Physics English Classified MCQ Properties of Matter 1992 - 2016

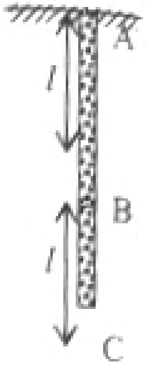
PROPERTIES OF MATTER

01. Elasticity

01) A rod AB of length l_1 is connected to another rod BC of length l_2 and the combined rod is subjected to a fixed stretching force of F as shown in the figure. If both rods have identical areas of cross section and the ratio,

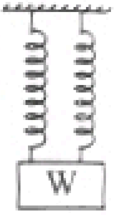
$$\frac{\text{Young's modulus of the material of the rod AB}}{\text{Young's modulus of the material of the rod BC}} = \frac{2}{3}$$

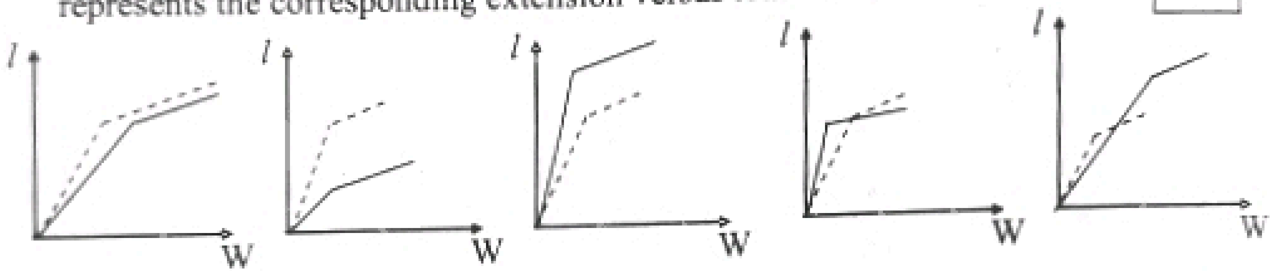
the extension produced by the rod AB becomes equal to that produced by BC when



1) $l_1 = \frac{Fl_2}{3}$ 2) $l_1 = \frac{2}{3} l_2$ 3) $l_1 = \frac{3}{2} Fl_2$ 4) $l_1 = \frac{5}{2} l_2$ 5) $l_1 = \frac{3}{5} l_2$ (1992)

02) The dotted lines in the following graphs represents the extension (l) versus load (W) curve of a light spring hung from a ceiling. When the load is hung from two such springs as shown in the figure, which graph represents the corresponding extension versus load curve?



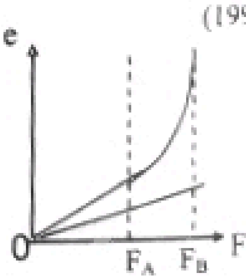


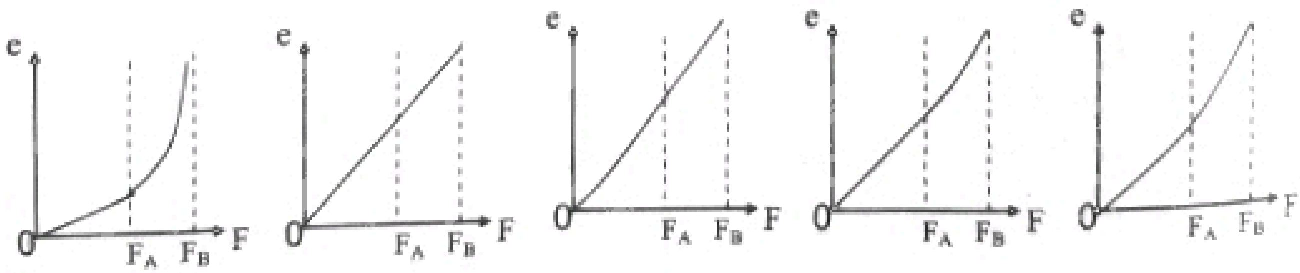
1) 2) 3) 4) 5) (1993)

03) Mercury will contract in volume by 0.01% , when subjected to a net pressure of 2.6×10^6 Pa. the bulk modulus of mercury is,

1) 2.6×10^7 Pa 2) 2.6×10^4 Pa 3) 2.6×10^6 Pa
4) 2.6×10^8 Pa 5) 2.6×10^{17} Pa (1994)

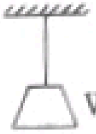
04) Figure shows the variations of extensions e of two wires X and Y with the applied force F. If one end of X is connected to one end of Y to form a long single wire, the variation of e with F for the composite wire is best represented by,





1) 2) 3) 4) 5) (1995)

05) One end of a wire of initial length l and cross-sectional area A is fixed to a ceiling and the other end is attached to a weight W as shown in the figure. When the attached weight is reduced by half the extension of the wire is found to be reduced by a length equal to $\frac{l}{10}$.



The Young's modulus of the material of the wire is,

1) $\frac{Wl}{A^2}$ 2) $\frac{W}{2A}$ 3) $\frac{5W}{A}$ 4) $\frac{10Wl}{A^2}$ 5) $\frac{9W}{10A}$ (1996)

06) The material of the human bone has a Young's modulus of 10^{10} Nm^{-2}. It fractures when the compressive strain exceeds 1%. The maximum load that can be sustained by a bone of cross-sectional area $3 \times 10^{-4} m^2$ is,

1) 3×10^2 N 2) 3×10^4 N 3) 3×10^6 N
4) 3×10^8 N 5) 3×10^{10} N (1998)

07) An elastic string has a length of 30 cm when the tension on it is 3N. When the tension is 4N the length becomes 32cm. if the tension is increased to 7N, the length of the string will be,

1) 34 cm 2) 38 cm 3) 40 cm 4) 42 cm 5) 64 cm (1999)

08) One end of a metal wire of length L and cross- sectional area A is tied to the ceiling. The other end is connected to a (mass less) spring of spring constant k. A body of mass m hangs from the free end of the spring. If the young's modulus of the material of the wire is Y, the total extension of the system is,

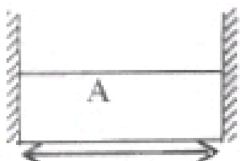
1) $\frac{mgl}{YA}$ 2) $\frac{mg}{k}$ 3) $mg\left(\frac{1}{YA}+\frac{1}{k}\right)$

4) $mg\left(\frac{1}{YA}+\frac{2}{k}\right)$ 5) $mg\left(\frac{1}{k}+\frac{1}{YA}\right)$ (1999)

09) A uniform wire of length L fixed at one end attains the proportional limit when a mass m is hung from the other end. If a $\frac{L}{2}$ length of the same wire is used the proportion limit will attain when the mass hung is

1) $\frac{m}{4}$ 2) $\frac{m}{2}$ 3) m 4) 2m 5) 4m (2000)

10) An aluminum (Young's modulus = 7.0×10^{10} Nm^{-2} ; Linear expansivity = 2.5×10^{-5} K^{-1}) cylinder A of length 10cm, and cross –sectional area $20 cm^2$, is to be used as a spacer between two rigid walls as shown in the figure, at 30^0C , it just slips in between the walls. When it warms to 34^0C, the force exerted by the cylinder on each wall is,



1) 1.4×10^3N 2) 3.5×10^3N 3) 1.4×10^4N
4) 1.4×10^5N 5) 7.5×10^6N (2000)

11) A uniform elastic wire is suspended vertically from the ceiling and a mass is hung from the bottom end. Consider the following statements assuming that the proportional limit of the wire is not exceeded.

(A) If the length of the wire is doubled, the strain in the wire doubles

(B) If the area of cross section of the wire is doubled, the strain in the wire doubles.

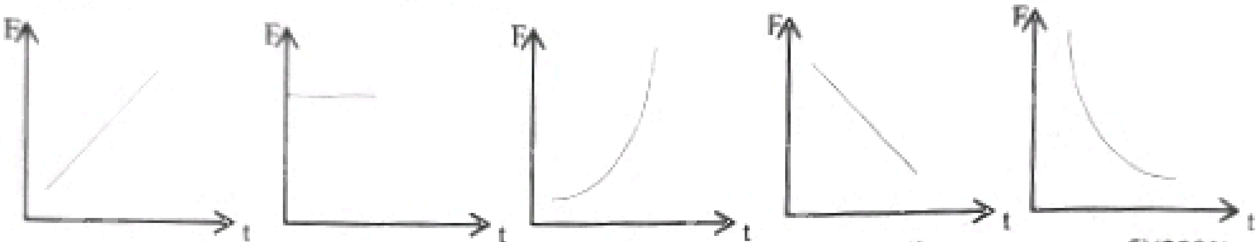
(C) If the hung mass is doubled, the strain in the wire doubles.

