PHYSICS

BOOKS - HC VERMA PHYSICS (HINGLISH)

SOME MECHANICAL PROPERTIES OF MATTER

Examples

1. A load of 4.0 kg is suspended from a ceiling through a steel wire of radius 2.0 mm. find the tensile stress developed in the wire when equilibrium is achieved. Take $g = 3.1\pi \frac{m}{s^{-2}}$

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2. A load of 4.0 kg is suspended from a ceiling through a steel wire of length 20 mand radius 2.0 mm. It is found that the length of the wire

increases by 0.031 mm as equilibrium is achieved. Find Young modulus of steel. Take $g = 3.1\pi ms^{-2}$

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3. A steel wire of length 2.0 m/s is stretched through 2.0 mm. The cross sectional area of the wire is 4.0 mm^2. Calculate the elastic potential energy stored in the wire in the stretched condition. Young modulus of steel $= 2.0x10^{11}Nm^{-2}$

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4. Water is kept in a beaker of radius 5.0 cm. Consider a diameter of the beaker on the surface of the water. Find the fore by which the surface on one side of the diameter pulls the surface on the other side. Surface tension of water $= 0.075Nm^{-1}$.

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5. A water drop of radius 10^{-2} m is brokenn into 1000 equal droplets. Calculate the gain in surface energy. Surface tension of water ils $0.075 Nm^{-1}$

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6. Find the excess pressure inside a mercury drop of radius 2.0 mm. The surface tension oif mercury $0.464 Nm^{-1}$.

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7. A 0.02 cm liquid column balances the excess pressure inside a soap bubbl of radius 7.5 mm. Determine the density of the liquid. Surface tension of soap solutionn $0.03 Nm^{-1}$.

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8. A capillary tube of radius 0.20 mm is dipped verticaly in water. Find the height of the water column raised in the tube. Surface tensionn of water $= 0.075Nm^{-1}$ and density of water $= 1000kgm^{-3}$. $Takeg = 10ms^{-2}$.

A. 7.5cm

B. 8.5cm

C. 10cm

D. None of the Above

Answer: A

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Worked Out Examples

1. One end of a wire 2m long and 0.2 cm^2 in cross section is fixed in a ceilign and a load of 4.8 kg is attached to the free end. Find the extension

of the wire. Young modulus of steel $= 2.0 \times 10^{11} Nm^{-2}$. Take $g = 10ms^{-2}$.

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2. One end of a nylon rope of length 4.5 m and diameter 6 mmis fixed to a tree limb. A monkey weighing 100 N jumps to catch the free end and stays there. Find the elongation of the rope and the corresponding change in the diameter. Young modulus of nylon =0.2.

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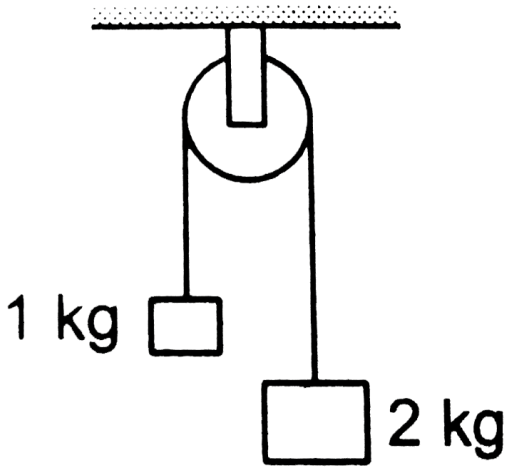
3. Two blocks of masses 1 kg and 2kg are connect by a metal wire going over a smooth pulley as shown in figure. The breaking stress of the metal is $2 \times 10^{9} m^{-2}$. What should be the minmum radius of the wire used if it

is not to break? Take $g = 10ms^{-2}$



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4. Two wires of equal cross section but one made of steel and the other of copper, are joined end to end. When the combination is kept under tension, the elongations in the two wires are found to be equal. Find the ratio of the lengths of the two wires. Young modulus of steel $= 2.0 \times 10^{11} Nm^{-2}$ and that of copper $= 1.1 \times 10^{1} Nm^{-2}$

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5. Find the decrease in the volume of a sample of water from the following data. Initial volume $= 1000cm^3$ initial pressure $= 10^5 Nm^{-2}$, final pressure $= 10^5 Nm^{-2}$, compressibility of water $= 50 \times 10^{-11} m^2 N^{-1}$.

