21. (b)

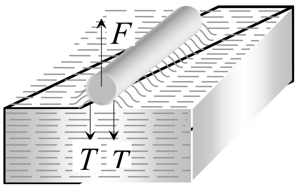
22. (d) $T = T_0(1 - \alpha t)$

23. (a) Due to force of attraction it is not easier to separate the two glass plates.

24. (a) Soluble impurities increases the surface tension.

25. (c) $T = \frac{F}{2l} = \frac{728}{2 \times 5}$

$\therefore\ T = 72.8\ dyne/cm$



26. (d) Cohesive force > Adhesive force, so shape of liquid surface near the solid would be convex.

For example mercury surface in glass capillary is convex.

27. (d) Surface tension decreases with increase in temperature.

28. (b)

29. (b)

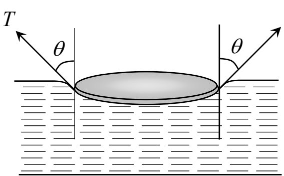
30. (d)

31. (d) Because surface tension of water > surface tension of oil

32. (c) Surface tension pulls the plates towards each other.

33. (d) Sphere has the minimum surface area for the given volume of the liquid.

34. (c)



Weight of metal disc = total upward force

= upthrust force + force due to surface tension

= weight of displaced water + $T\cos\theta\ (2\pi r)$

$= W + 2\pi rT\cos\theta$

35. (a) $T = \frac{F}{2l} = \frac{2 \times 10^{-2}}{2 \times 10 \times 10^{-2}} = 0.1\ N/m$

36. (b) Surface tension of water decrease with rise in temperature.

37. (b)

38. (a) Force required to separate the plates

$$F = \frac{2TA}{t} = \frac{2 \times 70 \times 10^{-3} \times 10^{-2}}{0.05 \times 10^{-3}} = 28\,N$$

39. (a)

40. (c) The cohesive force is the force of attraction between the molecules of same substance.

41. (d)

42. (c) $T = \frac{F}{l} = \frac{[MLT^{-2}]}{[L]} = [ML^0T^{-2}]$

43. (d) Net force on stick $= F_1 - F_2 = (T_1 - T_2)l$

$= (0.07 - 0.06)l = 0.01 \times 2 = 0.02\,N$

44. (a) Because film tries to cover minimum surface area.

45. (a) Force required, $F = 2\pi rT = 2\pi \times 2 \times 70 = 280\pi.\,Dyne$

46. (a)

Surface Energy

1. (a) Energy needed = Increment in surface energy

= (surface energy of n small drops) – (surface energy of one big drop)

$= n4\pi r^2T - 4\pi R^2T = 4\pi T(nr^2 - R^2)$

2. (d)

3. (a) When two droplets merge with each other, their surface energy decreases.

$W = T(\Delta A) = (\text{negative})$ *i.e.* energy is released.

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

$= 4 \times 3.14 \times (1.4 \times 10^{-1})^2 \times 75(125^{1/3} - 1) = 74\ erg$

5. (d) $W = 8\pi T(R_2^2 - R_1^2) = 8\pi T[(2r)^2 - (r)^2] = 24\pi r^2T$

6. (b) Work done in splitting a water drop of radius R into n drops of equal size $= 4\pi R^2T(n^{1/3} - 1)$

$= 4\pi \times (10^{-3})^2 \times 72 \times 10^{-3} \times (10^{6/3} - 1)$

$= 4\pi \times 10^{-6} \times 72 \times 10^{-3} \times 99 = 8.95 \times 10^{-5}\ J$

7. (c) $W = 4\pi R^2 T(r^{1/3} - 1) = 4\pi R^2 T(8^{1/3} - 1) = 4\pi R^2 T$

8. (d) $W = T \times 8\pi(r_2^2 - r_1^2) = T \times 8\pi\left(\frac{D^2}{4} - \frac{d^2}{4}\right)$

