PHYSICS

BOOKS - DHANPAT RAI & CO PHYSICS (HINGLISH)

FLUIDS AT REST

Example

1. Find the pressure exerted at the tip of a drawing pin if it is pushed against a board

with a force of $20N$. Assume the area of the tip to be $0.1mm^2$.

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2. How much pressure will man of weight $80kg$ f exert on the ground when (i) he is lying and (ii) he is standing on his feet ? Given that the area of the body of the man is $0.6m^2$ and that of a foot is $80cm^2$.

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3. Atmospheric pressure is nearly $100kPa$. How large the force does the air in a room exert on the inside of a window pan that is $40cm \times 80cm$?

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4. A hydraulic automobile lift is designed to lift cars with a maximum mass of 300 kg. the area of cross-section of the piston carrying the load is $425cm^3$. What maximum pressure would smaller piston have to bear?

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5. To lift an automobile of $200kg$. a hydraulic pump with a larger piston $900cm^2$ in area is employed. Calculate the force that must be applied to pump a small piston of area $10cm^2$ to accomplish this task.

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6. The area of the smaller piston of a hydraulic press is $1cm^2$ and that of larger piston is $22cm^2$. How much weight can be raised on the larger piston by a $200kg$ f exerted on the smaller piston?

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7. The neck and bottom of a bottle are 2 cm and 20 cm in diameter respectively if the cork is pressed with a force of 1.2 kgf in the neck of

the bottle, calculate the force exerted on the bottom of the bottle.

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8. Two piston of hydraulic press have diameters of $30.0cm$ and $2.5cm$. What is force exerted by larger piston , when $50.0kg$ wt is placed on the smaller piston ? If the stroke of the smaller piston is $4.0cm$, through what distance will the larger piston move after 10 strokes?

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9. Express standard atmospheric pressure in (i) Nm^{-2} (ii) bars and (iii) torr.

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10. A vertical off-shore structure is built to withstand a a maximum stress of $10^9 Pa$. Is the structure suitabel for putting upon top of an oil well in bombay high? Take the depth of the

sea to be roughly 3 km, and ignore oceam currents.

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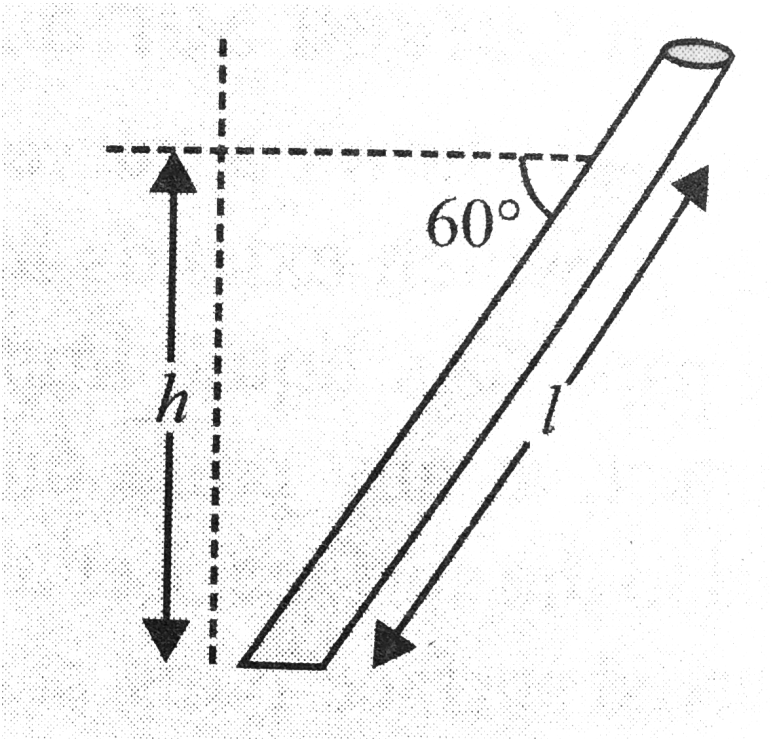
11. What will be the length of mercury column in a barometer tube when the atmospheric pressure is $75cm$ of mercury and the tube is inclined at an angle of 60° with the horizontal

direction?



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12. A rectangular tank is $10m$ long $5m$ broad and $3m$ high. It is filled to the rim with water

of density $10^3 kgm^{-3}$. Calculate the thrust at the bottom and walls of the tank due to hydrostatic pressure. Take $g = 9.8 \text{ms}^{-2}$.

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13. A tank with a square base of area $1.0m^2$ is divided by a vertical parition in the middle. The bottom of the partition has a small hinged door of area $20cm^2$. The tank is filled with water and an acid (of relative density 1.7) in the other, both to a height of $4.0m$. Compute

to force necessary the force nec cessary to keep the door closed.

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14. A U tube contains water and methylated spirts separated by mercury columns in the two arms are in level with 10.0cm of water in one arm and 12.5 cm of spirit in the other. What is the relative density of spirit?

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15. If 15.0 cm of water and spirit each are further poured into the respective arms of the tube, what is the difference in the levels of mercury in the two arms? (Relative density of mercury = 13.6).

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16. A tank contains water and mercury as shown in . An iron cube of edge $6cm$ is in equilibrium as shown. What is the fraction of cube inside the mercury ? Given density of iron

$= 7.7 \times 10^3 \text{kgm}^{-3}$ and density of mercury $= 13.6 \times 10^3 \text{kgm}^{-3}$.

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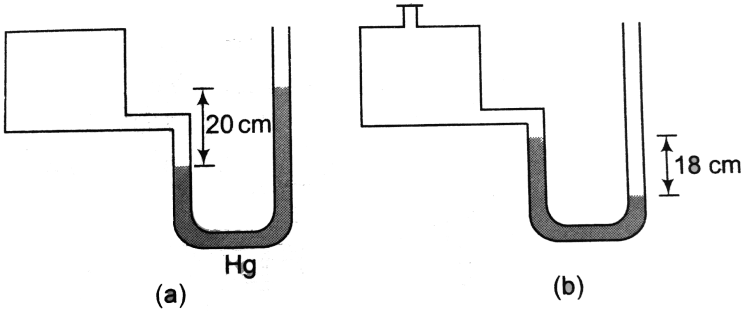
17. A manometer reads the pressure of a gas in a enclosure as shown in figure(a) When some of the gas is removed by a pump, the manometer reads as in (b). The liquid used in the manometers is mercury and the atmospheric pressure is $76cm$ of mercury.



