Q1. A sphere of relative density σ and diameter D has concentric cavity of diameter d. The ratio of $\frac{D}{d}$, if it just floats on water in a tank is : ***09 Apr 2024 (M)***

(1) $\left(\frac{\sigma-2}{\sigma+2}\right)^{1/3}$ (2) $\left(\frac{\sigma}{\sigma-1}\right)^{1/3}$

(3) $\left(\frac{\sigma-1}{\sigma}\right)^{1/3}$ (4) $\left(\frac{\sigma+1}{\sigma-1}\right)^{1/3}$

Q2. The excess pressure inside a soap bubble is thrice the excess pressure inside a second soap bubble. The ratio between the volume of the first and the second bubble is: ***09 Apr 2024 (E)***

(1) 1 : 9 (2) 1 : 3

(3) 1 : 27 (4) 1 : 81

Q3. A spherical ball of radius 1×10^{-4} m and density 10^5 kg/m^3 falls freely under gravity through a distance h before entering a tank of water, If after entering in water the velocity of the ball does not change, then the value of h is approximately:

(The coefficient of viscosity of water is 9.8×10^{-6} N s/m^2) ***09 Apr 2024 (E)***

(1) 2296 m (2) 2518 m

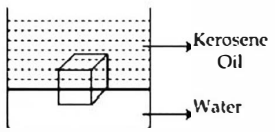
(3) 2249 m (4) 2396 m

Q4. Correct Bernoulli's equation is (symbols have their usual meaning) : ***08 Apr 2024 (M)***

(1) $P + mgh + \frac{1}{2}mv^2 = \text{constant}$ (2) $P + \rho gh + \frac{1}{2}\rho v^2 = \text{constant}$

(3) $P + \rho gh + \rho v^2 = \text{constant}$ (4) $P + \frac{1}{2}\rho gh + \frac{1}{2}\rho v^2 = \text{constant}$

Q5. A cube of ice floats partly in water and partly in kerosene oil. The ratio of volume of ice immersed in water to that in kerosene oil (specific gravity of Kerosene oil = 0.8, specific gravity of ice = 0.9)



08 Apr 2024 (E)

(1) 1 : 1 (2) 5 : 4

(3) 8 : 9 (4) 9 : 10

Q6. A liquid column of height 0.04 cm balances excess pressure of a soap bubble of certain radius. If density of liquid is 8×10^3 kg m^{-3} and surface tension of soap solution is 0.28Nm^{-1}, then diameter of the soap bubble is _____ cm. (if $g = 10$ m s^{-2}) ***08 Apr 2024 (M)***

Q7. Small water droplets of radius 0.01 mm are formed in the upper atmosphere and falling with a terminal velocity of 10 cm/s. Due to condensation, if 8 such droplets are coalesced and formed a larger drop, the new terminal velocity will be _____cm/s. ***08 Apr 2024 (E)***

Q8. Pressure inside a soap bubble is greater than the pressure outside by an amount :

(given : R = Radius of bubble S = Surface tension of bubble) ***06 Apr 2024 (E)***

(1) $\frac{2S}{R}$ (2) $\frac{4R}{S}$

(3) $\frac{S}{R}$ (4) $\frac{4\,S}{R}$

Q9. A big drop is formed by coalescing 1000 small droplets of water. The ratio of surface energy of 1000 droplets to that of energy of big drop is $\frac{10}{x}$. The value of x is _____ ***06 Apr 2024 (M)***

Q10. A small ball of mass m and density ρ is dropped in a viscous liquid of density ρ_0. After sometime, the ball falls with constant velocity. The viscous force on the ball is : ***06 Apr 2024 (M)***

(1) $mg(1-\rho\rho_0)$ (2) $mg\left(1+\frac{\rho}{\rho_0}\right)$

(3) $mg\left(\frac{\rho_0}{\rho}-1\right)$ (4) $mg\left(1-\frac{\rho_0}{\rho}\right)$

Q11. Given below are two statements :

Statement I : When a capillary tube is dipped into a liquid, the liquid neither rises nor falls in the capillary. The contact angle may be $0°$.

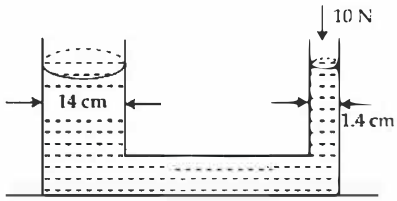
Statement II : The contact angle between a solid and a liquid is a property of the material of the solid and liquid as well.

In the light of the above statement, choose the correct answer from the options given below. ***05 Apr 2024 (M)***

(1) Both Statement I and Statement II are false (2) Both Statement I and Statement II are true

(3) Statement I is false but Statement II is true (4) Statement I is true and Statement II is false

Q12. A hydraulic press containing water has two arms with diameters as mentioned in the figure. A force of 10 N is applied on the surface of water in the thinner arm. The force required to be applied on the surface of water in the thicker arm to maintain equilibrium of water is _____N.



05 Apr 2024 (E)

Q13. Mercury is filled in a tube of radius 2 cm up to a height of 30 cm. The force exerted by mercury on the bottom of the tube is _____ N. (Given, atmospheric pressure $= 10^5 \text{Nm}^{-2}$, density of mercury $= 1.36 \times 10^4$ kg m^{-3},

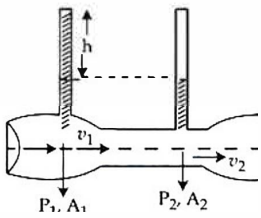
04 Apr 2024 (E)

Q14. Given below are two statements:

Statement I : When speed of liquid is zero everywhere, pressure difference at any two points depends on equation $P_1 - P_2 = \rho g(h_2 - h_1)$.

Statement II : In ventury tube shown $2gh = v_1^2 - v_2^2$

In the light of the above statements, choose the most appropriate answer from the options given below.



04 Apr 2024 (M)

(1) Both Statement I and Statement II are correct.

