PHYSICS

BOOKS - MODERN PUBLISHERS PHYSICS (HINGLISH)

MECHANICAL PROPERTIES OF FLUIDS

Solved Examples

1. A drawing pin with a tip area of 0.1 mm^2 is pushed against a board with a force of 30 N. Calculate the pressure exerted at the tip.

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2. The two thigh bones (femur bones) each of cross-sectional area $10cm^2$ support the upper part of a human body of mass 40 kg . Estimate the average pressure sustained by the femurs. $g = 10m/s^2$

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3. 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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4. Two syringes of different cross-sections (without needles) filled with water are connected with a tightly fitted rubber tube filled with water. Diameters of the smaller piston and larger piston are 1.0cm and 3.0 cm respectively.

(a) Find the force on the larger piston when a force of 10N is applied to the smaller piston.

(b) The smaller piston is paused in through 6.0 cm, much does the larger piston move out?

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5. The diameter of smaller piston of a hydraulic press is 3 cm that of a larger piston is 20cm. If a weight of 50 kg f is placed on the smaller piston, what will be the force exerted by the larger piston? If the stroke of smaller piston is 5cm, calculate

the distance through which the larger will move after 6 strokes?

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6. Calculate the length of mercury column in a barometer tube which is inclined at an angle of 45° with horizontal direction if the atmospheric pressure is 75 cm of mercury.

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7. What is the pressure on a swimmer 10m below the surface of lake? $g = 10ms^{-2}$, atmospheric pressure = $1.01 \times 10^5 Pa$

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8. The length breadth and height of a reactangle tank are 8m, 6m and 2m respectively. It is filled to the rim with a liquid of density of $2 \times 10^3 kg/m^3$. Calculate the thrust exerted by the liquid at the bottom and walls of the tank. Take $g = 9.8m/s^2$

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9. A cylindrical tube of cross sectional area $20cm^2$ is filled with water to a height of 10cm. The tube carries a tight fitting piston of negligible mass. What will be the pressure exerted at the bottom of the tube when a mass of 2 kg placed on the piston? Atmospheric pressure can be ignored.

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10. At a depth of 1000 m in an ocean (a) what is the absolute pressure? (b) what is the gauge pressure? (c) Find the force acting on the window of area $20cm \times 20cm$ of a submarine at this depth, the interior of which is maintained at sea-level atmospheric pressure. The density of sea water is $1.03 \times 10^3 kgm^{-3}$, $g = 10ms^{-2}$. Atmospheric pressure = $1.01 \times 10^5 Pa$.

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11. A barometer is kept in an elevator accelerating upwards at $4.9m/s^2$. If the barometer reads 77 cm of Hg, what will be the air pressure in the elevator?

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12. A body weights 5 kg in air. Calculate the apparent weight of the body in water if its density is $2000 kg/m^3$.

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13. A metal cube of mass 10 kg is floating in a liquid with $\frac{3}{4}$ of its volume inside the liquid. Calculate:

(i) buoyant force acting on the cube.

(ii) ratio between density of cube and density of liquid.

Take $g = 10 m/s^2$

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14. A ring of pure gold $\left(p = 19.3 g/cm^3\right)$ is suspected to be hollow from inside. It weighs 40.350 g in air and 35.965 g in

water. Calculate the volume of the hollow portion in gold, if any.

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15. A solid body is floating in water with 5/6th of its volume inside the water. What fraction of its volume will be outside if it ftoats in a liquid of specific gravity 1.6?

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16. 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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17. A merchant claims to sell pure gold coins of relative density 19.3. He sells gold coins of weight 26.075 gf to a customer. In order to check the purity of gold coins, the customer weighs the coins when immersed in pure water and funds that they weigh 24.225 gf in, water. Was the merchant lying?

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18. A tank conatins iodine and water as shown in the adjoining figure. As aluminium cube of side 5cm is the equlibrium as shown. Calculate the fraction of volume of cube inside the

iodine? Take

Relative density of iodine =4.927

Relative density of Aluminium =2.7 

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19. A sample of milk consists of pure milk (density = 1080 kg/m ^{3}) diluted with water $\left(\text{density} = 1000\,\text{kg/m}^3\right)$ and has a density of 1042 kg/m^3. Calculate the percentage of water by volume of milk.

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20. A circular metal plate of radius 4 cm rests on a layer of castor oil 2 mm thick, whose coefficient of viscosity is 16.5

Nsm^{-2}. Calculate the horizontal force required to move the plate with a speed of 3 cm/s.

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21. A square metal plate of 5 cm side is moving parallel to another plate with a velocity of 10 cm/s. Both the plates are immersed in water. If the viscous force is 300 dyne and viscotity of water is 0.01 poise, then calculate the distance between the paltes.

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22. The velocity of water near a river's surface is 20 km/hr. If the depth of the river is 4 m, calculate the shearing stress between

the horizontal layers of water. Take, coefficient of viscosity of water = 0.01 poise.

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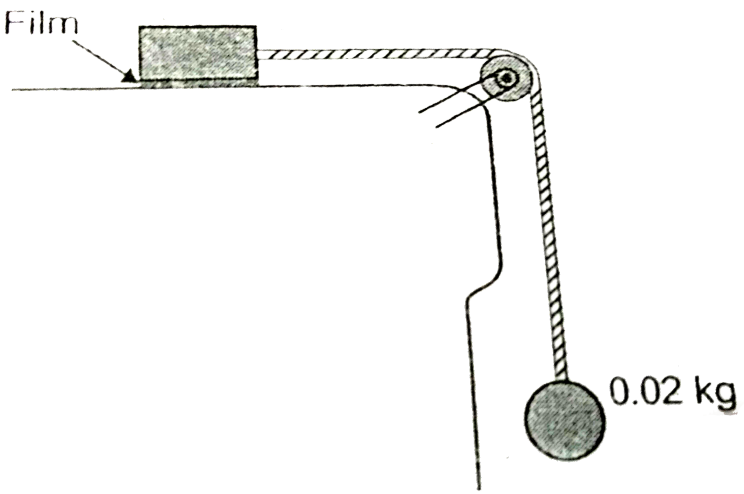
23. A metal block of area 0.10 m^2 is connected to a 0.02 kg mass via a string. The string passes over an ideal pulley (considered massless and frictionless) as shown in figure. A liquid with a flim of thickness 0.15 mm is placed between the plate and the table. When released the plate movees to the right with a constant speed of 0.075 m s^{-1}. What is the

coefficient of viscosity of the liquid?



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24. A liquid flows through a horizontal pipe of varying cross section at a rate of 10 litres per minute. Find the velocity of liquid at a point where radius of pipe is 5 cm.

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25. Water is flowing at a speed of 0.5 m/s through a horizontal pipe of internal diameter 3 cm. Determine the diameter of the nozzle if the water is to emerge at a speed of 3 m/s.

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26. Calculate the speed at which the velocity of stream of water will be equal to 30 cm of mercury column.

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27. A pressure meter when attached with a closed horizontal pipe shows a reading of $5 \times 10^5 \ \mathrm{N/m^2}$. When the valve of the pipe is opened, the reading of the pressure meter falls to

$3.5 \times 10^5 N/m^2$. Determine the speed of the water flowing in the pipe.

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28. A fully loaded Boeing aircraft has a mass of $3.3 \times 10^5 kg$. Its total wing area is $500m^2$. It is in level flight with a speed of $960km/h$.

(a) Estimate the pressure difference between the lower and upper surfaces of the wings

(b) Estimate the fractional increases in the speed of the air on the upper surfaces of the wing relative to the lower surface. The density of air is $1.2kg/m^3$.

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29. 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 $1.04 \mathrm{gcm}^{-3}$ and neglect friction.

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30. Two horizontal pipes of different diameters are connected together and water is allowed to flow through them. The speed of water in the first pipe is 5 m/s and the pressure is $1.5 \times 10^4 N/m^2$? What will be the speed and pressure of water in the second pipe? The diameters of first and second pipes are 2 cm and 4 cm, respectively.

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31. A pitot tube is mounted in a main pipe of diameter 40 cm. If the difference in pressure indicated by the gauge ie 6cm of water column, calculate the volume of air passing through the main pipe in two minutes.

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32. Calculate the velocity with which water emerges from an orifice in a tank if the gauge pressure is 2×10^5 N/m before the flow starts.

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33. A cylindrical drum of radius 20 cm has a capacity of $2.5m^3$ of water. It contains $1.8m^3$ of water and is placed on an iron

block of same size as the drum. Calculate the horizontal range of water on the ground from an orifice made at lower end of drum, perepndicular to its length.

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34. The diameter of a horizontal tube at points A and B are 6 cm and 3 cm, respectively. Two manometer limbs are attached at A and B. When water is allowed to flow through the tube, pressure difference of 10 cm is noted between the limbs. Calculate the rate of flow of water in the tube.

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35. The following observations were made in an experiment with Poiseuille's apparatus:

Diameter of tube = 0.1 cm

Density of liquid=2.4 g/cm^3

Volume of liquid collected per minute $= 10cm^3$

Pressure head of liquid = 25 cm

Length of tube = 20 cm

Using the above data, calculate the viscosity of the liquid.

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36. A capillary tube of length 25 cm and diameter 0.1cm is fitted horizontally to a vessel full of a liquid of coefficient of visocity 0.012 cgs unit. The depth of the capillary tube below the surface of liquid is 15 cm. If the density of liquid is $0.8g/cm^3$, calculate the amount of the liquid that will flow out in 7 minutes. Take $g = 980cm/s^2$

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37. While giving a patient a blood transfusion, a bottle is set up to pass the blood through a needle of length 2 cm and internal diameter 0.35 mm. If the level of blood is 1.4 m above needle, calculate the rate of flow and speed of the blood coming out of the needle. Take, coefficient of viscosity of blood =0.238 poise. Density of blood $= 1020 \ \ \mathrm{kg/m^3}$.

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38. Two tubes P and Q of lengths 100 cm and 30 cm have radii 0.1 mm and 0.2 mm, respectively. A liquid passing through the two tubes is entering P at a pressure of 60 cm of mercury-and leaving Q at a pressure of 55 cm of mercury. What is the pressure at the junction of Pand Q?

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39. Two capillary tubes AB and BC are joined end to end at B, AB is 16cm long and of diameter 4mm whereas BC is 4cm long and of diameter 2mm. The composite tube is held horizontally with A connected to a vessel of water giving a constant head of 3cm and C is open to the air. Calculate the pressure difference between B and C.

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40. A cylindrical vessel has three identical horizontal tubes of length 40 cm, each coming out at heights 0, 5 and 9 cm, respectively. What will be the length of a single overflow tube of the same radius as that of identical tubes which can replace

the three tubes if placed at the bottom of the vessel if the level of liquid in the cylindrical vessel is kept constant at 20 cm.

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41. A rain drop of radius 0.3 mm falls through air with a terminal viscosity of $1ms^{-1}$. The viscosity of air is 18×10^{-5} poise. The viscous force on the rain drop is

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42. A gas bubble of radius 1 cm rises at a constant rate of 3 mm/s through a solution of density 4.16 g/cm^3. Determine the coefficient of viscosity of the solution. Neglect the density of the gas.

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43. An iron ball of radius 0.2 cm and density 7.8 g/cm^3 falls through a tank of oil of density $= 1.5 \times 10^3 \ kg/m^3$ and viscosity 9.92 poise.

What will the terminal velocity of the iron ball in the oil? Also, determine its terminal velocity in water of viscosity $10^{-3} \ Nsm^{-2}$.

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44. 27 rain drops of radius 1 mm each are falling down with a terminal velocity of 4 cm/s. They then coalesce to form a bigger drop. Determine the radius of bigger drop.

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45. A sphere is dropped under gravity through a fluid of viscosity η. Taking the average acceleration as half of the initial acceleration, show that the time to attain the terminal velocity is independent of the fluid density.

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46. The following observations were made in an experiment noith Poiseuille's apparatus: Calculate the average velocity of water in a tube of radius 0.05 cm so that the flow is turbulent. Take, viscosity of water = 0.001 Pa s.

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47. The flow rate of water from a tap of diameter 1.25 cm is $0.48L/min$. The coefficient of viscosity of water is $10^{-3}Pa-s$. After sometime, the flow rate is increased to $3L/min$. Characterise the flow for both the flow rates.

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48. A rectangular frame of length 20 cm is dipped in a soap solution and then raised, forming a soup film on the frame. The pull required is 2.83 g wt more before the film breaks. Calculate the surface tension of the liquid.

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49. A soap bubble is blown from a radius of 1 cm to 2 cm. Calculate the work done in doing so, if the surface tension of the soap solution is 42 dyne/cm.

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50. A drop of liquid of surface tension σ and diameter D breaks up into 8 tiny drops. Calculate the resulting change in energy.

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51. Two soap bubbles of radii 2 cm and 5 cm coalesce under isothermal condition in vaccum, to form a bigger bubble. Find the radius of new bubble.

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52. A glass plate of length 8cm, breadth 3 cm and thickness 0.2cm weighs 15 g in air. What will the apparent weight of the plate if it is half immersed vertically in water its long side held hrizontal? Take, Surface tension of water =70 dyne/cm

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53. n small droplets of water, each of radius r, coalesce ot form a single drop of radius R. Find

(i) Velocity acquired by bigger drop if all the energy released is converted into kinetic energy.

(ii) Rise in temperature.

Take, surface tension of water $= \sigma$

Mechanical equivalent of heat =Q

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54. Calculate the pressure inside a small air bubble of radius 0.2 mm located just below the surface of water. Take,

Surface tension of water $= 7.2 \times 10^{-2} N/m$

Atmospheric pressure $= 1.01 \times 10^{5} N/m^{2}$

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55. If the excess pressure inside a soap bubble of radius 5 mm is balanced by a 1.5 mm column of oil of specific gravity 0.76, find the surface tension of the soap solution.

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56. A glass tube having 2 mm bore is dipped vertically into a vessel containing mercury such that its lower end is 8 cm below the mercury surface. Determine the gauge pressure of air in the tube to blow a hemispherical bubble at its lower end.

Take, density of mercury $= 13.6\mathrm{g/cm}^3$

Surface tension of mercury = 36 dyne/cm

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57. The lower end of a capillary tube of diameter 2.00 mm is dipped 8.00 cm 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 the temperature of the experiments is $7.30 \times 10^{-2}\mathrm{N/m}$. 1 atmospheric pressure $= 1.01 \times 10^5 Pa$

density of water $= 7000\ \mathrm{kg/m^3}, g = 9.80\ \mathrm{ms^{-2}}$. Also calculate the excess pressure.

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58. A capillary tube of radius 0.5 mm is dipped in a vessel containing water. Calculate the height to which water will rise in the capillary tube. Take, surface tension of water $= 7.4 \times 10^{-3}\ \mathrm{N/m}$.

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59. A liquid of specific gravity 0.8 rises up in a capillary tube up to a height of 10 cm, while mercury falls down by 4 cm in the same tube. If the angle of contact between surface of the tube and liquid is zero and it is 135° for mercury, calculate the ratio

of surface tension of mercury and the liquid. Take, specific gravity of mercury $= 13.6 \cos 135^\circ = -0.71$

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60. The radii of two capillary tubes A and B are in the ratio of 3:1. If water rises to a height of 3 cm in tube A, how much it will rise in tube B. If the tube A is inclined at an angle of 30° with the vertical, then what will the position of water in the tube.

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61. A U-tube is made of capillaries of bore 2 mm and 4mm, respectively. The tube is held vertically inverted with the open ends below the surface liquid in a beaker. Calculate the difference in the levels of the meniscus in the two limbs. Take.

Surface tension of liquid =48 dyne/cm density $= 0.8 gcm^{-3}$

Angle of contact between liquid and glass $= 0^{\circ}$

$g = 980 cm / s^2$.

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Practice Problems

1. Calculate the pressure that a man of weight 70 kgf will exert on ground.

(a) When he is standing on feet.

(b) When he is lying on the ground.

The are of foot is $70 cm^2$ and area of his body is $0.5 m^2$.

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2. Calculate the gauge pressure on an object at a depth of 20 m below the surface of a container filled with water.

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3. The total weight of a loaded four wheeler is 10000 kg. All the wheels show an air pressure of 40 kg f/cm^2 each. If all wheels are identical and load is distributed equally on all the four wheels, then find the area of contact of each wheel with the road.

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4. The barometer readings at the ground floor and at the top floor of a building are 80.55 cm and 80.00 cm, respectively. The

air density is 1.36 kg/m^3 and density of mercury is 13600 kg/m^3. Calculate height of the building,

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5. In a hydraulic press, the area of smaller and larger pistons are $5cm^2$ and $20cm^2$, respectively. Calculate the weight which can be raised by larger piston if a force of 100 kgf is applied on smaller piston.

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6. The diameters of neck and bottom of a bottle are 3 cm and 18 cm, respectively. What will be the force exerted on the bottom of a bottle if a force of 0.9 kgf is applied at the neck of the bottle?

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7. In a hydraulic press used for lifting heavy loads, the diameters of smaller and larger pistons are 2 cm and 5 cm, respectively. If the smaller piston is pushed in through 5 cm, then by how much distance will the larger piston move out?

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8. A barometer tube is inclined at an angle of 30° with horizontal direction. Calculate length of mercury column in tube if atmospheric pressure is 76 cm of mercury.

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9. A cylinder of 4 m height is half filled with oil of density 0.72 g cm^{-3}. If the Becond half of cylinder is filled with water, then find the pressure at the bottom of cylinder due to these liquids.

