## Exercise - I (only one option is correct)

**1.** There is a horizontal film of soap solution. On it a thread is placed in the form of a loop. The film is pierced inside the loop and the thread becomes a circular loop of radius R. If the surface tension of the loop be T, then what will be the tension in the thread?
(A) $\pi R^2/T$ (B) $\pi R^2 T$ (C) $2\pi RT$ (D) $2RT$

**2.** A container, whose bottom has round holes with diameter 0.1 mm is filled with water. The maximum height in cm upto which water can be filled without leakage will be what?
Surface tension = $75 \times 10^{-3}$ N/m and g = 10 m/s$^2$ :
(A) 20 cm (B) 40 cm (C) 30 cm (D) 60 cm

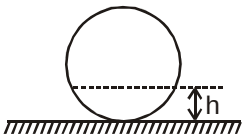
**3.** If two soap bubbles of different radii are connected by a tube :
(A) air flows from the bigger bubble to the smaller bubble till the sizes become equal
(B) air flows from bigger bubble to the smaller bubble till the sizes are interchanged
(C) air flows from the smaller bubble to the bigger
(D) there is no flow of air.

**4.** Two soap bubbles with radii r and ($r_1 > r_2$) come in contact. Their common surface has radius of curvature r.

(A) $r = \frac{r_1 + r_2}{2}$ (B) $r = \frac{r_1 r_2}{r_1 - r_2}$

(C) $r = \frac{r_1 r_2}{r_1 + r_2}$ (D) $r = \sqrt{r_1 r_2}$

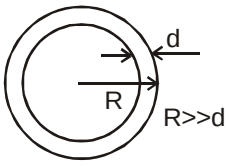
**5.** A liquid is filled in a spherical container of radius R till a height h. At this positions the liquid surface at the edges is also horizontal. The contact angle is




(A) 0 (B) $\cos^{-1}\left(\frac{R-h}{R}\right)$

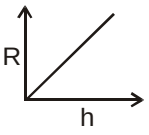
(C) $\cos^{-1}\left(\frac{h-R}{R}\right)$ (D) $\sin^{-1}\left(\frac{R-h}{R}\right)$

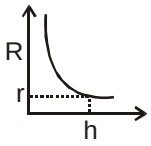
**6.** A soap bubble has radius R and thickness d(<< R) as shown. It colapses into a spherical drop. The ratio of excess pressure in the drop to the excess pres sure inside the bubble is.

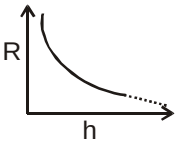


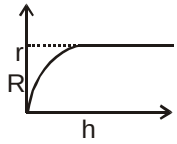

(A) $\left(\frac{R}{3d}\right)^{\frac{1}{3}}$ (B) $\left(\frac{R}{6d}\right)^{\frac{1}{3}}$ (C) $\left(\frac{R}{24d}\right)^{\frac{1}{3}}$ (D) None

**7.** A long capillary tyube of radius 'r' is initially just vertically completely imerged inside a liquid of angle of contact 0°. If the tube is slowly raised then relation between radius of curvature of miniscus inside the capillary tube and displacement (h) of tube can be represented by

(A) 


(B) 


(C) 


(D) 

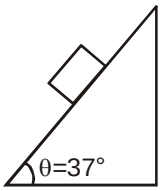

**8.** A Newtonian fluid fills the clearance between a shaft and a sleeve. When a force of 800N is applied to the shaft, parallel to the sleeve, the shaft attains a speed of 1.5 cm/sec. If a force of 2.4 kN is applied instead, the shaft would move with a speed of
(A) 1.5 cm/sec (B) 13.5 cm/sec
(C) 4.5 cm/sec (D) None

**9.** A solid metallic sphere of radius r is allowed to fall freely through air. If the frictional resistance due to air is proportional to the cross-sectional area and to the square of the velocity, then the terminal velocity of the sphere is proportional to which of the following?
(A) $r^2$ (B) r (C) $r^{3/2}$ (D) $r^{1/2}$

**10.** Two drops of same radius are falling through air with steady velocity of v cm/s. If the two drops coalesce, what would be the terminal velocity?
(A) 4 v (B) $(4)^{1/3}$v (C) 2 v (D) 64 v

