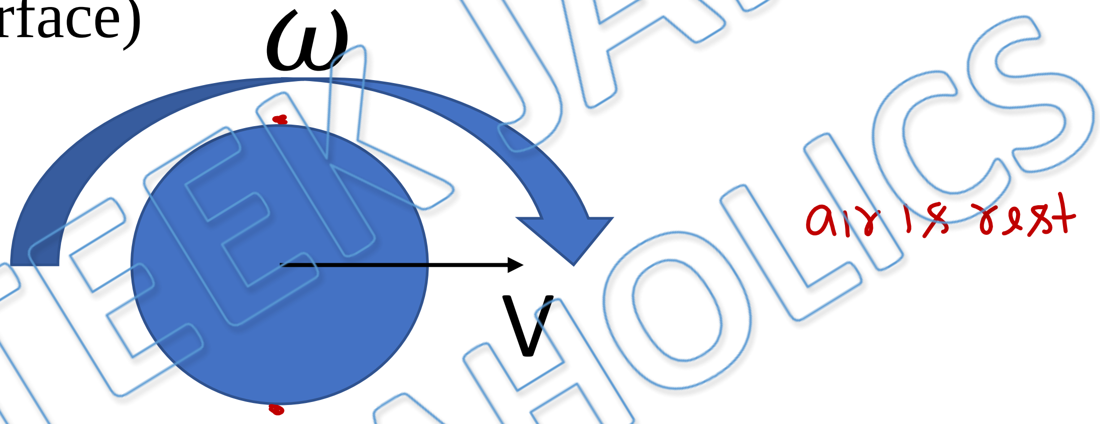
force on water $= -300$ N

by water, force on pipe $= 300$ N

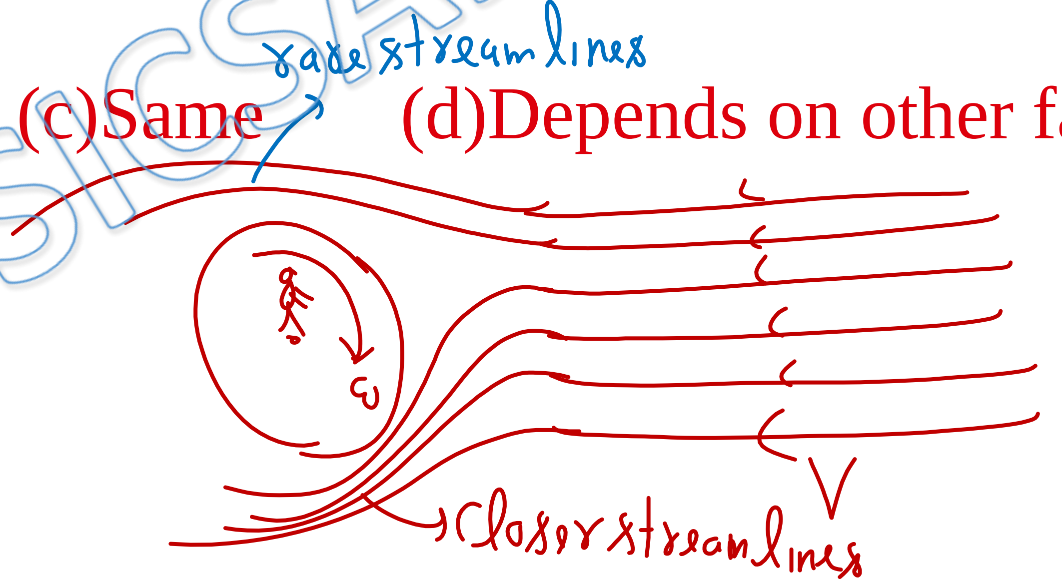
force by external agent on pipe $= -300$ N

Q7) A tennis ball receives a top spin when struck by a rocket and describe a curved trajectory. The top spin implies that the rotating motion of the surface of the ball is in the direction of the translating motion of the ball. Then pressure on the top surface is (w.r.t. Bottom surface)

Closer stream lines
⇒ high velocity
⇒ low Pressure.