(i) Give the absolute and gauge pressure of the gas in the enclosure for cases (a) and (b) in units of cm of mercury .

(ii) How would the level change in case (b) if $13.6cm$ of water are poured into the right limb of the manometer?

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18. Shows a hydraulic press with the larger piston of diameter $35cm$ at a height of $1.5m$ relative to the smaller piston of diameter $10cm$. The mass on the smaller piston is $20gk$. What is the force exerted on the load by the lerger piston ? The density of oil in the press is 750kgm^{-3}.

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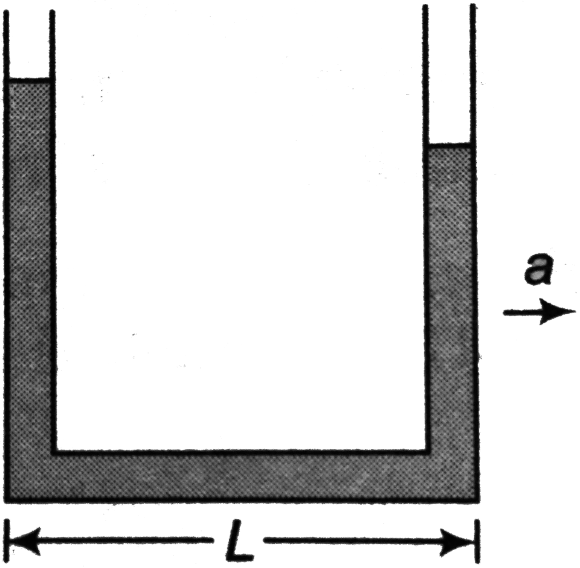
19. A liquid stands at the plane level in the U-tube when at reat. If areals of cross-section of both the limbs are equal, what will be the difference in height h of the two limbs of U-tube, when the sustem is given an acceleration a in horizontal direction towards right as

shown?



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20. A piece of wood of relative density 0.25 floats in a pail containing oil of relative density

0.81. What is the fraction of volume of the wood above the surface of the oil ?

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21. A solid floats in water with $3/4$ of its volume below the surface of water. Calculate the density of the solid.

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22. A piece of pure gold of density $19.3 g cm^{-3}$ is suspected to be hollow inside. It weighs 38.250 g in air and 33.865 g in water. Calculate the volume of the hollow portion of the gold, if any:

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23. The density of ice is $0.918 g \mathrm{cm}^{-3}$ and that of water is $1.03 g \mathrm{cm}^{-3}$. An iceberg floats with

a portion of $224m^3$ outside the surface of water. Find the total volume of the iceberg.

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24. A solid body floating in water has $1/6$th of the volume above surface . What fraction of its volume will project upward if it floats in a liquid of specific gravity 1.2 ?

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25. A spring balance reads 10 kg when a bucket of water is suspended from it. What is the reading on the spring balance when (i) an ice cube of mass 1.5 kg is put into the bucket (ii) an iron piece of mass 7.8 kg suspended by another spring is immersed with half its volume inside the water n the bucket. Relative density of iron = 7.8

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26. A cube of wood floating in water supports a $200g$ mass at the centre of its top face. When the mass is removed , the mass rises by $2cm$. Determine the volume of cube.

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27. A certain block weighs 15 N in air. But is weighs only 12 N when completely immersed in water. When immersed completely in another liquid, it weighs 13 N. Calculate the

relative density of (i) the block and (ii) the liquid.

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28. A jeweller claims that he sells ornaments made of pure gold that has the relative density of 19.3. He sells a necklace weighing $25.250g$ f to a person. The clever customer weighs the necklace when immersed in pure water and finds that it weighs $23.075g$ f in water. Is the ornament made of pure gold?

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29. A piece of alloy of gold and silver weighs $2kg$ in air and $1.86kg$ in water. What is the mass of silver? Density of gold $= 19.3 \times 10^3 \text{kgm}^{-3}$. Density of silver $= 10.5 \times 10^{30 \text{kg} m^{-3}}$.

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30. A hemispherical vessel having an outer diameter $18cm$ and weighing $200g$ floats in

water Find the maximum volume of liquid that may be poured into the vessel without sinking. Density of liquid $= 3100 \mathrm{kgm}^3$.

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31. A tank contains water and mercury as shown in . An iron cube of edge $6cm$ is in equilibrium as shown. What is the fraction of cube inside the mercury ? Given density of iron $= 7.7 \times 10^3 \mathrm{kgm}^{-3}$ and density of mercury $= 13.6 \times 10^3 \mathrm{kgm}^{-3}$.

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32. A body of density ρfloats with a volume V_1 of its total volume V immersed in one liquid of density ρ_1 and with the remainder of volume V_2 immersed in another liquid of density ρ_2, where $\rho_1 > \rho_2$. Find the relative volumes immersed in two liquids.

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33. A unifrom rod has a mass attached to one end to make it float upright in liquild. If 3.0 cm of the rod is immersed when floats in water and 3.5 cm when it floats in a liquid of sp. Gravity 0.9 , what length of it will be immersed, when it floats in a liquid of sp. gravity 1.2?

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34. A sample of milk diluted with water has density $1036 kgm^{-3}$. if pure milk has a density

$1080 kgm^{-3}$ what is the percentage of water by volume in milk ?

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35. A U-shaped wire is dipped in a soap solution, and removed. A thin soap film formed between the wire and a light slider supports a weight of $1.5 \times 10^{-2} N$ (which includes the small weigh of the slider). The length of the slider is 30cm. What is the surface tension of the film?

