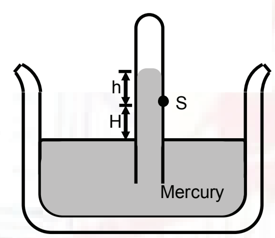
PHYSICS:

1. Water flows through two identical tubes A and B. A volume V_0 of water passes through the tube A and $2V_0$ through B in a given time. Which of the following may be incorrect?
   1) Flow in both the tubes are steady.
   2) Flow in both the tubes are turbulent.
   3) Flow is steady in A but turbulent in B.
   4) Flow is steady in B but turbulent in A.
2. Bernoulli's theorem is based on conservation of
   1) momentum
   2) mass
   3) energy
   4) angular momentum.
3. In a streamline flow,
   1) the speed of a particle always remains same
   2) the velocity of a particle always remains same
   3) the kinetic energies of all the particles arriving at a given point are the same
   4) the momentum of all the particles arriving at a given point are the same.
4. Consider the barometer shown in figure. Density of mercury is ρ small hole is made at point S as shown. The mercury comes out from this hole with speed v equal to



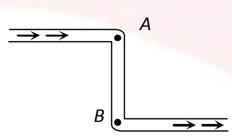
   1) $\sqrt{2gh}$ 2) $\sqrt{2gH}$
   3) $\sqrt{2g(H-h)}$ 4) none of these

5. Three identical holes, each of area ‘a’, are drilled on the curved surface of cylindrical tank such that they form an equilateral triangle in a horizontal plane just above the bottom. The tank is kept over a frictionless horizontal surface and is the filled with water up to height H by plugging the holes. Taking ‘A’ as the cross – sectional areas of cylinder (A >>a), the initial acceleration of tank, when the three holes are unplugged simultaneously, is

1) zero 2) $\frac{2ag}{A}$

3) $\frac{3ag\sqrt{g}}{A}$ 4) $\frac{2ag\sqrt{3}}{A}$

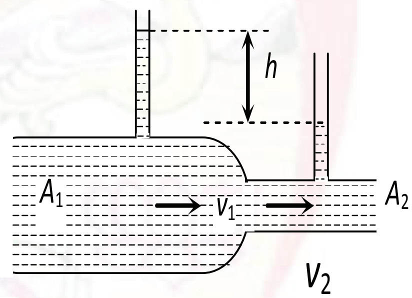
6. In this figure, an ideal liquid flows through the tube, which is of uniform cross-section. The liquid has velocities v_A and v_B, and pressure P_A and P_B at points A and B respectively



1) $v_A > v_B$ 2) $v_B > v_A$

3) $P_A = P_B$ 4) $P_B > P_A$

7. A liquid flows through a horizontal tube. The velocities of the liquid in the two sections, which have areas of cross-section A_1 and A_2, are v_1 and v_2 respectively. The difference in the levels of the liquid in the two vertical tubes is h



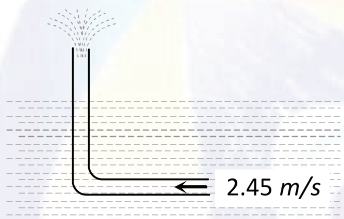
1) The volume of the liquid flowing through the tube is A_1v_1

2) $v_2 - v_1 = \sqrt{2gh}$

3) $v_2^2 - v_1^2 = 2gh$

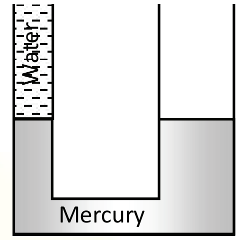
4) The energy of the liquid is the same in both sections of the tube

8. An L-shaped tube with a small orifice is held in a water stream as shown in fig. The upper end of the tube is 10.6 cm above the surface of water. What will be the height of the jet of water coming from the orifice? Velocity of water stream is 2.45 m/s