(2) Statement I is correct but Statement II is incorrect.

(3) Statement I is incorrect but Statement II is correct.

(4) Both Statement I and Statement II are incorrect.

Q15. Given below are two statements :

Statement I : The contact angle between a solid and a liquid is a property of the material of the solid and liquid as well.

Statement II : The rise of a liquid in a capillary tube does not depend on the inner radius of the tube.

In the light of the above statements, choose the correct answer from the options given below: ***04 Apr 2024 (E)***

(1) Statement I is true but Statement II is false. (2) Statement I is false but Statement II is true.
(3) Both Statement I and Statement II are false. (4) Both Statement I and Statement II are true.

Q16. A soap bubble is blown to a diameter of 7 cm.36960erg of work is done in blowing it further. If surface tension of soap solution is 40dyne/cm then the new radius is_____ cm Take $\left(\pi = \frac{22}{7}\right)$ ***04 Apr 2024 (M)***

Q17. A plane is in level flight at constant speed and each of its two wings has an area of 40 m^2. If the speed of the air is 180 km h^{-1} over the lower wing surface and 252 km h^{-1} over the upper wing surface, the mass of the plane is _____kg. (Take air density to be 1 kg m^{-3} and $g = 10\ m\ s^{-2}$) ***01 Feb 2024 (M)***

Q18. A big drop is formed by coalescing 1000 small droplets of water. The surface energy will become :
01 Feb 2024 (E)

(1) 100 times (2) 10 times
(3) $\frac{1}{100}$th (4) $\frac{1}{10}$th

Q19. A small spherical ball of radius r, falling through a viscous medium of negligible density has terminal velocity v. Another ball of the same mass but of radius $2r$, falling through the same viscous medium will have terminal velocity: ***31 Jan 2024 (E)***

(1) $\frac{v}{2}$ (2) $\frac{v}{4}$
(3) $4v$ (4) $2v$

Q20. A big drop is formed by coalescing 1000 small identical drops of water. If E_1 be the total surface energy of 1000 small drops of water and E_2 be the surface energy of single big drop of water, the $E_1 : E_2$ is $x : 1$, where $x =$_____. ***30 Jan 2024 (E)***

Q21. A small liquid drop of radius R is divided into 27 identical liquid drops. If the surface tension is T, then the work done in the process will be : ***29 Jan 2024 (E)***

(1) $8\pi R^2T$ (2) $3\pi R^2T$
(3) $\frac{1}{8}\pi R^2T$ (4) $4\pi R^2T$

Q22. Given below are two statements:
Statement I : If a capillary tube is immersed first in cold water and then in hot water, the height of capillary rise will be smaller in hot water.
Statement II : If a capillary tube is immersed first in cold water and then in hot water, the height of capillary rise will be smaller in cold water.
In the light of the above statements, choose the most appropriate from the options given below
29 Jan 2024 (M)

(1) Both Statement I and Statement II are true (2) Both Statement I and Statement II are false
(3) Statement I is true but Statement II is false (4) Statement I is false but Statement II is true

Q23. In a test experiment on a model aeroplane in wind tunnel, the flow speeds on the upper and lower surfaces of the wings are 70 m s^{-1} and 65 m s^{-1} respectively. If the wing area is 2 m^2, the lift of the wing is _____N. (Given density of air = 1.2 kg m^{-3}) ***29 Jan 2024 (M)***

Q24. The reading of pressure metre attached with a closed pipe is 4.5×10^4 N m^{-2}. On opening the valve, water starts flowing and the reading of pressure metre falls to 2.0×10^4 N m^{-2}. The velocity of water is found to be

$\sqrt{V}$ m s^{-1}. The value of V is _____. ***27 Jan 2024 (E)***

Q25. Given below are two statements :

Statement (I) : Viscosity of gases is greater than that of liquids.

Statement (II) : Surface tension of a liquid decreases due to the presence of insoluble impurities.

In the light of the above statements, choose the most appropriate answer from the options given below :

27 Jan 2024 (M)

(1) Statement I is correct but statement II is incorrect

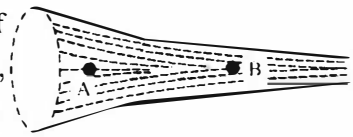
(2) Statement I is incorrect but Statement II is correct

(3) Both Statement I and Statement II are incorrect

(4) Both Statement I and Statement II are correct

Q26. There is an air bubble of radius 1.0 mm in a liquid of surface tension 0.075 N m^{-1} and density 1000 kg m^{-3} at a depth of 10 cm below the free surface. The amount by which the pressure inside the bubble is greater than the atmospheric pressure is _____ $Pa(g = 10\ m\ s^{-2})$. ***15 Apr 2023 (M)***

Q27. The figure shows a liquid of given density flowing steadily in horizontal tube of varying cross-section. Cross-sectional areas at A is 1.5 cm^2, and B is 25 mm^2, if the speed of liquid at B is 60 cm s^{-1} then $(P_A - P_B)$ is ____ (Given P_A and P_B are liquid pressures at A and B points. Density $\rho = 1000$ kg m^{-3}. A and B are on the axis of tube)



13 Apr 2023 (M)

(1) 135 Pa (2) 27 Pa

(3) 175 Pa (4) 36 Pa

Q28. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**

Assertion A : A spherical body of radius (5 ± 0.1) mm having a particular density is falling through a liquid of constant density. The percentage error in the calculation of its terminal velocity is 4%.

Reason R : The terminal velocity of the spherical body falling through the liquid is inversely proportional to its radius. In the light of the above statements, choose the correct answer from the options given below

13 Apr 2023 (E)

(1) Both A and R are true and R is the correct explanation of A

(2) Both A and R are true but R is NOT the correct explanation of A

(3) A is true but R is false

(4) A is false but R is true

Q29. Glycerin of density 1.25×10^3 kg m^{-3} is flowing through the conical section of pipe. The area of cross-section of the pipe at its ends are 10 cm^2 and 5 cm^2 and pressure drop across its length is 3 N m^{-2}. The rate of flow of glycerine through the pipe is $x \times 10^{-5}$ m^3 s^{-1}. The value of x is _____.