$= 2\pi(D^2 - d^2)T$

9. (c) Work done to increase the diameter of bubble from d to D

$W = 2\pi(D^2 - d^2)T = 2\pi\left[(2D)^2 - (D)^2\right]T = 6\pi D^2 T$

10. (c) $W = 8\pi T(r_2^2 - r_1^2) = 8\pi T\left[\left(\frac{2}{\sqrt{\pi}}\right)^2 - \left(\frac{1}{\sqrt{\pi}}\right)^2\right]$

$\therefore W = 8 \times \pi \times 30 \times \frac{3}{\pi} = 720\ erg$

11. (c) $W = T \times \Delta A = 5 \times 2 \times (0.02)$ (Film has two free surfaces)

$= 2 \times 10^{-1}\ J$

12. (c) $W = 8\pi R^2 T\ \therefore\ W \propto R^2$ (T is constant)

If radius becomes double then work done will become four times.

13. (c) $W = 4\pi R^2 T(n^{1/3} - 1) = 4\pi \times 1 \times 50(10^{3/3} - 1)$

$= 1800\pi\ erg$

14. (a)

15. (b) Surface energy of combined drop will be lowered, so excess surface energy will raise the temperature of the drop.

16. (b) Surface energy = surface tension × increment in area

$= T \times A$

17. (d) $W = 8\pi R^2 T = 8 \times \pi \times (10^{-2})^2 \times 2 \times 10^{-2} = 16\pi \times 10^{-6}\ J$

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

$= 4 \times 3.14 \times 10^{-4} \times 35 \times 10^{-1}(10^{6/3} - 1)$

$= 4.4 \times 10^{-3}\ J$

19. (a)

20. (b) $W = 8\pi R^2 T = 8\pi \times (1 \times 10^{-2})^2 \times 1.9 \times 10^{-2} = 15.2 \times 10^{-6}\ \pi J$

21. (b) Surface energy = $T \times \Delta A = 0.5 \times 2 \times (0.02) = 2 \times 10^{-2}\ J$

22. (d) Volume of liquid remain same *i.e.* volume of 1000 small drops will be equal to volume of one big drop

$n\frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3 \Rightarrow 1000 r^3 = R^3 \Rightarrow R = 10r$

$\therefore \frac{r}{R} = \frac{1}{10}$

$\frac{\text{surface energy of one small drop}}{\text{surface energy of one big drop}} = \frac{4\pi r^2 T}{4\pi R^2 T} = \frac{1}{100}$

23. (a) $E = T \times \Delta A = 3 \times 10^{-2} \times 2(100 \times 10^{-4}) = 6 \times 10^{-4}\ J$

24. (a) $W = 8\pi R^2 T = 8 \times 3.14 \times (10 \times 10^{-2}) \times \frac{3}{100}$

$= 7.536 \times 10^{-3}\ J$

25. (b) Work done = $4\pi R^2 T(n^{1/3} - 1)$

$= 4\pi\left(\frac{D}{2}\right)^2 \sigma(n^{1/3} - 1)$

$= \pi D^2 \sigma(27^{1/3} - 1) = 2\pi D^2 \sigma$

26. (d) As volume remain constant therefore $R = n^{1/3} r$

$\frac{\text{surface energy of one big drop}}{\text{surface energy of } n \text{ drop}} = \frac{4\pi R^2 T}{n \times 4\pi r^2 T}$

$\frac{R^2}{nr^2} = \frac{n^{2/3} r^2}{nr^2} = \frac{1}{n^{1/3}} = \frac{1}{(1000)^{1/3}} = \frac{1}{10}$

27. (b) $W = T \times \Delta A\ \therefore\ T = \frac{W}{\Delta A}$

$T = \frac{3 \times 10^{-4}}{2 \times (110 - 60) \times 10^{-4}}$ (Soap film has two surfaces)

$= 3 \times 10^{-2}\ N/m$

28. (d)

29. (d) $\frac{4}{3}\pi R^3 = 1000 \times \frac{4}{3}\pi r^3$ (As volume remains constant)

$R^3 = 1000 r^3 \Rightarrow R = 10r \Rightarrow r = \frac{R}{10}$

30. (c) Because energy is liberated

31. (a,d)