**11.** A cubical block of side 'a' and density '$\rho$' slides over a fixed inclined plane with constant velocity 'v'. There is a thin film of viscous fluid of thickness 't' between the plane and the block. Then the coefficient

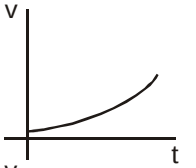
of viscosity of the thin film will be:

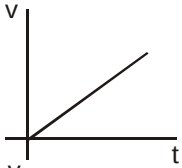


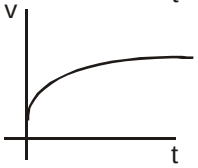

(A) $\frac{3\rho agt}{5v}$ (B) $\frac{4\rho agt}{5v}$ (C) $\frac{\rho agt}{v}$

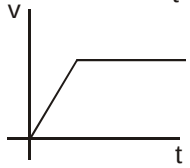
(D) none of these

**12.** Which of the following graphs best represents the motion of a raindrop?

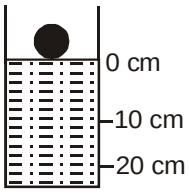
(A) 


(B) 


(C) 


(D) 


**13.** A spherical ball of density $\rho$ and radius 0.003m is dropped into a tube containing a viscous fluid filled up to the 0 cm mark as shown in the figure. Viscosity of the fluid = 1.260 $N.m^{-2}$ and its density $\rho_L = \rho/2 = 1260\ kg.m^{-3}$. Assume the ball reaches a terminal speed by the 10 cm mark. The time taken by the ball to traverse the distance between the 10 cm and 20 cm mark is.




(A) 500 μs (B) 50 ms

(C) 0.5 s (D) 5 s

(g = acceleration due to gravity = 10 $ms^{-2}$)

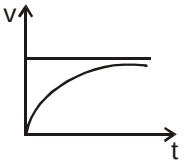
**14.** A sphere is dropped under gravity through a fluid of viscosity $\eta$. If the average acceleration is half of the initial acceleration, the time to attain the terminal velocity is ($\rho$ = density of sphere, r = radius)

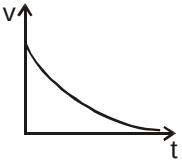
(A) $\frac{4\rho r^2}{9\eta}$ (B) $\frac{9\rho r^2}{4\eta}$ (C) $\frac{4\rho r}{9\eta}$ (D) $\frac{9\rho r}{4\eta}$

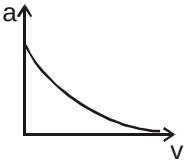
**15.** A ball of mass m and radius r is gently released in a viscous liquid. The mass of the liquid displaced by it is m′ such that m>m′. The terminal velocity is proportional to

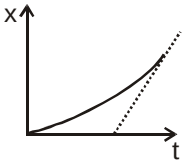
(A) $\frac{m-m'}{r}$ (B) $\frac{m+m'}{r}$ (C) $\frac{(m+m')}{r^2}$ (D) $(m-m')r^2$

**16.** Which of the following is the incorrect graph for a sphere falling in a viscous liquid?
(Given at t = 0, velocity v = 0 and displacement x = 0.)

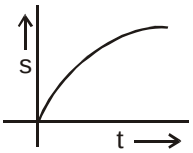
(A) 

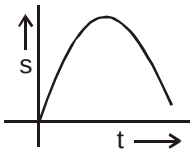

(B) 

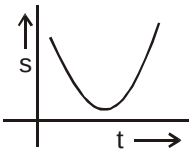

(C) 

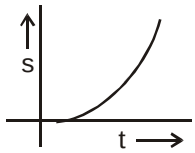

(D) 


**17.** The displacement of a ball falling from rest in a viscous medium is platted against time. Choose a possible option.

(A) 


(B) 


(C) 


(D) 


**18.** There is a 1 mm thick layer of glycerine between a flat plate of area 100 $cm^2$ & a big fixed plate. If the coefficient of viscosity of glycerine is 1.0 kg/m-s then how much force is required to move the plate with a velocity of 7 cm/s?

(A) 3.5 N (B) 0.7 N (C) 1.4 N (D) None