DPP – 5

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Q 1. If a liquid of specific gravity 1, rises to a height of 2.5 cm in a capillary tube, then another liquid of specific gravity 1.25 will rise to the height in the same tube will be (if contact angle and surface tension is same in both cases)
(a) 1 cm (b) 2 cm
(c) 1.25 cm (d) 1.5 cm

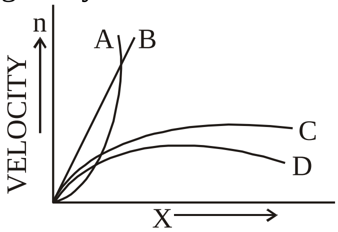
Q 2. Water rises to a height h in a capillary tube of cross-sectional area A. the height to which water will rise in a capillary tube of cross-sectional area 4A will be
(a) h (b) h/2
(c) h/4 (d) 4h

Q 3. Find the terminal velocity with which an air bubble of density 1 kgm^{-3} and 0.6 mm in diameter will rise in a liquid of viscosity 0.15 $Nm^{-2}s$ and of specific gravity 0.9?
(a) 1.2×10^{-3} m/s (b) 2.1×10^{-3} m/s
(c) 2.4×10^{-3} m/s (d) 4.2×10^{-3} m/s

Q 4. Flow of fluid through a tube is streamlined, when the Reynold number is
(a) 3100 (b) 2500
(c) 200 (d) 2200

Q 5. If a capillary tube is tilted to 45º and 60º from the vertical then the ratio of length l_1 and l_2 of liquid columns in it will be-
(a) $1 : \sqrt{2}$ (b) $\sqrt{2} : 1$ (c) 2 : 1 (d) 1 : 2

Q 6. A small spherical solid ball is dropped in a viscous liquid. Its journey in the liquid is best described in the figure by –

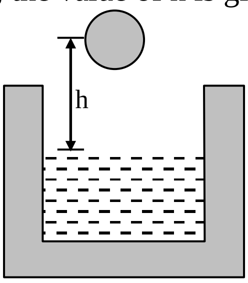


(a) Curve A (b) Curve B
(c) Curve C (d) Curve D

Q 7. A steel shot of diameter 2 mm is dropped in a viscous liquid filled in a drum. Find the terminal speed of the shot. Density of the material of the shot = 8.0×10^3 kg/ m^3, density of liquid = 1.0×10^3 kg/ m^3 . Coefficient of viscosity of liquid = 1.0 kg/(m-s), g= 10 m/ s^2

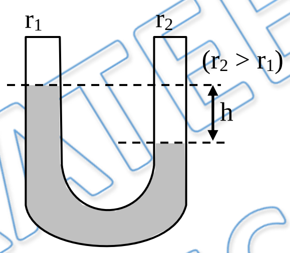
(a) 1.55 cm/s (b) 1.455 cm/s
(c) 5.1 cm/s (d) None of these

Q 8. A ball of radius r and density r falls freely under gravity through a distance h before entering water (density 1g/cc). Velocity of ball does not change on entering water. If viscosity of water is h, the value of h is given by –



(a) $\frac{2}{9}r^2\left(\frac{1-\rho}{\eta}\right)$g (b) $\frac{2}{81}r^2\left(\frac{\rho-1}{\eta}\right)$g
(c) $\frac{2}{81}r^4\left(\frac{1-\rho}{\eta}\right)^2$ g (d) $\frac{2}{81}r^4\left(\frac{\rho-1}{\eta}\right)$g

Q 9. In a U-tube the radii of two columns are respectively r_1 and r_2 and if a liquid of density d filled in it has level difference of h then the surface tension of the liquid is –



(a) T = $\frac{hdg}{2}\left(\frac{r_1r_2}{r_2-r_1}\right)$
(b) T = $\frac{hdg}{4}\left(\frac{r_1r_2}{r_2-r_1}\right)$
(c) T = $\frac{hdg}{3}\left(\frac{r_1r_2}{r_2-r_1}\right)$
(d) T = $\frac{hdg}{6}\left(\frac{r_1r_2}{r_2-r_1}\right)$

Q 10. Two rain drops of same radius coalesce. Before doing so each was moving with terminal velocity v. What is terminal velocity of the single drop so formed ?