32. (c) As volume remains constant $R^3 = 8000 r^3$

$\therefore R = 20r$

$$\frac{\text{Surface energy of one big drop}}{\text{Surface energy of 8000 small drop}} = \frac{4\pi R^2 T}{8000\, 4\pi r^2 T}$$

$$= \frac{R^2}{8000 r^2} = \frac{(20r)^2}{8000 r^2} = \frac{1}{20}$$

33. (b) Surface energy = $T \times A = 5 \times 2 \times (0.15) = 1.5 J$

34. (c) As volume remains constant therefore $R = n^{1/3} r$

$$\frac{\text{Energy of big drop}}{\text{Energy of small drop}} = \frac{4\pi R^2 T}{4\pi r^2 T} = \frac{R^2}{r^2} = (8)^{2/3} = 4$$

35. (a) $T = \frac{W}{\Delta A} = \frac{2 \times 10^{-4}}{2 \times (50 \times 10^{-4})} = 2 \times 10^{-2}\ N/m$

36. (a) $W = T\Delta A = 4\pi R^2 T(n^{1/3} - 1)$

$= 4 \times 3.14 \times (10^{-2})^2 \times 460 \times 10^{-3} \times [(10^6)^{1/3} - 1] = 0.057$

37. (a)

38. (b) Increment in area of soap film = $A_2 - A_1$

$= 2 \times [(10 \times 0.6) - (10 \times 0.5)] \times 10^{-4} = 2 \times 10^{-4}\ m^2$

Work done = $T \times \Delta A$

$= 7.2 \times 10^{-2} \times 2 \times 10^{-4} = 1.44 \times 10^{-5}\ J$

39. (a) Increase in surface energy or work done in splitting a big drop $= 4\pi R^2 T(n^{1/3} - 1)$

$\Rightarrow W = 4\pi \times (2 \times 10^{-3})^2 \times 0.465(8^{1/3} - 1) = 23.4\ \mu J$

40. (b) The ratio of the total surface energies before and after the change $= n^{1/3} : 1 = 2^{1/3} : 1$

41. (a) $W = 8\pi S(R_2^2 - R_1^2) = 8\pi S[(2R)^2 - R^2] = 24\pi R^2 S$

42. (a) $W = 8\pi r^2 \times T = 8\pi \times (0.2)^2 \times 0.06 = 192\pi \times 10^{-4}\ J$

43. (b) Increment in Potential energy = $T \times \Delta A$

$= 0.02 \times 2 \times 0.05 = 2 \times 10^{-2}\ J$

44. (a) $E = T \times \Delta A = 75 \times 0.04 = 3\ J$

45. (c) $r = \frac{r_1 r_2}{r_2 - r_1} = \infty$ since $r_1 = r_2$

Angle of Contact

1. (b)
2. (a)
3. (b) Cohesive force decreases so angle of contact decreases.
4. (d)
5. (b)
6. (b)
7. (d)
8. (b)
9. (a)
10. (c) Angle of contact is acute.
11. (a)
12. (c)
13. (b)
14. (b) Since for such liquid (Non-wetting) angle of contact is obtuse.
15. (b) Both liquids water and alcohol have same nature (*i.e.* wet the solid). Hence angle of contact for both is acute.
16. (d) Tangent drawn at point of contact makes 0° with wall of container.

Pressure Difference

1. (c)

2. (c) Since $\Delta P \propto \frac{1}{R}$

3. (b) Excess pressure $\Delta P = \frac{4T}{r}$

$$= \frac{4 \times 2 \times 25 \times 10^{-3}}{1 \times 10^{-2}} = 20\ N/m^2 = 20\ Pa\ (\text{as } r = d/2)$$

4. (c)

5. (c)

6. (c) $hdg = \frac{2T}{r} \Rightarrow h = \frac{2T}{rdg}$

7. (b) $\Delta P = \frac{4T}{r} = 40\ N/m^2$

8. (b)

9. (b) $\Delta P = \frac{4T}{r} = hdg \Rightarrow T = \frac{rhdg}{4} = \frac{0.35 \times 0.8 \times 1 \times 10^3}{4}$

