DPP – 4

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Q 1. A and B are two soap bubbles. Bubble A is larger than B. If these are now joined by a tube then:
(a) the bubble A becomes more large
(b) the bubble B becomes more large
(c) both the bubbles acquire the same size
(d) both the bubbles will get busted

Q 2. If a million tiny droplets of water of the same radius coalesce into one larger drop the ratio of the surface energy of the large drop to the total surface energy of all the droplets will be
(a) 1 : 10 (b) 1 : 10^2 (c) 1 : 10^4 (d) 1 : 10^6

Q 3. 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 tension in the thread will be:
(a) $\pi R^3 T$ (b) 2RT (c) RT (d) πR^2/T

Q 4. When too many water drops coalesce to form a bigger drop:
(a) energy is absorbed
(b) energy is liberated
(c) energy is neither liberated nor absorbed
(d) energy may either be liberated or be absorbed depending on the nature of liquid

Q 5. A soap bubble of radius r is placed on another bubble of radius 2r. The radius of the surface common to both the bubbles is
(a) 2r/3 (b) 3r (c) 2r (d) r

Q 6. One cubic plate, having 15 cm side, floats on water surface. If surface tension of water is 60 dyne/cm. To lift this plate from water, Find the extra force required against weight.
(a) 3600 dyne (b) 1800 dyne
(c) 900 dyne (d) 7200 dyne

Q 7. A soap bubble is very slowly blown on the end of a glass tube by a mechanical pump which supplied a fixed volume of air every time whatever be the pressure against which it pumping. The excess of pressure inside the bubble varies with time as shown by which of the graph-

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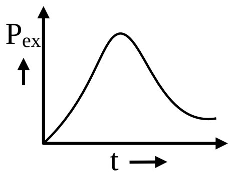
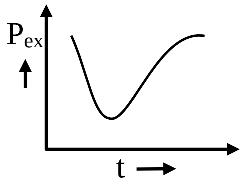
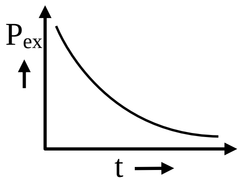
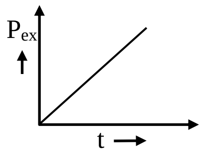
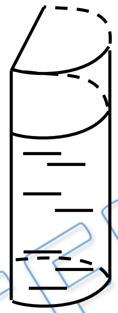
(a) 

(b) 

(c) 

(d) 

Q 8. A liquid is contained in a vertical tube of semicircular cross-section (shown in figure). The contact angle is zero. The force of surface tension on the curved part and on the flat part are in ratio–



(a) 1 : 1
(b) 1 : 2
(c) π : 2
(d) 2 : π

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Q 9. If more air is pushed in a soap bubble, the pressure in it–
(a) decreases
(b) increases
(c) remains same
(d) becomes zero

Q 10. Two spherical soap bubbles coalesce to form a single bubble. If V is the consequent change in volume of the contained air and S the change in total surface area, then (P = atmospheric pressure)
(a) 3PV + 4ST = 0
(b) 4PV + 3ST = 0
(c) 6PV + ST = 0
(d) PV + 4ST = 0

Q 11. A big drop of water whose diameter is 0.2 cm, is broken into 27000 small drops of equal volume. Work done in this process will be - (surface tension of water is 7×10^{-2} N/m).
(a) 5×10^{5} joule
(b) 2.9×10^{-5} joule
(c) 2.55×10^{-5} joule
(d) zero

Q 12. A drop of water of volume V is pressed between the two glass plates so as to spread to an area A. If T is the surface tension, the normal force required to separate the glass plates
(a) $\frac{TA^2}{V}$
(b) $\frac{2TA^2}{V}$
(c) $\frac{4TA^2}{V}$
(d) $\frac{TA^2}{2V}$

