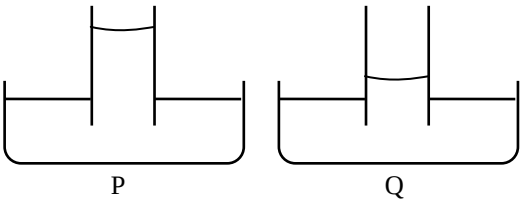
Q.1 Which water is having detergent dissolved in it



(A) P (B) Q

(C) both (D) data insufficient **[B]**

Sol. detergent decreases the surface tension so level of water rise will be lesser.

Q.2 In a capillary tube, water rises to a height of 4 cm. If the cross-sectional area of the tube were one-fourth, water would have risen to a height of -

(A) 2 cm (B) 4 cm

(C) 8 cm (D) 16 cm **[C]**

Sol. $h = \frac{2T\cos\theta}{rdg} \Rightarrow r_1 h_1 = r_2 h_2$

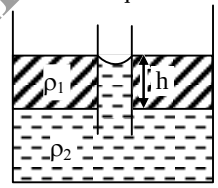
and $A = 2\pi r^2 \Rightarrow r \alpha\sqrt{A}$

$\therefore \sqrt{A_1}\ h_1 = \sqrt{A_2}\ h_2$

$\Rightarrow \sqrt{A} \times 4 = \sqrt{\frac{A}{4}} \times h_2$

$\Rightarrow h_2 = 8$ cm

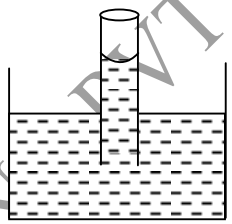
Q.3 A container contains two immiscible liquids of density ρ_1 and ρ_2 ($\rho_2 > \rho_1$). A capillary of radius r is inserted in the liquid so that its bottom reaches upto denser liquid. Denser liquid rises in capillary and attain height equal to h which is also equal to column length of lighter liquid. Assuming zero contact angle find surface tension of heavier liquid–



(A) $\frac{r\rho_2 gh}{2}$ (B) $2\pi r\rho_2 gh$

(C) $\frac{r}{2}(\rho_2 - \rho_1)gh$ (D) $2\pi r(\rho_2 - \rho_1)gh$ **[C]**

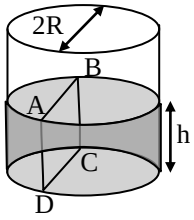
Q.4 A long capillary tube of mass π gram radius 2mm, and negligible thickness is partially immersed in a liquid of surface tension 0.1 N/m. Take contact angle to be zero and neglect buoyant force. The force required to hold the tube vertically will be. ($g = 10\ m/s^2$)



(A) 10.4π mN (B) 10.8π mN

(C) 0.8π mN (D) 4.8π mN **[A]**

Q.5 Water is filled up to a height h in a beaker of radius R as shown in the figure. The density of water is ρ, the surface tension of water is T and the atmospheric pressure is P_0. Consider a vertical section ABCD of the water column through a diameter of the beaker. The force on water on one side of this section by water on the other side of this section has magnitude -



(A) $|2P_0Rh + \pi R^2\rho gh - 2RT|$

(B) $|2P_0Rh + R^2\rho gh - 2RT|$

(C) $|P_0\pi R^2 + R\rho gh^2 - 2RT|$

(D) $|P_0\pi R^2 + R\rho gh^2 + 2RT|$ **[B]**

Q.6 The drops of a liquid of density ρ are swimming half immersed inside a liquid of density σ. If the surface tension of the liquid is T, then the radius R of the drop is-

(A) $R = \sqrt{\frac{3T}{g(2\rho-\sigma)}}$ (B) $R = \sqrt{\frac{3T}{2g(2\rho-\sigma)}}$

(C) $R = \sqrt{\frac{3T}{2g\rho}}$ (D) $R = \sqrt{\frac{2T}{3g\rho}}$ **[A]**

Q.7 A thin metal ring of radius r floats on water surface and bends the surface downwards along the perimeter making an angle θ with vertical edge of the ring. If the ring displaces a weight of water W and surface tension of water is T, then the weight of metal ring is–

(A) $2\pi rT\cos\theta + W$ (B) $2\pi rT\cos\theta - W$

(C) $4\pi rT\cos\theta + 2W$ (D) $4\pi rT\cos\theta + W$ **[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 flat part and on the curved part are in ratio-

(A) 1 : 1 (B) 1 : 2

(C) π : 2 (D) 2 : π **[D]**

Q.9 Energy liberated in combining n equal drops (surface tension = T) of radius r to form a big drop of radius R is