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36. A wire ring of $3cm$ redius is rested on the surface of a liquid and then reaised. The pull required is $3.03g$ more before the film breaks than it is afterwards. Find the surface tension of the liquid.

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37. Calculate the work done in blowing a soap bubble from a radius of $2cm\text{to}3cm$. The

surface tension of the soap solution is $30 \quad \text{dyne} \quad cm^{-2}$.

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38. The surface tension of a soap solution is $0.03Nm^{-1}$. How much work is done to produce a soap bubble of radius $0.05m$

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39. A liquid drop of diameter D breaks up into 27 tiny drops. Find the resulting change in energy. Take surface tension of the liquid as σ

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40. A mercury drop of radius $1.0cm$ is sprayed into 10^8 droplets of equal size. Calculate the energy expanded. (Surface tension of mercury $= 32 \times 10^{-2} N/m$).

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41. What amount of energy will be liberated if 1000 droplets of water, each of diameter $10^{-8}cm$, coalesce to form a bigger drop. Surface tension of water is $0.072\mathrm{Nm}^{-1}$.

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42. A soap bubble is blown to a diameter of 7 cm. if 36960 ergs of work is done in blowing if further find the new radius, if surface tension of the soap solution is 40 dynes/cm.

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43. A soap bubble in vacuum has a radius of $3cm$ and another soap bubble in vacuum has a radius of $4cm$. If the two bubbles coalesce under isothermal conditions then the radius of the new bubble is :

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44. If 500 erg of work is done in blowing a soap bubble to a radius r, what additional work is required to be done to blow it to a radius equal to 3r?

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45. A liquid drop of mass $0.0129g$ drops from a capillary. When the drop breaks away, the diameter of the neck of capillary is 1mm. Find surface tension of liquid.

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46. A glass plate of length 10 cm, breadth 4 cm, and the thickness 0.4cm , weighs 20g in air. It is held vertically with long side horizontal and half the plate immersed in water. What will be its apparent weight? Surface tension of water = $70 dyne / cm$.

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47. If a number of little droplets of water each of radius r, coalesce to form a single drop of radius R, show that the rise in temperature will be given by

$$\Delta 0 = \frac{3\sigma}{J}\left(\frac{1}{r} - \frac{1}{R}\right)$$

Where σ is the surface tension of water and J is the mechanical equivalent of heat.

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48. What would be the gauge pressure inside an air bubble of $0.2mm$ radius situated just below the surface of water ? Surface tension of water is $0.07\mathrm{Nm}^{-1}$.

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49. What is the pressure inside a drop of mercury of radius 3.0mm at room temperature? Surface tension of mercury at that temperature $(20^{\circ}C)$ is

$4.65 \times 10^{-1} Nm^{-1}$. The atmospheric pressure is $1.01 \times 10^{5} Pa$. Also give the excess pressure inside the drop.

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50. What should be the pressure inside a small air bubble of $0.1mm$ radius situated just below the surface of water? Surface tension of water $= 72 \times 10^{-3} N/m$ and atmospheric pressure $= 1.013 \times 10^{5} N/m^{2}$

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51. What is the excess pressure inside a bubble of soap solution of radius 5.00mm, given that the surface tension of soap solution at the temperature $(20^{\circ}C)$ is $2.50 \times 10^{-2} Nm^{-1}$? If an air bubble of the same dimension were formed at a depth of 40.0 cm inside a container containing the soap solution (of relative density 1.20), what would be the pressure inside the bubble? (1atm. is $1.01 \times 10^{5} Pa$).

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52. The excess pressure inside a soap bubble of radius $6mm$ is balanced by $2mm$ column of oil of specific gravity 0.8. Find the surface tension of soap solution.

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53. Two soap bubbles have radii in the ratio $2:3$. Compare the excess of pressure inside these bubbles. Also compare the woeks done in blowing these bubbles.

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54. A small hollow vessel which has a small hole in it is immerse in water to a depth of 40 cm before any water penetrates into the vessel. If the surface tension of water is $70 \times 10^{-3} Nm^{-1}$, find the radius of the hole

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55. A glass tube of 1mm diameter is dipped vertically into a tube of mercury, with its lower end 3 cmm below the mercury surface. What must be the gauge pressure of air in the tube to blow a hemispherical bubble at its lower and ? Given, density of mercury $= 13.6g/cc$ and surface tension of mercury $= 0.540Nm^{-1}$. $g = 10ms^{-2}$.

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56. The lower end of a capillary tube of diameter 2.0 mm is dipped 8.00cm below the surface of water in a beaker. What is the pressure required in the tube in order to blow a hemispherical bubble at its end in water? The surface tension of water at temperature of the experiments is $7.30 \times 10^{-2} Nm^{-1}$. 1 atmospheric pressure $=1.01 \times 10^{5} Pa$, density of water $= 1000 kg/m^{3}$, $g = 9.80 ms^{-2}$. also calculate the excess pressure.

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57. Calculate the height to which water will rise in a capillary tube of diameter 1×10^{-3}m [given surface tension of water is $0.072 Nm^{-1}$ angle of contact is $0^{\circ}, g = 9.8 ms^{-2}$ and density of water $= 1000 kgm^{-3}$]

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58. Mercury has an angle of contact equal to 140° with soda lime galss. A narrow tube of radius $1.00 mm$ made of this glass is dipped in

a through containing mercury. By what amount does the mercury dip down in the tube relative to the mercury surface outside? Surface tension of mercury at the temperature of the experiment is $0.465 Nm^{-1}$. Density of mercury = $13.6 \times 10^3 kgm^{-3}$.

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59. A liquid rises to a height of 7.0 cm in a capillary tube of radius 0.1 mm. The density of the liquid is $0.8 \times 10^3 \mathrm{kgm}^{-3}$. If the angle of

contact between the liquid and the surface of the tube zero , calculate the surface tension of the liquid Given $g = 10\mathrm{ms}^{-2}$.

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60. Two capillary tubes of diameters 5.0mm and 4.0 mm are held vertically inside water one by one. How much high the water will rise in each tube ? Given $g = 10ms^{-2}$ and surface tension of water $7.0 \times 10^{-2}\mathrm{Nm}^{-1}$.