Answer Key

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

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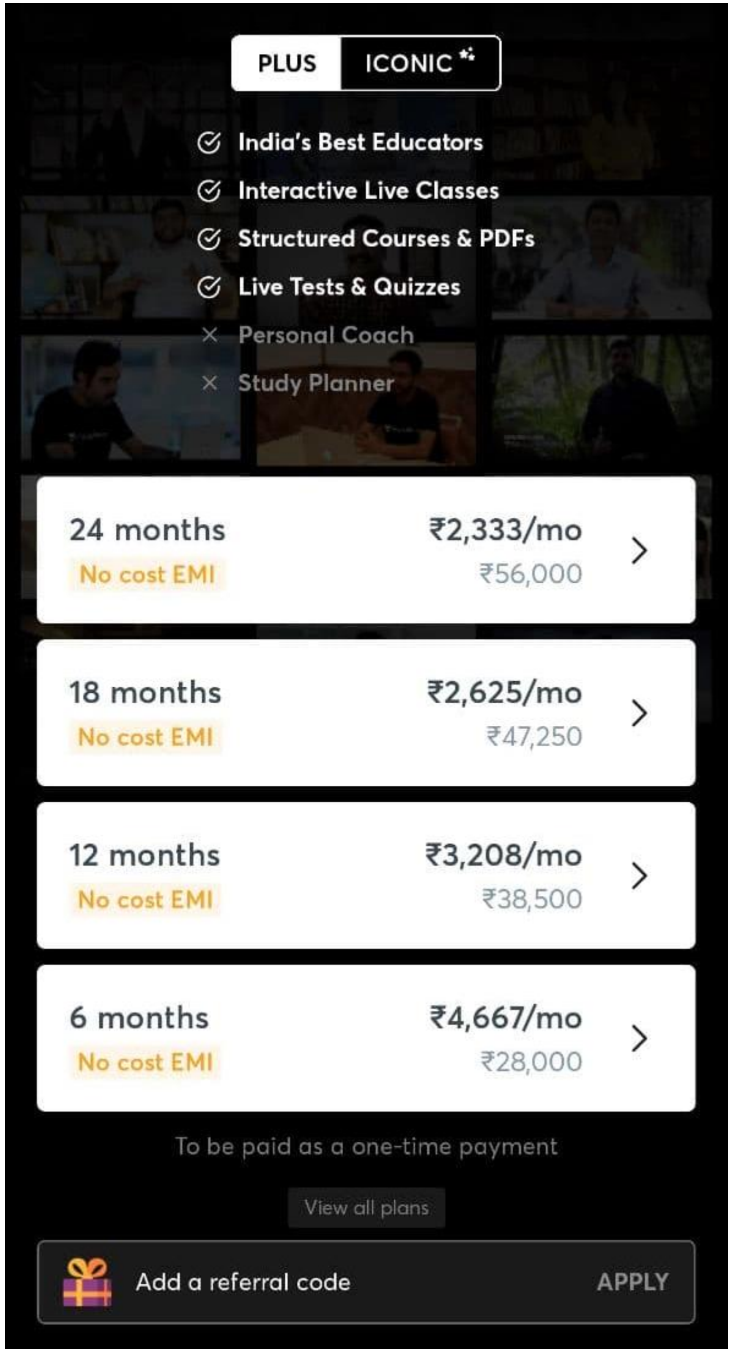