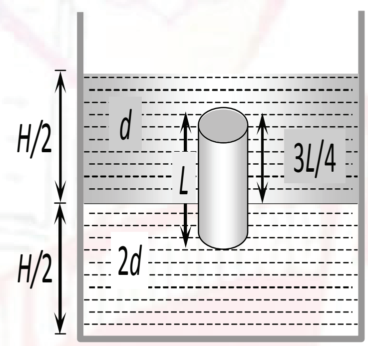
1) Zero 2) 20.8 cm
3) 10.6 cm 4) 40.0 cm

9. A U-tube in which the cross-sectional area of the limb on the left is one quarter of the limb on the right contains mercury (density 13.6 g/cm^3). The level of mercury in the narrow limb is at a distance of 36 cm from the upper end of the tube. What will be the rise in the level of mercury in the right limb if the left limb is filled to the top with water



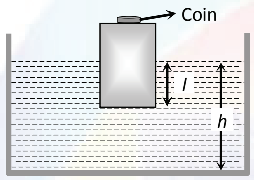
1) 1.2 cm 2) 2.35 cm
3) 0.56 cm 4) 0.8 cm

10. A homogeneous solid cylinder of length L $(L < H/2)$. The cylinder is immersed such that it floats with its axis vertical at the liquid-liquid interface with length $L/4$ in the denser liquid as shown in the fig. The lower density liquid is open to atmosphere having pressure P_0. Then density D of solid is given by



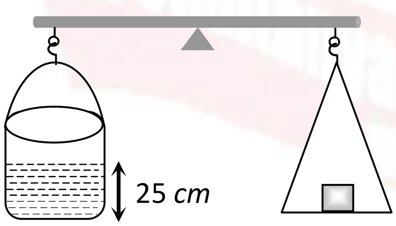
1) $\frac{5}{4}d$ 2) $\frac{4}{5}d$
3) d 4) $\frac{d}{5}$

11. A wooden block, with a coin placed on its top, floats in water as shown in fig. the distance l and h are shown there. After some time the coin falls into the water. Then



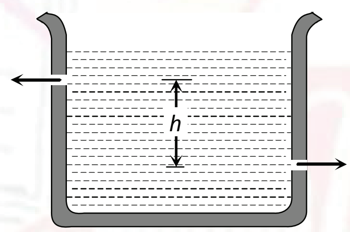
1) l decreases and h increases
2) l increases and h decreases
3) Both l and h increase
4) Both l and h decrease

12. A cylinder containing water up to a height of 25 cm has a hole of cross-section $\frac{1}{4}cm^2$ in its bottom. It is counterpoised in a balance. What is the initial change in the balancing weight when water begins to flow out



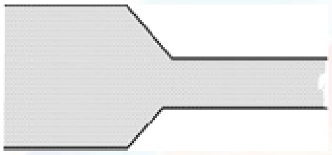
1) Increase of 12.5 *gm-wt*
2) Increase of 6.25 *gm-wt*
3) Decrease of 12.5 *gm-wt*
4) Decrease of 6.25 *gm-wt*

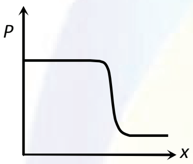
13. There are two identical small holes of area of cross-section a on the opposite sides of a tank containing a liquid of density ρ. The difference in height between the holes is h. Tank is resting on a smooth horizontal surface. Horizontal force which will has to be applied on the tank to keep it in equilibrium is

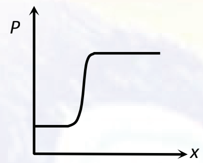


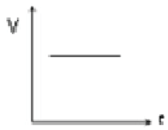
1) $gh\rho a$
2) $\frac{2gh}{\rho a}$
3) $2\rho agh$
4) $\frac{\rho gh}{a}$

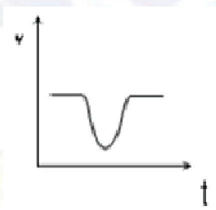
14. Water flows through a frictionless duct with a cross-section varying as shown in fig. Pressure p at points along the axis is represented by



