Physicsaholics

DPP – 4

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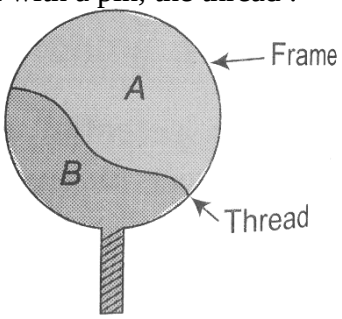
Q 1. The spherical shape of rain-drop is due to
(a) Density of the liquid
(b) Surface tension
(c) Atmospheric pressure
(d) Gravity

Q 2. Soap helps in cleaning clothes, because
(a) It attracts the dirt particles
(b) It decreases the surface tension of water
(c) It increases the cohesive force between water molecules
(d) It increases the angle of contract

Q 3. A rectangular glass plate of dimensions 5 cm × 4 cm is placed flat on the surface of water. Find the downward force on the plate due to surface tension. [Given surface tension of water = 0.073 N/m]
(a) 1.314 N
(b) 0.04132 N
(c) 0.3114 N
(d) 0.01314 N

Q 4. The length of a needle floating on water is 2.5cm. The minimum force in addition to its weight needed to lift the needle above the surface of water will be (surface tension of water is 0.072N/m)
(a) 3.6×10^{-3} N
(b) 10^{-2} N
(c) 9×10^{-4} N
(d) 6×10^{-4} N

Q 5. A thread is tied slightly loose to a wire frame as in figure and the frame is dipped into a soap solution and taken out. The frame is completely covered with the film. When the portion A is punctured with a pin, the thread :



(a) Becomes concave towards A
(b) Becomes convex towards A
(c) Either (a) or (b) depending on the size of A with respect to B
(d) Remains in the initial position

Q 6. The force required to take away a flat circular plate of radius 2 cm from the surface of water, will be (the surface tension of water is 70 dyne/cm)
(a) 280π dyne (b) 250π dyne
(c) 140π dyne (d) 210π dyne

Q 7. P is the excess pressure inside a water drop. If that drop is divided into 8 identical droplets, excess pressure inside smaller droplet is
(a) P (b) P/2
(c) 2P (d) P/8

Q 8. Surface tension of water is 0.072 N/m. The excess pressure inside a water drop of diameter 1.2 mm is :-
(a) 240 N/m^2 (b) 24 N/m^2
(c) 0.06 N/m^2 (d) 60 N/m^2

Q 9. The surface tension of soap solution is 0.05 N/m if the diameter of the soap bubble is 4 cm. The excess pressure inside the soap bubble over that of outside is (in pascal)
(a) 10 (b) 1
(c) 0.1 (d) 0.25

