PHYSICS

BOOKS - CENGAGE PHYSICS (ENGLISH)

PROPERTIES OF SOLIDS AND FLUIDS

Illustration

1. Two rods A and B, each of equal length for different materials are suspended from a common support as shown in the figure. The rods A and B can support a maximum load of $W_1 = 600N$ and $W_2 = 6000N$ respectively. If their cross sectional area are $A_1 = 10mm^2$ and $A_2 = 1000mm^2$, respectively then identify the stronger material.

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2. Assume that if the shear stress in steel exceeds about $4.00 \times 10^8 N/m^2$ the steel ruptures. Determine the shearing force necessary to (a) shear a steel bolt $1.00 cm$ in diameter and (b) punch a $1.00 cm$ diameter hole in a steel plate $0.500 cm$ thick.

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3. A bar of cross section A is subjected to equal and opposite tensile force at its ends. Consider a plane section of the bar whose normal makes an angle θ with the axis of the bar.

a. What is the tensile stress on the plane?

b. What is the shearing stress on the this plane?

c. For what value of θ is the tensile stress maximum?

d. For what value of θ is the shearing stress maximum?

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4. $a.$ Estimate the force with which a karate master strikes a board, assuming that hand's speed at the moment of impact is $10.0ms^{-1}$, decreasing to $1.00ms^{-1}$ during a $0.002s$ time interval of contact between the hand and the board. The mass of his hand and arm is $1.00kg$.

b Estimate the shear, assuming this force it exerted on a $1.00cm$ thick pine board that is $10.0cm$ wide.

c. If we maximum shear stress a pine board can support before breaking is $3.60 \times 10^6 N / m^2$, will the board break?

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5. A steel wire $2m$ long is suspended from the ceiling. When a mass is hung from its lower end, the increase in length recorded is $1cm$. Determine the strain in the wire.

A. 0.002

B. 0.005

C. 0.008

D. 0.02

Answer: B

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6. A brass rod of length $1m$ is fixed to a vertical wall at one end, with the other end keeping free to expand. When the temperature of the rod is increased by $120^{\circ} C$, the length increases by $3cm$. What is the strain?

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7. A $30.0kg$ hammer, moving with speed $20.0ms^{-1}$ strikes a steel spike $2.30cm$ in diameter. The hammer rebounds with speed $10.0ms^{-1}$ after $0.110s$. What is the average strain in the spike during the impact.?

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8. The shear modulus for a metal is $50000 Mpa$. Suppose that a shear force of $200 N$ is applied on the upper surface of a cube of this metal that is $3.0 cm$ on each edge. How far will the top surface be displaced?

A. $2.67 \times 10^{-7} m$

B. $4.5 \times 10^{-7} m$

C. $6.0 \times 10^{-7} m$

D. $1.33 \times 10^{-7} m$

Answer: D

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9. When a weight W is hung from one end of a wire of length L (other end being fixed), the length of the wire increases by l. If the same wire is passed over a pulley and two weights W each are hung at the two ends,what will be the total elongation in the wire?

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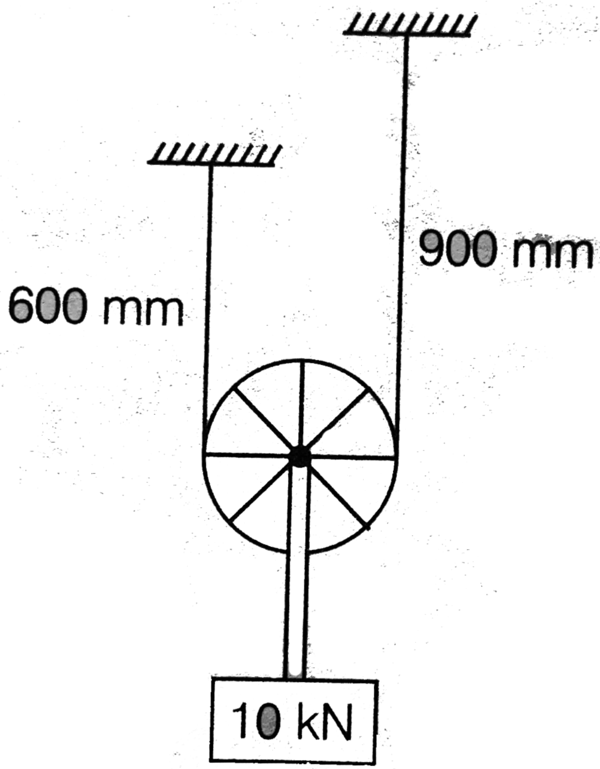
10. A load of $10KN$ is supported from a pulley , which in turn is supported by a rope of cross-sectional area $10^3 mm^2$ and modulus of elasticity $10^3 Nmm^{-2}$ as shown in the figure. Neglecting friction at the pulley , then downward deflection of the load (in mm) is



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11. A uniform heavy rod of weight W, cross sectional area a and length L is hanging from fixed support. Young modulus of the material of the rod is Y. Neglect the lateral contraction. Find the elongation of the rod.

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12. A uniform rod of length L and mass M is pulled horizontally on a smooth surface with a force F. Determine the elongation of rod if Young's modulus of the material is Y.

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13. A $0.05m$ cube has its upper face displaced by $0.2cm$ by a tangential force of $8N$. Calculate the shearing strain, shearing stress and modulus of rigidity of the material of the cube.

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14. A cube of sponge rubber with edge length $5cm$ has a force of $2N$ applied horizontally to the top face (parallel to an edge) while the bottom face is held fixed. If the top face is displaced horizontally through a distance of $1mm$, find the shear modulus for the sponge rubber. (in $\frac{N}{m^2}$)

A. 2×10^4

B. 3×10^4

C. 4×10^4

D. 5×10^4

Answer: C

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15. Two parallel and opposite forces, each of magnitude $4000N$, are applied tangentially to the upper and lower faces of a cubical metal block $25cm$ on a side. Find the angle of shear and the displacement of the upper surface relative to the lower surface. The shear modulus for the metal is $80GPa$.

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16. A horizontal aluminum rod of diameter $4.8cm$ projects $5.3cm$ from a wall. A $1200kg$ object is suspended from the end of the rod. The shear modulus of aluminum is $3.0 \times 10^{10} N/m^2$. Neglecting the mass of the rod find a shearing stress on the rod and b the vertical deflection of the end of the rod.

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17. A metal cube of side $10cm$ is subjected to a shearing stress of $10^6 N/m^2$. Calculate the modulus of rigidity if the of the cube is displaced by $0.05cm$ with respect to its bottom.

A. 1×10^8

B. 2×10^8

C. 3×10^8

D. 4×10^8

Answer: B

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18. A hydraulic press contains $0.25m^3 (250L)$ of oil. Find the decrease in volume of the oil wen it is subjected to a pressure

increase $\triangle p = 1.6 \times 10^{7} Pa$. The bulk modulus of the oil is $B = 5.0 \times 10^{9} Pa$.

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19. Compressibility of water is $5 \times 10^{-10} m^{2} / N$. Find the decrease in volume of $100 mL$ of water when subjected to a pressure of $15 MPa$.

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20. To what depth must a rubber ball be taken in deep sea so that its volume is decreased by 0.1 %.

(Take, density of sea water $= 10^{3} kgm^{-3}$, bulk modulus of rubber $= 9x10^{8} Nm^{-2}, g = 10ms^{-2}$)

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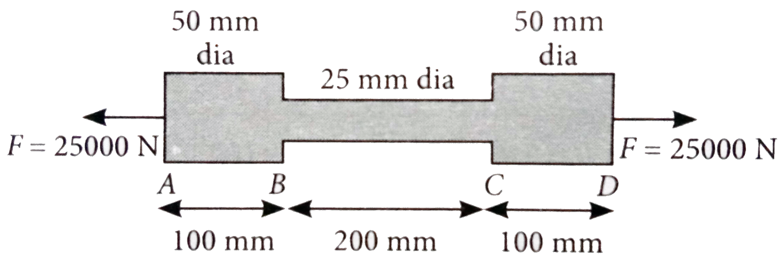
21. A steel bar ABCD 40 cm long is made up of three parts AB, BC and CD, as shown in figure.The rod is subjected to a pull of 25 kN. The total extension of the rod is (Young's modulus for steel $= 2 \times 10^{11} Nm^{-2}$).



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22. Three elastic wires PQ, PR and PS support a body P of mass M, as shown in figure. The wires are of the some material and cross sectional area, the middle one being vertical. Find the loads by each wire.

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23. A composite tube is made by striking a thin steel tube on a brass tube. If A_S and A_B are the respective sectional areas of the steel and brass tubes and Y_S and Y_B their Young's moduli, then find the Young's modulus of single tube of the same length and total sectional area, which would behave in the same fashion as that of the composite tube.

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24. Two vertical rods of equal lengths, one of steel and the other of copper, are suspended from the ceiling at a distance l

apart and are connected rigidly to a rigid horizontal bar at their lower ends. If A_S and A_C be their respective cross-sectional areas, and Y_S and Y_C,their respective Young's moduli of elasticities, where should a vertical force F be applied to the horizontal bar in order that the bar remains horizontal?

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25. A metallic wire is stretched by suspending a weight of it. If α is the longitudinal strain and Y is its Young's modulus of elasticity, then slow that the elastic potential energy per unit volume is given by $\frac{1}{2}Y\alpha^2$.

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26. Calculate the elastic potential energy per unit volume of water at a depth of $1km$. Compressibility (α) of water $= 5 \times 10^{-10}$ SI units. Density of water $= 10^3 kg/m^3$

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27. A catapult consists of two parallel rubber strings each of lengths, $10cm$ and cross sectional area $10mm^2$. When stretched by $5cm$, it can throw a stone of mass $10gm$ to a vertical height of $25m$. Determine Young's modulus of elasticity of rubber.

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28. A plate of area $100cm^2$ is placed on the upper surface of castor oil, $2mm$ thick. Taking the coefficient of viscosity to be 15.5 poise, calculate the horizontal force necessary to move the plate with a velocity $3cms^{-1}$.

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29. A metal block of area $0.10m^2$ is connected to a 0.010 kg mass via a string that passes over an ideal pulley (cosidered massless and frictionless). As in figure. A liquid with a film thickness of 0.30 mm is placed b etween the block and the table. when released the block moves to the right with a constant speed of $0.085ms^{-1}$. find the coefficient of viscosity of the liquid.

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30. A sliding fit cylindrical body of mass of $1kg$ drops vertically down at a constant velocity of $5cms^{-1}$. Find the viscosity of the oil.

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31. A powder comprising particle of various sizes is stirred up in a vessel filled to a height of $10cm$ with water. Assuming the particle to be spherical, find the size of the largest particle that will remain in suspension after $1h$ (density of powder $= 4g/cm^3$, viscosity of water $= 0.01$poise).

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32. Spherical particles of pollen are shaken up in water and allowed to settle. The depth of water is $2 \times 10^{-2} m$. What is the diameter of the largest particles remaining in suspension one hour later? Density of pollen $= 1.8 \times 10^3 kgm^{-3}$ viscosity of water $= 1 \times 10^{-2}$ poise and density of water $= 1 \times 10^{-3} kgm^{-3}$

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

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34. A cube of mass $m = 800g$ floats on the surface of water. Water wets it completely. The cube is $10cm$ on each edge. By what additional distance is it buoyed up or down by surface tension? Surface tension of water $= 0.07Nm^{-1}$

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35. Find the maximum possible mass of a greased needle floating on water surface.

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

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37. Calculate the work down against surface tension in blowing a soap bubble from a radius of $10 cm$ to $20 cm$, if the surface tension of soap solution in $25 \times 10^{-3} N/m$.

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38. Calculate the difference h in water levels in two commnicating capillary tube of radius $1mm$ and $1.5mm$. Surface tension of water $= 0.07 Nm^{-1}$

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39. A vessel filled with air under pressure p_0 contains a soap bubble of diameter d. The air pressure have been reduced n-fold, and the bubbled diameter increased r-fold isothermally. Find the surface tension of the soap water solution.

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40. What should be the pressure inside a small air bubble of 0.1 mm radius situated just below the water surface ? Surface tension of water $= 7.2 \times 10^{-2} Nm^{-1}$ and atmospheric pressure $= 1.013 \times 10^5 Nm^{-2}$.

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

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42. A capillary tube of inside diameter 1mm is dipped vertically into water, so that the length of its part protruding over the water surface is 20mm.What is the radius of curvatur of the meniscus ? Surface tension of water is $72 \times 10^{-3} N/m$.

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43. A glass rod of diameter $d_1 = 1.5 mm$ in inserted symmetrically into a glass capillary with inside diameter $d_2 = 2.0$ mm. Then the whole arrangement is vertically oriented and brought in contact with the surface of water. To what height will the liquid rise in the capillary?

Surface tension of water $= 73 \times 10^{-3} N/m$

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44. The end of a capillary tube with a radius r is immersed in water. Is mechanical energy conserved when the water rises in the tube? The tube is suficiently long. If not calculate the energy change.

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45. A glass capillary tube of internal radius $r = 0.25mm$ is immersed in water. The top end of the tube projects by $2cm$ above the surface of water. At what angle does the liquid meet the tube? Surface tension of water $= 0.7Nm^{-1}$.

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46. Derive an expression for the height of capillary rise between two parrallel plates dipping in a liquid of density σ separated by a distance d. The surface tension of the liquid is T.

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Solved Examples

1. A boy's catapult is made of rubber cord which is $42cm$ long, with $6mm$ diameter of cross-section and of negligible mass. The boy keeps a stone weighing $0.02kg$ on it and stretches the cond by $20cm$ by applying a constant force. When released. The stone flies off with a velocity of $20ms^{-1}$. Neglect the change in the area of cross-section of the cord while stretched. The Young's modulus of rubber is closet to:

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2. A steel wire of cross-sectional area $0.5mm^2$ is held between two fixed supports. If the wire is just taut at $20^\circ C$, determine the tension when the temperature falls to $0^\circ C$. Coefficient of linear expansion of steel is $1.2 \times 10^{-5} C^{-1}$ and its Young's modulus is $2.0 \times 10^{11} Nm^{-2}$.

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3. A sphere of radius $10cm$ and mass 25 kg is attached to the lower end of a steel wire of length $5m$ and diameter $4mm$ which is suspended from the ceiling of a room . The point of support is $521cm$ above the floor. When the sphere is set swinging as a simple pendulum, its lowest point just grazes the floor. Calculate the velocity of the ball at its lowest position $\left(Y_{steel} = 2 \times 10^{11} N/m^2\right)$.

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4. A steel bolt is insertede into a copper tube as shown in the figure. Find the forces induced in the bolt and in the tube when the nut is turned through one revolution. Assume that the length of the tube is l, the pitch of the bolt thread is h and the cross sectional areas of the steel bolt and the copper tube are A_s and A_c respectively.

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5. A circular ring of radius R and mass m made of a uniform wire of cross sectional area A is rotated about a stationary vertical axis passing throgh its centre and perpendicular to the plane of the ring. If the breaking stress of the material of the ring is σ_b, then determine the maximum angular speed $\omega_{\max}$ at which the ring may be rotated without failure.

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6. A glass plate of length $10cm$, breath $1.54cm$and thickness $0.20cm$ weigh $8.2gm$ in air. It is held vertically with the long side horizontal and the lower half under water. Find the apperent weight of the plate. Surface tension of water $= 73$ dyne per cm, $g = 980 cm / \sec^2$.

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7. A barometer contains two uniform capillaires of radii $1.44 \times 10^{-3} m$ and $7.2 \times 10^{-3} N / m$ and $g = 9.8 m / s^2$.

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8. A glass capillary sealed at the upper end is of length $0.11 m$ and diameter 2×10^5m.The tube is immersed vertically into a liquid of surface tension $5.06 \times 10^{-2} N / m$. To what length has the capillary to be immeresed so that the liquid levels inside and outside the capillary become the same? What will happen to the water levels inside the capillary if the seal is now broken?

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9. An open capillary tube contains a drop of water. When the tube is in its vertical position, the drop forms a column with a length of a $2cm$, b. $4cm$, and c. $2.98cm$. The internal diameter of the capillary tube is $1mm$. Determine the radii of curvature of the upper and lower meniscuses in each case. Consider the wetting to be complete. Surface tension of water $= 0.0075N/m$

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10. Two identical spherical soap bubbles collapses. If V is consequent change in volume of the contained air, S is the chage in the total surface area and T is the surface tension of the soap solution. Then (ifp_0 is atmospheric pressure and assume temperature to remain same in all the bubbles).

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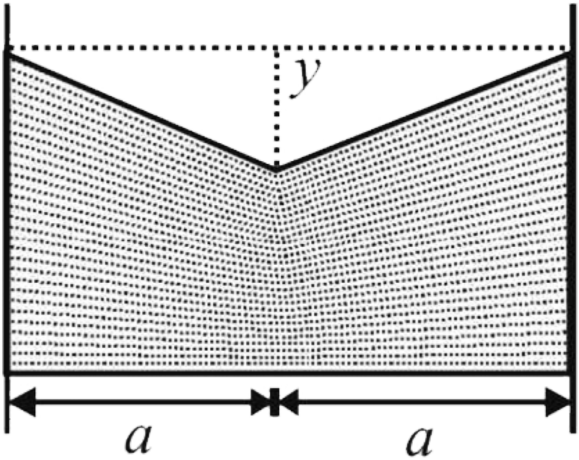
11. A uniform wire having mass per unit length λ is placed over a liquid surface. The wire causes the liquid to depress by $y(y < < a)$ as shown in figure. Find surface tension of liquid.

Neglect end effect.



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Exercise 5.1

1. Stress and pressure are both forces per unit area. T in what respect does stress differ from Pressure?

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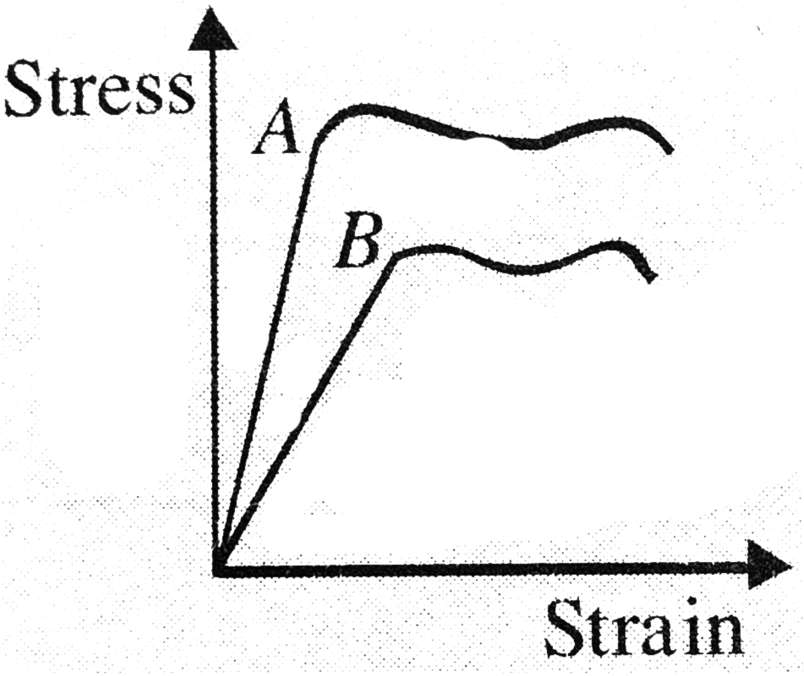
2. The stress and strain graphs for two materials, A and B are shown here. Answer the following :give reasons



A. Which material has greater Young's modulus?

B. Which material is more ductile?

C. Which material is more brittle?

D. Which material has greater tensile strength?

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3. State whether the following statements are true or false with reasons.

a. Elastic forces are always conservative.

b. Elastic forces are strictly conservative only when Hooke's law is obeyed.

c. When a wire is loaded beyond the elastic limit and then reloaded, the work done disappears completely as heat.

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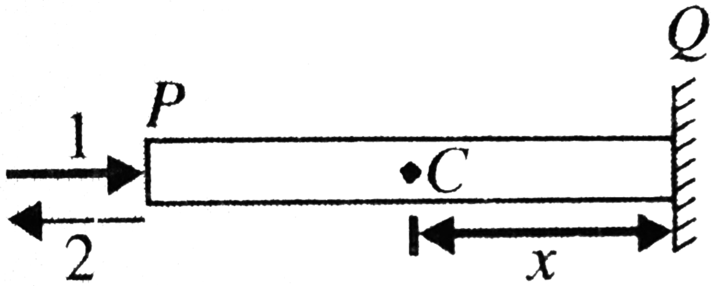
4. A horizontal force of magnitude Facts at the end P of a uniform rigid rod which is welded at point Q. In each case 1 and 2, as shown in Fig., find the reaction. force acting at a point

C at a distance x from the fixed end Q of the rod.



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5. A rubber ball of bulk modulus B is taken to a depth h of a liquid of density ρ. Find the fractional change in the radius of the ball.