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6. One end of a metal wire is fixed to a ceiling and a load of 2 kg hangs from the other end. A similar wire is attached to the bottomof the lod and another road of 1 kg hangs from this lower wire. Find the longitudial strain in both wires. Area of cross section of each wire is $0.005cm^2$ and Young modulus of the metasl is $2.0 \times 10^{11} Nm^{-2}$. $Takeg = 10ms^{-2}$

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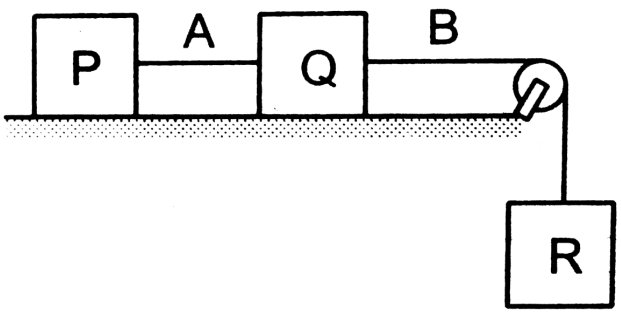
7. Each of the three blocks P, Q and R shown in figure has a mass of 3 kg. Easch of the wires A and B has cross sectional area 0.005 cm^2 and Young modulus $2x10^{11} Nm^{-2}$. Neglect friction. Find the longitudinal strain

developed ineach of the wires. Take $g = 10ms^{-2}$



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8. A wire of area of cross section $3.0mm^2$ and natural length 50 cm is fixed at one end and a mas of 2.1 kg is hung from the other end. Find the elastic potential energy stored in the wire in steady state. Young modulus of the material of the wire $= 1.9 \times 10^{11} Nm^{-2}. Takeg = 10ms^{-2}$

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9. A block of weight 10 N is fastened to one end of a wire of cross sectional area $3mm^2$ and is rotated in a vertical circle of radius 20 cmk.

The speed of the block at the bottom of the circle is $2ms^{-1}$. Find the elongation of the wire when the block is at the bottom of the circle. Young modulus of the material of the wire $= 2 \times 10^{11} Nm^{-2}$.

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10. 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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11. Thre is an air bubble of radius .0 mm in a liquid of surface tension $0.075Nm^{-1}$ and density 1000 kg m^-3 . $Thebu \leq isatadepthof10cmbelowtheesurface. Bythantheatmospheric$.

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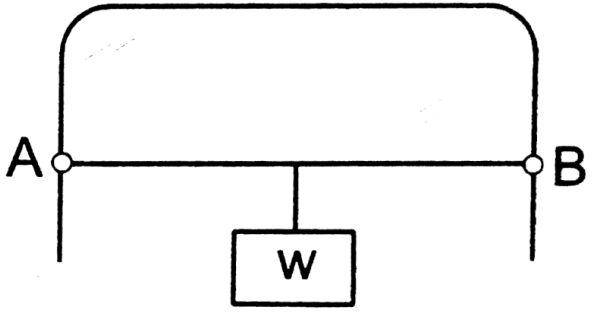
12. A light wire AB of length 10 cm can slide on a vertical frame as shown in figure. There is a film of soap solution trapped between the frame and the wire. Find the load W that should be suspended from the wire to keep it in equilibrium. Neglect friction. Surface tension of soat solution $= 25dy \neq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



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13. The lower end of a capillary tube is dipped into water and it is seen that the water rises through 7.5 cm in the capillary. Find the radius of the capilary. Surface tension of water $= 7.5 \times 10^{-2} Nm^{-1}$. Contact angle between water and glass $= 0^{\circ}. Takeg = 10ms^{-2}$.

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

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15. A large wooden plate of area $10m^2$ floating on the surface of river is made to move horizontally wilth a speed of $2ms^{-1}$ by applying a tangential force. If the river is 1m deep and the water contact with the bed is stationary, find the tangential force needed to keep the plate moving. Coefficient of viscosity of water at the temperature of the river $= 10^{-2}poise.$

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16. The velocity of water in a rier is $18kmh^{-1}$ near the surface. If the river is 5 m deepm, find the shearing stress between the horizontal lyers of

water. The coefficient of viscosity of water `=10^-2 poise.

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17. Find the terminal velocity of a rain drop of radius 0.01 mm. The coefficient of viscosity of air is $1.8 \times 10^{-5} N - sm^{-2}$ and its density is $1.2 kgm^{-3}$.Density of water $= 1000 kgm^{-3}. Takeg = 10 ms^{-2}$

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Short Answer

1. The ratio stress/strain remains constant for small deformation of a metal wire. When the deformation is made larger, will this ratio increase or decrease ?

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2. When a block of mass M is suspended by a long wire of length L, the elastic potential energy stored in the wire is $\frac{1}{2} \times stress \times stra \in \times volume. Showt\hat{i}tisequal \to$ 1/2Mgl $where1istheextension. Theloss \in gravitationalpotentiale \neq rgyofthem$ 1/2Mgl` energy go ?

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3. When the skeleton of an elephant and the skeleton of a mouse are prepared in the same size, the bones of the elephant are shown thicker than those of the mouse. Explain why the bones of an elephant are thicker than proportionate. The bones are expected to with stand the stress due to the weight of the animal.

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4. The yield point of a typical solid is about 1%. Suppose you are lying horizontally and two persons are pulling your hands and two persons are

pulling your legs along your own length. How much will be the increase in your length if the strain is 1% ? Do you think your yield point is 1% or much less than that ?

