PHYSICS

BOOKS - BINA LIBRARY PHYSICS (ASSAMESE ENGLISH)

PROPERTIES OF FLUIDS

Example

1. Calculate the work done in blowing o soap bubble of radius 5 cm(surface tension of soap

solution=3×10^{-2} N/m).

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2. A soap buble is slowing enlarged from a radius of 0.01 m to 0.1 m. Calculate the work done in the process[S= 26×10^{-3} N/m].

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3. Calculate the amount of energy neeeded to break a drop of water of diameter 2×10^{-3} m

into10^9 droplets of equal size(Surface tension of water = $72 \times 10^{-31} \frac{N}{m}$.

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4. Calculate the excess of pressure in a soap bubble of radius 3×10^{-3} m surface tension of the soap solution is 20×10^{-3} N/m.

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5. Calculate the depth of water at which an air bubble of radius 4×10^{-4} m may remain in equilibrium(surface tension =70×10^{-3} N/m).

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6. A long capillary tube with both ends open is filled with water and set in a vertical position. What will be the height of column of water remaining in the tube? The radius of the tube

is 1mm and surface tension of water is 0.07 newton/meter.

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7. In an experiment to determine the surface tension of water by capillary rise, water rises to a height of 0.03m in a capillary tube of diameter 10^{-3}m. If the angle of contact is negligibly small, calculate the surface tension of water.

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8. A narrow tube of radius 1.0 mm made of glass is dipped in mercury. By what amont does the mercury dip down in the tube relative to the mercury surface outside?

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9. Oil of density $800k\frac{g}{m^3}$ is flowing through a horizontal pipe line. At two points separated by a distance of 1km pressure difference is 5

$\frac{N}{m^3}$. Calculate the change in KE per kg of the oil flowing at these points.

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10. Water flows horizontally through a pipeline of varying cross-section. At two points A and B, the diameters are 0.6 m and 0.2m. The pressure difference between the points is 1m. Column of water. Calculate the volume of water flowing per second.

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Exercise

1. What is sarface tension? What is its unit?

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2. What is surface energy? What is its unit?

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3. State the dimension and unit of surface tension.

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4. What is the effect of temperature on surface tension?

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5. What phenomenon is involved in the working of kerosene lamp?

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6. What is the angle of contact?

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7. Why are rain drops spherical?

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8. Sate Jurin's law.

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9. On which side of a liquid surface, pressure is more?

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10. Why does mercury not cling to glass?

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11. why does ink get absorbed by a blotting paper?

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12. Define laminar flow of liquid?

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13. What is meant by turbulent flow of a liquid?

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14. What is meant by streamline motion?

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15. Why terminals velocity so named?

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16. What is the shape of a body for which Stokes'law holds goods?

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17. What is Reynold's number? What is its physical significance?

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18. What is meant by critical velocity?

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19. What is difference between viscosity and friction?

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20. The dimension of co - efficient of viscocity is

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21. What is the basic requirement for the equation of continuity?

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22. What is Pascal's law? Is the law true in the presence of gravity?

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23. Why does the level of mercury fall in a capillary?

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24. What happens when a fluid rises in a capillary of insufficient length?

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25. How is the clearning ability of water improved by detergent?

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26. Establish the equation of continuity.

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27. Why is the velocity of water is large in the middle and less near the bank?

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28. What is Reynold's number? What is its physical significance?

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29. Explain the difference between surface tension and surface energy. What are their units?

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30. Distinguish between streamline and turbulent flow of a liquid.

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31. What is viscosity? Define co-efficient of viscosity. What are its units dimensions?

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32. Show that the pressure at a point in a liquid is directly proportional to the depth of the point from the surface.

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33. State and explain Pascal's law of transmission of liquid pressure. Explain how this principle is applied in hydraulic lift.

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34. What is surface tension of a liquid ? Show that the surface tension of a liquid is numerically equal to the sueface energy per unit area.

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35. What is surface tension of a liquid ? Show that the surface tension of a liquid is numerically equal to the sueface energy per unit area.

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36. What is surface tension of a liquid ? Show that the surface tension of a liquid is numerically equal to the sueface energy per unit area.

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37. Derive an expression for excess of pressure in a liquid drop.

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38. What is capillarity? Derive an expression for the ascent of liquid in a capillary.

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39. Distinguish between streamline and turbulent flow of a liquid.

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40. What is viscosity? Define co-efficient of viscosity. What are its units dimensions?

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41. State and obtain Stokes's law by the method of dimensions

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42. State and obtain Stokes's law by the method of dimensions

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43. Explain the meaning of terminal velocity. Find an expression for it.

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44. Using Stokes' Law show that the constant terminal velocity v of a sphere of radius r, density ρ falling vertically under gravity through a viscous fluid of density σ and co-efficient of viscosity η is given by-

$$v = \left(\frac{2}{9}\right) \cdot \left[\frac{r^2 g(\rho - \sigma)}{\eta}\right]$$

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45. State Bernoulli's theorem. Establish it on the basis of work-energy theorem.