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10. An elevator is accelerating downwards with an acceleration of 4.9 ms^{-2}. A barometer placed in this elevator reads 75 cm of Hg. Calculate the air pressure inside the elevator.

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11. A water column of height 30 cm is supporting a 20 cm column of a liquid of density p. Calculate the value of p.

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12. A heavy ball weighing 5 N displaces 100 ml of water when immersed in water. Calculate the apparent weight of the ball in water.

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13. A body weighs 100 N in air. When immersed in water, its weight decreases by 5 N. Calculate the density of the body.

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14. A body is floating in water with 3/5th of its volume below the water surface. What will be density of the body?

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15. A piece of aluminium of relative density 2.7 floats in mercury. Find the fraction of volume of aluminium piece which remains outside the mercury. The density of mercury is $13.6 \times 10^3 \ \ \mathrm{kg/m^3}$.

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16. Water is flowing through a horizontal pipe at the rate of $\frac{1}{3}$ litre per second. Calculate the velocity of flow at a point where diameter is 3 cm.

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17. Calculate the velocity head of water which is flowing with a velocity of 5 m/s in a horizontal pipe.

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18. A shower head having 20 holes each of 0.1 cm in diameter is connected to a water pipe having an internal diameter of 1.8 cm. The speed of water flowing in the pipe is 108 cms^{-1}. Calculate the speed of water leaving the shower head holes.

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19. Water is flowing through a horizontal pipe whose one end is closed with a valve. Initially the pressure recorded by pressure gauge ia $4 \times 10^5 N/m^2$. On opening the valve, the

pressure gauge records $2 \times 10^5 N/m$. Find the speed of water flowing through the pipe.

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20. Blood is flowing at constant velocity from the heart to the top of head, covering a vertical distance of 60 cm. Calculate the minimum pressure required to force the blood from the heart to the head top. Density of blood is $\left(1.07\ \mathrm{g/cm^3}\right)$

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21. Depth of water in a large container is 1000 cm. Water flows out with a rate of 5 It/s through an orifice near the bottom of the container. Calculate the rate at which water will escape

through the orifice if an additional pressure of 20 kg f/cm^2 is applied at the surface of the water.

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22. Water is flowing through a horizontal tube having non-uniform area of cross section. If pressure difference between two points along a horizontal tube is 1.5 cm of mercury and speed of flow of water at a point of smaller cross section is $3ms^{-1}$, then find the speed of water flow at the other point of larger cross section. Take $g = 10\ \mathrm{m/s^2}$.

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23. Two horizontal pipes of diameter 4 cm and 8 cm are connected together and water is flowing through the first pipe

with a speed of 5 ms^{-1}. Calculate the speed and pressure of water in the second pipe if water pressure in the first pipe is $3 \times 10^4 N/m^2$.

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24. The diameters of open and narrow ends of a pipe connected to a venturi-meter is 20 cm and 15 cm, respectively. If the difference of pressure at the ends is 25 cm of Hg, then calculate the volume of water flowing through the pipe per second.

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25. Two parallel layers of water are moving with a relative velocity of 10 cm/s. What will be the velocity gradient if the

perpendicular distance between the layers is 0.2 cm.

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26. A liquid solution of coefficient of viscosity $2 \times 10^{-3} Nsm^{-2}$ made to drive with velocity of 10^{-4} $\mathrm{m/s}$ along the Xylem vessels of radius 3/4 m and length 7cm. Calculate the pressure difference across the length of Xylem vessel.

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27. A capillary tube of 2 mm diameter and 20 cm long is fitted horizontally to a vessel kept full of alcohol of density $0.8g/cm^3$. The depth of the centre of capillary tube below the

free surface of alcohol is 30 cm. If viscosity of alchole is 0.112 poise, find the amount that will flow in 5 minutes.

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28. A metallic plate having area 0.03 m^2 is lying on a layer $(10^{-2}\ \text{m thick})$ of liquid having coefficient of viscosity as 100 poise. What will be the horizontal force required to move the plate with a speed of 0.03 ms^{-1}?

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29. Water is flowing through two capillary tubes under constant pressure head. The ratio of their lengths is 3:1 and of diameters is 2 : 1. Find the ratio of rate of flow of water through two tubes.

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30. Water is flowing through a horizontal tube of radius 5 cm and length 5 cm at the rate of 30 lt/s. Find the pressure required to maintain the flow of water if coefficient of viscosity of water is 0.002 Pa s.

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31. Calculate the viscous force on a liquid drop of radius 0.3 mm moving with a velocity of $5cms^{-1}$ through a medium of viscosity $2 \times 10^{-5} Nm^{-2} s$.

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32. Twenty-seven drops of radius 2 mm each falling downwards with a terminal velocity of $4ms^{-1}$ coalesce to form a bigger drop. What will be the terminal velocity of the bigger drop?

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33. An air bubble is rising at a constant rate of 3 mm/sec through a liquid of density $2.47 \times 10^3 \ \mathrm{kg/m^3}$. What will be the coefficient of viscosity of liquid if the radius of air bubble is 5 mm?

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34. A rubber ball takes 5 s to fall through a height of 0.5 m inside a large container containing water of specific gravity 1.

Calculate the viscosity of water if mass of the ball is 1.24×10^{-3} kg and diameter is $6.6 \times 10^{-3} m$.

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35. Calculate the average velocity of water in a tube of diameter 0.3 m so that the flow is (i) laminar (ii) turbulent. The viscosity of water is $10^{-3}\ \mathrm{Nm}^{-2} s$.

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36. Find the nature of flow of water flowing at a speed of $8 cm s^{-1}$ through a horizontal tube of radius 2 cm. The viscosity of water at room temperature is 0.01 Poise.

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37. Water is flowing out from a tap of diameter 1.32 cm at a rate of 0.52 lt/min. After some time the flow rate is increased to 2 lt/min. Discuss the nature of flow in two cases if coefficient of viscosity of water is $10^{-3}\mathrm{Pa\,s}$.

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38. Calculate the surface tension of a liquid if $5 \times 10^{-3} Nm^{-1}$ of work is done to increase the surface area of a liquid film from $4cm \times 3 \text{ cm}$ to $8 \text{ cm} \times 5 \text{ cm}$.

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39. A membrane is formed on a square wire frame of 10 cm side when taken out from a liquid of surface tension

$20 \times 10^{-3} Nm^{-1}$. Calculate the force acting on the surface of frame.

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40. What will be the work done in blowing out a soap bubble of radius 0.4 cm? The surface tension of soap solution is 30×10^{-3} N/m.

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41. Calculate the amount of energy released if 27 drops of diameter $10^{-9} m$ each coalesce to form a bigger drop. The surface tension of water is 0.072 N/m.

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42. A needle of length 3 cm is floating on the surface of water. Calculate the minimum force needed to lift the needle above the surface of water. Surface tension of water is 0.072 N/m.

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43. A rectangular frame having dimensions $8\,\mathrm{cm} \times 4\,\mathrm{cm}$ and width of 3 mm is initially placed with its largest face flat on water surface. Calculate the downward force acting on the frame due to surface tension of water $\left(\text{Surface tension of water} = 7.2 \times 10^{-4}\mathrm{Ncm}^{-1}\right)$

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44. In the above problem calculate the downward force on the frame if the fame placed vertically with its longest aide just touching the surface of water.

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45. What will be the surface tension of soap solution if the excess pressure of air in soap bubble of radius 0.4 cm is 10 mm of water column?

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46. A spherical bubble of radius 0.3 mm is formed inside water at a depth of 20 cm. The surface tension of water at this depth is 75 dyne cm^{-1}?. What will be total pressure inside this

bubble if atmospheric pressure is 76 cm of mercury column and density of mercury is $13.6 g/cm^3$.

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47. Calculate the difference in excess pressure inside a spherical rain drop if its radius changes from 0.05 cm to 0.0005 cm by evaporation. Surface tension of water is 72 dyne cm^{-1}.

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48. Calculate the diameter of a capillary tube if angle of contact of mercury is 140° and mercury is depressed by 10.2 mm in the tube. Surface tension of mercury is $5400 \times 10^{-4} \text{ N/m}$.

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49. Calculate the ratio of surface tension of mercury and water if in a capillary tube, mercury is depressed by 3.45 cm and water rises by 9.8 cm in the same tube. The angle of contact for mercury is 140° and that for water is 0°.

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50. In a capillary tube C, water rises to a height of 10 cm. How much will the water rise in another tube C' whose radius is one fourth of radius of tube C? If C is inclined at an angle of 60° with vertical then what is the position of water in the tube?

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51. A U-tube made up of two capillaries is held vertically and partially filled with a liquid of surface tension 50 dyne/crn. The diameters of bore of capillaries are 2 mm and 3 mm, respectively. What will be density of liquid if difference in menuscus levels is 1.30 cm. The angle of contact for that liquid ie zero degree.

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52. Calculate the radius of a bubble which is formed when two goap bubbles having radii 4 cm and 5cm coalesce under isothermal conditions.

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Conceptual Questions

1. The bags and suitcases are proveded with broad handles. Why?

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2. Give reasons for the following statements:

(a) Railway tracks are laid on large sized wooden sleepers.

(b) It is difficult to walk on and.

(c) Walking bare footed on a pebbled path is painful.

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3. Give reason for the following statements:

(a) A liquid inside a dropper comes out only when its rubber

bulb is pressed hard.

(b) Two holes are made to empty an oil tin.

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4. Explain why an air bubble in water rises frim bottom to top and grows in size.

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5. A liquid cannot withstand a shear stress. How does it explain the fact the surface of a liquid at rent must be leveled?

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6. A piece of ice is floating in a jar containg water. When the ice melets,then the level of water,

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7. We have three beakers A , B and C containing glycerine, water and kerosene respectively. They are stirred vigorously and placed on a table. The liquid which comes to rest at the earliest is

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8. Give reason for the following:

(a) Machine parts get jammed in the winters.

(b) A constant driving force is always required for the

maintenance of the flow of oil through pipe lines in the refineries.

(c) Velocity of water in a river is less near the banks and more in the middle.

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9. Explain the reason behind:

(a) Use of parachutes while jumping from an aircraft during emergency.

(b) Floating of clouds in the sky.

(c) Settling of dust particles in a closed room.

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10. It is advised not to stand near a running train. Why?

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11. A student tries to remove a filter paper from a funnel by blowing air into its narrow end. Will he succeed? Give reason in support of your answer.

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12. Does Archimede's principle hold in a vessel in free fall?

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13. What will happen if the water is replaced by another liquid whose dennity is greater than water?

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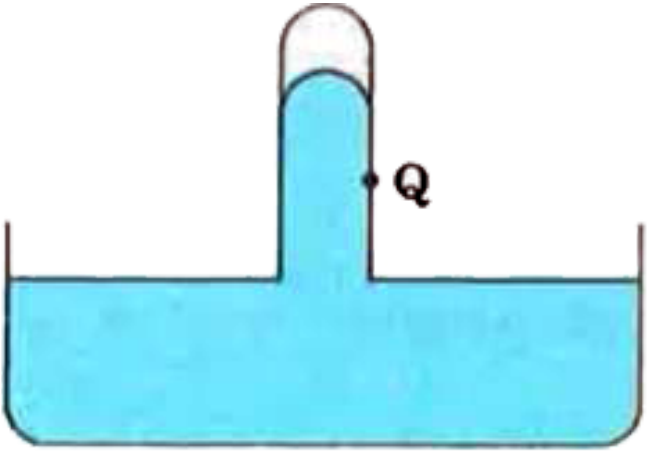
14. A boy is carrying a fish in one hand and a bucket full of water in the other hand. He hen places the fish in the bucket thinking that is accordance with Archimedes' principle he is now carrying less weight as the weight of the fish will reduce due to upthrust. Is he right ?

Watch Video Solution

15. It is often observed that a sinking ship turns over as it becomes immersed in the water. Explain the reason behind this observation.

Watch Video Solution

16. Consider a barometer tube filled with mercury as shown in the adjoining figure.



If a hole is made at a point Q as shown in the figure, will mercury come out from this hole? Given reasons

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17. Is Archimedes' principle valid in a lift which is

(a) accelerating upwards

(b) accelerating downwards

(c) under free fall

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18. When a pipe, through which water is flowing out, is partially closed with a finger, the water stream coming out falls to a greater distance from the pipe. Why?

Watch Video Solution

19. A ball is held submerged just below the water surface in a vessel. It is then taken to a deeper point inside water. Will the force needed to hold the ball now as compared to when it was just below the surface greater, less or equal?

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20. A water pipe is pointed straight up and water flows out from it with constant volume flow rate, reaching a certain maximum height. In order to make the water reach double the height, which of the following adjustments to the nozzle of the pipe will be required?

(a) Decrease the area by a factor of 2

(b) Decrease the area by a factor of $\sqrt{2}$

(c) Decrease the area by a factor of 4.

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21. To a block of wood, a metal sphere is attached with the help of a string and the whole arrangement is dropped in a water container as shown in the figure.

If the wooden block floats in water, then which of the following statements is true?

(a) Upthrust on the wooden block is equal to its weight.

(b) Upthrut on the metal sphere is equal to its weight.

(c) Tension in the string is equal to its weight. of metal sphere.

(d) Tension in the string is less than the weight of metal sphere.

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22. Two solid spheres of same size, of one iron and other of copper, are suspended by strings and submaerged in a beaker containing a certain liquid (the density of liquid is less than that of both iron and copper). If the density of copper is greater than that of iron, which of the following statements

are true?

(a) The upthrust on copper sphere is greater than that on the iron sphere.

Upthrust is equal on both spheres.

(c) Tension in the string supporting copper sphere is greater than that in the string supporting iron sphere.

(d) Tension in both the strings is equal.

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23. A small piece of iron is tied to a wooden block and the compound block so formed is immersed into a container filled with water, with iron piece above the wooden block. What will happen to the volume of wood submerged inside the water

(a) the block is now inverted with iron piece below the wooden block?

(b) if the whole arrangement is sealed and pressurised above atmospheric pressure.

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24. A block of ice with a large pebblle frozen inside it is floating on water contained in a beaker. Will the level of water increase or decrease when the ice around the pebble melts completely?

Watch Video Solution

25. An ice cube containing a piece of lead floats in water What would be the effect on the level of water if the ice cube melts ?

Watch Video Solution

26. A wooden block is floating on water at $1^{\circ}C$ with volume v above the water level. If the temperature of water starts increasing slowly, how will the volume of block above the water level is affected?

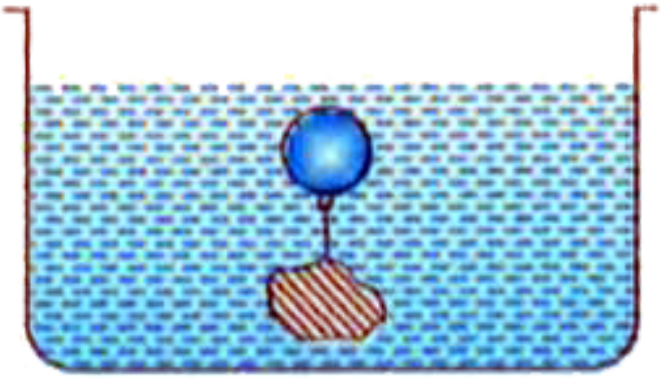
Watch Video Solution

27. While sewing, a person often wets the end of a thread before, trying to put it through the eye of the needle. Why?

Watch Video Solution

28. A balloon is filled with air and a stone is tied to it by thread. It is then put inside a vessel containing water, where it barely floats as shown in the adjoining figure. If it is pushed more

towards the bottom by a small distance, it sinks. Explain.



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29. A rubber ball floats on the surface of water contained in a beaker, exposed to atmosphere certain volume immersed inside the water. If the whole arrangement is shifted to the ball remain immersed at the same depth?

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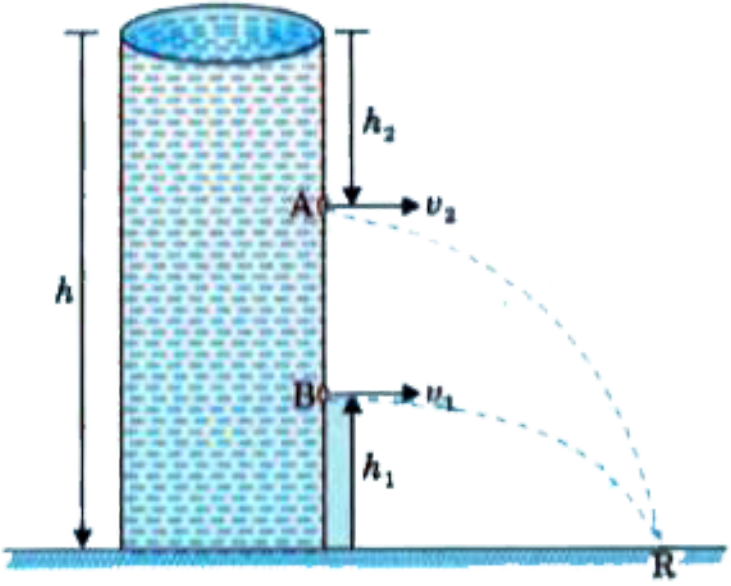
Problems

1. On the wall of a cylindrical water tank, two holes are made as shown in figure. Water coming out from these holes hits the ground at the same point. What will be the ration $\frac{h_1}{h_2}$?



