SAMPLE QUESTION FOR FIRST SEMESTER PHYSICS HONOURS
UNIT: GENERAL PROPERTIES OF MATTER

Short Answer type Questions:

1. Define 'gravitational flux'.
2. Write down the difference between gravitational potential and electrostatic potential.
3. Show graphically the variation of gravitational potential due to a thin spherical shell when the point of observation is moved from the centre of the hollow sphere to infinity.
4. What do you mean by 'parking orbit'?
5. Explain the term 'internal bending moment' related to bending of a beam.
6. What is the SI unit of rigidity modulus?
7. Prove that the value of Poisson's ratio lies in between -1 and $\frac{1}{2}$.
8. What is meant by the term 'torsional rigidity'?
9. What is the difference between angle of twist and angle of shear?
10. Define 'strain energy'.
11. What is 'flexural rigidity'?
12. What is fugitive elasticity?
13. How does the viscosity of a fluid depend on temperature?
14. What do you mean by neutral surface related to bending of beam?
15. Define co-efficient of viscosity. What is its dimensional formula?
16. The co-efficient of viscosity of water is 0.0101 poise- explain.
17. How does the co-efficient of viscosity of a liquid depend on temperature?
18. What do you mean by Newtonian and Non-Newtonian fluids?
19. Distinguish between streamline and turbulent motion.
20. State various energy possessed by a liquid in motion.
21. State the SI unit of Surface tension.
22. Define critical temperature related to surface tension.

Long Answer type Questions:

1. (a) State and prove Gauss's theorem.
   (b) Using Gauss's theorem, derive expression for the gravitational field intensity at a point inside, outside and on the surface due to thin spherical shell.
   (c) Using Gauss's theorem, derive expression for the gravitational field intensity at a point inside, outside and on the surface due to uniform solid sphere.

2. (a) Define elastic constant.
   (b) Define Young's modulus (Y), Bulk modulus (K) and rigidity modulus (η) and Poisson's ratio.
   (c) Establish the relation, $\frac{9}{Y} = \frac{3}{\eta} + \frac{1}{K}$, where symbols have their usual meanings.
   (d) Prove that a shear is equivalent to a compression and an equal extension at right angles to each other.
   (e) Derive an expression for the torque necessary for twisting a wire of length l and radius R through an angle of 1 radian. Or, Show that in case of torsion of a cylinder, couple per unit twist is $C = \frac{\pi\eta r^4}{2l}$, where symbols have their usual meanings.
   (f) Prove that the stored energy density of a stretched wire is independent of the wire dimensions.

Or, Find out an expression for the work done in stretching a wire and hence find the energy per unit volume. Or, What do you mean by elastic strain energy? Derive an expression for strain energy for bending of a beam.

(g) Show that the elastic strain energy of a twisted wire is $\frac{1}{2}C_m\theta_m$, where C_m is the torsional couple for the twist θ_m.

(h) Explain 'internal bending moment' of a beam and derive an expression for the same.

(i) Explain what do you mean by cantilever. Find an expression for the depression due to a load attached to the free end of a cantilever.

Or, Calculate the depression at a point of a cantilever beam loaded at the free end, neglecting the weight of the beam.

Or, Show that the depression produced at the free end of a cantilever of length l when it is loaded with weight W at its free end is $\delta = \frac{Wl^3}{3YI}$, where Y= Young's modulus of the material of the cantilever and I = geometrical moment of inertia of the cantilever.

(j) Find an expression for the depression of a uniform light beam supported at two ends and loaded at the middle.

(k) A straight beam of circular cross section, rigidly clamped at one end and loaded at the free end with a weight W. Derive an expression for the depression at the end of weight if the weight of the beam is negligible.

Or, Consider a light beam resting in a horizontal position supports at its ends. It carries a load of weight W at its midpoint. Find the depression at the midpoint of the beam.

(l) A uniform rod of mass m, length L, area of cross section A and Young's modulus Y hangs from the ceiling. Find its elongation due to its own weight.

(m) Two rods of identical dimensions, with Young's moduli Y_1 and Y_2 are joined end to end. Find the equivalent Young's modulus for the composite rod.

3. (a) What are meant by (i) surface tension and (ii) surface energy?

(b) Establish a relation between the surface tension and surface energy at an absolute temperature T.

(c) Explain the molecular theory of surface tension.

(d) Write the factors affecting the surface tension of a liquid.

(e) State the respective changes in surface tension of a liquid when organic and inorganic substances are dissolved into the liquid.