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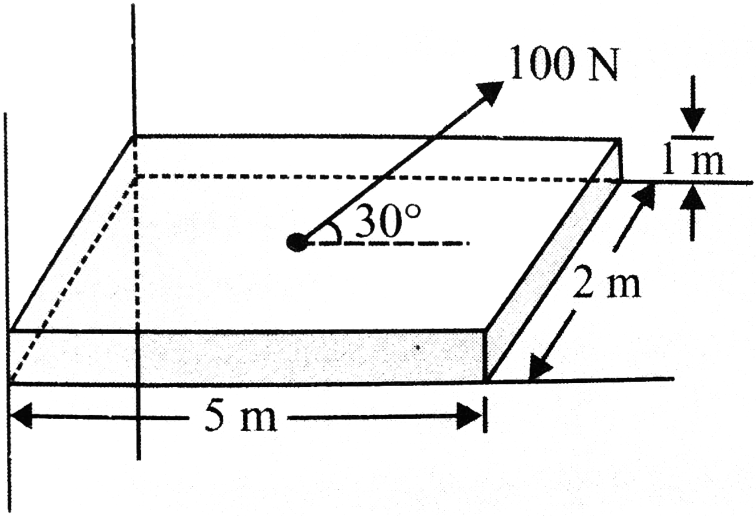
6. Find out longitudinal stress and tangential stress on a fixed block.



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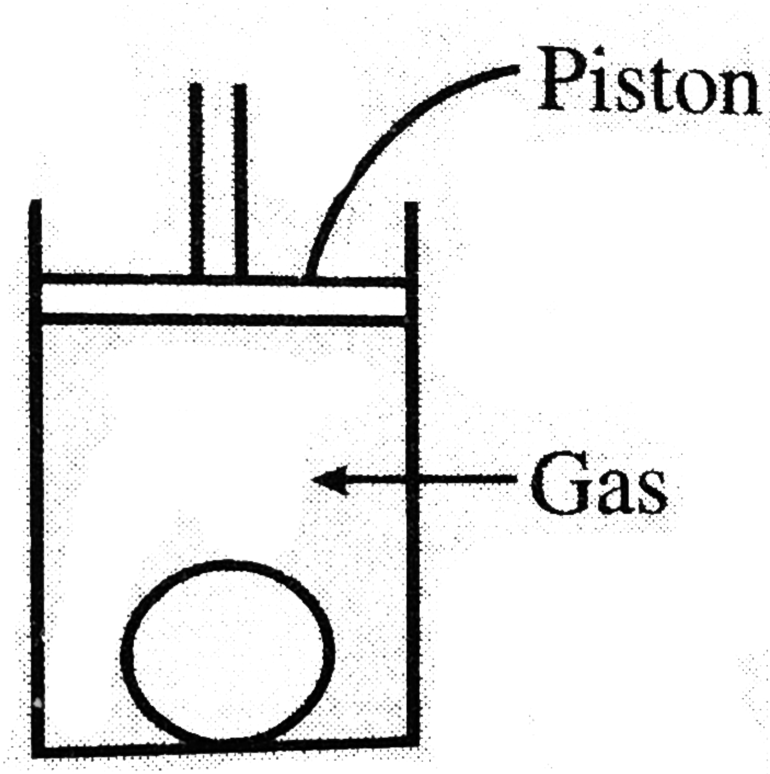
7. Find out bulk stress on the spherical object of radius $10/\pi$ cm if area and mass of piston are $50cm^2$ and $50kg$, respectively, for a cylinder filled with gas as shown in figure.



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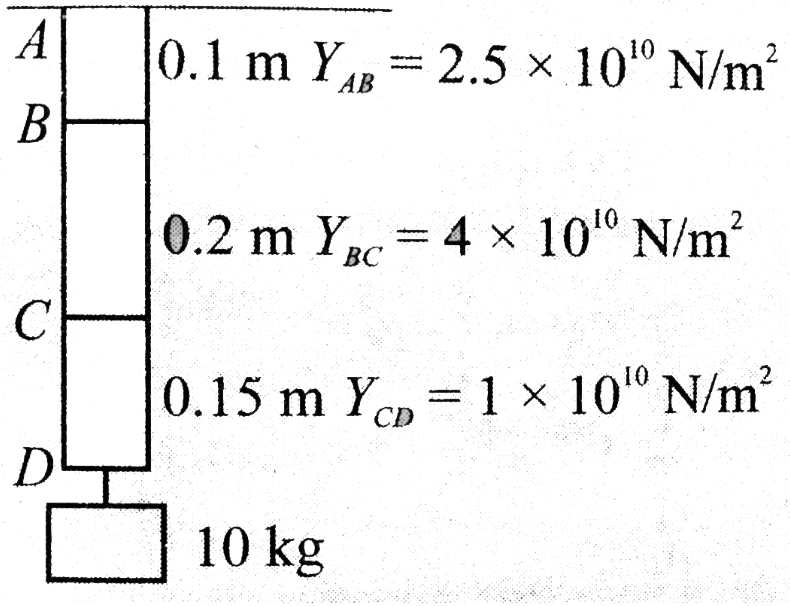
8. Three rods of uniform area of cross section $A = 10^{-7}m^2$ are arranged as shown in Fig. Find out the shift in point B, C

and D.



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9. Find the depth of lake at which density of water is 1% greater than that at the surface. Given compressibility $k = 50 \times 10^{-6} atm^{-1}$.

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10. A rubber cube of side $5cm$ has one side fixed while a tangential force equal to $1800N$ is applied to opposite face. Find the shearing strain and the lateral displacement of the strained face. Modulus of rigidity for rubber is $2.4 \times 10^6 N/m^2$

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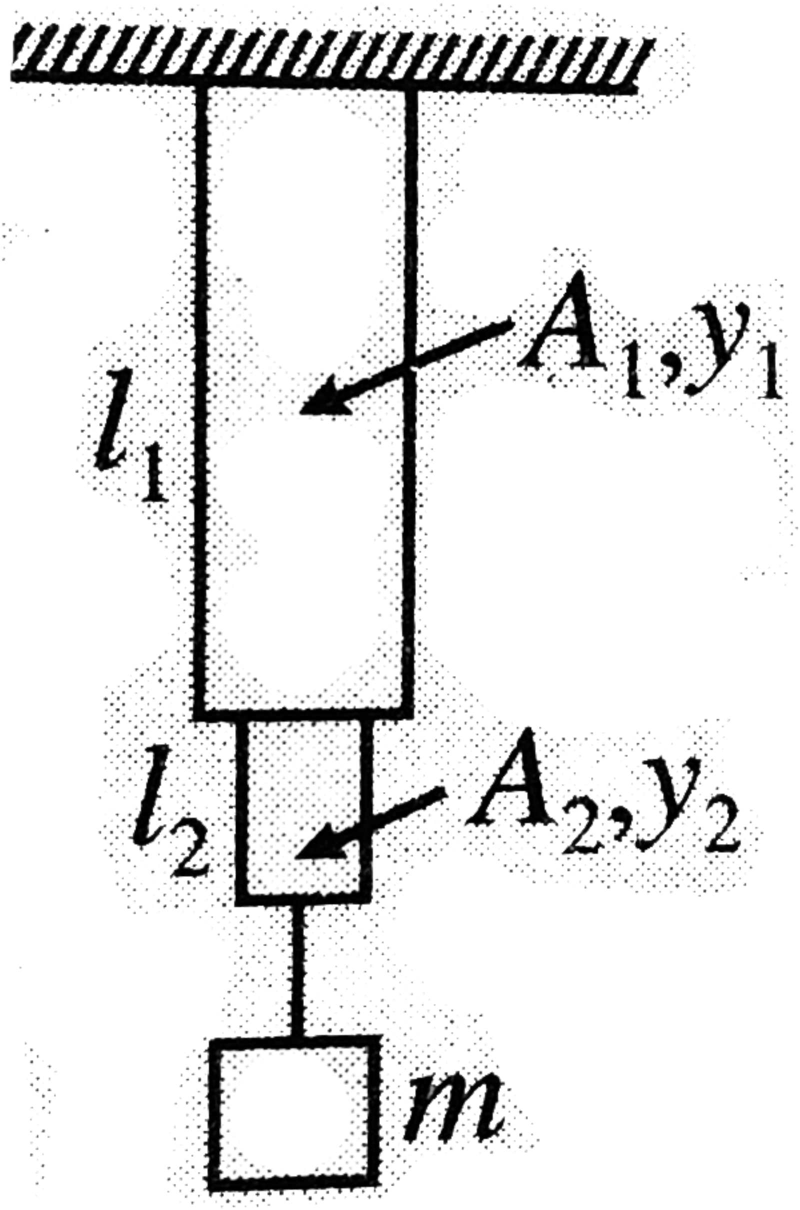
11. A mass $'m'$ is attached with rods as shown in Fig. This mass is slightly stretched and released. Find out whether the motion of mass is $S.H.M.$ If yes then find out the time period.



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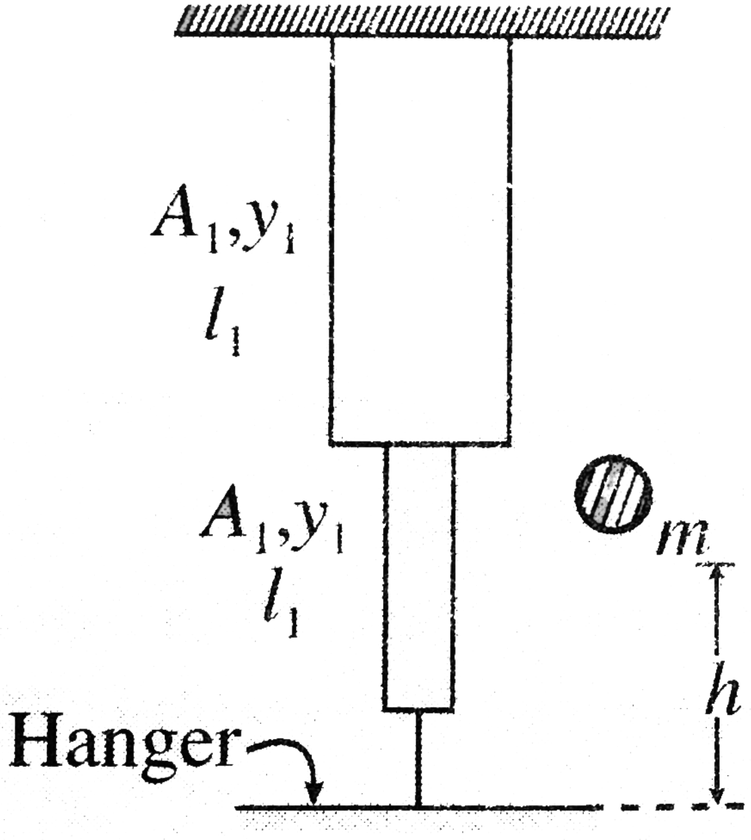
12. A ball of mass $'m'$ drops from a height which sticks to a massless hanger after striking it. Neglecting overturning. Find out the maximum extension in rod, assuming that the rod is massless.



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Exercise 5.2

1. A man is rowing a boat with a constant velocity v_0 in a river. The contact area of boat is $'A'$ and coefficient of viscosity is η. The depth of river is $'D'$. Find the force required to row the boat.

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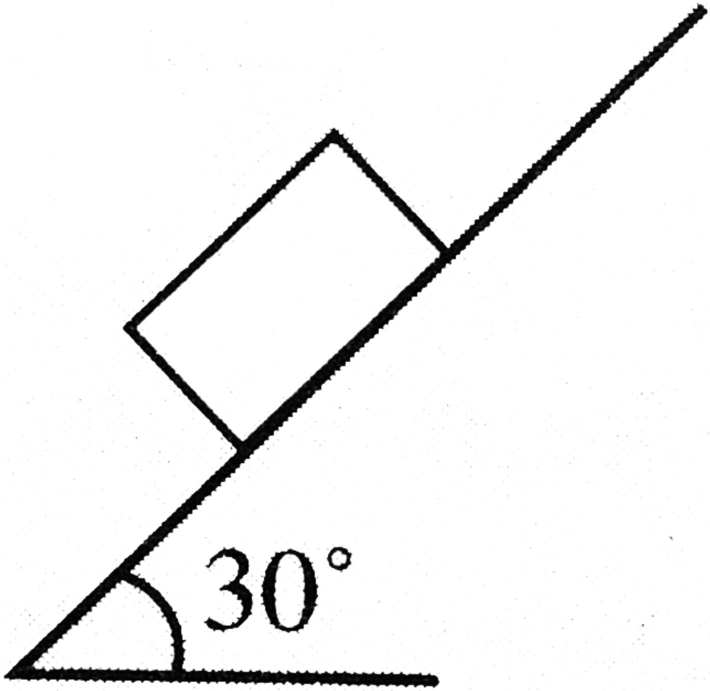
2. A cubical block (of side $2m$) of mass $20kg$ slides on inclined plane lubricated with the oil of viscosity $\eta = 10^{-1}$ with constant velocity of $10ms^{-1}$. Find out the thickness of the layer of liquid (take $g = 10 ms^{-2}$).



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3. A drop of water of radius $0.0015 mm$ is falling in air. If the coefficient of viscosity of air is $1.8 \times 10^{-5} kg/ms$, what will be the terminal velocity of the drop? Density of water

$= 1.0 \times 10^3 kg/m^3$ and $g = 9.8 N/kg$. Density of air can be neglected.

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4. A metallic sphere of radius $1.0 \times 10^{-3} m$ and density $1.0 \times 10^4 kg/m^3$ enters a tank of water, after a free fall through a distance of h in the earth's gravitational field. If its velocity remains unchanged after entering water, determine the value of h. Given: coefficient of viscosity of water $= 1.0 \times 10^{-3} Ns/m^2, g = 10 ms^{-12}$ and density of water $= 1.0 \times 10^3 kg/m^3$.

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5. Find the minimum force required to drag a hard polythene plate of area $2m^2$ on a thin film of oil of thickness $0.25cm$ and $\eta = 15$ poise. Assume the speed of the plate is $10cms^{-1}$.

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6. A force of $3.14N$ is required to drag a sphere of radius $4cm$ with a speed of $5ms^{-1}$ in a medium in gravity free space. Find the coefficient of the viscosity of the medium.

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Exercise 5.3

1. Why is moisture retained longer in the soil if it is harrowed?

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2. A capillary tube is dipped in water vertically. It is long enough for the water to rise to the maximum height h in the tube. The length of portion immersed in water is $I < h$. The lower end of the tube is closed and then the tube is taken out and opened again. Will all the water flow out of tube? Explain.

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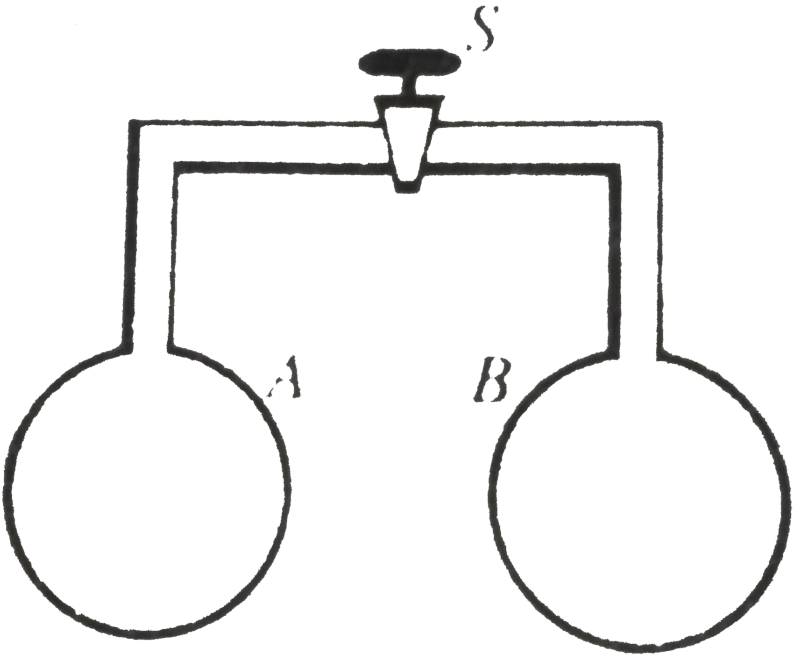
3. Two soap bubbles A and B of different diameters are blown at the two ends of a bent tube. By opening the stopcock S, the two bubbles are put in communication. What will happen?



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4. A mercury drop of radius R is sprayed into n droplets of equal size. Calculate the energy expanded if surface tension of mercury is T.

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5. If a number of little droplets of water, each of radius r, coalesce to form a single drop of radius R, show that the rise in temperature will be given by $\frac{3T}{J}\left(\frac{1}{r}-\frac{1}{R}\right)$ where T is the surface tension of water and J is the mechanical equivalent of heat.

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6. A liquid of specific gravity 1.5 is observed to rise $3.0cm$ in a capollary tube of diameter 0.50mm and the liquid wets the surface of the tube. Calculate the excess pressure inside a spherical bubble of $1.0cm$ diameter blown from the same liquid. Angle of contact $= 0^\circ$

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7. A drop of water of volume $0.05 cm^3$ is pressed between two glass plates, as a consequence of which, it spreads and occupies an are of $40 cm^2$. If the surface tension of water is $70 \text{dyne} / cm$, find the normal force required to separate out the two glass plates is newton.

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8. A glass tube of circular cross section is closed at one end. This end is weighted and the tube floats vertically in water, heavy end down. How far below the water surface is the end of the tube? Given: outer radius of the tube is $0.14 cm$, mass of weighted tube is $0.2 g$, surface tension of water $73 dyn / cm$ and $g = 980 cms^{-12}$.

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9. If a 5 cm long capillary tube with $0.1mm$ internal diameter open at both ends is slightly dipped in water having surface tension $75dy \neq cm^{-1}$, state whether (a) water eill rise half way in the capillary , (b) Water will rise up to the upper end of capillary and (c) water will overflow out of the upper end of capollary? Explain your answer.

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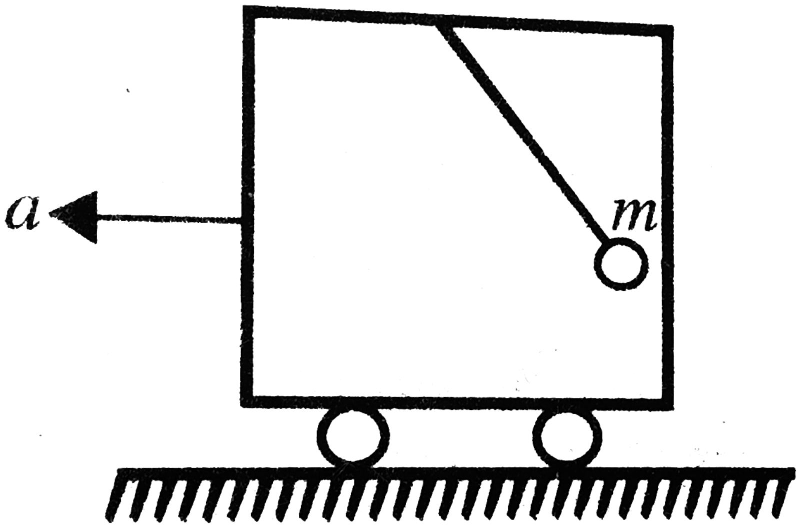
Subjective

1. A bob of mass m hangs from the ceiling of a smooth trolley car which is moving with a constant acceleration a. If young's modulus, radius and length of the string are Y, r and I, respectively, find the (a) stress in the string and (b) extension of the string when it makes a constant angle relative to vertical.



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2. A smooth uniform, string of natural length l, cross-sectional area A and Young's modulus Y is pulled along its length by a force F on a horizontal surface. Find the elastic potential energy stored in the string.

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3. A narrow capillary tube is dipped $10cm$ below water surface and a liquid bubble of radius $2mm$ formed at the lower end by blowing air through the tube.

a. Calculate the excess pressure due to surface tension.

b. What is the pressure required in the tube in order to blow a hemispherical bubble at its end in water?

The surface tension of water at temperature of the experiment is $7.30 \times 10^{-2} N/m$. 1 atmospheric pressure $= 10^5 Pa$, density of water $= 1000 kg/m^3$

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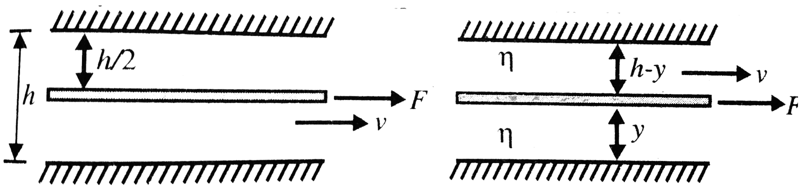
4. A thin plate of large area is placed midway in a gap of height h filled with oil of viscosity and the plate is pulled at constant

velocity $v$by applying the same drag force on the plate. If a lighter oil of viscosity η is then substituted in the gap. it is found that for the velocity v, and the same drag force as previous case the plate is located unsymmetrically in the gap but parallel to the walls. Find η in terms of distance from nearer wall to the plane y.