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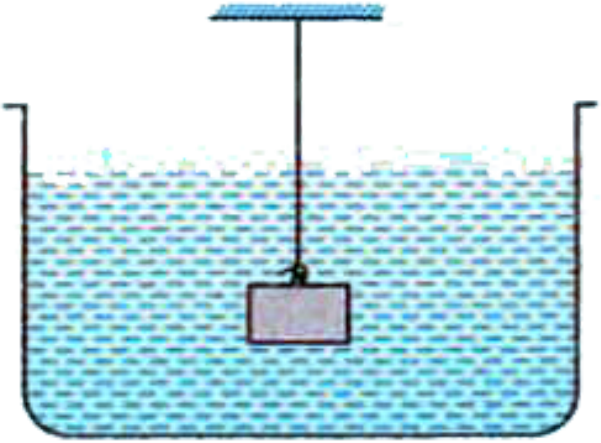
2. From a massless string, a metallic cube of edge 3 cm is suspended and them immersed in water as shown in figure. If the density of metal is $5 \times 10^3 kg/m^3$ then find the tension in the string if the given system is

(a) at rest

(b) moving downwards with an acceleration of $3m/s^2$.

(C) moving upwards with an acceleration of $3m/s^2$.



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3. A cylindrical tank of cross sectional area a_1 is filled with water to a height h. A hole of cross sectional area a_2 is made at the bottom. If $a_1 = 5a_2$, then find the

(i) initial velocity with which the water falls in tank.

(ii) initial velocity with which water emerges out from hole.

(iii) time taken to make the tank empty.

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4. A spring elongates by 2 cm when a piece of cobalt of mass 20g is suspended from it. A water conatiner is placed below the pieces in such a way that the piece is immersed completely in water. Calculate the elongation produced in the spring.

Density of cobalt $= 8700\text{kg/m}^3, Useg = 10\frac{m}{s^2}$.

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5. A cubical block of wood of specific gravity 0.5 and chunk of concrete of specific gravity 2.5 are fastened together. the ratio of mass of wood to the mass of concrete which makes the combination to float with entire volume of the combination submerged in water is

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6. One third height of a cubical block of edge 6cm is floating in kerosene oil of specific gravity 0.8. To make the block to be just immersed some water is poured. What is the height of the water column?

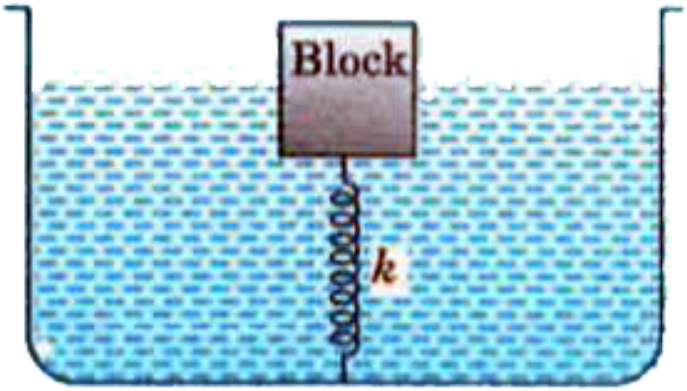
Watch Video Solution

7. A horizontal tube of 1m is closed at both ends. A mercury column of 20 cm is contained in the middle of the tube and two equal lengths of this tube contain air at an atmospheric pressure of 76cm. The tube is now placed vertically. Calculate the distance through which the mercury column will be displaced at a constant temperature.

View Text Solution

8. A spring is attached to a wooden cubical block of edge 5cm and placed in a water conatiner as shown in figure. Calculate the maximum weight to be placed on the block so that it is just immersed in water completely. Density of wood $= 700\text{kg}/\text{m}^3$, spring constant of spring $= 70N/m, g = 10m/s^2$. Assume

that initially spring is in its normal length.



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9. A large container contains a liquid of density p, mass m, and placed on a smooth horizontal floor. The mass of container is negligible and cross sectional area is A. Now at the bottom of the container, there is small hole of cross section area A/200 in the side wall through which the liquid starts flowing horizontally at t=0. What will be the velocity of efflux when half

of the liquid is drained out. Also, find the acceleration of the liquid flowing out.

View Text Solution

Ncert Textbook Exercises

1. Explain why (a) the blood pressure is humans is greater at the feet than at the brain.

(b) Atmospheric pressure at a height of about 6 km decreases to nearly half its value at the sea level through the 'height' of the atmospheric is more than 100 km.

(c) Hydrostatic pressure is a scalar quantity even though pressure is force divided by area , and force is a vector.

Watch Video Solution

2. Explain why

(a). The angle of contact of mercury with galss is obtuse, while that of water with glass is acute.

(b). Water on a clean glass surface tends to spread out while mercury on the same surface tends to form drops. (Put differently, water wets glass while mercury does not).

(c). Surface tension of a liquid is independent of the area of the surface

(d). Water with detergent disolved in it should have small angles of contact.

(e). A drop of liquid under no external forces is always spherical in shape.

3. Find in the blanks using the word (s) from the test appended with each statement.

(a) Surface tension of liquid generally .....with temperatures (increase//decreases).

(b) Viscosity of gases ..... With temperature, whereas viscosity of liquids .....with temperature. (increases//decreases)/

(c) For solids with elastic modulus of rigidity, the shearing force is proportional to .....while for fluids it is proportional to ....(shear strain//rate of shear strain).

(d) For a fluid in a steady flow, from .....(conservation of mass// Bernoulli's principle)

(e) For the model of a plane in a wind tunnel, turbulence oc curs at a ..... speed for turbulence for an actual plane (greater//smaller)/

Watch Video Solution

4. Explain why

(a). To keep a piece of paper horizontal, you should blow over, not under, it

(b). When w try to close a water tap with our fingers, fast jets of water gush through the openings between our fingers

(c). The size of the needle of a syringe controls flow rate better than the thumb pressure exerted by a doctor while administering an injection

(d). A fluid flowing out of a small hole in a vessel results in a backward thrust on the vessel

(e). A spinning cricket ball in air does not follow a parabolic trajectory.

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5. A 50 kg. girl wearing high heel shoes balance on a single heel. The heel is circular with a diameter 1 cm. what is the pressure exerted by the heel on the horizontal floor?

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6. Torricelli's barometer used mercury. Pascal duplicated it using French wine of density $984 kgm^{-3}$. Determine the height of the wine column for normal atmospheric pressure.

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7. 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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8. A hydraulic automobile lift is designed to lift cars with a maximum mass of $3000Kg$. The area of cross section of the piston carrying the load is $425cm^2$. What maximum pressures would the smaller piston have to bear?

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9. 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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10. in previous question, if 15 cm of water and spirit each are further poured into the respective arms of the tube. Difference in the level of mercury in the two arms is (Take, relvative density of mercury = 13.6)

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11. Can Bernoulli's equation be used to describe the flow of water through a rapid in a river? Explain.

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12. Does it matter if one uses gauge instead of absolute pressures in applying Bernoulli's equation. Explain.

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13. Glycerine flows steadily through a horizontal tube of length 1.5m and radius 1.0 cm. if the amount of glycerine collected per second at one end is $4.0 \times 10^{-3} kgs^{-1}$, what is the pressuer difference between the two ends of the tube? (density of glycerine = $1.3 \times 10^{3} kgm^{-3}$ and viscosity of glycerine = $0.83 Nsm^{-2}$).

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14. In a test experiment on a model aeroplane in a wind tunnel, the flow speeds on the upper and lower surfaces of the wing are $70ms^{-1}$ and $83ms^{-1}$ respectively. What is the lift on the wing, if its area is $2.5m^2$? Take the density of air to be $1.3kgm^{-3}$

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15. The steady flow of (non-viscous) liquid. Which of the two figure is incorrect?why?

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16. The cylinderical tube of a spray pump has a cross-section of $8.0cm^2$ one end of which has 40 fine holes each of diameter

1.0mm. If the liquid flow inside the tube is 1.5 m per minute, what is the speed of ejection of the liquid through the holes?

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17. 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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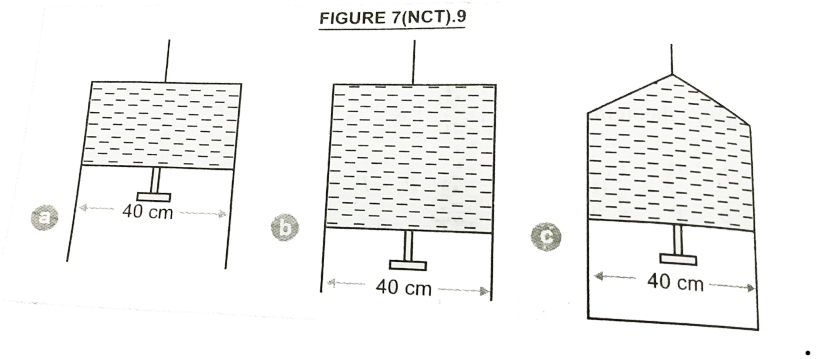
18. Fig, shown a thin film supporting a small weight = $4.5 \times 10^{-2} N$. What is the weight supported by a film of the same liquid at the same temperature in fig. explain your

answer physically.



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19. 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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20. 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 $1.01 \times 10^{5} Pa$).

Watch Video Solution

Ncert Additional Exercises

1. 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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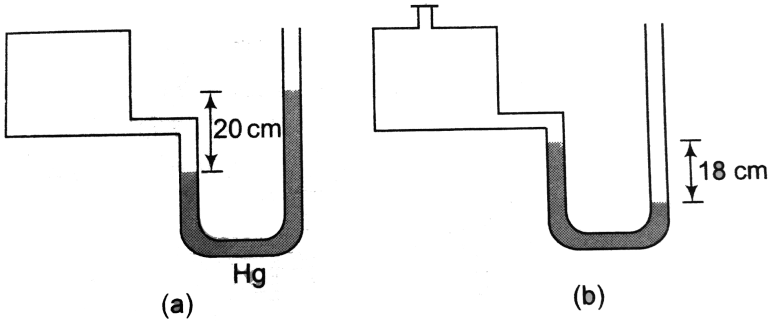
2. A manometer reads the pressure of a gas in a enclosure as shown in figure(a) When some of the gas is removed by a pump, the manometer reads as in (b). The liquid used in the manometers is mercury and the atmospheric pressure is $76cm$ of mercury.



(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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3. Two vessels have the same base area but diffrenent shapes. The first vessel takes twice the vloume of water that the second vessel requires to fill up to a paricular common height . Is the force exerted by water on the base of the vessel the same in the two case? If so, why do the vessels filled with water to that same height give different reading on a weighting scale ?

Watch Video Solution

4. During blood transfusion the needle is inserted in a veinn where the gauge pressure is 2000 Pa. At what height must the blood container be placed so that blood may just enter the vein? [density of hole blood $= 1.06 \times 10^3 kgm^{-3}$]

(a). 0.192

(b). 0.182

(c). 0.172

(d). 0.162

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5. In deriving Bernoulli's equation , we equated the workdone on the fluid in the tube to its change in the potential and kinetic energy (a) How does the pressure change as the fluid moves along the tube if dissipative forces are present ? (b) Do

the dissipative forces becomes more important as the fluid velocity increase? Discuss qualitatively.

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6. (a) What is the largest average velocity of blood flow in an artery of radius $2 \times 10^{-3} m$ if the flow must remian laminar? (b) What is the corresponding flow rate? Take viscosity of blood to be $2.084 \times 10^{-3} Pa - s$. Density of blood is $1.06 \times 10^{3} kg / m^{3}$.

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7. A plane is in level flight at constant speed and each of its wings has an area of $25 m^{2}$. If the speed of the air is $180 km / h$

over the upper wing surface, determine the plane's mass . (Take air density to be $1kg/m^3$). $g = 9.8m/s^2$.

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8. In Millikan's oil drop experiment, what is the terminal speed of a speed of a drop of radius $2.0 \times 10^5 m$ and density $1.2 \times 10^3 m^{-3}$? Take the viscosity of air at the temperature of the experimental to be $1.8 \times 10^{-5} Nsm^2$. How much is the viscous force on the drop at that speed? Neglect buoyancy of the drop due to air.

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9. Mercury has an angle of contact equal to 140° with soda lime galss. A narrow tube of radius $1.00mm$ 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 $0.465Nm^{-1}$. Density of mercury = $13.6 \times 10^3 kgm^{-3}$.

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10. 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 $1.0 \times 10^3 kg/m^3$.

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

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11. (a). It is known that density ρ of air decreases with height y as

$\rho = \rho_0 e^{-y/y(-o)}$ ltb rgt where $p_o = 1.25 kgm^{-3}$ is the density at sea level, and y_o is a constant. This density variation is called the law of atmospheres. Obtain this law assuming that the temperature of atmosphere remains a constant (isothermal conditions). Also assume that the value of g remains constant

(b). A large He balloon of volume $1425 m^3$ is used to lift a payload of 400 kg. Assume that the balloon maintains constant radius as it rises. How high does it rise?

[take $y_o = 8000 m$ and $\rho_{He} = 0.18 kgm^{-3}$]

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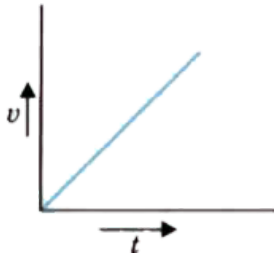
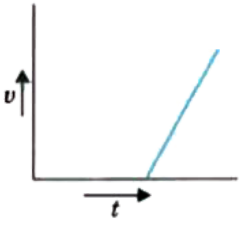
Ncert File Exemplar Problems Objective Questions

1. A tall cylinder is filled with viscous oil. A round pebble is dropped from the top with zero initial velocity. From the plot shown in figure, indicate the one that represents the velocity (v) of the pebble as a function of time (t)

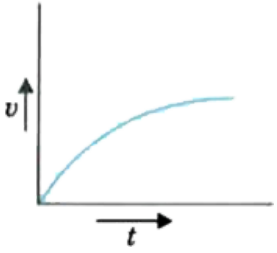
A.

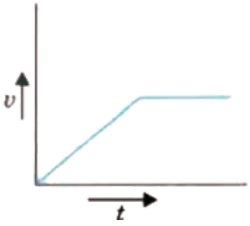


B.



C.



D. 

Answer: C

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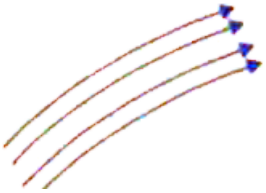
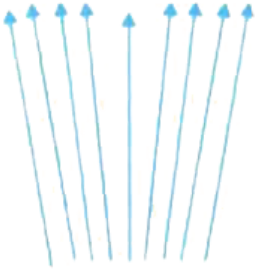
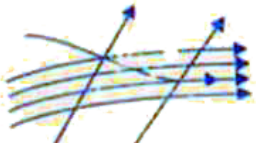
2. Which of the following diagrams does not represent a streamline flow?

A. 

B. 

C. 

D. 

Answer: A::C::D

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3. Along a streamline,

A. the velocity of a fluid particle remains constant.

B. the velocity of all fluid particles crossing a given position is constant.

C. the velocity of all fluid particle at a given instant is constant.

D. the speed of a fluid particle remains constant.

Answer: B::D

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4. An ideal fluid flows through a pipe of circular cross section made of two section with diamters 2.5 cm and 9.76 cm. The ratio of the velocities in the two pipes is

A. $9:4$

B. $3:2$

C. $\sqrt{3}:\sqrt{2}$

D. $\sqrt{2}:\sqrt{3}$

Answer: A

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5. The angle of contact at the interface of water glass is 0° ethylalcohol-glass is 0° mercury glass is 140° and methyliodide-glass is 30° A glass capillary is put in a through containing one of these four liquids. It is observed that the meniscus is convex. The liquid in the through is

A. water

B. ethyl alcohol

C. mercury

D. methyl iodide

Answer: C

Watch Video Solution

Ncert File Mcq

1. For a surface molecule,

A. the net force on it is zero

B. there is a net downward force

C. the potential energy is less than that of a molecule inside

D. the potential energy is more than that of a molecule inside.

Answer: B::D

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2. Pressure is a scalar quantity, because

A. it is the ratio of force to area and both force and area are vectors

B. it is the ratio of the magnitude of the force to area

C. it is the ratio of the component of the force normal to the area

D. it does not depend on the size of the area chosen.

Answer: C::D

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3. A wooden block with a coin placed on its top floats in water as shown in figure. 

The distance l and h are shown in the figure. After some time the coin falls into the water. Then

A. l decreases

B. h decreases

C. l increases

D. h increases

Answer: A::B

Watch Video Solution

4. With increase in temperature the viscosity of

A. gases decreases

B. liquids increases

C. gases increasses

D. liquids decreases

Answer: A::B::C::D

Watch Video Solution

5. Streamline flow is more likely for liquid with

A. high density

B. high viscosity

C. low density

D. low viscosity

Answer: B::C

Watch Video Solution

Ncert Exemplar Problems Subjective Questions

1. Is viscosity a vector ?

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2. Is surface tension a vector ?

Watch Video Solution

3. Iceberg floats in water with part of it submerged. What is the fraction of the volume of iceberg submerged if the density of ice is $\rho_i = 0.917 gcm^{-3}$?

Watch Video Solution

4. A vessel filled with water is kept on a weighing pan and the scale adjusted of zero. A block of mass M and density ρ is suspended by a masselss spring of spring constant k. This block is submerged inside into the water in the vessel. What is the reading of the scale /

Watch Video Solution

5. A cubical block of density ρ is floating on the surface of water. Out of its height L, fraction x is submerged in water. The vessel is in an elevator accelerating upward with acceleration a. What is the fraction immersed ?