12 Apr 2023 (M)

Q30. 64 identical drops each charged upto potential of 10 mV are combined to form a bigger drop. The potential of the bigger drop will be _____ mV. ***12 Apr 2023 (M)***

Q31. The surface tension of soap solution is 3.5×10^{-2} N m^{-1}. The amount of work done required to increase the radius of soap bubble from 10 cm to 20 cm is _____ $\times 10^{-4}$ J . (take $\pi = \frac{22}{7}$) ***11 Apr 2023 (E)***

Q32. Eight equal drops of water are falling through air with a steady speed of 10 cm s^{-1}. If the drops coalesce, the new velocity is:- ***11 Apr 2023 (E)***

(1) 16 cm s^{-1} (2) 40 cm s^{-1}

(3) 5 cm s^{-1} (4) 10 cm s^{-1}

Q33. Given below are two statements:

Statement I: Pressure in a reservoir of water is same at all points at the same level of water.

Statement II: The pressure applied to enclosed water is transmitted in all directions equally.

In the light of the above statements, choose the correct answer from the options given below:

10 Apr 2023 (M)

(1) Both Statement I and Statement II are false (2) Statement I is true but Statement II is false

(3) Statement I is false but Statement II is true (4) Both Statement I and Statement II are true

Q34. Figure below shows a liquid being pushed out of the tube by a piston having area of cross section 2.0 cm^2. The area of cross section at the outlet is 10 mm^2. If the piston is pushed at a speed of 4 cm s^{-1}, the speed of outgoing fluid is _____ cm s^{-1}

10 Apr 2023 (E)

Q35. A hydraulic automobile lift is designed to lift vehicles of mass 5000 kg. The area of cross section of the cylinder carrying load is 250 cm^2. The maximum pressure the smaller piston would have to bear is [Assume g = 10 m s^{-2}] ***08 Apr 2023 (E)***

(1) 20×10^6 Pa (2) 2×10^5 Pa

(3) 200×10^6 Pa (4) 2×10^6 Pa

Q36. An air bubble of diameter 6 mm rises steadily through a solution of density 1750 kg m^{-3} at the rate of 0.35 cm s^{-1}. The co-efficient of viscosity of the solution (neglect density of air) is _____ Pas (given, g = 10 m s^{-2}). ***08 Apr 2023 (M)***

Q37. An air bubble of volume 1 cm^3 rises from the bottom of a lake 40 m deep to the surface at a temperature of 12°C. The atmospheric pressure is 1×10^5 Pa, the density of water is 1000 kg m^{-3} and g = 10 m s^{-2}. There is no difference of the temperature of water at the depth of 40 m and on the surface. The volume of air bubble when it reaches the surface will be ***08 Apr 2023 (M)***

(1) 2 cm^3 (2) 3 cm^3

(3) 4 cm^3 (4) 5 cm^3

Q38. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**

Assertion A: When you squeeze one end of a tube to get toothpaste out from the other end, Pascal's principle is observed.

Reason R: A change in the pressure applied to an enclosed incompressible fluid is transmitted undiminished to every portion of the fluid and to the walls of its container.

In the light of the above statements, choose the most appropriate answer from the options given below.

06 Apr 2023 (E)

(1) Both A and R are correct but R is NOT the correct explanation of A

(2) A is not correct but R is correct

(3) A is correct but R is not correct

(4) Both A and R is correct and R is the correct explanation of A

Q39. A small ball of mass M and density ρ is dropped in a viscous liquid of density ρ_0. After some time, the ball falls with a constant velocity. What is the viscous force on the ball?

06 Apr 2023 (M)

(1) $F = Mg\left(1 + \frac{\rho_0}{\rho}\right)$ (2) $F = Mg\left(1 + \frac{\rho}{\rho_0}\right)$

(3) $F = Mg\left(1 - \frac{\rho_0}{\rho}\right)$ (4) $F = Mg(1 \pm \rho\rho_0)$

Q40. The surface of water in a water tank of cross section area 750 cm^2 on the top of a house is h m. above the tap level. The speed of water coming out through the tap of cross section area 500 mm^2 is 30 cm s^{-1}. At that instant, $\frac{dh}{dt}$ is $x \times 10^{-3}$ m s^{-1}. The value of x will be _____. ***01 Feb 2023 (E)***

Q41. A mercury drop of radius 10^{-3} m is broken into 125 equal size droplets. Surface tension of mercury is 0.45 N m^{-1} . The gain in surface energy is: ***01 Feb 2023 (M)***

(1) 2.26×10^{-5} J (2) 28×10^{-5} J

(3) 17.5×10^{-5} J (4) 5×10^{-5} J

Q42. If 1000 droplets of water of surface tension 0.07 N m^{-1}. having same radius 1 mm each, combine to from a single drop. In the process the released surface energy is _____ $\left(\text{Take } \pi = \frac{22}{7}\right)$

31 Jan 2023 (M)

(1) 7.92×10^{-6} J (2) 7.92×10^{-4} J

(3) 9.68×10^{-4} J (4) 8.8×10^{-5}J

Q43. The height of liquid column raised in a capillary tube of certain radius when dipped in liquid A vertically is, 5 cm. If the tube is dipped in a similar manner in another liquid B of surface tension and density double the values of liquid A, the height of liquid column raised in liquid B would be _____ m. ***30 Jan 2023 (M)***

(1) 0.20 (2) 0.5

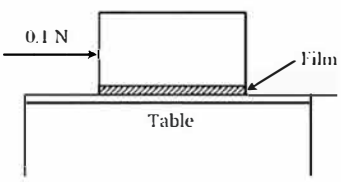
(3) 0.05 (4) 0.10

Q44. Surface tension of a soap bubble is 2.0×10^{-2} N m^{-1} . Work done to increase the radius of soap bubble from 3.5 cm to 7 cm will be : [Take $\pi = \frac{22}{7}$] ***29 Jan 2023 (M)***

(1) 0.72×10^{-4} J (2) 5.76×10^{-4} J

(3) 18.48×10^{-4} J (4) 9.24×10^{-4} J

Q45. A metal block of base area 0.20 m^2 is placed on a table, as shown in figure. A liquid film of thickness 0.25 mm is inserted between the block and the table. The block is pushed by a horizontal force of 0.1 N and moves with a constant speed. If the viscosity of the liquid is 5.0×10^{-3} Pl, the speed of block is _____ $\times 10^{-3}$ m s^{-1}.