Of the above statements

1) Only (A) is true 2) Only (B) is true 3) Only (C) is true

4) Only (A) and (B) are true 5) Only (B) and (C) are true (2001)

12) A mass is attached to the lower end of a vertical elastic string which is rigidly fixed at the other end. The mass is then moved down with a constant velocity by applying a force F. The variation of F with time t is best represented by,



1) 2) 3) 4) 5) (2001)

13) The material of a wire X has a higher value of Young's modulus than the material of a wire Y, when the two wires are subjected to the same tension, the extension of wire X is found to be more than that of wire. Y consider the following statements.

(A) The above will happen only if the diameter of the wire X is smaller than that of wire Y.

(B) The above will happen only if the ratio $\frac{\text{original length}}{\text{diameter}}$ for X is higher than that of Y.

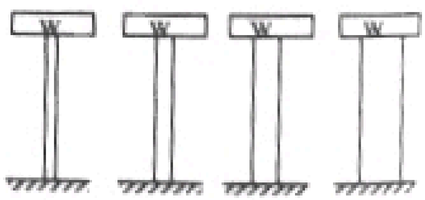
(C) The above will never happen if the length of the wire X is shorter than that of Y

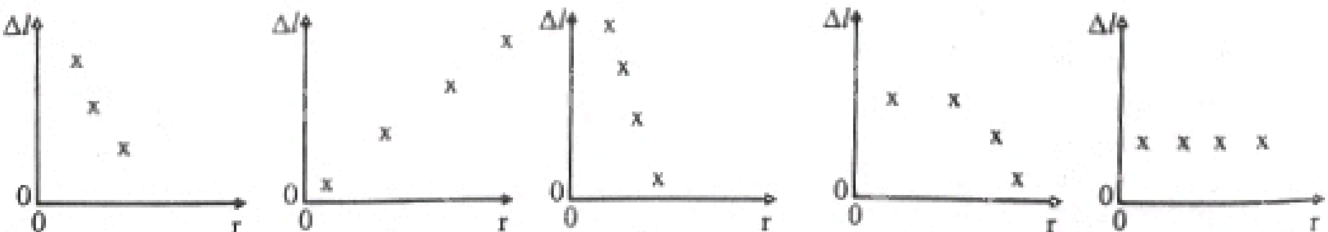
Of the above statements

1) Only (A) is true 2) Only (B) is true 3) Only(C) is true

4) Only (A and (B) are true 5) Only (B) and (C) are true (2002)

14) Consider a situation where weights w are placed on vertical rods of radii r, 2r, 3r and 4r respectively and made of same material as shown in the figure. If the rods have the same length, and not attained the proportional limit, variation of the compression (Δl) with radius r is best represented by,





1) 2) 3) 4) 5) (2003)

15) The force required to increase the length of an elastic string by a unit length is given by k. Consider the following statements made about k,

A) The value of k can be increased by increasing the Young's Modulus (Y) of material of the string

B) The value of k can be increased by increasing the cross- sectional area of the string

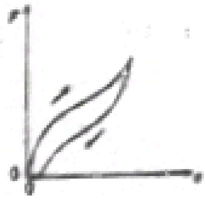
C) The value of k can be increased by decreasing the length of the string

Of the above statements

1) Only (A) is true
2) Only (A) and (B) are true
3) Only (B) and (C) are true
4) Only (A) and (C) are true
5) all (A), (B) and (C) are true

(2004)

16) The figure shows a force (F) – extension (e) graph for a rubber band. Consider the following statement.



A) The rubber band does not return to its original length after stretching.

B) The magnitude of the total work done during the increase of the length is less than the magnitude of the total work done during the decrease of the length.

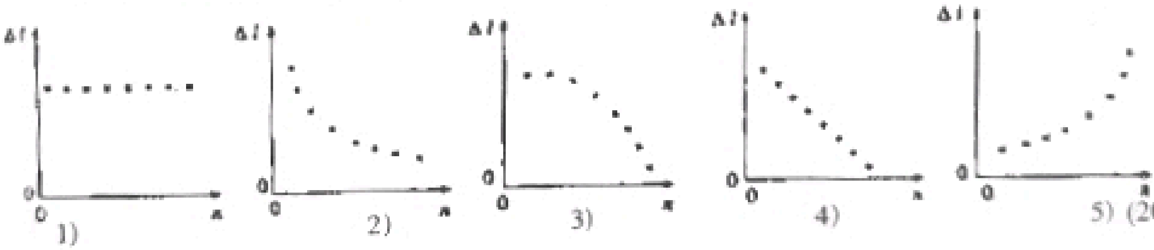
C) Heat can be generated in this process.

Of the above statements,

1) only (A) is true
2) only (A) and (B) are true.
3) only (B) and (C) are true
4) only (A) and (C) are true.
5) All (A), (B) and (C) are true.

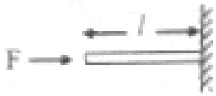
(2005)

17) A heavy metal box is to be supported by n number of uniform identical legs of the same material in such a way that the entire weight of the box is equally distributed among all legs. In this situation, the variation for the contraction Δl of each leg with the number of legs n due to the weight of the box is best represented by,



1) 2) 3) 4) 5) (2006)

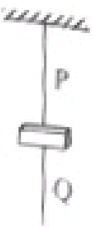
18) As shown in the figure a device is to measure the magnitude of the force by applying it to a uniform metal rod of length ℓ and area of cross – section A, and measuring the resultant compression (Δl), E is the Young's modules of the material of the rod.



1) $l \geq \frac{EA}{F_0}\Delta l_0$ 2) $l \geq \frac{F_0}{EA}\Delta l_0$ 3) $l \leq \frac{EA}{EA\Delta l_0}$ 4) $l \geq \frac{F_0 A}{E\Delta l_0}$ 5) $l \leq \frac{EA}{F_0}\Delta l_0$

(2007)

19) A metal block is hung from a support by a string P as shown in the figure. An identical piece of string Q is attached underneath the block.



Consider the following statements,

A) If Q is taut the tension in P is greater than that of Q.

B) If Q is pulled with slowly increasing tension, then P has a tendency to break down Q.

C) If Q is pulled with a jerk, then Q has a tendency to break down before P.

Of the above statements,

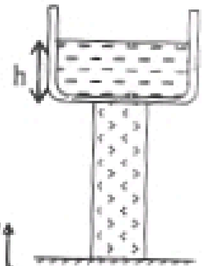
1) only (A) is true.
2) only (A) and (B) are true.
3) only (A) and (C) are true.
4) all (B) and (C) are true.
5) all (A), (B) and (C) are true

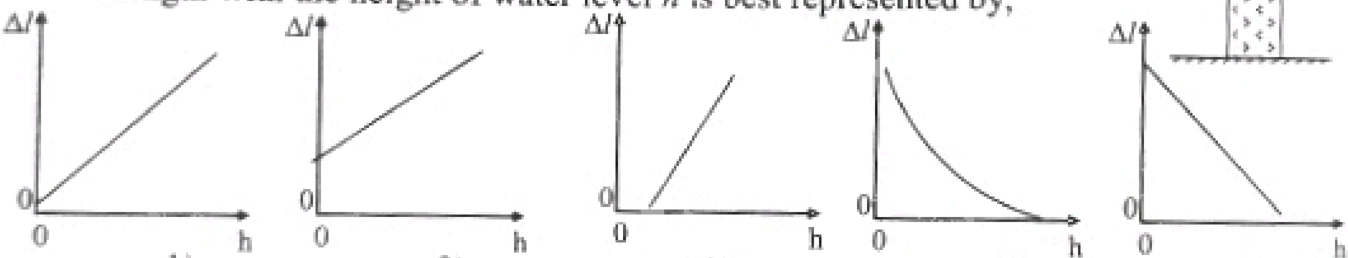
(2007)

20) A steel (Young's modules = E, linear expansivity = α) beam of cross – sectional area A is clamped between two concrete supports as shown in the figure. When the temperature of the beam rises by ΔT, the force that must be exerted by the concrete supports to each end of the beam, in order to keep the beam without expanding is given by,

