PUNJAB GROUP OF COLLEGES

FAISALABAD

Chapter # 06

Chapter Name ,, Fluid Dynamics

(Short Answers and Numericals)

Notice By ,

Zia-Ullah Munir Chaudhry

M.phil Physics (U.A.F)

Lecturer, Punjab Group of Colleges Faisalabad Daewoo Road Campus

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Short Answers :-

6.1 :- The Frictional Effect between different layers of a flowing fluid.
viscosity depends upon the Nature of fluid and on its temperature.
It is Given by: $F = 6\pi\eta r v$
$$\eta = \frac{F}{6\pi r v}$$

6.2 :- The opposing force on the body when it is moving through the fluid.
Drag force depends upon,
(i) velocity of sphere (ii) Radius of sphere.
(iii) Co-efficient of viscosity.

6.3 :- As;
$$V_t = \frac{mg}{6\pi\eta r}$$
$$V_t \propto m$$
A fog droplet has very small Mass. So it has very small Terminal velocity. Hence, it appears to be suspended in Air.

6.4 :- In Laminar Flow, each particle of fluid moves along a smooth path and stream lines donot cross each other.
In Turbulent flow, each particle of fluid does not moves along a smooth path.

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(6.5) The Sum of Pressure, K.E and P.E per unit volume of an ideal fluid remains Constant.

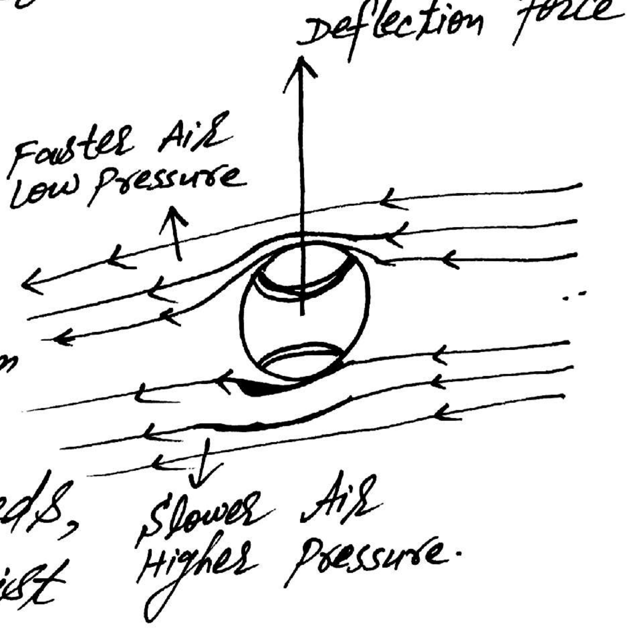
$$P + \frac{1}{2}\rho v^2 + \rho g h = \text{Constant}$$

Applications:-
(i) Swing of Ball (ii) Chimney (iii) Carburetor of a Car.

(6.6) Yes, there is danger.
Near a fast moving Train speed of air become high and pressure of air decreases. The Greater Pressure behind the man pushes the Man towards the Train.

(6.8) Speed of water between the row boats increases. So, the pressure between the row boats decreases. The Greater pressure on the other sides of the boats pushes the boats towards each other.

(6.9) A Cricket ball has two sides. Bowler makes its one surface shining from which air passess with high speed while on the other side of ball is rough from which air passes slowly.
Due to difference in speeds, Pressure difference exist hence ball swing.



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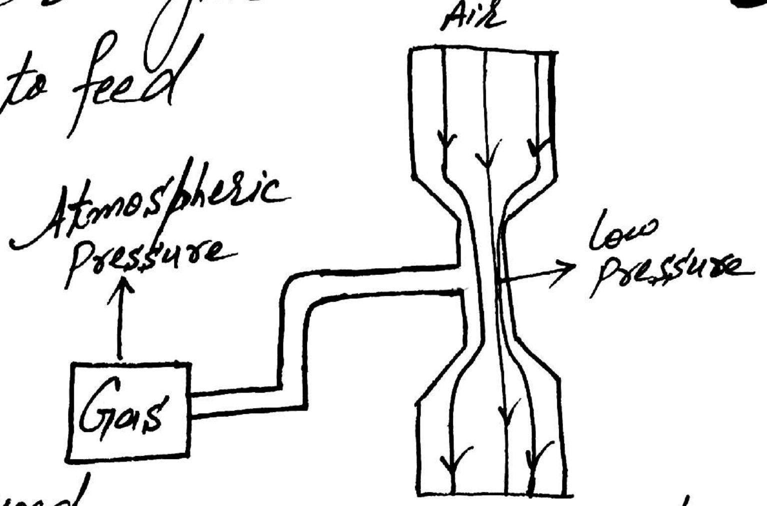
6.10 :- The Carburator of a Car engine uses a venturi duct to feed the correct mixture of air and petrol to the engine.



At the Narrow part of the duct, speed of air ~~decreases~~ increases and Pressure decreases. This low pressure of air draws petrol vapours into the Air Stream. This Mixture of air and Petrol is fed to the engine.

6.12 :- No, Blood Pressure will be equal due to State of weightlessness in an orbiting Space station.