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61. Water rises up in a glass capillary upto a height of $9.0cm$, while mercury falls down by $3.4cm$ in the same capillary. Assume angles of contact for water glass and mercury glass 0° and 135° respectively. Determine the ratio of surface tension of mercury and water $(\cos 135^\circ = -0.71)$.

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62. Water rises in a capillary tube to a height 2.0 cm. In an another capillary tube whose radius is one third of it, how much the water will rise ? If the first capillary tube is inclined at an angle of 60° with the vertical then what will be the position of water in the tube.

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63. A capillary tube whose inside radius is 0.6 mm is dipped in water in a bucket of surface

tension 75 dyn e cm^{-1} To what height is the water raised in the capillary tube above the level water in bucket ? What is the weight of water raised ?

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64. If a $5cm$ long capillary tube with $0.1mm$ internal diameter, open at both ends, is slightly dipped in water having surface tension $75dyn/cm$, state whether:

(i) water will rise halfway in the capillary,

(ii) water will rise up to the upper end of capillary,

(iii) water will overflow out of the upper end of capillary.

Explain your answer.

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65. Two narrow bores of diameters 3.0mm and 6.0 mm are joined together to form a U-shaped tube open at both ends. If th U-tube contains water, what is the difference in its

levels in the two limbs of the tube? Surface tension of water at the temperature of the experiment is $7.3 \times 10^{-2} Nm^{-1}$. Take the angle of contact to be zero. and density of water to be $1.0 \times 10^{3} kg/m^{3}$.

$(g = 9.8 ms^{-2})$

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66. A $U-$ tube is made up of capillaries of bores $1mm$ and $2mm$ respectively. The tube is held vertically and partically filled with a liquid

of surface tension $49 \mathrm{dyne} / \mathrm{cm}$ and zero contact angle. Calculate the density of the liquid of the difference in the levels of the meniscus is $1.25 cm$.

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67. A glass U-tube is such that the diameter of one limb is $3.0 mm$ and that of the other is 6.0mm. The tube is inverted vertically with the open ends below the surface of water in a beaker. What is the difference between the

height to which water rises in the two limbs? Surface tension of water is $0.07Nm^{-1}$. Assume that the angle of contact between water and glass is 0°.

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Problem

1. The height to which a cylindrical vessel be filled with a homogenous liquid, to make the average force with which the liquid presses

the side of the vessel equal to the force exerted by the liquid on the bottom of the vessel, is equal to.

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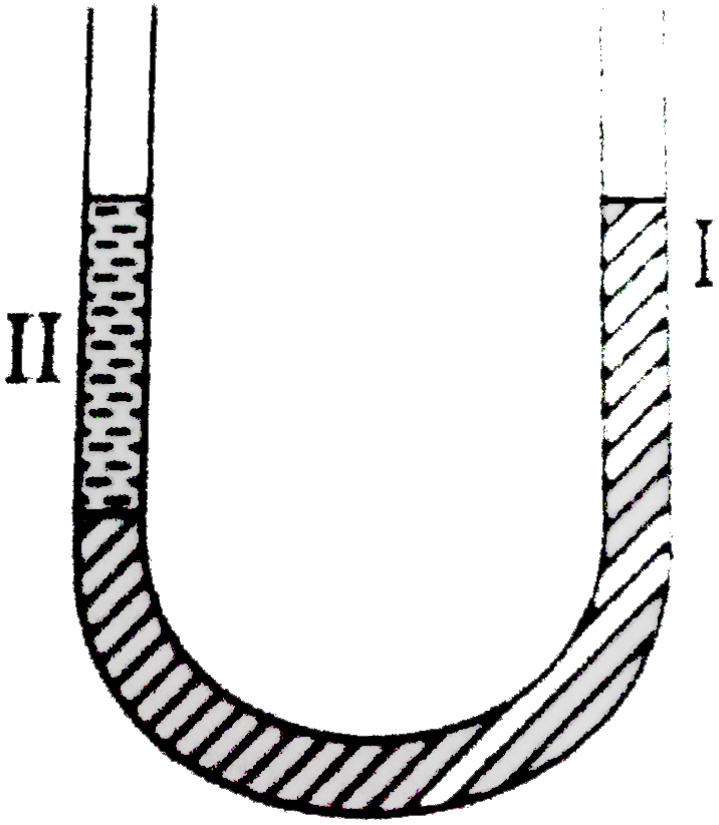
2. A U-tube of uniform cross-section shown in figure is partially filled with liquid Igt Another liquid II which does not mix with I is poured into one side. The liquid levels of the two sides is found the same, while the level of liquid I has risen by 2 cm. If the specific gravity of

liquid I is 1.1, then specific gravity of liquid II must be



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3. A boat floating in a water tank is carrying a number of large stones. If the stones are unloaded into water, what will happen to the water level?

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4. Vessel contains oil $(density 0.8 g/cc)$ over mercury (density $13.6 g/cc$) A homogeneous sphere floats with half its volume immersed in mercury and the other half in oil. The density of the sphere in g/c c is

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5. An iceberg weighs 400 tonnes. The specific gravity of iceberg is 0.92 and the specific gravity of water is 1.02. what percentage of iceberg is below the water surface?

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6. A balloon filled with hydrogen has a volume of 1000 litres and has mass of 1kg. What would

be the volume of the block of very light material which it can just lift? One litre of the material has a mass 91.3g and density of air is $1.3g \quad \text{litre}^{-1}$.

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7. A cubical block of iron 5 cm on each side is floating on mercury in a vessel. (i) what is the height of the block above mercury level ?