(a) v/2 (b) 2v
(c) v $(2)^{1/3}$ (d) v $(2)^{2/3}$

Q 11. A metallic sphere of volume V falls through glycerin with a terminal velocity 2 m/s. If we drop a ball of volume 8V of the same metal into the column of glycerin, the terminal velocity of the ball will be –

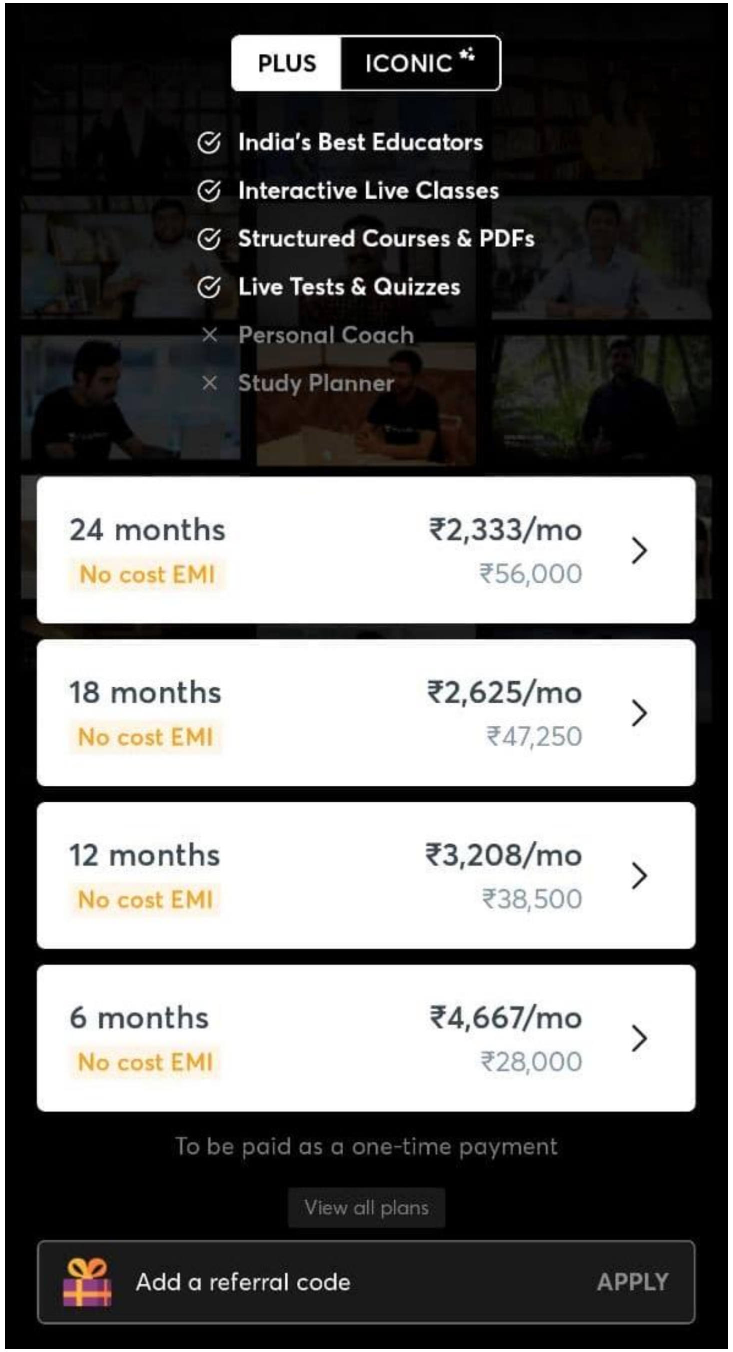
(a) 2 m/s (b) 4 m/s
(c) 8 m/s (d) 16 m/s

Q 12. A metallic sphere is projected in glycerin with velocity 4 m/s in vertically downward direction, it finally moves with terminal velocity 20 m/s. If same metallic sphere is projected in glycerin with velocity 4 m/s in vertically upward direction, it's terminal velocity will be –