$= 70\ dyne/cm \equiv 68.66\ dyne/cm$

10. (c) Outside pressure = 1 *atm*

Pressure inside first bubble = 1.01 *atm*

Pressure inside second bubble = 1.02 *atm*

Excess pressure $\Delta P_1 = 1.01 - 1 = 0.01\ atm$

Excess pressure $\Delta P_2 = 1.02 - 1 = 0.02\ atm$

$\Delta P \propto \frac{1}{r} \Rightarrow r \propto \frac{1}{\Delta P} \Rightarrow \frac{r_1}{r_2} = \frac{\Delta P_2}{\Delta P_1} = \frac{0.02}{0.01} = \frac{2}{1}$

Since $V = \frac{4}{3}\pi r^3 \therefore \frac{V_1}{V_2} = \left(\frac{r_1}{r_2}\right)^3 = \left(\frac{2}{1}\right)^3 = \frac{8}{1}$

11. (b) $S = \frac{rhdg}{2\cos\theta} \Rightarrow$ Pressure difference $= hdg = \frac{2S}{r}\cos\theta$

12. (c)

13. (c) Excess pressure inside soap bubble is inversely proportional to the radius of bubble *i.e.* $\Delta P \propto \frac{1}{r}$

This means that bubbles *A* and *C* posses greater pressure inside it than *B*. So the air will move from *A* and *C* towards *B*.

14. (c) $P_1V_1 = P_2V_2 \Rightarrow (H + h)\rho g \times \frac{4}{3}\pi r^3 = H \times \frac{4}{3}\pi(2r)^3$

$\Rightarrow H + h = 8H \therefore h = 7H$

15. (c) $r = \sqrt{r_1^2 + r_2^2} = \sqrt{9+16} = 5\ cm$

16. (c) $P_1V_1 = P_2V_2 \Rightarrow (H_{Hg}\rho_{Hg} + H_W\rho_W)V = H_{Hg}\rho_{Hg} \times 3V$

$\Rightarrow H_{Hg}\rho_{Hg} + H_W\frac{\rho_{Hg}}{10} = 3H_{Hg}\rho_{Hg}$

$\Rightarrow H_W = 2H_{Hg} \times 10 = \frac{2 \times 75 \times 10}{100} = 15m$

17. (a) $\Delta P = \frac{4T}{r} \Rightarrow \frac{\Delta P_1}{\Delta P_2} = 4 \therefore \frac{r_2}{r_1} = 4$ and $\frac{V_1}{V_2} = \left(\frac{r_1}{r_2}\right)^3 = \frac{1}{64}$

18. (b) $\Delta P \propto \frac{1}{r}$

19. (b) Pressure at half the depth $= P_0 + \frac{h}{2}dg$

Pressure at the bottom $= P_0 + hdg$

According to given condition

$P_0 + \frac{h}{2}dg = \frac{2}{3}(P_0 + hdg)$

$\Rightarrow 3P_0 + \frac{3h}{2}dg = 2P_0 + 2hdg$

$\Rightarrow h = \frac{2P_0}{dg} = \frac{2 \times 10^5}{10^3 \times 10} = 20\ m$

20. (a) $\Delta P \propto \frac{1}{r} \Rightarrow \frac{\Delta P_1}{\Delta P_2} = \frac{r_2}{r_1} = \frac{r}{4r} = \frac{1}{4}$

21. (c) $\Delta P = \frac{2T}{R} = \frac{2 \times 70 \times 10^{-3}}{1 \times 10^{-3}} = 140\ N/m^2$

22. (c) $P = h\rho g$

23. (d)

24. (b) $r = \frac{r_1r_2}{r_1 - r_2} = \frac{5 \times 4}{5-4} = 20\ cm$

25. (c) Excess pressure inside the air bubble $= \frac{2T}{r}$

$\Rightarrow P_{in} - P_{out} = \frac{2T}{r} = \frac{2 \times 70 \times 10^{-3}}{0.1 \times 10^{-3}} = 1400Pa$

$\Rightarrow P_{in} = 1400 + 1.013 \times 10^5 = 1.027 \times 10^5\ Pa$

26. (a) $r_A > r_B$ and $P \propto \frac{1}{r}$ so $P_A < P_B$

So air will flow from *B* to *A* *i.e.* size of *A* will increase.