1) $AE\alpha\Delta T$ 2) $\dfrac{AE}{\alpha\Delta T}$ 3) $\dfrac{AE\alpha}{\Delta T}$ 4) $\dfrac{AE\Delta T}{\alpha}$ 5) $E\alpha\Delta T$ (2008)

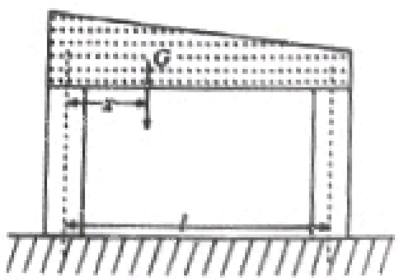
21) A water tank is constructed on a steel pillar of original length l_0 and water is filled – up to a height is as shown in figure. The variation of the compression (Δl) of the pillar from its original length with the height of water level h is best represented by,





1) 2) 3) 4) 5) (2008)

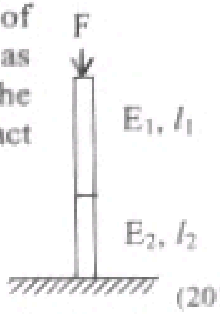
22) A and B are two iron columns with exactly the same length. A has a square cross – section of side length a, while B has a circular cross section of diameter a. One end of both A and B are firmly fixed on horizontal ground. A non – uniform concrete beam is placed over two columns as shown in figure. If the lower side of the concrete beam remains horizontal, the distance x to the centre of gravity of the beam from the axis of A is given by ($a << l$)



1) $x = \dfrac{4l}{(\pi+4)}$ 2) $x = \dfrac{2l}{(\pi+1)}$ 3) $x = \dfrac{l}{(\pi+1)}$

4) $x = \dfrac{\pi l}{(\pi+1)}$ 5) $x = \dfrac{\pi l}{(\pi+4)}$ (2009)

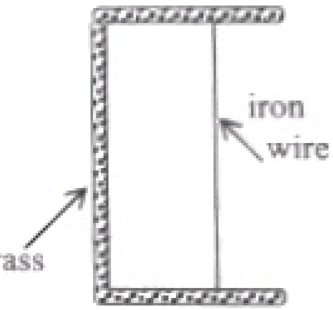
23) Two light rods of initial lengths l_1 and l_2 having equal areas of cross – section are joined end to end, and a force F is applied as shown in the figure. If the respective Young's module of the materials of rods are E_1 and E_2 (see figure) then they will contract by the same amount when



1) $E_2 l_1 = E_1 l_2$ 2) $E_2 l_2 = E_1 l_1$
3) $E_1^2 l_2 = E_2^2 l_1$ 4) $E_1 l_2^2 = E_2 l_1^2$
5) $E_1^2 l_1 = E_2^2 l_2$

(2010)

24) The figure shows as iron wire fastened to a brass frame. At room temperature the wire is neither slack nor under stress. The linear expansivity of brass and iron are 18 $\times 10^{-6}$ K^{-1} and 10×10^{-6} K^{-1} respectively. Young's modulus of iron is 30×10^9 Nm^{-2}. When the temperature of the whole system is increased by 1°C, the stress on the wire will become,



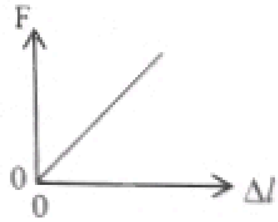
1) 2.4×10^5 Nm^{-2} 2) 3×10^5 Nm^{-2} 3) 5.4×10^5 Nm^{-2}
4) 8.4×10^5 Nm^{-2} 5) 3×10^6 Nm^{-2}

(2011/O & 2011/N)

25) The minimum amount of work that has to be done in order to fix a light elastic string of initial length l_0 between two parallel with separated by a distance d ($d > l_0$) with a tension T is,

1) $\frac{1}{2}T(d - l_0)$ 2) $\frac{Td}{l_0}$ 3) $T(d - l_0)$ 4) $\frac{1}{2}\frac{T}{(d - l_0)}$ 5) $\frac{1}{2}\frac{(d - l_0)^2}{T}$ (2012N)

26) The applied force F and extension Δl curve for a metal wire is shown in figure. Consider the following statements.



(A) If another wire of lower cross-sectional area is used without changing other parameters, the corresponding curve would fall above the curve shown in figure.

(B) If a wire having identical parameters but with a larger Young's Modulus is used then the corresponding curve would fall below the curve shown in figure.

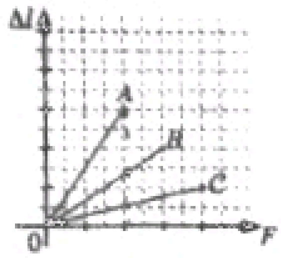
(C) If a longer wire is used without changing the other parameters the corresponding curve would fall below the curve shown in figure.

Of the above statements.

1) only (A) is true 2) only (C) is true 3) only (A) and (B) are true
4) only (B) and (C) are true 5) all (A), (B) and (C) are true

(2013)

27) Figure shows the variation of the extensions (Δl) produced by three different metal rods A, B and C with the force when they are subjected to a tensile force F. If E_A, E_B and E_C are the corresponding energies stored in the rods due to extensions, then,



1) $E_A > E_B = E_C$ 2) $E_A = E_B > E_C$ 3) $E_A = E_B = E_C$
4) $E_A > E_B > E_C$ 5) $E_A < E_B < E_C$

(2014)

28) A straight composite rod is made by connecting end-to-end an n number of rods with identical physical dimensions but having different Young's moduli $Y_1, Y_2, Y_3, \ldots, Y_n$.

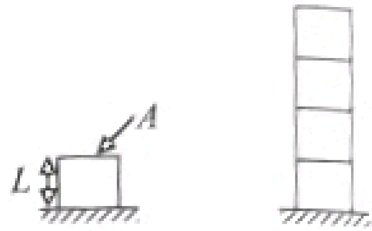
The equivalent Young's modulus of the composite rod is given by

1) $\frac{Y_1 + Y_2 + Y_3 + \ldots + Y_n}{n}$ 2) $(Y_1 + Y_2 + Y_3 + \ldots + Y_n)n$

3) $\frac{1}{\frac{1}{Y_1} + \frac{1}{Y_2} + \frac{1}{Y_3} + \ldots + \frac{1}{Y_n}}$ 4) $\frac{n}{\frac{1}{Y_1} + \frac{1}{Y_2} + \frac{1}{Y_3} + \ldots + \frac{1}{Y_n}}$

5) $(Y_1 Y_2 Y_3 \ldots Y_n)^{\frac{1}{n}}$ (2015)

29) The height of a rectangular heavy metal block of mass M, area of cross-section A, and made of a material of Young's modulus Y, when placed on a horizontal surface as shown in figure (a) is L. If your blocks identical to the above mentioned block are stacked together as shown in figure (b), the overall height of the four blocks will be,

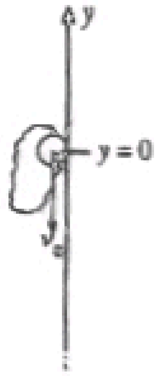


(a) (b)

1) $L\left(4 - \frac{2Mg}{YA}\right)$ 2) $L\left(4 - \frac{8Mg}{YA}\right)$ 3) $L\left(4 - \frac{7Mg}{YA}\right)$

4) $L\left(4 - \frac{6Mg}{YA}\right)$ 5) $L\left(4 - \frac{4Mg}{YA}\right)$ (2016)

30) A particle of mass m is attached to one end of a light elastic string of force constant k and unstreatched length of l_0. The other end of the string is fixed onto a vertical frictionless wall at $y = 0$ as shown in t he figure. The particle is then projected vertically. downwards from the position $y = 0$ with a velocity v_0. $(v_0 < \sqrt{2gl_0})$. Neglect the air resistance. After passing through its lowest point in the path, the particle will again come to rest momentarily at a point whose y coordinate is,



1) $-\frac{[m(v_0^2 + 2gl_0) - kl_0^2]}{2gm}$ 2) $-\frac{(v_0^2 + 2gl_0)}{2g}$ 3) $\frac{v_0^2 + 2gl_0}{2g}$