(a) 10 m/s (b) 20 m/s (c) 30 m/s (d) 40 m/s

Answer Key

Q.1 b	**Q.2 b**	**Q.3 a**	**Q.4 c**	**Q.5 a**
Q.6 c	**Q.7 a**	**Q.8 c**	**Q.9 a**	**Q.10 d**
Q.11 c	**Q.12 b**			



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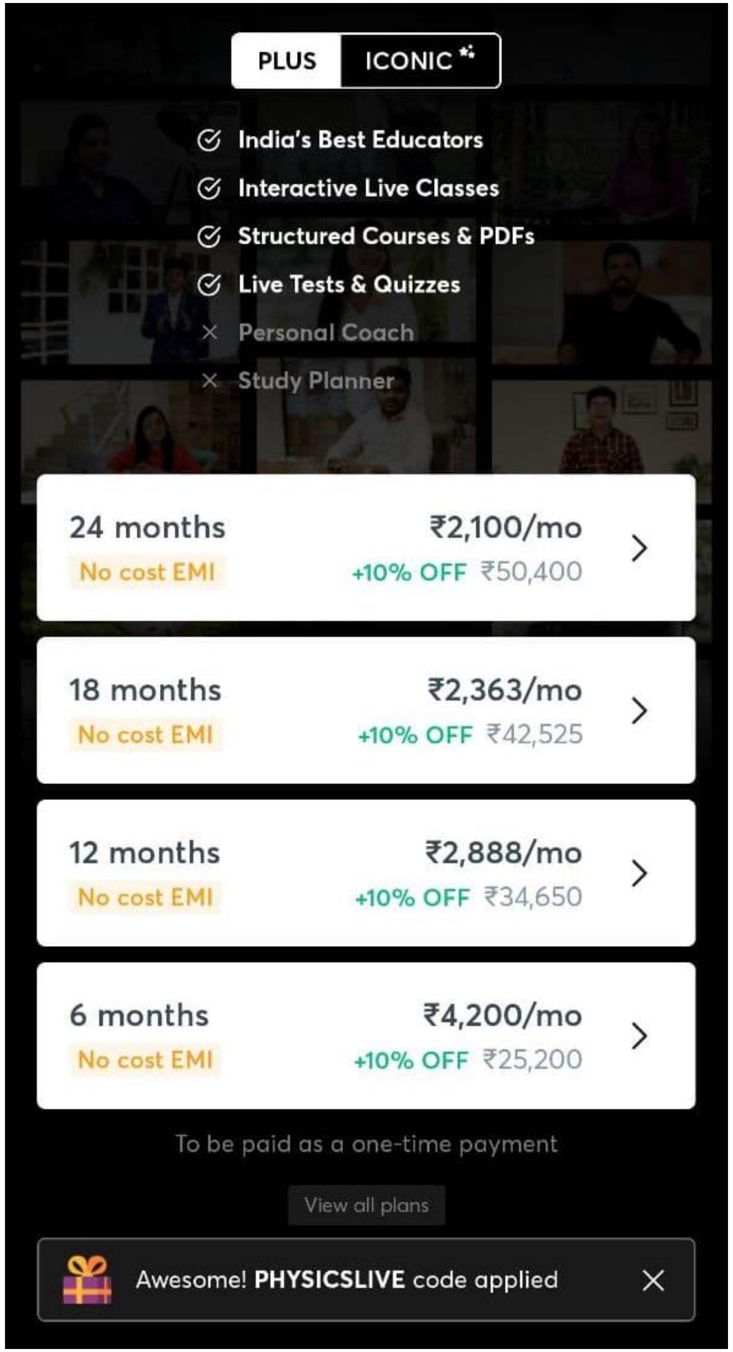


NEET & JEE Main
Physics DPP – Written Solution

DPP- 5 Fluid : Capillary Rise and Viscosity

By Physicsaholics Team

Q1) If a liquid of specific gravity 1 , rises to a height of 2.5 cm in a capillary tube , then another liquid of specific gravity 1.25 will rise to the height in the same tube will be (if contact angle and surface tension is same in both cases)