(ii) Water is poured in the vessel until it just covers the iron block. What is the height of

water column . density of mercury $13.6gm/cm^3$. Density of iron 7.2 gm/cm^3

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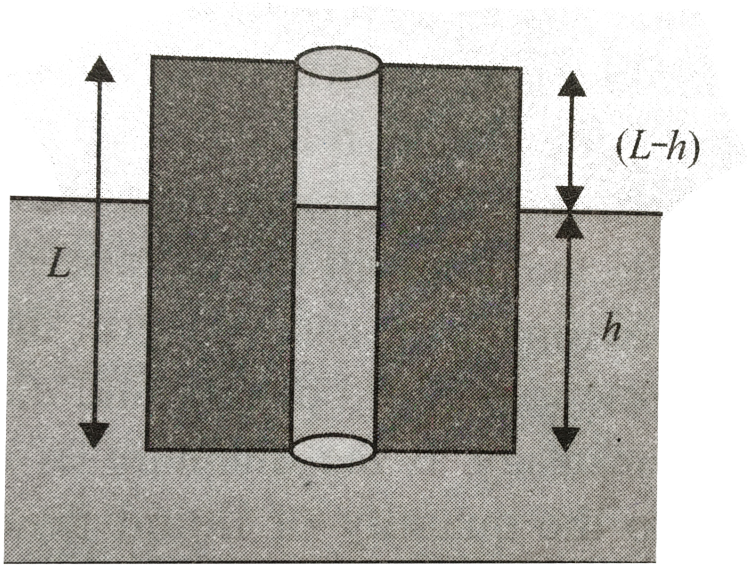
8. A large block of ice $5m$ thick has a vertical hole drilled through it and is floating in the middle of a lake. What is the minimum length of a rope required to scoop up a bucket full of water through the hole? Relative density of ice

$= 0.9.$



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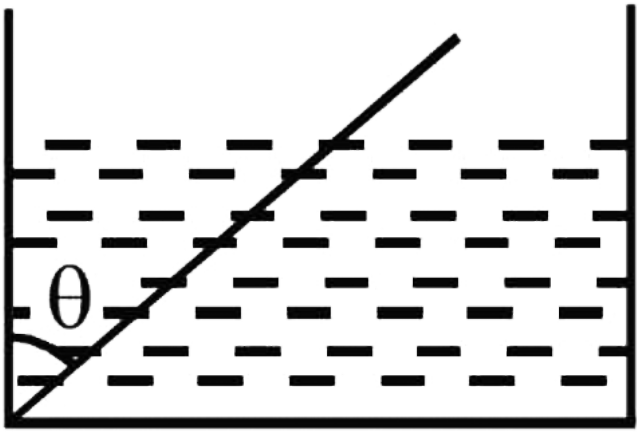
9. A wooden plank of length 1m and uniform cross-section is hinged at one end to the bottom of a tank as shown in fig. The tank is

filled with water upto a hight 0.5m. The specific gravity of the plank is 0.5. Find the angle θ that the plank makes with the vertical in the equilibrium position. (Exclude the case $\theta = \theta^\circ$)



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10. A film of water is formed between two straight parallel wires each $10cm$ long and at a seperation of $0.5cm$. Calculate the work required to increase $1mm$ distance between the wires. Surface tension of water $= 72 \times 10^{-3} N/m.$

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11. Water rises in a capillary tube upto a certain height such that the upward force of

surface tension balances the force of $75 \times 10^{-5} N$ due to weight of the liquid. If surface tension of water is $6 \times 10^{-2} Nm^{-1}$, what must be the internal circumference of the capillary tube?

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12. A ring is cut from a platinum tube $8.5cm$ internal and $8.7cm$ external diameter. It is supported horizontally from the pan of a balance, so that it comes in contact with the

water in a glass vessel. If an extra $3.103g.f.$ is required to pull it away from water, the surface tension of water is

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13. There is a soap bubble of radius $2.4 \times 10^{-4}m$ in air cylinder at a pressure of $10^5 N/m^2$. The air in the cylinder is compressed isothermal until the radius of the bubble is halved. Calculate the new pressure

of air in the cylinder. Surface tension of soap solution is $0.08Nm^{-1}$.

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14. Two separate air bubbles (radii $0.002cm$ and 0.004) formed of the same liquid (surface tension $0.07N/m$) come together to form a double bubble. Find the radius and the sense of curvature of the internal film surface common to both the bubbles.

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15. Two soap bubble of radii r_1 and r_2 combime to form a single bubble of radius r under isothermal conditions . If the external pressure is P, prove that surface tension of soap solution is given by $S = \frac{P\left(r^3 - r_1^3 - r_2^3\right)}{4\left(r_1^2 + r_2^2 - r^2\right)}$.

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16. A long capillary tube of radius 1 mm, open at both ends is filled with water and placed vertically. What will be the height of water column left in the capillary ? (Surface tension of water is $73.5 \times 10^{-3} Nm^{-1}$)

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17. A glass capillary sealed at the upper end is of length $0.11m$ and internal diameter 2×10^{5} m. The tube is immersed vertically into a liquid

of surface tension $5.06 \times 10^{-2} N/m$. To what length the capillary has to be immersed so that the liquid level inside and outside the capillary becomes the same. What will happen to water level inside the capillary if the seal is now broken?

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18. A tapering glass capillary tube A of length $0.1m$ has diameters 10^{-3} m and 5×10^{4} m at the ends. When it is just immersed in a liquid

at 0° C with larger radius in contact with liquid surface, the liquid rises 8×10^{-2} m in the tube. In another experiment, in a cylindrical glass capillary tube B, when immersed in the same liquid at 0°C, the liquid rises to 6×10^{-2} m height. The rise of liquid in tube B is only 5.5×10^{-2} m when the liquid is at 50° C. Find the rate at which the surface tension changes with temperature considering the change to be linear. The density of liquid is $(1/14) \times 10^4 kg/m^3$ and the angle of contact is zero. Effect of temperature on the density of liquid and glass is negligible.

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19. Two spherical soap bubble coalesce. If V is the consequent change in volume of the contained air and S the change in total surface area, show that

$3PV + 4ST = 0$

where T is the surface tension of soap bubble and P is

Atmospheric pressure

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Problem For Self Practice

1. A force of $40N$ is applied on a nail , whose tip has an area of cross-section of 0.001cm^2. Calculate the pressure on the tip.