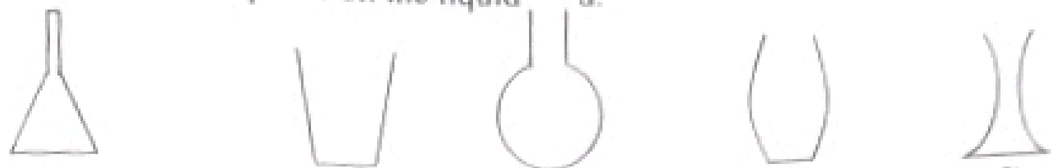
4) $\frac{mv_0^2 + kl_0^2}{gm}$ 5) $\frac{v_0^2}{2g}$ (2016)

02. Surface Tension

01) On the earth the rise of a liquid in a capillary tube is observed to be h above the liquid level in a container. When this arrangement is transported to a planet, where the acceleration due to gravity at the surface is two thirds of the value on the earth and the atmospheric pressure is half that on the earth, the expected height of the liquid column is,

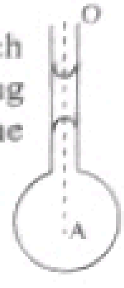
1) $\frac{h}{3}$ 2) $\frac{h}{2}$ 3) $\frac{3}{2}h$ 4) h 5) 3 h (1992)

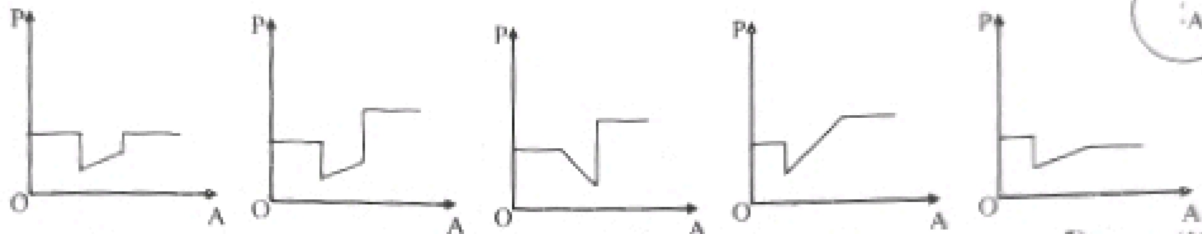
02) In which of the following vessels the liquid surface can be seen flat right up to the wall. When it is filled with any liquid to a certain height? The height to which the liquid is filled depends on the liquid used.



1) 2) 3) 4) 5) (1993)

03) A soap bubble is formed at one end of a vertical capillary tube which contains a liquid column as shown in the figure. Which of the following graphs best represents the variation of the pressure P from O to A along the direction OA?





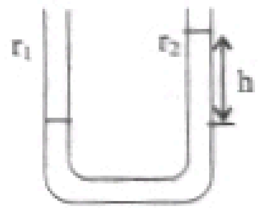
1) 2) 3) 4) 5) (1994)

04) In the equation given below V is the velocity, γ is the surface tension and ρ is the density.

$V^2 = \frac{gA}{2\pi} + \frac{2\pi\gamma}{\rho A}$ A has the dimensions

1) L 2) LT 3) LT^{-4} 4) LT^{-2} 5) L^3 (1995)

05) A U tube whose limbs are made of two capillary tubes having internal radii r_1 and r_2 ($r_1 > r_2$) is kept vertical and is filled with water as shown in the figure. If ρ is the density and γ is the surface tension of water the difference in water levels h is given by



1) $\frac{2\gamma}{\rho g}(r_1 - r_2)$ 2) $\frac{2\gamma}{\rho g}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$ 3) $\frac{2\gamma}{\rho g}\left(\frac{1}{r_2} - \frac{1}{r_1}\right)$

4) $\frac{2\gamma}{\rho g}\left(\frac{1}{r_1 - r_2}\right)$ 5) $\frac{2\gamma}{\rho g}\left(\frac{r_1 - r_2}{r_1 + r_2}\right)$ (1995)

06) A soap bubble has a radius of 3cm, if the surface tension of soap solution is 1.5 x 10^{-2} Nm^{-1}, the excess pressure inside the bubble is,

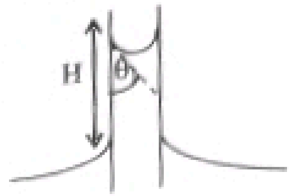
1) 10^{-2} Nm^{-2} 2) 2 x 10^{-2} Nm^{-2} 3) 1 Nm^2 4) 2 Nm^2 5) 4 Nm^{-2} (1996)

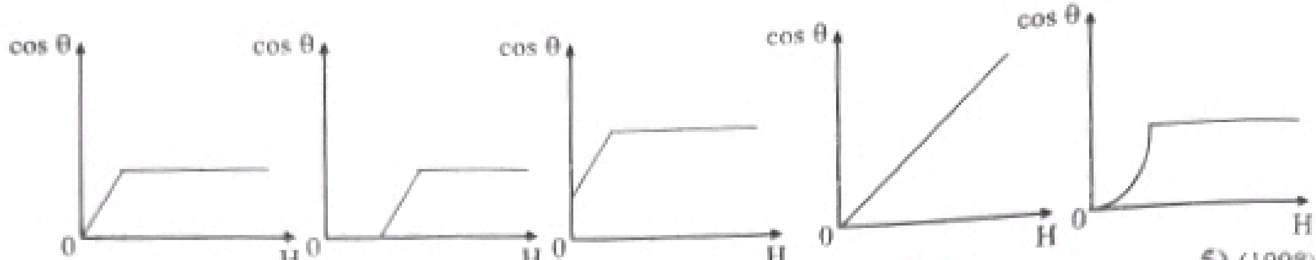
07) Capillary rise of water inside a metallic capillary tube of internal radius R is found to be same as that of a glass capillary tube of internal radius r. If the angle of contact between water and glass is zero, the angle of contact between water and the metal is,

1) zero 2) $\cos^{-1}\left(\frac{r}{R}\right)$ (3) $\cos^{-1}\left(\frac{R}{r}\right)$ 4) $\cos^{-1}\left(\frac{r}{2R}\right)$ 5) $\cos^{-1}\left(\frac{2R}{r}\right)$

(1997)

08) A capillary the is gently dipped vertically in a liquid as shown in the figure. The variation of the cosine of the contact angle θ with H is best represented by



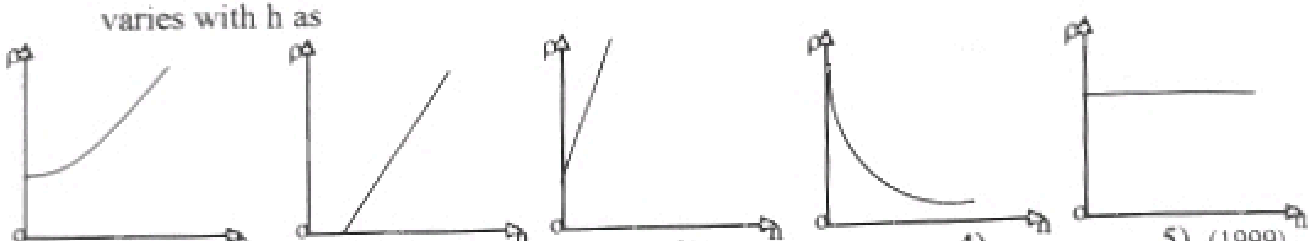


1) 2) 3) 4) 5) (1998)

09) Two soap bubbles, one of radius 3cm other of radius 4cm, coalesce in vacuum under isothermal conditions. The radius of the bubble formed is, (1999)

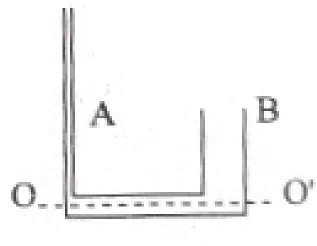
1) 1cm 2) 2cm 3) 5cm 4) 6 cm 5) 8 cm

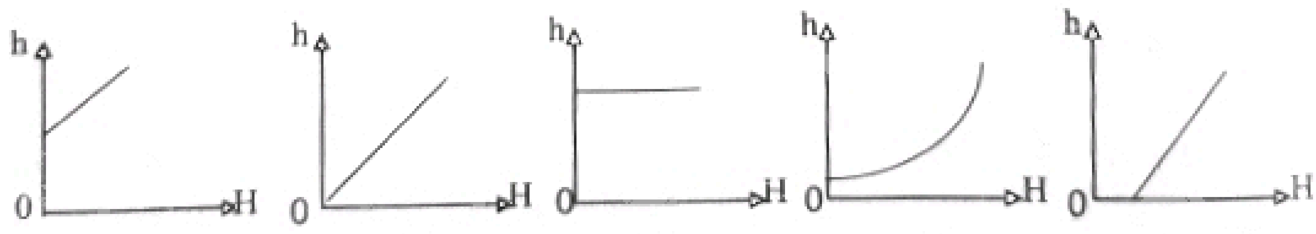
10) A vertical capillary tube is partially immersed in water in gradually increased by pumping air into it. The lower end of the tube is at a depth h beneath the water surface. As h is varied the maximum pressure p that can exist inside the tube varies with h as



1) 2) 3) 4) 5) (1999)

11) One limb of a glass U tube is made of a capillary and the other limb is made of a wider tube as shown in figure. When water is poured into the U tube. The equilibrium heights of the water columns inside the capillary and the wider tubes as measured form the OO' level are h and H respectively. The variation of h with H is best represented by,





1) 2) 3) 4) 5) (2000)

12) A steel razor blade can be made to stay on the surface of water. Consider the following statements regarding this

A) Staying of the steel razor blade on the surface of water contradicts the Archimedes's principle because there is no up thrust acting on the blade

B) The steel razor blade is kept on the surface of water by the forces due to the surface tension of water

C) Adding soap to water would cause the steel razor blade to sink because soap reduces the surface tension of water.