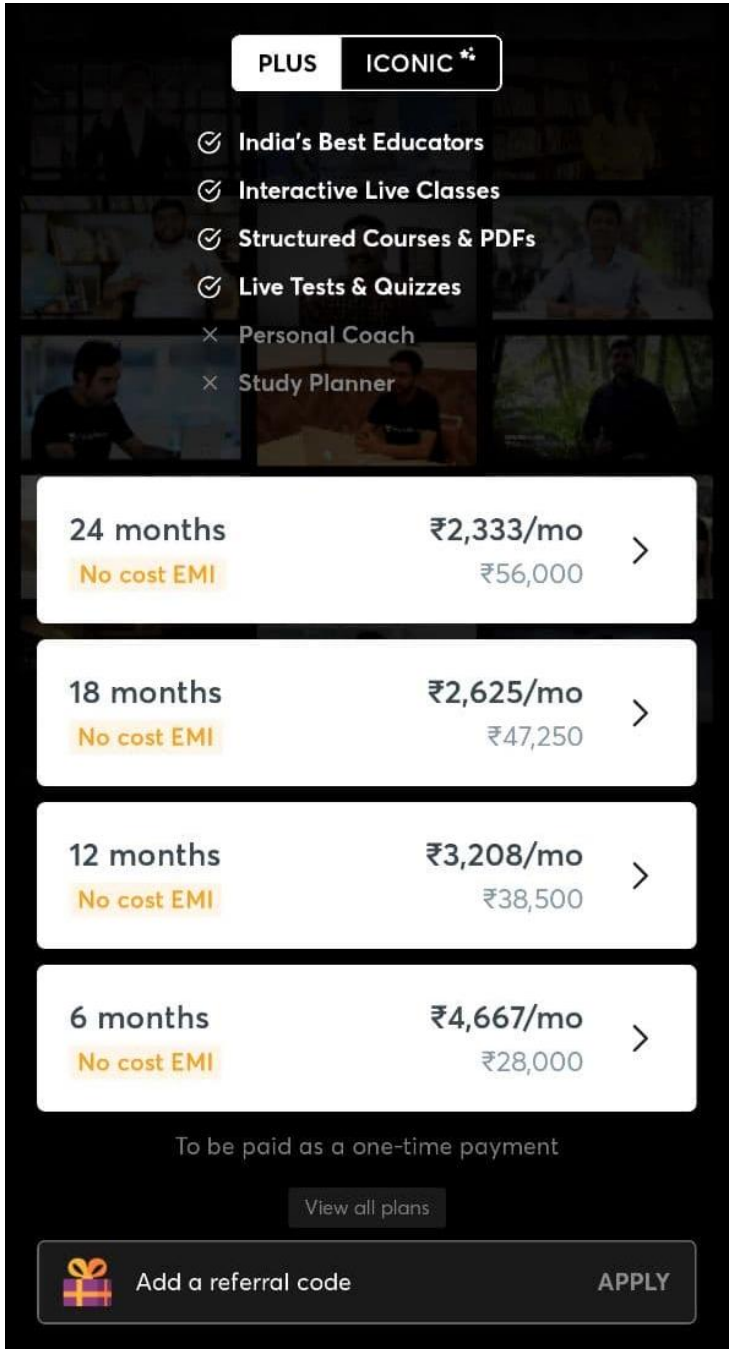
Q 10. The surface energy of a liquid drop is E. It is sprayed into 1000 equal droplets. Then its surface energy becomes
(a) 1000E (b) 100E
(c) 10E (d) E

Q 11. A water drop of radius 10^{-2} m is broken into 1000 equal droplets. Calculate the gain in surface energy. Surface tension of water is 0.075N/m
(a) 8.5×10^{-4} J (b) 3.5×10^{-3} J
(c) 2.5×10^{-4} J (d) 5.8×10^{-3} J

Q 12. A vessel, whose bottom has round holes with diameter of 0.1mm, is filled with water. The maximum height to which the water can be filled without leakage is (S.T. of water =75 dyne/cm, g =1000 cm/s^2)
(a) 100 cm (b) 75 cm
(c) 50 cm (d) 30 cm