1) 

2) 

3) 

4) 

15. A uniform rod of density ρ is placed in a wide tank containing a liquid of density $\rho_0 (\rho_0 > \rho)$. The depth of liquid in the tank is half the length of the rod. The rod is in equilibrium, with its lower end hinged at the bottom of the tank. In this position the rod makes an angle θ with the horizontal $(\theta \neq 90^o)$

1) $\sin\theta = \frac{1}{2}\sqrt{\rho_0/\rho}$ 2) $\sin\theta = \frac{1}{2}\cdot\frac{\rho_0}{\rho}$

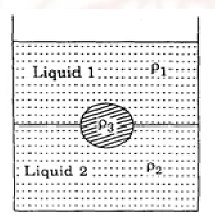
3) $\sin\theta = \sqrt{\rho/\rho_0}$ 4) $\sin\theta = \rho_0/\rho$

16. A large tank filled with water to a height h is to be emptied through a small hole at the bottom. The ratio of times taken for the level of water to fall from h to $\frac{h}{2}$ and from $\frac{h}{2}$ to zero is

1) $\sqrt{2}$ 2) $\frac{1}{\sqrt{2}}$ 3) $\sqrt{2}-1$ 4) $\frac{1}{\sqrt{2}-1}$

17. A jar filled with two non–mixing liquids 1 and 2 having densities ρ_1 and ρ_2 respectively. A solid ball, made of a material of density ρ_3, is dropped in the jar. It comes to equilibrium in the position shown in the figure.

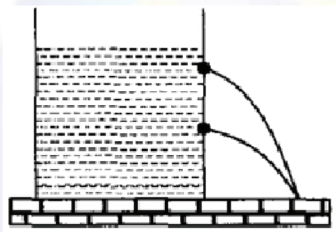
Which of the following is true for ρ_1, ρ_2 and ρ_3?



1) $\rho_1 < \rho_3 < \rho_2$ 2) $\rho_3 < \rho_1 < \rho_2$

3) $\rho_1 < \rho_3 > \rho_2$ 4) $\rho_1 < \rho_2 < \rho_3$

18. In a cylindrical vessel containing liquid of density ρ, there are two holes in the side walls at heights of h_1 and h_2 respectively such that the range of efflux at the bottom of the vessel is same. The height of a hole for which the range of efflux would be maximum, will be:



1) $h_2 - h_1$ 2) $h_2 + h_1$

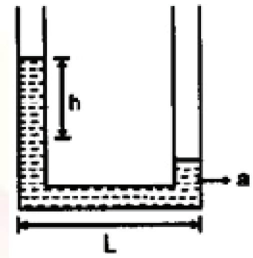
3) $\frac{h_2 - h_1}{2}$ 4) $\frac{h_2 + h_1}{2}$

19. A pump draws water front a reservoir and sends it through a horizontal pipe with speed v. The power of the pump is proportional to:

1) v 2) v^2

3) v^3 4) $v^{3/2}$

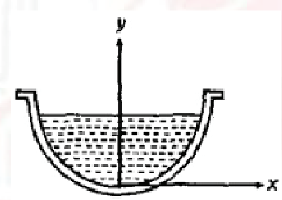
20. When at rest, a liquid stands at the same level in the tubes shown in figure. But as indicated a height difference of h occurs when the system is given an acceleration a towards the right. Here, h is equal to:



1) $\frac{aL}{2g}$ 2) $\frac{gL}{2a}$

3) $\frac{gL}{a}$ 4) $\frac{aL}{g}$

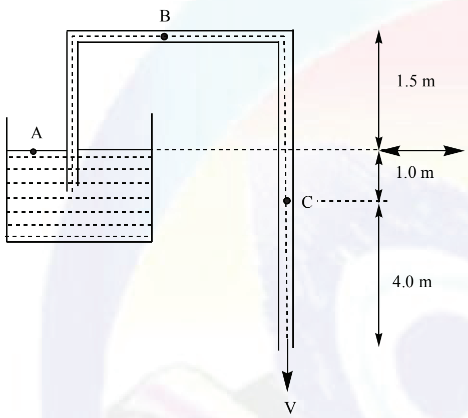
21. A small hole is made at the bottom of a symmetrical jar as shown in figure. A liquid is filled into the jar upto a certain height The rate of descension of liquid is independent of the level of liquid in the jar. Then the surface of jar is a surface of revolution of the curve:



1) $y = k\,x^4$ 2) $y = k\,x^2$

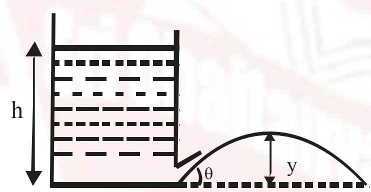
3) $y = k\,x^3$ 4) $y = k\,x^5$

22. A siphon tube is discharging a liquid of density $900\frac{kg}{m^3}$ as shown in figure.($P_0 = 1.01 \times 10^5$ N/m^2) The speed of liquid through the siphon is:



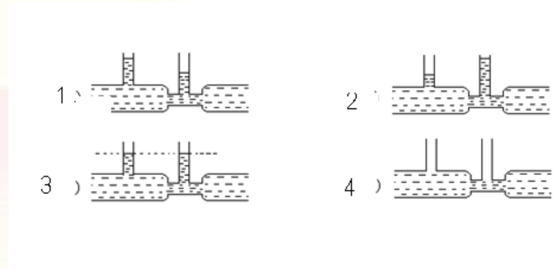
1) 6 m/s 2) 8 m/s
3) 10 m/s 4) 12 m/s

23. Figure shows a stream of liquid emerging from a tube in the base of an open tank. The maximum height 'y' attained by the liquid jet is

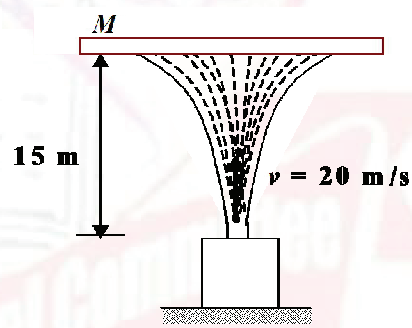


1) $h\sin\theta$ 2) $2h\sin\theta$
3) $h\sin^2\theta$ 4) $h\cos^2\theta$

24. For a fluid which is flowing steadily the level in the vertical tubes is best represented by

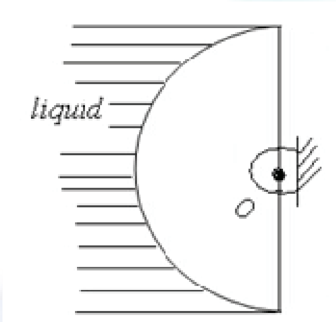


25. A vertical jet of water coming out of a nozzle with velocity 20 m/s supports a plate of mass M stationary at a height h = 15m, as shown in the figure. If the rate of water flow is 1 litre per second, the mass of the plate is (Assume the collision to be inelastic).



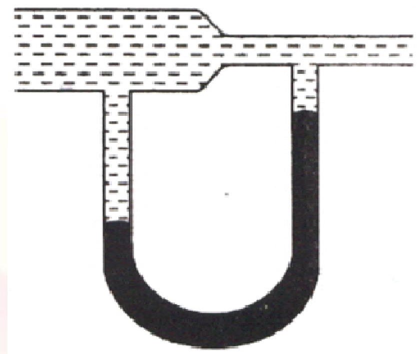
1) 1 kg 2) 1.414 kg
3) 2 kg 4) 10 kg

26. A smooth cylindrical gate is pivoted at its axis, with one side liquid and on other side atmosphere, then



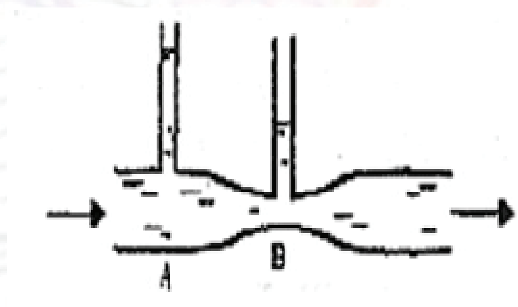
1) Torque by liquid about axis is zero
2) Angular acceleration of cylinder about axis is zero
3) Net force on cylinder due to liquid is non – zero
4) All of these