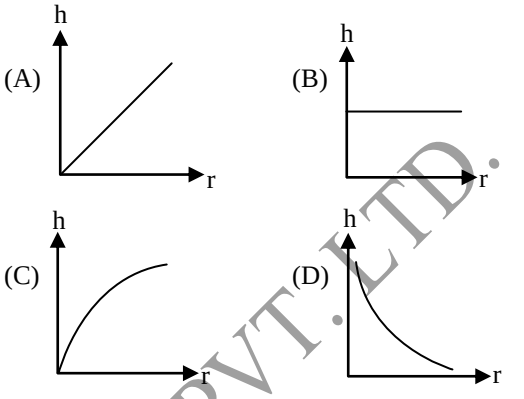
(A) $E = 4\pi r^2 T(n^{1/3} - 1)$

(B) $E = 4\pi R^2 T(n^{1/3} - 1)$

(C) $E = \pi r^2 T(n^{1/3} - 1)$

(D) $E = \pi R^2 T(n^{1/3} - 1)$ **[B]**

Q.10 If in a liquid, different capillaries (radius = r) are dipped, then the graph between liquid rise (h) and r is



[D]

Q.11 The amount of work done in increasing size of a soap film from 10cm × 6cm to 10cm × 10 cm is (surface tension = 30×10^{-3} N/m)

(A) 2.4×10^{-2} J (B) 2.4×10^{-4} J

(C) 1.2×10^{-2} J (D) 1.2×10^{-4} J

[B]

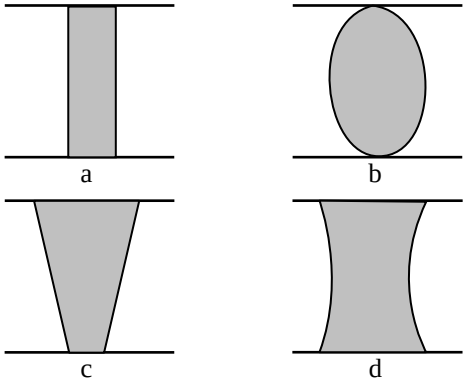
Q.12 Two spherical soap bubbles coalesce. If V is the consequent change in volume of the contained air and S is the change in the total surface area, then

(A) 3PV + 4ST = 0 (B) 4PV + 3ST = 0

(C) PV + 4ST = 0 (D) 4PV + ST = 0

[A]

Q.13 When a drop of water is placed between two glass-plates, the drop squeezes into



(A) d (B) c

(C) b (D) a **[A]**

Q.14 The surface energy of a small liquid drop is U. It is sprayed into 1000 small and equal drops. The surface energy will be

(A) U (B) 10 U

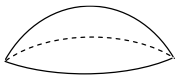
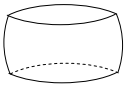
(C) 100 U (D) 1000 U **[B]**

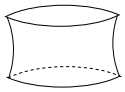
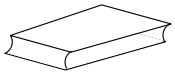
Q.15 Hair of shaving brush cling together when it is removed from water, due to

(A) surface tension (B) viscosity

(C) friction (D) elasticity **[A]**

Q.16 A mercury pallet is trapped between two horizontal glass plate having small space between them. The shape of mercury pallet is best described by -

(A)  **(B)** 

(C)  **(D)** 

[B]

Sol. Contact angle between mercury and glass plate is acute.

Q.17 The pressure inside two soap bubbles are 1.02 atm. and 1.03 atm. respectively. The ratio of their volumes is -

(A) 102 : 103 (B) 103 : 102

(C) $(103)^3 : (102)^3$ (D) 27 : 8 **[D]**

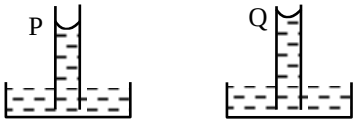
Sol. $P_{in} - P_{atm}$ = excess pressure = $\frac{4T}{R}$

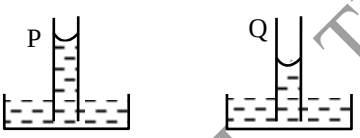
[$P_{in} - P_{atm}$ = nkc vkf/kD; = $\frac{4T}{R}$]

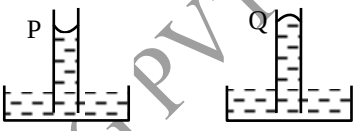
$$\therefore \frac{R_1}{R_2} = \frac{\Delta P_2}{\Delta P_1} = \frac{3}{2}$$

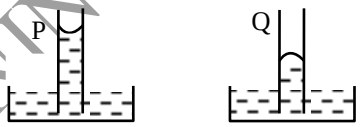
$$\therefore \frac{V_1}{V_2} = \frac{{R_1}^3}{{R_2}^3} = \frac{27}{8}$$

Q.18 A capillary tube (P) is dipped in water. Another identical tube (Q) is dipped in a soap water solution. Which of the following shows the relative nature of the liquids columns in the two tubes ?