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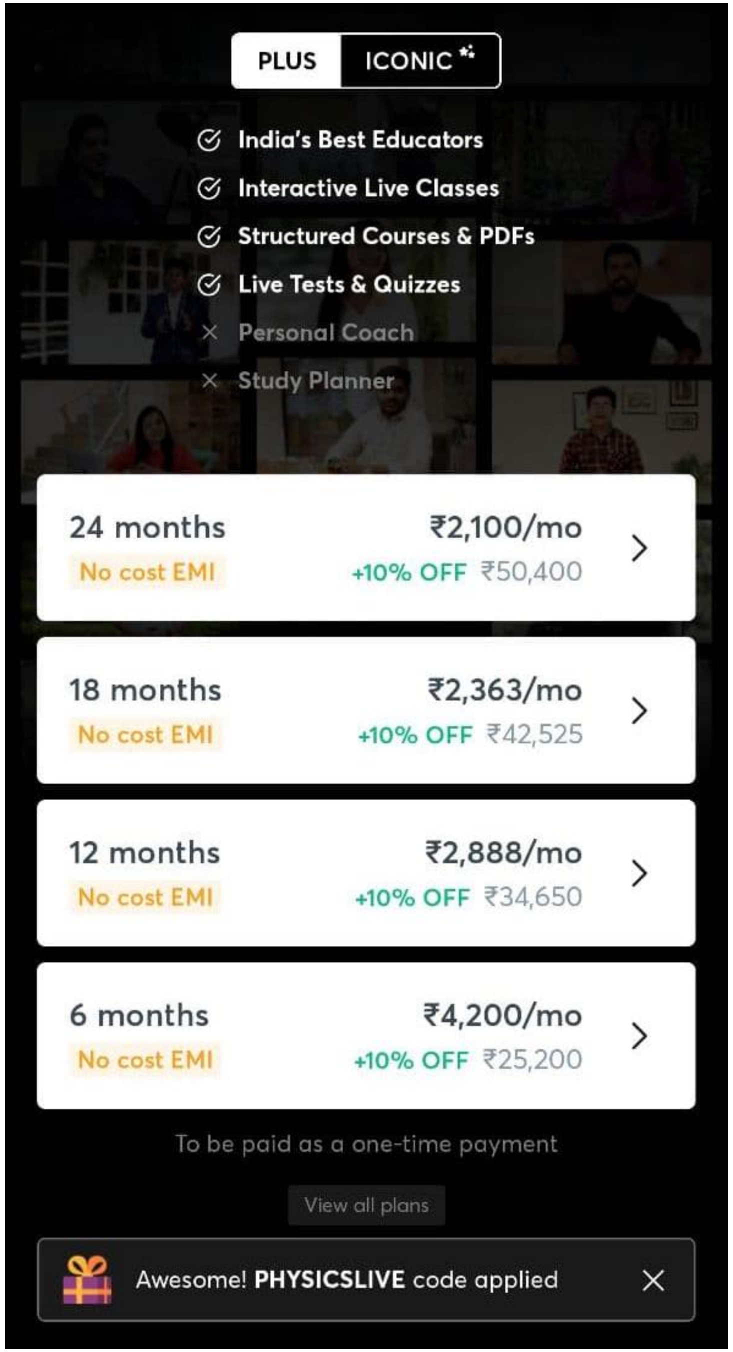

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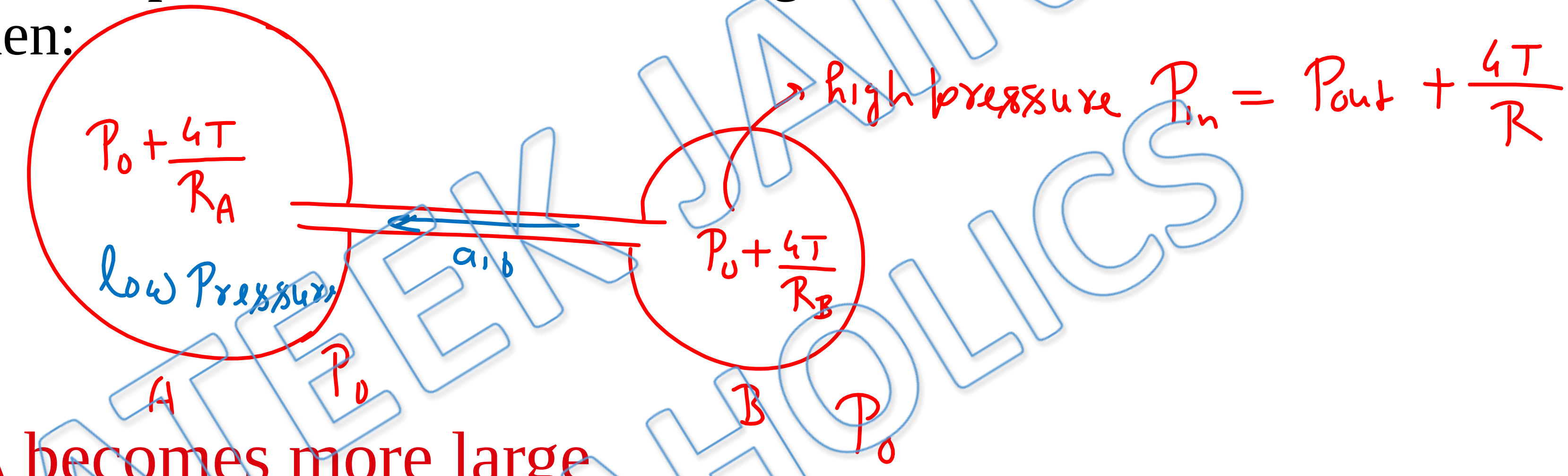
Physics DPP - Written Solution