(a) 1 cm

(b) 2 cm

(c) 1.25 cm

(d) 1.5 cm

$$h = \frac{2S\cos\theta}{\rho g r}$$

$$h \propto \frac{1}{\rho}$$

$$\frac{h_1}{h_2} = \frac{\rho_2}{\rho_1}$$

$$\frac{2.5}{h_2} = \frac{1.25}{1}$$

$$h_2 = \frac{2.5}{1.25} = 2\ cm$$

Q2) Water rises to a height h in a capillary tube of cross-sectional area A. the height to which water will rise in a capillary tube of cross-sectional area 4A will be

(a) h

(b) h/2

(c) h/4

(d) 4h

A → 4A

⇒ r → 2r

Since $A = \pi r^2$

$$h = \frac{2S\cos\theta}{\rho g r}$$

h ↓ $\frac{1}{2}$ times

r → 2 times

$r = 3\,mm = 3\times10^{-4}\,m$

Q3) Find the terminal velocity with which an air bubble of density 1 kgm^{-3} and 0.6 mm in diameter will rise in a liquid of viscosity 0.15 $Nm^{-2}s$ and of specific gravity 0.9 ?

(a) 1.2×10^{-3} m/s ✓ (b) 2.1×10^{-3} m/s

(c) 2.4×10^{-3} m/s (d) 4.2×10^{-3} m/s

$$V_T = \frac{2}{9}\frac{r^2}{\eta}(\rho - \sigma)g$$

$$= \frac{2}{9} \times \frac{9\times10^{-8}}{.15}\left(1 - .9\times10^{3}\right)10$$

$$= \frac{-2\times10^{2}}{15}\times10^{-8}\times900\times10$$

$$= -\frac{18}{15}\times10^{-3}\ m/sec = 12\times10^{-3}\ m/sec \uparrow$$

Q4) Flow of fluid through a tube is streamlined, when the Reynold number is

(a) 3100

(b) 2500

(c) 200

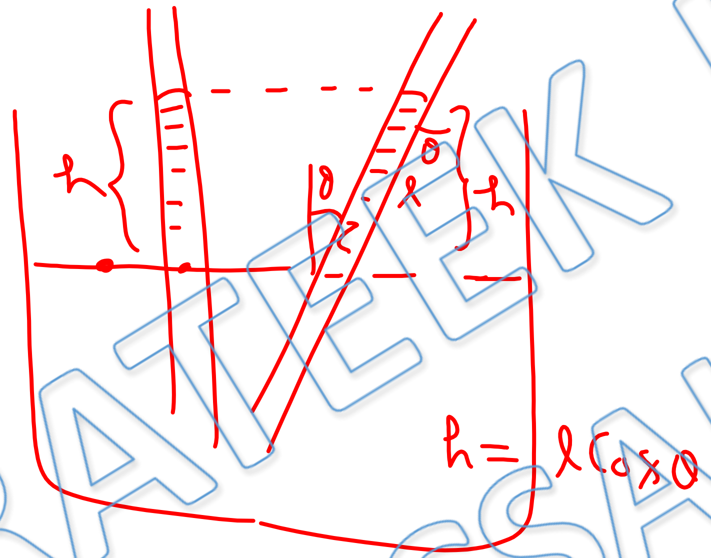
(d) 2200

$N = \frac{\rho V D}{\eta}$

$N < 2000$

$\Rightarrow$ streamline flow

Q5) If a capillary tube is tilted to 45º and 60º from the vertical then the ratio of length l_1 and l_2 of liquid columns in it will be-