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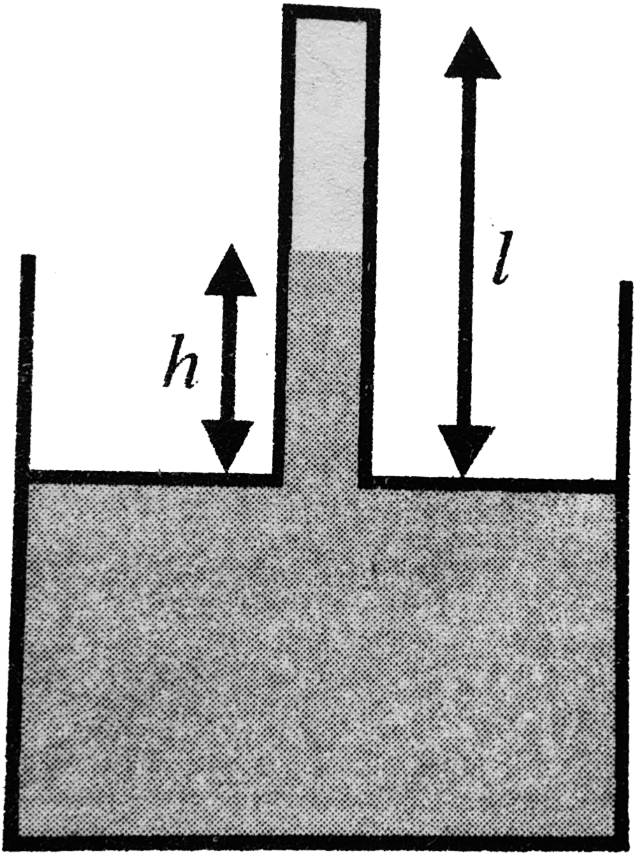
5. When a vertical capillary of length with the sealed upper end was brought in contact with the surface of a liquid, the level of this liquid rose to the height h. The liquid density is ρ, the inside diameter the capillary is d, the contact angle is θ, the atmospheric pressure is ρ_0. Find the surface tension of the liquid. (Temperature this process remains constant.)



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6. A rubber cord has a cross -sectional area $1mm^2$ and total un-stretched length $10.0cm$. It is stretched to $12.0cm$ and then

released to project a missile of mass 5.0 g. Taking young's modulus Y for rubber as $5.0 \times 10^8 N/m^2$.Calculate the velocity of projection .

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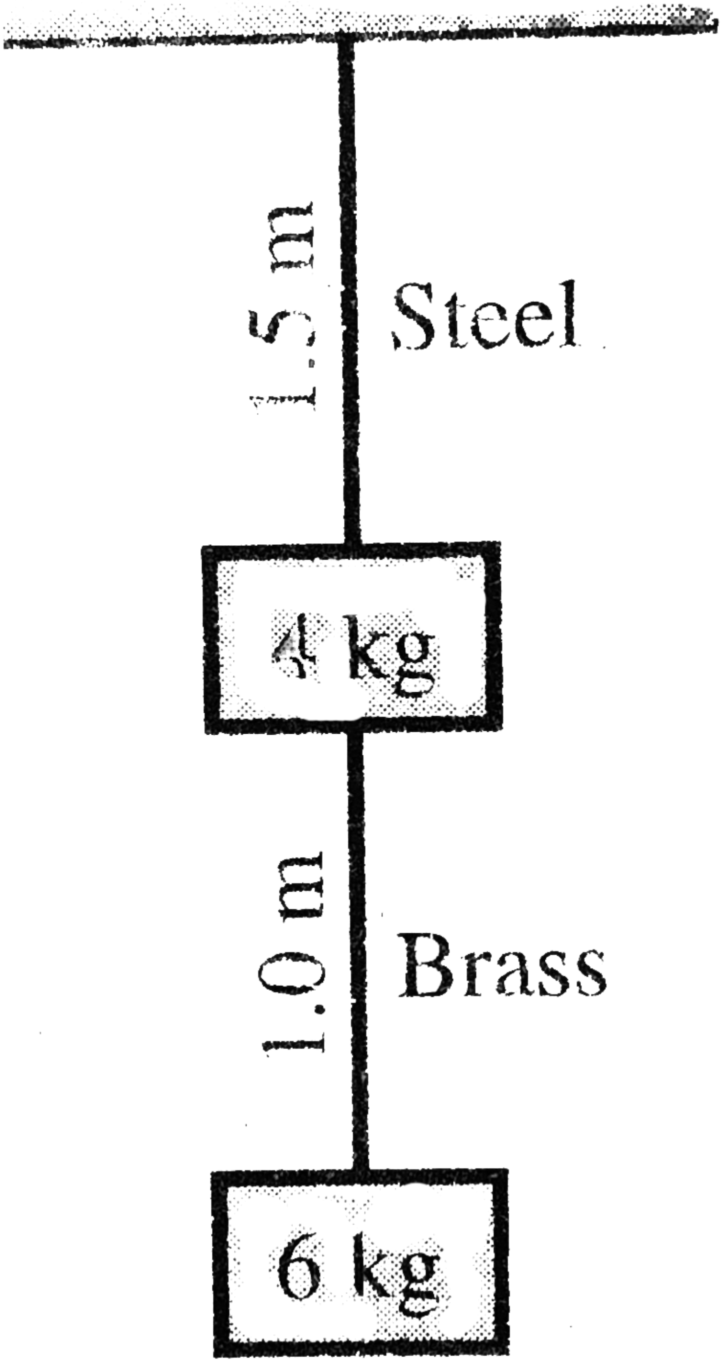
7. Two wires of diameter $0.25cm$, one made of steel and other made of brass, are loaded as shown in the figure. The unloaded length of the steel wire is $1.5m$ and that of brass is $1.0m$. Young's modulus of steel is 2.0×10^{11}Pa and that of brass is 1.0×10^{11} Pa. Compute the ratio of elongations of steel and brass wires. $\frac{\triangle l_{\text{steel}}}{\triangle l_{\text{brass}}} = ?$



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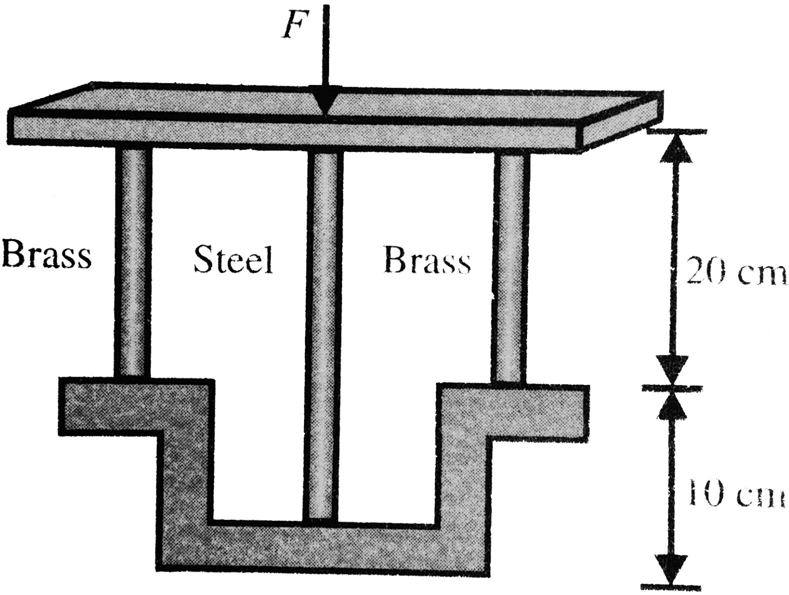
8. A steel rod of length $l_1 = 30 cm$ and two identical brass rod of length $l_2 = 20 cm$ each support a light horizontal platform as shown in Fig. Cross-sectional area of each of the three rods is $A = 1 cm^2$. A vertically downward force $F = 5000 N$ is applied on the platform. Young's modulus of elasticity for steel $Y_s = 2 \times 10^{11} Nm^{-2}$ and brass $Y_b = 1 \times 10^{11} Nm^{-2}$. Find

stress (in MPa) developed in a. Steel rod b. Brass rod



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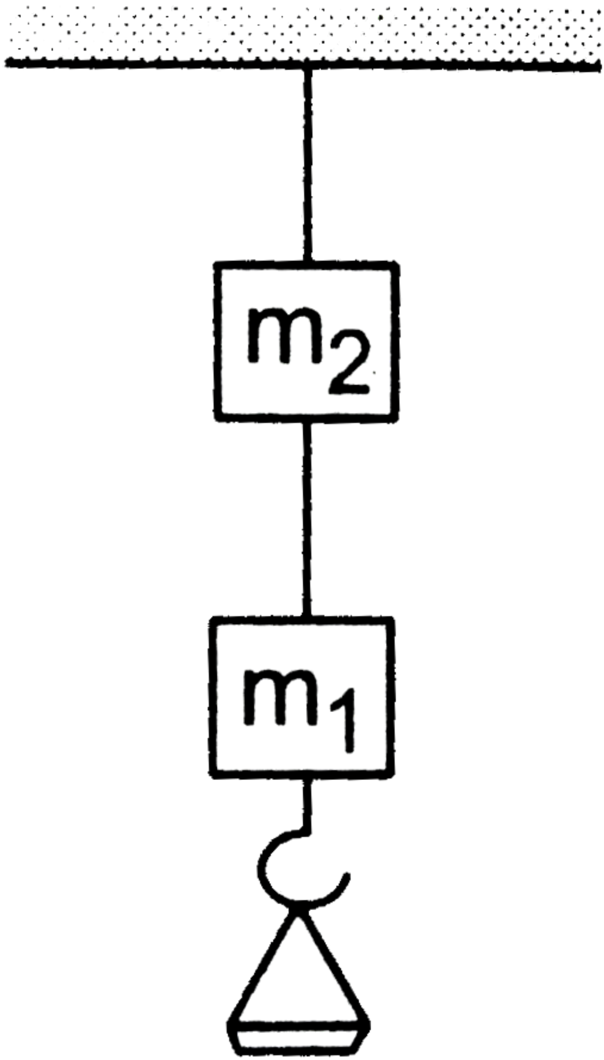
9. The two wires shown in figure are made of the same material which has a breaking stress of $8 \times 10^8 Nm^{-2}$. The area of cross section of the upper wire is $0.006cm^2$ and that of the lower wire is $0.003cm^2$. The mass $m_1 = 10kg, m_2 = 20kg$ and the hanger is light. a. Find the maximum load that can be put on the hanger without breaking a wire. Which wire will break first if the load is increased? b. Repeat the above part $m_1 = 10kg$ and $m_2 = 36kg$.



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10. A copper wire of negligible mass, $1m$ length and cross-sectional area $10^{-6}m^2$ is kept on a smooth horizontal table with one end fixed. A ball of mass $1kg$ is attached to the other end. The wire and the ball are rotating with an angular velocity of $20rad/s$. If the elongation in the wire is $10^{-3}m$.

a. Find the Young's modulus of the wire (in terms of $\times 10^{11}N/m^2$).

b. If for the same wire as stated above, the angular velocity is increased to $100rad/s$ and the wire breaks down, find the breaking stress (in terms of $\times 10^{10}N/m^2$).

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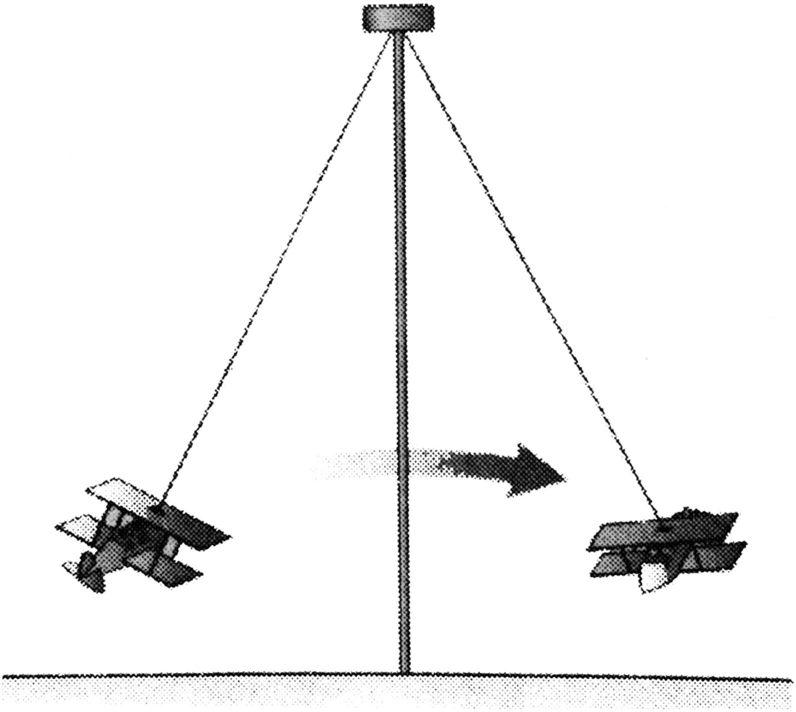
11. An amusement park ride consists of airplane shaped cars attached to steel rods. Each rod has a length of $20.0m$ and a cross-sectional area of $8.00cm^2$. Young's modulus for steel is $2 \times 10^{11} N/m^2$.

a. How much is the rod stretched (in mm) when the ride is at rest ? (Assume that each car plus two people seated in it has a total weight of $2000N$.)

b. When operating, the ride has a maximum angular speed of

$\sqrt{\frac{19}{5}} rad / s$. How much is the rod stretched (in mm) then?



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12. A capillary tube of length (i) $l = 60 cm$, (ii) $l = 50 cm$ and radius $r = 1/4 mm$ is immersed vertically into water. Find the capillary rise in both cases. Angle of contact $= 0^{\circ}$. Take coefficient of surface tension as $72 \text{dyne} / cm, g = 1000 cms^{-12}$

.

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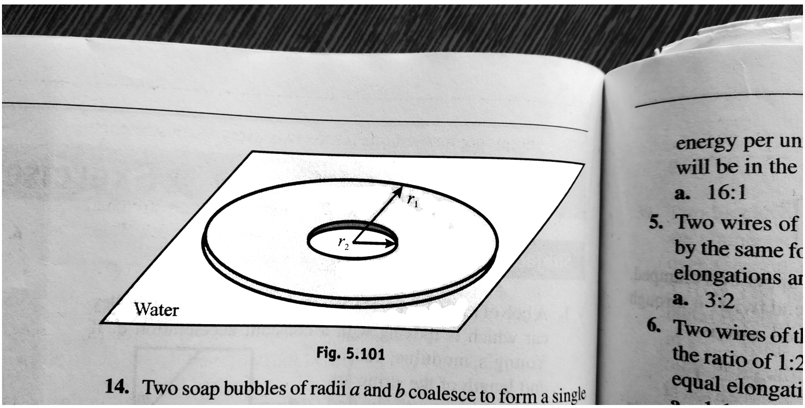
13. An annular disc of radius $r_1 = 10cm$ and $r_2 = 5cm$ is placed on a water surface. Find the surface tension force on the disc if we want to pull it from water surface. Take coefficient of surface tension as $\sigma = 7 \times 10^{-3} N / m, g = 10 ms^{-12}$.



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14. Two soap bubbles of radii a and b combine to form a single bubble of radius c. If P is the external pressure, then the surface tension of the soap solution is

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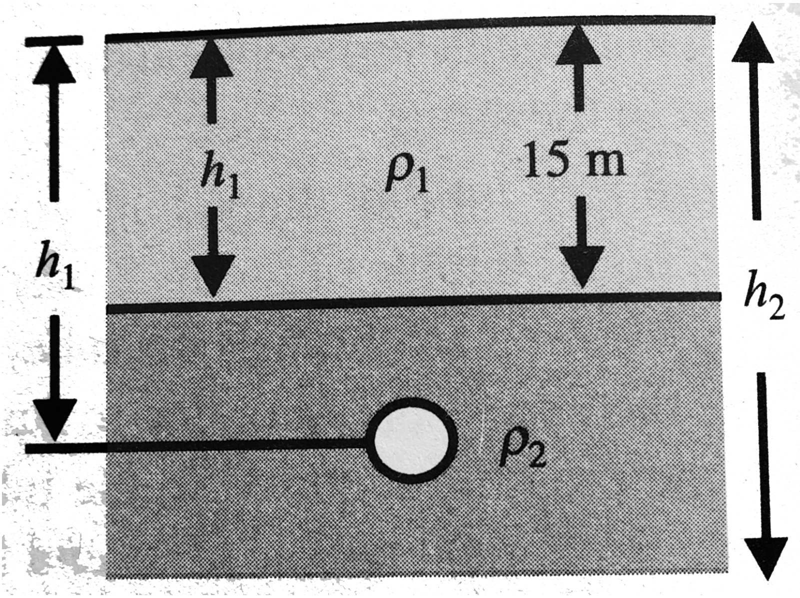
15. Calculate the pressure indise a small air bubble of radius $0.01mm$ situated at a depth of $h = 20m$ below the fre surface of liquid of density $\rho_1 = 10^3 kg/m^3$, $\rho_2 = 800km/m^3$ and surface tension $T_2 = 7.5 \times 10^{-2} N/m$. The thickness of the first liqid is $h_1 = 15m$ and $h_2 = 25m$.



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16. A mercury drop of radius R is sprayed into n droplets of equal size. Calculate the energy expended if surface tension of mercury is T.

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Single Correct

1. The ratio of diameters of two wires of same material is $n:1$. The length of each wire is $4m$. On applying the same load, the increases in the length of the thin wire will be $(n > 1)$

A. n^2times

B. n times

C. $2n$ times

D. $(2n + 1)$ times

Answer: A

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2. A nylon rope $2cm$ in diameter has a breaking strength of $1.5 \times 10^5 N$. The breaking strength of a similar rope $1cm$ in diameter is

A. $0.375 \times 10^5 N$

B. $2 \times 10^5 N$

C. $6 \times 10^5 N$

D. $9 \times 10^4 N$

Answer: A

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3. The dimensions of four wires of the same material an given below. In which wire the increase in the length will be maximum?

A. Length $100cm$, diameter $1mm$

B. Length $200cm$, diameter $2mm$

C. Length $300cm$, diameter $3mm$

D. Length $50cm$, diameter $0.5mm$

Answer: D

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4. Two wires of the same material and length but diameter in the ratic 1: 2 are stretched by the same load. The ratio of elastic potential energy per unit volume for the two wires is

A. $16:1$

B. $4:1$

C. $2:1$

D. $1:1$

Answer: A

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5. Two wires of the same material and length are stretched by the same force. Their masses are in the ratio $3:2$. Their elongations are in the ratio

A. $3:2$

B. $9:4$

C. $2:3$

D. $4:9$

Answer: C

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6. Two wires of same length and same material but of radii r and 2r are stretched by forces F and f respectively to produce equal elongation . The ratio F to f is

A. $1:1$

B. $1:2$

C. $1:3$

D. $1:4$

Answer: D

7. When a weight of $5kg$ is suspended from a copper wire of length $30m$ and diameter $0.5mm$, the length of the wire increases by $2.4cm$. If the diameter is doubled, the extension produced is

A. $1.2cm$

B. 0.6

C. $0.3cm$

D. $0.15cm$

Answer: B

8. The length of a wire is increased by $1mm$ on the application, of a given load. In a wire of the same material, but of length and radius twice that of the first, on application of the same load, extension is

A. $0.25mm$

B. $0.5mm$

C. $2mm$

D. $4mm$

Answer: B

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9. An cube is shifted to a depth of $100m$ is a lake. The change in volume is 0.1%. The bulk modulus of the material is

A. $10Pa$

B. $10^4 Pa$

C. $10^7 Pa$

D. $10^9 Pa$

Answer: D

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10. If S is stress and Y is Young's modulus of material of a wire, the energy stored in the wire per unit volume is

A. $\frac{SY}{2}$

B. $\frac{S^2}{2Y}$

C. $\frac{S}{2y}$

D. $\frac{2S}{Y}$

Answer: B

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11. What amount of work is done in increasing the length of a wire through unity?

A. $\frac{YL}{2A}$

B. $\frac{YL^2}{2A}$

C. $\frac{YA}{2L}$

D. $\frac{YL}{A}$

Answer: C

Watch Video Solution

12. Young's modulus of rubber is $10^4 Nm^{-2}$ and area of cross-sectionis $2cm^2$. If force of 2×10^5 dynes is applied along its length ,then its initial length L becomes

A. $3l$

B. $4l$

C. $2l$

D. none of these

Answer: C

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13. When a certain weight is suspended from a long uniform wire, its length increases by $1cm$. If the same weight is suspended from another wire of the same material and length but having a diameter half of the first one, the increases in length will be

A. $0.5cm$

B. $2cm$

C. $4cm$

D. $8cm$

Answer: C

Watch Video Solution

14. Two wires of the same material have lengths in the ratio $1:2$ and their radii are in the ratio $1:\sqrt{2}$ If they are stretched by applying equal forces, the increase in their lengths will be in the ratio

A. $\sqrt{2}:2$

B. $2:\sqrt{2}$

C. $1:1$

D. $1:2$

Answer: C

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15. A piece of copper wire has twice the radius of a piece of steel wire. Young's modulus for steel is twice that of the copper. One end of the copper wire is joined to one end of the steel wire so that both can be subjected to the same longitudinal force. By what fraction of its length will the steel have stretched when the length of the copper has increased by 1% ?