Answer Key

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



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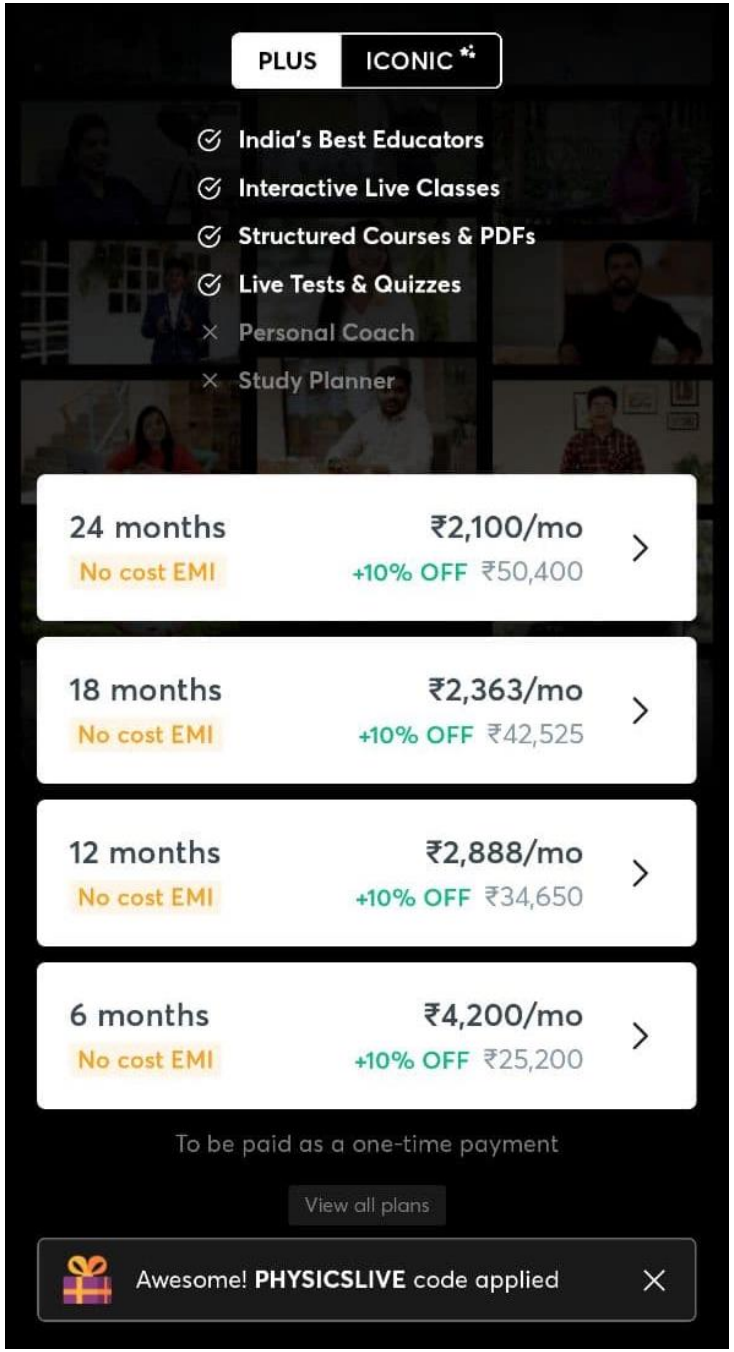


NEET & JEE Main
Physics DPP – Written Solution

DPP- 4 Fluid : Surface Tension , Excess Pressure, Surface Energy

By Physicsaholics Team

Solution: 1

The surface of water tends to contract which is known as surface tension. In case of water droplets, the surface tension attains minimum value when its shape is spherical. So water droplets are spherical in shape.

Ans. b

Solution: 2

Soaps decreases the surface tension of water so as to increase wetting ability of water which helps in cleaning clothes.

Ans. b

Solution: 3

$$F = 2(l+b) \times T$$

$$F = 2(0.05+0.04) \times 0.073$$

$$F = 2 \times 0.09 \times 0.073$$

$$\boxed{F = 0.01314} \text{ Ans.}$$

Ans. d

Solution: 4

$$F_{cnt} = f_T + mg$$

$$f_{cnt} = (2lxT) + mg$$

$$f_{cnt} - mg = (2 \times 2.5 \times 10^{-2} \times 0.072)$$

$$\boxed{f_{cnt} - mg = 0.0036\ N}$$

$$F_{net} = f_{cnt} - mg$$

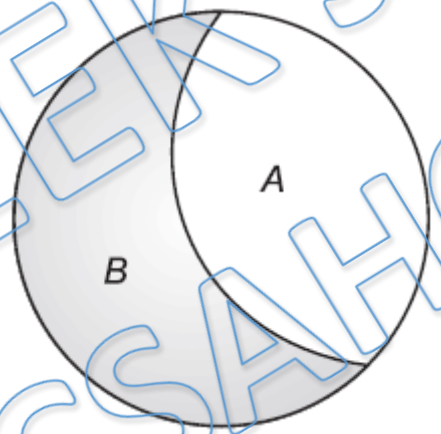
$$\boxed{F_{net} = 0.0036\ N} \quad \text{Ans.}$$

Ans. a

Solution: 5

The potential energy of the surface tension force is given by the formula.