29 Jan 2023 (E)

Q46. A fully loaded boeing aircraft has a mass of 5.4×10^5 kg. Its total wing area is 500 m^2. It is in level flight with a speed of 1080 km h^{-1}. If the density of air ρ is 1.2 kg m^{-3}, the fractional increase in the speed of the air on the upper surface of the wing relative to the lower surface in percentage will be ($g = 10$ m s^{-2})

29 Jan 2023 (E)

(1) 16 (2) 6

(3) 8 (4) 10

Q47. A spherical drop of liquid splits into 1000 identical spherical drops. If u_i is the surface energy of the original drop and u_f is the total surface energy of the resulting drops, the (ignoring evaporation), $\frac{u_f}{u_i} = \left(\frac{10}{x}\right)$. Then value of x is _____:

25 Jan 2023 (E)

Q48. A spherical ball of radius 1 mm and density 10.5 g cc^{-1} is dropped in glycerine of coefficient of viscosity 9.8 poise and density 1.5 g cc^{-1}. Viscous force on the ball when it attains constant velocity is 3696×10^{-x} N . The value of x is

(Given, $g = 9.8$ m s^{-2} and $\pi = \frac{22}{7}$)

24 Jan 2023 (E)

Q49. The velocity of a small ball of mass 0.3 g and density 8 g cc^{-1} when dropped in a container filled with glycerine becomes constant after some time. If the density of glycerine is 1.3 g cc^{-1}, then the value of viscous force acting on the ball will be $x \times 10^{-4}$ N, the value of x is ___. [use $g = 10$ m s^{-2}]

29 Jul 2022 (E)

Q50. Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Clothes containing oil or grease stains cannot be cleaned by water wash.

Reason (R) : Because the angle of contact between the oil/ grease and water is obtuse. In the light of the above statements, choose the correct answer from the option given below.

29 Jul 2022 (M)

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(3) (A) is true but (R) is false

(4) (A) is true but (R) is true

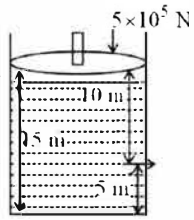
Q51. A pressure-pump has a horizontal tube of cross-sectional area 10 cm^2 for the outflow of water at a speed of 20 m s^{-1}. The force exerted on the vertical wall just in front of the tube which stops water horizontally flowing out of the tube, is: [given : density of water = 1000 kg m^{-3}] ***28 Jul 2022 (E)***

(1) 300 N (2) 500 N

(3) 250 N (4) 400 N

Q52. The diameter of an air bubble which was initially 2 mm, rises steadily through a solution of density 1750 kg/m^3 at the rate of 0.35 cm/s. Coefficient of viscosity of the solution is _____ (Assume mass of the bubble to be negligible) (Answer in Poise to the nearest integer) ***28 Jul 2022 (M)***

Q53. Consider a cylindrical tank of radius 1 m is filled with water. The top surface of water is at 15 m from the bottom of the cylinder. There is a hole on the wall of cylinder at a height of 5 m from the bottom. A force of 5×10^5 N is applied an the top surface of water using a piston. The speed of efflux from the hole will be: (given atmospheric pressure $P_A = 1.01 \times 10^5\ Pa$, density of water $\rho_w = 1000\ \text{kg m}^{-3}$ and gravitational acceleration $g = 10\ \text{m s}^{-2}$)



28 Jul 2022 (E)

(1) $11.6\ \text{m s}^{-1}$
(2) $10.8\ \text{m s}^{-1}$
(3) $17.8\ \text{m s}^{-1}$
(4) $14.4\ \text{m s}^{-1}$

Q54. Two cylindrical vessels of equal cross-sectional area 16 cm^2 contain water upto heights 100 cm and 150 cm respectively. The vessels are interconnected so that the water levels in them become equal. The work done by the force of gravity during the process, is [Take density of water $= 10^3\ \text{kg m}^{-3}$ and $g = 10\ \text{ms}^{-2}$]

27 Jul 2022 (M)

(1) 0.25 J
(2) 1 J
(3) 8 J
(4) 12 J

Q55. A spherical soap bubble of radius 3 cm is formed inside another spherical soap bubble of radius 6 cm. If the internal pressure of the smaller bubble of radius 3 cm in the above system is equal to the internal pressure of the another single soap bubble of radius r cm. The value of r is _____

27 Jul 2022 (E)

Q56. A water drop of radius 1 cm is broken into 729 equal droplets. If surface tension of water is 75 dyne cm^{-1}, then the gain in surface energy upto first decimal place will be [Given $\pi = 3.14$]

26 Jul 2022 (M)

(1) 8.5×10^{-4} J
(2) 8.2×10^{-4} J
(3) 7.5×10^{-4} J
(4) 5.3×10^{-4} J

Q57. A drop of liquid of density ρ is floating half immersed in a liquid of density σ and surface tension $7.5 \times 10^{-4}\ \text{N cm}^{-1}$. The radius of drop in cm will be : (Take : $g = 10\ \text{ms}^{-2}$)

25 Jul 2022 (E)

(1) $\frac{15}{\sqrt{2\rho-\sigma}}$
(2) $\frac{15}{\sqrt{\rho-\sigma}}$
(3) $\frac{3}{2\sqrt{\rho-\sigma}}$
(4) $\frac{3}{20\sqrt{2\rho-\sigma}}$

Q58. A small spherical ball of radius 0.1 mm and density $10^4\ \text{kg m}^{-3}$ falls freely under gravity through a distance h before entering a tank of water. If, after entering the water the velocity of ball does not change and it continue to fall with same constant velocity inside water, then the value of h will be ____ m. (Given $g = 10\ \text{m s}^{-2}$, viscosity of water $= 1.0 \times 10^{-5}$ N-s m^{-2}).