Of the above statements

1) Only (A) is true 2) Only (B) is true 3) Only (C) is true
4) Only (A) and (B) are true 5) Only (B) and (C) are true (2001)

13) Two soap bubbles coalesce. Once they joined together, the radii of the two bubbles become a and b (a>b). The radius of curvature of the interface between the two bubbles would be

1) b – a 2) b + a 3) $\frac{b^2}{a} - \frac{a^2}{b}$ 4) $\frac{ab}{a-b}$ 5) $\frac{a^2b}{(a-b)^2}$ (2002)

14) A six – legged insect stands on the surface of water. The radius of each circular flat foot is 2×10^{-4} m. The maximum weight of the insect that can be supported by the water surface is (surface tension of water is 7×10^{-2} N m^{-1})

1) 8.80×10^{-5} N 2) 5.28×10^{-4} N 3) 5.28×10^{-8} N
4) 8.80×10^{-9} N 5) 2.00×10^{-4} N (2003)

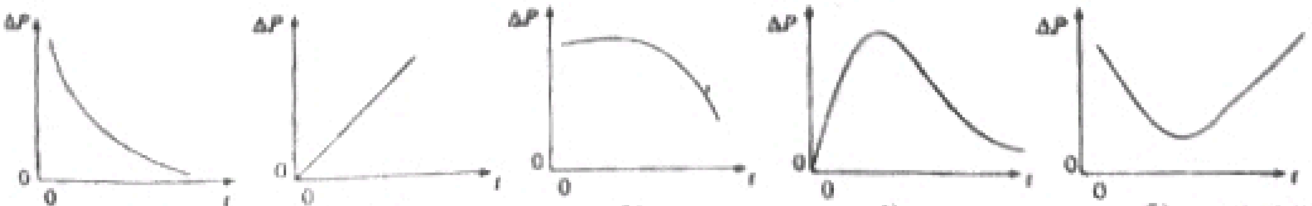
15) A loop made of a string of length l is kept on a soap film. When the section of the film inside the loop is broken, the tension of the string becomes T. If the length of the string is 2l then the tension of the string would be

1) $\frac{T}{4}$ 2) $\frac{T}{2}$ 3) T 4) 2T 5) 4T (2004)

16) The capillary rise of water, in a certain glass capillary tube is h. The angle of contact between glass and water is zero. Another capillary tube having the same dimension as the glass tube is made with a material for which the angle of contact with water is 90°. The capillary rise of water in the second tube is,

1) 0 2) $\frac{h}{4}$ 3) $\frac{h}{2}$ 4) h 5) $2h$ (2005)

17) A soap bubble is formed gradually at one end of a glass tube from time t = 0 by slowly blowing air from the other end. The variation of excess pressure (Δp) inside the bubble with time (t) is best represented by,



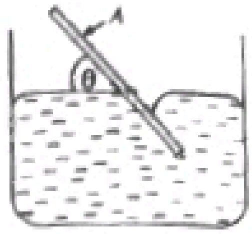
1) 2) 3) 4) 5) (2006)

18) SI unit of surface tension is,

1) N 2) N m^{-1} 3) N m 4) N m^{-2} 5) N m^{2} (2007)

19) Figure shows a glass plate, A dipped in a liquid. If the glass plate makes an angle θ with the horizontal, the angle of contact of the liquid with glass is,

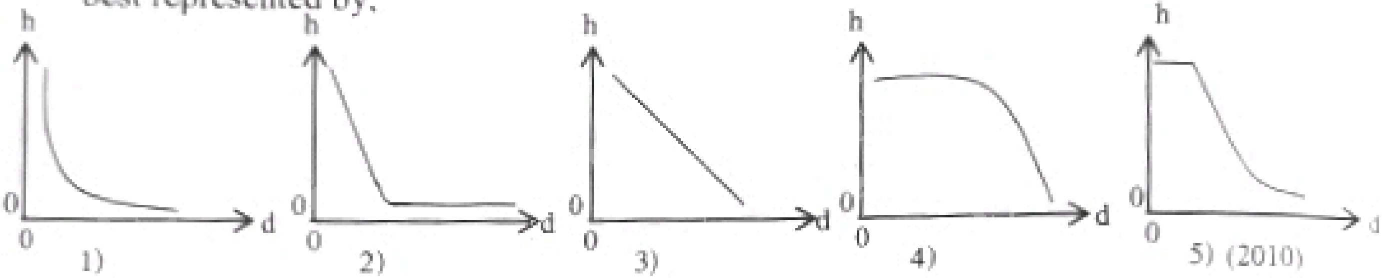
1) 0 2) θ 3) $90^o - \theta$ 4) $180^o - \theta$ 5) $90^o + \theta$ (2008)



20) A cylindrical metal vessel of height 5cm has a small circular hole of radius 0.2 mm at its bottom. This vessel is lowered vertically in a certain liquid of density 800 kg m^{-3}, keeping the bottom down. What should be the minimum value of the surface tension the liquid must have so that the vessel can be lowered up to the brim without liquid entering into the vessel through the hole?

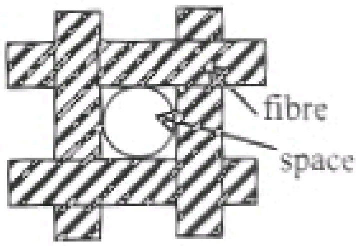
1) 0.02 N m^{-1} 2) 0.03 N m^{-1} 3) 0.04 N m^{-1} 4) 0.05 N m^{-1} 5) 0.06 N m^{-1} (2009)

21) When a glass capillary tube of internal diameter d is immersed vertically in water, the water level inside the tube rises to a height of h. The variation of h with d is best represented by,



(2010)

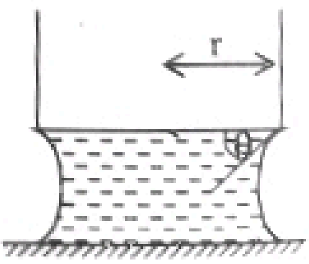
22) As shown in the figure, spaces between the nylon fibres of an umbrella made of nylon cloth could be considered approximately as circular. If the diameter of these space is ℓ and the density of water is d, the minimum surface tension that the water should have in order to prevent water from seeping through the spaces is (Take the contact angle between water and nylon to be zero)



1) ℓ^2 dg 2) $\frac{1}{2}\ell^2$ dg 3) $\frac{1}{4}\ell^2$ dg

4) $\frac{1}{12}\ell^2$ dg 5) $\frac{1}{16}\ell^2$ dg (2011/O & 2011/N)

23) A water layer exists between the bottom of a cylindrical bottle and a glass plate as shown in the figure. The radius of the bottom of the bottle is r. When the bottle is raised slowly at one instant the contact angle between water and the bottom of the bottle become θ. (see figure) The magnitude of the force on the bottom of the bottle at that instant due to surface tension T of water is,



1) $2\pi rT \sin\theta$ 2) $2\pi rT \cos\theta$ 3) $\pi r^2T \sin\theta$

4) $\pi r^2T \cos\theta$ 5) $4\pi r T \sin\theta$ (2012 N)

24) Small amount of powdered pepper was sprinkled on the surface of water in a cup and the water surface was touched with a clean dry finger tip. Then the finger tip was rubbed with a little soap and the same process was repeated. Which of the following observations is likely to be seen in the above processes?

	cleaned and dried finger tip	soapy finger tip
1)	Pepper powder tend to move away from the finger tip.	Pepper powder tend to flock around the finger tip.
2)	Pepper powder tend to move away from the finger tip.	Pepper powder tend to move away from the finger tip.
3)	Nothing happens to the distribution of pepper powder.	Pepper powder tend to flock around the finger tip.
4)	Nothing happens to the distribution of pepper powder.	Pepper powder tend to move away from the finger tip.
5)	Pepper powder tend to flock around the finger tip.	Pepper powder tend to flock around the finger tip.