A. 1%

B. 2%

C. 2.5%

D. 3%

Answer: B

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16. The breaking stress for a substance is $10^6 N/m^2$. What length of the wire of this substance should be suspended verticaly so that the wire breaks under its own weight? (Given: density of material of the wire $= 4 \times 10^3 kg/m^3$ and $g = 10ms^{-12}$)

A. $10m$

B. $15m$

C. $25m$

D. $34m$

Answer: C

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17. Water rises to a height of $2cm$ in a capillary tube. If the tube is tilted 60° from the vertical, water will rise in the tube to a length of

A. $4.0cm$

B. $2.0cm$

C. $1.0cm$

D. water will not rise at all

Answer: A

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18. A spherical liquid drop of radius R is divided into eight equal droplets. If the surface tension is T, then the work done in this process will be

A. $2\pi R^2 T$

B. $3\pi R^2 T$

C. $4\pi R^2 T$

D. $2\pi R T^2$

Answer: C

Watch Video Solution

19. Air is pushed into a soap bubble of radius r to double its radius. If the surface tension of the soap solution is S, the work done in the process is

A. $2\pi D^2 T$

B. $4\pi D^2 T$

C. $6\pi D^2 T$

D. $8\pi D^2 T$

Answer: C

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20. A water drop is divided into eight equal droplets. The pressure difference between inner and outer sides of big drop

A. will be the same as for smaller droplet

B. will be half of that for smaller droplet

C. will be one-fourth of that for smaller droplet

D. will be twice of that for smaller droplet

Answer: B

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21. A vessel whose , bottom has round holes with diameter $0.1mm$, is filled with water. The maximum height up to which water can be filled without leakage is

A. $100cm$

B. $75cm$

C. $50cm$

D. $30cm$

Answer: D

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22. Water rises to a height of $10cm$ in a certain capillary tube. An another identical tube when dipped in mercury is depressed by $3.42cm$.Density of mercury is $13.6g/cc$.The angel of contact for water in contact with glass is 0° and mercury in contact with glass is 135°. The ratio of surface tension of water to that of Hg is

A. $1:0.15$

B. $1:3$

C. $1:6.5$

D. $1.5:1$

Answer: C

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23. The velocity of small ball of mass M and density ($d_1 =$ when dropped a container filled with glycerine becomes constant after some time. If the density glycerine is d_2, the viscous force acting on ball is

A. $\frac{Md_1g}{d_2}$

B. $Mg\left(1 - \frac{d_2}{d_1}\right)$

C. $\frac{M(d_1 + d_2)}{g}$

D. Md_1d_2

Answer: B

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24. Two soap bubbles, one of radius $50mm$ and the other of radius $80mm$, are brought in contact so that they have a common interface. The radius of the curvature of the common interface is

A. $0.003m$

B. $0.133m$

C. $1.2m$

D. $8.9m$

Answer: B

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25. A glass rod of radius r_1 is inserted symmetrically into a vertical capillary tube of radius r_2 such that their lower ends are at the same level. The arrangement is now dipped in water.

The height to which water will rise into the tube will be ($\sigma =$ surface tension of water, $\rho =$ density of water)

A. $\dfrac{2\sigma}{(r_2 - r_1)\rho g}$

B. $\dfrac{\sigma}{(r_2 - r_1)\rho g}$

C. $\dfrac{2\sigma}{(r_2 + r_1)\rho g}$

D. $\dfrac{2\sigma}{(r_2^2 + r_1^2)\rho g}$

Answer: A

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26. A large number of droplets, each of radius a, coalesce to form a bigger drop of radius b. Assume that the energy released in the process is converted into the kinetic energy of the drop. The velocity of the drop is $\sigma =$ surface tension, $\rho =$ density)

A. $\left[\frac{\sigma}{\rho}\left(\frac{1}{a}-\frac{1}{b}\right)\right]^{\frac{1}{2}}$

B. $\left[\frac{2\sigma}{\rho}\left(\frac{1}{a}-\frac{1}{b}\right)\right]^{\frac{1}{2}}$

C. $\left[\frac{3\sigma}{\rho}\left(\frac{1}{a}-\frac{1}{b}\right)\right]^{\frac{1}{2}}$

D. $\left[\frac{6\sigma}{\rho}\left(\frac{1}{a}-\frac{1}{b}\right)\right]^{\frac{1}{2}}$

Answer: D

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27. A thick rope of density ρ and length L is hung from a rigid support. The increase in length of the rope due to its own weight is (Y is the Young's modulus)

A. $\frac{0.1}{4Y}\rho L^2 g$

B. $\frac{1}{2Y}\rho L^2 g$

C. $\frac{\rho L^2 g}{Y}$

D. $\frac{\rho L g}{Y}$

Answer: B

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28. When the load on a wire is increased from 3 kg wt to 5 kg wt the elongation increases from 0.61 mm to1.02 mm. The required work done during the given wire?

A. $0.16J$

B. $0.016J$

C. $1.6J$

D. $16J$

Answer: B

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29. Two identical wires of iron and copper with their Young's modulus in the ratio $3:1$ are suspended at same level. They are to be loaded so as to have the same extension and hence level. Ratio of the weight is

A. $1:3$

B. $2:1$

C. $3:1$

D. $4:1$

Answer: C

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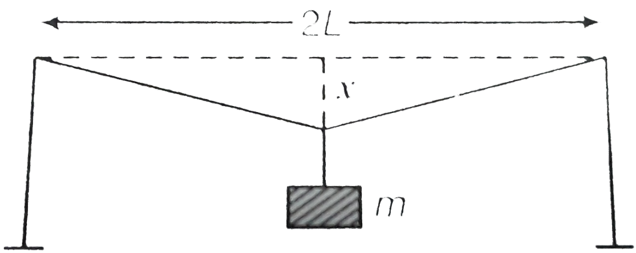
30. A mild steel wire of length 2L and cross-sectional area A is stretched, well within elastic limit, horizontally between two pillars (figure). A mass m is suspended from the mid-point of the wire. Strain in the wire is



A. $\frac{2x^2}{l^2}$

B. $\frac{x^2}{l^2}$

C. $\frac{x^2}{2l^2}$

D. none of these

Answer: C

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31. A long wire hangs vertically with its upper end clam A torque of $8Nm$ applied to the free end twists it through45°. The potential energy of the twisted wire is

A. πJ

B. $\frac{\pi}{2}J$

C. $\frac{\pi}{4}J$

D. $\frac{\pi}{8}J$

Answer: A

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32. The bulk modulus of water is $2.0 \times 10^9 N/m^2$. The pressure required to increase the density of water by 0.1% is

A. $2 \times 10^9 N/m^2$

B. $2 \times 10^8 N/m^2$

C. $2 \times 10^6 /m^2$

D. $2 \times 10^4 N/m^2$

Answer: C

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33. Two rods of different materials having coefficients of thermal expansion α_1, α_2 and Young's modulii Y_1, Y_2 respectively are fixed between two rigid massive walls. The rods are heated such that they undergo the same increase in temperature. There is no bending of the rods. If $\alpha_1 : \alpha_2 = 2 : 3$, the thermal stresses developed in the two rods are equal provided $Y_1 : Y_2$ is equal to

A. $2 : 3$

B. $1 : 1$

C. $3 : 2$

D. $4 : 9$

Answer: C

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34. One end of a uniform wire of length L and of weight W is attached rigidly to a point in the roof and a weight W_1 is suspended from its lower end. IF S is the area of cross-section of the wire, the stress in the wire at a height 3L/4 from its lower end is

A. $\frac{W_1}{s}$

B. $\left[W_1 + \frac{W}{4}\right]s$

C. $\left[W_1 + \frac{3W}{4}\right]/s$

D. $\frac{W_1 + W}{s}$

Answer: C

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35. A wire is stretched $1mm$ by a force of $1kN$. How far would a wire of the same material and length but of four times that diameter be stretched by the same force?

A. $\frac{1}{2}mm$

B. $\frac{1}{4}mm$

C. $\frac{1}{8}mm$

D. $\frac{1}{16}mm$

Answer: D

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36. The Young's modulus of brass and steel are respectively $10 \times 10^{10} N/m^2$. And $2 \times 10^{10} N/m^2$ A brass wire and a steel wire of the same length are extended by 1 mm under the same force, the radii of brass and steel wires ar R_B and R_S respectively. Then

A. $R_s = \sqrt{2} R_B$

B. $R_S = \frac{R_B}{\sqrt{2}}$

C. $R_S = 4R_B$

D. $R_S = (R_B)/4$

Answer: B

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37. The length of a steel wire is l_1 when the stretching force is T_1 and l_2 when the stretching force is T_2. The natural length of the wire is

A. $\frac{T_2}{R} - 1(l_1 + l_2)$

B. $T_1 l_1 + i_2 l_2$

C. $\frac{l_2 T_2 - l_2 T_1}{T_2 - T_1}$

D. $\frac{l_1 T_2 + l_2 T_1}{T_2 + T_1}$

Answer: C

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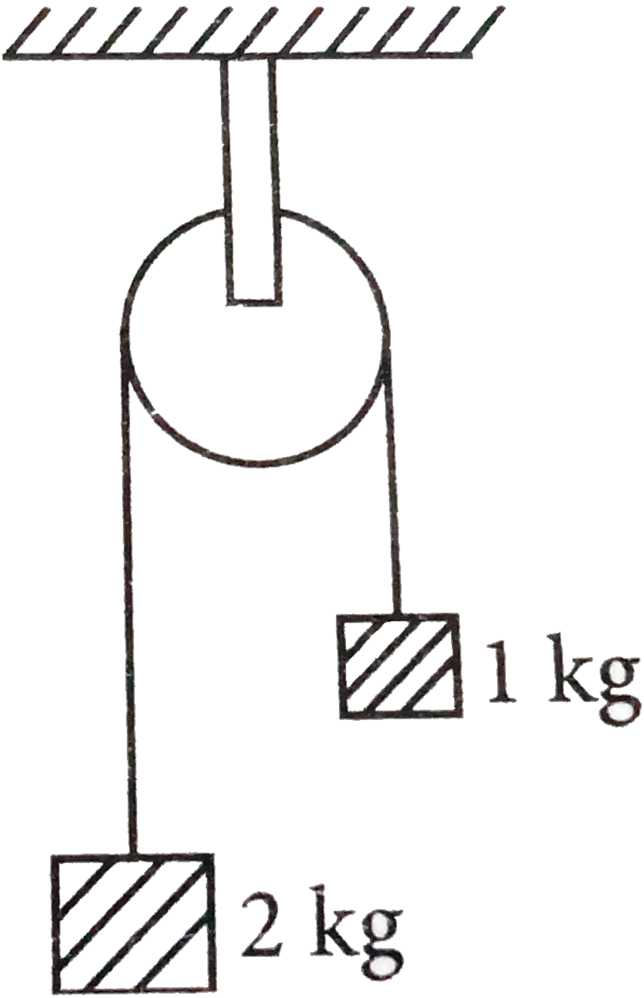
38. Two blocks of masses 1 kg and 2 kg are connected by a metal wire going over a smooth pulley as shown is figure. The breaking stress of the metal is $(40/3\pi) \times 10^6 N/m^{-2}$. If $g = 10ms^{-2}$, them the minimum radius of the wire used if it s not to break is



A. $0.5mm$

B. $1mm$

C. $1.5mm$

D. $2mm$

Answer: B

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39. A long elastic spring is stretched by $2cm$ and its potential energy is U. If the spring is stretched by $10cm$, the PE will be

A. $5U$

B. $25U$

C. $U/5$

D. $U/20$

Answer: B

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40. A copper bar of length L and area of cross section A is placed in a chamber at atmospheric pressure. If the chamber is evacuated, the percentage change in its volume will be (compressibility of copper is $8 \times 10^{-12} m^2 / N$ and $1atm = 10^5 N / m)$

A. 8×10^{-7}

B. 8×10^{-5}

C. 1.25×10^{-4}

D. 1.25×10^{-5}

Answer: B

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41. A body of mass m=10kg is attached to one end of a wire of length 0.3 m. The maximum angulr speed (in rad s^{-1}) with which it can be rotated about its other end in space station is (Breaking stress of wire $= 4.8 \times 10^7 Nm^{-2}$ and area of cross-section of the wire $= 10^{-2} cm^2$ is:

A. $4rad/s$

B. $8rad/s$

C. $10rad/s$

D. $32rad/s$

Answer: A

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42. A ball falling in a lake of depth 200m shown 0.1% decrease in its volume at the bottom .What is the bulk modulus of the materialof the ball

A. $10^9 N/m^2$

B. $2 \times 10^9 N/m^2$

C. $3 \times 10^9 N/m^2$

D. $4 \times 10^9 N/m^2$

Answer: B

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43. A massive stone pillar $20m$ high and of uniform cross section rests on a rigid base and supports a vertical load of

$5.0 \times 10^5 N$ at its upper end. If the compressive stress in the pillar is not exceed $1.6 \times 10^6 N/m^2$, what is the minimum cross-sectional area of the pillar? (Density of the stone $= 2.5 \times 10^3 kg/m^3$ take $g = 10N/kg$)

A. $0.15m^2$

B. $0.25m^2$

C. $0.35m^2$

D. $0.45m^2$

Answer: D

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44. If the work done in stretching a wire by $1mm$ is $2J$, then work necessary for stretching another wire of same material but with double radius of cross -section and half of the length by $1mm$ is

A. $\frac{1}{4}J$

B. $4J$

C. $8J$

D. $16J$

Answer: B

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45. Two wires of the same material and same mass are stretched by the same force. Their lengths are in the ratio 2:3. Their elongation are in the ratio

A. $3:2$

B. $2:3$

C. $4:9$

D. $9:4$

Answer: C

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46. A wire is suspended vertically from a rigid support. When loaded with a steel weight in air, the wire extends by $16cm$. When the weight is completely immersed in Water, the extension is reduced to $14cm$. The relative density of the material of the weight is

A. $2g/cm^3$

B. $6g/cm^3$

C. $8g / cm^3$

D. $16g / cm^3$

Answer: C

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47. Two bars A and B of circular cross section, same volume and made of the same material, are subjected to tension. If the diameter of A is half that of B and if the force applied to both the rod is the same and it is in the elastic limit, the ratio of extension of A to that of B will be

A. 16

B. 8

C. 4

D. 2

Answer: A

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48. A uniform cylindrical wire is subjected to a longitudinal tensile stress of $5 \times 10^7 N/m^2$. Young's modulus of the material of the wire is $2 \times 10^{11} N/m^2$. The volume change in the wire is 0.02%. The factional change in the radius is

A. 0.25×10^{-4}

B. 0.5×10^{-4}

C. 1.0×10^{-4}

D. 1.5×10^{-4}

Answer: A

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49. A material has normal density ρ and bulk modulus K. The increase in the density of the material when it is subjected to an external pressure P from all sides is

A. $P / \rho K$

B. $K / \rho P$

C. $\rho P / K$

D. $\rho K / P$

Answer: C

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50. A rubber rope of length $8m$ is hung from the ceiling of a room. What is the increase in length of rope due to its own weight? (Given: Young's modulus of elasticity of rubber $= 5 \times 10^6 N/m$ and density of rubber $= 1.5 \times 10^3 kg/m^3$. Take $g = 10ms^{-12}$)

A. $1.5mm$

B. $6mm$

C. $24mm$

D. $96mm$

Answer: D

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51. A straw $6cm$ long floats on water. The water film on one side has surface tension of $50dyn/cm$. On the other slide, camphor reduces the surface tension to $40dyn/cm$. The resultant force acting on the straw is

A. $(50 \times 6 - 40 \times 6)dyn$

B. $10dyn$

C. $\left(\frac{50}{6} - \frac{40}{6}\right)dyn$

D. $90dyn$

Answer: A

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52. Two glass plates are separated by water. If surface tension of water is $75 dyn / cm$ and the area of each plate wetted by water is $8 cm^2$ and the distance between the plates is $0.12 mm$, then the force applied to separate the two plates is

A. $10^2 dyn$

B. $10^4 dyn$

C. $10^5 dyn$

D. $10^6 dyn$

Answer: C

Watch Video Solution

53. A ring of internal and external diameters $8.5 \times 10^{-2} m$ and $8.7 \times 10^{-2} m$ is supported horizontally from the pan of a physical balance such that it comes in contact with a liquid. An extra force of 40N is required to pull it away from the liquid . Determine the surface tension of the liquid?

A. $72 dyn / cm$

B. $70.80 dyn / cm$

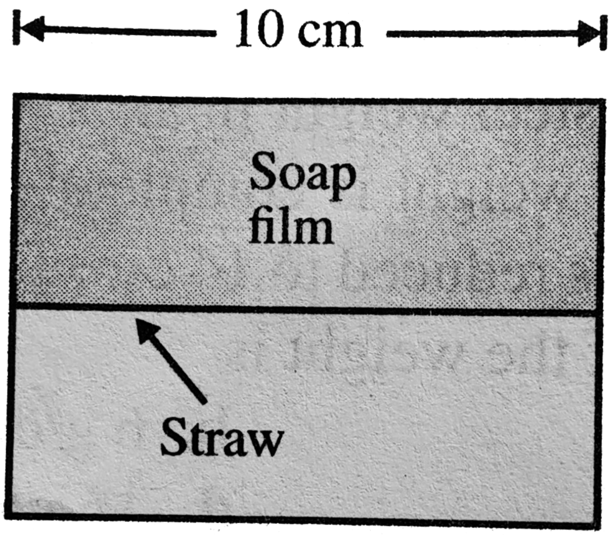
C. $63.35 dyn / cm$

D. $60 dyn / cm$

Answer: A

Watch Video Solution

54. A soap film of surface tension 3×10^{-2} formed in a rectangular frame can support a straw as shown in Fig. If $g = 10ms^{-12}$, the mass of the straw is



A. $0.006g$

B. $0.06g$

C. $0.6g$

D. $6g$

Answer: C

Watch Video Solution

55. The lower end of a capillary tube is at a depth of $12cm$ and water rises $3cm$ in it. The mouth pressure required to blow an air bubble at the lower end will be xcm of water column, where x is

A. 12

B. 15

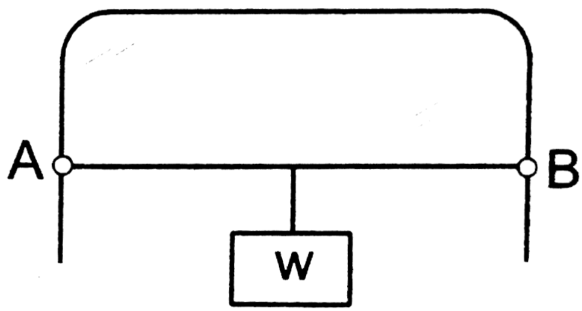
C. 3

D. 9

Answer: B

Watch Video Solution

56. A light wire AB of length 10 cm can slide on a vertical frame as shown in figure. There is a film of soap solution trapped between the frame and the wire. Find the load W that should be suspended from the wire to keep it in equilibrium. Neglect friction. Surface tension of soat solution $= 25$ dyne cm^{-1}. Take $g = 10ms^{-2}$



A. $0.2g$

B. $0.3g$

C. $0.4g$

D. $0.5g$

Answer: D

Watch Video Solution

57. The angle of contact between glass and water is 0° and water (surface tension $70 dyn / cm$) rises in a glass capillary up to $6 cm$. Another liquid of surface tension $140 dyn / cm$, angle of contact 60° and relative density 2 will rise in the same capillary up to

A. $12 cm$

B. $24 cm$

C. $3 cm$

D. $6cm$

Answer: C

Watch Video Solution

58. A hollow sphere has a small hole in it. On lowering the sphere in a tank of water, it is observed that water enters into the hollow sphere at a depth of $40cm$ below the surface. Surface tension of water is $7 \times 10^{-2} N/m$. The diameter of the hole is

A. $\frac{1}{28}mm$

B. $\frac{1}{21}mm$

C. $\frac{1}{14}mm$

D. $\frac{1}{7}mm$

Answer: C

Watch Video Solution

59. If W_1 be the work to be done to form a bubble of volume V from a given solution.The work required to be done to form a bubble of volume 2V is

A. W

B. $2W$

C. $2^{\frac{1}{3}}W$

D. $4^{\frac{1}{3}}W$

Answer: D

Watch Video Solution

60. The surface energy of a liquid drop is S. It is sprayed into 1000 equal droplets. Then its surface energy becomes

A. $1000E$

B. $100E$

C. $10E$

D. E

Answer: C

Watch Video Solution

61. A cube with a mass $= 20g$ wettable water floats on the surface of water. Each face of the cube is $\alpha = 3cm$ long. Surface tension of water is $70dyn/cm$. The distance of the lower face of the cube from the surface of water is ($g = 980cms^{-12}$)