29 Jun 2022 (E)

Q59. A water drop of radius 1μm falls in a situation where the effect of buoyant force is negligible. Co-efficient of viscosity of air is $1.8 \times 10^{-5}\ \text{N s m}^{-2}$ and its density is negligible as compared to that of water $10^6\ \text{g m}^{-3}$. Terminal velocity of the water drop is
(Take acceleration due to gravity $= 10\ \text{m s}^{-2}$)

28 Jun 2022 (E)

(1) $145.4 \times 10^{-6}\ \text{m s}^{-1}$
(2) $123.4 \times 10^{-6}\ \text{m s}^{-1}$
(3) $118.0 \times 10^{-6}\ \text{m s}^{-1}$
(4) $132.6 \times 10^{-6}\ \text{m s}^{-1}$

Q60. A liquid of density 750 kg m^{-3} flows smoothly through a horizontal pipe that tapers in cross-sectional area from $A_1 = 1.2 \times 10^{-2}$ m^2 to $A_2 = \frac{A_1}{2}$. The pressure difference between the wide and narrow sections of the pipe is 4500 Pa. The rate of flow of liquid is _____ $\times 10^{-3}$ m^3 s^{-1}. ***28 Jun 2022 (E)***

Q61. A water drop of diameter 2 cm is broken into 64 equal droplets. The surface tension of water is 0.075 N m^{-1}. In this process the gain in surface energy will be ***28 Jun 2022 (M)***

(1) 2.8×10^{-4} J (2) 1.5×10^{-3} J

(3) 1.9×10^{-4} J (4) 9.4×10^{-5} J

Q62. The velocity of a small ball of mass m and density d_1, when dropped in a container filled with glycerine, becomes constant after some time. If the density of glycerine is d_2, then the viscous force acting on the ball, will be ***27 Jun 2022 (M)***

(1) $mg\left(1 - \frac{d_1}{d_2}\right)$ (2) $mg\left(1 - \frac{d_2}{d_1}\right)$

(3) $mg\left(\frac{d_1}{d_2} - 1\right)$ (4) $mg\left(\frac{d_2}{d_1} - 1\right)$

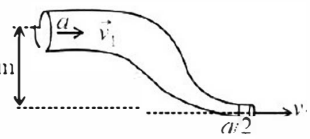
Q63. The area of cross-section of a large tank is 0.5 m^2. It has a narrow opening near the bottom having area of cross-section 1 cm^2. A load of 25 kg is applied on the water at the top in the tank. Neglecting the speed of water in the tank, the velocity of the water, coming out of the opening at the time when the height of water level in the tank is 40 cm above the bottom, will be _____ cm s^{-1}. [Take $g = 10$ m s^{-2}] ***27 Jun 2022 (M)***

Q64*. If p is the density and η is coefficient of viscosity of fluid which flows with a speed v in the pipe of diameter d, the correct formula for Reynolds number R_e is ***26 Jun 2022 (E)***

(1) $R_e = \frac{\pi d}{\rho v}$ (2) $R_e = \frac{\rho v}{\eta d}$

(3) $R_e = \frac{\rho v d}{\eta}$ (4) $R_e = \frac{\eta}{\rho v d}$

Q65. An ideal fluid of density 800 kg m^{-3}, flows smoothly through a bent pipe (as shown in figure) that tapers in cross-sectional area from a to $\frac{a}{2}$. The pressure difference between the wide and narrow sections of pipe is 4100 Pa. At wider section, the velocity of fluid is $\frac{\sqrt{x}}{6}$ m s^{-1} for $x =$_____. (Given $g = 10$ m s^{-2})



26 Jun 2022 (M)

Q66. The terminal velocity (v_t) of the spherical rain drop depends on the radius (r) of the spherical rain drop as ***25 Jun 2022 (M)***

(1) r (2) r^2

(3) $\frac{1}{r}$ (4) $\frac{1}{r^2}$

Q67. The velocity of upper layer of water in a river is 36 km h^{-1}. Shearing stress between horizontal layers of water is 10^{-3} N m^{-2}. Depth of the river is _____ m. (Co-efficient of viscosity of water is 10^{-2} Pa s) ***25 Jun 2022 (M)***

Q68. A glass tumbler having inner depth of 17.5 cm is kept on a table. A student starts pouring water $\left(\mu = \frac{4}{3}\right)$ into it while looking at the surface of water from the above. When he feels that the tumbler is half filled, he stops pouring water. Up to what height, the tumbler is actually filled ? ***01 Sep 2021 (E)***

(1) 10 cm
(2) 11.7 cm
(3) 7.5 cm
(4) 8.75 cm

Q69. In Millikan's oil drop experiment, what is viscous force acting on an uncharged drop of radius 2.0×10^{-5} m and density 1.2×10^{3} kg m^{-3}? Take viscosity of liquid $= 1.8 \times 10^{-5}$ N s m^{-2}. (Neglect buoyancy due to air). ***27 Aug 2021 (M)***

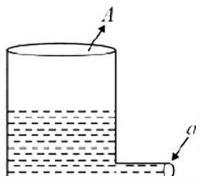
(1) 5.8×10^{-10} N
(2) 3.9×10^{-10} N
(3) 1.8×10^{-10} N
(4) 3.8×10^{-11} N