DPP- 4 surface Tension , Surface Energy , Excess Pressure

By Physicsaholics Team

Q1) A and B are two soap bubbles. Bubble A is larger than B. If these are now joined by a tube then:



(a) the bubble A becomes more large

(b) the bubble B becomes more large

(c) both the bubbles acquire the same size

(d) both the bubbles will get busted

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Q2) If a million tiny droplets of water of the same radius coalesce into one larger drop the ratio of the surface energy of the large drop to the total surface energy of all the droplets will be

$r + \bigcirc + \ldots + 10^6$ droplets $\Rightarrow R$

$$10^6 \times \frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$$

$$R = 100r$$

final surface energy $U_f = T \times 4\pi R^2 = T\,4\pi r^2 \times 10^4$

(a) 1 : 10 (b) 1 : 10^2 (c) 1 : 10^4 (d) 1 : 10^6

Initial surface tension $U_i = T.\,4\pi r^2 \times 10^6$

$$\frac{U_f}{U_i} = \frac{10^4}{10^6} = \frac{1}{10^2}$$

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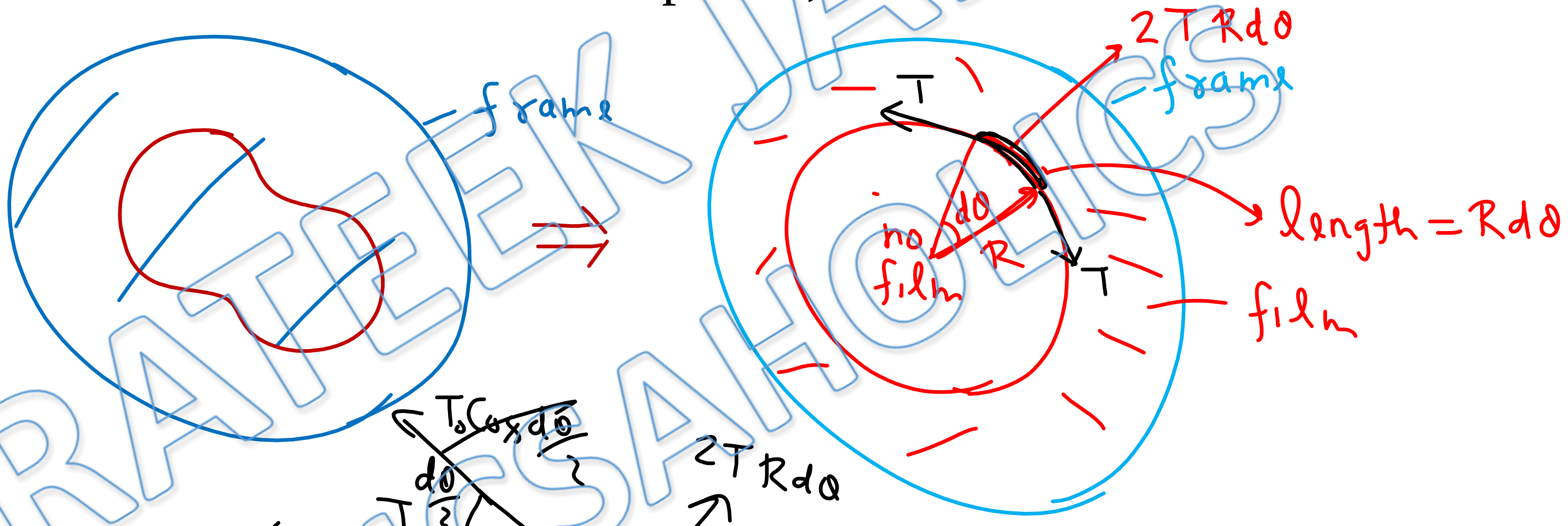
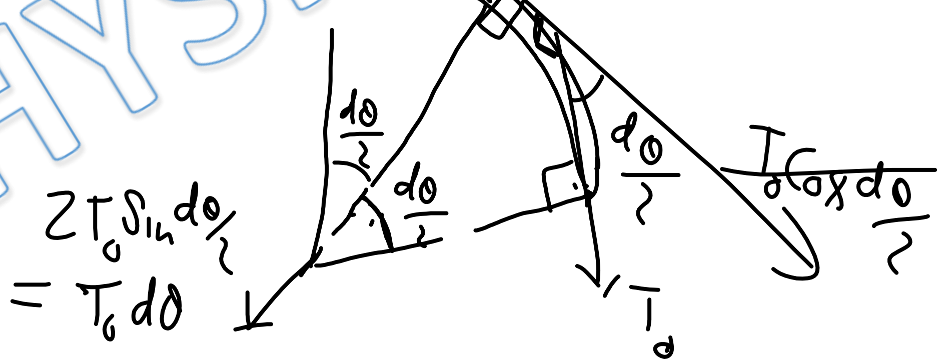
Q3) There is a horizontal film of soap solution. On it a thread is placed in the form of a loop. The film is pierced inside the loop and the thread becomes a circular loop of radius R. If the surface tension of the loop be T, then tension in the thread will be:



(a) $\pi R^3 T$ (b) 2RT (c) RT (d) $\pi R^2/T$



$T_0 d\theta = 2TR d\theta$

$T_0 = 2TR$

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Q4) When too many water drops coalesce to form a bigger drop:

Surface area ↓

⇒ Energy ↓

⇒

(a) energy is absorbed

(b) energy is liberated

(c) energy is neither liberated nor absorbed

(d) energy may either be liberated or be absorbed depending on the nature of liquid

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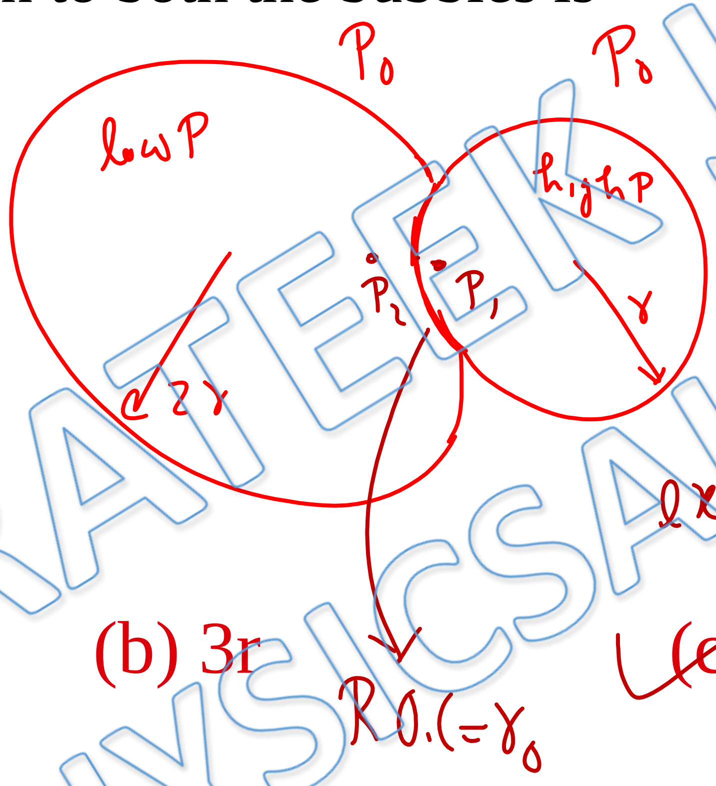
Q5) A soap bubble of radius r is placed on another bubble of radius 2r. The radius of the surface common to both the bubbles is