27. 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 $cm^3 s^{-1}$. The approximate difference of mercury levels in the U-tube is



1)1cm 2) 2cm 3) 3cm 4) 4cm

28. Water flows through a horizontal tube as shown in figure. If the difference of heights of water column in the vertical tubes is 60m, and the areas of cross-section at A and B are 4m^2 and 2 m^2 respectively, the rate of flow of water across any section is (in SI units)



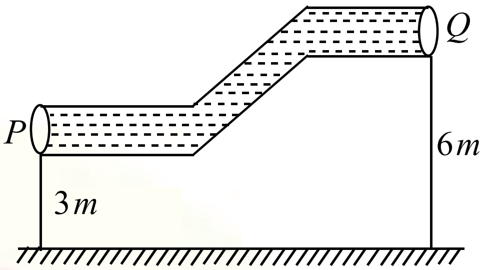
1) 60 2) 40
3) 80 4) 50

29. In a horizontal pipeline of uniform area of cross section the pressure falls by $5N/m^2$ between two points separated by a distance of 1km. What is the change kinetic energy per kg of the oil flowing at these points. Density of oil=$800kg/m^3$

1) $8.25\times10^{-3}J/kg$ 2) $7.25\times10^{-3}J/kg$

3) $6.25\times10^{-3}J/kg$ 4) $5.25\times10^{-3}J/kg$

30. A non-viscous liquid of constant density $500\ kg/m^3$ flows in a variable cross-sectional tube. The area of cross-section of the tube at two points P and Q at heights of 3 m and 6 m are $2\times10^{-3}m^2$ and $4\times10^{-3}\ m^2$ respectively. The work done per unit volume by the forces of gravity as the fluid flows from point P to Q, is:



1) $29.4\ J/m^3$

2) $-1.47\times10^4\ J/m^3$

3) $-2.94\times10^4\ J/m^3$

4) zero

Sri Chaitanya IIT Academy., India.

A.P, TELANGANA, KARNATAKA, TAMILNADU, MAHARASHTRA, DELHI, RANCHI

A right Choice for the Real Aspirant

ICON CENTRAL OFFICE, MADHAPUR - HYD

Sec: Jr.Super60 **Date: 17-09-16**

Time: 07:30AM to10:30AM **WTM-20** **Max. Marks: 360**

KEY SHEET

PHYSICS

1	4	**2**	3	**3**	3	**4**	4	**5**	1	**6**	4
7	3	**8**	2	**9**	3	**10**	1	**11**	4	**12**	3
13	3	**14**	1	**15**	1	**16**	3	**17**	1	**18**	4
19	3	**20**	4	**21**	1	**22**	3	**23**	3	**24**	1
25	1	**26**	4	**27**	2	**28**	3	**29**	3	**30**	2

CHEMISTRY

31	4	**32**	4	**33**	2	**34**	2	**35**	1	**36**	2
37	1	**38**	1	**39**	3	**40**	3	**41**	3	**42**	3
43	2	**44**	1	**45**	1	**46**	2	**47**	4	**48**	4
49	2	**50**	4	**51**	2	**52**	1	**53**	4	**54**	3
55	2	**56**	4	**57**	2	**58**	2	**59**	2	**60**	1