Q70. A soap bubble of the radius 3 cm is formed inside another soap bubble of radius, 6 cm. The radius of an equivalent soap bubble that has the same excess pressure as inside the smaller bubble with respect to the atmospheric pressure is____cm. ***26 Aug 2021 (M)***

Q71. Two narrow bores of diameter 5.0 mm and 8.0 mm are joined together to form a U–shaped tube open at both ends. If this U–tube contains water, what is the difference in the level of two limbs of the tube. [Take surface tension of water $T = 7.3 \times 10^{-2}$ N m^{-1}, angle of contact $= 0$, $g = 10$ m s^{-2} and density of water $= 1.0 \times 10^{3}$ kg m^{-3}] ***26 Aug 2021 (M)***

(1) 5.34 mm
(2) 3.62 mm
(3) 2.19 mm
(4) 4.97 mm

Q72. A light cylindrical vessel is kept on a horizontal surface. Area of the base is A. A hole of cross-sectional area a is made just at its bottom side. The minimum coefficient of friction necessary to prevent sliding the vessel due to the impact force of the emerging liquid is



27 Jul 2021 (M)

(1) $\frac{A}{2a}$
(2) None of these
(3) $\frac{2a}{A}$
(4) $\frac{a}{A}$

Q73. The water is filled up to a height of 12 m in a tank having vertical sidewalls. A hole is made in one of the walls at a depth h below the water level. The value of h for which the emerging stream of water strikes the ground at the maximum range is _____ m. ***27 Jul 2021 (E)***

Q74. A raindrop with radius R $= 0.2$ mm falls from a cloud at a height h $= 2000$ m above the ground. Assume that the drop is spherical throughout its fall and the force of buoyance may be neglected, then the terminal speed attained by the raindrop is : [Density of water $f_w = 1000$ kg m^{-3} and Density of air $f_a = 1.2$ kg m^{-3}, g $= 10$ m/s^2 Coefficient of viscosity of air $= 1.8 \times 10^{-5}$N s m^{-2}]

27 Jul 2021 (E)

(1) 250.6 m s^{-1}
(2) 43.56 m s^{-1}
(3) 4.94 m s^{-1}
(4) 14.4 m s^{-1}

Q75. Two spherical soap bubbles of radii r_1 and r_2 in vacuum combine under isothermal conditions. The resulting bubble has a radius equal to: ***25 Jul 2021 (E)***

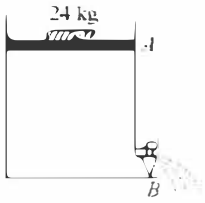
(1) $\frac{r_1 r_2}{r_1 + r_2}$
(2) $\sqrt{r_1 r_2}$
(3) $\sqrt{r_1^2 + r_2^2}$
(4) $\frac{r_1 + r_2}{2}$

Q76. Two small drops of mercury each of radius R coalesce to form a single large drop. The ratio of total surface energy before and after the change is *20 Jul 2021 (E)*

(1) $2^{\frac{1}{3}} : 1$ (2) $1 : 2^{\frac{1}{3}}$

(3) $2 : 1$ (4) $1 : 2$

Q77. Consider a water tank as shown in the figure. It's cross-sectional area is $0.4\ m^2$. The tank has an opening B near the bottom whose cross-section area is $1\ cm^2$. A load of 24 kg is applied on the water at the top when the height of the water level is 40 cm above the bottom, the velocity of water coming out the opening B is $v\ m\ s^{-1}$. The value of v, to the nearest integer, is ___.[Take the value of g to be $10\ m\ s^{-2}$]



18 Mar 2021 (E)

Q78. When two soap bubbles of radii a and $b(b > a)$ coalesce, the radius of curvature of common surface is: *17 Mar 2021 (M)*

(1) $\frac{ab}{b-a}$ (2) $\frac{a+b}{ab}$

(3) $\frac{b-a}{ab}$ (4) $\frac{ab}{a+b}$

Q79. Suppose you have taken a dilute solution of oleic acid in such a way that its concentration becomes $0.01\ cm^3$ of oleic acid per cm^3 of the solution. Then you make a thin film of this solution (monomolecular thickness) of area $4\ cm^2$ by considering 100 spherical drops of radius $\left(\frac{3}{40\pi}\right)^{\frac{1}{3}} \times 10^{-3}$ cm. Then the thickness of oleic acid layer will be $x \times 10^{-14}$ m. Where x is _____ . *17 Mar 2021 (E)*

Q80. The pressure acting on a submarine is 3×10^5 Pa at a certain depth. If the depth is doubled, the percentage increase in the pressure acting on the submarine would be: (Assume that atmospheric pressure is 1×10^5 Pa density of water is $10^3\ kg\ m^{-3}$, $g = 10\ ms^{-2}$) *16 Mar 2021 (M)*

(1) $\frac{200}{3}\%$ (2) $\frac{200}{5}\%$

(3) $\frac{5}{200}\%$ (4) $\frac{3}{200}\%$

Q81*. What will be the nature of flow of water from a circular tap, when its flow rate increased from $0.18\ L\ (min)^{-1}$ to $0.48\ L\ (min)^{-1}$? The radius of the tap and viscosity of water are 0.5 cm and 10^{-3} Pa s, respectively. (Density of water : $10^3\ kg\ m^{-3}$)

16 Mar 2021 (E)

(1) Unsteady to steady flow (2) Remains steady flow

(3) Remains turbulent flow (4) Steady flow to unsteady flow

Q82. A large number of water drops, each of radius r, combine to have a drop of radius R. If the surface tension is T and mechanical equivalent of heat is J, the rise in heat energy per unit volume will be: *26 Feb 2021 (M)*

(1) $\frac{2T}{rJ}$ (2) $\frac{3T}{rJ}$

(3) $\frac{2T}{J}\left(\frac{1}{r} - \frac{1}{R}\right)$ (4) $\frac{3T}{J}\left(\frac{1}{r} - \frac{1}{R}\right)$