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5. When rubber sheets are used in a shock absorber, what happens to the energy of vibration ?

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6. If a compressed spring is dissolved in acid, what happens to the elastic potential energy of the spring ?

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7. A steel blade placed gently on the surface of water floats on it. If the same blade is kept well inside the water, it sinks. Explain. 8. When some

wax is rubbed on a cloth, it becomes waterproof. Explain.

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8. The contact angle between pure water and pure sliver is 90° If a capillary tube made of silver is dipped at one end in pure water, will the water rise in the capillary?

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9. It is said that a liquid rises or is depressed in a capillary due to the surface tension. If a liquid neither rises nor depresses in a capillary, can we conclude that the surface tension of the liquid is zero ?

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10. Assertion :The contact angle between water and glass is acute.

Reason :The surface of water in the capillary is convex .

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11. A uniform vertical tube of circular crss section contaons a liquid. The contact angle is 90°. Consider a diameter of the tube lying in the surface of the liquid. The surface of the right of this diameter pulls the surface on the left of it. What keeps the surface on the left in equilibrium?

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12. When a glass capillary tube is dipped ast one end in water, water rises in the tube. The gravitational potential energy is thus increased. Is it a violation of conservation of eneryg?

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13. If a mosquito dipped into water and relesed it is not able to fly till it is dry again. Explain.

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14. The force of surface tension acts tangentially to surface whereas the force due to air pressure perpendicularly on the surface. How is then due to excess pressure inside a bubble bal force due to the surface tension ?

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15. When the size of a soap bubble is increased by oushing more air in it, the surface area increases. Does it mean that the average separation between the surface molecutes is increased?

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16. Frictional force between solids operates even when they do not move with respect to each other. Do we have viscous force acting between two layers even if there is no relative motion?

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17. Water near the bed of a deep river is quiet while that near the surface flows. Give reasons.

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

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Objective 1

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

A. 500N

B. 250 N

C. 1000 N

D. 2000N

Answer:

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2. The breaking stress of a wire depends on

A. material of the wire

B. length of the wire

C. radus of the wire

D. shape of the cross section

Answer:

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3. 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. 10 kg

B. 20 kg

C. 40 kg

D. 80 kg

Answer:

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4. Two wires A and B are made of same material. The wire A has a length l and diameter r while the wire B has a length l and diameter r while the wire B has a length 2l and diameter r/2. If the two wires are stretched by the same force the elongationn in A divided by the elongation in B is

A. 43108

B. 43104

C. 4

D. 8

Answer:

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5. A wire elongastes by 1.0 mm when a load W ils hung from it. If this wire goes over a pulley and two weights W each are hung at the two ends the elongation of the wire will be

A. 0.5 m

B. 1.0 mn

C. 2.0 mn

D. 4.0 mm

Answer:

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6. AS heavy uniform rod is hanging verticallly from a fixed support. It is streetched by its own weight. The diameter of the rod is

A. smallest at the top and graduay increases down the rod

B. largest at the top and gradually decreases down the rod

C. uniform everywhere

D. maximum iln the middle

Answer:

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7. When metal wire is stretched by a load the fectional change in its volume $\triangle \frac{V}{V}$ is proportional to

A. j

B. $\left(\frac{\triangle l}{l_{\square}}\right)^2$

C. $\sqrt{\triangle \frac{l}{l}}$

D. none of these

Answer:

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8. The length of a metal wire is l_1 when the tensionin it is T_1 and isl_2 when the tension is T_2. The natural length of the wire is

A. $\frac{l_2 + l_2}{2}$

B. $\sqrt{l_1 l_2}$

C. $\frac{l_1 T_2 - l_2 T_1}{T_2 - T_1}$

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

Answer:

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9. A heavy mass is attached to a thin wire and is whirled in a vertical circle. The wire is most likely to break

A. when the mass is ast the highest point

B. when the mass is ast the lowest point

C. when the wire is horizontal

D. at an angle of $\cos^{-1}\left(\frac{1}{3}\right)$ from the upward vertical.

Answer:

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10. When a metal wire elongates by hanging a load on it, the gravitational potential energy is decreased.