U=SA where A is the area of the film. Since after puncturing, the film will try to minimize its potential energy and hence the surface area, the thread will become concave towards A.



Ans. a

Solution: 6

$$F_{freq} = (2\pi R)T$$

$$F_{freq} = (2\pi \times 2) \times (70)$$

$$\boxed{F_{freq} = 280\pi \text{ dyne}} \quad \text{Ans.}$$

Ans. a

Solution: 7

$P = \frac{2T}{r}$

$P \propto \frac{1}{r}$

$\frac{P_1}{P_2} = \frac{r_2}{r_1}$

$\frac{P}{P_2} = \frac{1}{2}$

$P_2 = 2P$ Ans.

$[V_1 = 8V_2]$

$\frac{4}{3}\pi r_1^3 = (2)^3 \frac{4}{3}\pi r_2^3$

$r_1 = 2r_2$

$\frac{r_2}{r_1} = \frac{1}{2}$

Ans. c

Solution: 8

$\Delta P = \frac{2T}{R}$ $\quad d = 1.2\,mm,\ r = 0.6\,mm$

$= \frac{2 \times 0.072}{0.6 \times 10^{-3}}$

$= \frac{2 \times 0.072}{0.6} \times 10^{3}$

$= 2 \times \frac{0.72}{6} \times 10^{3}$

$= 2 \times 120$

$\boxed{\Delta P = 240\ Pa}$ Ans

Ans. a

Solution: 9

$T = 0.05\ N/m$

$d = 4\ cm$

$r = 2\ cm;\ 0.02\ m$

For soap bubble :-

$$\Delta P = \frac{4T}{R}$$

$$\Delta P = \frac{4 \times 0.05}{0.02} = \frac{4 \times 1}{2}$$

$$\boxed{\Delta P = 10\ N/m^2}$$

Ans. a

Solution: 10

$$\frac{4}{3}\pi R_1^3 = (1000)\times\frac{4}{3}\pi R_2^3$$

$$\boxed{R_1 = 10R_2}$$

$$E_i = T(4\pi R_1^2)$$

$$E_f = [T(4\pi R_1^2)]\times 1000$$

$$\frac{E_i}{E_f} = \frac{R_1^2}{R_2^2}\times 1000$$

$$\frac{E}{E_f} = \frac{(10)^2}{1000}$$

$$\frac{E}{E_f} = \frac{100}{1000}$$

$$\boxed{E_f = 10E}$$ Ans.

Ans. c

Solution: 11

$$\frac{4}{3}\pi r_1^3 = 1000\left(\frac{4}{3}\pi r_2^3\right)$$

$$r_1 = 10 r_2$$

$$10^{-2} = 10 r_2$$

$$\boxed{r_2 = 10^{-3}\ m}$$

$$E_1 = (4\pi r_1^2) \times T$$

$$= (4\pi \times T)(10^{-2})^2$$

$$E_2 = (4\pi \times T)(10^{-3})^2 \times 1000$$

gain in energy:

$$\Delta E = E_2 - E_1 = [4\pi \times T]\times[(10^{-3})^2 \times 1000 - (10^{-2})^2]$$ Ans. a

$$\Delta E = (4\pi \times T) \times [10^{-3} - 10^{-4}]$$

$$= (4\pi \times T) \times 10^{-3}[1 - 0.1]$$

$$= 4 \times 3.14 \times 0.075 \times 10^{-3} \times 0.9$$

$$= 0.85 \times 10^{-3}$$

$$\boxed{\Delta E = 8.5 \times 10^{-4}\ J}$$ Ans.

Solution: 12

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

$d = 0.1\text{ mm}$

$r = 0.05\text{ mm} = 0.005\text{ cm}$

for max height; $(\cos\theta)_{max} = 1$

$$h = \frac{2T}{\rho r g}$$

$$h = \frac{2 \times 75}{1 \times 0.005 \times 1000}$$

$$h = \frac{150}{5}$$

$$\boxed{h = 30\text{ cm}}$$ Ans

Ans. d

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