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Numericals

6.1:- Given data;

$\rho = 1246\,kg\,m^{-3}$, $\eta = 8\times10^{-4}\,N\,m^{-2}\,s$

$v_t = 3\,cm\,h^{-1} = \frac{3\times10^{-2}}{3600}\,m\,s^{-1} = 8.3\times10^{-6}\,m\,s^{-1}$

$r = ??$

As; $v_t = \frac{2\rho g r^2}{9\eta}$

$$r^2 = \frac{9\eta v_t}{2\rho g}$$

$$r = \sqrt{\frac{9\times8\times10^{-4}\times8.3\times10^{-6}}{2\times1246\times9.8}}$$

$$\boxed{r = 1.6\times10^{-6}\,m}$$

6.2 Imp.

Given data;

$d_1 = 1\,cm = 1\times10^{-2}\,m$, $v_1 = 1\,m/s$

$v_2 = 21\,m\,s^{-1}$, $d_2 = ?$

As, $A_1 v_1 = A_2 v_2$

$$\cancel{\pi} r_1^2 v_1 = \cancel{\pi} r_2^2 v_2$$

$$\frac{d_1^2}{\cancel{4}} v_1 = \frac{d_2^2}{\cancel{4}} v_2$$

$$d_2^2 = \frac{d_1^2 v_1}{v_2}$$

$$d_2 = \sqrt{\frac{d_1^2 v_1}{v_2}} = \sqrt{\frac{(1\times10^{-2})^2(1)}{21}}$$

$$\boxed{d_2 = 0.2\,cm}$$

6.3. Given data;

$h_1 = 15\,m$, $h_2 = 0$

$A = 0.060\,cm^2$

$A = 0.06\times10^{-4}\,m^2$

(i) $v = ?$ (ii) volume flow per second $= Av = ??$

(i) As;

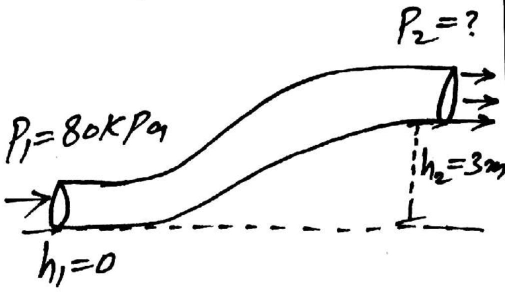
$$v = \sqrt{2g(h_1 - h_2)}$$

$$v = \sqrt{2\times9.8\times15} = 17\,m\,s^{-1}.$$

(ii):- $\frac{V}{t} = Av = (0.06\times10^{-4})(17).$

$$\frac{V}{t} = 102\,cm^3$$

6.4:-



Given data;

$v_1 = 3\,m\,s^{-1}$

$v_2 = 4\,m\,s^{-1}$

$h_2 = 3\,m$, $h_1 = 0$, $P_1 = 80\,KPa$

$P_1 = 80\times10^3\,Pa$; $P_2 = ??$

As;

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$$

$$P_2 = P_1 + \frac{1}{2}\rho v_1^2 - \frac{1}{2}\rho v_2^2 - \rho g h_2$$

$$P_2 = 80\times10^3 + \frac{1}{2}(1000)(3)^2 - \frac{1}{2}(1000)(4)^2 - (1000)(9.8)(3)$$

$$P_2 = 47.1\times10^3\,Pa.$$

$$\boxed{P_2 = 47\,KPa}$$

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6.5 Given data:

$v_1 = 450\,ms^{-1}$, $v_2 = 410\,ms^{-1}$

$\rho = 1.29\,Kgm^{-3}$, $P_2 - P_1 = ??$

$h_1 \approx h_2$

$$P_1 + \frac{1}{2}\rho v_1^2 + \cancel{\rho g h_1} = P_2 + \frac{1}{2}\rho v_2^2 + \cancel{\rho g h_2}$$

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

$$P_2 - P_1 = \frac{1}{2}\rho(v_1^2 - v_2^2)$$

$$P_2 - P_1 = \frac{1}{2}(1.29)((450)^2 - (410)^2)$$

$$P_2 - P_1 = 22188\,Pa = 22.18\times10^3\,Pa$$

$$\boxed{P_2 - P_1 = 22\,KPa}$$

6.7:- Given data:

$v = 3\,ms^{-1}$, $V = 300\,m^3$

$t = 15\text{ minutes} = 15\times60 = 900\,S.$

$r = ??$

As, $\frac{V}{t} = Av$

$$\frac{V}{t} = (\pi r^2)v$$

$$r^2 = \frac{V}{\pi t v}$$

$$r = \sqrt{\frac{V}{\pi t v}}$$

$$r = \sqrt{\frac{300}{(3.14)(900)(3)}}$$

$$r = 0.19\,m.$$

$$\boxed{r = 19\,Cm}$$

6.9. Given data:

$h_1 - h_2 = 15\,m$

$\rho = 1000\,Kgm^{-3}$

$v_1 \approx v_2$

$P_2 - P_1 = ??$

$$P_1 + \cancel{\frac{1}{2}\rho v_1^2} + \rho g h_1 = P_2 + \cancel{\frac{1}{2}\rho v_2^2} + \rho g h_2$$

$$P_1 + \rho g h_1 = P_2 + \rho g h_2$$

$$P_2 - P_1 = \rho g(h_1 - h_2)$$

$$P_2 - P_1 = (1000)(9.8)(15)$$

$$\boxed{P_2 - P_1 = 1.47\times10^5\,Pa}$$

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