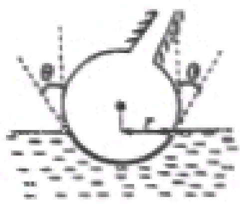
(2013)

25) Three sphericalliquid films of surface tensions T_1, T_2 and T_3 respectively are in equilibrium as shown in figure such that the corresponding radii $R_1 = r$, $R_2 = 2r$ and $R_3 = 3r$

1) $T_1 = T_2 = T_3$
2) $\frac{T_1}{3} = \frac{T_2}{2} = T_3$
3) $\frac{T_1}{6} = \frac{T_2}{4} = T_3$
4) $T_1 = \frac{T_2}{2} = \frac{T_3}{4}$

(2014)

26) Due to surface tension $(0.07 Nm^{-1})$ of water, certain small insects are able to walk on water surfaces by pushing down the water surface. The feet of insects can be considered to be approximately spherical as shown in the figure. When an insect is stationary on a water surface, the position of a leg is shown in the figure. Radius of the circular cross-section of the spherical foot at the water level is r. The mass of the insect is 5.0×10^{-6} kg and $r = 2.5 \times 10^{-5}$ m. If the weight of the insect is supported by its 6 legs, the value of $\cos\theta$ (see figure) is approximately (Take π as 3)



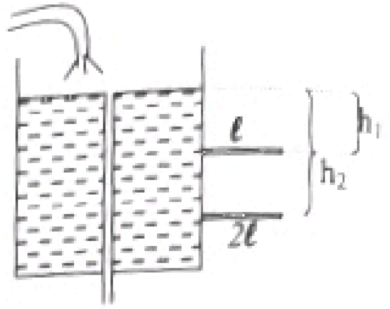
1) 0.1 2) 0.2 3) 0.4 4) 0.6 5) 0.8 (2015)

27) Which of the following is **not** a result of surface tension?
1) Formation of spherical water droplets.
2) Capillary rise of water.
3) Ability of insects to walk on water surfaces without sinking.
4) The excess pressure inside a soap bubble.
5) Escaping of water molecules from water surfaces. (2016)

03. Viscosity

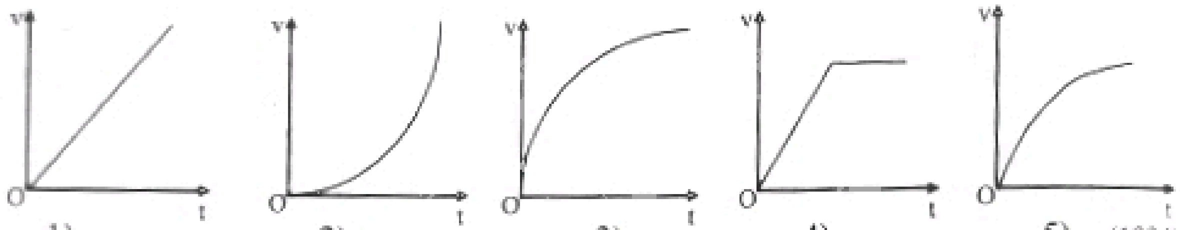
01) Which of the following pairs of physical quantities have the same dimensions?
1) Work and power. 2) Stress and strain 3) Young's modulus and pressure
4) Coefficient of viscosity and surface tension 5) Force and momentum (1992)

02) In the apparatus shown water flows at the same rate through two narrow tubes of lengths ℓ, 2ℓ and radii a, $\frac{a}{2}$ respectively. If the tubes are at depths h_1 and h_2 below the surface of water, then the ration h_1/h_2 will be



1) $\frac{1}{2}$ 2) $\frac{1}{4}$ 3) $\frac{1}{8}$ 4) $\frac{1}{16}$ 5) $\frac{1}{32}$ (1992)

03) An air bubble liberated from the bed of a deep sea is moving upwards. Which of the following graphs best represents the variation of speed (v) of the air bubble with time t?



1) 2) 3) 4) 5) (1994)

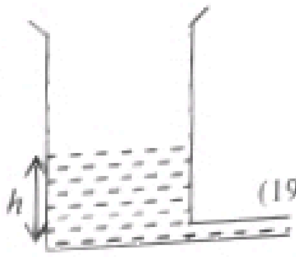
04) Which of the following statements regarding the rate of flow of a viscous liquid flowing steadily through a narrow tube is not correct?
1) The rate of flow is directly proportional to the pressure difference between the ends of the tube
2) The rate of flow is directly proportional to the fourth power of the diameter of the tube
3) The rate of flow in inversely proportional to the coefficient of viscosity of the liquid
4) The rate of flow is inversely proportional to the length of the tube
5) The rate of flow is independent of the pressure gradient across the tube (1995)

05) A sphere of radius a attains a terminal velocity v_0 when it falls down in a fluid of coefficient of viscosity $_1$ and density d_1 . The same sphere is found to attain the same terminal velocity v_0 when if rises up in a different fluid of coefficient of viscosity η_2 and density d_2. The difference of the densities to two fluids (d_2-d_1) is then proportional to

1) $\frac{(\eta_2+\eta_1)v_0}{a^2}$ 2) $\frac{(\eta_2-\eta_1)v_0}{a^2}$ 3) $\frac{(\eta_2+\eta_1)v_0}{a^3}$

4) $\frac{(\eta_2-\eta_1)v_0}{a^3}$ 5) $\frac{(\eta_2-\eta_1)a^2}{v_0}$ (1996)

06) A tank carries a horizontal narrow tube at the bottom as shown in the figure. In order to maintain the water level at a height h, water should be supplied to the tank at a constant rate of Q. The rate at which the water should be supplied to the tank to maintain its water level at 2h is



1) Q/2 2) Q 3) 2Q 4) 3Q 5) 4Q (1997)

07) Two small metal spheres of equal radii, but different densities ρ_1 and ρ_2 are released from rest inside a tall vassal filled with a liquid of density ρ . If the terminal velocities reached by the spheres are v_1 and v_2 respectively, the ratio $\frac{v_1}{v_2}$ us equal to

1) 1 2) $\frac{\rho_1}{\rho_2}$ 3) $\frac{\rho_2}{\rho_1}$ 4) $\frac{\rho_1 - \rho}{\rho_2 - \rho}$ 5) $\frac{\rho_1 + \rho}{\rho_2 + \rho}$ (1998)

08) A liquid flows through two capillary tubes which are not connected to each other, under the same pressure difference. The internal diameter of the two tubes are in the ratio of 2:1 and the lengths are in the ratio of 1:2 . The ratio of the rate of flow of the liquid through the two tubes is equal to

1) 32 : 1 2) 16 : 1 3) 8 : 1 4) 4 : 1 5) 2 : 1 (1999)

09) Consider the following statements regarding the flow of a viscous liquid through a narrow tube.