$$P_{in} = P_0 + \frac{4T}{R}$$

$$P_1 = P_0 + \frac{4T}{r}$$

$$P_2 = P_0 + \frac{4T}{2r}$$

Excess pressure of Common surface

(a) 2r/3 (b) 3r (c) 2r ✓ (d) r

$$P_1 - P_2 = \frac{4T}{r_0} = 4T\left(\frac{1}{r} - \frac{1}{2r}\right)$$

$$\frac{1}{r_0} = \frac{1}{2r}$$

$$r_0 = 2r$$

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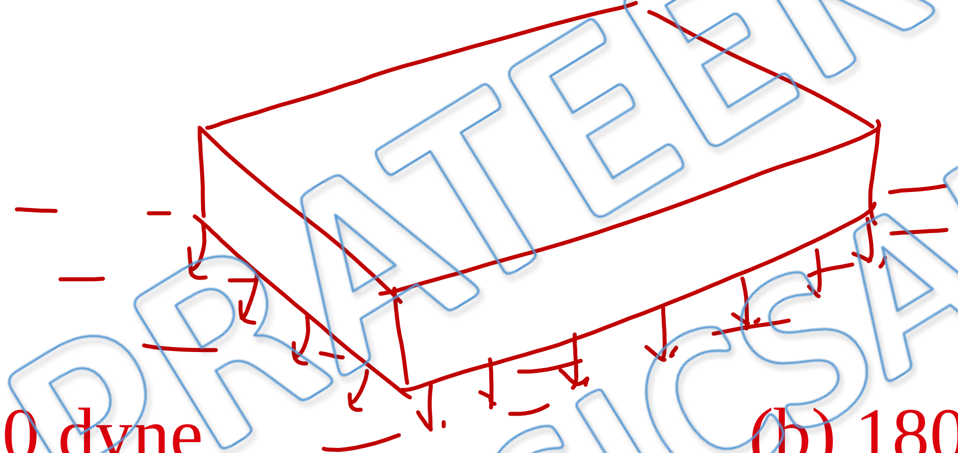
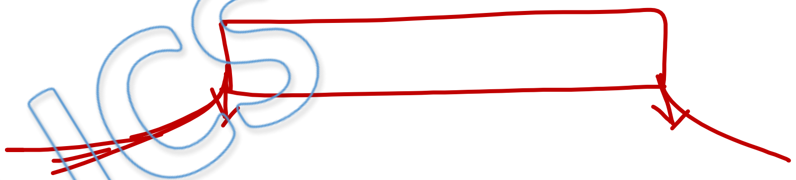
Q6) One cubic plate, having 15 cm side, floats on water surface. If surface tension of water is 60 dyne/cm. To lift this plate from water, Find the extra force required against weight.





$F = T l$

$= 60 \times (4 \times 15)$

$= 3600$ dyne

(a) 3600 dyne ✓

(b) 1800 dyne

(c) 900 dyne

(d) 7200 dyne

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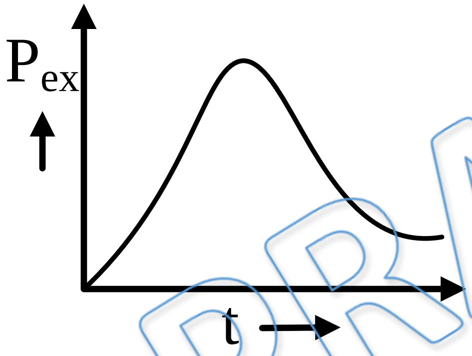
Q7) A soap bubble is very slowly blown on the end of a glass tube by a mechanical pump which supplied a fixed volume of air every time whatever be the pressure against which it pumping. The excess of pressure inside the bubble varies with time as shown by which of the graph-

$P_{excess} = \frac{4T}{r}$

P_{excess} decreases with t

r increases with t

(a)