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46. Explain the principle of a venturimeter from Bernoulli's theorem.

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47. Explain why the path of a spinning ball through air becomes curved.

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48. What are various types of energies of a flowing liquid? Express them in terms of unit mass of the liquid.

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49. Explain the principle of the action of a siphon. What are the conditions for its action?

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50. Why is the tip of the nib of your writing pen split?

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51. Why is the surface tension concept held for liquids only and not for gases?

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52. Why does soap or detergent clean the cloths better?

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53. Explain why rain drops are spherical while the surface of water in a pond is flat.

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54. Why water wets glass, but not mercury?

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55. Why does a needle float on clear water, but sinks when some detergent is added to water?

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56. Why does oil spread over the surface of water?

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57. Can two streamlins cross each other?

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58. Distinguish between streamline and turbulent flow of a liquid.

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59. Why does velocity increase when water flowing in broader pipe enters a narrow pipe?

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60. Why does deep water run slow?

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61. Why does a flag flutter in breeze?

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62. If a person stands near a fast moving train, there is a possibility of his falling-- explain.

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63. A ball-bearing falling in a tall jar of motor oil attains a constant velocity. Explain the reason.

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64. Water flows faster than honey-- explain the reason?

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65. A bigger rain drop falls faster than smaller one. Why ?

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66. Dust generally settles down in a closed room. Why?

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67. Machine parts are jammed in winter. Why ?

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68. Find the work done in blowing a soap bubble of surface tension $30 \times 10^{-3} Nm^{-1}$

from 20mm radius to 40mm radius.

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69. A drop of water 1mm radius is split into 64tiny drops. Find the increase in surface energy.[$S = 72 \times 10^{-3} Nm^{-1}$]

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70. Calculate the energy spent in sprying a drop of mercury of 1 cm radius into 10^6

droplets of same size.[surface tension of mercury is $35 \times 10^{-3} Nm^{-1}$]

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71. In a capillary tube of diameter $10^{-3} m$, water rises to a height of 0.03 m. calculate the surface tension of water.

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72. Water rises in a capillary tube to a height 2cm. In another capillary tube whose radius is one third of it, how much the water will rise? If the first capillary tube is inclined at an angle 60^0 with the vertical, then what will be the position of water in the tube?

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73. Two equal drops of water are falling through air with a steady velocity of 0.1m/s. if

the drops coalese, what will be its velocity?

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74. What should be the maximum average velocity of water in a tube of diameter 25mm so that the flow is laminar?

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75. Water flows through a pipe of varying cross-section. If the velocity of flow is 0.24 m/s

at a cross- section of $5cm^2$, what will beits velocity at a cross-section of $10cm^2$?

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76. A sphere of radius 0.25mm and of density $9000k\frac{g}{m^3}$ falls through an oil of co-efficient of viscosity $0.2N\frac{s}{m^2}$ and of density $800k\frac{g}{m^3}$. Find the terminal velocity of the sphere.

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77. Two drops of water of same size are falling through air with terminal veloity 10m/s. if the two drops coalese to form a single drop, what will be the new ternimal velocity?

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78. Find the ternimal velocity of a steel ball 2 mm in diameter falling through glycerine.(Sp gr. Of steel = 8 and of glycerine =1.3, viscosity of glycerine = 8.3 poise)

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79. Determine the radius of a drop of water falling through air, if it covers 4.1 cm in 4 seconds with a uniform velocity.[density of air 0.001293 gcm^{-3}, viscosity of air = 1.8×10^{-4} poise]

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80. Water is flowing steadily through a horizontal pipe of non- uniform cross-section.

The pressure of water is 4×10^4 at a point, where cross-section is $0.02m^2$ and velocity of flow is $2ms^{-1}$. What is the pressure at a point, where cross-section reduces to $0.01m^2$?

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81. At which of the following temperatures the value of surface tension of water is minimun?

A. 4^0C

B. 25^0C

C. 50^0C

D. 75^0C

Answer: D

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82. When two soap bubbles of radii r_1 and r_2 ($r_2 > r_1$)coalese, the radius of curvature of common surface is

A. $(r_2 - r_1)$

B. $(r_2 + r_1)$

C. $\frac{r_2 - r_1}{r_1} r_2$

D. $\frac{r_1 r_2}{r_1 - r_2}$

Answer: D

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83. What change of surface energy will be noticed when a drop of radius R splits into 1000 droplets radius r, surface tension being T

A. $4\pi R^2 T$

B. $7\pi R^2 T$

C. $16\pi R^2 T$

D. 36piR^2T`

Answer: D

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84. The capillary rise in a tube of diameter 1mm when surface tension of water is $0.06 Nm^{-1}$ is

A. 1.22 cm

B. 2.44 cm

C. 3.12 cm

D. 3.86 cm

Answer: B

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85. The capillary tubes of radii of 0.2 cm and 0.4 cm are dipped in the same liquid. The ratio

of the heights through which liquid will rise in tubes is

A. $1:2$

B. $2:1$

C. $1:4$

D. $4:1$

Answer: B

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86. Small liquid drops assume sherical shape because

A. of adhesion

B. of the gravitational force

C. of the pressure from all sides

D. the liquid tends to have minimun surface area due to surface tension

Answer: D

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87. Why does soap or detergent clean the cloths better?