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Ncert Short Answer Type Questions

1. The sap in trees, which consists mainly of water in summer, rises in a system of capillaries of radius $r = 2.5 \times 10^{-5} m$. The surface tension of sap is $T = 7.28 \times 10^{-2} Nm^{-1}$ and the angle of contact is 0°. Does surface tension alone ac count for the supply of water to the top of all trees ?

Watch Video Solution

2. The free surface of oil in a tanker, at rest, is horizontal if the tanker starts ac celerating the free surface will be titled by an angle θ. If the ac celeration is a ms^{-2} what will be the slope of the free surface ?

Watch Video Solution

3. Two mercury droplets of radii 0.1 cm and 0.2 cm collapse into one single drop. What amount of energy is released? The surface tension of mercury $T = 435.5 \times 10^{-3} Nm^{-1}$

Watch Video Solution

4. If a drop of liquid breaks into smaller droplets, it result in lowering of temperature of the droplets. Let a drop of radius R, breaks into N small droplets each of radius r. Estimate the drop in temperature.

Watch Video Solution

5. The surface tension and vapour pressure of water at $20^\circ C$ is $7.28 \times 10^{-2} Nm^{-1}$ and $2.33 \times 10^3 Pa$, respectively. What is the radius of the smallest spherical water droplet which can form without evaporating at $20^\circ C$?

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Hots Higher Order Thinking Skills Advanced Level

1. A lawn sprinkler has 20 holes, each of cross-sectional area $2.0 \times 10^{-2} cm^2$, and is connected to a hose pipe of cross sectional area $2.4 cm^2$. If the speed of water in the hose pipe is $1.5 ms^{-1}$, the speed of water as it emerges from the holes is

Watch Video Solution

2. A tank is filled with water to a height h. A hole is made at the bottom of the tank through which water can flow out. Calculate the ratio of time taken to make the level of water from h to $\frac{h}{4}$ and then $\frac{h}{4}$ to 0.

Watch Video Solution

3. F and are the forces exerted by the liquid on the curved surface and at the bottom of a cylindrical vessel (radius r) respectively. To which height should the vessel be filled to make F and f equal?

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4. While sewing, a person often wets the end of a thread before, trying to put it through the eye of the needle. Why?

Watch Video Solution

5. A boat carrying a large number of stones is floating in a water tank. What will happen to water level if the stone are unloaded into water?

Watch Video Solution

6. A cylindrical vessel of radius 3 cm has at the bottom a horizontal capillary tube of length 20 cm and internal radius 0.4 mm. If the vessel is filled with water, find the time taken by it to empty one half of its contents. Given that the viscosity of water is 0.01 poise.

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7. There is a conical pipe of radii of its two ends as 0.2m and 0.02m with 20 N/m^2 as the pressure difference along its length. A liquid of density $1.00 \times 10^3 \mathrm{kg/m}^3$ is flowing through the pipe. Calculate the rate of flow of liquid through the pipe.

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8. Two holes are made at a depth of h and 5 h from the water surface in a water container kept on a horizontal surface as shownn in figure. For which value of r, equalt amount of water will come out of the two holes? Here, l is the length of side of the square hole and r is the radius of circular hole.

Watch Video Solution

9. Two air bubbles are formed in water (surface tension 0.72 N/m). The bubbles come together to form a bigger bubble. What will be radius and sense of curvature of common surface of that bubble? The radii of bubbles are 0.003 m and 0.005 m.

Watch Video Solution

10. A body is released from rest on the surface of water filled to a height of 2 m in a big cylinder. Assuming there is no viscous force, calculate of the time taken by the body to reach the bottom of cylinder. The relative density of body is 6.

Watch Video Solution

11. Two capillary tubes of radii r and 4r and lengths l, 3l are fitted horizontally to the bottom of the vessel with pressure head p in parallel with each other. Calculate the radius of the single tube of same length l which can replace the two capillaries such that rate of flow is not affected.

View Text Solution

12. Water is filled to a height in a long container. From what height below the free surface a hole should be bored in the wall of a container so that the horizontal range is maximum?

Watch Video Solution

13. On removing a hemispherical part from the bottom of a cylinder, the mass and volume of cylinder become M and v. The remaining cylinder is suspended by a string in a liquid of density σ as show in figure. Calulate the force exerted by the liquid at the bottom of cylinder. 

View Text Solution

14. A ball is falling from a height of 15 cm into water. To which depth the ball sinks if density of ball is $0.6 \times 10^3 \ \ \mathrm{kg/m^3}$?

Watch Video Solution

15. Water rises to a height of 0.3 m in a capillary tube while doing an experiment on surface of earth. To which height will the water rise in the tube if the same experiment is done in an artificial satellite revolving around the earth?

Watch Video Solution

Revision Exercise Very Short Answer Questions

1. What is a fluid?

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2. Pressure is a scalar quantity, because

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3. What is 1 torr?

Watch Video Solution

4. Write the relation between bar and Pascal.

View Text Solution

5. Why is the dam of water reservoir thick at the bottom?

Watch Video Solution

6. What do you mean by buoyancy?

Watch Video Solution

7. What is buoyancy and centre of buoyancy?

Watch Video Solution

8. If water be used to construct a barometer, what would be the height of water column at a standard atmospheric presure (76cm of mercury)?

Watch Video Solution

9. State Archimedes' principle.

Watch Video Solution

10. A body will weigh maximum in which case? Water or in vacuum

Watch Video Solution

11. Hydraulic press is based upon

Watch Video Solution

12. State the law of floatation.

Watch Video Solution

Watch Video Solution

13. What is an adhesive force?

Watch Video Solution

14. What is a cohesive force?

Watch Video Solution

15. Do cohesive and adhesive forces obey inverse square law?

Watch Video Solution

16. How cohesive forces.change with decrease in distance between molecules?

Watch Video Solution

17. What is molecular range?

Watch Video Solution

18. The radius of sphere of influence is

Watch Video Solution

19. What is surface film?

Watch Video Solution

Watch Video Solution

20. Define Surface tension. Write its formula. What is its S.I unit?

Watch Video Solution

21. Dimensions of surface tension are

Watch Video Solution

22. What do you mean by surface energy?

Watch Video Solution

23. Is surface tension a vector ?

Watch Video Solution

24. What do you mean by Gauge pressure at a depth h inside the liquid?

Watch Video Solution

25. The excess pressure inside a soap bubble is

Watch Video Solution

26. The excess pressure inside a soap bubble is

Watch Video Solution

Watch Video Solution

27. Define angle of contact.

Watch Video Solution

28. What will be the effect on the angle of contact of a liquid if the temperature increases?

Watch Video Solution

29. What will happen to the angle of contact on adding soluble impurity to a liquid?

Watch Video Solution

30. What is a capillary tube?

Watch Video Solution

31. What do you mean by capillarity or capillary action ?

Watch Video Solution

32. What is the shape of a liquid meniscus in a capillary tube dipped in water?

Watch Video Solution

33. What is the shape of a liquid meniscus in a capillary tube dipped in mercury?

Watch Video Solution

34. Why a liquid rises more in a capillary with narrow bore than same with wider bore?

Watch Video Solution

35. The surface tension of a liquid ___ with rise of temperature.

Watch Video Solution

36. Oil spreads over the surface of water whereas water does not spread over the surface of the oil, due to

Watch Video Solution

37. When wax is rubbed on cloth becomes water proof, why?

Watch Video Solution

38. Why the tip of the nib of a pen is split?

Watch Video Solution

39. Define Viscosity. What are its units and dimensions?

Watch Video Solution

40. What do you mean by coefficient of viscosity?

Watch Video Solution

41. The dimensional formula of coefficient of viscosity is

Watch Video Solution

42. Define 1 Pa-s.

Watch Video Solution

43. State Stoke's law.

Watch Video Solution

44. What do you mean by terminal velocity?

Watch Video Solution

45. How terminal velocity depends on the radius of the falling body?

Watch Video Solution

46. Discuss the effect of temperature on the viscosity of liquids and gases.

Watch Video Solution

47. Discuss the effect of temperature on the viscosity of liquids and gases.

Watch Video Solution

48. What is a streamline?

Watch Video Solution

49. What is meant by critical velocity of a liquid?

Watch Video Solution

50. What is a Reynold's number? What is its unit?

Watch Video Solution

51. What is the nature of flow of a liquid if the Reynold's number for that liquid is 2500?

Watch Video Solution

Watch Video Solution

52. What are the porperties of a liquid satisfying the Bernoulli's theorem?

Watch Video Solution

53. What will happen to the flow of a liquid if it passes through a region of high pressure?

Watch Video Solution

54. What is pressure head and velocity head?

Watch Video Solution

Revision Exercise Additional Questions

1. The diameter of ball A is half of that of B. The ratio of their terminal velocities will be

A. $2:4$

B. $4:1$

C. $1:4$

D. $2:4$

Answer: C

Watch Video Solution

2. With increase of temperature

A. The viscosity of liquids decreases.

B. The viscosity of gases increases.

C. Surface tension of liquids decreases.

D. All of above.

Answer: D

Watch Video Solution

3. Which of the following statements is incorrect?

A. Surface tension of liquids decreases with increase of temperature.

B. Viscosity of gases increases with increase of temperature.

C. Viscosity of liquids increases with increase of temperature.

D. With increase of pressure the velocity of liquid flow decreases.

Answer: C

Watch Video Solution

Revision Exercise Fill In The Blanks

1. .....is the property by virtue of which the free surface of the liquid at rest behaves like a stretched elastic membrane tending to contract to occupy minimum surface area.

Watch Video Solution

2. The force that acts on a body by virtue of its motion through a lift is known as.....

Watch Video Solution

3. Bernoulli's equation is applicable only to..... fluids.

Watch Video Solution

4. A device used for measuring the rate of flow of liquid through pipes is called.....

Watch Video Solution

5. The maximum constant velocity acquired by the body while falling freely in a viscous medium is called.

Watch Video Solution

6. The dimensional formula of coefficient of viscosity is

Watch Video Solution

7. The difference in lateral pressure, causes a spinning ball to take a curved path which is convex towards the greater pressure side, this effect is called.....

Watch Video Solution

8. .....is the phenomena of rise or fall of a liquid in a capillary tube.

Watch Video Solution

9. For a fluid in a steady flow, the increase in flow speed at a constrictin follows _____.

Watch Video Solution

10. A drop of liquid under no external forces is always .....in shape.

Watch Video Solution

Revision Exercise Short Answer Questions

1. Show that liquid in equilibrium of rest exerts normal force on the surface in contact with it.

Watch Video Solution

2. State Pascal's law and verify it with the help of an experiment.

Watch Video Solution

3. Explain the working of hydraulic press by giving an example.

Watch Video Solution

4. Explain hydraulic lift and hydraulic brakes.

Watch Video Solution

5. Show that the pressure exerted by a liquid increases with depth

Watch Video Solution

6. ABSOLUTE PRESSURE AND GAUGE PRESSURE

Watch Video Solution

7. Why mercury is used in barometer instead of water ?

Watch Video Solution

8. Why it is painful to walk barefooted on the floor covered with edge pebbles?

Watch Video Solution

9. Pins and nails are made to have ponted end because

Watch Video Solution

10. ARCHIMEDES PRINCIPLE

Watch Video Solution

11. State the conditions for stable equilibrium for fleating bodies.

Watch Video Solution

12. For a freely falling body

Watch Video Solution

13. Why is it easier to swim in sea water than in river water?

Watch Video Solution

14. What is the cause of viscosity? What are the factors on which the viscosity of a liquid depends?

Watch Video Solution

15. State Poiseuille's formula. Derive it with the help of dimensional analysis.

Watch Video Solution

16. State and prove Stoke's law with the help of dimensional analysis.

Watch Video Solution

17. TERMINAL VELOCITY

Watch Video Solution

18. Distinguish between streamline and turbulent flows.

Watch Video Solution

19. Can two streamlines intersect each other, in a flowing liquid?

Watch Video Solution

20. What do you mean by the surface tension of a liquid?

Watch Video Solution

21. Explain surface energy. Establish its relation with surface tension.

Watch Video Solution

22. Discuss the effect of presence of impurities and the temperature on the surface tengion of a liquid.

Watch Video Solution

23. How dirty clothes can be cleaned using a detergent in hot water?

Watch Video Solution

24. What is Reynold's number ? Give its significance.

Watch Video Solution

25. The equation of continuity leads to

Watch Video Solution

26. Angle of contact depends on

Watch Video Solution

27. State and explain Torricelli's theorem.

Watch Video Solution

28. What do you mean by blood pressure and heart attack? Explain.

Watch Video Solution

Watch Video Solution

Revision Exercise Long Answer Questions

1. Explain hydraulic lift and hydraulic brakes.

Watch Video Solution

2. The surface tension of a liquid is affected by

Watch Video Solution

3. Derive an expression for the excess pressure (i) inside a liquid drop (ii) inside a soap bubble.

Watch Video Solution

4. What do you mean by capillarity? Give some daily life examples of capillarity. Also derive an expression for rise of liquid in a capillary tube.

Watch Video Solution

5. Expalin streamline flow, laminar flow and turbulent flow.

Watch Video Solution

6. State and prove Bernoulli's theorem.

Watch Video Solution

7. What is venturi-meter? Derive an expression for the rate of flow of a liquid using this device.

Watch Video Solution

Revision Exercise Numerical Problems

1. What is the pressure on a scuba diver at a depth of 30 m?

Watch Video Solution

2. A cylinder has a radius 20 cm. To what height should it be filled with water so that thrust in its walls is equal to that on its bottom? Find the mass of water filled in cylinder.

Watch Video Solution

3. In a hydraulic press, the area of smaller piston is 5 cm^2. The weight raised by larger piston is 900 kgf if a force of 150 kgf is applied on smaller piston. Calculate the area of larger piston.

Watch Video Solution

4. The diameters of smaller and larger pistons in a hydraulic press are 3 cm and 15 cm respectively. To move out the larger piston by 0.4 cm calculate the distance through which the smaller piston should be pushed in.

Watch Video Solution

5. One third of a cylinder of 3 m height is filled with oil of density 0.62 g cm^{-3}. and the rest of it is filled with mercury of density 13.6 g cm^{-3}. Calculate the total pressure at the bottom of cylinder due to both oil and mercury.

Watch Video Solution

6. The arms of a vertical U tube of uniform inner cross section contains mercury. In one of the arms of the tube, water column of length 8 cm is introduced. In the other arm, oil of density 0.75 g/cm^3 is poured till the upper surfaces of water and oil are at same horizontal level. Calculate the length of oilcolumn.

Watch Video Solution

7. The weight of a body in air is 50 N. When the same body is weighed in water its weight decreases by 5N. Calculate the density of the given body.

Watch Video Solution

8. A solid cube of sides 2 cm each is suspended by a thread and completely immersed in a liquid of density $0.85 \times 10^3 \ \ \mathrm{kg/m^3}$. What will be the tension in the thread if relative density of solid is 5?

Watch Video Solution

9. A Square metal plate of side 10 cm is moving parallel to another plate with a velocity of $10cm/s$ and both plates are

immersed in water. If the viscosity of water is 0.01 poise and the distance between the plates is 0.05 cm then calculate the viscous force.

Watch Video Solution

10. Alcohol flows through two capillary tubes under a constant pressure head the diameters of the two tubes are in the ratio of $4:1$ and the lengths are in the ratio $4:1$ Compare the rates of flow of alcohols through the two tubes .

Watch Video Solution

11. 1000 drops of radius 1 mm each falling downwards with a terminal velocity of 5 cms^{-1} coalesce to form a bigger drop. What will be the terminal velocity of the bigger drop?

Watch Video Solution

12. Calculate the terminal velocity of a water drop of radius 0.002 mm falling in air. Density of air $= 1.3 \ \mathrm{kg/m^3}$. Density of water $= 10^3 \mathrm{kg/m^3}$. Coefficient of viscosity of air is 1.7×10^{-5} decapoise.

Watch Video Solution

13. Water is flowing down from a water tap of diameter 1.12 cm at the rate of 2 L/min. Discuss the type of flow - laminar or turbulent. The coefficient of viscosity of water is 10^{-3} Pas.

View Text Solution

14. For the laminar flow of water of viscosity 0.0012 Nsm^{-2} through a tube of diameter 0.8 cm, calculate the critical velocity of water.

Watch Video Solution

15. The rate of flow of water through a horizontal pipe of changing cross section is 100 litres per hour. Calculate the velocity of water flow at a point where diameter of the tube is 4 cm?

Watch Video Solution

16. What will be the total energy possessed by 1 kg of water at a point where pressure is $30\ \mathrm{gf/mm^2}$, velocity is 0.5 m/s^{-1}

and height is 70 cm above the ground level?

Watch Video Solution

17. The pressure difference between two points along a horizontal tube through which water is flowing is 2.5 cm of mercury. Calculate the speed of water at a point of smaller cross section if the speed at a point of larger cross section is $2.61\ ms^{-1}$.

Watch Video Solution

18. Calculate the discharge in litres per minute of a venturi-meter if it is of 86 cm diameter in main part and of 10 cm diameter in neck part. Specific gravity of Hg=13.6 and difference of pressure of water between mains and neck is 20 cm of Hg.

Watch Video Solution

19. What will be the work done in blowing a soap bubble from a radius of 3 cm to a radius of 5 cm? The surface tension of soap solution is 40 dyne cm^{-1}.