27. (a) $\Delta P = \frac{4T}{R} \therefore \Delta P \propto \frac{1}{R}$ (T = constant)

Hence, the internal pressure of smaller bubble is larger than that of larger bubble.

28. (b) $\frac{4T}{R} = hdg \therefore \quad T = \frac{Rhdg}{4}$

$T = \frac{10^{-2} \times 2 \times 10^{-3} \times 0.8 \times 10^3 \times 9.8}{4} = 3.9 \times 10^{-2}\ N/m$

29. (a)

30. (d) $\Delta P \propto \frac{1}{r} \Rightarrow \frac{r_1}{r_2} = \frac{\Delta P_2}{\Delta P_1} = \frac{1}{3} \Rightarrow \frac{V_1}{V_2} = \left(\frac{r_1}{r_2}\right)^3 = \frac{1}{27}$

Capillarity

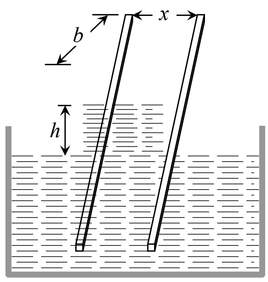
1. (d) $h = \frac{2T\cos\theta}{rdg} \therefore h \propto \frac{1}{r}$ (T, θ, d and g are constant)

If r is less then h will be more.

2. (a) $h = \frac{2T\cos\theta}{rdg}$. If θ is less than 90° then h will be positive

3. (d) In the state of weightlessness or in gravity free space, water will rise to the upper end of the tube of any length.

4. (b)



Let the width of each plate is b and due to surface tension liquid will rise upto height h then upward force due to surface tension

$= 2Tb\cos\theta$ ...(i)

Weight of the liquid rises in between the plates

$= Vdg = (bxh)dg$ ...(ii)

Equating (i) and (ii) we get , $2T\cos\theta = bxhdg$

$\therefore h = \frac{2T\cos\theta}{xdg}$

5. (d) $6\times10^{-2}\times$ Circumference = Force

$\therefore$ Circumference $= \frac{75\times10^{-4}}{6\times10^{-2}} = 12.5\times10^{-2}\,m$

6. (d) Due to capillarity it absorbs the ink.

7. (b) $r\propto\frac{1}{h} \Rightarrow \frac{r_P}{r_Q} = \frac{h_Q}{h_P} = \frac{h}{\frac{2}{3}h} = \frac{2}{3}$

8. (c) $r\propto\frac{1}{h} \Rightarrow \frac{r_1}{r_2} = \frac{h_2}{h_1} = \frac{6.6}{2.2} = \frac{3}{1}$

9. (c) $\frac{h_2}{h_1} = \frac{r_1}{r_2} = \frac{1}{2} \Rightarrow h_2 = \frac{30}{2} = 15cm$

10. (b)

11. (b)

12. (d) $h = \frac{2T}{rdg} = \frac{2\times75}{0.005\times1\times10^3} = 30cm$

13. (c) $T = \frac{rh\rho g}{2} \Rightarrow 75\times10^{-3} = \frac{3\times10^{-2}\times r\times10^3\times9.8}{2}$

$\Rightarrow r = \frac{1}{2}mm \therefore D = 2r = 1\,mm$

14. (c) The angle of contact of mercury with glass is obtuse. So it gets depressed below the liquid level outside.

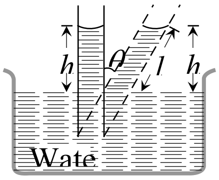
15. (d) The water rises to height h due to capilarity.

16. (b) $h\propto\frac{1}{r}$

17. (b) $h = \frac{2T}{rdg} = \frac{2\times6\times10^{-2}}{5\times10^{-4}\times10^3\times10} = 2.4\times10^{-2}m = 2.4cm$

18. (b) $h\propto\frac{1}{r} \therefore r_1h_1 = r_2h_2 \Rightarrow \frac{h_1}{h_2} = \frac{r_2}{r_1} = \frac{0.4}{0.2} = 2:1$

19. (b)



Vertical height of the water in the tube remains constant

So, $l = \frac{h}{\cos\theta} = \frac{3}{\cos60^o} = 6\,cm$

20. (c)

21. (a)

22. (d) If lift moves downward with some acceleration then effective g decreases, so h increases.