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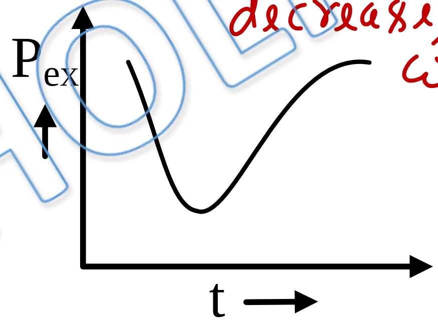
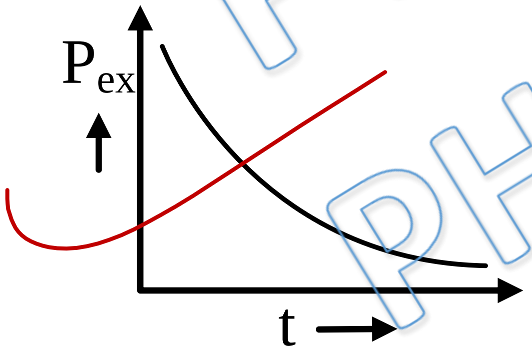
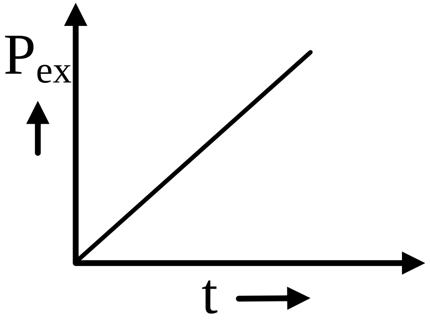


(c)



(d)



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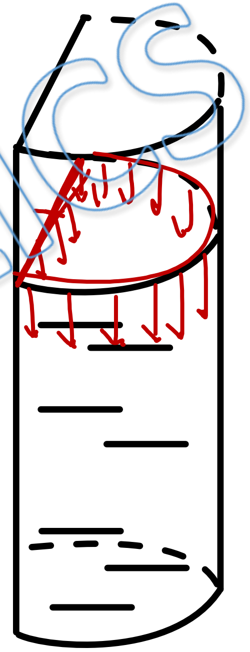
Q8) A liquid is contained in a vertical tube of semicircular cross-section (shown in figure). The contact angle is zero. The force of surface tension on the curved part and on the flat part are in ratio–

$$\frac{\text{force on curved}}{\text{,, ,, flat}} = \frac{T \pi R}{T\, 2R}$$



(a) 1 : 1

(b) 1 : 2

(c) π : 2

(d) 2 : π

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Q9) If more air is pushed in a soap bubble, the pressure in it–

(a) decreases

(b) increases

(c) remains same

(d) becomes zero

Sol: On pushing more air in sop bubble, its radius increases.
Due to which, excess pressure decreases.
Since, outside pressure is constant so, inner pressure decrease.

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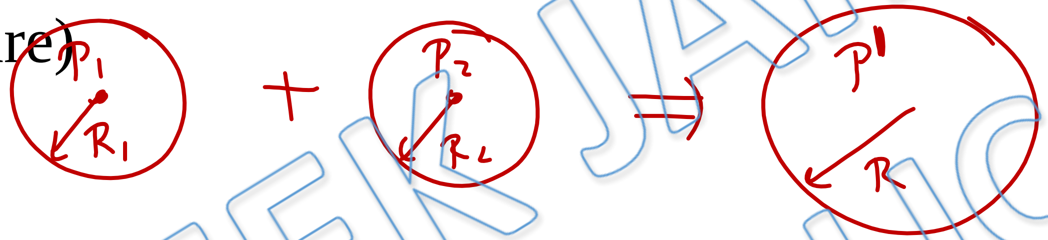
Q10) Two spherical soap bubbles coalesce to form a single bubble. If V is the consequent change in volume of the contained air and S the change in total surface area, then
(P = atmospheric pressure)



atmospheric Pressure

Temperature is Constant

(a) 3PV + 4ST = 0 (b) 4PV + 3ST = 0

(c) 6PV + ST = 0 (d) PV + 4ST = 0

no of moles of air in bubble 1.