A. This energy completely appears as the incresed kinetic energy of the block

B. This energy completely appers as the increased elastic potentiasl energy of the wire.

C. This energy completely appears as heat

D. none of these

Answer:

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11. By a surface of a liquid we mean

A. a geometrical plane like x=0

B. all molecules exposed to the atmosphere

C. a layer of thicknesss of the order of 10^{-8} m

D. a layer of thickneess of the order of $10^{-4}m$

Answer:

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12. An ice cubeis suspended in a vacuum in gravity free hall. As the ice melts it

A. will retain its cubicasl shape

B. will change its shape to spherical

C. wil fall down on the floor of the hall

D. wil fly up

Answer:

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13. When water droplets merge to form a bigger drop

A. energy is liberated

B. energy is absorbed

C. energy may either be liberated nor absorbed

D. energy may either be liberated or absorbed depending on the nature of the liquid

Answer: A

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14. The dimension $ML^{-1}T_2$ can correspond to

A. moment of a force

B. surface tension

C. modulus of elasticity

D. coefficient of viscosity

Answer:

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15. Air is pushed inot a soap bubble of radius r to duble its radius. If the surface tension of the soap solution is S, the work done in the process is

A. $8\pi r^2 S$

B. $12\pi r^2 S$

C. $16\pi r^2 S$

D. $24\pi r^2 S$

Answer:

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16. If more aire is pushed in a soap bubble the pressure in it

A. decreases

B. increases

C. remains same

D. becomes zero

Answer:

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

A. air flows from bigger bubble to the smaller bubble till the sizes become equal.

B. air flows from bigger bubble to the smaller bubble till the sizes are interchanged.

C. air flows from the smaller bubble to the bigger.

D. there is no flow of air.

Answer: C

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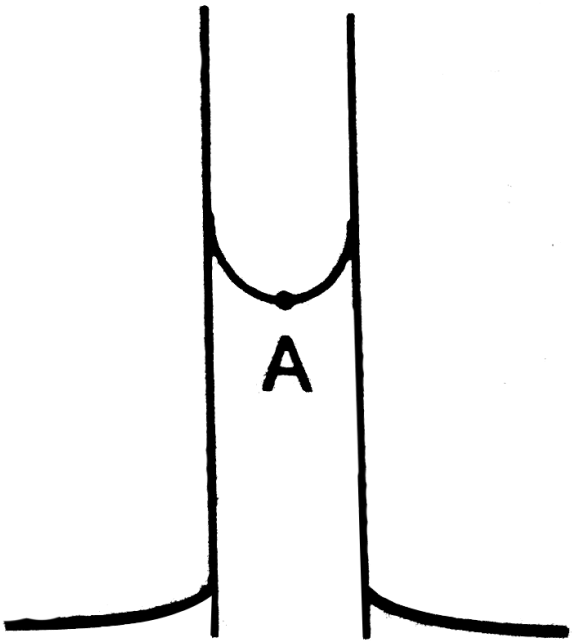
18. Figure shows a capillary tube of radius r dipped into water. If the atmosphere pressure is P_0, the pressure at point A is



A. P_0

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

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

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

Answer:

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19. The excess pressure inside a soap bubble is twice the excess pressurre inside a second soap bubble. The volume of the first bubble is n times the volume of the second where n is

A. 4

B. 2

C. 1

D. 0.125

Answer:

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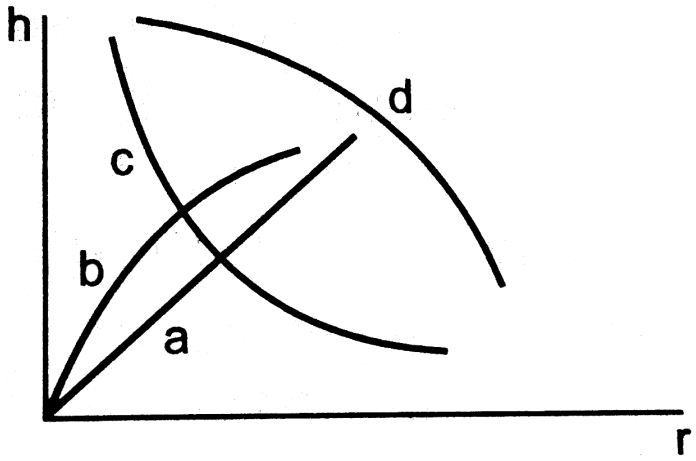
20. Which of the following graphs may represent the relation between the capillary rise h and the radius r of the capillary?



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21. Water rises in a vertical capillary tube up to a length of 10 cm. If the tube is inclined at 45°, the length of water risen in the tube will be

A. 10 cm

B. $10\sqrt{2}$ cm

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

D. none of these

Answer: B

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22. 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. 8 cm

B. 6 cm

C. 10 cm

D. 20 cm

Answer:

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23. Viscosity si property of

A. liquids only

B. solids only

C. solids and liquids only

D. liquids and gases only

Answer:

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24. The force of viscosity is

A. electromagnetic

B. gravitational

C. nuclear

D. weak

Answer:

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25. The viscous force acting between two layers of a liquid is given by $\frac{F}{A} = \eta \frac{dv}{dz}$. This F/A may be caled

A. pressure

B. longitudinal stress

C. tangential stress

D. volume stress

Answer: C

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26. A raindrop fasllls near the surface of the earth with almost uniform velocity because

A. its weight is negligible

B. the force of surface tension balances its weight

C. the force of viscosity of air balances its weight

D. the drops are charged and atmospheric electric field balances its weight

Answer:

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27. A piece of wood is taken deep inside a long column of water and released. It wil move up

A. with a constant upward acceleration

B. with a decreasing upward acceleration

C. with a deceleration

D. with a uniform velocity

Answer:

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

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

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

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

D. there will be no terminal velocity

Answer:

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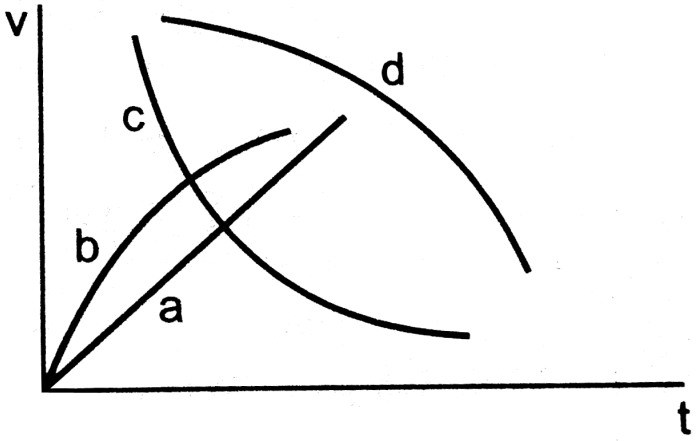
29. A spherical bal is dropped in a long column of a viscous liquid. The speed of the ball as a function of time may be best represented by the

graph



A. A

B. B

C. C

D. D

Answer:

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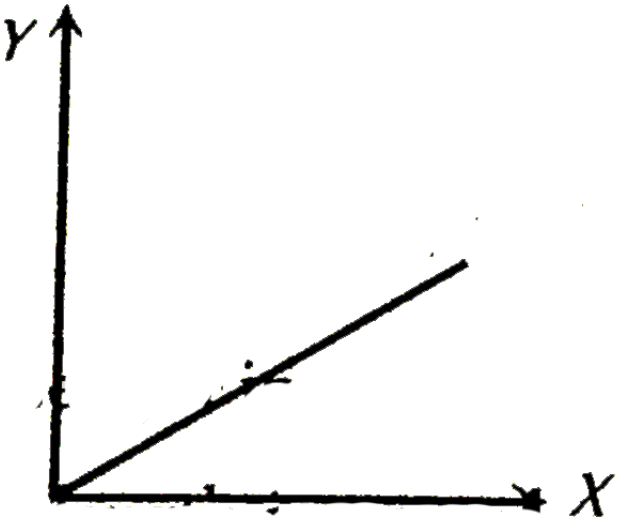
Objective 2

1. A student plots a graph from his reading on the determination of Young's modulus of a metal wire but forgets to label. The quantities on X and Y may be respectively.



A. weight hung and length increased

B. stress applied and length increased

C. stress applied and strain developed

D. length increased and the weight hung.

Answer:

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2. The properties of a surface are different from those of the bulk liquid because the surface molecules

A. are smaller than other molecules

B. acquire charge due to collision from air molecules

C. find different type of molecules in their range of influence

D. feel a net force in one direction

Answer:

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3. The rise of a liquid inn a capillary tube depends on

A. the material

B. the length

C. the outer radius

D. the inner radius of the tube

Answer:

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4. The contact angle between a solid anda liquid is a property of

A. the material of the solid

B. the material of the liquid

C. the shape of the solid

D. the mass of the solid

Answer:

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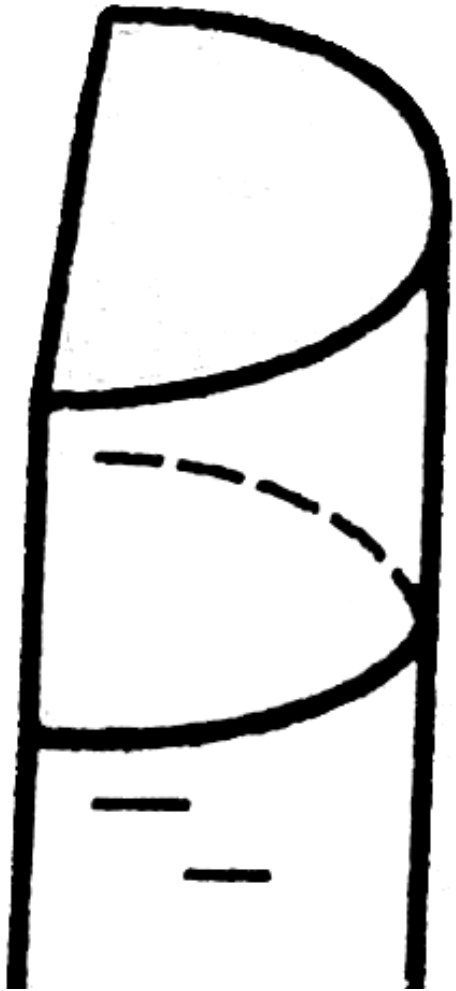
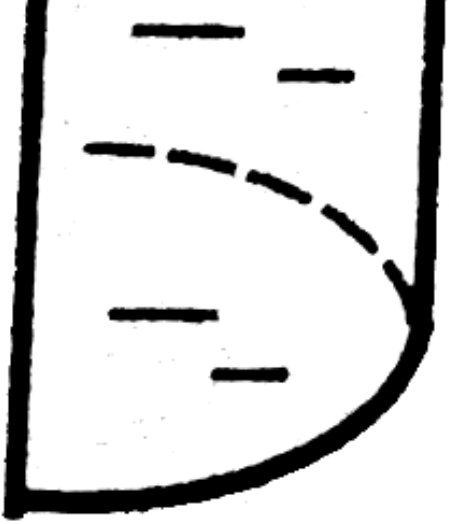
5. A liquid is containe in a vertical tube of semicircular cross section figure.The contact angle is zero. The force of surface tension on the curved part and on the flat part are in ratio