(f) Show that the excess pressure acting on the curved surface of a curved membrane is given by, $\Delta P = 2T\left(\frac{1}{r_1}+\frac{1}{r_2}\right)$, where r_1 and r_2 are the radii of curvature of two sides of curved membrane and T is the surface tension.

Or, Find an expression for the excess pressure in a spherical air bubble of radius r in a liquid whose surface tension relative to air is T.

Or, Find out an expression for the excess pressure within a spherical soap bubble. What is its expression for an air-bubble in water?

(g) What is angle of contact? On what factors does it depend? Why is angle of contact obtuse in some cases and acute in some other cases? Explain your answer with relevant diagrams. Give example for each.

(h) Explain why water rises in a capillary tube dipped partially in water and obtain an expression for the height of rise. State Jurin's law from it.

4. (a) State Newton's law of viscous flow and hence define co-efficient of viscosity of liquid. What is its unit?

(b) Deduce an expression for Poiseuille's equation. Is there any need of correction? Can this expression be applied to the flow of blood?
Or, Derive Poiseuille's equation for the flow of an incompressible liquid flowing through a horizontal cylindrical capillary tube of radius r and length l.
(c) Establish Stoke's law from dimensional analysis. Using this law, derive an expression for the terminal velocity.
(d) Establish the differential form of the equation of continuity of a homogenous and incompressible fluid.
(e) State clearly the assumptions in Bernoulli's theorem. Derive Bernoulli's equation in case of steady flow of an incompressible, non-viscous fluid and explain each term of the equation.
(f) Explain the principle of venturimeter for the measurement of volume of liquid passing through a tube in time t, using Bernoulli's theorem.
(g) Explain the working of a pitot tube.
(h) State and prove Torricelli's law.
(i) What is the critical velocity? What is the significance of Reynold's number? Obtain by the method of dimensions, a relation between the critical velocity and Reynold's number for a liquid flowing through a capillary tube.
(j) Distinguish between streamline and turbulent flow of fluid with reference to Reynold's number.

Solve the followings:

1. The radius of the earth 6.4×10^6 m, its mean density 5.5×10^3 kg/m^3 and the gravitational constant is 6.67×10^{-11} Nm^{2}kg^{-2}. Calculate the gravitational potential on the surface of the earth.
2. Suppose the gravitational force varies inversely as the nth power of distance then find the expression for the time period of a planet in a circular orbit of radius 'r' around the sun.
3. Two bodies of masses m_1 and m_2 are initially at rest. They are allowed to move towards each other under their mutual gravitational attraction. Show that their relative velocity of approach at separation r is $v = \sqrt{\frac{2G(m_1+m_2)}{r}}$
4. A rocket is fired from the earth towards the sun. At what point on its path is the gravitational force on the rocket zero? Given that the mass of the sun is 2×10^{30} kg, mass of the earth is 6×10^{24} kg and distance from earth to the sun is 1.5×10^{11} m.
5. A wire of length 'l' and mass 'm' is bent in the form of a semicircle. Find the gravitational intensity at the centre of the semicircle.
6.
7. Three particles each of mass 'm' are located at the vertices of an equilateral triangle of side 'a'. What is the gravitational potential and intensity at the centre of the triangle?
8. Two particles of masses m_1 and m_2 are placed at a distance 'x' apart. Find the gravitational potential at a point where the gravitational field intensity due to them is zero.