(a)Lower (b)Higher (c)Same (d)Depends on other factors



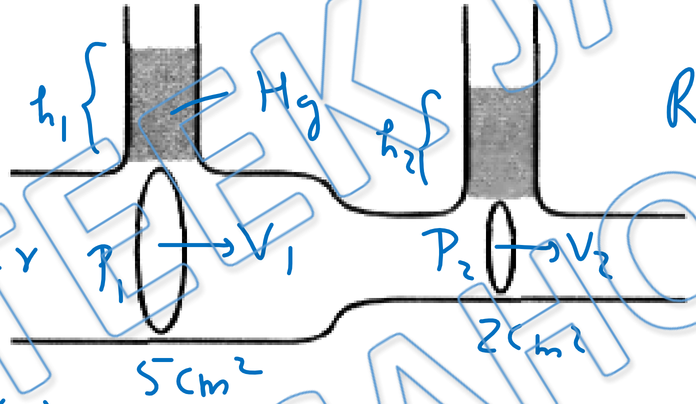
Q8) In the experimental arrangement shown in figure the areas of cross-section of the wide and narrow portions of the tube are 5 cm^2 and 2 cm^2 respectively. The rate of flow of water through the tube is 500 cm^3/sec. The difference of mercury levels in the U-tube is

$P_1 = \rho_{Hg} g h_1$

$P_2 = \rho_{Hg} g h_2$

$P_1 - P_2 = \rho_{Hg} g (h_1 - h_2)$

$= \rho_{Hg} g h$ — — (ii)



$5V_1 = 2V_2$

$V_1 = \frac{2}{5} V_2$ — — (i)

Rate of flow

$Q = AV$

$500 = 2V_2$

$V_2 = 250$ cm/se $= 2.5$ m/sec

(a) 0.97 cm (b) 1.93 cm (c) 0.67 cm (d) 4.67 m

$P_1 + \frac{1}{2}\rho_w V_1^2 = P_2 + \frac{1}{2}\rho_w V_2^2$

$P_1 - P_2 = \frac{1}{2} \times 10^3 (V_2^2 - V_1^2)$

$13.6 \times 10^3 \times 10\, h = \frac{10^3}{2}\left(V_2^2 - \frac{4}{25}V_2^2\right) = \frac{10^3}{2} \times \frac{21}{25} V_2^2$ — — (iii)

Ans. b

$$136\,h = \frac{21}{50} \times (25)^2$$

$$h = \frac{21}{50} \times \frac{25 \times 25}{136} \text{ meter}$$

$$= \frac{21}{\cancel{50}_{2}} \times \frac{\cancel{25} \times 25}{136} \text{ cm}$$

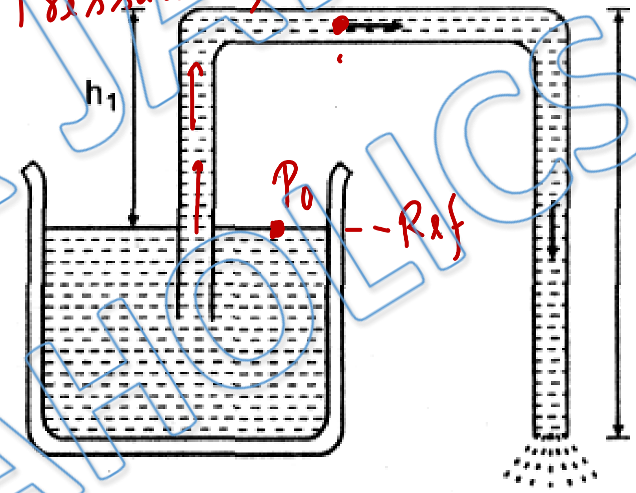
$$= \frac{525}{272} \text{ cm}$$

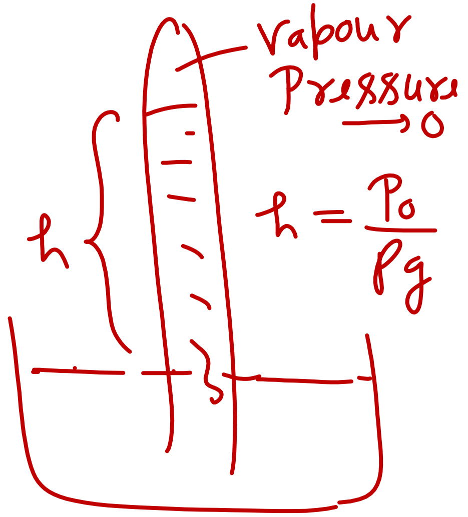
Q9) Siphon is a device to transfer liquid from a higher level to a lower level. The condition of working of a siphon is: (assuming Vapour Pressure → 0)