A. $1:1$

B. $1:2$

C. $\pi:2$

D. $2:\pi$

Answer:

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6. When a capillary tube is dipped into a liquid, the liquid neither rises nor falls in the capillary.

A. the surface tension of the liquid must be zero

B. the contact angle must be 90°

C. the surface tension may be zero

D. the contact angle may be 90°

Answer:

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7. A solid sphere moves at a terminal velocity of $20ms^{-1}$ in air at a place where $g = 9.8ms^{-2}$. The sphere is taken in a gravity free hall having air at the same pressure and pushed down at a speed of $20ms^{-1}$

A. its initial acceleration will be $9.8ms^{-2}$ downward

B. its initial acceleration will be $9.8ms^{-2}$ upward

C. The magnitude of acceleration will decrease as the time passes.

D. It will eventually stop

Answer:

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Exercises

1. A load of 10 kg is suspended by a metal wire 3 m long and having a cross sectional area $4mm^2$. Find a. the stress b. the strain and c. the elongation. Young modulus of the metal is$2.0 \times 10^{11} Nm^{-2}$

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2. A vertical metal cylinder of radius 2 cm and length 2 m is fixed art the lower end and a load of 10 kg is put on it. find a. the stress b. the strain

and c. the compression of the cylinder. Young modulus of the metl $= 2 \times 10^{11} Nm^{-2}$

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3. The elastic limit of stees is $8 \times 10^{8} Nm^{-2}$ andits Young modulus $2x10^{11} Nm^{-2}$. Find the maximum eleongatin of a half metre steel wire that can be given without exceeding the elastic limit.

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4. A steel wire and a copper wire of equal length and equal cross sectionasl area area joined end to end and the combination is subjected to as tension. Find the ratio of as. The stresses developed in the two wire and b. the strains developed. Y of steel $= 2 \times 10^{11} Nm^{-2}$. Y o copper $= 1.3 \times 1011 Nm^{-2}$.

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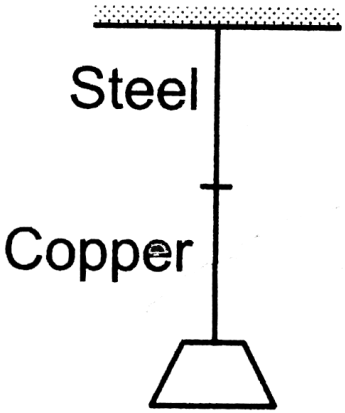
5. In figure the upper wire is made of steel and the lower of copper. The wires have equal cross section. Find the ratio of the longitudinals strains developed in the two wires.



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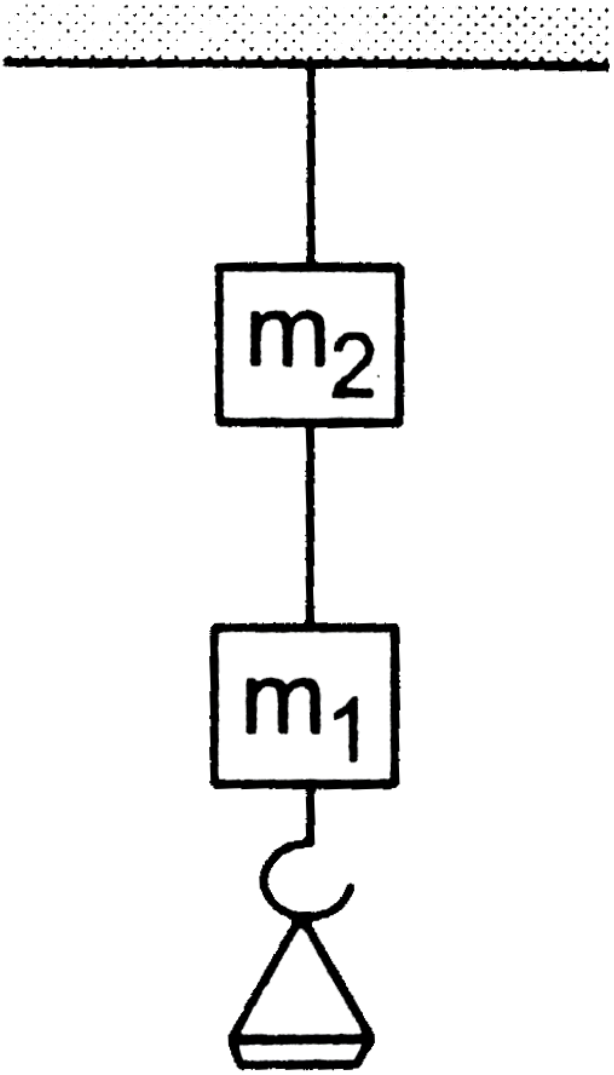
6. The two wires shown in figure are made of the same material which has a breaking stress of $8 \times 10^8 Nm^{-2}$. The area of cross section of the upper wire is 0.006 cm^2 and that of the lower wire is 0.003 cm^2. The mass $m - 1 = 10kg, m_2 = 20kg$ and teh hanger is light. a. Fidn the