A. $2.3cm$

B. $4.6cm$

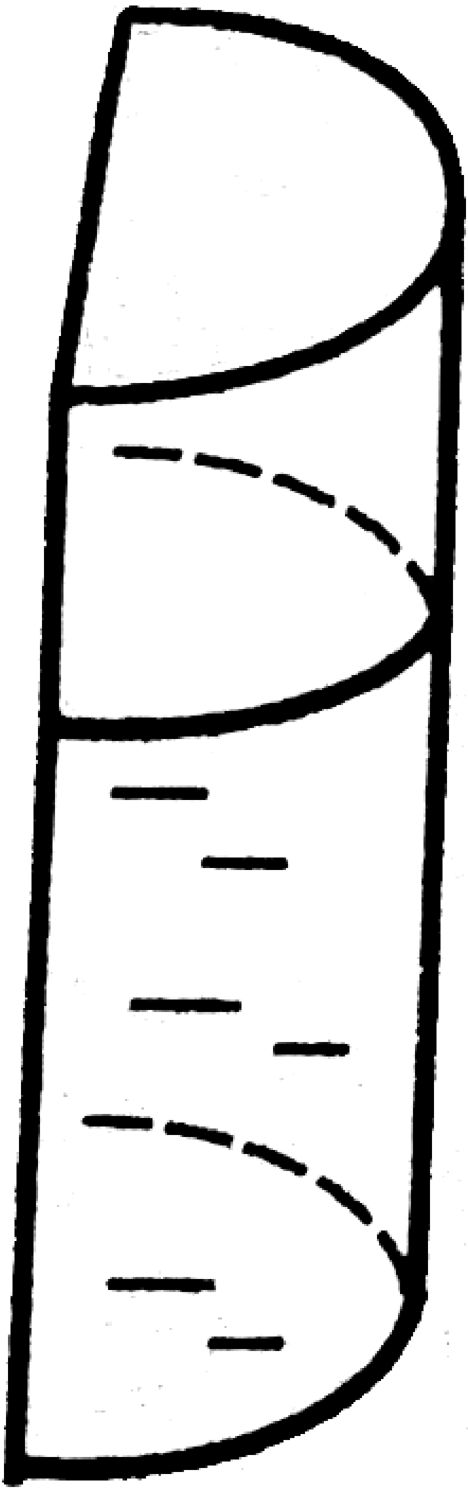
C. $9.7cm$

D. $12.7cm$

Answer: A

Watch Video Solution

62. A liquid is contain in a vertical tube of semicircular cross section figure. The contact angle is zero. The force of surface tension on the curved part and on the flat part are in ratio



A. $2 : \pi$

B. $1 : \pi$

C. $3 : \pi$

D. $2.7 : \pi$

Answer: A

Watch Video Solution

63. Two vertical parallel glass plates are partially submerged in water. The distance between the plates is d and the length is l. Assume that the water between the plates does not reach the upper edges of the plates and the plates and the wetting is complete. The water will rise to height ($\rho =$ density of water and $\alpha =$ surface tension of water)

A. $\frac{2\sigma}{\rho g d}$

B. $\frac{\sigma}{2\rho g d}$

C. $\frac{4\sigma}{\rho g d}$

D. $\frac{5\sigma}{\rho g d}$

Answer: A

Watch Video Solution

64. A number of droplets, each of radius r, combine to form a drop of radius R. If T is the surface tension, the rise in temperature will be

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

B. $\frac{3T}{R}$

C. $2T\left[\frac{1}{r}-\frac{1}{R}\right]$

D. $3T\left[\frac{1}{r}-\frac{1}{R}\right]$

Answer: D

Watch Video Solution

65. A drop of liquid of density ρ is floating half-immersed in a liquid of density d. If σ is the surface tension the diameter of the drop of the liquid is

A. $\sqrt{\frac{\sigma}{g(2\rho-d)}}$

B. $\sqrt{\frac{2\sigma}{g(2\rho-d)}}$

C. $\sqrt{\dfrac{6\sigma}{g(2\rho - d)}}$

D. $\sqrt{\dfrac{12\sigma}{g(2\rho - d)}}$

Answer: D

Watch Video Solution

66. A drop of liquid of density ρ is floating half-immersed in a liquid of density d. If σ is the surface tension the diameter of the drop of the liquid is

A. $\dfrac{TA^2}{V}$

B. $\dfrac{2TA^2}{V}$

C. $\dfrac{4TA^2}{V}$

D. $\dfrac{TA^2}{2V}$

Answer: B

Watch Video Solution

67. Two soap bubbles of radii a and b coalesce to form a single bubble of radius c. If the external pressure is P, find the surface tension of the soap solution.

A. $\dfrac{P(c^3 + a^3 + b^3)}{4(a^2 + b^2 - c^2)}$

B. $\dfrac{P(c^3 - a^3 - b^3)}{4(a^2 + b^2 - c^2)}$

C. $Pc^3 - 4a^2 - 4b^2$

D. $Pc^3 - 2a^2 - 3b^2$

Answer: B

Watch Video Solution

68. A thin square plate of side $5cm$ is suspended vertically a balance so that lower side just dips into water with side to surface. When the plate is clean $(\theta = 0^{\circ})$, it appears to weigh $0.044N$. But when the plate is greasy $(\theta = 180^{\circ})$ it appears to weigh $0.03N$. The surface tension of water is

A. $3.5 \times 10^{-2} N/m$

B. $7.0 \times 10^{-2} N/m$

C. $14.0 \times 10^{-2} N/m$

D. $1.08 N/m$

Answer: B

Watch Video Solution

69. A wire forming a lop is dipped into soap solution and taken out, so that a film of soap solution is formed. A loop of 6.28 cm long thread is gently put on the film and the film is pricked with a meedle inside the loop. The thread loop takes the shape of a circle. Find the tension in the thread. Surface tension of soap solution $= 0.030N/m$.

A. $1 \times 10^4 n$

B. $2 \times 10^{-4} N$

C. $3 \times 10^{-4} N$

D. $4 \times 10^{-4} N$

Answer: C

Watch Video Solution

70. A 20 cm long capillary tube is dipped in water. The water rises up to 8 cm. If the entire arrangement is put in a freely falling elevator, the length of water column in the capillary tube will be

A. $20cm$

B. $4cm$

C. $10cm$

D. $8cm$

Answer: A

Watch Video Solution

71. A marble of mass x and diameter $2r$ is gently released in a tall cylinder containing honey. If the marble displaces mass

$y(< x)$of the liquid, then the terminal velocity is proportional to

A. $x + y$

B. $x - y$

C. $\frac{x+y}{r}$

D. $\frac{x-y}{r}$

Answer: D

Watch Video Solution

72. A small metal ball of diameter $4mm$ and density $10.5g/cm^3$ in dropped in glycerine of density $1.5g/cm^3$. The ball attains a terminal velocity of $8/cms^{-1}$. The coefficient of viscosity of glycerine is

A. 4.9 poise

B. 9.8 poise

C. 98 poise

D. 980 poise

Answer: B

Watch Video Solution

73. A capillary tube is attached horizontally to a constant heat arrangement. If the radius of the capillary tube is increased by 10%, then rate of flow of liquid will change nearly by

A. $+10\%$

B. 46%

C. $-10\,\%$

D. $-40\,\%$

Answer: B

Watch Video Solution

74. A sphere of brass released in a long liquid column attains a terminal speed v_0. If the terminal speed is attained by a sphere of marble of the same radius and released in the same liquid is nv_0, then the value of n will be (Given: The specific gravities of brass, marble and liquid are 8.5, 2.5 and 0.8, respectively)

A. $\frac{5}{17}$

B. $\frac{17}{77}$

C. $\frac{1}{31}$

D. $\frac{17}{5}$

Answer: B

Watch Video Solution

75. Between a plate of area $100cm^2$ and another plate of area $100m^2$ there is a $1mm$, thick layer of water, if the coefficient of viscosity of water is 0.01 poise, then the force required to move the smaller plate with a velocity $10cms^{-1}$ with reference to large plate is

A. $100dyn$

B. $10^4 dyn$

C. $10^6 dyn$

D. $10^9 dyn$

Answer: A

Watch Video Solution

76. A river $10m$ deep is flowing at $5ms^{-1}$. The shearing stress between horizontal layers of the rivers is $(\eta = 10^{-(3)}SI$ units)

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

B. $0.8 \times 10^{-3}N/m^2$

C. $0.5 \times 10^{-3}N/m^2$

D. $1N/m^2$

Answer: C

Watch Video Solution

77. A ball rises to the surface of a liquid with constant velocity. The density of the liquid is four lime the density of the material of the ball. The frictional force of the liquid on the rising ball is greater than the weight of the ball by a factor of

A. 2

B. 3

C. 4

D. 6

Answer: B

Watch Video Solution

78. A spherical ball falls through viscous medium with terminal velocity v. If this ball is replaced by another ball of the same mass but half the radius, then the terminal velocity will be (neglect the effect of buoyancy.)

A. v

B. $2v$

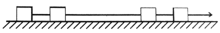
C. $4v$

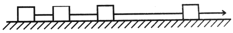
D. $8v$

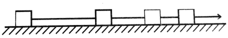
Answer: B

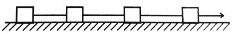
Watch Video Solution

79. Each of the pictures shows four objects tied together with rubber bands being pulled to the right across a horizontal frictionless surface by a horizontal force F. All the objects have the same mass, all the rubber bands obey Hooke's law and have the same equilibrium length and the same force constant. Which of these pictures is drawn most correctly?

A. a. 

B. b. 

C. c. 

D. d. 

Answer: B

Watch Video Solution

80. A glass rod of radius $1mm$ is inserted symmetrically into a glass capillary tube with inside radius $2mm$. Then the whole arrangement is brought in contact of the surface of water. Surface tension of water is $7 \times 10^{-2} N/m$. To what height will the water rise in the capillary? ($\theta = 0^{\circ}$)

A. $1.4cm$

B. $4.2cm$

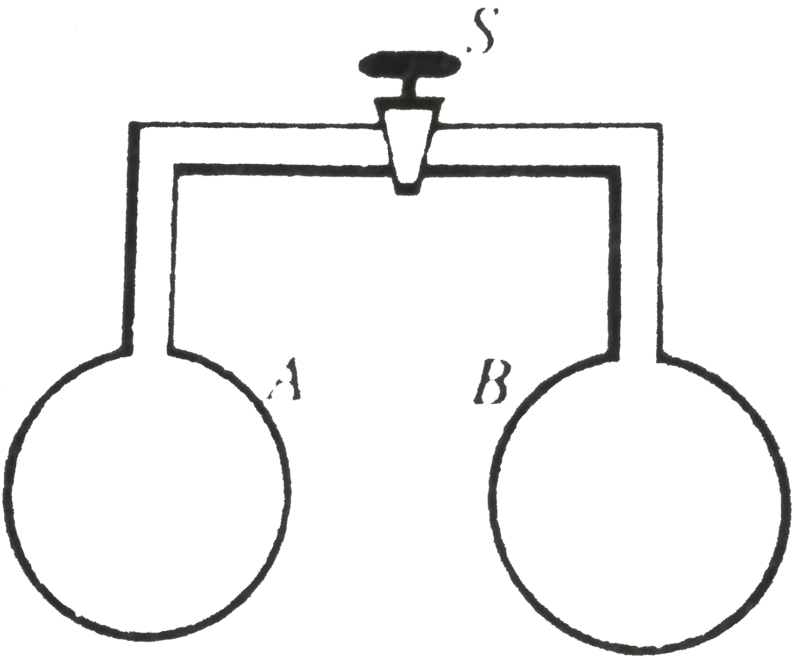
C. $2.1cm$

D. $6.8cm$

Answer: A

Watch Video Solution

81. Two soap bubbles A and B of different diameters are blown at the two ends of a bent tube. By opening the stopcock S, the two bubbles are put in communication. What will happen?



A. There will be change in the size of the bubbles

B. The bubbles will become of equal size

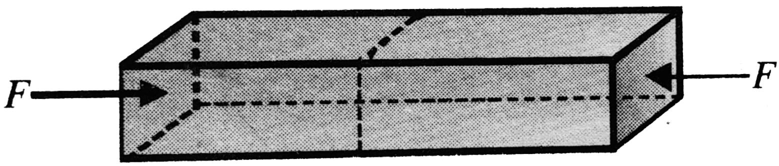
C. The bubbles will become of equal size

D. The bubbles will become of equal size

Answer: C

Watch Video Solution

82. In the figure shown, forces of equal magnitude are applied to the two ends of a uniform rod. Consider A as the cross-sectional area of the rod. For this situation, mark out the incorrect statements.



A. The rod is in compressive stress.

B. The numerical value of stress developed in the rod is equal to F/A.

C. The stress is defined as internal force developed at any cross section per unit area.

D. none of these

Answer: D

Watch Video Solution

83. The space between two large horizontal metal plates, $6cm$ apart, is filled with a liquid of viscosity $0.8N/m^2$. A thin plate of surface area $0.01m^2$ is moved parallel to the length of the plate such that the plate is at a distance of $2m$ from one of the plates and $4cm$ from the other. If the plate moves with a constant speed of $1ms^{-1}$, then

A. the layer of the fluid, which is having the maximum velocity, is lying mid-way between the plates

B. the layers of the fluid, which is in contact with the moving plate, is having the maximum velocity

C. the layer of the fluid, which is in contact with the moving plate and is on the side of farther plate, is moving with the maximum velocity

D. the layer of the fluid, which is in contact with the moving plant and is on the side of nearer plate, is moving with the maximum velocity

Answer: B

Watch Video Solution

84. The pressure that has to be applied to the ends of a steel wire of length 10 cm to keep its length constant when its temperature is raised by $100^\circ C$ is :

(For steel Young's modulus is $2 \times 10^{11} Nm^{-2}$ and coefficient of thermal expansion is $1.1 \times 10^{-5} K^{-1}$)

A. $22 \times 10^7 atm$

B. $2.2 \times 10^3 atm$

C. zero

D. $4.3 \times 10^3 atm$

Answer: B

Watch Video Solution

85. Maximum excess pressure inside a thin-walled steel tube of radius r and thickness $\triangle r(< < r)$, so that the tube would not rupture would be (breaking stress of steel is $\sigma_{\max}$

A. $\sigma_{\max} \times \frac{r}{\triangle r}$

B. $\sigma_{\max} \times \frac{\triangle r}{r}$

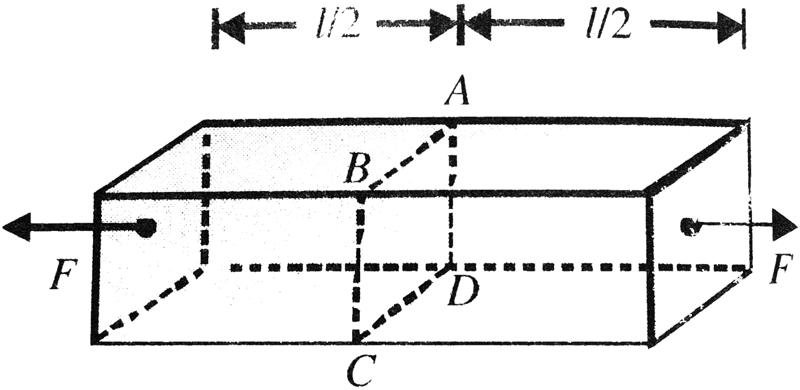
C. $\sigma_{\max}$

D. $\sigma_{\max} \times \frac{\triangle 2r}{r}$

Answer: B

Watch Video Solution

86. Two equal and opposite point forces applied at mid- points of the ends of a rod of square cross shown. Consider the dotted section $ABCD$. If the rod is cut across this Gloss section, the force exerted by the right part of the rod on left part across this cross section is



A. acting at point passing through cross section acting at point passing through cross section $ABCD$

B. acting at a point but not passing through the centre of cross section $ABCD$

C. uniformly distributed across the cross section $ABCD$

D. non-uniformly distributed across the cross section $ABCD$

Answer: C

Watch Video Solution

87. A $5kg$ rod of square cross section $5cm$ on a side and $1m$ long is pulled along a smooth horizontal surface by a force applied at one end. The rod has a constant acceleration of $2ms^{-12}$. Determine the elongation in the rod. (Young's modulus of the material of the rod is $5 \times 10^3 N/m^9$).

A. Zero, as for elongation to be there, equal and opposite forces must act on the rod

B. Non-zero but cannot be determine from the give, situation

C. $0.4 \mu m$

D. $16\mu m$

Answer: C

Watch Video Solution

88. If two soap bubbles of different radii are connected by a tube

A. air follows from the larger bubble into smaller bubble till both bubbles acquire-same size

B. air follows from the smaller bubble into larger bubble and the larger bubble grows in size with decrease in size of the smaller bubble

C. air does not flow but the sizes of the bubbles changes

D. sizes of the bubbles remain unchanged

Answer: B

Watch Video Solution

89. A paper disc of radius R from which a hole of radius r is cut out is floating in a liquid of the surface tension S. The force on the disc due to the surface tension is

A. $S \times 2\pi R$

B. $S \times 2\pi r$

C. $S \times 2\pi(R - r)$

D. $S \times 2\pi(R + r)$

Answer: D

Watch Video Solution

90. A glass rod of radius $1mm$ is inserted symmetrically into a glass capillary tube with inside radius $2mm$. Then the whole arrangement is brought in contact with the surface of water. Surface tension of water is $7 \times 10^{-2} N/m$. To what height will the water rise in the capillary? ($\theta = 0^{\circ}$)

A. $1.44cm$

B. $6cm$

C. 4.86

D. none of these

Answer: A

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91. The elastic limit of an elavator cable is $2 \times 10^9 N / m^2$. The maximum upward acceleration that an elavator of mass $2 \times 10^3 kg$ can have when supported by a cable whose cross sectional area is $10^{-4} m^2$, provided the stres in cable would not exceed half to the elastic limit would be

A. $10 ms^{-2}$

B. $50 ms^{-2}$

C. $40 ms^{-2}$

D. Not possible to move up

Answer: C

Watch Video Solution

92. A wire can sustain the weight of 20 kg before breaking. If the wire is cut into two equal parts each part can sustain a weight of

A. $10kg$

B. $20kg$

C. $40kg$

D. $35kg$

Answer: B

Watch Video Solution

93. A wire of length L and radius r is clamped rigidly at one end. When the other end of the wire is pulled by a force f, its length increases by l. Another wire of the same material of length 2L and radius 2r, is pulled by a force 2f. Find the increase in length of this wire.

A. $\frac{l}{2}$

B. l

C. $2l$

D. $\frac{l}{4}$

Answer: B

Watch Video Solution

94. On applying a stress of $x N / m^2$, the length of wire of some material gets doubled. Value of Young's modulus for the material of wire in N/m^2, is (assume Hooke's law to be valid and go for approx. results)

A. x

B. $2x$

C. $\frac{x}{2}$

D. Insufficient information

Answer: A

Watch Video Solution

95. A copper and a steel wire of the same diameter are connectedend toend. A deforming force F is applied to this composite wire which causes a total elongation of 1 cm. The two wires will have

A. same stress and same strain

B. same stress and different strains

C. different stresses and same strain

D. different stresses and different strains

Answer: B

Watch Video Solution

96. A steel wire of length 4.7 m and cross-sectional area 3.0 $\times 10^{-5} m^2$ stretches by the same amount as a copper wire of length 3.5 m and cross-sectional area of 4.0 $\times 10^{-5} m^2$ under a given load. What is the ratio of the ratio of the Young's modulus of steel to that of copper?

A. 1.8

B. 3.6

C. 0.6

D. 8.7

Answer: A

Watch Video Solution

97. The edge of an aluminium cube is 10 cm long. One face of the cube is firmly fixed to a vertical wall. A mass of 100 kg is then attached to the opposite tace of the cube. The vertical deflection of this face is (Shear modulus cf aluminium 25 GPa, $g = 10ms^{-2}$)

A. $4 \times 10^{-4}m$

B. $4 \times 10^{-7}m$

C. $25 \times 10^{-6} m$

D. $6x10^{-7} m$

Answer: B

Watch Video Solution

98. A solid sphere of radius r made of a soft material of bulk modulus K is surrounded by a liquid in a cylindrical container. A massless piston of area a floats on the surface of the liquid, covering entire cross section of cylindrical container. When a mass m is placed on the surface of the piston to compress the liquid, the fractional decrement in the radius of the sphere, $\left(\frac{dr}{r}\right)$, is :

A. $\frac{Mg}{AK}$

B. $\frac{Mg}{3AK}$

C. $\frac{3Mg}{AK}$

D. $\frac{Mg}{2AK}$

Answer: B

Watch Video Solution

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

A. $1.44 \times 10^{-5} \times 10^{-5} J$

B. $1.72 \times 10^{-5} J$

C. $1.44 \times 10^{-4} J$

D. $1.72 \times 10^{-4} J$

Answer: A

Watch Video Solution

100. The length of a needle floating on water is $2.5cm$. The minimum force in addition to its weight needed to lift the needle above the surface of water will be (surface tension of water is $0.072N/m$)

A. $3.6 \times 10^{-3} N$

B. $10^{-2} N$

C. $9 \times 10^{-4} N$

D. $6 \times 10^{-4} N$

Answer: A

Watch Video Solution

101. A steel wire is stretched by $1kgwt$. If the radius of the wire is doubled, its Young's modulus will

A. remain unchanged

B. become half

C. become double

D. become four times

Answer: A

Watch Video Solution

102. Two long metallic strips are joined together by two rivets each of radius $2mm$. Each rivet can withstand a maximum shearing stress of $1.5 \times 10^9 N/m^2$. Assuming that each rivet shares the stretching load equally, the maximum tensile force the strip can exert without rupture is

A. $1.88 \times 10^4 N$

B. $3.8 \times 10^4 N$

C. $6 \times 10^7 N$

D. $3 \times 10^4 N$

Answer: B

Watch Video Solution

103. A solid sphere falls with a terminal velocity of $20ms^{-1}$ in air. If it is allowed to fall in vacuum

A. terminal velocity will be $20ms^{-1}$

B. terminal velocity will be less than $20ms^{-1}$

C. terminal velocity will be greater than $20ms^{-1}$

D. no terminal velocity will be attained

Answer: D

Watch Video Solution

104. The density of water at the surface of the ocean is ρ and atmospheric pressure is P_0 If the bulk modulus of water is K, what is the density of ocean water at a depth where the pressure is nP_0?