9. Calculate the distance from the earth to the point where the gravitational field due to the earth and the moon cancel out. Given the distance between the earth and moon is 3.8 x 10^8 m, mass of the earth is 81 times to that of moon.
10. A smooth tunnel is bored through the earth and a small particle is allowed to move in it from the position at rest. Find the periodic time of one vibration. Given G=6.67 × 10^{-11} Nm^2kg^{-2}, mean density of the earth is 5500 kg/m^3.
11. Show that if a body be projected vertically upward from the surface of the earth so as to rise height nR above the surface. Find the increase in the gravitational potential energy. Also find the velocity with which it is to be projected to attain that height.
12. Calculate the amount of work needed to send a body of mass 'm' from the earth's surface to a height (i) R/2 (ii) 10R and (iii) 1000R , where R is the radius of the earth. What should be the velocities given to the body to attain those heights?
13. What will be the gravitational potential and intensity of a thin spherical shell of mass 100 kg and radius 0.1 m at a point (i) 0.2 m outside, (ii) 0.05 m inside and (iii) at a point on its surface?
14. Calculate the time taken by an earth satellite moving in a circular orbit, close to its surface, in completing one round. Take the radius of the earth as 6 × 10^8 cm.
15. Show that the escape velocity from the surface of the earth is $\sqrt{2}$ times the velocity of projection of an artificial satellite revolving very close to the earth's surface.
16. The minimum and maximum distances of a comet from the sun are 7×10^{10} m and 1.4 $\times 10^{12}$m respectively. If the speed of the comet at the nearest point is $6\times 10^4\ m/s$, then calculate the speed at the farthest point.
17. A satellite revolves round a planet in an elliptical orbit. Its minimum and maximum distances from the planet are 0.5×10^7 m and 1.5×10^7m respectively. If the speed of the satellite at the farthest point is $5\times 10^3\ m/s$, then calculate the speed at the nearest point.
18. Suppose the earth is revolving round the sun in a circular orbit of radius 1 Astronomical Unit (AU). Find the mass of the sun.
19. The radius of the earth is R and the acceleration due to gravity at its surface is g. Calculate the work required in raising a body of mass m to a height h from the surface of the earth.
20. Two uniform solid spheres of equal radii R, but mass M and 4M have a centre to centre separation 6R. The two spheres are held fixed. A projectile of mass 'm' is projected from the surface of the sphere of mass M directly towards the centre of the second sphere. Obtain an expression for the minimum speed of the projectile so that its reaches the surface of the second sphere.
21. If the period of revolution of an artificial satellite just above the earth's surface be T and the density of the earth be ρ, then show that ρT^2 is a universal constant.
22. Show that the velocity of a body released at a distance r from the centre of the earth, when it strikes the surface of the earth is given by, $v = \sqrt{2GM\left(\frac{1}{R}-\frac{1}{r}\right)}$, where R and M are the radius and mass of the earth respectively. Also show that the velocity with which the meteorites strike the surface of the earth is equal to the escape velocity.
23. The distance between the centers of two stars is 10a. The masses of these stars are M and 16M and their radii a and 2a respectively. A body of mass 'm' starts is fired straight from the surface the larger star towards the smaller star. What should be its minimum initial speed to reach the surface of the smaller star? Obtain the expression in terms of G, M and a.

24. Show that the force of attraction of a thin uniform rod of length l on a mass m situated on the line along the rod, at a distance d from an end is given by $F = \frac{GMm}{d(d+l)}$
25. In a spherical mass the density varies inversely as the distance from the centre. Show that the attraction (field) is the same at any two internal points.
26. Two masses of 1 kg and 4 kg are placed at a distance of 12 cm. a third mass of 1 kg is placed on the line in between the two masses so that it experiences no resultant force. What is its position? Calculate the binding energy of the system and energy needed in removing the third mass alone?
27. Two satellites each of mass m are moving in the same circular orbit of radius r around the earth in the opposite sense and therefore in course they collide. Find the total energy of two satellites plus earth system in terms of G, M, m and r just before collision. If the collision is perfectly inelastic find the total mechanical energy just after the collision.
28. Prove that the least velocity with which a particle must be projected from the surface of a planet of radius R and mean density ρ, in order that it may escape completely is $v = R\sqrt{\frac{8\pi G\rho}{3}}$.
29. Example 28: Show that the moon would depart for ever if its speed were increased 42% (nearly).
30. In a hydrogen atom the electron is at a distance 0.53 A^0 . Find the ratio of electrostatic and gravitational forces and potential energies.
31. A man can jump vertically 1.5 m on the earth's surface. Calculate the maximum radius of sphere of the same mean density as the earth from whose gravitational field he could escape by jumping. (radius of the earth = 6.4×10^6 m)
32. A spherical hollow sphere is made in a metallic sphere of radius r such that its surface touches the outside surface of the metallic sphere. The mass of the sphere before hollowing is M. Calculate the force of attraction on a point mass m placed at a distance d due to this sphere.
33. Show that the gravitational field intensity due to a ring of mass M on an axial point distance r from its centre is $E = -\frac{GM}{(R^2+r^2)^{\frac{5}{2}}}$. Also calculate its potential.
34. A satellite is in circular orbit about a planet of radius R. If the altitude of the satellite is h and its period is T then show that density of the planet, $\rho = \frac{3\pi}{GT^2}\left[1+\frac{h}{R}\right]^3$.
35. Find the mean density of the earth from the following data: Radius = 6300 km, g = 980 cm/s^2, G= 6.66×10^{-8} CGS units.
36. The mass of the moon is $1/10^{th}$ that of the earth and its diameter is $1/4^{th}$ that of earth. Find the acceleration due to gravity on the surface of the moon.
37. A sphere of mass 40 kg is attracted by a second sphere of mass 15 kg when their centres are 20 cm apart with a force equal to $1/10^{th}$ of a milligram weight. Calculate the constant of gravitation.
38. Calculate the mass of the sun, given that distance between the sun and the earth is 1.49×10^{13} cm and G = 6.66×10^{-8} CGS units, 1 year is equal to 365 days.
39. If the period of revolution of an artificial satellite just above the earth's surface be T and the density of the earth be ρ, then show that $T = \sqrt{\frac{3\pi}{G\rho}}$.
40. Prove that the gravitational force on a point mass m situated at a distance r from an infinite line mass of uniform density ρ per unit length is $\frac{2Gm\rho}{r}$.