$P_0 = P_B + \frac{1}{2}\rho v^2 + \rho g h_1$

$P_B = P_0 - \frac{1}{2}\rho v^2 - \rho g h_1$

for working Siphon $h_{1_{max}} = \frac{P_0 - \frac{1}{2}\rho v^2}{\rho g}$





(a) $h_2 > h_1$ $(P_B \geq 0)$

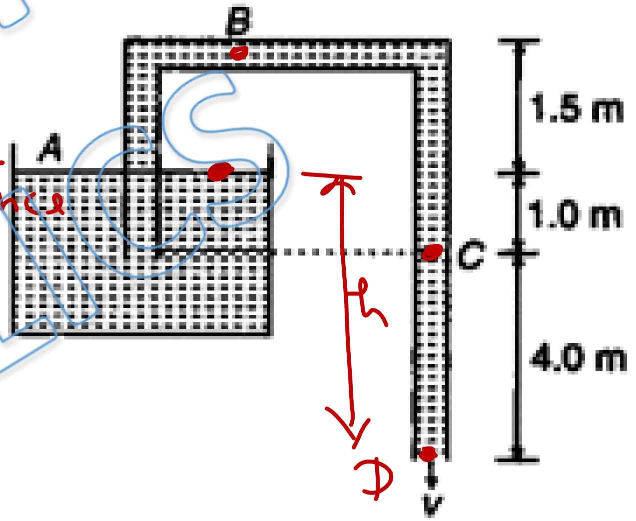
(b) $h_2 = 2\, h_1$

(c) h_1 should be less than the height of corresponding liquid barometer

(d) h_1 should be greater than the height of corresponding liquid barometer

Comprehension

A siphon tube is discharging a liquid of density 900 kg/m^3 as shown in figure.
($P_0 = 1.01 \times 10^5$ N/m^2)



$V = \sqrt{2gh}$

$= \sqrt{2 \times 10 \times 5}$

$= 10$ m/sec

reference

h

D

(Q10) The speed of liquid through the siphon is:

(a) 6 m/s (b) 8 m/s (c) 10 m/s (d) 12 m/s

Using Bernaulli's theorem for A & B →

$P_0 = P_B + \frac{1}{2}\rho v^2 + \rho g h$

$P_B = 10.1 \times 10^4 - \frac{1}{2} \times 900 \times 100 - 900 \times 10 \times 1.5 = (10.1 - 4.5 - 1.35) \times 10^4$

Q11) Pressure at point B is:

(a) $4.25 \times 10^4 \ N/m^2$

(b) $6.25 \times 10^4 \ N/m^2$

(c) $2.50 \times 10^4 \ N/m^2$

(d) $2.0 \times 10^5 \ N/m^2$

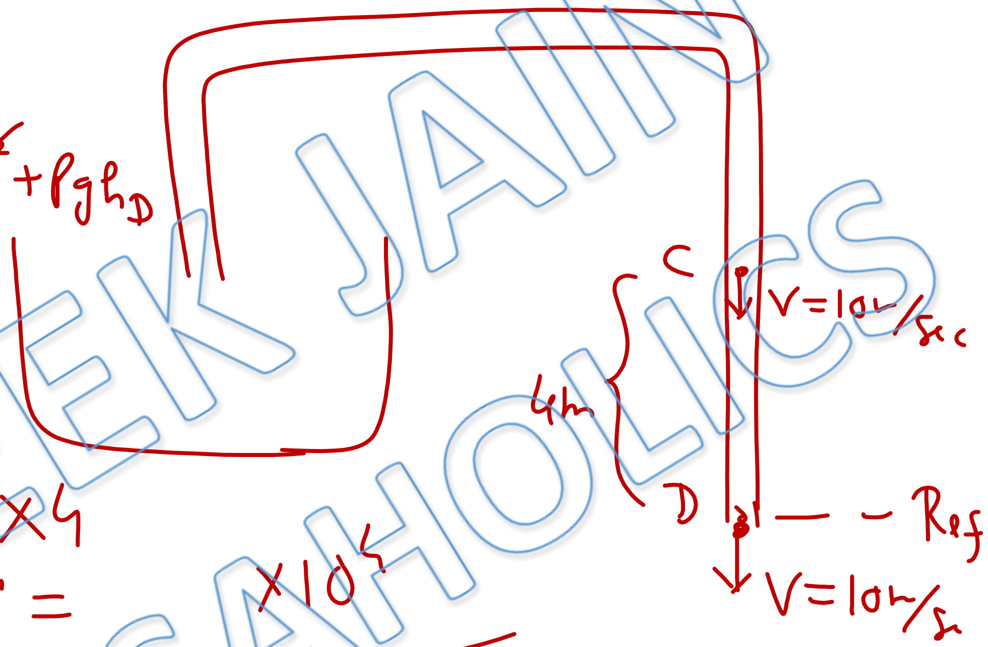
Q12) Pressure at point C is:

$$P_C + \frac{1}{2}\rho v_C^2 + \rho g h_C = P_D + \frac{1}{2}\rho v_D^2 + \rho g h_D$$

$$P_C = P_D - \rho g (h_C - h_D)$$

$$= 1.01 \times 10^5 - 900 \times 10 \times 4$$

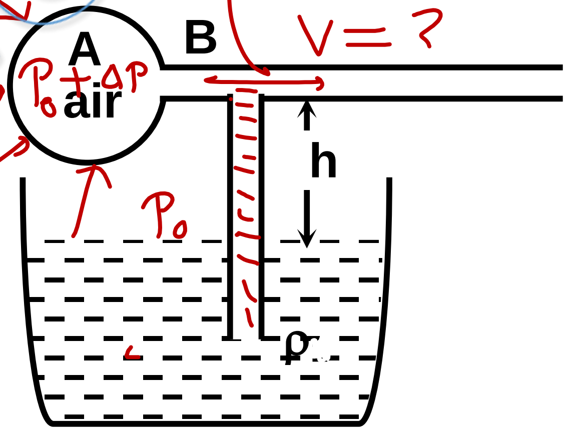
$$= 10.1 \times 10^4 - 3.6 \times 10^4 = 6.5 \times 10^4$$



(a) 5.5×10^4 N/m^2
(b) 6.5×10^4 N/m^2
(c) 8.0×10^4 N/m^2
(d) 10.5×10^4 N/m^2

$$\begin{array}{r} 10.1 \\ -\ 3.6 \\ \hline 6.5 \end{array}$$

Q13) The figure shows a model of perfume atomizer. When the bulb A is compressed, air flows through the narrow tube. Consequently, pressure at the position of the vertical tube reduces. The liquid (perfume) rises through the vertical tube and emerges through the end. If the excess pressure applied to the bulb in this process be Δp, then find the minimum speed of air in the tube to lift the perfume



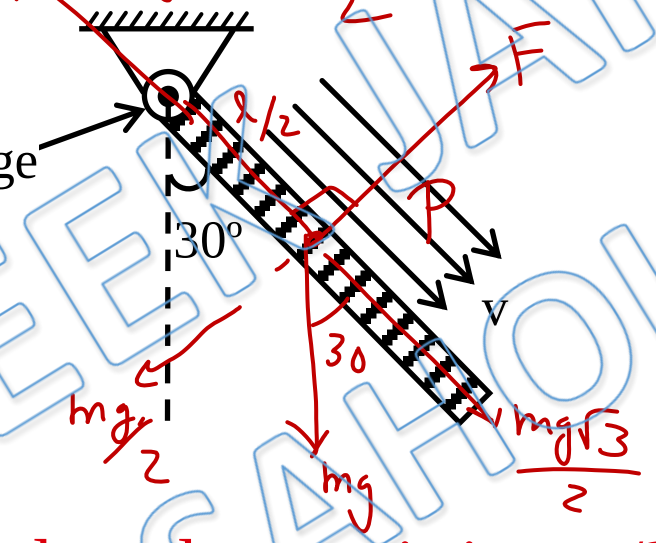
(a) $\sqrt{\frac{2(\Delta p+\rho g h)}{\rho_a}}$

(b) $\sqrt{\frac{(\Delta p+\rho g h)}{\rho_a}}$

(c) $\sqrt{\frac{(\Delta p+\rho g h)}{2\rho_a}}$

(d) $\sqrt{\frac{(\Delta p+2\rho g h)}{\rho_a}}$

Q14) A plate of mass m and area A is at rest as shown in figure, by blowing air with velocity v, density of air is ρ –