A. $\dfrac{pB}{B-(\alpha-1)p_0}$

B. $\dfrac{pB}{B+(\alpha-1)p_0}$

C. $\dfrac{pB}{B-\alpha p_0}$

D. $\dfrac{pB}{B+\alpha p_0}$

Answer: A

Watch Video Solution

105. Water rises to a height h in a capillary tube of cross-sectional area A. the height to which water will rise in a capillary tube of cross-sectional area $4A$ will be

A. h

B. $h/2$

C. $h/4$

D. $4h$

Answer: B

Watch Video Solution

106. Neglecting the density of air, the terminal velocity obtained by a raindrop of radius $0.3mm$ falling through the air of viscosity $1.8 \times 10^{-5} N/m^2$ will be

A. $10.9m/s$

B. $8.3m/s$

C. $9.2m/s$

D. $7.6m/s$

Answer: A

Watch Video Solution

107. A composite rod consists of a steel rod of length $25cm$ and area $2A$ and a copper rod of length $50cm$ and area A. The composite rod is subjected to an axial load F. If the Young's moduli of steel and copper are in the ratio $2:1$ then

A. the extension produced in copper rod will be more

B. the extension in copper and steel parts will be in the ratio $1:2$

C. the stress applied to copper rod will be more

D. no extension will be produced in the steel rod

Answer: A::B::C

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108. Four rods A, B, C and D) of the same length and material but of different radii $r, r\sqrt{2}, r\sqrt{3}$ and $2r$, respectively, are held between two rigid walls. The temperature of all rods is increased through the same range. If the rods do not bend, then

A. the stress in the rods A, B, C and D is in the ratio $1:2:3:4$

B. the forces on them exerted by the wall are in the ratio $1:2:3:4$

C. the energy stored in the rods due to elasticity is in the ratio $1:2:3:4$

D. it is independent of area like surface tension while friction depends

Answer: B::C

Watch Video Solution

109. Viscous force is somewhat like friction as it opposes the motion and is non-conservative but not exactly so because

A. it is velocity dependent while friction is not

B. it is velocity independent while friction is

C. it is temperature dependent while friction is not

D. it is independent of area is like surface tension while friction is dependent

Answer: A::C

Watch Video Solution

110. Excess pressure can be $(2T/R)$ for

A. spherical drop

B. spherical meniscus

C. cylindrical bubble in air

D. spherical bubble in water

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

Watch Video Solution

111. If a liquid rises to the same height in two capillaries of the same material at the same temperature, then

A. the weight of liquid in both capillaries must be equal

B. the radius of meniscus must be equal

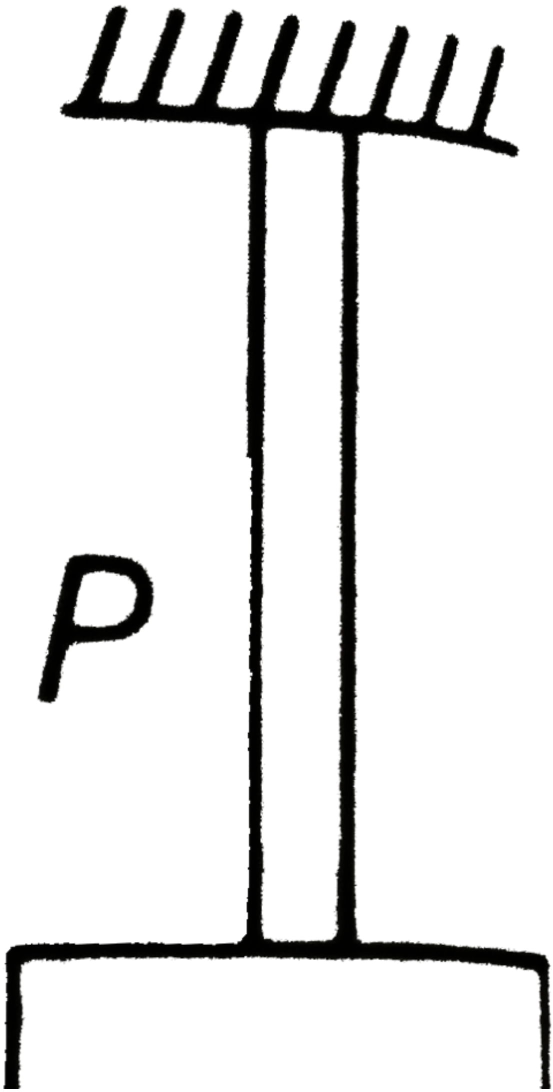
C. the capillaries must be cylindrical and vertical

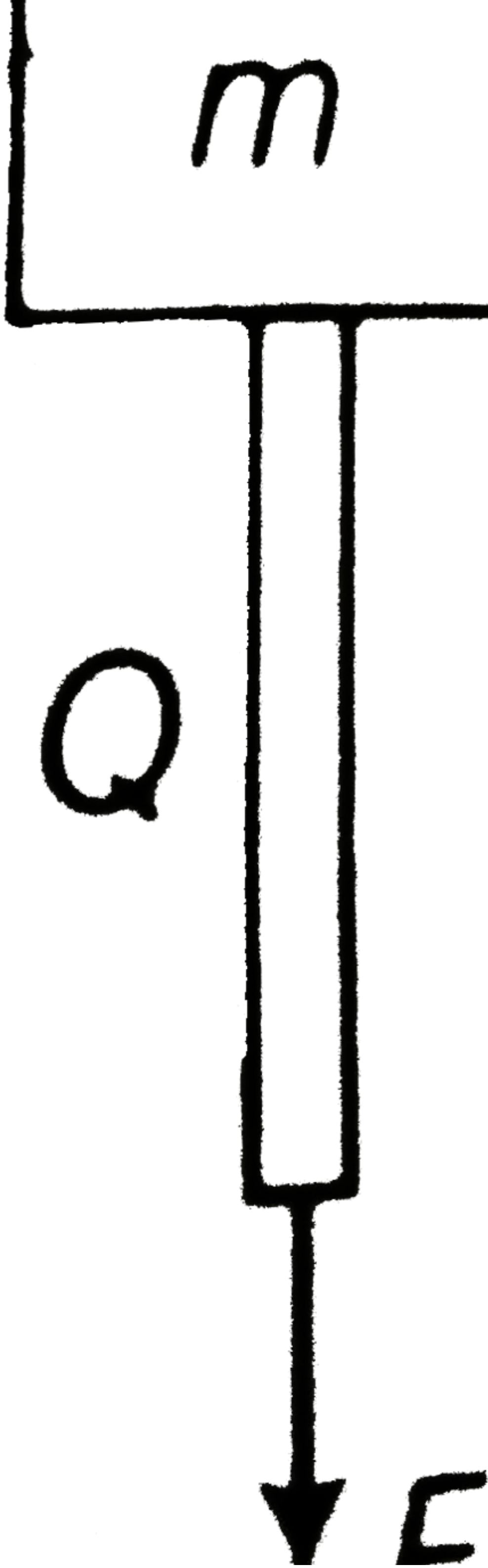
D. the hydrostatic pressure at the base of capillaries must be same

Answer: A::B

Watch Video Solution

112. Two light wires P and Q shown in the figure are made of same material and have radii r_p and r_Q, respectively . The block between them has a mass m. When the force $F = \frac{mg}{3}$, then one of the wires breaks. Choose the correct option(s).




m
Q

A. A will break before B if $r_A = r_B$

B. A will break before B if $r_A < 2r_B$

C. either A or B may break if $r_A = 2r_B$

D. the lengths of A and B must be known to predict which wire will break.

Answer: A::B::C

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Multiple Correct

1. If n drops of a liquid, form a single drop, then

A. some energy will be released in the process

B. some energy will be absorbed in the process

C. the energy released or absorbed will be $E\left(n - n^{\frac{2}{3}}\right)$

D. the energy released or absorbed will be $nE\left(2^{\frac{2}{3}} - 1\right)$

Answer: A::C

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2. When a capillary tube is dipped in a liquid, the liquid rises to a height H in the tube. The free liquid surface inside the tube is hemispherical in shape. The tube is now pushed down sothat the height of the tube outside the liquid is less than H. Then the

A. the liquid will come out of the tube like in a small fountain

B. the liquid will ooze out of the tube slowly

C. the liquid will fill the tube but not come out of its upper end

D. the free liquid surface inside the tube will not be hemispherical

Answer: C::D

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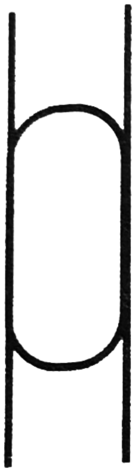
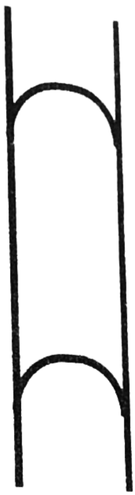
3. A vertical glass capillary tube, open at both ends, contains some water. Which of the following shapes may not be taken by the water -in the tube?

a.



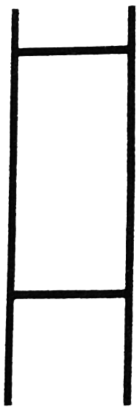
A.

b.

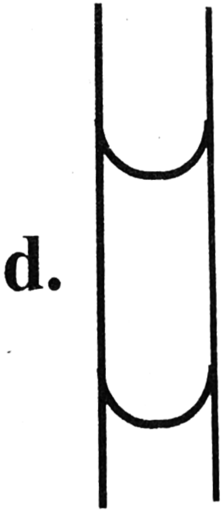


B.

c.



C.



D.

Answer: A::B::C

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4. A uniform plank is resting over a smooth horizontal floor and is pulled by applying a horizontal force at its one end. Which of the following statements are not correct?

A. Stress developed in plank material is maximum at the end at which force is applied and decrease linearly to zero at the other end.

B. A uniform tensile stress is developed in the plank material.

C. Since plank is pulled at one end only, plank starts to accelerate along direction of the force. Hence, no stress developed in the plank material.

D. none of these

Answer: B::C

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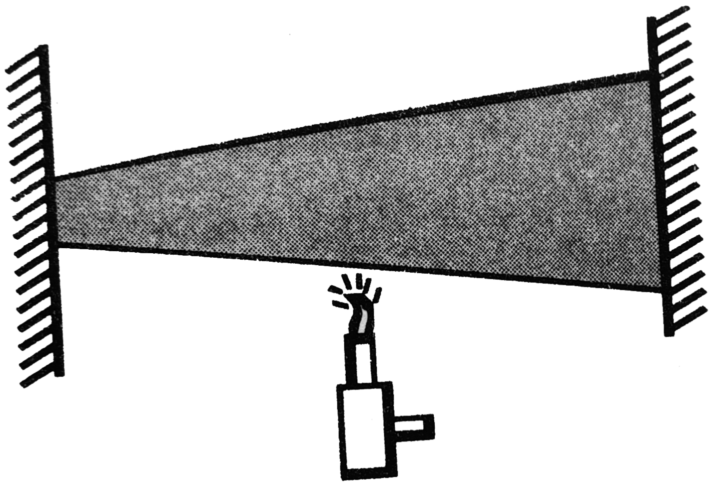
5. A rod is made of uniform material and has non-uniform cross section. It is fixed at both the ends as shown and heated at mid-section. Which of the following are not correct?



A. Force of compression in the rod will be maximum at mid section

B. comressive stress in the rod will be maximum at left end

C. since rod in fixed at both the ends, its length will remain unchanged. Hence, no strain will be induced in it.

D. none of these

Answer: A::C

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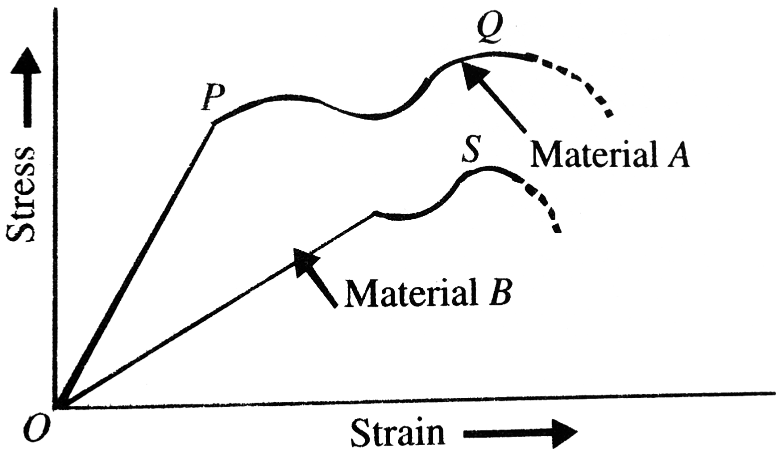
6. Figure shows the stress-strain graphs for materials .A and B. From the graph it follows that



A. to material A has a higher Young's modulus

B. material B is more ductile

C. material A can withstand greater stress

D. material B can withstand greater stress

Answer: A::D

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7. Two wires A and B have the same cross section and are made of the same material, but the length of wire A is twice that of B. Then, for a given load

A. the extension of A will be twice that of B

B. the extensions of A and B will be equal

C. the strain in A will be half that in B

D. the strains in A and B will be equal

Answer: A::D

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8. Two wires A and B have equal lengths and are made of the same material , but diameter of wire A is twice that of wire B. Then, for a given load,

A. The extension of B will be four times that of A

B. the extension of A and B will be equal

C. the strain in B is four times that in A

D. the strains in A and B will be equal

Answer: A::C

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9. Choose the correct statements from the following:

A. Steel is more elastic than rubber.

B. The stretching of a coil spring is determined by the Young's modulus of the wire of the spring.

C. The frequency of a tuning fork is determined by the shear modulus of the material of the fork.

D. When a material is subjected to a tensile (stretching) stress the restoring forces are caused by interatomic attraction.

Answer: A

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10. Which of the following are correct?

A. For a small deformation of a material, the ratio (stress/ strain) remains same.

B. For a large deformation of a material, the ratio (stress/ strain) decreases.

C. Two wires made of different materials, having the same diameter and length are connected end to end. A force is applied. This stretches their combined length by $2mm$. Now, the strain is same in both the wire but stress is different.

D. None of these is correct.

Answer: A::B

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11. A light rod of length $2m$ is suspended from the ceiling horizontally by means of two vertical wires of equal length tied to its ends. One of the wires is made of steel and is of cross section $0.1cm^2$. The other wire is a brass of cross section $0.2cm^2$. A weight is suspended from a certain point of the rod such that equal stress are produced in both the wires. Which of the following are correct?

A. The ratio of tension in the steel and brass wires is 0.5

B. The load is suspended at a distance of $400/3$ cm from the steel wire.

C. Both (a) and (b) are correct

D. Neither (a) nor b) is correct.

Answer: A::B::C

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12. Which of the following are correct?

A. The product of bulk' modulus of elasticity and compressibility is 1

B. A rope $1cm$ in diameter breaks if the tension in it exceeds $500N$. The maximum tension that may be given to a similar rope of diameter $2cm$ is $2000N$.

C. Both (a) and (b) are correct.

D. Neither (a) nor (b) is correct.

Answer: A::B::C

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13. Which of the following are correct?

A. The shear modulus of a liquid is infinite.

B. Bulk modulus of a perfectly rigid body is infinite.

C. According to Hooke's law, the ratio of the stress and strain remains constant.

D. None of the above

Answer: B::C

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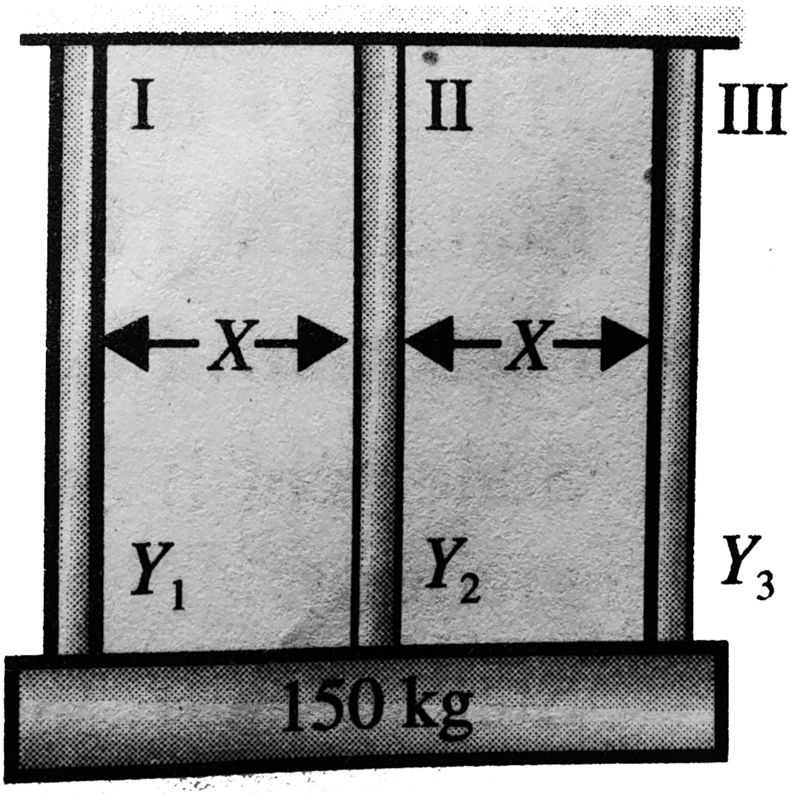
14. A heavy block of mass $150 kg$ hangs with the help of three vertical wires of equal length and equal cross-sectional area as shown in Fig.

Wire is attached to the mid-point (centre of mass) of block. Take $Y_2 = 2Y_1$. For this arrangement mark out the correct statement(s).



A. The wire I and III should have same Young's modulus.

B. Tension in I and III would be always equal.

C. Tension in I and III would be different.

D. Tension in II is $75g$

Answer: A::B::D

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15. A body of mass M is attached to the lower end of a metal wire, whose upper end is fixed . The elongation of the wire is l.

A. Loss in gravitational potential energy of M is Mgl

B. Elastic potential energy stored in the wire is $\frac{Mgl}{2}$

C. Elastic potential energy stored in the wire is Mgl

D. Elastic potential energy stored in the wire is $\frac{Mgl}{3}$

Answer: A::B

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16. A metal wire of length L, area of cross-section A and young's modulus Y is stretched by a variable force F such that F is always slightly greater than the elastic forces of resistance in the wire. When the elongation of the wire is l

A. the work done by F is $\frac{YAl^2}{2L}$

B. the work done by F is $\frac{YAl^2}{L}$

C. the elastic potential energy stored in wire is $\frac{YAl^2}{2L}$

D. no energy is lost during elongation

Answer: A::C::D

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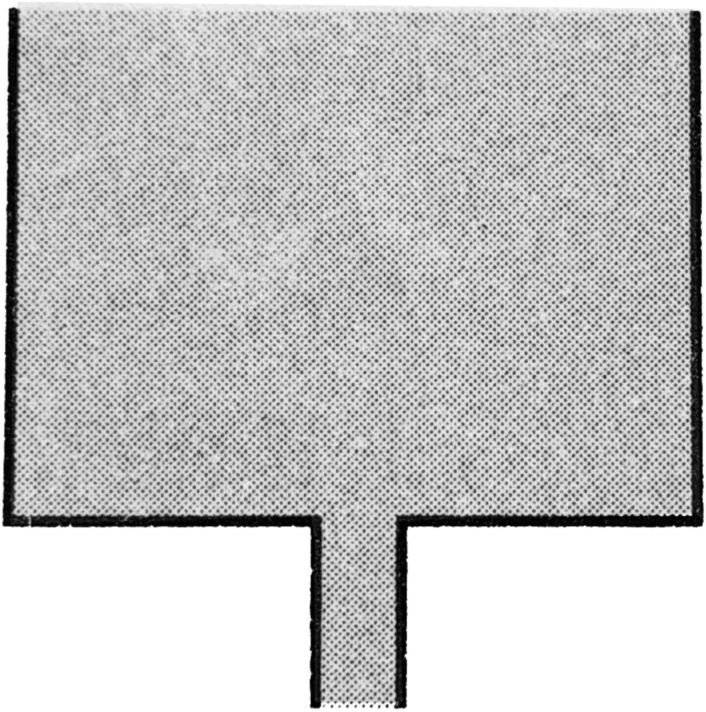
17. A tank of large base area is filled with water up to a height of $5m$. A hole of $2cm^2$ cross section in the bottom allows the water to drain out in continuous streams. For this situation, mark out the correct statement(s) (take

$\rho_{\text{water}} = 1000 kg/m^3, g = 10 ms^{-12})$



A. The cross-sectional area of the emerging stream of water decreases as it falls down.

B. The cross-sectional area of the emerging stream of water increases as it falls down.

C. At a distance of $5m$ below the bottom of the tank, the cross-sectional area of the stream is $1.414cm^2$.

D. At a distance of $5m$ below the bottom of the tank, the cross-sectional area of the stream is $2.86cm^2$.

Answer: A::C

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Assertion- Reasoning

1. Statement I: Surface tension has the same units as fore gradient.

Statement II: Surface tension is the force gradient along the surface of liquid.