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2. Atmospheric pressure is $1.01 \times 10^5 Pa$. How large a force does the air in a room exert on the inside of a window pan that is $50cm \times 100cm$?

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3. The force on a Phonograph needle is $1.2N$. the point has a circular cross-section whose radius is 0.1 mm. Find the pressure (in atm) it exerts on the recods. Given $1\text{atm} = 1.013 \times 10^5 Pa$.

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4. A cylinderical vessel contaning liquid is closed by a smooth piston of mass m. the area of cross-section of the piston is A. if the atmospheric pressure is P_0, Find the pressure of the liquid just below the piston.

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5. The cross-section of two piston in hydraulic press are $2cm^2 \text{and} 150cm^2$ respectivley . Calculate the minimum force required to

support a weight of 2000kg wt on the broader face of the press.

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6. The average mass that must be lifted by a hydraulic press is 80kg.If the radius of the larger piston is five times that of the smaller piston, what is the minimum force that must be applied?

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7. In a hydraulic press used for compressing cotton the area of the piston is $0.1m^2$ and the force exerted along the piston rod is $200N$. If the area of the larger cylinder is $0.8m^2$, find the pressure produced in the cylinder and the total crushing force exerted on the bale of cotton.

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8. An automobile sack is lifted by a hydraulic jack that consists of two pistons. The large

piston is $1m$ in diameter and the small piston is $10cm$ in diameter. If W be the weight of the car, how much smaller a force is needed on the small piston to lift the car?

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9. What is the minimum pressure required to force blood from the heart to the top of the heart (a vertical distance of 50 cm) ? Assume that the density of blood is 1.04gcm^{-3} and neglect friction.

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10. A column of water $40cm$ height supports a $30cm$ column of an unknown liquid . What is the density of the liquid ?

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11. If the water pressure gauge shows the pressure at ground floor to be $270k \quad \mathrm{Pa},$ how high would water rise in the pipes of a building?

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12. A cylinderical jar of cross-sectional area of $50cm^2$ is filled with water to a height of $20cm$. It carries a tight fitting piston of negligible mass. Calculate the pressure at the bottom of the jar when a mass of $1kg$ is placed on the piston . Ignore atmospheric pressure.

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13. Water is filled in a flask upto a height of $20cm$. The bottom of the flask is circular with radius $10cm$. If the atmospheric pressure is 1.013×10^5 Pa, find the force exerted by the water on the bottom . Take $g = 10\text{ms}^{-2}$ and density of water $= 1000\text{kgm}^{-3}$.

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14. The density of asir ner earth's surface is $1.3kgm^{-3}$ and the atmospheric pressure is

$1.0 \times 10^5 Nm^{-2}$. If the atmosphere had uniform density, same as that observed at the surface of the earth what would be the height of the atmosphere to exert the same pressure?

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15. A vertical U-tube of uniform inner cross-section contains mercury in both of its arms. A glycerine $\left(\text{density} 1.3 \text{gcm}^{-3}\right)$ column of length $10cm$is introduced into one of the

arms Oil of density $0.8 \mathrm{gcm}^{-3}$ is poured in the other arm until the upper surface of the oil and glycerine are in the same horizontal level. Find the length of the oil column.

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16. Two liquids of specific gravity $1.2 \text{and} 0.84$ are poured into the limbs of a U tube until the difference in levels of their upper surfaces is 9 cm . What will be the heights of their respective surface above the common surface

in U tube ? What is the pressure at the common surface ? Take $g = 10\text{ms}^{-2}$

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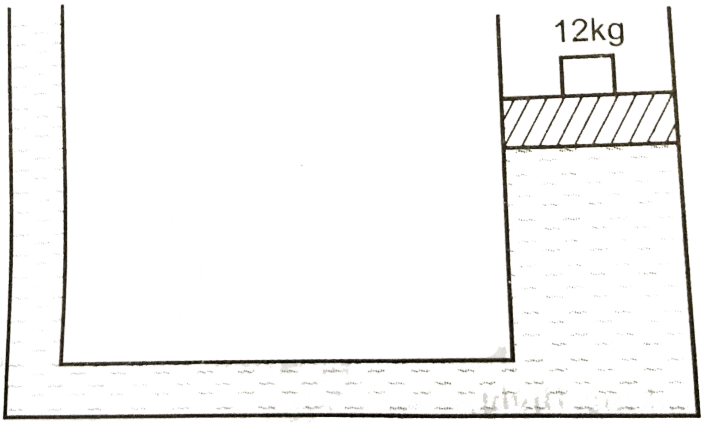
17. The area of cross-section of the wider tube shown in fig., is $800cm^2$. If a mass of 12 kg is placed on the massless piston, what is the

difference in the level of water in two tubes.



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18. A barometer kept in an elevator accelerating upwards reads 76 cm of Hg. If the elevator is accelerating upwards at $4.9 \mathrm{ms}^{-2}$, what will be the air pressure in the elevator?

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19. How much will a body of $70N$ weight in water if it displaces 20 ml of water ?

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20. A solid weighs $6kg$ in air. If its density is $2000\text{kg}m^3$ what will be its apparent weight in water?

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21. A solid weighs $10N$ in air. Its weight decreases by $2N$ when weighed in water what is the density of solid?

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22. A solid weighs $3N$ in air $2.5N$ in water and 2.6 N in a liquid . Calculate the relative density of solid.

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23. A copper cube of mass $0.50kg$ is weighed in water. The mass comes out to be $0.40kg$. Is the cube hollower solid ? Given density of copper $= 8.96 \times 10^3 \text{kgm}^{-3}$ and density of water $= 10^3 \text{kgm}^{-3}$.

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24. A piece of ice floats in water . What fraction of its volume will be above the surface of

water ? Given density of ice $= 0.90 \times 10^3 \text{kgm}^{-3}$.

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25. A boat having a length of 3 m and breadth of 2 m is floating on a lake. The boat sinks by 1 cm when a man gets on it. The mass of the mas is:

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26. When a body of mass 240 kg is placed on a ice berg floating in sea water, it is found that the ice berg just sinks. What is the mass of the ice berg ? Take the relative density of ice as 0.9 and that of sea water as 1.02.