41. the mass of the earth is 144 times that of the moon and distance between their centres is 3.8×10^5 km, find the position at which the gravitational field intensities of the bodies are equal and opposite.
42. The moon describes a circular orbit of radius 3.8×10^5 km about the earth in 27 days and the earth describes a circular orbit of radius 1.5×10^8 km round the sun in 365 days. Determine the mass of the sun in terms of the earth.
43. A uniform solid spheres of mass M and radius 'a' is surrounded by a uniform thin spherical shell of mass M and radius 2a. Find out the gravitational field intensity at a distance $\frac{3}{2}a$ from the centre.
44. Show that the gravitational potential at a point inside the material of thick hollow sphere is $V = -\frac{3GM(a+b)}{2(a^2+ab+b^2)}$, where a and b are the inner and outer radii of the hollow sphere respectively.
45. Determine the surface potential of the earth when the radius of the earth is 6.637×10^6 m, its mean density = 5.57×10^3 kg/m^3 and G = 6.66×10^{-11} Nm^2/kg^2.
46. The gravitational potentials within two thin homogeneous spherical shells of same surface density of mass are in the ratio 1:2. Calculate the ratio of their radii.
47. A satellite revolves round a planet in an elliptical orbit, its maximum and minimum distances from the planet are 1.5×10^7 m and 0.5×10^7 m respectively. If the speed of the satellite at the farthest point is 5×10^3 m/s calculate the speed at the nearest point.
48. A and B are the centres of two spherical bodies of masses m_1 and m_2 respectively. Find the point O at which the gravitational intensity vanishes. Show that if a particle at rest at O be given a small displacement in the direction perpendicular to AB, it will execute SHM. In case $m_1 = m_2 = m$ (say) show that the time period will be $T = \frac{\pi}{2}\sqrt{\frac{r^3}{Gm}}$.
49. Calculate the gravitational potential due to a circular plate of uniform areal density ρ and radius a, at a distance r from the centre of the plate on the axis perpendicular to the plate at its centre.
50. Calculate the gravitational potential due to a uniform circular plate of mass M and radius a at a distance r from the centre of the plate located on the axis perpendicular to the plate through its centre.
51. Gauss's theorem for gravitation is $\oint \boldsymbol{E}.\boldsymbol{ds} = -4\pi G\int \rho dV$, where ρ is the density of matter in the enclosed volume. What is E in this equation? Use the above equation to calculate the magnitude and direction of the gravitational field intensity at the point P inside a very long cylinder of uniform density. The point P is at a distance r from the axis.
52. Find the gravitational potential energy of a uniform solid sphere of mass M and radius R.
53. Find the gravitational potential of a circular disc of uniform surface density σ and radius a at a point on its circumference.
54. A self-attracting sphere of uniform density ρ and radius R changes to one of uniform density and radius r. Show that the work done by its mutual attraction forces is $\frac{3}{5}GM^2\left(\frac{1}{r}-\frac{1}{R}\right)$, where M is the mass of the sphere.
55. If M be the mass of solid sphere of radius R, then show that the loss of gravitational potential energy in assembling the particles from a state of diffusion at an infinite distance is $\frac{3}{5}\frac{GM^2}{R}$, where G is the constant of gravitation.