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: A

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2. Statement I: Small liquid drops assume sphereical shape.

Statement II: Due to surface tension liquid drops tend to have minimum surface area.

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: A

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3. Statement I: A small drop of mercury is spherical F bigger drops are oval in shape.

Statement II: Surface tension of liquid decreases with increase in temperature.

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: B

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4. Statement I: Droplets of liquid are usually more spherical in shape than large drops of the same liquid.

Statement II: Force of surface tension predominates force of gravity in case of small drops.

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: A

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5. Statement I: Finer the capillary, greater is the height to which the liquid rises in the tube

Statement II: This is in accordance with the ascent formula.

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: A

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6. Statement I: A raindrop after failing through some height attains a constant velocity.

Statement II: At constant velocity, the viscous drag is just equal to its weight.

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: A

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7. Assertion: A neddleplaced carefully on the surface of water may float while a ball of the same material will always sink.

Reason: The buoyancy of an object depends both on the material and the shape of the object.

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: C

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8. Statement I: Dust particles generally settle down in a closed room.

Statement II: The terminal velocity is inversely proportional to the square of their radii.

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: C

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9. Assertion Smaller drop of water resist deformation forces better than the larger drops.

Reason Excess pressure inside drop is inversely porportional to its radius

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: C

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10. Statement I: An object from a greater height reaches a steady terminal velocity.

Statement II: The viscous forces on a body depends upon its velocity. The greater the velocity the greater is the viscous force.

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: B

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11. Statement I: Spraying of water causes cooling.

Statement II: For an isolated system, surface energy increase on the expense of internal energy.

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: A

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12. Statement I: While blowing a soap bubble. to increase the size of soap bubble, we have to increase the air pressure within the soap bubble.

Statement II: To increase the size of soap bubble more air has to be pushed into the bubble.

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: D

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13. Statement I: More is the cohesive force, more is the surface tension.

Statement II: More cohesive force leads to more shrinking of liquid surface.

A. Statement I is true, statement II is true and Statement II is a correct explanation for Statement I.

B. Statement I is true, Statement II is true and Statement II is NOT the correct explanation for Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: A

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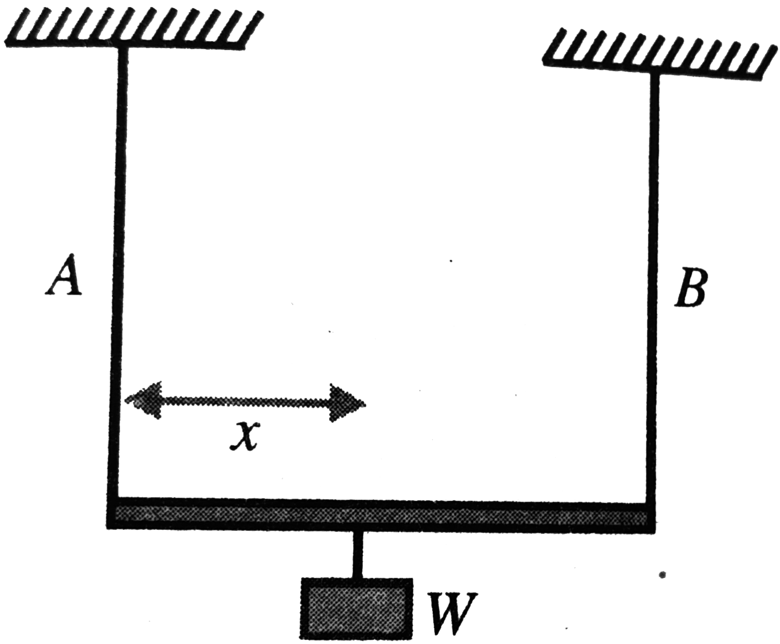
Linked Comprehension

1. A light rod of length $L = 2m$ is suspended horizontally from the ceiling by two wires A and B of equal lengths. The wire A is made of steel with the area of cross section $A_S = 1 \times 10^{-5} m^2$, while the wire B is made of brass of cross sectional area $A_b = 2 \times 10^{-5} m^2$. A weight W is suspended at a distance x from the wire A as shown in figure.

Take, Young's modulus of steel and brass as $Y_s = 2 \times 10^{11} Nm^{-2}$ and $Y_b = 1 \times 10^{11} Nm^{-2}$.



Determine the value of x so that equal stresses are produced in each wire.

A. $1.33m$

B. $2.5m$

C. $3.6m$

D. $2.1m$

Answer: A

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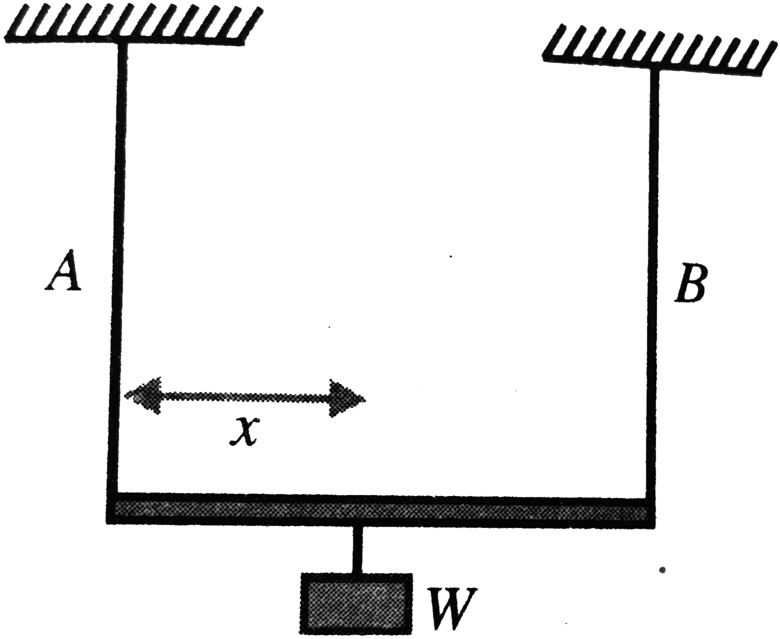
2. A light rod of length $L = 2m$ is suspended horizontally from the ceiling by two wires A and B of equal lengths. The wire A is made of steel with the area of cross section $A_S = 1 \times 10^{-5} m^2$, while the wire B is made of brass of cross sectional area $A_b = 2 \times 10^{-5} m^2$. A weight W is suspended at a distance x from the wire A as shown in figure.

Take, Young's modulus of steel and brass as $Y_s = 2 \times 10^{11} Nm^{-2}$ and $Y_b = 1 \times 10^{11} Nm^{-2}$.



Determine the value of x so that equal strains are produced in each wire

A. $1m$

B. $2m$

C. $3m$

D. $2.2m$

Answer: A

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3. A lead sphere of $1.0mm$ diameter and relative density 11.20 attains a terminal velocity of $0.7cms^{-1}$ in a liquid of relative density 1.26.

Determine the coefficient of dynamic viscosity of the liquid.

A. $0.45N/m^2$

B. $0.85N/m^2$

C. $0.56N/m^2$

D. $0.77N/m^2$

Answer: D

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4. A lead sphere of $1.0mm$ diameter and relative density 11.20 attains a terminal velocity of $0.7cms^{-1}$ in a liquid of relative density 1.26.

What is the value of the Reynolds number?

A. 0.01

B. 0.03

C. 0.15

D. 0.26

Answer: A

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5. A long capillary tube of radius $0.2mm$ is placed vertically inside a beaker of water.

If the surface tension of water is $7.2 \times 10^{-2} N/m$ the angle of contact between glass and water is zero, then determine the height of the water column in the tube.

A. $3cm$

B. $9cm$

C. $7cm$

D. $5cm$

Answer: C

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6. A long capillary tube of radius $0.2mm$ is placed vertically inside a beaker of water.

If the tube is now pushed into water so that only $5.0cm$ of its length is above the surface, then determine the angle of contact between the liquid and glass surface.

A. $\cos^{-1}\left(\frac{4}{5}\right)$

B. $\cos^{-1}\left(\frac{5}{7}\right)$

C. $\cos^{-1}\left(\frac{3}{5}\right)$

D. $\cos^{-1}\left(\frac{5}{4}\right)$

Answer: B

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7. An oil of relative density 0.9 and viscosity $0.12kg/ms$ flows through a $2.5cm$ diameter pipe with a pressure drop of $38.4kN/m^2$ in a length of $30m$. Determine

Determine the discharge

A. $2.16 \times 10^{-4} m^3/s$

B. $2.9 \times 10^{-3} m^3/s$

C. $1 \times 10^{-4} m^3/s$

D. $2 \times 10^{-4} m^3/s$

Answer: C

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8. An oil of relative density 0.9 and viscosity $0.12kg/ms$ flows through a $2.5cm$ diameter pipe with a pressure drop of $38.4kN/m^2$ in a length of $30m$. Determine

Determine the shear stress at the pipe wall

A. $8 \times 10^{-6} N/m^2$

B. $3.9 \times 10^{-6} N/m^2$

C. $2.3 \times 10^{-6} N/m^2$

D. $10.6 \times 10^{-6} N/m^2$

Answer: A

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9. An oil of relative density 0.9 and viscosity $0.12kg/ms$ flows through a $2.5cm$ diameter pipe with a pressure drop of $38.4kN/m^2$ in a length of $30m$. Determine

Determine the power required to maintain the flow

A. $2.2W$

B. $3.84W$

C. $5.6W$

D. $9.3W$

Answer: B

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10. A steel wire of length 4.5 m and cross-sectional area $3 \times 10^{-5} m^2$ stretches by the same amount as a copper wire of length 3.5 m and cross-sectional area of $4x10^{-5} m^2$ under a given load. The ratio of the Young's modulus of steel to that of copper is

A. 10^{-4}

B. 5×10^{-5}

C. 2×10^{-3}

D. 10^{-6}

Answer: B

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11. A steel wire of length 4.5 m and cross-sectional area $3 \times 10^{-5} m^2$ stretches by the same amount as a copper wire of length 3.5 m and cross-sectional area of $4x10^{-5} m^2$ under a given load. The ratio of the Young's modulus of steel to that of copper is

A. $5 \times 10^6 N / m^2$

B. $10^5 N / m^2$

C. $10^8 N / m^2$

D. $10^3 N / m^2$

Answer: A

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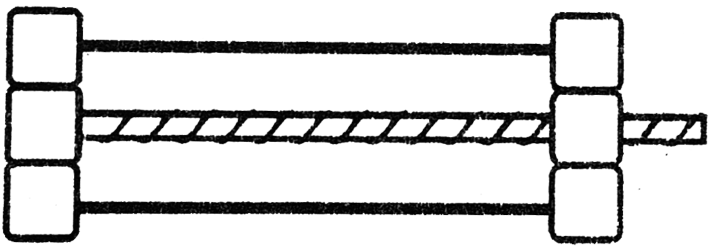
12. A steel bolt of cross-sectional area $A_b = 5 \times 10^{-5} m^2$ is passed through a cylindrical tube made of aluminium. Cross-sectional area of the tube material is $A_t = 10^{-4} m^2$ and its length is $l = 50 cm$. The bolt is just taut so that there is no stress in the bolt and temperature of the assembly increases through $\triangle \theta = 10^\circ C$. Given, coefficient of linear thermal expansion of steel, $\alpha_b = 10^{-5} / ^\circ C$.



Young's modulus of steel $Y_b = 2 \times 10^{11} N/m^2$

Young's modulus of $Al, Y_t = 10^{11} N/m^2$, coefficient of linear thermal expansion of $Al \alpha_t = 2 \times 10^{-5} / ^\circ C$

The tensile stress in bolt is

A. $10^4 N/m^2$

B. $10^7 N / m^2$

C. $2 \times 10^8 N / m^2$

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

Answer: B

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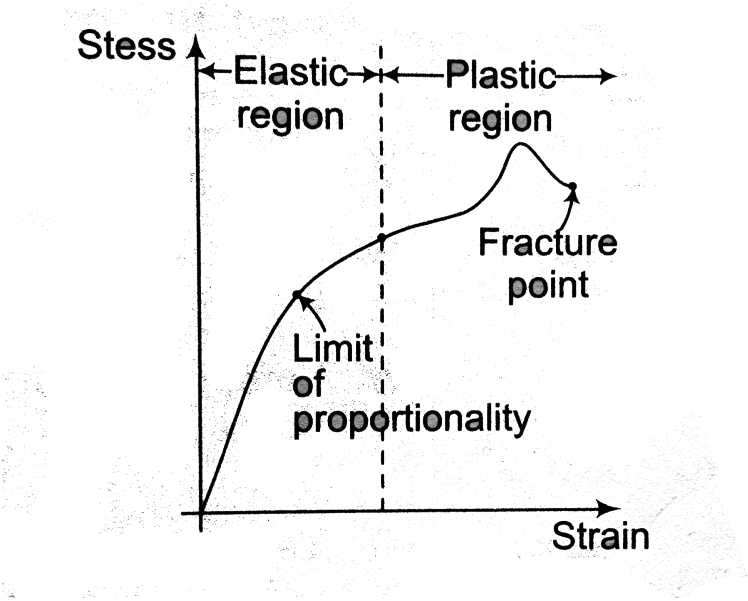
13. On gradual loading , stress - strain relationship for a metal wire is as follows . Within proportionality limit , stress $\propto$ strain or, $\frac{\text{Stress}}{\text{strain}}$ = a constant for the material of wire.

Two wires of same material have length and radius (L, r) and

$\left(2L, \frac{r}{2}\right)$. The ratio of their young's moduli is



A. $1 : 2$

B. $2 : 3$

C. $2 : 1$

D. $1 : 1$

Answer: D

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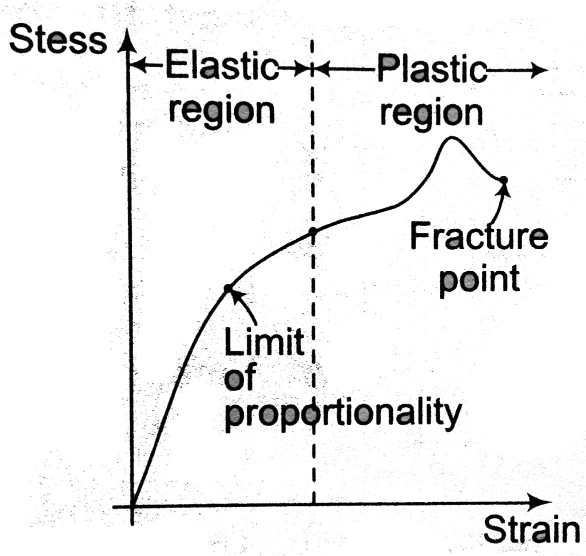
14. On gradual loading , stress - strain relationship for a metal wire is as follows . Within proportionality limit , stress proportional to strain or, $\frac{\text{Stress}}{\text{strain}}$ = a constant for the material of wire.

Just on crossing the yield region, the material will have



A. reduced stress

B. increased stress

C. breaking stress

D. constant stress

Answer: A::C

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15. According to Hooke's law, within the elastic limit stress/strain $=$ constant. This constant depends on the type of strain or the type of force acting. Tensile stress might result in compressional or elongative strain, however, a tangential stress can only cause a shearing strain. After crossing the elastic limit, the material undergoes elongation and beyond a stage beaks. All modulus of elasticity are basically constants for the materials under stress.

If stress/strain is x in elastic region and y in the region of yield, then

A. $x = y$

B. $x > y$

C. $x < y$

D. $x = 2y$

Answer: B

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16. Molecular forces exist between the molecules of a liquid in a container. The molecules on the surface have unequal force leading to a tension on the surface. If this is not compensated by a force, the equilibrium of the liquid will be a difficult task.

This leads to an excess pressure on the surface. The nature of the meniscus can inform us of the direction of the excess pressure. The angle of contact of the liquid decided by the forces between the molecules, air and container can make the angle of contact.

The direction of the excess pressure in the meniscus of a liquid of angle of contact $2\pi / 3$ is

A. upward

B. downward

C. horizontal

D. cannot be determined

Answer: A

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17. Molecular forces exist between the molecules of a liquid in a container. The molecules on the surface have unequal force leading to a tension on the surface. If this is not compensated by a force, the equilibrium of the liquid will be a difficult task. This leads to an excess pressure on the surface. The nature of the meniscus can inform us of the direction of the excess pressure. The angle of contact of the liquid decided by the forces between the molecules, air and container can make the angle of contact.

If the excess pressure in a soap bubble is p, the excess pressure in an air bubble is

A. $\frac{p}{2}$

B. p

C. $2p$

D. $4p$

Answer: A

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18. Molecular forces exist between the molecules of a liquid in a container. The molecules on the surface have unequal force leading to a tension on the surface. If this is not compensated by a force, the equilibrium of the liquid will be a difficult task. This leads to an excess pressure on the surface. The nature of the meniscus can inform us of the direction of the excess pressure. The angle of contact of the liquid decided by the forces between the molecules, air and container can make the angle of contact.

In a meniscus of radius r, with excess pressure p in atmospheric pressure p_0, the force experienced is

A. $(p - p_0)pr^2$

B. $(p - p_0)2\pi r$

C. $p\pi r^2$

D. $p_0 2\pi r$

Answer: C

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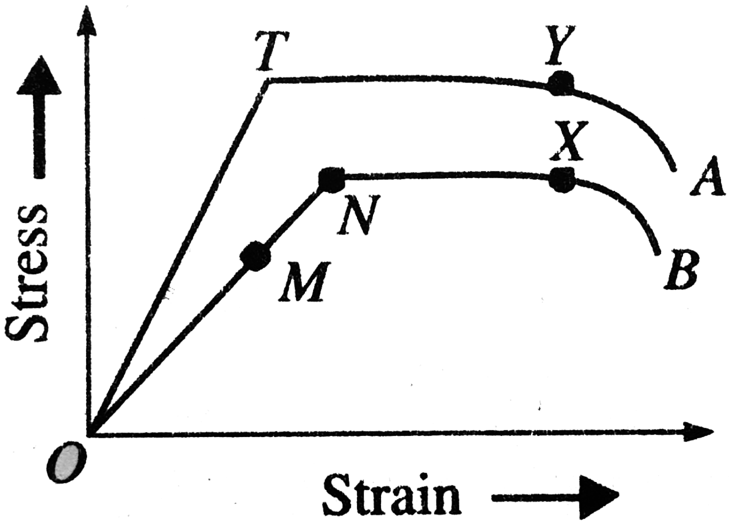
19. Materials get deformed when force is applied. Some of them regain their status when the applied force is removed. They are termed as elastic. Those of which not regaining are called plastic. There may be delay in the regaining in some materials. They are said to have got elastic aftereffect, since they have gone beyond the elastic limit. Repeated application and removal of force leads to fatigueness in the material.

Fatigued materials may break at any point time and so are avoided.

The stress strain graph for two materials A and B is shown in the following figure:



If the intensity of A and B is E_A and E_B, respectively

A. $E_A = E_B$

B. $E_A > E_B$

C. $E_A < E_B$

D. $E_A < < E_B$

Answer: B

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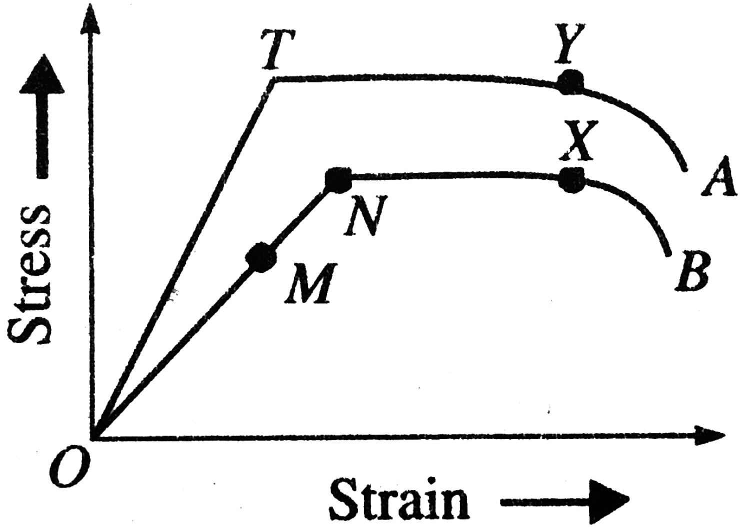
20. Materials get deformed when force is applied. Some of them regain their status when the applied force is removed. They are termed as elastic. Those of which not regaining are called plastic. There may be delay in the regaining in some materials. They are said to have got elastic aftereffect, since they have gone beyond the elastic limit. Repeated application and removal of force leads to fatigueness in the material. Fatigued materials may break at any point time and so are avoided.