Watch Video Solution

20. A liquid drop of diameter 6 mm breaks into 27 droplets of same size. What will be the change in surface energy if surface tension of liquid drop is $0.06 Nm^{-1}$?

Watch Video Solution

21. 1000 ergs of work is done in blowing a soap bubble to a radius x cm. Calculate the additional work required to blow it to a radius of 2 x cm.

Watch Video Solution

22. A needle of length 5 cm is floating on the surface of water. Calculate the minimum force needed to lift the needle above the aurface of water. Surface tension of water is 0.073 N/m.

Watch Video Solution

23. A rectangular frame having dimensions of $5cm \times 3cm \times 3mm$ is placed vertical in such a way that its longest side just touches the water surface. What will be the

downward force acting on the frame? Surface tension of water is 0.72 Nm^{-1}.

View Text Solution

24. The excess pressure inside a soap bubble is balanced by 4 mm column of water of specific gravity 1. What will be the surface tension of soap solution if the diameter of soap bubble is 6 mm?

Watch Video Solution

25. The ratio of radii of two soap bubbles is 4 : 9. Find the ratio of

(i) excess pressure inside these bubbles

(ii) work done to blow these bubbles.

View Text Solution

26. A capillary tube of radius 0.03 mm is held vertically in a liquid of density $0.85 \times 10^3 \ \mathrm{kg/m^3}$ and surface tension $4 \times 10^{-2} \ \mathrm{N/m}$. The angle of contact of liquid -glass is given by $\cos\theta = 0.5$ then rise of liquid in the capillary tube is.?

Watch Video Solution

27. A capillary tube is dipped in water. Calculate the weight of water raised in capillary above the normal level due to capillary action. Surface tension of water is 72 dyne cm . The radius of capillary tube is 0.3 mm.

View Text Solution

28. The diameter of the mercury barometer tube is recorded as 6 mm. How much error is introduced due to surface tension in this reading. Surface tension of mercury is 540×10^{-3} $\mathrm{N/m}$ Angle of contact for mercury is 140°.

Watch Video Solution

Competition File A Mcq Objectie Type Questions

1. A water container has water upto a height of 20 cm, volume 2 litres. Top of container has area 60 cm^2 and bottom has area of 20 cm^2. The downward force exerted by water at the bottom will be.

A. 200 N

B. 100 N

C. 222 N

D. 122 N

Answer: C

Watch Video Solution

2. Bulk modulus of water is $22 \times 10^9 N/m^2$. If the average depth of an ocean is 2600 m, then fractional $\left(\frac{\triangle V}{V}\right)$ compression in volume of water at the bottom of ocean will be:

A. 0.0113

B. 0.0226

C. 0.0056

D. 0.03

Answer: A

Watch Video Solution

3. A solid piece weighs 200 g in air, 150 g in water and 100 g in a liquid. The relative density of the liquid will be

A. 2

B. 3

C. 4

D. 5

Answer: A

Watch Video Solution

4. Oil of density 0.5 g/cm^3 is contained over mercury of density 13.6 g/cm^3 in a vessel. A homogeneous body is floating with its half of volume immersed inside mercury and half inside oil. The density of homogeneous material will be

A. $6g/cm^3$

B. $7.05g/cm^3$

C. 8.05 g/cc

D. 10 g/cc

Answer: B

Watch Video Solution

5. A bird is sitting on the floor of a wire cage and the cage is in the hand of a boy . The bird starts flying in the cage . Will the

boy experience any change in the weight of the cage ?

A. less

B. more

C. no change in weight

D. heavier in beginning and becomes lighter later.

Answer: A

Watch Video Solution

6. A bubble of volume V is formed, when W Joules of work is done on a given solution. The work done to form a bubble of volume 3V will be

A. $(2)^{\frac{2}{3}}W$

B. $(3)^{\frac{2}{3}}W$

C. 1

D. $(4)^{\frac{2}{3}}W$

Answer: B

View Text Solution

7. The pressure inside two soap bubbles are 1.05 atm and 1.07 atmosphere. The volume of two bubbles are in the ratio of

A. $2:7$

B. $3:7$

C. $1:7$

D. $4:7$

Answer: A

Watch Video Solution

8. A particle is placed at the origin and a force F=Kx is acting on it (where k is a positive constant). If $U_{(0)} = 0$, the graph of $U(x)$ verses x will be (where U is the potential energy function.)

A. 

B. 

C. 

D. 

Answer: D

Watch Video Solution

9. A soap bubble has a radius of 6cm. The work done in increasing the radius from 6 cm to 10 on will be (in mJ). (Surface tension of soap solution is 0.04 Nm.)

A. 2.04π

B. 1.02π

C. 4.05π

D. 6.05π

Answer: A

Watch Video Solution

10. Two bodies of masses M and 27 M are allowed to fall on a viscous liquid simultaneously. The respective terminal velocities of bodies are V and kV. The value of k is

A. 5

B. 7

C. 8

D. 9

Answer: D

Watch Video Solution

11. Water rises to a height h in a capillary tube of radius r. The mass of water in the capillary tube is 10 g. The mass of water

rising in another capillary tube of radius 4r will be

A. 30g

B. 40g

C. 20g

D. 10g

Answer: B

Watch Video Solution

12. A wooden cube supporting a mass of 100 g just floats in water. On removing the mass from the cube, the cube rises by 4 cm. The side of the cube is

A. 5 cm

B. 8 cm

C. 7 cm

D. 9 cm

Answer: A

Watch Video Solution

13. A spherical ball of density σ is freely falling in a viscous liquid of density $p(p < \sigma)$. The initial acceleration of the ball will be

A. $\left(\frac{p-\sigma}{p}\right)g$

B. $\left(\frac{\sigma-p}{\sigma}\right)g$

C. $\left(\frac{p-\sigma}{\sigma}\right)g$

D. $\left(\frac{p+\sigma}{\sigma}\right)g$

Answer: B

Watch Video Solution

14. When equal volumes of three liquids of densities p_1, p_2, p_3 are mixed then the resultant density of the mixture will be:

A. $\frac{p_1+p_2+p_3}{3}$

B. $\frac{p_1+p_2+p_3}{6}$

C. $\frac{p_1^2+p_2^2+p_3^2}{6}$

D. $p_1+p_2+p_3$

Answer: A

Watch Video Solution

15. A piece of wood floats in water kept in a breaker. IF the beaker moves with a vertical acceleration a, the wood will

A. will sink in liquid if beaker moves downward

B. will sink in liquid if beaker moves upward

C. remain in same position relative to water as before

D. rises more above the liquid if beaker moves downward

Answer: C

Watch Video Solution

16. If X represents force, Y represents area and Z represents time. The quantities having same dimensions as coefficient of

viscosity in are

A. $\frac{XY}{Z}$

B. $\frac{XZ}{Y}$

C. $\frac{YZ}{X}$

D. $\frac{X}{YZ}$

Answer: B

Watch Video Solution

17. If water in one flask and castor oil in other area violently shaken and kept on a table, which will come to rest earlier

A. Water will come to rest earlier

B. Castor oil will come to rest earlier

C. Both will come to rest simultaneously

D. Anyone of them can come to rest earlier

Answer: B

Watch Video Solution

18. A boat floating in a lake sinks by 2 cm when a man of mass m gets into it. What will be the mass of man if length and breadth of the boat are 1 m and 2 m?

A. 40 kg

B. 60 kg

C. 30 kg

D. 100 kg

Answer: A

Watch Video Solution

19. At a depth of 5 m below the free surface of a liquid, an air bubble of radius 2 mm is formed. The pressure inside the bubble will be (The surface tension of water is 20×10^{-8} N/m.)

A. $2 \times 10^5 N/m^2$

B. $1.5 \times 10^5 N/m^2$

C. $3 \times 10^5 N/m^2$

D. $5 \times 10^5 N/m^2$

Answer: B

View Text Solution

20. The graph between the height of liquid in a capillary tube against the radius of the tube for a liquid , then the graph is

A. 

B. 

C. 

D. 

Answer: C

Watch Video Solution

Competition File B Mcq Aipmt Neet Other State Boards For Medical Entrance

1. Two small spherical metal balls, having equal masses, are made from materials of densities ρ_1 and $\rho_2(\rho_1 = 8\rho_2)$ and have radii 1 mm and 2mm respectively, they are made to fall vertically (from rest) in a viscous medium whose coefficient of viscosity equal η and whose density is 0.1 ρ_2. The ratio of their terminal velocities would be

A. $\frac{79}{36}$

B. $\frac{79}{72}$

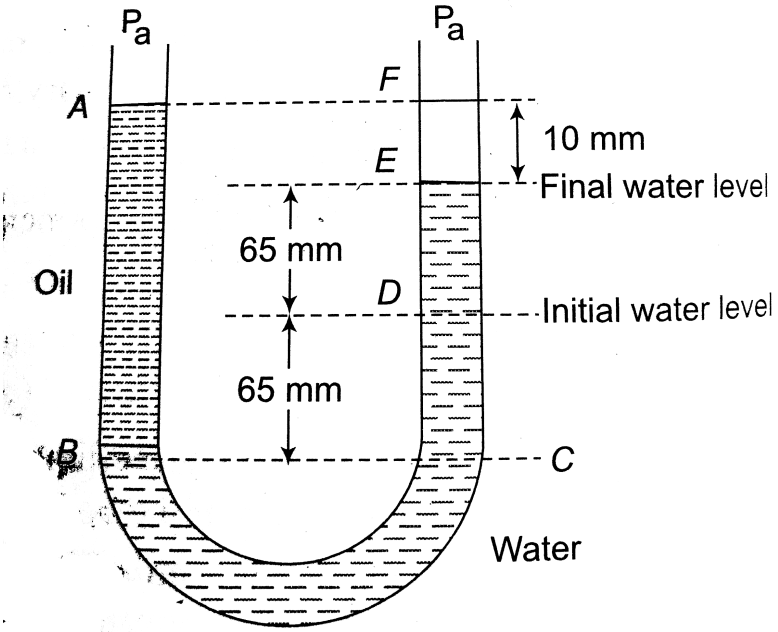
C. $\frac{19}{36}$

D. $\frac{39}{72}$

Answer: A

Watch Video Solution

2. A U-tube with both ends open to the atmosphere is partially filled with water. Oil, which is immiscible with water. Is poured into one side until it stands at a distance of $10mm$ above the water level on the other side. Meanwhile the water rises by $65mm$ from its original level (see diagram). The density of the oil is:



A. $650kgm^{-3}$

B. $425kgm^{-3}$

C. $800kgm^{-3}$

D. $928kgm^{-3}$

Answer: D

Watch Video Solution

3. A small sphere falls from rest in a viscous liquid. Due to frication, heat is produced. Find the relation between the rate of production of heat and the radius of the sphere at terminal velocity.

A. r^5

B. r^2

C. r^3

D. r^4

Answer: A

Watch Video Solution

4. A certain number of spherical drops of a liquid of radius r coalesce to form a single drop of radius R and volume V. If T is the surface tension of the liquid, then

A. Energy $= 4VT\left(\frac{1}{r} - \frac{1}{R}\right)$ is released

B. Energy $= 3VT\left(\frac{1}{r} + \frac{1}{R}\right)$ is absorbed

C. Energy $= 3VT\left(\frac{1}{r} - \frac{1}{R}\right)$ is released

D. Energy is neither released nor absorbed.

Answer: C

Watch Video Solution

5. A vessel contains water up to a height of 20 cm and above it an oil up to another 20 cm. The refractive indices of the water and the oil are 1.33 and F30 respectively. Find the apparent depth of the vessel when viewed from above.

A. $1333 kg / m^3$

B. $1200 kg / m^3$

C. $750 kg / m^3$

D. $1000 kg / m^3$

Answer: C

Watch Video Solution

6. Two non-mixing liquids of densities ρ and $(n > 1)$ are put in a container. The height of each liquid is h. A solid cylinder of length L and density d is put in this container. The cylinder floats with its axis vertical and length $pL(p < 1)$ in the denser liquid. The density d is equal to :

A. $\{2 + (n - 1)]\}p$

B. $\{1 + (n - 1)p]p$

C. $\{1 + (n + 1)p\}p$

D. $\{2 + (n + 1)p]p$

Answer: B

Watch Video Solution

Competition File Jee Main Other State Boards For Engineering Entrance

1. A ball is made of a material of density ρ where $\rho_{oil} < \rho < \rho_{water}$ with ρ_{oil} and ρ_{water} representing the densities of oil and water, respectively. The oil and water are immiscible. If the above ball is in equilibrium in a mixture of this oil and water, which of the following pictures represents its equilibrium position?

A. 

B. 

C. 

D. 

Answer: C

Watch Video Solution

2. The potential energy function for the force between two atoms in a diatomic molecule is approximate given by $U(r) = \frac{a}{r^{12}} - \frac{b}{r^6}$, where a and b are constants and r is the distance between the atoms. If the dissociation energy of the molecule is $D = [U(r = \infty) - U_{\text{at equilibrium}}]$, D is

A. $\frac{b^2}{6a}$

B. $\frac{b^2}{2a}$

C. $\frac{b^2}{12a}$

D. $\frac{b^2}{4a}$

Answer: D

Watch Video Solution

3. The top of a water tank is open to air and its water lavel is maintained. It is giving out $0.74m^3$ water per minute through a circular opening of 2 cm radius in its wall. The depth of the centre of the opening from the level of water in the tank is close to :

A. 2.9m

B. 9.6m

C. 4.8m

D. 6.0m

Answer: C

Watch Video Solution

4. A small soap bubble of radius 4 cm is trapped inside another bubble of radius 6 cm without any contact. Let P_2 be the pressure inside the inner bubble and P_0, the pressure outside the outer bubble. Radius of another bubble with pressure difference $P_2 - P_0$ between its inside and outside would be :

A. 2.4m

B. 12cm

C. 4.8cm

D. 6cm

Answer: A

Watch Video Solution

5. if a ball of steel (density $\rho = 7.8g/cm^3$) attains a terminal velocity of $10cm/s$ when falling in a tank of water (coefficient of viscosity, $\eta_{water} = 8.5 \times 10^{-4}$Ps s), then its terminal velocity in glycerine $\left(\rho = 1.2g/cm^2, \eta = 13.2Pas\right)$ would be nearly

A. $6.25 \times 10^{-4} cms^{-1}$

B. $6.45 \times 10^{-4} cms^{-1}$

C. $1.5 \times 10^{-5} cms^{-1}$

D. $1.6 \times 10^{-3} cms^{-1}$

Answer: A

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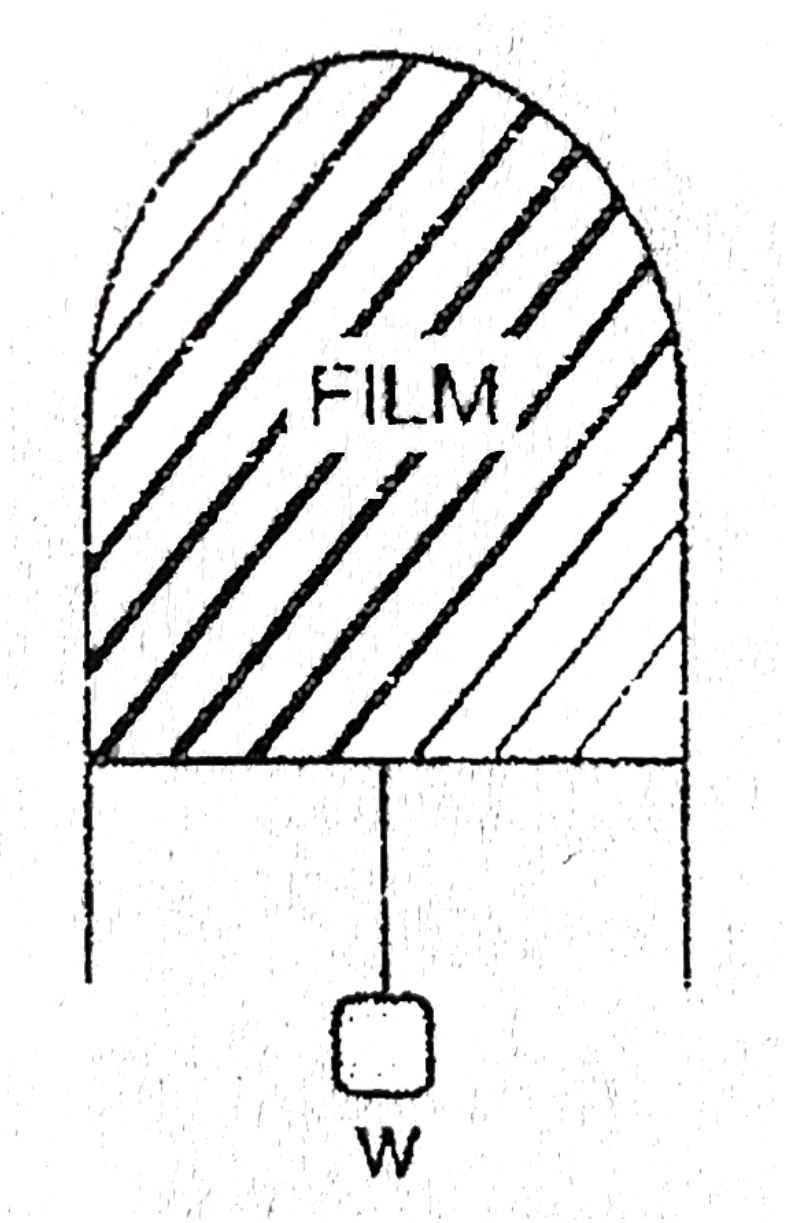
6. A thin liquid film formed between a $U-$ shaped wire and a light slider supports a weight of $1.5 \times 10^{-2} N$(see figure). The length of the slider is $30 cm$ and its weight negligible. The

surfaces tension of the liquid film is :



A. $0.025 Nm^{-1}$

B. $0.0125Nm^{-1}$

C. $0.1Nm^{-1}$

D. $0.05Nm^{-1}$

Answer: A

Watch Video Solution

7. Assume that a drop of liquid evaporates by decreases in its surface energy, so that its temperature remains unchanged. What should be the minimum radius of the drop for this to be possible? The surface tension is T, density of liquid is ρ and L is its latent heat of vaporization.