As $h = \frac{2T\cos\theta}{rdg} \;\therefore h\propto\frac{1}{g}$

23. (c)

24. (a) $\frac{2T}{r} = hdg \Rightarrow r = \frac{2T}{hdg}$

25. (b) $h\propto\frac{1}{r} \therefore r_1h_1 = r_2h_2 \Rightarrow h_2 = \frac{r_1h_1}{r_2} = 2.4\,mm$

26. (a)

27. (a) $h\propto\frac{1}{r} \therefore rh =$ constant

28. (a) $h = \frac{2T\cos\theta}{rdg} \therefore h\propto\frac{1}{g}$

As $g_m = \frac{g_e}{6} \therefore\; h_m = 6h_e$

29. (d) Ascent formula $h = \frac{2T\cos\theta}{rdg}$

$\Rightarrow \frac{h_1}{h_2} = \frac{T_1}{T_2}\times\frac{d_2}{d_1}$ (r, θ and g are constants)

$= \frac{60}{50}\times\frac{0.6}{0.8} = \frac{9}{10}$

30. (b) $l = \frac{h}{\cos\theta} = \frac{2}{\cos60^o} = 4.0\,cm$

31. (d) $T = \frac{rhdg}{2\cos\theta}$. For pure water $\theta = 0^o$ so $T = \frac{rhdg}{2}$

32. (c) The length of the water column will be equal to full length of capillary tube.

33. (b) $T = \frac{F}{2\pi r} = \frac{6.28 \times 10^{-4}}{2 \times 3.14 \times 2 \times 10^{-3}} = 5 \times 10^{-2}\ N/m$

34. (a) $h \propto \frac{1}{R}$

35. (a) $h = \frac{2T\cos\theta}{rdg}$, for water $\theta = 0°$

$\Rightarrow r = \frac{2T}{hdg} = \frac{2 \times 7.2 \times 10^{-2}}{3 \times 10^{-2} \times 10^3 \times 10} = 4.8 \times 10^{-4}$

$\therefore\ d = 2r = 9.6 \times 10^{-4}\ m$

36. (c) $h = \frac{2T}{rdg} \Rightarrow r = \frac{2T}{hdg} = \frac{2 \times 75 \times 10^{-3}}{15 \times 10^{-3} \times 10^3 \times 10} = 1\,mm$

37. (d) $h \propto \frac{1}{r}$

38. (a)

39. (a)

40. (b) Mass of liquid in capillary tube

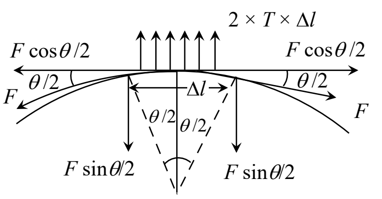
$M = \pi R^2 H \times \rho\ \therefore\ M \propto R^2 \times \left(\frac{1}{R}\right)$ (As $H \propto 1/R$)

$\therefore\ M \propto R$. If radius becomes double then mass will becomes twice.

41. (c) $h \propto \frac{1}{r} \Rightarrow \frac{h_2}{h_1} = \frac{r_1}{r_2} = \frac{D_1}{D_2} = 2 \Rightarrow h_2 = 2h_1$

Critical Thinking Questions

1. (d) Suppose tension in thread is F, then for small part Δl of thread



$\Delta l = R\theta$ and $2F\sin\theta/2 = 2T\Delta l = 2TR\theta$

$\Rightarrow F = \frac{TR\theta}{\sin\theta/2} = \frac{TR\theta}{\theta/2} = 2TR(\sin\theta/2 \approx \theta/2)$

2. (c) Rise in temperature, $\Delta\theta = \frac{3T}{JSd}\left(\frac{1}{r} - \frac{1}{R}\right)$

$\therefore\ \Delta\theta = \frac{3T}{J}\left(\frac{1}{r} - \frac{1}{R}\right)$ (For water $S = 1$ and $d = 1$)

3. (b,c) $P_{Bottom} > P_{Surface}$. So bubble rises upward.