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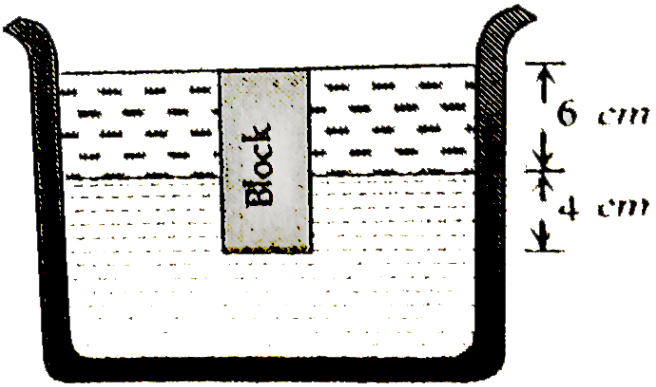
27. A cubical block of wood 10 cm on a side floats at the interface between oil and water with its lower surface horizontal and 4 cm

below the interface. The density of oil is $0.6gcm^{-3}$. The mass of block is



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28. A Piece of brass (alloy of zinc and copper) weighs 12.9 g in air. When completely immersed in water it weighs 11.3 g . What is

the mass of copper contained in the alloy ? Specific gravity of zinc and copper are 7.1 and 8.9 respectively.

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29. A piece of iron floats in mercury. Given that the density of iron is $7.8 \times 10^3 \text{kg} m^{-3}$ and that of mercury is $13 \times 10^3 \text{kgm}^{-3}$, Calculate the fraction of the volume of iron piece that remains outside the mercury.

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30. A metal cube of 5cm side and relative density 9 is suspended by thread so as to be dompletely immersed in a liquid of density $1.2 \times 10^3 \mathrm{kg} m^{-3}$. Find the tension in the thread.

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31. A piece of cork whose weight is 19 g is attached to a bar of silver weighing 63 g . The two together just float in water . Specific

gravity of silver is 10.5. Find the specitic gravity of cork. Density of water $= 1 g \mathrm{cm}^{-3}$.

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32. A cube of side 4cm is just completely immersed liquid A. When it is put in liquid B, it floats with 2 cm outside the liquid. Calculate the ratio fo densities of two liquids.

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33. An iron ball has an air space in it. It weighs 1 kg in air and 0.6 kg in water .Find the volume of air space. Density of iron $= 7200 \mathrm{kgm}^3$.

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34. A soap film is formed on a rectangular frame of length 7 cm dipping in soap solution. The frame hanges from the arm of a balance. An extra weight of 0.38 g is to be placed in the opposite pan to balance the pull on the frame.

Calculate the surface tension of the soap solution. Given $g = 980 \text{cms}^{-2}$.

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35. A soap film is on a rectangular wire ring of size $5cm \times 4cm$. If the size of the film is changed to $5cm \times 5cm$, then calculate the work done in this process. The suface tension of soap is $5 \times 10^{-2} \text{Nm}^{-1}$.

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36. The surface area of a soap-bubble is $2.0 \times 10^{-3} m^2$. How much work will be done in blowing the bubble twice its surface area? Surface tension of soap solution $= 3.0 \times 10^{-2} \mathrm{Nm}^{-2}$.

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37. In increasing the area of a film of soap solution from $50 \mathrm{cm}^2 \quad \text{to} \quad 100 \mathrm{cm}^2 3 \times 10^{-4} J$ of work is done. Calculate the value of surface tension of the soap solution.

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38. A drop of water of diameter 0.2 cm is broken up into $27,000$ droplets of equal volume. How much work will be done against surface tension in the process ? Surface tension of water $= 7 \times 10^{-2} \mathrm{Nm}^{-1}$.

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39. Calculate the work done in blowing a soap bubble from radius 2cm to 5cm. Surface tension of water $= 60\text{dyne}cm^{-1}$.

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40. A soap bubble of radius $1/\sqrt{\pi}\text{cm}$ is expanded to radius $2/\sqrt{\pi}\text{cm}$. Calculate the work done. Surface tension of soap solution $= 30\text{dyne} \quad cm^{-1}$.

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41. Calculate the amount of energy evolved when 8 droplets of water $\left(\text{surface tension} = 72\text{dyne} \quad cm^{-1}\right)$ of radius 0.5 mm each combine into one.

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42. Calculate the amount force required to take away a flat plate of radius 5 cm from the surface of water . Given surface tension of water $= 72\text{dyne} \quad cm^{-1}$.

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43. A thin wire is bent in the form of a ring of diameter 3.0 cm . The ring is placed horizontally on the surface of soap solution and then raised up slowly . How much upward force is necessary to break the vertical film formed between the ring and the solution ? surface tension of a soap solution $= 3.0 \times 10^{-2} \mathrm{Nm}^{-1}$.

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44. the langth of a needle floating on water is 2.5 cm . How much minimum force in addition to the weight of the needle, will be needed to lift the needle above the surface of water ? Surface tension of water $= 7.2 \times 10^{-4} \mathrm{Ncm}^{-1}$.

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45. A rectangular plate of dimensions $6cm \times 4cm$ and thickness 2 mm is placed with

its largest face flat on surface of water . (i) What is the downward force on the plate due to surface tension ? Surface tension of water $= 7.0 \times 10^{-2} \mathrm{Nm}^{-1}$ (ii) If the plate is placed vertical so that the longest side just touches the water surface, find the downward force on the plate.

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46. If a number of little droplets of water of surface tension σ all of the same radius r

combine to form a single drop of radius R and the energy released in converted into kinetic energy find the velocity acquired by the bigger drop.

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47. A soap bubble of radius α has been formed at normal temperature and pressure under isothermal process. Compute the work done. The surface tension of soap solution is σ

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48. Two mercury drops each of radius r merge to form a bigger drop. Calculate the surface energy released.