$n_1 + n_2 = n$

$\frac{P_1 V_1}{RT} + \frac{P_2 V_2}{RT} = \frac{P' V}{RT}$

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Ans. a

$$\left(P_0 + \frac{4T}{R_1}\right)\frac{4}{3}\pi R_1^3 + \left(P_0 + \frac{4T}{R_2}\right)\frac{4}{3}\pi R_2^3 = \left(P_0 + \frac{4T}{R}\right)\frac{4}{3}\pi R^3$$

$$P_0\left[\frac{4}{3}\pi R^3 - \frac{4}{3}\pi R_1^3 - \frac{4}{3}\pi R_2^3\right] + 4T\left[\frac{4}{3}\pi R^2 - \frac{4}{3}\pi R_1^2 - \frac{4}{3}\pi R_2^2\right]$$

$$P_0 V + \frac{4T}{3}\left[S\right] = 0$$

$$3P_0 V + 4ST = 0$$

P_0 → atmospheric pressure

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Q11) A big drop of water whose diameter is 0.2 cm, is broken into 27000 small drops of equal volume. Work done in this process will be - (surface tension of water is 7×10^{-2} N/m).

W = change in surface energy

$\frac{4}{3}\pi R^3 = 27000 \times \frac{4}{3}\pi r^3 \Rightarrow R = 30r \Rightarrow r = R/30 = \frac{.1}{30}$ cm

29×88: 232, 2320, 2552

(a) 5×10^{5} joule (b) 2.9×10^{-5} joule

(c) 2.55×10^{-5} joule (d) zero

$W = T\,4\pi r^2 \times 27000 - T\,4\pi R^2 = T\,\frac{4\pi R^2}{900} \times 27000 - T\,4\pi R^2$

$= 29\,T\,4\pi R^2 = 29 \times 7 \times 10^{-2} \times 4\pi \times 10^{-6}$

$= 29 \times 7 \times 4 \times \frac{22}{7} \times 10^{-8} = 29 \times 88 \times 10^{-8} = 2552 \times 10^{-8}$

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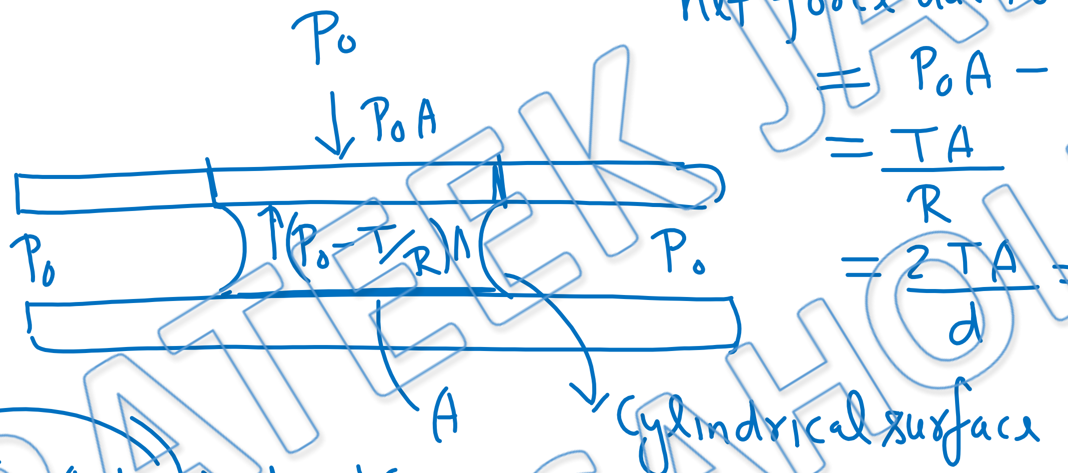
Q12) A drop of water of volume V is pressed between the two glass plates so as to spread to an area A. If T is the surface tension, the normal force required to separate the glass plates

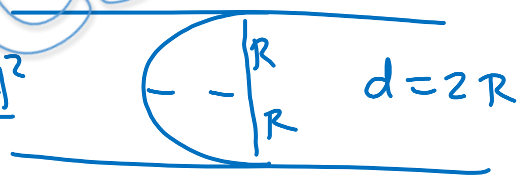


net force due to pressure difference

$= P_0A - (P_0 - T/R)A$

$= \frac{TA}{R}$

$= \frac{2TA}{d} = \frac{2TA^2}{V}$



$V = Ad \Rightarrow d = V/A$

(a) $\frac{TA^2}{V}$ (b) $\frac{2TA^2}{V}$ (c) $\frac{4TA^2}{V}$ (d) $\frac{TA^2}{2V}$

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