56. If a body is falling freely in the earth's gravitational field from infinity show that it will the same velocity as that attained by a free fall from a height R above the earth surface under constant acceleration due to gravity g.
57. A shell is projected horizontally from a rocket when it is at a height h above the surface of the earth. Calculate the velocity of projection necessary for the shell to circle round the earth as a satellite at the above height.
58. Assuming the moon to describe a circular orbit of radius 4×10^5 km round the earth in 27 days, calculate the time taken by an artificial satellite moving very close to earth's surface. (radius of the earth = 6400 km).
59. Find the work done in producing an extension of 2 mm in a steel wire of original length of 2 m and diameter 0.8 mm. [$Y=2\times10^{12}$ CGS Unit]
60. The shear modulus of a metal is 50,000 N/m^2. Suppose that a shear force of 200 N is applied to the upper surface of a cube of this metal that is 3.0 cm on each side. How far will the top surface be displaced?
61. A wire 4m long and 0.3 mm in diameter is stretched by a force of 800 g-wt. If the extension in the length amounts to 1.5 mm, calculate the energy stored in the wire.
62. A metallic bar 30 cm long, 2 cm broad and 0.2 cm thick is clamped at one end and loaded at the other end with a mass of 10g. Calculate the depression at a point 20 cm away from the clamped end. (Take Y = 1.013 $x10^{11}$ dyne/cm^2, g=980 cm/s^2).
63. A uniform rigid rod of negligible weight is of length 120 cm and diameter 2 cm. The rod is clamped horizontally at one end and loaded at the other end with a mass of 100g. Calculate the depression at a point 70 cm away from the clamped end. (Take Y = 1.013 $x10^{11}$ dyne/cm2, g=980 cm/s^2).
64. Calculate the work done in twisting a steel wire of radius 10-3 m and length 0.25 m through an angle 45^0. Given rigidity modulus of the material of the wire is 8 x 10^{10} N/m^2.
65. A metallic bar 30 cm long, 2 cm broad and 0.2 cm thick is clamped at one end and loaded at the other end with a mass of 10g. Calculate the period of vibration of the bar, neglecting the weight of the bar (Take Y = 20 $x10^{11}$ dyne/cm^2).
66. The breaking stress for a metal is 7.8×10^9 Nm^{-2}. Calculate the maximum length of the wire made of this metal that can be suspended without breaking. The density of material of wire is 7.8×10^3kg/m^3 and g = 10 N/kg.
67. A uniform heavy rod of weight W, cross-sectional area A and length l is hanging from a fixed support. Young's modulus of material of the rod is Y. Neglecting the lateral contraction, find the elongation produced in the rod.
68. The length of a metal wire is l_1 when the tension is it is T_1 and l_2 when the tension is T_2. Find the original length of the wire.
69. A metal bar of length l and area of cross-section A is rigidly clamped between two walls. The Young's modulus of the material is Y and the co-efficient of linear expansion is α. The bar is heated so that its temperature is increased by ΔT. Find the force exerted at the ends of the bar.
70. A lead ball of radius 0.05 cm falls through glycerin with a terminal velocity of 0.648 cm/s. If the specific gravities of lead and glycerin are 11.36 and 1.26 respectively, calculate the co-efficient of viscosity of glycerin.
71. Find the terminal velocity of an oil drop of density 0.95 g/c.c, and radius 10^{-4} cm falling through air of density 0.00013 g/c.c., if the viscosity of air is 181×10^{-6} CGS unit.
72. A tiny glass sphere (density 2600 kg/m^3), is let fall through oil (density 950 kg/m^3, co-efficient of viscosity = 0.21 Poise). In 100 s, it is observed to drop through 43 cm. how large is the radius of the sphere?