maximum load that casn 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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7. Two person pull a rope towards themselves. Each person exerts a force of 100 N on the rope. Find the Young modulus of the material of the rope if it extends in length by 1 cm. Original length of the rope=2 m and the area of cross section =2 cm^2.

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8. A steel rod of cross sectional area $4cm^2$ and length 2m shrinks by 0.1 cm as the temperature decreases in night. If the rod is clamped at both ends during the day horus, find the tension developed in it during night hours. Young modulus of steel $= 1.9 \times 10611$ nm^-2`

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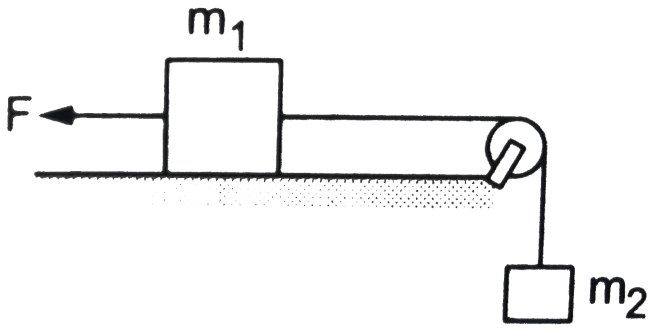
9. Consider the situation shown in figure. The force F is equalk to the $m_2 \frac{g}{2}$. If the area of cross section of the string is A and its Young modulus Y, find the strain develolped in it. The string is lilght and there is no

friction anywhere.



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10. A sphere of mass 20 kg is suspended by a metal wire of unstretched length 4 m and diameter 1 mm. When in equilibrium there is a clear gap of 2 mm between the sphere and the floor. The sphere is gently pushed aside so that the wire makes an angle θ with the vertical and is released. Find the maximum value of θ so that the metal of the wire is $2.0 \times 10^{11} Nm^{-2}$. Make appropriate approximation.

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11. A steel wire of original length 1 m and cross-sectional area 4.00 mm^2 is clamped at the two ends so that it lies horizontally and without tension. If a load of 2.16 kg is suspended from the middle point of the wire, what would be its vertical depression ?

$Yofthesteel$=2.0x10^11Nm^-2. Take $g = 10ms^{-2}$

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12. A copper wire of cross sectional asrea 0.01 cm is under a tension of 20 N. Find the decrease in the cross sectional area. Young modulus of copper $= 1.1 \times 10^{11} Nm^{-2}$ and Poisson ratio 0.32.

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13. Find the increase in pressure required to decrease the volume of a water sample of 0.01%. Bulk modulus of water $= 2.1 \times 10^{9} Nm^{-2}$.

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14. Calculate the apprroximate change in density of water in a lake at a depth of $400m$ below the surface. The density of water at the surface id $1030kg/m^3$ and bulk modulus of water is $2 \times 10^9 N/m^2$.

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15. A steel plate of face area 4 cm2 and thickness 0.5 cm is fixed rigidly at the lower surface. A tangential force of 10 N is applied on the upper surface. Find the lateral displacement of the upper surface with respect to the lower surface. Rigidity modulus of steel $= 8.4 \times 10^{10} Nm^{-2}$.

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16. A 5.0 cm long straight piece of thread is kept on the surface of water. Find the force with which the surface on one side of the thread pulls it. Surface tension of water $= 0.076 Nm^{-1}$

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17. Find the excess pressure inside (a) a drop of mercury of radius 2 mm (b) a soap bubble of radius 4 mm and (c) an air bubble of radius 4 mm formed inside a tank of water. Surface tension of mercury, soap solution and water are $0.465 Nm^{-1}$, $0.03 Nm^{-1}$ and $0.076 Nm^{-1}$ respectively.