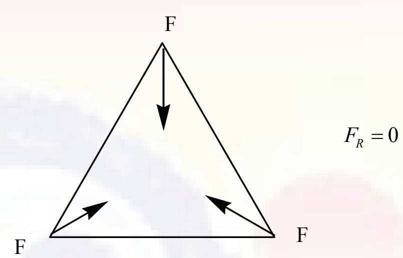
MATHS

61	3	**62**	1	**63**	2	**64**	3	**65**	2	**66**	1
67	4	**68**	1	**69**	2	**70**	1	**71**	2	**72**	2
73	3	**74**	1	**75**	1	**76**	3	**77**	2	**78**	1
79	1	**80**	3	**81**	1	**82**	4	**83**	1	**84**	4
85	2	**86**	2	**87**	2	**88**	4	**89**	1	**90**	2

SOLUTIONS

PHYSICS

1. AV= constant
2. Bernoulli's theorem is based on conservation of " energy
3. In a streamline flow the momentum of all the particles arriving at a given point are the same.
4. Outside pressure is more than inside pressure
5.



6 According to equation of continuity $v_A = v_B$

7. According to equation of continuity the volume of liquid flowing through the tube in unit time remains

constant *i.e.* $A_1v_1 = A_2v_2$,

According to Bernoulli's theorem,

$P_1 + \frac{1}{2}\rho v_1^2 = P_2 + \frac{1}{2}\rho v_2^2$

$\Rightarrow P_1 - P_2 = \frac{1}{2}\rho\left(v_2^2 - v_1^2\right) \Rightarrow h\rho g = \frac{1}{2}\rho\left(v_2^2 - v_1^2\right)$

$\therefore v_2^2 - v_1^2 = 2gh$

Hence option (c) is correct.

8 According to Bernoulli's theorem, $h = \frac{v^2}{2g}$

$\Rightarrow h = \frac{(2.45)^2}{2 \times 10} = 0.314 = 31.4\ cm$

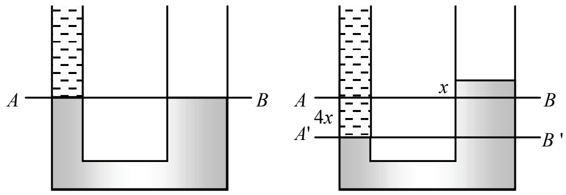
$\therefore$ Height of jet coming from orifice

$= 31.4 - 10.6 = 20.8\ cm$

9 If the rise of level in the right limb be *x cm.* the fall of level of mercury in left limb be 4*x cm* because the area

of cross section of right limb is 4 times as that of left limb.

$\therefore$ Level of water in left limb is $(36 + 4x)\ cm$.



Now equating pressure at interface of Hg and water (at $A'B'$)

$(36+4x)\times 1\times g = 5x \times 13.6 \times g$

By solving we get $x = 0.56\ cm$.

10 Weight of cylinder = upthrust due to both liquids

$$V \times D \times g = \left(A \times \frac{3}{4}L\right) \times d \times g + \left(A \times \frac{L}{4}\right) \times 2d \times g$$

$$\Rightarrow (A \times L) \times D \times g = \frac{5A \times L \times d \times g}{4} \Rightarrow \therefore D = \frac{5}{4}d$$

11. As the block moves up with the fall of coin, l decreases, similarly h will also decrease because when the coin is in water, it displaces water equal to its own volume only.

12 . Let A = The area of cross section of the hole

v = Initial velocity of efflux

d = Density of water,

Initial volume of water flowing out per second = Av

Initial mass of water flowing out per second = Avd

Rate of change of momentum = Adv^2

Initial downward force on the flowing out water = Adv^2

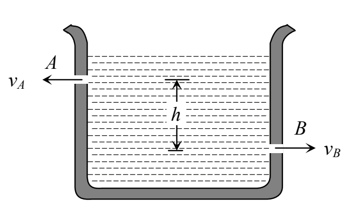
So equal amount of reaction acts upwards on the cylinder.