At constant temperature $V \propto \frac{1}{P}$ (Boyle's law)

Since as the bubble rises upward, pressure decreases, then from above law volume of bubble will increase *i.e.* its size increases.

4. (d) In the satellite, the weight of the liquid column is zero. So the liquid will rise up to the top of the tube.

Graphical Questions

1. (b) $h = \frac{2T\cos\theta}{rdg}\ \therefore\ h \propto \frac{1}{r}$. So the graph between h and r will be rectangular hyperbola.

2. (a) $\Delta P = \frac{4T}{r}\ \therefore\ \Delta P \propto \frac{1}{r}$

As radius of soap bubble increases with time $\therefore \Delta P \propto \frac{1}{t}$

3. (b) $T_c = T_o(1 - \alpha t)$ *i.e.* surface tension decreases with increase in temperature.

Assertion and Reason

1. (c) When a liquid is sprayed, the surface area of the liquid increases. Therefore, work has to be done in spraying the liquid, which is directly proportional to the surface tension.

Because on adding soap, surface tension of water decreases, the spraying of water becomes easy.

2. (e) The soap solution, has less surface tension as compared to ordinary water and its surface tension decreases further on heating. The hot soap solution can, therefore spread over large surface area and also it has more wetting power. It is on account of this property that hot soap solution can penetrate

and clean the clothes better than the ordinary water.

3. (a) $h = \frac{2T}{Rdg} \Rightarrow hR = \frac{2T}{Rdg}$ $\therefore$ $hR =$ constant

Hence when the tube is of insufficient length, radius of curvature of the liquid meniscus increases, so as to maintain the product *hR* a finite constant.

i.e. as *h* decreases, *R* increases and the liquid meniscus becomes more and more flat, but the liquid does not overflow.

4. (c) Needle floats due to surface tension there is no role of buoyant force in its floating

Buoyant force = $V\sigma g$

Where *V* = volume of body submerged in liquid

σ = density of liquid.

i.e. the buoyancy of an object depends on the shape of the object.

5. (c) The two glass plates stick together due to surface tension.

6. (e) The presence of impurities either on the liquid surface or dissolved in it, considerably affect the force of surface tension, depending upon the degree of contamination. A highly soluble substance like sodium chloride when dissolved in water increase the surface tension. But the sparing soluble or substance like phenol when dissolved in water reduces the surface tension of water.

7. (c) With increase in temperature surface tension of the liquid decreases and angle of contact also decreases.

8. (b) We know that the intermolecular distance between the gas molecules is large as compared to that of liquid. Due to it the forces of cohesion in the gas molecules are very small and these are quite large for liquids. Therefore, the concept of surface tension is applicable to liquid but not to gases.

9. (a) Zero surface tension means no opposition to expansion.

10. (a) Since the excess pressure due to surface tension is inversely proportional to its radius, it follows that smaller the bubble, greater is the excess pressure. Thus, when the larger and the smaller bubbles are put in communication, air starts passing from the smaller into the large bubble because excess pressure inside the former is greater than inside the latter. As a result, the smaller bubble shrinks and the larger one swells.

11. (b) When a drop of liquid is poured on a glass plate, the shape of the drop is governed by two forces, the force of gravity. For very small drops, the potential energy due to gravity is insignificant compared to that due to surface tension. Hence, in this case the shape of the drop is determined by surface tension alone and drop becomes spherical.

12. (a) The height of capillary rise is inversely proportional to radius (or diameter) of capillary tube *i.e.* $h \propto \frac{1}{r}$

So for smaller *r* the value of *h* is higher.

13. (c) With increase in temperature of liquid its surface tension decreases so that it tends to acquire larger area. Hence hot soup having low value of surface tension spread properly on our tongue & provides better taste than cold soup.

14. (b) The free surface of liquid tries to acquire a minimum area due to surface tension, hence liquid drop is spherical because sphere has minimum area than other shape.