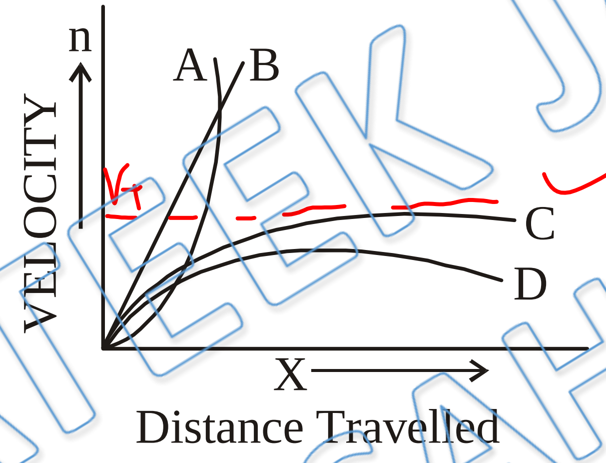


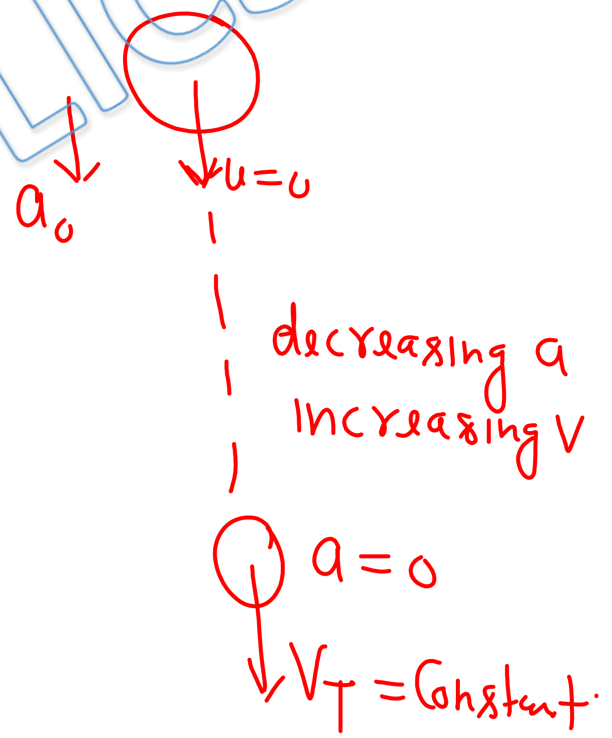
$h = l_1 \cos 45° = l_2 \cos 60°$

$\frac{l_1}{l_2} = \frac{\cos 60}{\cos 45} = \frac{1/2}{1/\sqrt{2}} = 1/\sqrt{2}$

(a) $1 : \sqrt{2}$ (b) $\sqrt{2} : 1$ (c) $2 : 1$ (d) $1 : 2$

Q6) A small spherical solid ball is dropped in a viscous liquid. Its journey in the liquid is best described in the figure by –





(a) Curve A

(b) Curve B

(c) Curve C

(d) Curve D

$r = 1\,mm = 10^{-3}\,m$

Q7) A steel shot of diameter 2 mm is dropped in a viscous liquid filled in a drum. Find the terminal speed of the shot. Density of the material of the shot = 8.0×10^3 kg/ m^3, density of liquid = 1.0×10^3 kg/ m^3 . Coefficient of viscosity of liquid = 1.0 kg/(m-s), g= 10 m/ s^2

$$V_T = \frac{2}{9}\frac{r^2 g}{\eta}(\rho - \sigma)$$

$$= \frac{2}{9} \times \frac{10^{-6} \times 10}{1}(8\times10^3 - 1\times10^3)$$

$$= \frac{2}{9} \times 7 \times (10^{-2}\ m/sec) = \frac{14}{9}\ cm/sec$$

$$= 1.55\ cm/sec$$

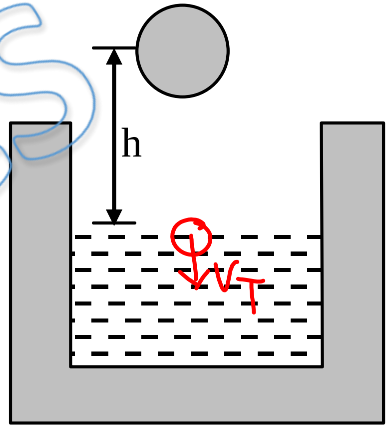
(a) 1.55 cm/s ✓

(b) 1.455 cm/s

(c) 5.1 cm/s

(d) None of these

Q8) A ball of radius r and density r falls freely under gravity through a distance h before entering water (density 1g/cc). Velocity of ball does not change on entering water. If viscosity of water is η, the value of h is given by -