$\therefore$ Initial upward reaction = Adv^2 [As $v = \sqrt{2gh}$]

$\therefore$ Initial decrease in weight $= Ad(2gh)$

$= 2Adgh = 2 \times \left(\frac{1}{4}\right) \times 1 \times 980 \times 25 = 12.5$ gm-wt.

13.



Net force (reaction) = $F = F_B - F_A = \frac{dp_B}{dt} - \frac{dp_A}{dt}$

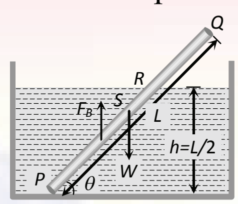
$= av_B \rho \times v_B - av_A \rho \times v_A$

$\therefore \quad F = a\rho\left(v_B^2 - v_A^2\right) \quad \ldots$(i)

$v_B^2 - v_A^2 = 2gh$

From equation (i), $F = 2a\rho gh.$

14 . When cross-section of duct is decreased, the velocity of water increased and in accordance with Bernoulli's
theorem, the pressure P decreased at that place.



15 . Let $L = PQ$ = length of rod

$\therefore \; SP = SQ = \frac{L}{2}$

Weight of rod, $W = Al\rho g$, acting

At point S

And force of buoyancy,

$F_B = Al\rho_0 g$, $[l = PR]$

which acts at mid-point of PR.

For rotational equilibrium,

$Al\rho_0 g \times \frac{l}{2}\cos\theta = AL\rho g \times \frac{L}{2}\cos\theta$

$\Rightarrow \frac{l^2}{L^2} = \frac{\rho}{\rho_0} \Rightarrow \frac{l}{L} = \sqrt{\frac{\rho}{\rho_0}}$

From figure, $\sin\theta = \frac{h}{l} = \frac{L}{2l} = \frac{1}{2}\sqrt{\frac{\rho_0}{\rho}}$

16. $\therefore \frac{t_1}{t_2} = \frac{1 - \frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}} - 0} = \sqrt{2} - 1.$

17. $\rho_1 < \rho_3 < \rho_2$

18. Range is maximum when $\frac{h_2+h_1}{2}$

19. Power $= \rho A V^3$

20. $P_0 + L\rho a - h\rho g = P_0$

21. $AV = con$

$$\pi x^2\left(\frac{dy}{dt}\right) = a\sqrt{2gy}$$

22. $V = \sqrt{2gh}$

23.

$$y = \frac{1}{2}\frac{V_1^2 \sin^2\theta}{g}$$

$$y = \frac{1}{2}\frac{(2gh)\sin^2\theta}{g}$$

$$y = h\sin^2\theta$$

24. At narrow cross-section speed is more, so pressure is less.

25. Force by liquid = Mg

$$\Rightarrow \rho(AV)V = Mg$$

But $AV = av = 1\times10^{-3}\ m^3/s$ and

$$V = \sqrt{(20)^2 - 2\times10\times15} = 10\ m/s$$

$$\therefore\ M = 1\ kg$$

26. The force exerted by liquid at any point, intersects axis, so torque and angular acceleration are zero.

27. $P_A = P_B + (\rho_m - \rho_w)gh$

$$\frac{1}{2}\rho_w\left(V_B^2 - V_A^2\right) = P_A - P_B = (\rho_m - \rho_w)gh$$

28. $\frac{1}{2}\rho_w\left(V_B^2 - V_A^2\right) = P_A - P_B = \rho_w gh$

29. $p + \frac{1}{2}\rho v^2 = P - 5 + \frac{1}{2}\rho V_1^2$

$$\frac{1}{2}\rho\left(v_1^2 - v^2\right) = \frac{5}{\rho}$$

30. $p_2 + \frac{1}{2}\rho v^2 = P_1 + \frac{1}{2}\rho V_1^2$

Final Key

S.NO	SUB	Q.NO	GIVEN KEY	FINALIZED KEY	EXPLANATION
1	PHY	3	3	3 or 4	Both statements are true because velocity direction at a point is same for every instant

Question Paper setter is **total responsible** for the Key finalization:

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