(A) 

(B) 

(C) 

(D)  **[B]**

Sol. Meniscus will be concave from upside and in soap solution it should decrease.

Q.19 The angle of contact between liquid and solid doesn't depend upon –

(A) nature of liquid and solid

(B) impurity on the surface of contact

(C) third medium or atmosphere

(D) inclination of solid **[D]**

Q.20 A metallic wire of density ρ floats horizontal in water. The maximum radius of the wire sothat the wire may not sink will be : (surface tension of water = T and angle of contact $\theta = 0^o$) -

(A) $\sqrt{\frac{2T}{\pi\rho g}}$ (B) $\sqrt{\frac{4T}{\rho g}}$

(C) $\sqrt{\frac{T}{\pi\rho g}}$ (D) $\sqrt{\frac{T\rho}{\pi g}}$ **[A]**

Sol. $2T\ell \cos\theta = mg = \pi r^2 \ell \rho g$

$$\therefore r = \sqrt{\frac{2T}{\pi\rho g}}$$

Q.21 In the bottom of a vessel with mercury of density ρ there is a round hole of radius r. At what maximum height of the mercury layer will the liquid still not flow out through this hole? (Surface tension = T) -

(A) $\frac{T}{r\rho g}$ (B) $\frac{T}{2r\rho g}$

(C) $\frac{2T}{r\rho g}$ (D) $\frac{4T}{r\rho g}$ **[C]**

Sol. Because mercury meniscus is convex. The pressure just inside the hole will be less than the outside pressure by $\frac{2T}{r}$

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

Q.22 In a U-tube the radii of two columns are respectively r_1 and r_2. When a liquid of density ρ ($\theta = 0^o$) is filled in it, a level difference of h is observed on two arms, then the surface tension of the liquid is -

(A) $\frac{\rho g h r_1 r_2}{2(r_2 - r_1)}$ (B) $h\rho g (r_2 - r_1)$

(C) $\frac{h\rho g(r_2 - r_1)}{2}$ (D) $\frac{h\rho g}{2(r_2 - r_1)}$ **[A]**

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

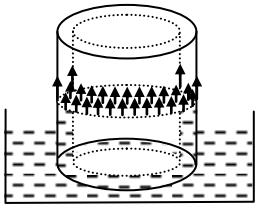
$\therefore T = \frac{\rho g h r_1 r_2}{2(r_2 - r_1)}$

Q.23 A coaxial cylinder made of glass is immersed in liquid of surface tension 'S'. Radius of inner and outer surface of cylinder are R_1 and R_2 respectively. Height till which liquid will rise is (Density of liquid is ρ)-

(A) $\frac{2S}{R_2\rho g}$ (B) $\frac{2S}{R_1\rho g}$

(C) $\frac{S}{(R_2 - R_1)\rho g}$ (D) $\frac{2S}{(R_2 - R_1)\rho g}$ **[D]**

Sol.



Net upward force

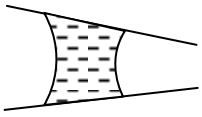
$= 2\pi R_2 S + 2\pi R_1 S$ contact angle = 0°

$\therefore$ Capillary rise is given by

$h = \frac{2\pi S(R_1 + R_2)}{\pi(R_2^2 - R_1^2)\rho g}$

$= \frac{2S}{(R_2 - R_1)\rho g}$

Q.24 A conical pipe shown in figure have a water drop. The drop will tend to move towards -



(A) tapered end (B) wider end

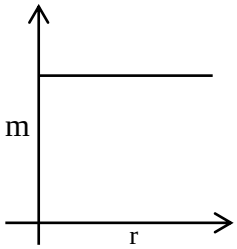
(C) in any direction (D) no tendency to move

[A]

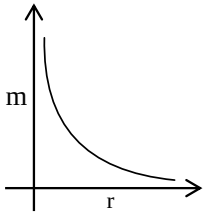
Sol. Excess pressure is directed towards centre of curvature and inversely proportional to radius of curvature.

Q.25 Graph between the mass of liquid inside the capillary and radius of capillary is –

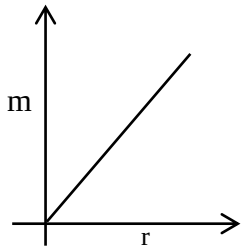
(A)



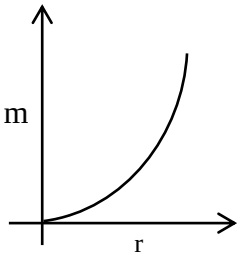
(B)



(C)



(D)



[C]

Sol. Mass of liquid inside the capillary = $\pi r^2 h\, d$
$= (\pi r\, h\, d).\, r$
since, hr = constant
$\therefore$ mass of liquid inside α r

Q.26 If one increases the volume of a soap bubble the surface tension of the bubble -
(A) increase
(B) decrease
(C) remains the same
(D) becomes zero **[C]**

Sol. Surface tension does not depend upon area of surface.