The stress strain graph for two materials A and B is shown in the following figure:



The strength of the material A and B is S_A and S_B, respectively, while the longevity of plastic behaviour is L_A and L_B. Then

A. $S_A > S_B, L_A < L_B$

B. $S_A = S_B, L_A = L_B$

C. $S_A > S_B, L_A > L_B$

D. $S_A < S_B, L_A < L_B$

Answer: C

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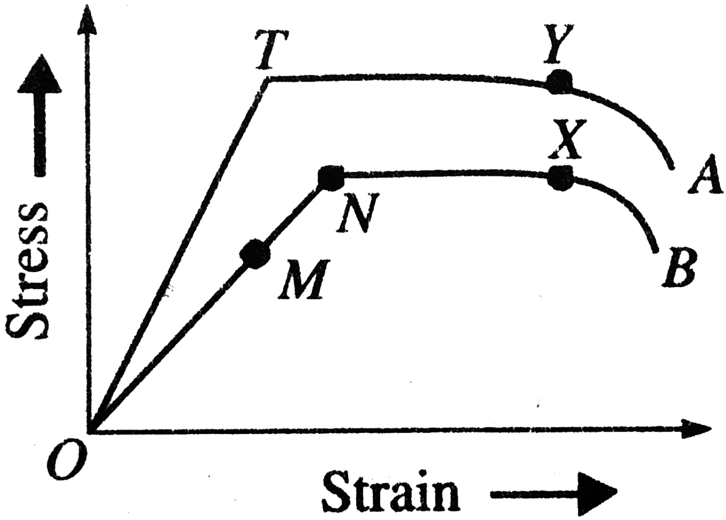
21. Materials get deformed when force is applied. Some of them regain their status when the applied force is removed. They are termed as elastic. Those of which not regaining are called plastic. There may be delay in the regaining in some materials. They are said to have got elastic aftereffect, since they have gone beyond the elastic limit. Repeated application and removal of force leads to fatigueness in the material. Fatigued materials may break at any point time and so are avoided.

The stress strain graph for two materials A and B is shown in the following figure:



The time in which the two materials regain their original status is t_A and t_B related as $t_B = 2t_B$. Then the material under elastic aftereffect (relatively) is

A. B

B. A

C. both A and B

D. neighter A nor B

Answer: A

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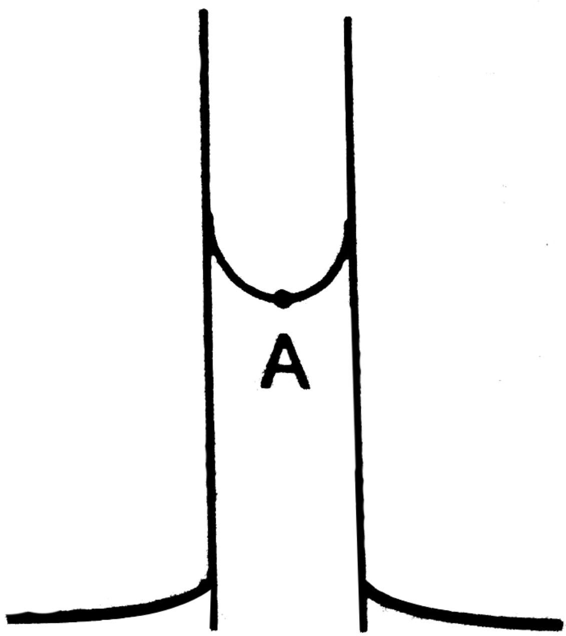
22. Figure shows a capillary tube of radius r dipped into water. If the atmosphere pressure is P_0, the pressure at point A is



A. P_0

B. $P_0 + \frac{2s}{r}$

C. $P_0 - \frac{2s}{r}$

D. $P_0 - \frac{4s}{r}$

Answer: C

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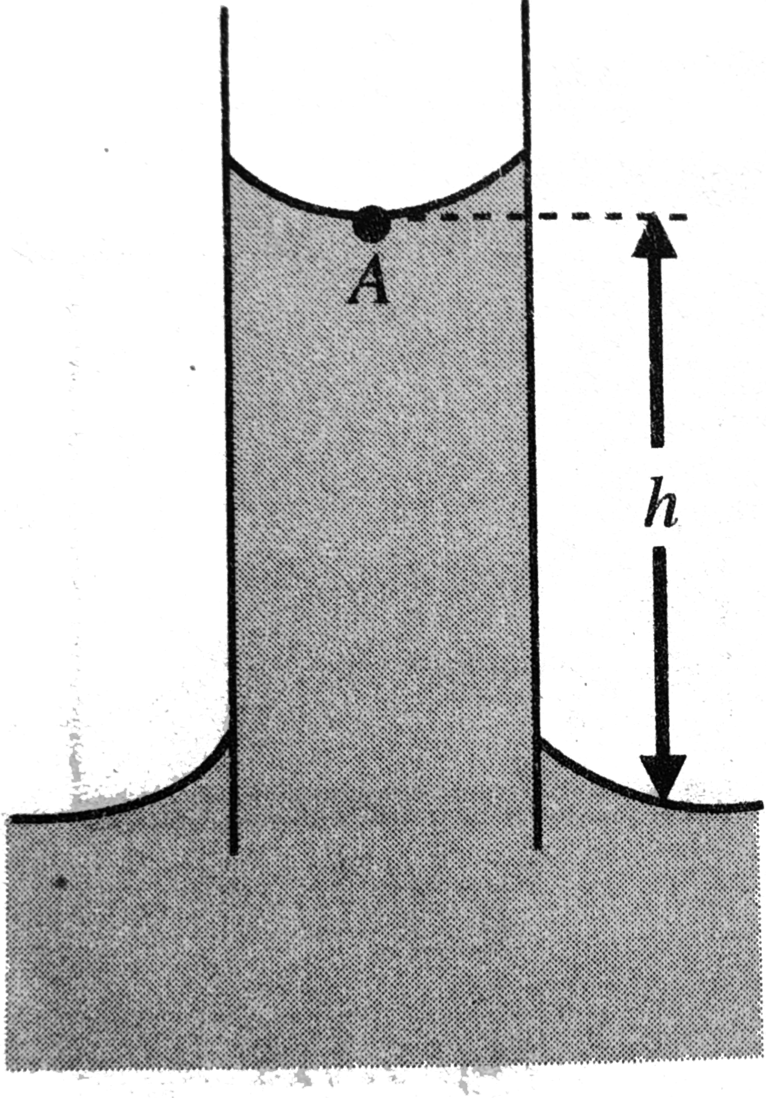
23. Figure shows a capillary tube of radius r dipped into The atmospheric pressure is P_0 and the capillary rise of water is h. s is the surface tension for water-glass.



Initially, $h = 10cm$. If the capillary tube is now incline at 45°, the length of water rising in the tube will be

A. $10cm$

B. $10\sqrt{2}cm$

C. $\frac{10}{\sqrt{2}}cm$

D. none of these

Answer: B

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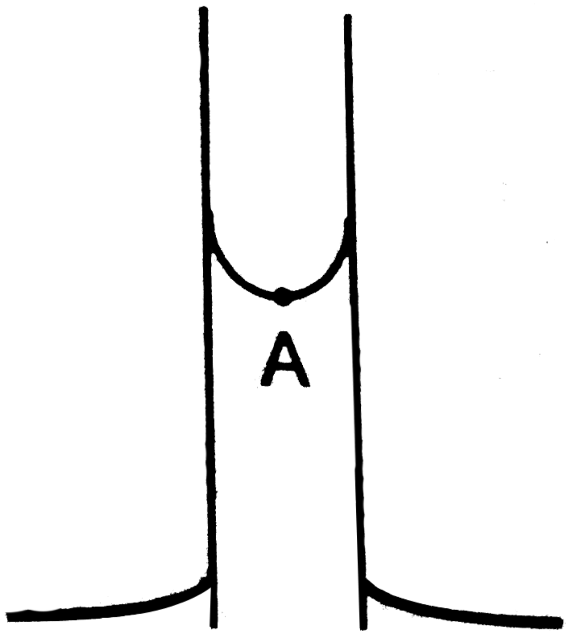
24. Figure shows a capillary tube of radius r dipped into water.

If the atmosphere pressure is P_0, the pressure at point A is



A.

B.

C.

D.

Answer: C

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25. In the figure shown, A and B are two short steel rods each of cross-sectional area $5cm^2$. The lower ends of A and B are welded to a fixed plate CD. The upper end of A is welded to the L-shaped piece EFG, which can slide without friction on upper end of B. A horizontal pull of $1200N$ is exerted at G as shown. Neglect the weight of EFG.

Longitudinal stress in B is

A. Shearing stress in A is zero.

B. Shearing stress in B is zero

C. Shearing stress in both A and B is zero

D. Shearing stress in both A and B is non-zero

Answer: B

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26. In the figure shown, A and B are two short steel rods each of cross-sectional area $5cm^2$. The lower ends of A and B are welded to a fixed plate CD. The upper end of A is welded to the L-shaped piece EFG, which can slide without friction on upper end of B. A horizontal pull of $1200N$ is exerted at G as shown. Neglect the weight of EFG.

Longitudinal stress in A is

A. (a)tensile in nature and having magnitude $180N/m^2$

B. (b)tensile in nature and having magnitude $240N/m^2$

C. (c)compressive in nature and having magnitude $180N/m^2$

D. (d)compressive in nature and having magnitude $240N/m^2$

Answer: A

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27. In the figure shown, A and B are two short steel rods each of cross-sectional area $5cm^2$. The lower ends of A and B are welded to a fixed plate CD. The upper end of A is welded to the L-shaped piece EFG, which can slide without friction on upper end of B. A horizontal pull of $1200N$ is exerted at G as shown. Neglect the weight of EFG.

Longitudinal stress in B is

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28. Two opposite forces $F_1 = 120N$ and $F_2 = 80N$ act on an elastic plank of modulus of elasticity $Y = 2x10^{11} N/m^2$ and length $l = 1m$ placed over a smooth horizontal surface. The cross-sectional area of the plank is $S = 0.5m^2$. The change in length of the plank is $x \times 10^{-11} m$. Find the value of x.

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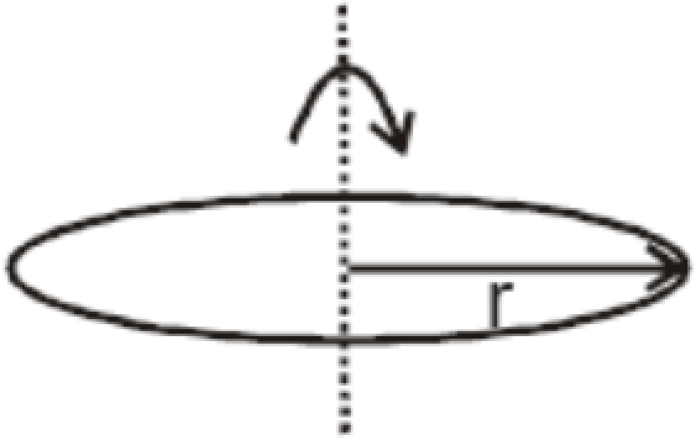
29. A ring of radius r made of wire of density ρ is rotated about a stationary vertical axis passing through its centre and perpendicular to the plane of the ring as shown in the figure. Determine the angular velocity (in rad/s) of ring at which the ring breaks. The wire breaks at tensile stress σ. Ignore gravity.

Take $\sigma / \rho = 4$ and $r = 1m$.



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30. The weight of a body at earth's surface is W. At a depth half way to the centre of earth it will weight

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Integer

1. A thin plate AB of large area A is placed symmetrically in a small gap of height h filled with water of viscosity $\eta_0$and the plate has a constant velocity v by applying a force F as shown in the figure. If the gap is filled with some other liquid of viscosity $0.75\eta_0$ at what minimum distance (in cm) from top wall should the plate be placed in the gap, so that the plate can again be pulled at the same constant velocity V. by applying the same force F? (Take $h = 20cm$)

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2. The diameter of a gas bubble formed at the bottom of a pond is $d = 4cm$. When the bubble rises to the surface, its diameter tension of water $= T = 0.07Nm^{-1}$

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3. n drops of water, each of radius $2mm$, fall through air at a terminal velocity of $8cms^{-1}$ If they coalesce to form a single drop, then the terminal velocity of the combined drop is $32cms^{-1}$ The value of n is

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4. A substance breaks down under a stress of $10^5 Pa$. If the density of the wire is $2 \times 10^3 kg/m^3$, find the minimum length of the wire which will break under its own weight $(g = 10ms^{-12})$.

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5. A wire of length L and cross-sectional area A is made of a material of Young's modulus Y. IF the wire is stretched by an amount x, the workdone is

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6. A solid sphere of radius r made of a soft material of bulk modulus K is surrounded by a liquid in a cylindrical container. A massless piston of area a floats on the surface of the liquid, covering entire cross section of cylindrical container. When a mass m is placed on the surface of the piston to compress the liquid, the fractional decrement in the radius of the sphere, $\left(\frac{dr}{r}\right)$, is :

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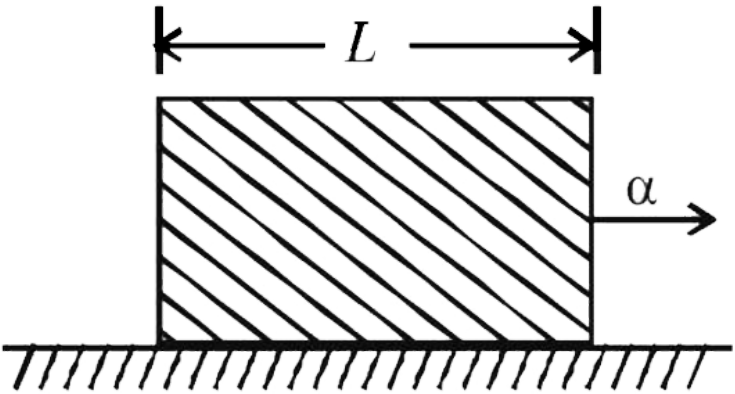
Fill In The Blanks

1. A uniform rod of length L and density ρ is being pulled along a smooth floor with a horizontal acceleration α (see Fig.) The magnitude of the stress at the transverse cross-section through the mid-point of the rod is........



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SCQ_TYPE

1. The following four wires of length L and radius r are made of the same material. Which of these will have the largest extension, when the samne tersion is applied?

A. Length $= 50cm$, diameter $= 0.5mm$

B. Length $100cm$, diameter $= 1$

C. Length $= 200cm$, diameter $= 2mm$

D. Length $= 300cm$, diameter $= 3mm$

Answer: A

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2. Two rods of different materials having coefficients of linear expansion α_1 and α_2 and Young's moduli Y_1 and Y_2, respectively, are fixed between two rigid massive walls. The rods are heated such that they undergo the same increase in temperature. There is no bending of rods. If $\alpha_1 / \alpha_2 = 2/3$, then the thermal stresses developed in the two rods are equal, provided Y_1 / Y_2, is equal to

A. $2 : 3$

B. $1 : 1$

C. $3 : 2$

D. $4 : 9$

Answer: C

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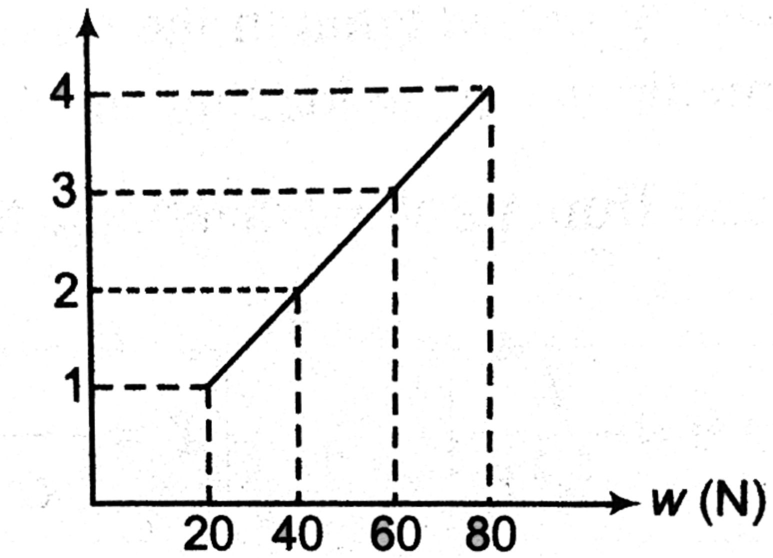
3. The adjacent graph shows the extension(Δl) of a wire of length 1 m suspended from the top of a roof at one end and with a load$w$ connected to the other end . If the cross-sectional area of the wire is $10^{-6}m^2$, calculate from the graph the Young's modulus of the material of the wire.



A. $2 \times 10^{11} N/m$

B. $2 \times 10^{11} N/m$

C. $3 \times 10^{-12} N/m$

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

Answer: A

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4. When temperature of a gas is $20^{\circ} C$ and pressure is changed from $p_1 = 1.01 \times 10^5 Pa$ to $p_2 = 1.165 \times 10^5 Pa$, the volume changes by 10%. The bulk modulus is

A. $1.55 \times 10^5 Pa$

B. $0.115 \times 10^5 Pa$

C. $1.4 \times 10^5 Pa$

D. $1.01 \times 10^5 Pa$

Answer: A

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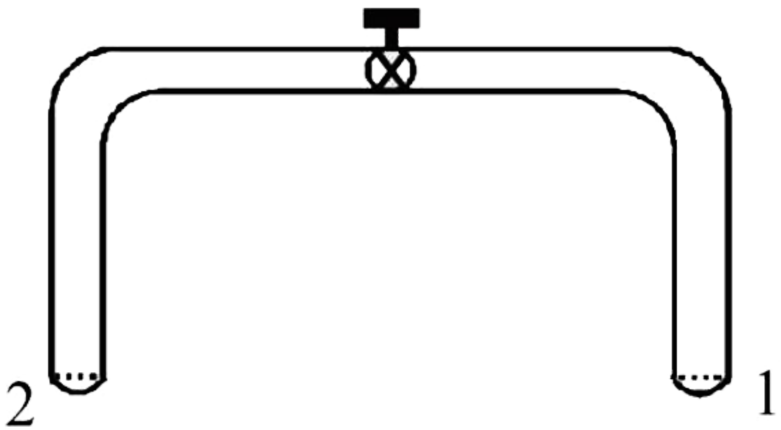
5. A glass tube of uniform internal radius(r) has a valve separating the two identical ends. Intially, the valve is in a tightly closed position. End 1 has a hemispherical soap bubble or radius r. End 2 has sub-hemispherical soap bubble as shown in figure. Just after opening the valve,



A. Air from end 1 flows towards end 2. There is no change in the volume of the soap bubble.

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

C. No change occurs.

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

Answer: B

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6. Â One end of a horizontal thick copper wire of length 2L and radius 2R is welded to an end of another horizontal thin copper wire of length L and radius R. When the arrangement is stretched by applying forces at two ends, the ratio of the elongation in the thin wire is .

A. 0.25

B. 0.50

C. 2.00

D. 4.00

Answer: C

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LC_TYPE

1. 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 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 $r < < R$) is

A. $2\pi rT$

B. $2\pi RT$

C. $2\pi r^2 T / R$

D. $2\pi R^2 T / r$

Answer: C

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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

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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. $2.7 \times 10^{-6} J$

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

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

Answer: B

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INTEGER_TYPE

1. Two soap bubbles A and B are kept in aclosed chamber where the air is maintained at pressure $8\frac{N}{m^2}$. The radiiof bubbles A and B are 2cm and 4 cm , respectively. Surface tension of the soap-water used to make bubbles is 0.04 N/m. The ratio of $n_B/n_A$is (where n_A and n_B are the numbe of moles of air in bubbles A and B,respectively.)

[Neglect the effect of gravity]

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2. A $0.1kg$ mass is suspended from a wire of negligible mass. The length of the wire is $1m$ and its cross - sectional area is $4.9 \times 10^{-7} m^2$. If the mass is pulled a little in the vertically downward direction and released , it performs SHM with angular frequency $140 rads^{-1}$. If the young's modulus of the material of the wire is $p \times 10^9 Nm^{-2}$, find the value of p.

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