73. An air bubble of radius r rises from the bottom of tube of depth H. When it reaches the surface, its radius becomes 3r. What is the atmospheric pressure in terms of height of water column?
74. n identical water drops are falling through air with terminal velocity of 10 cm/s. if they coalesce to form a single drop, what will be the new terminal velocity?
75. Two drops of water of same size are falling through air with terminal velocity of 1 m/s. If the two drops combine to form a single drop calculate the terminal velocity.
76. A tank full of water has a small hole at its bottom. If one fourth of the tank is emptied in t_1 s and the remaining three fourth of the tank s emptied in t_2 s, then show that $\frac{t_1}{t_2} = \frac{2-\sqrt{3}}{\sqrt{3}}$.
77. A capillary tube of radius r and length l is fitted at the bottom of a cylindrical container of cross-section α. Initially, there is a liquid in the container up to a height H. What time would be required for the half of the liquid to flow out? The co-efficient of viscosity of the liquid is η.
78. A pitot tube is fixed on the wing of an aeroplane to measure the speed of the aeroplane. The tube contains a liquid of density 800 kg/m^3. The difference in level between two limbs is 0.5 m. Density of air is 1.293 kg/m^3. Calculate the speed of the aeroplane.
79. A cylindrical vessel of diameter 10 cm has its bottom a horizontal capillary tube of length 25 cm and radius 0.4 mm. If the vessel is filled with water, find the time in which level becomes half the initial height. Viscosity of water is 10^{-3} $N\text{-}s/m^2$.
80. A sphere is dropped under gravity through a fluid of viscosity η. Taking the average acceleration as the half of the initial acceleration, show that the time taken to attain the terminal velocity is independent of fluid density.
81. Two exactly similar rain drops falling with terminal velocity of $(2)^{\frac{1}{3}}$ m/s coalesce to form a bigger drop. Find the new terminal velocity of the bigger drop.
82. What is the work done in blowing a soap bubble of radius 10 cm? Surface tension of soap solution is 30 dynes/cm.
83. If S is the surface tension of a liquid, find the energy needed to break a liquid drop of radius R into 64 drops of equal size.
84. Two soap bubbles have radii in the ratio 2:3. Compare the excess pressure inside these bubbles. Also compare the works done in blowing these bubbles.
85. One large soap bubble of diameter D breaks into 27 bubbles having surface tension T. Find the change in surface energy.
86. The excess pressure inside a soap bubble is thrice that in another bubble. What is the ratio between the volume of the first and second bubble?
87. Water rises to a height of 15 cm in a glass capillary tube. If the cross-sectional area is reduced to $1/4^{th}$ of the former, then find the height to which water will be raised now?
88. A capillary tube of radius r is immersed in water and water rises into a height h. the mass of water in the capillary tube is 5 g. another capillary tube of radius 2r is immersed in water. Find the mass of the water that will rise in the latter tube.
89. Two spherical soap bubbles coalesce at constant temperature. If V is the consequent change in the volume of the contained air and S is the change in the total surface area and T is the surface tension of the soap solution then show that $3P_0V + 4ST = 0$, where P_0 is the atmospheric pressure.
90. An air-bubble of radius 1mm exists in a liquid of surface tension 0.075 N/m and density 1000 kg/m^3 at a depth of 10 cm below the surface of a liquid. By what amount is the pressure is the pressure inside the bubble greater than the atmospheric pressure? Take $g=9.8\ m/s^2$.

91. Calculate the work done on the thin film in blowing a soap bubble from a diameter of 4 cm to 30 cm if its surface tension be 45 CGS units.
92. Three capillaries of same length but of internal radii 3r, 4r and 5r are connected in series and a liquid flows through them in streamline motion. If the pressure difference across the third capillary tube is 8.1 mm, then find the pressure difference across the first tube.
93. The excess pressure inside a soap bubble of radius 8 mm balances 2 mm column of oil of specific gravity 0.8. Calculate the surface tension of soap solution.
94. A number of droplets of water, all of same radius r, coalesce to form a single drop of radius R. If the specific heat capacity of water is 1 cal/g^{0}C, and its density 1g/c.c., show that the rise in the temperature of water will be $\Delta\theta = \frac{3S}{J}\left(\frac{1}{r} - \frac{1}{R}\right)$, where S is the surface tension of water and J is mechanical equivalent of heat.
95. Two spherical soap bubbles having radii a and b respectively coalesce so as to have a part of their surface common. Find the radius of curvature of their common surface.
96. If a number of little droplets of water of surface tension σ , all of same radius r combine to form a single drop of radius R and the energy released is converted into kinetic energy, find the velocity acquired by the bigger drop.
97. Two spherical soap bubbles having radii 3 cm and 4 cm respectively coalesce so as to have a part of their surface common. Find the radius of curvature of their common surface.
98. Calculate the radius of largest drop of water that can be evaporated at 0^{0}C without heat being communicated to it from the surroundings. Given surface energy of water at 0^{0}C is 117 ergs/cm^2, latent heat of vaporization at 0^{0}C is 606 cal/g.
99. Two soap bubbles of radii a and b coalesce to form a single bubble of radius r in isothermal condition. If the external pressure is P, prove that the surface tension of the soap solution from which the bubbles are formed is $S = \frac{P\,(r^3 - b^3 - a^3)}{(a^2 + b^2 - r^2)}$.
100. A number of droplets of water, all of same radius r, coalesce to form a single drop of radius R. If the specific heat capacity of water is c, and its density ρ., show that the rise in the temperature of water will be $\Delta\theta = \frac{3\sigma}{\rho c}\left(\frac{1}{r} - \frac{1}{R}\right)$, where σ is the surface tension of water.