A) Speed of flow is maximum along the axis of the tube
B) rate of flow of the liquid is proportional to the internal cross- sectional area of the tube.
C) Rate of flow does not depend on the temperature of the liquid

1) Only (A) is true 2) Only (A) and (B) are true
3) Only (A) and (C) are true 4) Only (B) and (C) are true
5) all (A), (B) and (C) are true (2000)

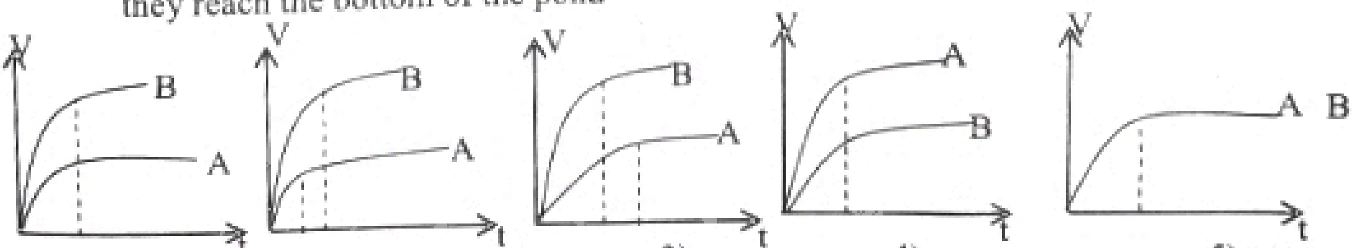
10) The viscous force acting on a sphere moving in a fluid is,

A) directly proportional to the velocity of the sphere
B) directly proportional to the mass of the sphere
C) inversely proportional to the radius of the sphere

Of the above statement

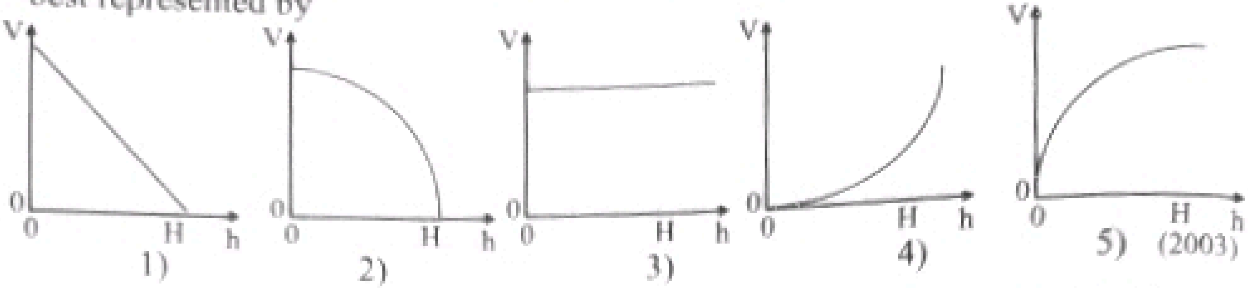
1) Only (A) is true 2) Only (B) is true 3) Only (A) and (B) are true
4) Only (B) and (C) are true 5) all (A), (B) and (C) are true (2001)

11) Two masses, A of mass m and B of mass 2 m but of the same volume, are released from rest at time t = 0 at the surface of a deep pond. Which of the following graphs best represents the variation of the speed of two masses from t = 0 until they reach the bottom of the pond



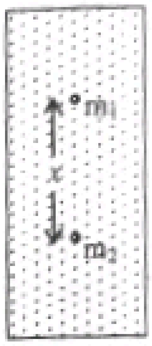
1) 2) 3) 4) 5)(2002)

12) A small rain drop releases from a cloud at a height H above the earth surface. The variation of the speed (v) of the rain drop with height h from the earth surface is best represented by



(2003)

13) Two spheres each of radius a but of different masses m_1 and m_2 ($m_1 > m_2$) move down at their terminal velocities in a liquid of viscosity η at the instant shown in the figure, the separation x between the two spheres in being.



(1) increased at a rate of $\frac{m_1 m_2}{6\pi a\eta}$ g per second.

(2) decreased at a rate of $\frac{6\pi a\eta}{m_1 - m_2}$ g per second

(3) increased at a rate of $\frac{m_1 - m_2}{6\pi a\eta}$ g per second

(4) decreased at a rate of $\frac{m_1 + m_2}{6\pi a\eta}$ g per second

(5) decreased at a rated of $\frac{m_1 - m_2}{6\pi a\eta}$ g per second (2004)

14) Small ball starting from rest rises through a viscous liquid and reaches its terminal velocity. Consider the following statements,

A) The upthrust on the ball is greater then the weight of the ball.
B) At the initial moment of the motion the viscous force on the ball is zero.
C) The acceleration of the ball remains constant until the ball reaches the terminal velocity.

Of the above statement,

1) Only A and B are true
2) Only A and C are true.
3) Only B and C are true
4) Only A is true
5) all A, B and C are true

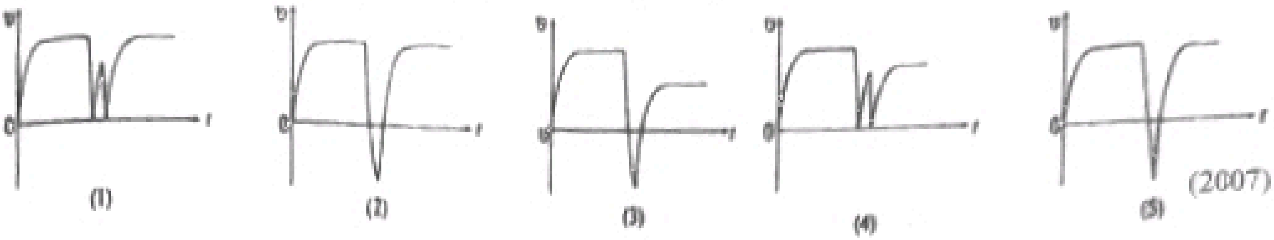
(2005)

15) Two small plastic spheres *A* and *B* of which *A* is hollow and *B* is solid, made of the same material and having the same external radii are released from rest from a tall building. Both spheres reach their terminal velocities before hitting the ground. When the spheres reach the ground,

1) the speed of *A* is greater than the speed of *B*.
2) the viscous force on *A* is less than that on *B*.
3) the viscous force on *B* is less than that on *A*.
4) *A* has taken a shorter time than *B*.
5) both spheres gain the same speed

(2006)

16) A tiny sphere with a static charge $+q$ starts to fall through air under gravity at = 0. After the sphere has reached terminal velocity, a vertically upward electric field E of constant magnitude is applied. A short time after the sphere changes direction of its motion, the electric field is removed.
The variation of the velocity (υ) of the sphere with time (t) is best represented by,

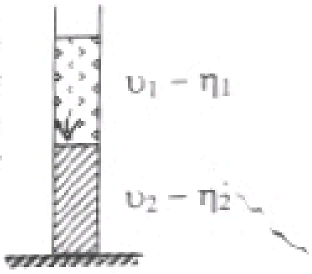


(2007)

17) A blood vessel of length 0.1m has a radius 1×10^{-3} viscosity 3.0×10^{-3} pass flows through the vessel at a rate of $1.0 \times 10^{-7} m^3 s^{-1}$. The pressure difference between the two ends of the vessels is (take $\pi = 3$)
1) 80 Pa 2) 8 Pa 3) 0.8 Pa 4) 0.5 Pa 5) 0.1 Pa (2008)

18) A small metal sphere of mass 40g is released from rest in a viscous medium. When the velocity of the sphere is $0.03\ m\ s^{-1}$, the viscous force on the sphere is found to be 0.1N. If the buoyancy force is negligible, the terminal velocity of the sphere is,
1) $0.06\ m\ s^{-1}$ 2) $0.09\ m\ s^{-1}$ 3) $0.12\ m\ s^{-1}$ 4) $0.15\ m\ s^{-1}$ 5) $0.18\ m\ s^{-1}$ (2009)

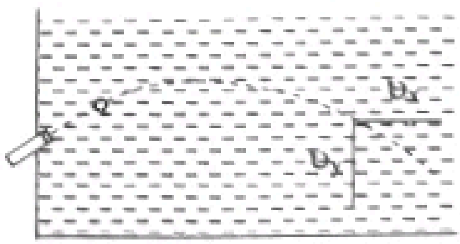
19) A small sphere falls through two columns of immiscible liquid in a deep container as shown in the figure. If η_1 and η_2 are the viscosities of the two liquids, and υ_1 and υ_2 are the corresponding terminal velocities of the sphere respectively then,



1) $\eta_1\upsilon_1 = \eta_2\upsilon_2$ 2) $\eta_1\upsilon_1 > \eta_2\upsilon_2$ 3) $\eta_1\upsilon_1 < \eta_2\upsilon_2$
4) $\eta_1\upsilon_2 > \eta_2\upsilon_1$ 5) $\eta_1\upsilon_2 = \eta_2\upsilon_1$ (2010)

20) How much more thumb pressure should a nurse apply in administrating an injection with a needle of inside diameter 0.2 mm compared to a needle of inside diameter 0.4mm ? Assume that the two needles have the same length and that the volume flow rate is the same in both cases.
1) 2 times 2) 4 times 3) 8 times 4) 10 times 5) 16 times (2011/N)