A. $\sqrt{T/pL}$

B. T/pL

C. $2T/pL$

D. $p\frac{L}{T}$

Answer: C

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8. A uniform cylinder of length L and mass M having cross-sectional area A is suspended, with its length vertical, from a fixed point by a massless spring such that it is half submerged in a liquid of density σ at equilibrium position. The extension x_0 of the spring when it is in equlibrium is:

A. $\frac{Mg}{k}\left(1-\frac{LA\sigma}{M}\right)$

B. $\frac{Mg}{k}\left(1-\frac{LA\sigma}{2M}\right)$

C. $\frac{Mg}{k}\left(1+\frac{LA\sigma}{M}\right)$

D. $\frac{Mg}{k}$

Answer: B

Watch Video Solution

9. A thin uniform tube is bent into a circle of radius r in the vertical plane. Equal volumes of two immiscible liquids, whose densities are ρ_1 and $\rho_2(\rho_1 > \rho_2)$ fill half the circle. The angle θ between the radius vector passing though the common interface and the vertical is :

A. $\theta = \tan^{-1}\left(\frac{p_1 + p_2}{p_1 - p_2}\right.$

B. $\theta = \tan^{-1}\left(\frac{p_1 - p_2}{p_1} + p_2\right)$

C. $\theta = \tan^{-1}\left(\frac{p_2}{p_1}\right)$

D. $\theta = \tan^{-1}\left(\frac{p_1}{p_2}\right)$

Answer: B

Watch Video Solution

10. An open glass tube is immersed in mercury in such a way that a length of 8 cm extends above the mercury level. The open end of the tube is then closed and sealed and the tube is raised vertically up by additional 46 cm. what will be length of the air column above mercury in the above now ?

(Atmospheric pressure = 76 cm of Hg)

A. 38 cm

B. 6 cm

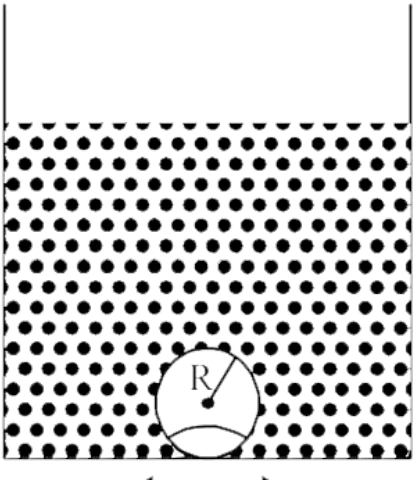
C. 16 cm

D. 22 cm

Answer: C

Watch Video Solution

11. On heating water, bubbles being formed at the bottom of the vessel detach and rise. Take the bubbles to be spheres of radius R and making a circular contact of radius r with the bottom of the vessel. If $r << R$ and the surface tension of water is T, value of r just before bubbles detach is: (density of water is ρ_w)



A. $R^2\sqrt{\frac{p_w g}{T}}$

B. $R^2\sqrt{\frac{3p_w g}{T}}$

C. $R^2\sqrt{\frac{p_w g}{3T}}$

D. $R^2\frac{\sqrt{p_w g}}{6T}$

Answer:

Watch Video Solution

12. Water rises upto a height x in capillary tube immersed vertically in water . When this whole arrangement is taken to a depth d in a mine , the water level rises upto a height y . If R is the radius of the earth , then the ration $\frac{x}{y}$ is given by

A. $\left(1-\frac{d}{R}\right)$

B. $\left(1-\frac{2d}{R}\right)$

C. $\left(\frac{R-d}{R+d}\right)$

D. $\left(\frac{R+d}{R-d}\right)$

Answer: A

Watch Video Solution

13. A tank with a small hole at the bottom has been filled with water and kerosene (specific gravity 0.8). The height of water is 3 m and that of kerosene 2 m. When the hole is opened the velocity of fluid coming out from it is nearly: $\left(\text{take g} = 10\ \text{ms}^{-2}\ \text{and density of water} = 10^3\ \text{kg m}^{-3}\right)$

A. $10.7ms^{-1}$

B. $9.6ms^{-1}$

C. $8.5ms^{-1}$

D. $7.6ms^{-1}$

Answer: B

View Text Solution

14. An air bubble of radius 0.1 cm is in a liquid having surface tension 0.06 N/m and density $10^3\ \text{kgm}^{-3}$. The pressure inside the bubble is 1100 Nm greater than the atmospheric pressure. At what depth is the bubble below the surface of the liquid? $(g = 9.8ms^{-2})$

A. 0.1m

B. 0.15m

C. 0.20m

D. 0.25m

Answer: A

Watch Video Solution

15. A cylindrical vessel of cross section A contains water to a height h. There is a hole in the bottom of radius 'a'. The time in which it will be emptied is:

A. $\frac{2A}{\pi a^2}\sqrt{\frac{h}{g}}$

B. $\frac{\sqrt{2}A}{\pi a^2}\sqrt{\frac{h}{g}}$

C. $\frac{2\sqrt{2}A}{\pi a^2}\sqrt{\frac{h}{g}}$

D. $\frac{A}{\sqrt{2}\pi a^2}\sqrt{\frac{h}{g}}$

Answer: B

Watch Video Solution

16. 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

A. 4PV+3ST=0

B. 3PV+4ST=0

C. 2PV+3ST=0

D. 3PV+2ST=0

Answer: B

Watch Video Solution

17. The velocity of water in a rier is $18kmh^{-1}$ near the surface. If the river is 5 m deepm, find the shearing stress between the horizontal lyers of water. The coefficient of viscosity of water `=10^-2 poise.

A. $10^{-1}N/m^2$

B. $10^{-2}N/m^2$

C. $10^{-3}N/m^2$

D. $10^{-4}N/m^2$

Answer: B

Watch Video Solution

18. In the diagram shown, the difference in the two tubes of the manometer is 5 cm, the cross section of the tube at A and B is $6mm^2$ and 10^2 respectively. The rate at which water flows through the tube is $(g = 10ms^{-2})$. 

A. 7.5 cc/s

B. 8.0 cc/s

C. 10.0 cc/s

D. 12.5 cc/s

Answer: A

View Text Solution

19. A large number of liquid drops each of radius 'a' coalesce to form a single spherical drop of radish b. The energy released in the process is converted into kinetic energy of the big drops formed. The speed of big drop will be

A. $\sqrt{\frac{T}{p}\left(\frac{1}{r}-\frac{1}{R}\right)}$

B. $\sqrt{\frac{2T}{p}\left(\frac{1}{r}-\frac{1}{R}\right)}$

C. $\sqrt{\frac{4T}{p}\left(\frac{1}{r}-\frac{1}{R}\right)}$

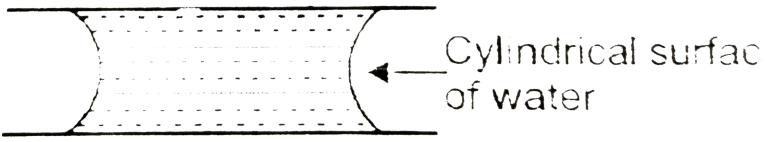
D. $\sqrt{\frac{6T}{p}\left(\frac{1}{r}-\frac{1}{R}\right)}$

Answer: D

Watch Video Solution

20. If two glass plates have water between them and are separated by very small distance (see figure). It is very difficult to pull them apart. It is because the water in between forms cylindrical surface on the side that gives rise ot lower pressure in the water in comparison to atmosphere. If the radius of the cylindrical surface is R and surface tension of water is T then the pressure in water between the plates is lowr by:

is lower by :



A. $\frac{2T}{R}$

B. $\frac{4T}{R}$

C. $\frac{T}{4R}$

D. $\frac{T}{R}$

Answer: A

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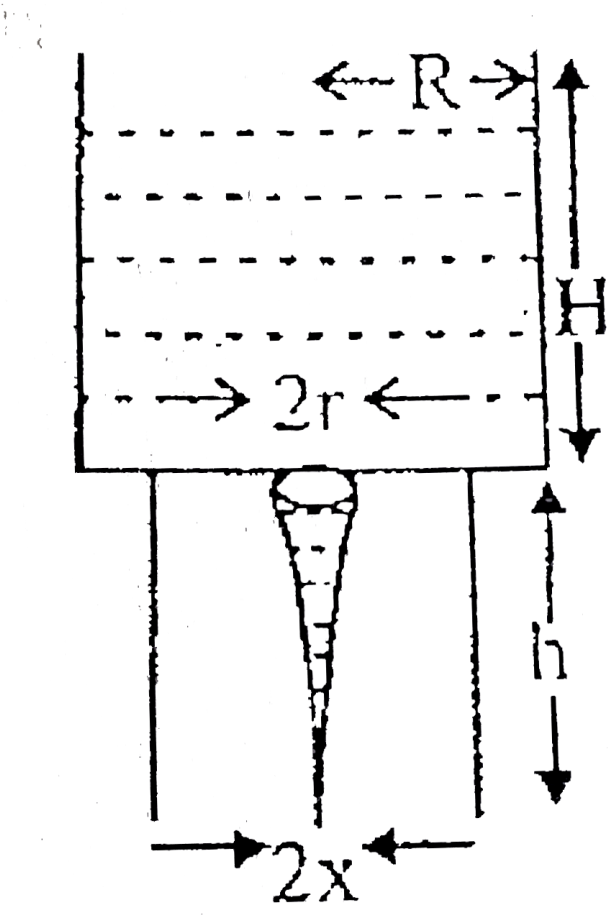

21.

Consider a water jar of radius R that has water filled up to

height H and is kept on a stand of height h (see figure) through a hole of radius $r(r << R)$ at its bottom the water leaks out and the stream of water coming down towards the ground has a shape like a funnel as shown in the figure. it the radius of the cross-section of water stream when it hits the ground is x. then.

A. $x = r\left(\frac{H}{H+h}\right)$

B. $x = r\left(\frac{H}{H+h}\right)^{\frac{1}{2}}$

C. $x = r\left(\frac{H}{H+h}\right)^{\frac{1}{4}}$

D. $x = r\left(\frac{H}{H+h}\right)^{2}$

Answer: C

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22. A wooden block floating in a bucket of water has 4/5 of its volume submerged. When certain amount of an oil is poured into the bucket, it is found that the block is just under the oil surface with half of its volume under water and half in oil. The density of oil relative to that of water is:

A. 0.8

B. 0.6

C. 0.7

D. 0.5

Answer: B

Watch Video Solution

23. The ratio of surface tensions of mercury and water is given to be 7.5 while the ratio of their densities is 13.6. Their contact angles, with glass, are close to 135° and 0°, respectively. It is observed that mercury gets depressed by an amount h in a capillary tube of radius r_1 while water rises the same amount h in a capillary tube of radius r_2. The ratio, (r_1/r_2), is then close to

A. $4/5$

B. $2/5$

C. $3/5$

D. $2/3$

Answer: B

Watch Video Solution

1. When liquid medicine of density ρ is to put in the eye, it is done with the help of a dropper. As the bulp on the top of the dropper is pressed, a drop forms at the opening of the dropper. We wish to estimate the size of the drop. We first assume that the drop formed at the opening is spherical because that requires a minimum increase in its surface energy. To determine the size, we calculate the net vertical force due to the surface tension T when the radius of the drop is R. When this force becomes smaller than the weight of the drop, the drop gets detached from the dropper.

If the radius of the opening of the dropper is r, the vertical force due to the surface tension on the drop of radius R (assuming r ltltR) is

A. $2\pi rT$

B. $2\pi RT$

C. $\frac{2\pi r^2 T}{R}$

D. $\frac{2\pi R^3 T}{r}$

Answer: C

Watch Video Solution

2. When liquid medicine of density ρ is to be put in the eye, it is done with the help of a dropper. As the bylb on the top of the dropper is pressed. A drop frons at the opening of the dropper. We wish to estimate the size of the drop.

We first assume that the drop formed at the opening is spherical because that requires a minimum increase in its surface energy, To determine the size. We calculate the net vertical force due to the surface tension T when the radius of

the drop is R. when this force become smaller than the weight of the drop the drop gets detached from the dropper.

If

$r = 5 \times 10^{-4} m, \rho = 10^3 kgm^{-3}, g = 10ms^{-2}, T = 0.11Nm^{-1},$

The radius of the drop when it detaches from the dropper is approximately,

A. $1.4 \times 10^{-3} m$

B. $3.3 \times 10^{-3} m$

C. $2.0 \times 10^{-3} m$

D. $4.1 \times 10^{-3} m$

Answer: A

Watch Video Solution

3. When liquid medicine of density ρ is to be put in the eye, it is done with the help of a dropper. As the bylb on the top of the dropper is pressed. A drop frons at the opening of the dropper. We wish to estimate the size of the drop.

We first assume that the drop formed at the opening is spherical because that requires a minimum increase in its surface energy, To determine the size. We calculate the net vertical force due to the surface tension T=0.11 when the radius of the drop is R=1.4mm. when this force become smaller than the weight of the drop the drop gets detached from the dropper.

After the drop detaches, its surface energy is

A. $1.4 \times 10^{-6} J$

B. $3.3 \times 10^{-6} J$

C. $5.4 \times 10^{-6} J$

D. $8.1 \times 10^{-6} J$

Answer: B

Watch Video Solution

4. Water is filled in a container upto height 3m. A small hole of area 'a' is punched in the wall of the container at a height 52.5 cm from the bottom. The cross sectional area of the container is A. If $a/A = 0.1$ then v^2 is (where v is the velocity of water coming out of the hole)

A. $50 m^2/s^2$

B. $51 m^2/s^2$

C. $50.2 m^2/s^2$

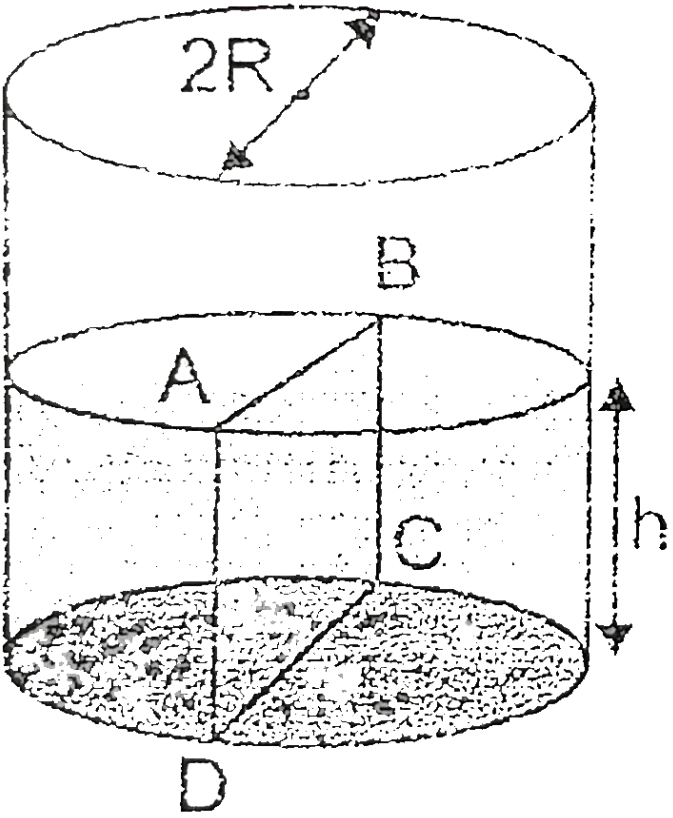
D. $52 m^2/s^2$

Answer: A

Watch Video Solution

5. Water is filled up to a height h in a beaker of radiys 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 on this section by water on the other side of this section

has magnitude



A. $\left[2P_0Rh + \pi R^2pgh - 2RT\right]$

B. $\left[2P_0Rh + Rpgh^2 - 2RT\right]$

C. $\left[P_0\pi R^2 + Rpgh^2 - 2RT\right]$

D. $\left[P_0\pi R^2 + Rpgh^2 + 2RT\right]$

Answer: B

Watch Video Solution

6. Two soap bubbles A and B are kept in a closed chamber where the air is maintained at pressure $8N/m^2$. The radii of bubbles A and B are $2cm$ and $4cm$, respectively. Surface tension of the soap. Water used to make bubbles is $0.04N/m$. Find the ratio n_B/n_A, where n_A and n_B are the number of moles of air in bubbles A and B respectively. [Neglect the effect of gravity.]

A. 9

B. 6

C. 4

D. 3

Answer: B

Watch Video Solution

7. A cylindrical vessel of height 500mm has an orifice (small hole) at its bottom. The orifice is initially closed and water is filled in it up to height H. Now the top is completely sealed with a cap and the orifice at the bottom is opened. Some water comes out from the orifice and the water level in the vessel becomes steady with height of water column being 200mm. Find the fall in height(in mm) of water level due to opening of the orifice.