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49. A big drop of radius R is formed by coalescing 1000 small droplets of water. What will be the change in surface eneryg ? What will be the ratio between the total surface

energy of the droplets and surface energy of the big drop ?

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50. What is the difference in pressure between the inside and outside of a spherical drop of radius 2mm Surface tension of water $= 70 \times 10^{-3} \mathrm{Nm}^{-1}$.

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51. the pressure of air in a soap bubble of 0.7 cm diameter is 8 mm of water above the atmospheric pressure . Calculate the surface tension of soap solution .take $g = 9.8\text{ms}^{-2}$.

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52. Calculate the total pressure inside a spherical air bubble of radius 0.2 mm formed inside water at depth of 10 cm. Surface tension of water at a depth of 30 cm is $70\text{dyne}cm^{-1}$,

barometric pressure is 76 cm, density of mercury is $13.6 g \mathrm{cm}^{-3}$ and $g = 980 \mathrm{cms}^{-2}$.

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53. Calculate the total pressrue inside a spherical air bubble of radius 0.1mm at a depth of 10 cm below the surface of a liquid of density $1.1 g \mathrm{cm}^{-3}$ and surface tension $50 \mathrm{dyne}\ cm^{-1}$. Height of Hg barometer $= 76 \mathrm{cm}$.

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54. Find the difference in excess pressure on the inside and outside of a rain drop if its diameter change from 0.03 cm to 0.0002 cm by evaporation . Surface tension of water is $72\text{dyne} \quad cm^{-1}$.

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55. What is the pressure inside a vapour bubble of radius 10^{-3} m formed in boiling

wate? Surface tension of water at $100^\circ C$is$0.059 \mathrm{Nm}^{-1}$and$1 \mathrm{atm} = 101325 \mathrm{nm}^{-2}$.

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56. There is an air bubble of radius $1.0mm$ in a liquid of surface tension $0.075 \mathrm{Nm}^{-1}$ and density $10^3 \mathrm{kgm}^{-3}$. The bubble is at a depth of $10.0cm$ below the free surface of a liquid. By what amount is the pressure inside the bubble greater than the atmospheric pressure?

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57. An ancient building has a done of 5m radius and uniform but small thickness. The surface tension of its masionary structure is about $500\mathrm{Nm}^{-1}$. Treated as hemisphere, find the maximum load that dome can support.

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58. A 0.02 cm liquid column balances the excess pressure inside a soap bubbl of radius

7.5 mm. Determine the density of the liquid. Surface tension of soap solutionn $0.03Nm^{-1}$.

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59. The diameter of a capillary tube is $0.4 \times 10^{-3}m$. It is held vertically in a liquid whose density is $0.8 \times 10^{3}\mathrm{kgm}^{-3}$ and the surface tension is $9.8 \times 10^{-2}\mathrm{Nm}^{-1}$. Determine the height to which the liquid will rise in the tube. Given$g = 9.8\mathrm{ms}^{-2}$ and angle of contact is zero.

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60. Water rises in a capillary tube to a height of $10cm$. If surface tension of water is $9.8 \times 10^{-2}\mathrm{Nm}^{-1}$. Then find out the radius of the capillary tube. Given $g = 9.8\mathrm{ms}^{-2}$ and density of water $= 10^{3}\mathrm{kgm}^{-3}$.

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61. The radius of capillary tube is 0.025 mm. If is held vetically in a liquid whose density is

$0.8 \times 10^3 \mathrm{kg} m^{-3}$, surface tension is $3.0 \times 10^{-2} \mathrm{Nm}^{-1}$ and for which the cosine of the angle of contact is 0.3. Determine the height upto which the liquid will rise in the tube . Given $g = 10 \mathrm{ms}^{-2}$.

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62. A capillary tube of inner radius $0.5mm$ is dipped keeping it vertical in a mercury of specific gravity 13.6, surface tension $545 dyne / cm$ and angle of contact 135° . Find

the depression or elevation of liquid in the tube.

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63. Calculate the diameter of a capillary tube in which mercury is derpessed by 1.21 cm. Given surface tension for mercury is $540 \times 10^{-3} \mathrm{Nm}^{-1}$. the angle of contact with glass is 140° and density of mercury is $13.6 \times 10^{3} \mathrm{kg} m^{-3}$.

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64. The tube of mercury barometer is 4mm in diameter. How much error does the surface tension cause in the reading? Surface tension of mercury = $540 \text{ x } 10^{-3} Nm^{-1}$, angle of contact = 135°. Density of mercury $= 13.6 \times 10^{3} kgm^{-3}$.

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65. Water rises to a height of 9 cm in a certain capillary tube. If in the same tube, level of Hg

is depressed by 3cm compare the surface tension of water and mercury. Specific gravity of Hg is 13.6, the angle of contact for water is zero and that for Hg is 135°.

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66. A glass tube of radius $0.4mm$ is dipped vertically in water. Find upto what height the water will rise in the capollary? If the tube in inclined at an angle of 60° with the vertical, how much length of the capillary is occupied

by water? Suface of water $= 7.0 \times 10^{-2} N/m$,density of water $= 10^3 kg/m^3$.

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67. Water rises in a capillary upto a height of 8.0 cm. if the capillary is inclined at an angle of 45° with the vertical then determine the vertical height of water. How much length of the capillary will be occupied by water ? If the length of the capillary is reduced to 4.0 cm

and it is held vertically in water then what will be the position of water?

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68. Find the difference in levels of mercury in the limbs of a U-tube if the diameter fo bore of one limb is 1mm and of the other 4mm. The surface tension of mercury is $544 \times 10^{-3} \mathrm{Nm}^{-1}$ its density is $13.6 \times 10^{3} \mathrm{kg} m^{-3}$ and angle of contact is 130°.

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69. A U tube is supported with its limbs vertical and is partly filled with water. If the inner diameter of the limbs are 1cm,and 0.01 cm , respectively, what will be the difference in height of water in the two limbs? S.T. or water $70 \times 10^{-3} Nm^{-1}$. Angle of contact , $\theta = 0^{\circ}$.

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