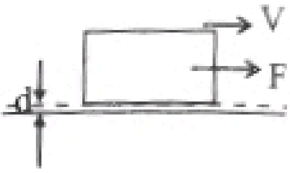
21) A lead ball of radius a is fixed from a toy gap in water in a large swimming pool as shown in the figure. The densities of water and lead are ρ_w and ρ_{pb} respectively and the viscosity of water is η. If the X and Y components of the velocity of the ball at a certain instant are υ_x and υ_y respectively then the magnitudes of the corresponding acceleration components at that instant would be,



	X horizontal	Y Vertical
1)	$\frac{9\eta\upsilon_x}{2a^2\rho_{pb}}$	$\left(1-\frac{\rho_w}{\rho_{pb}}\right)g-\frac{9\eta\upsilon_y}{2a^2\rho_{pb}}$
2)	0	$\left(1-\frac{\rho_w}{\rho_{pb}}\right)g-\frac{9\eta\upsilon_y}{2a^2\rho_{pb}}$
3)	$\frac{9\eta\upsilon_x}{2a^2\rho_{pb}}$	$\left(1-\frac{\rho_w}{\rho_{pb}}\right)g$
4)	$\frac{9\eta\upsilon_x}{2a^2\rho_{pb}}$	g
5)	0	$\left(1-\frac{\rho_w}{\rho_{pb}}\right)g$

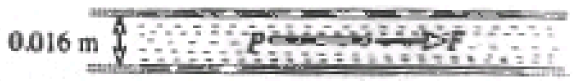
(2012 N)

22) As shown in figure, a *box* is placed on an oil layer of viscosity η and thickness *d*, The area of the surface of the box in contact with the oil is *A*, What should be the horizontal force F to be applied on the box in order to move it at a constant velocity v



1) $F=\frac{\eta Ad}{v}$ 2) $F=\frac{\eta Av}{d}$ 3) $F=\frac{\eta v}{dA}$ 4) $F=6\pi\eta Avd$ 5) $F=6\pi vA\eta$ (2013)

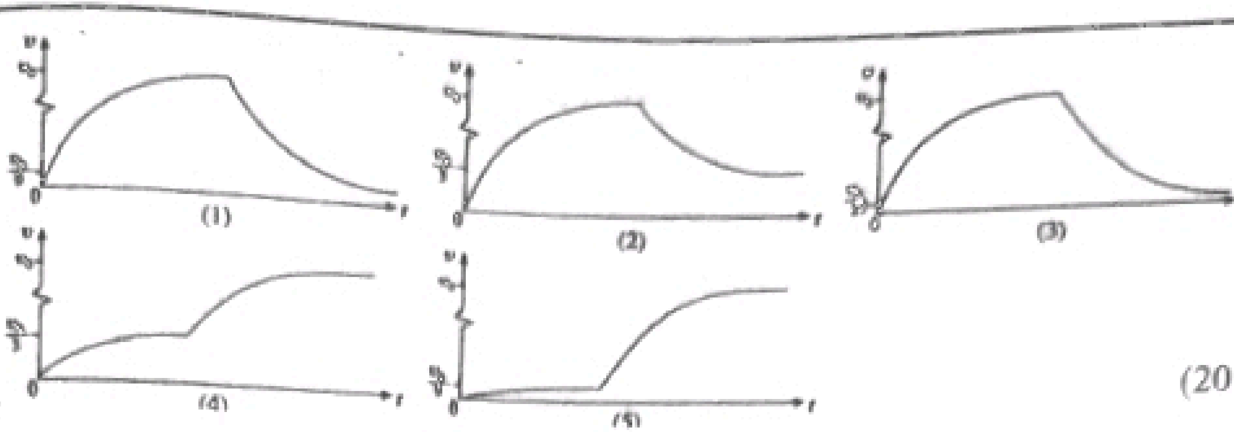
23) Figure shows a section of a long horizontal rectangular tube of height 0.016 m having a large surface area, and filled with a lubricating oil of viscosity 0.072 Pa s. What is the force F required to drag a very thin plate P of area 0.4 m^2 with a velocity of 0.02 ms^{-1} along the middle plane between the top and bottom surfaces of the tube as shown in figure?



1) $3.5\pi \times 10^{-3}$ N 2) $7.0\pi \times 10^{-3}$ N 3) 3.6×10^{-2} N
4) 7.2×10^{-2} N 5) 1.44×10^{-1} N

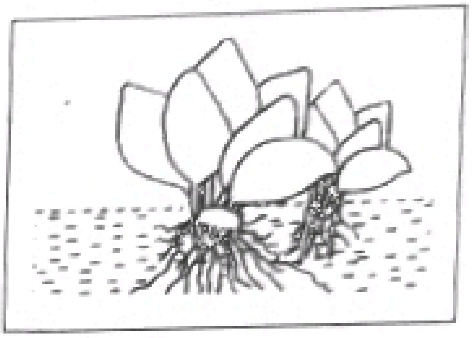
(2014)

24) Seven identical metal spheres each of radius R and mass m are packed inside a hollow spherical container of mass 20 m and radius 3R. When this container is released from the water surface of a calm, deep sea, it moves vertically towards the bottom of the sea. Once the container has reached its terminal velocity v_0, it is opened and the metal spheres are allowed to continue their motion vertically and independently towards the bottom of the sea without any influence from the container. The variation of the velocity (v) of a metal sphere with time (t) is best represented by,



(2015)

25) When wind blows over the surface of a still lake, a bunch of water hyacinth floating on water as shown in figure is observed to move in the direction of the wind with a velocity υ. Consider the following statements made about υ.



(A) Magnitude of υ depends on the rate at which the momentum transferred from air molecules to the bunch.

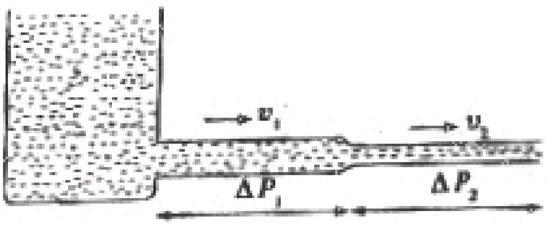
(B) Magnitude of υ depends on the viscosity of water.

(C) Magnitude of υ depends on the mass of the bunch.

Of the above statements,

1) Only C is true. 2) Only A and B are true. 3) Only B and C are true.
4) Only A and C are true. 5) All A, B and C are true. (2016)

26) Two narrow tubes of equal lengths but different radii of cross-sections are connected end to end, and water is allowed to flow through it as shown in the figure.



If υ_1 and υ_2 are the average velocities with which water flows through cross-sections of the tubes, and ΔP_1 and ΔP_2 are the pressure differences built up across the tubes as shown, then the ratio, $\frac{\Delta P_1}{\Delta P_2}$ is equal to,

1) $\left(\frac{\upsilon_1}{\upsilon_2}\right)^{\frac{1}{4}}$ 2) $\frac{\upsilon_1}{\upsilon_2}$ 3) $\left(\frac{\upsilon_1}{\upsilon_2}\right)^2$ 4) $\left(\frac{\upsilon_1}{\upsilon_2}\right)^3$ 5) $\left(\frac{\upsilon_1}{\upsilon_2}\right)^4$ (2016)

PROPERTIES OF MATTER

01) Elasticity

(01)	2	(02)	1	(03)	5	(04)	3	(05)	3	(06)	2	(07)	2
(08)	3	(09)	3	(10)	3	(11)	3	(12)	1	(13)	2	(14)	1
(15)	5	(16)	4	(17)	2	(18)	1	(19)	5	(20)	1	(21)	2
(22)	5	(23)	1	(24)	1	(25)	1	(26)	2	(27)	1	(28)	4
(29)	4	(30)	5										

02) Surface Tension

(01)	5	(02)	3	(03)	2	(04)	1	(05)	3	(06)	4	(07)	3
(08)	1	(09)	3	(10)	3	(11)	1	(12)	5	(13)	4	(14)	2
(15)	4	(16)	1	(17)	4	(18)	2	(19)	4	(20)	3	(21)	1
(22)	4	(23)	1	(24)	4	(25)	5	(26)	5	(27)	5		

03) Viscosity

(01)	3	(02)	5	(03)	2	(04)	5	(05)	1	(06)	3	(07)	4
(08)	1	(09)	1	(10)	1	(11)	All	(12)	2	(13)	5	(14)	1
(15)	2	(16)	2	(17)	1	(18)	3	(19)	2	(20)	5	(21)	1
(22)	2	(23)	5	(24)	1	(25)	5	(26)	3				