[Take atmospheric pressure $= 1.0 \times 10^5 N/m^2$, density of water=1000kg//m^3 and g=10m//s^2`. Neglect any effect of surface tension.]

A. 6mm

B. 8mm

C. 10mm

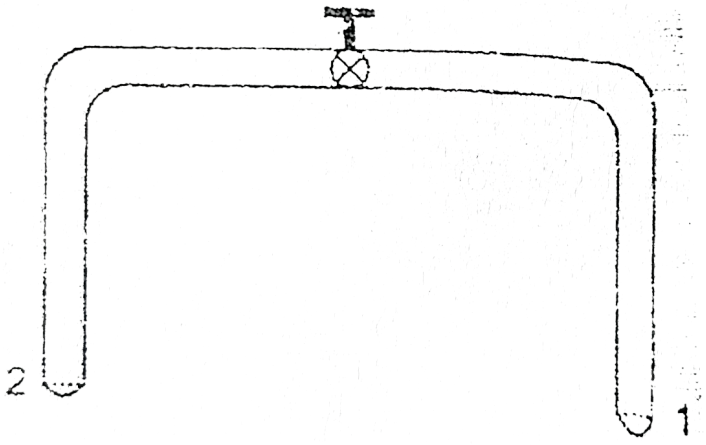
D. 12mm

Answer: A

Watch Video Solution

8. A glass tube of uniform internal radius (r) has a valve separating the two identical ends. Initially, the valve is in a tightly closed position. End 1 has a hemispherical soap bubble of radius r. End 2 has sub-hemispherical soap bubble as shown

in figure. Just after opening the valve.



A. Air from end 1 flows towards end 2 No change in the volume of the soap bubbles

B. Air from end 1 flows towards end 2. Vole of the soap bubble at end 1 decreases

C. No change occurs

D. Air from end 2 flows towards end 1 decreases the soap bubble at end 1 increases

Answer: B

Watch Video Solution

9. A spherical solid ball of volume V is made of a material of density ρ_1. It is falling through a liquid of density $\rho_2(\rho_2 < \rho_1)$. Assume that the liquid applies a viscous force on the ball that is proportional to the square of its speed v, i.e., $F_{viscous} = -kv^2(k > 0)$. The terminal speed of the ball is

A. $\sqrt{\frac{V_g(p_1 - p_2)}{k}}$

B. $\frac{Vgp_1}{k}$

C. $\sqrt{\frac{Vgp_1}{k}}$

D. $\frac{V_g(p_1 > p_2)}{k}$

Answer: A

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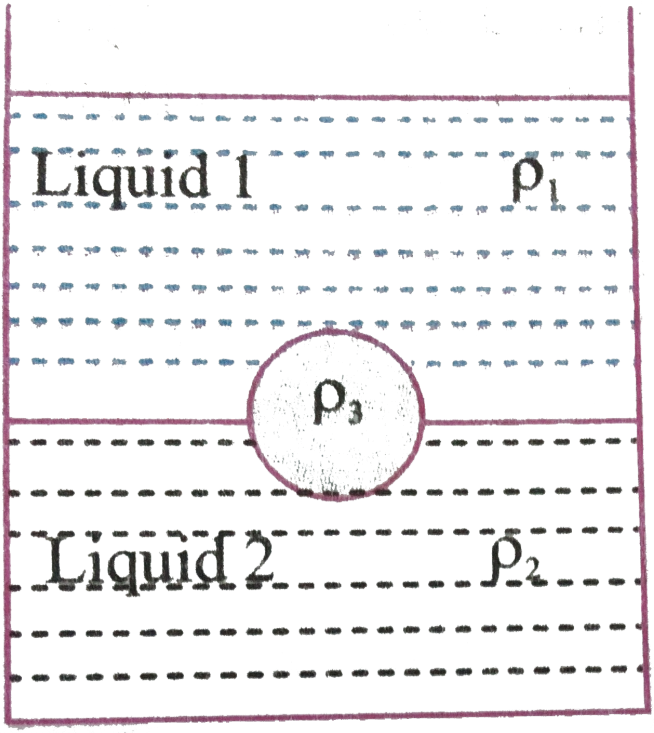


10.

A jar filled with two non-mixing liquid 1 and 2 having densities ρ_1 and ρ_2 respectively. A solid ball, made of a material of density ρ_3 is dropped in the jar. It come to equilibrium in the position shown in the figure. Which of the following is true for ρ_1, ρ_2 and ρ_3?

A. $p_3 < p_1 < p_2$

B. $p_1 > p_3 > p_2$

C. $p_1 < p_2 < p_3$

D. $p_1 < p_3 < p_2$

Answer: D

Watch Video Solution

11. A capillary tube (A) is dipped in water. Another identical tube (B) is dipped in a soap-water solution. Which of the following shows the relative nature of the liquid columns in the two tubes?

A. 

B. 

C. 

D. 

Answer: C

Watch Video Solution

12. The pressure of a medium is charged from $1.01 \times 10. Pa$ to $1.165 \times 10. Pa$ and change in volume is 10 % keeping temperature constant. The Bulk modulus of the medium is

A. $204.8 \times 10^5 Pa$

B. $51.2 \times 10^5 Pa$

C. $102.4 \times 10^5 Pa$

D. $1.55 \times 10^5 Pa$

Answer: D

Watch Video Solution

13. Consider the spring-mass system, with the mass submerged in water, as shown in the figure. The phase space diagram for one cycle of this system is: 

A. 

B. 

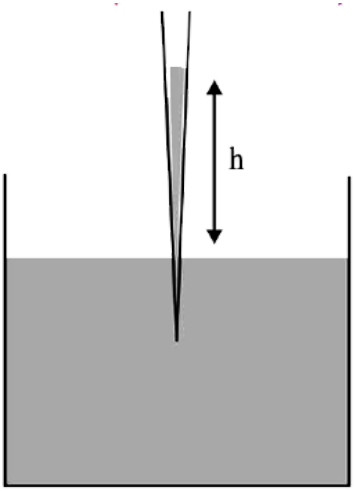
C. 

D. 

Answer: B

View Text Solution

14. A glass capillary tube is of the shape of a truncated cone with an apex angle α so that its two ends have cross sections of different radii. When dipped in water vertically, water rises in it to a high h, where the radius of its cross section is b. If the surface tension of water is S, its density if ρ, and its contact angle with glass is θ, the value of h will be (g is the acceleration due to gravity)



A. $\frac{2S}{bpg}\cos(\theta - \alpha)$

B. $\frac{2S}{bgp}\cos(\theta + \alpha)$

C. $\frac{2S}{bpg}\cos(\theta - \alpha/2)$

D. $\frac{2S}{bpg}\cos\left(\theta + \frac{\alpha}{2}\right)$

Answer: D

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Competition File C Mcq With More Than One Correct Answers

1. When an air bubble rise from the bottom of a deep lake to a point just below the water surface, the pressure of air inside the bubble

A. will be less than the pressure outside it

B. will decrease as the bubble moves up

C. is greater than the pressure outside it

D. will increase as the bubble moves up

Answer: B::C

Watch Video Solution

2. A uniform capillary tube of inner radius r is dipped vertically into a beaker filled with water. The water rises to a height h in the capillary tube above the water surface in the beaker. The surface tension of water is σ. The angle of contact between water and the wall of the capillary tube is θ. Ignore the mass of water in the meniscus. Which of the following statements is (are) true?

A. For a given material of the capillary Lube, decreases with increase in r.

B. For a given material of the capillary tube, h is independent of σ.

C. If this experiment is performed in a lift going up with a constant acceleration, then h decreases.

D. h is proportional to contact angle θ.

Answer: A::C

Watch Video Solution

3. Consider a thin square plate floating on a viscolas liquid in a large tank. The heighth of the liquid in the tank is much less than the width of the tank. The floating plate is pulled horizontally with a constant velocity u_0. Which of the following statements is (are) true?

A. The resistive force of liquid on the plate is inversely proportional to h

B. The resistive force of liquid on the plate is independent of the area of the plate

C. The tangential (shear) stress on the floor of the tank increases with u_0

D. The tangential (shear) stress on the plate varies linearly with the viscosity η of the liquid

Answer: A::C::D

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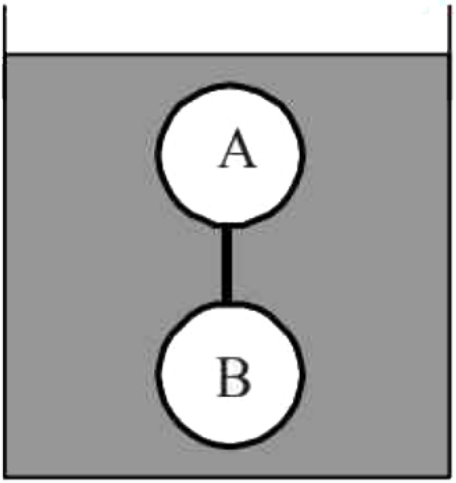
4. Two solid spheres A and B of equal volumes but of different densities d_A and d_B are connected by a string. They are fully

immersed in a fluid of density d_F. They get arranged into an equilibrium state as shown in the figure with a tension in the string. The arrangement is possible only if



A. $d_P < d_L$

B. $d_Q > d_L$

C. $d_P > d_L$

D. $d_P + d_Q = 2d_L$

Answer: A::B::D

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5. Large number of stones are placed in a small boat. The boat is floating in a water tank. If stones are unloaded in the water in the tank then which of the following are incorrect.

A. Level of water will fall

B. Level of water will rise

C. Water level falls at first and then rises

D. Water level remains unchanged

Answer: B::C::D

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6. Two-thirds of a container is filled with a liquid and then the cylinder is sealed. F is the force exerted at the bottom of the container and P is the pressure exerted at the surface. On removing some air from the container with the help of a vacuum pump

A. Pand F both decrease

B. P and F both increase

C. The liquid level in container will fall

D. The liquid level in container will be unchanged

Answer: A::D

Watch Video Solution

7. Choose the correct statements

A. Surface tension is a vector quantity.

B. The angle of contact for pure water is 90°.

C. The tube required for water barometer is longer than that required for mercury barometer.

D. Archimedes principle does not hold good for free fall.

Answer: C::D

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8. As shown in figure, through a horizontal tube, some liquid is flowing. Let V_A and V_B are speeds of liquid at points A and B and PA and Pg are the pressures at points A and B. Then

A. $P_A > P_B$

B. $P_A = P_B$

C. $P_B > P_A$

D. $V_A > V_B$

Answer: C::D

View Text Solution

9. A small tank of cylindrical shape and of radius R is containing a liquid of density σ. On rotating the vessel about its axis with angular velocity ω, the liquid rises at the sides of vessel through height h. P_1 and P_2 are pressure at sides and at the centre of tank respectively, then

A. $P_1 > P_2$

B. $P_1 = P_2$

C. $P_2 > P_1$

D. $h = \frac{R^2\omega^2}{2g}$

Answer: B::D

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10. A metal cube is weighing 4 N in air, 3 N in water and 2.5 N in a liquid

A. Relative density of liquid is smaller than that of cube.

B. Relative density of Liquid is greater than unity.

C. Relative density of liquid is 1.5.

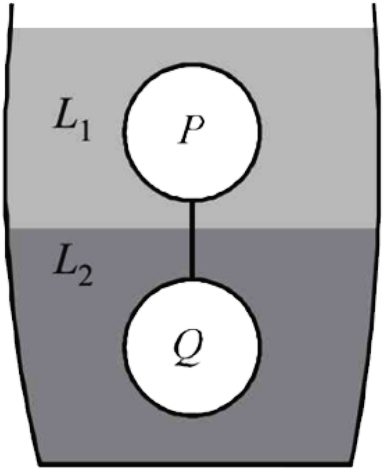
D. Relative density of cube is 4.

Answer: A::B::C::D

View Text Solution

11. Two spheres P and Q of equal radii have densities ρ_1 and ρ_2, respectively. The spheres are connected by a massless string and placed in liquids L_1 and L_2 of densities σ_1 and σ_2 and viscosities η_1 and η_2, respectively. They float in equilibrium with the sphere P in L_1 and sphere Q in L_2 and the string being taut(see figure). If sphere P alone in L_2 has terminal velocity

$\vec{V}_p$ and Q alone in L_1 has terminal velocity $\vec{V}_Q$, then



A. $\left|\frac{\vec{V}_P}{\vec{V}_Q}\right| = \frac{\eta_1}{\eta_2}$

B. $\left|\frac{\vec{V}_P}{\vec{V}_Q}\right| = \frac{\eta_2}{\eta_1}$

C. $\vec{V}_P . \vec{V}_Q > 0$

D. $\vec{V}_P . \vec{V}_Q < 0$

Answer: A::D

Watch Video Solution

12. A solid sphere of radius R and density ρ is attached to one end of a mass-less spring of force constant k. The other end of the spring is connected to another solid sphere of radius R and density 3ρ. The complete arrangement is placed in a liquid of density 2ρ and is allowed to reach equilibrium. The correct statements(s) is (are)

A. the net elongation of the spring is $\frac{4\pi R^3 pg}{3k}$

B. the net elongation of the spring is $\frac{8\pi R^3 pg}{3k}$

C. the light sphere is partially submerged

D. the light sphere is completely submerged.

Answer: A::D

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Competition File D Mcq Based On A Given Passage Comprehension

1. When a liquid moves steadily under some pressure through a horizontal tube, it moves in the form of cylindrical layers coaxial to the ends of the tube. The velocity of different layers is different. The velocity of the layer is maximum along the axis of the tube and it decreases as one moves towards the walls of the tube. According to Poiseuille, the rate of flow of liquid through a horizontal capillary tube varies as the relation $V\alpha\frac{pr^4}{\eta l}$ where l and r are the length and radius of the tube and p is the pressure different between the ends of the tube and is the constant of proportionality.

The dimensional formula for rate of flow

A. MLT^{-2}

B. $M^0L^3T^{-1}$

C. MLT^{-1}

D. ML^2T^{-3}

Answer: B

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2. When a liquid moves steadily under some pressure through a horizontal tube, it moves in the form of cylindrical layers coaxial to the ends of the tube. The velocity of different layers is different. The velocity of the layer is maximum along the axis of the tube and it decreases as one moves towards the walls of the tube. According to Poiseuille, the rate of flow of liquid through a horizontal capillary tube varies as the relation $V\alpha\frac{pr^4}{\eta l}$ where l and r are the length and radius of the tube

and p is the pressure different between the ends of the tube and is the constant of proportionality.

$\frac{\pi p r^4}{8\eta l}$ is dimensionally equivalent to (R is the resistance)

A. p/R

B. p/R^2

C. p/R^3

D. p/R

Answer: A

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3. When a liquid moves steadily under some pressure through a horizontal tube, it moves in the form of cylindrical layers coaxial to the ends of the tube. The velocity of different layers

is different. The velocity of the layer is maximum along the axis of the tube and it decreases as one moves towards the walls of the tube. According to Poiseuille, the rate of flow of liquid through a horizontal capillary tube varies as the relation $V\alpha\frac{pr^4}{\eta l}$ where l and r are the length and radius of the tube and p is the pressure different between the ends of the tube and is the constant of proportionality.

When two capillary tubes through which the liquid is flowing are joined in series then the equivalent liquid resistance is

A. $R_s = R_1 + R_2$

B. $Rs = R_1 - R_2$

C. $\frac{1}{Rs} = \frac{1}{R_1} + \frac{1}{R_2}$

D. $\frac{K\eta}{pr} = \frac{1}{R_1} - \frac{1}{R_2}$

Answer: A

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4. When a liquid moves steadily under come pressure through a horizontal tube, it moves in the form of cylindrical layers coaxial to the exds of the tube. The velocity of different layers is different. The velocity of the layer is maximum along the axis of the tube and it decreases as one moves towards the walls of the tube. According to Poiseuille, the rate of flow of liquid through a horizontal capillary tube varies as the relation $V\alpha\frac{pr^4}{\eta l}$ where l and rare the length and radius of the tube and p is the pressure different between the ends of the tube and is the constant of proportionality.

Which of the following is correct:

A. The unit of coefficient of viscosity is Pa-s.

B. coefficient of viscosity is a vector quantity.

C. The dimensional formula of coefficient of viscosity is $ML^{-2}T^{-1}$.

D. water is more viscous than blood

Answer: A

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5. Streamline flow of the liquid is the flow in which every particle of the liquid follows the same path as the path of the preceeding particle and has the same velocity as that of the preeding particle while crossing through the same points. Two streamlines can never cut each other. When a liqui moves randomly or in irregular manner such that its velocity becomes greater than the critical velocity than the flow is turbulent flow. Critical velocity is given by $v_c = \frac{K\eta}{pr}$.

For liquids having Reynold number greater than 3000 the flow is

A. streamlined

B. turbulent

C. laminar

D. changing from laminar to turbulent

Answer: B

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6. Streamline flow of the liquid is the flow in which every particle of the liquid follows the same path as the path of the preceeding particle and has the same velocity as that of the preeding particle while crossing through the same points. Two

streamlines can never cut each other. When a liqui moves randomly or in irregular manner such that its velocity becomes greater than the critical velocity than the flow is turbulent flow. Critical velocity is given by $v_c = \frac{K\eta}{pr}$.