Q.27 Molecular force are -
(A) only adhesive
(B) only cohesive
(C) only repulsive
(D) cohesive and adhesive **[D]**

Q.28 Forces responsible for surface tension differ from that of gravitational and electrostatic force because these are -
(A) electromagnetic
(B) weak forces
(C) obeying inverse square law
(D) both attractive and repulsive in character
[B]

Q.29 The net force acting on a molecule inside the liquid is -
(A) directed upwards at the liquid surface
(B) directed inwards at the liquid surface
(C) zero
(D) infinite **[C]**

Q.30 Free surface of a liquid behaves as a stretched membrane and tends to assume the smallest possible area due to the-
(A) cohesive force
(B) adhesive force
(C) centrifugal force
(D) centripetal force **[A]**

Q.31 The liquid surfaces have a tendency to contract, this phenomenon is due to-
(A) surface tension (B) viscosity
(C) friction (D) dispersion **[A]**

Q.32 Surface tension may be defined as the mechanical work required to create an additional unit area of the liquid under-
(A) isobaric conditions
(B) isothermal conditions
(C) adiabatic conditions
(D) isometric conditions. **[B]**

Q.33 The surface tension of a liquid depends on -
(A) contamination
(B) impurity dissolved in the liquid
(C) temperature
(D) all of the above **[D]**

Q.34 If we increase the surface area of a soap film, the surface tension of the film -
(A) increases (B) decreases
(C) remains the same (D) becomes infinite
[C]

Q.35 When the temperature of liquid is increased/current flows through a liquid, then its surface tension -
(A) remains constant
(B) increases
(C) decreases
(D) first increases then decreases **[C]**

Q.36 The soap and the detergent make water suitable for washing clothes because they-
(A) make it rich in lather
(B) increase its density
(C) reduce its hardness
(D) reduce its surface tension **[D]**

Q.37 Which of the following liquids has the maximum value of surface tension-

(A) water (B) soap-solution

(C) alcohol (D) mercury **[D]**

Q.38 The surface tension of mercury at normal temperature and pressure is-

(A) 72 dyne/cm (B) 72 N/m.

(C) 453 dyne/cm (D) 435×10^{-3} N/m

[D]

Q.39 At critical temperature, the surface tension of a liquid-

(A) is zero

(B) is infinity

(C) is the same as that any other temperature

(D) can not be determined. **[A]**

Q.40 On wearing a rain coat on which some greasy material is coated, a person does not wet in rain because-

(A) the rain coat absorbs water

(B) the cohesive force of water is more

(C) the adhesion between the rain coat and water becomes less

(D) none of these **[C]**

Q.41 Few drops of alcohols are poured on the surface of water contained in a tube. The water goes away from the side from which alcohol is being poured. This shows that -

(A) the surface tension of the alcohol solution is more than that of water

(B) the viscosity of the alcohol solution is more than that of water

(C) the surface tension of the alcohol solution is less than that of water

(D) the viscosity of the alcohol solution is less than that of water **[C]**

Q.42 It is possible to join two metals by soldering due to the property of-

(A) diffusion (B) elasticity

(C) viscosity (D) surface tension

[D]

Q.43 If there is a thin layer of water between two parallel plates then it is easier to separate the plates by-

(A) displacing them

(B) applying force perpendicular to the surface of the plates

(C) applying force in the some direction

(D) none of the above **[A]**

Q.44 The writing of a fountain pen on a newspaper is not legible due to-

(A) cohesion

(B) adhesion

(C) capillary rise effect

(D) none of the above **[C]**

Q.45 The incorrect statement is -

(A) Tree gets water from earth through capillary action

(B) Towel absorbs water from our body by capillary action

(C) We get water in house tops through the action of surface tension

(D) Our teeth get blood from the body by capillary action **[C]**

Q.46 If a liquid is stirred for some time and then left. It comes to rest after some time. Its reason is-

(A) viscosity (B) surface tension

(C) gravitation (D) centripetal force

[A]

Q.47 Big liquid drops are not spherical due to -

(A) viscosity

(B) surface tension

(C) gravitational force

(D) atmospheric pressure **[C]**

Q.48 The length of a needle floating on water is 2.5 cm. The minimum force in addition to its weight needed to lift the needle above the surface of water will be -

(A) 36 N (B) 10 N

(C) 9 N (D) 6 N **[A]**

Q.49 W is the work done in forming a bubble of radius r, the work done in forming a bubble of radius 2r will be -

(A) 4W (B) 3W

(C) 2W (D) W **[A]**

Q.50 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 **[C]**