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18. Consider a small surface area of 1 mm2 at the top of a mercury drop of radius 4.0 mm. Find the force exerted on this area (a) by the air above it (b) by the mercury below it and (c) by the mercury surface in contact with it. Atmospheric pressure $= 1.0x10^5 Pa$ and surface tension of mercuru $= 0.465 Nm^{-1}$. Neglect the effect fo gravity. Assume all numbers to be exact.

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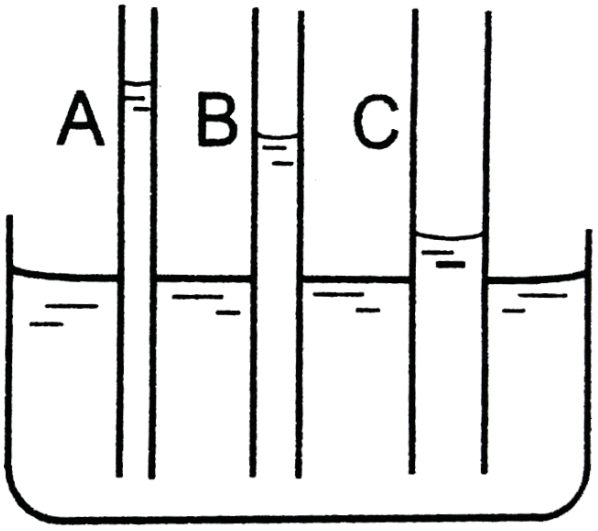
19. The capillaries shown in figure (14-E4) have inner radii 0.5 mm, 1.0 mm and 1.5 mm respectively. The liquid in the beaker is water. Find the heights

of water level in the capillaries. The surface tension of water is $7.5 \times 10^{-2} Nm^{-1}$.



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20. The lower end of a capillary tube is immersed in mercury. The level of mercury in the tube is found to be 2 cm below the outer level. If the same tube is immersed in water, up to what height will the water rise in the capillary ?

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21. A barometer is constructed with its tube having radius 1.0 mm. Assume that the surface of mercury in the tube is spherical in shape. If the atmospheric pressure is equal to 76 cm of mercury, what will be the height raised in the barometer tube? The contact angle of mercury with glass135° and surface tension of mercury $= 0.465Nm^{-1}$. Density of mercury $= 13600kgm^{-3}$.

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22. A capillary tube of radius 0.50 mm is dipped vertically in a pot of water. Find the difference between the pressure of the water in the tube 5.0 cm below the surface and the atmospheric pressure. Surface tension of water $= 0.075Nm^{-1}$

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23. Find the surface energy of water kept in a cylindrical vessel of radius 6.0 cm. Surface tension of water $= 0.075Jm^{-2}$.

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24. A drop of mercury of radius 2 mm is split into 8 identical droplets. Find the increase in surface energy. Surface tension of mercury $= 0.465 Jm^{-2}$

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25. A capillary tube of radius 1 mm is kept vertical with the lower end in water. (a) Find the height of water raised in the capillary. (b) If the length of the capillary tube is half the answer of part (a), find the angle θ made by the water surface in the capillary with the wall.

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26. The lower end of a capillary tube of radius 1 mm is dipped vertically into mercury. (a) Find the depression of mercury column in the capillary. (b) If the length dipped inside is half the answer of part (a), find the angle

made by the mercury surface at the end of the capillary with the vertical. Surface tension of mercury $= 0.465 Nm^{-1}$ and the contact angle of mercury with glass $= 135^{\circ}$.

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27. Two large glass plates are placed vertically and parallel to each other inside a tank of water with separation between the plates equal to 1 mm. Find the rise of water in the space between the plates. Surface tension of water $= 0.075 Nm^{-1}$.

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28. Consider an ice cube of edge 1.0 cm kept in a gravity-free hall. Find the surface area of the water when the ice melts. Neglect the difference in densities of ice and water.

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29. A wire forming a loop 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 needle inside the loop. The thread loop takes the shape of a circle. Find the tension in the thread. Surface tension of soap solution $= 0.030 Nm^{-1}$.

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30. A metal sphere of radius 1 mm and mass 50 mg falls vertically in glycerine. Find (a) the viscous force exerted by the glycerine on the sphere when the speed of the sphere is 1 cm s-1, (b) the hydrostatic force exerted by the glycerine on the sphere and (c) the terminal velocity with which the sphere will move down without acceleration. Density of glycerine $= 1260 kgm^{-3}$ and its coefficient of viscosity at room temperature = 8.0 poise.

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31. Estimate the speed of verticaly falingn raindriops from the following data. Radius of the drops=0.02cm, viscosity of ir $= 1.8 \times 10^{-4} poise, g = 9.9 \times 10 ms^2$ and density of water =1000 kg m^-3`.

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32. Water flows at a speed of 6 cms^{-1} through a tube of radius 1 cm. coefficient of viscosity of water at room temperature is 0.01 poise. Calculate the Reynolds number. Is it a steady flow.

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