$F_{Hinge} = \frac{mg\sqrt{3}}{2}$

$\tau_{Hing} = 0$

$F\frac{l}{2} = \frac{mg}{2} \times \frac{l}{2}$

$F = \frac{mg}{2}$

$P_0 = P + \frac{1}{2}\rho v^2$

$P_0 - P = \frac{1}{2}\rho v^2$

$(P_0 - P)A = \frac{1}{2}\rho A v^2$

force due to pressure difference

$\frac{mg}{2} = \frac{1}{2}\rho A v^2$

$v = \sqrt{\frac{mg}{\rho A}}$

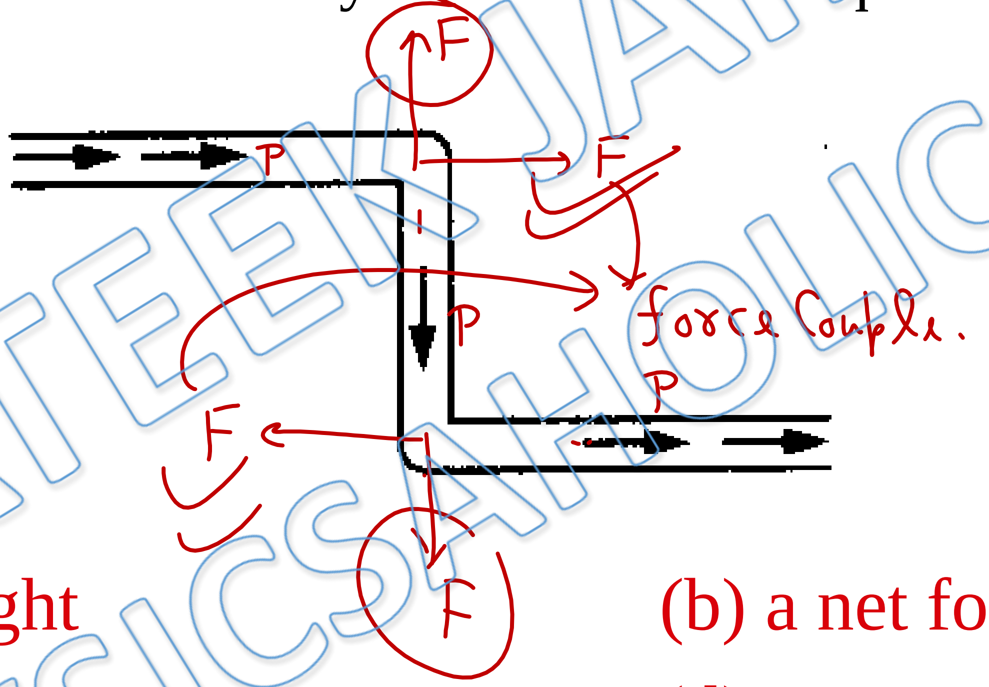
(a) The lift force acting on plate due to air is mg/2

(b) Velocity of air flow is $\sqrt{mg/\rho A}$

(c) Force exerted by hinge on plate is $\sqrt{3}mg$

(d) Torque due to gravity about hinge is zero

Q15) The tube shown is of uniform cross-section. Liquid flows through it at a constant speed in the direction shown by the arrows. The liquid exerts on the tube



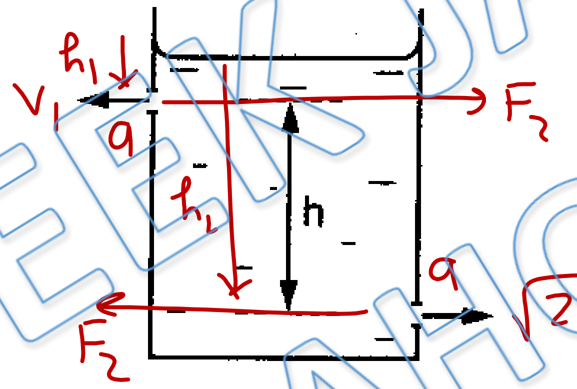
(a) a net force to the right

(b) a net force to the left

(c) a clockwise torque

(d) an anticlockwise torque

Q16) There are two identical small holes on the opposite sides of a tank containing a liquid. The tank is open at the top. The difference in height between the two holes is h. As the liquid comes out of the two holes, the tank will experience a net horizontal force proportional to



$F_2 = \mu V_{rel}$

$= \rho a V_2 V_2$

$= \rho a V_2^2$

$F_1 = \rho a V_1^2$

$\sqrt{2gh_2} = V_2$

(a) $\sqrt{h}$ (b) h (c) $h^{3/2}$ (d) h^2

$F_{net} = F_2 - F_1 = \rho a (V_2^2 - V_1^2)$

$= \rho a (2gh_2 - 2gh_1) = 2a\rho g(h)$

For Video Solution of this DPP, Click on below link

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/82

Video Solution on YouTube:- https://youtu.be/dtbAn-lu34Q

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/20

SUBSCRIBE

@Physicsaholics

@Physicsaholics_prateek

@NEET_Physics
@IITJEE_Physics

physicsaholics.com

Unacademy

CLICK

Chalo Niklo