A. chemicals of soap change

B. it increases surface tensionof the solution

C. iy absorbs dirt

D. it lowers the surface tension of the solution.

Answer: D

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88. Ball pen functions on the principle of

A. viscosity

B. Boyle's law

C. gravatational force

D. surface tension

Answer: D

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89. The value of surface tension depends upon

A. nature of solid in contact with liquid

B. nature of the liquid

C. both nature of liquid and solid in contact

D. none of these

Answer: B

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90. Surface tension is due to

A. cohesive forces between molecules

B. adhesive forces between molecules

C. frictinoal forces

D. gravitational force

Answer: A

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91. When two capillary tubes of different diameters are dipped vertically in a liquid, the height of the liquid is:

A. more in the tube of large diameter

B. more in the tube of smaller diameter

C. same in both the tubes

D. less in the tube of smaller diameter

Answer: B

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92. When two water drops merge to form a large drop

A. energy is liberated

B. energy is asborbed

C. energyneither liberated nor absorbed

D. some mass is converted into energy

Answer: A

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

A. $2\pi R^2 S$

B. $3\pi R^2 S$

C. $4\pi R^2 S$

D. $2\pi R S^2$

Answer: C

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94. A number of small drop of mercury coalesce adiabatically to form a single drop. The temperature of the drop.

A. increases

B. decreases

C. remains unchanged

D. may increase or decrease depending on size.

Answer: A

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95. Excess pressure inside a bubble is

A. directly proportional to its radius

B. inversely proportional to its radius

C. directly proportional to the square of its radius

D. independent of radius

Answer: B

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96. Due to capillary action a liquid will rise in a tube if the angle of contact is

A. zero

B. 45^0

C. an acute one

D. an obtuse one

Answer: A

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97. When the temperature is increased the angle ofs contact of a liquid

A. increases

B. decreases

C. remains the same

D. first increases and then decreases

Answer: B

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98. The clouds float in the atmosphere because of

A. low temperature

B. low viscosity

C. low density

D. creation of low pressure

Answer: C

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99. With increase in temperature viscosity of liquid and gases

A. increases for both

B. decreases for both

C. increases for liquid and decreases for gases

D. decreases for liquid and increases for gases

Answer: D

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100. Bernoulli's theorem is applicable for processes which are

A. isothermal

B. adiabatic

C. isochoric

D. isobaric

Answer: A

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101. Viscous force on small sphere of radius R moving in fluid varies as

A. R^2

B. R

C. 1/R

D. $\left(\frac{1}{R}\right)^2$

Answer: B

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102. The dimension of co - efficient of viscocity is

A. $ML^{-2}T^{-1}$

B. $ML^{-2}T^{-2}$

C. $ML^{-1}T^{-1}$

D. $ML^{-1}T^{-2}$

Answer: C

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103. Two equal drops of water are falling through air with a steady velocity of 10 cm/s. If the two drops recombine to a single drop, what will be the terminal velocity

A. 20cm/s

B. 5.9 cm/s

C. 10 cm/s

D. 15.9 cm/s

Answer: D

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104. A ball of mass m and radius r is released in a viscous fluid. The value of its terminal velocity is proportional to

A. 1/r

B. m/r

C. $\frac{\sqrt{m}}{r}$

D. m only

Answer: B

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105. The radius of a tube is doubled, the rate of flow increases by

A. 8 times

B. 16 times

C. 4 times

D. 2 times

Answer: B

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106. Under a constant pressure head, the rate of flow of orderly volume flow of liquid through a capillary tube is V. if the length of the capillary is doubled and the diameter of the bore is halved, the rate of flow would become

A. V/4

B. 16V

C. V/8

D. V/32

Answer: D

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107. The ternimal velocity of small sized spherical ball of radius r falling vertically in a viscous liquid is

A. $\alpha \frac{1}{r^2}$

B. $\alpha \frac{1}{r}$

C. αr

D. αr^2

Answer: D

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108. The velocity of falling rain drops attain limited veloity because of

A. upthrust of air

B. viscous force exerted by air

C. surface tension effect

D. air current is atmosphere

Answer: B

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109. In Bernoulli's theorem which one of the following is conserved?

A. mass

B. energy

C. linear momentum

D. angular momentum

Answer: B

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