For flow to be streamlined the

A. critical velocity should be large.

B. critical velocity should be amall.

C. radius of the tube should be very large.

D. coefficient of viscosity should be small

Answer: A

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7. Streamline flow of the liquid is the flow in which every particle of the liquid follows the same path as the path of the preceeding particle and has the same velocity as that of the preeding particle while crossing through the same points. Two streamlines can never cut each other. When a liqui moves randomly or in irregular manner such that its velocity becomes greater than the critical velocity than the flow is turbulent flow. Critical velocity is given by $v_c = \frac{K\eta}{pr}$.

Which of the following is incorrect?

A. The Reynold number is a pure number and its value is always greater than unity.

B. The Reynold number determines the nature of flow of liquid and is unitless.

C. The Reynold number is the ratio of internal force per unit area to the viscous force per unit area.

D. Greater is the crowding of streamlines, more is the velocity

Answer: A

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8. Streamline flow of the liquid is the flow in which every particle of the liquid follows the same path as the path of the preceeding particle and has the same velocity as that of the preeding particle while crossing through the same points. Two streamlines can never cut each other. When a liqui moves randomly or in irregular manner such that its velocity becomes greater than the critical velocity than the flow is turbulent flow.

Critical velocity is given by $v_c = \frac{K\eta}{pr}$.

The viscosity of water is 0.0013 Nsm $\hat{}$ (-2). The maximum velocity of water in a tube of diameter 0.3 cm for the flow to be laminar is

A. 0.34m/s

B. 0.86m/s

C. 0.95m/s

D. 0.55m/s

Answer: B

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9. A wooden cylinder of diameter 4r height H and density $\frac{p}{\det <}a$ is kept on a hole of diameter 2r of a tank filled with

water of density as shown in the figure. If level of liquid starts decreasing slowly when the level of liquid is at a height h_1 above the cylinder the block just starts moving up. Then value of h_1 is: 

A. $\frac{4H}{9}$

B. $\frac{5H}{9}$

C. $\frac{5H}{3}$

D. remains same

Answer: C

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10. The block in the above questions is maintained by external means and the level of liquid is lowered. The height h_2 when

the external force reuces to zero is : 

A. $\frac{4H}{9}$

B. $\frac{5H}{9}$

C. remains same

D. $\frac{2H}{3}$

Answer: A

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11. If a height h_2 of water level is further decreases then:

A. cylinder will not move up and remains at original positoin.

B. for $h_2 = \frac{H}{3}$, cylinder again starts moving up

C. for $h_2 = \frac{H}{4}$, cylinder again starts moving up

D. for $h_2 = \frac{H}{5}$, cylinder again starts moving up

Answer: A

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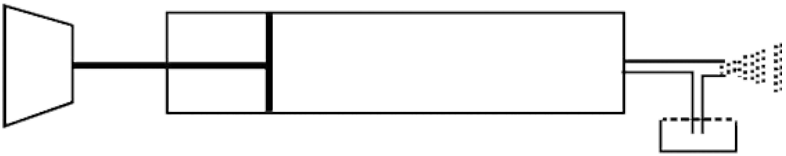
12. A spray gun is shown in the figure where a piston pushes air out of a nozzle. A thin tube of uniform cross section is connected to the nozzle. The other end of the tube is in a small liquid container. As the piston pushes air through the nozzle, the liquid from the container rises into the nozzle and is sprayed out. For the spray gun shown, the radii of the piston and the nozzle are 20mm and 1mm respectively. The upper end of the container is open to the atmosphere.



If the piston is pushed at a speed of $5mms^{-1}$, the air comes out of the nozzle with a speed of

A. $0.1ms^{-1}$

B. $1ms^{-1}$

C. $2ms^{-1}$

D. $8ms^{-1}$

Answer: C

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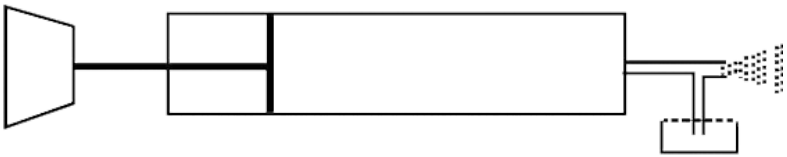
13. A spray gun is shown in the figure where a piston pushes air out of a nozzle. A thin tube of uniform cross section is connected to the nozzle. The other end of the tube is in a small liquid container. As the piston pushes air through the nozzle, the liquid from the container rises into the nozzle and is sprayed out. For the spray gun shown, the radii of the piston and the nozzle are 20mm and 1mm respectively. The upper end of the container is open to the atmosphere.



If the piston is pushed at a speed of $5mms^{-1}$, the air comes out of the nozzle with a speed of

A. $\sqrt{\frac{p_a}{p_1}}$

B. $\sqrt{p_a p_1}$

C. $\sqrt{\frac{p_1}{p_a}}$

D. p_1

Answer: A

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14. A small spherical monoatomic ideal gas bubble $(\gamma = 5/3)$ is trapped inside a liquid of density p_1 (see figure). Assume that bubble does not exchange any heat with the liquid. The bubble contains n moles of gas. The temperature of the gas when the bubble is at the bottom is T_0. Height of the liquid is H and atmospheric pressure is P_0. -Neglect surface tension.

As the bubble moves upwards, besides the buoyancy force the following forces are acting on it.

A. Only the force of gravity.

B. The force due to gravity and the force due to the pressure of the liquid.

C. The force due to gravity, the force due to the pressure of the liquid and force due to viscosity of the liquid,

D. The force due to gravity and the force due to viscosity of the liquid.

Answer: D

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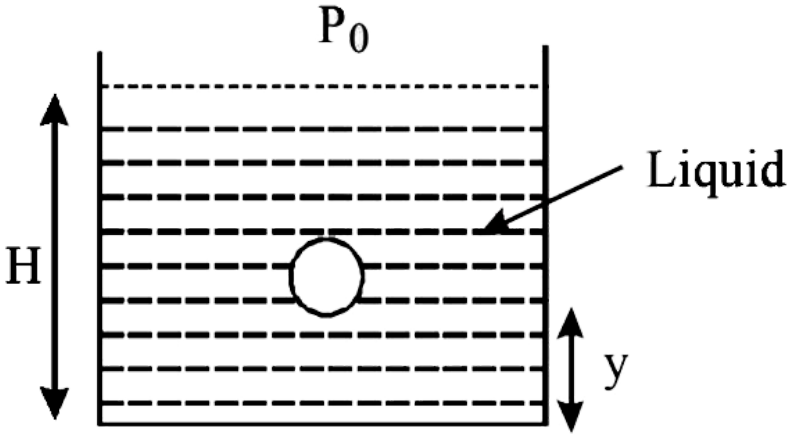
15. A small spherical monoatomic ideal gas bubble $(\gamma = 5/3)$ is trapped inside a liquid of density ρ (see figure). Assume that the bubble does not exchange any heat with the liquid. The bubble contains n moles of gas. The temperature of the gas when the bubble is at the bottom is T_0, the height of the liquid is H and the atmospheric pressure P_0 (Neglect surface tension).



When the gas bubble is at a height y from the bottom, its temperature is-

A. $T_0\left(\frac{P_0+p_1gH}{P_0+p_1gy}\right)^{\frac{2}{5}}$

B. $T_0\left(\frac{P_0+p_1g(H-y)}{P_0+p_1gH}\right)^{\frac{2}{5}}$

C. $\left(\frac{P_0+p_1gH}{P_0+p_1gy}\right)^{\frac{3}{5}}$

D. $\left(P_0+\frac{p_{10g(H-y)}}{P_0+p_1gyH}\right)^{\frac{3}{5}}$

Answer: B

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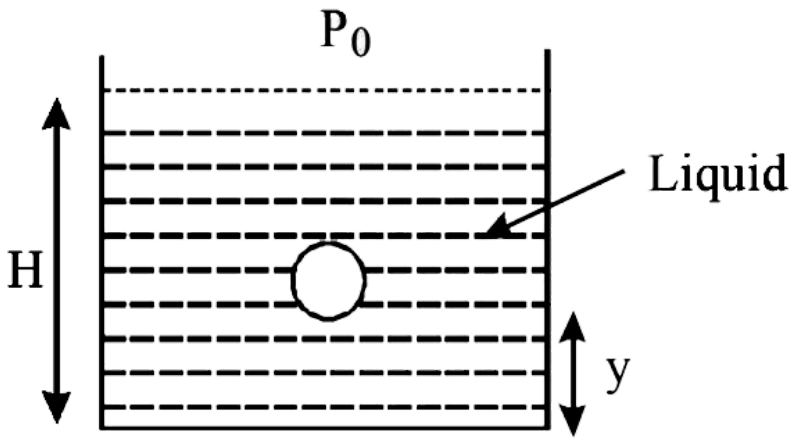
16. A small spherical monoatomic ideal gas bubble $(\gamma = 5/3)$ is trapped inside a liquid of density ρ (see figure). Assume that the bubble does not exchange any heat with the liquid. The bubble contains n moles of gas. The temperature of the gas when the bubble is at the bottom is T_0, the height of the liquid is H and the atmospheric pressure P_0 (Neglect surface

tension).



When the gas bubble is at a height y from the bottom, its temperature is-

A. $p_1 nRgT_0 \dfrac{(P_0 + p_1 gH)}{(P_0 + p_1 gy)^{\frac{7}{2}}}$

B. $\dfrac{p_1 nRgT_0}{(P_0 + p_1 gH)^{\frac{2}{5}} \left(P_0 + p_1 g(H-y)^{\frac{3}{5}}\right)}$

C. $p_1 nRgT_0 \dfrac{(P_0 + p_1 gH)^{3-5}}{(P_0 + p_1 gy)^{\frac{8}{5}}}$

D. $\dfrac{p_1 nRgT_0}{(P_0 + p_1 p_1 gH)^{\frac{2}{5}} \left[P_0 + p_1 g(H-y)^{\frac{3}{5}}\right)}$

Answer: B

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Competition File Assertion Reason Type Questions

1. Deep water runs slow. Explain.

A. If both assertion and reason are correct and remad is a correct explanation of the assertion.

B. If both assertion and reason are correct bat reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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2. Flags flutter in breeze. Why?

A. If both assertion and reason are correct and remad is a correct explanation of the assertion.

B. If both assertion and reason are correct bat reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

 Watch Video Solution

3. Two row boats moving parallel to each other and near by, are pulled towards each other. Explain.

A. If both assertion and reason are correct and remad is a correct explanation of the assertion.

B. If both assertion and reason are correct bat reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: B

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4. Assertion: Reynolds number determines the nature of flow of a liquid through a pipe.

Reason: For streamlined flow, the critical velocity should be as small as possible.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion.

B. If both assertion and reason are correct but reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: C

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5. Assertion: An air bubble in water grows in size when it rises from bottom to top.

Reason: On moving from bottom to top, pressure of the air bubble will decrease, volume will increase and hence, size of air bubble will rise.

A. If both assertion and reason are correct and remad is a correct explanation of the assertion.

B. If both assertion and reason are correct bat reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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6. Assertion: Oil drops spread on cold water and remain as a drop on hot water.

Reason : Surfnce tension of oil is less than cold water and more than that of hot water.

A. If both assertion and reason are correct and remad is a correct explanation of the assertion.

B. If both assertion and reason are correct bat reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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7. Assertion: Pressure on the concave side of the liquid will be greater than pressure on the convex side if the liquid surface is curved.

Reason: Excess pressure depends on the angle of contact of the liquid surface with the solid surface.

A. If both assertion and reason are correct and remad is a correct explanation of the assertion.

B. If both assertion and reason are correct bat reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: C

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8. Assertion: Cohesive and adhesive forces obey inverse square law.

Reason: While writing, graphite sticks to the paper on account of cohesive forces.

A. If both assertion and reason are correct and remad is a correct explanation of the assertion.

B. If both assertion and reason are correct bat reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect.

Answer:

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9. Explain why small drops of mercury are spherical and large drops become flat?

A. If both assertion and reason are correct and remad is a correct explanation of the assertion.

B. If both assertion and reason are correct bat reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: C

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10. Aeroplanes having wings fly at low altitudes while jet planes fly at high altitudes . Why ?

A. If both assertion and reason are correct and remad is a correct explanation of the assertion.

B. If both assertion and reason are correct bat reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: C

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11. Statement-1 : The stream of water flowing at high speed from a garden hose pipe tends to spread like a foundtion when held vertically up, but tends to narrow down when held vertically down.

Statement-2 : In any steady flow of an incompressible fluid, the volume flow rate of the fluid remain constant.

A. If both assertion and reason are correct and remad is a correct explanation of the assertion.

B. If both assertion and reason are correct bat reason is not the correct explanation of assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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Competition File Matching Type Questions

1. 

A.

	P	Q	R	S
a	1	2	3	4

B.

	P	Q	R	S
b	2	3	1	4

C.

	P	Q	R	S
c	2	3	4	1

D.

	P	Q	R	S
d	3	1	2	4

Answer: D

View Text Solution

2.

A.

	P	Q	R	S
a	4	3	1	2

B.

	P	Q	R	S
b	3	4	2	1

C.

	P	Q	R	S
c	2	1	3	4

D.

	P	Q	R	S
d	1	3	4	2

Answer: B

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Competition File Integers Type Questions

1. In a hydraulic press, the diameters of two pistons are 6 cm and 60 cm. The force exerted on the larger piston is $n \times$ 7200

kg wt if 100 kg wt is placed on smaller piston. Find the value of n.

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2. The surface area of a rectangular film of a liquid is extended from $10cm \times \quad 6\ \mathrm{cm}$ to $12\ \mathrm{m} \times 10cm$. If the work done during this process is $6 \times 10^{-4} J$ and surface tension of liquid is $n \times 10^{-2}\ \ \mathrm{N/cm}$, find the value of n.

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3. An air bubble of radius 2 mm is at a depth of 5 cm below the free surface of a liquid of surface tension 0.06 N/m and density 1000 kg/m^3. The pressure inside the bubble is greater than the atmospheric pressure by $n \times 140\mathrm{N/m^2}$. Find the value of n.

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4. When 8 droplets of water of radius 1 mm each combine into one, then the energy evolved is approximately equal to $7 \times 10^{-6} J$. Find the value of x.

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5. In a capillary tube, liquid rises to a height of 4 cm. In the same capillary tube, mercury falls to a depth of 3 cm. The density of liquid and mercury are 1.5 g/cc and 13.6 g/cc. Then angles of contact of liquid and mercury with the same capillary tubes are 0° and 140°, respectively. What is the ratio of magnitudes of approximate surface tension of mercury and the liquid?

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6. In the middle of a pond, a large ice block of 10 m thickness of floating. Let a vertical hole is drilled in this block. The minimum length (in cm) of a rope required to lift a bucket full of water through the hole is $x \times 10cm$? (Specify gravity of ice =0.91).

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7. The cross sectional area of a horizontal pipe is decreasing from $5 \times 10^{-2}m^2$ to $1 \times 10^{-2}m^2$?. Water is flowing with speed of 5 m/s through this pipe with a pressure of $5 \times 10^5 Pa$ through the larger cross section. The pressure at the smaller cross section of the pipe is $n \times 10^4 Pa$. Find the value of n.

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8. The diameter of a soap bubble is 3.5 cm. In blowing it further, if 36960 ergs of work is done then calculate the approximate value of final radius of the soap bubble in cm if surface tension of soap solution is 40 dynes/cm.

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9. The level of water in a huge tank is 20 m. Nearly at the bottom of the tank, there is a hole of 2 cm? cross section. The rate with which the water will leak through the hole is $n \times 10^{-3} cm$. Find the value of n.

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10. The horse power needed to pump 1000 kg of water in a tank in 5 minutes under pressure of 100 g wt/$(mm)^2$ is appromiately equalt o x (1 hp =746 Watt). Find the value of x.

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11. Consider two solid spheres P and Q each of density $8gmcm^{-3}$ and diameters 1cm and 0.5cm, respectively. Sphere P is dropped into a liquid of density $0.8gmcm^{-3}$ and viscosity $\eta = 3$ poiseulles. Sphere Q is dropped into a liquid of density $1.6gmcm^{-3}$ and viscosity $\eta = 2$ poiseulles. The ratio of the terminal velocities of P and Q is

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Chapter Practise Test

1. In which case a body will have maximum weight? Water or in vacuum.

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2. What will be the effect on the angle of contact of a liquid if the temperature increases?

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3. The meniscus of mercury in the capillary tube is

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4. What are velocity head and pressure head?

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5. Atmospheric pressure can be measured in terms of pascal, millibar and torr. Which is the correct relation between one torr and one millibar.

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6. How viscosity of water and other liquids depend on the temperature and pressure?

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7. It is difficult for a man to walk bare footed on sand. Why ? How can this difficulty be removed?

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8. How a hydraulic press works?

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9. Statement-1: Roofs of buildings are blown off during a strong storm.

Statement-2: Roofs of buildings becomes lighter during storm.

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10. In a hydraulic lift, the area of smaller piston is $5cm^2$. The weight raised by larger piston is 900 kgf, if a force of 150 kg fis applied on smaller piston. Calculate the area of larger piston.

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11. Give the expression for the excess pressure in a soap bubble.

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12. Derive Poiseuille's formula with the help of dimensional analysis.

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13. Explain surface energy. Establish its relation with surface tension.

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14. What do you mean by angle of contact? What are the factors on which the angle of contact depends?

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15. What is capillarity? Derive an expression for the height to which the liquid rise in capillary tube of r with angle of contact θ. Give two examples of capillarity from daily life.

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16. Mention any two applications of Bernoulli's theorem.

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