(a) $\frac{2}{9} r^2 \left(\frac{1-\rho}{\eta}\right) g$

(b) $\frac{2}{81} r^2 \left(\frac{\rho-1}{\eta}\right) g$

(c) $\frac{2}{81} r^4 \left(\frac{1-\rho}{\eta}\right)^2 g$

(d) $\frac{2}{81} r^4 \left(\frac{\rho-1}{\eta}\right) g$

Q9) In a U-tube the radii of two columns are respectively r_1 and r_2 and if a liquid of density d filled in it has level difference of h then the surface tension of the liquid is –

(a) $T = \frac{hdg}{2}\left(\frac{r_1 r_2}{r_2 - r_1}\right)$

(b) $T = \frac{hdg}{4}\left(\frac{r_1 r_2}{r_2 - r_1}\right)$

(c) $T = \frac{hdg}{3}\left(\frac{r_1 r_2}{r_2 - r_1}\right)$

(d) $T = \frac{hdg}{6}\left(\frac{r_1 r_2}{r_2 - r_1}\right)$

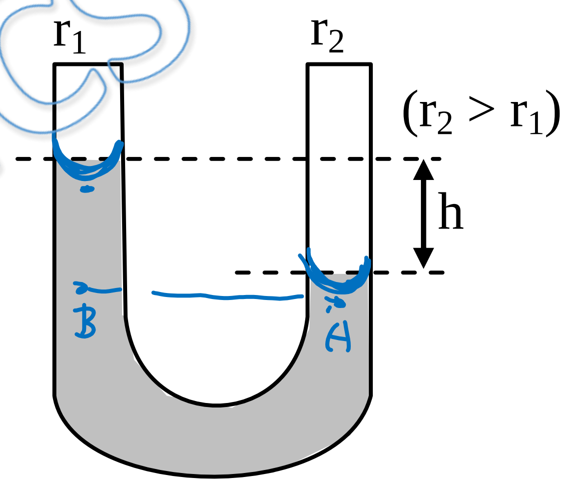
$P_A = P_B$

$\Rightarrow P_0 - \frac{2T}{r_2} = P_0 - \frac{2T}{r_1} + \rho g h$

$\Rightarrow 2T\left(\frac{1}{r_1} - \frac{1}{r_2}\right) = \rho g h$

$\Rightarrow 2T\left(\frac{r_2 - r_1}{r_1 r_2}\right) = \rho g h$

$\Rightarrow T = \frac{\rho g h}{2}\left(\frac{r_1 r_2}{r_2 - r_1}\right)$



Q10) Two rain drops of same radius coalesce. Before doing so each was moving with terminal velocity v. What is terminal velocity of the single drop so formed ?

$V = C r^2$

$V_T = C R^2 = C r^2 (2)^{2/3}$

$= v (2)^{2/3}$

(a) v/2

(b) 2v

(c) v $(2)^{1/3}$

(d) v $(2)^{2/3}$

$2 \times \frac{4}{3} \pi r^3 = \frac{4}{3} \pi R^3$

$R = r (2)^{1/3}$

Q11) A metallic sphere of volume V falls through glycerin with a terminal velocity 2 m/s. If we drop a ball of volume 8V of the same metal into the column of glycerin, the terminal velocity of the ball will be –

$V \rightarrow 8V$

$\Rightarrow r \rightarrow 2r$

$V = \frac{4}{3}\pi r^3$

$r \propto V^{1/3}$

$V_T \propto r^2$

4 times   2 times

(a) 2 m/s
(b) 4 m/s
(c) 8 m/s
(d) 16 m/s

Q12) A metallic sphere is projected in glycerin with velocity 4 m/s in vertically downward direction , it finally moves with terminal velocity 20 m/s. If same metallic sphere is projected in glycerin with velocity 4 m/s in vertically upward direction , it's terminal velocity will be –

(a) 10 m/s (b) 20 m/s (c) 30 m/s (d) 40 m/s

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