Q83. A hydraulic press can lift 100 kg when a mass m is placed on the smaller piston. It can lift kg when the diameter of the larger piston is increased by 4 times and that of the smaller piston is decreased by 4 times keeping the same mass m on the smaller piston. *24 Feb 2021 (M)*

Q84. A fluid is flowing through a horizontal pipe of varying cross-section, with v ms^{-1} at a point where the pressure is P Pascal. At another point where pressure $\frac{P}{2}$ Pascal its speed is V ms^{-1}. If the density of the fluid is $\rho\, kg - m^{-3}$ and the flow is streamline, then V is equal to ***06 Sep 2020 (E)***

(1) $\sqrt{\frac{P}{\rho} + v}$ (2) $\sqrt{\frac{2P}{\rho} + v^2}$

(3) $\sqrt{\frac{P}{2\rho} + v^2}$ (4) $\sqrt{\frac{P}{\rho} + v^2}$

Q85. A hollow spherical shell at outer radius R floats just submerged under the water surface. The inner radius of the shell is r . If the specific gravity of the shell material is $\frac{27}{8}$ with respect to water, the value of r is:

05 Sep 2020 (M)

(1) $\frac{8}{9}R$ (2) $\frac{4}{9}R$

(3) $\frac{2}{3}R$ (4) $\frac{1}{3}R$

Q86. In an experiment to verify Stokes law, a small spherical ball of radius r and density ρ falls under gravity through a distance h in air before entering a tank of water. If the terminal velocity of the ball inside water is same as its velocity just before entering the water surface, then the value of h is proportional to: (ignore viscosity of air) ***05 Sep 2020 (E)***

(1) r^4 (2) r

(3) r^3 (4) r^2

Q87. Two identical cylindrical vessels are kept on the ground and each contain the same liquid of density d. The area of the base of both vessels is S but the height of liquid in one vessel is x_1 and in the other x_2. When both cylinders are connected through a pipe of negligible volume very close to the bottom, the liquid flows from one vessel to the other until it comes to equilibrium at a new height. The change in energy of the system in the process is : ***04 Sep 2020 (E)***

(1) $gdS\left(x_2^2 + x_1^2\right)$ (2) $gdS(x_2 + x_1)^2$

(3) $\frac{3}{4}gdS(x_2 - x_1)^2$ (4) $\frac{1}{4}gdS(x_2 - x_1)^2$

Q88. A air bubble of radius 1 cm in water has an upward acceleration of 9.8 cm s^{-2}. The density of water is 1 gm cm^{-3} and water offers negligible drag force on the bubble. The mass of the bubble is $\left(g = 980\ cm/s^2\right)$.

04 Sep 2020 (M)

(1) 4.51 gm (2) 3.15 gm

(3) 4.15 gm (4) 1.52 gm

Q89. When a long glass capillary tube of radius 0.015 cm is dipped in a liquid, the liquid rises to a height of 15 cm within it. If the contact angle between the liquid and glass to close to 0°, the surface tension of the liquid, in milliNewton m^{-1}, is $\left[\rho_{(liqued)} = 900\ kg\ m^{-3}, g = 10\ m\ s^{-2}\right]$ (Given answer in closed integer)

03 Sep 2020 (M)

Q90. Pressure inside two soap bubbles are 1.01 and 1.02 atmosphere, respectively. The ratio of their volumes is :

03 Sep 2020 (M)

(1) 4 : 1 (2) 0.8 : 1

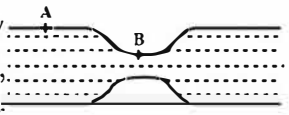
(3) 8 : 1 (4) 2 : 1

Q91. A capillary tube made of glass of radius 0.15 mm is dipped vertically in a beaker filled with methylene iodide (surface tension $= 0.05\ \text{N m}^{-1}$, density $= 667\ \text{kg m}^{-3}$) which rises to height h in the tube. It is observed that the two tangents drawn from observed that the two tangents drawn from liquid-glass interfaces (from opp. sides of the capillary) make an angle of 60° with one another. Then h is close to ($g = 10\ \text{m s}^{-2}$)

02 Sep 2020 (E)

(1) 0.049 m
(2) 0.087 m
(3) 0.137 m
(4) 0.172 m

Q92. Water flows m a horizontal tube (see figure). The pressure of water changes by $700\ Nm^{-2}$ between A and B where the area of cross section are $40\ cm^2$ and $20\ cm^2$, respectively. Find the rate of flow of water through the tube. (density of water $= 1000\ kgm^{-3}$)



09 Jan 2020 (M)

(1) $3020\text{cm}^3/\text{s}$
(2) $2720\text{cm}^3/\text{s}$
(3) $2420\text{cm}^3/\text{s}$
(4) $1810\text{cm}^3/\text{s}$

Q93. A small spherical droplet of density d is floating exactly half immersed in a liquid of density ρ and surface tension T. The radius of the droplet is (take note that the surface tension applies an upward force on the droplet):

09 Jan 2020 (E)

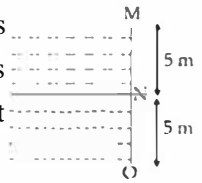
(1) $r = \sqrt{\frac{2T}{3(d+\rho)g}}$
(2) $r = \sqrt{\frac{T}{(d-\rho)g}}$
(3) $r = \sqrt{\frac{T}{(d+\rho)g}}$
(4) $r = \sqrt{\frac{3T}{(2d-\rho)g}}$

Q94. A leak proof cylinder of length 1 m, made of a metal which has very low coefficient of expansion is floating vertically in water at 0°C such that its height above the water surface is 20 cm. When the temperature of water is increased to 4°C, the height of the cylinder above the water surface becomes 21 cm. The density of water at $T = 4^\circ$C, relative to the density at $T = 0^\circ$C is close to:

08 Jan 2020 (M)

(1) 1.26
(2) 1.04
(3) 1.01
(4) 1.03

Q95. Two liquids of densities ρ_1 and $\rho_2 (\rho_2 = 2\rho_1)$ are filled up behind a square wall of side 10m as shown in figure. Each liquid has a height of 5m. The ratio of the forces due to these liquids exerted on upper part MN to that at the lower part NO is (Assume that the liquids are not mixing):



08 Jan 2020 (E)

(1) $\frac{1}{3}$
(2) $\frac{2}{3}$
(3) $\frac{1}{2}$
(4) $\frac{1}{4}$

Q96. Consider a solid sphere of radius R and mass density $\rho(r) = \rho_0\left(1 - \frac{r^2}{R^2}\right), 0 < r \leq R$. The minimum density of a liquid in which it will float is:

08 Jan 2020 (M)

(1) $\frac{\rho_0}{3}$
(2) $\frac{\rho_0}{5}$
(3) $\frac{2\rho_0}{5}$
(4) $\frac{2\rho_0}{3}$

Q97. An ideal fluid flows (laminar flow) through a pipe of non-uniform diameter. The maximum and minimum diameters of the pipes are 6.4cm and 4.8cm , respectively. The ratio of the minimum and the maximum velocities of fluid in this pipe is: ***07 Jan 2020 (E)***

(1) $\frac{9}{16}$ (2) $\frac{\sqrt{3}}{2}$

(3) $\frac{3}{4}$ (4) $\frac{81}{256}$

Q98. A solid sphere, of radius R acquires a terminal velocity v_1 when falling (due to gravity) through a viscous fluid having a coefficient of viscosity η. The sphere is broken into 27 identical solid spheres. If each of these spheres acquires a terminal velocity, v_2, when falling through the same fluid, the ratio $\left(\frac{v_1}{v_2}\right)$ equals: ***12 Apr 2019 (E)***

(1) $\frac{1}{9}$ (2) 27

(3) $\frac{1}{27}$ (4) 9

Q99. A submarine experiences a pressure of 5.05×10^6 Pa at a depth of d_1 in a sea. When it goes further to a depth of d_2 , it experiences a pressure of 8.08×10^6 Pa . Then $d_2 - d_1$ is approximately (density of water $= 10^3$ kg/m^3 and acceleration due to gravity $= 10$ ms^{-2}): ***10 Apr 2019 (E)***

(1) 600 m (2) 500 m

(3) 300 m (4) 400 m

Q100. A cubical block of side 0.5 m floats on water with 30% of its volume under water. What is the maximum weight that can be put on the block without fully submerging it under water?
[Take, density of water $= 10^3$ kg/m^3] ***10 Apr 2019 (E)***

(1) 87.5 kg (2) 65.4 kg

(3) 30.1 kg (4) 46.3 kg

Q101. Water from a tap emerges vertically downwards with an initial speed of 1.0 ms^{-1} . The cross − sectional area of the tap is 10^{-4} m^2. Assume that the pressure is constant throughout the stream of water and that the flow is streamlined. The cross − sectional area of the stream, 0.15 m below the tap would be: (Take g $= 10$ ms^{-2}) ***10 Apr 2019 (E)***

(1) 1×10^{-5} m^2 (2) 5×10^{-4} m^2

(3) 2×10^{-5} m^2 (4) 5×10^{-5} m^2

Q102. The ratio of surface tensions of mercury and water is given to be 7.5, while the ratio of their densities is 13.6 . Their contact angles, with glass, are close to 135° and 0°, respectively. If it is observed that mercury gets depressed by an amount h in a capillary tube of radius r_1, while water rises by the same amount h in a capillary tube of radius r_2, then the ratio $\frac{r_1}{r_2}$ is close to ***10 Apr 2019 (M)***

(1) $\frac{3}{5}$ (2) $\frac{2}{3}$

(3) $\frac{4}{5}$ (4) $\frac{2}{5}$

Q103. If 'M' is the mass of water that rises in a capillary tube of radius 'r' , then mass of water which will rise in a capillary tube of radius '2r' is: ***09 Apr 2019 (M)***

(1) 4 M (2) 2 M

(3) $\frac{M}{2}$ (4) M

Q104. A wooden block floating in a bucket of water has $\frac{4}{5}$ of its volume submerged. When certain amount of an oil is poured into the bucket, it is found that the block is just under the oil surface with half of its volume under water and half in oil. The density of oil relative to that of water is: ***09 Apr 2019 (E)***

(1) 0.8 (2) 0.7

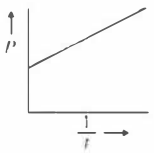
(3) 0.5 (4) 0.6

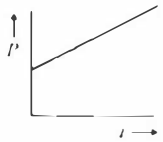
Q105*. Water from a pipe is coming at a rate of 100 liters per minute. If the radius of the pipe is 5 cm, the Reynolds number for the flow is of the order of: (density of water = 100 kg/m^3, coefficient of viscosity of water $= 1\ mPa\ s$) ***08 Apr 2019 (M)***

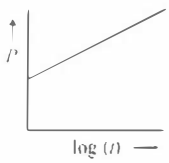
(1) 10^2 (2) 10^4

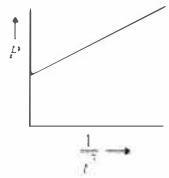
(3) 10^3 (4) 10^6

Q106. A soap bubble, blown by a mechanical pump at the mouth of a tube increases in volume with time at a constant rate. The graph that correctly depicts the time dependence of pressure inside the bubble is given by: ***12 Jan 2019 (E)***

(1) 

(2) 

(3) 

(4) 

Q107. A liquid of density ρ is coming out of a hose pipe of radius a with horizontal speed v and hits a mesh. 50% of the liquid passes through the mesh unaffected. 25% looses all of its momentum and 25% comes back with the same speed. The resultant pressure on the mesh will be: ***11 Jan 2019 (M)***

(1) $\frac{1}{4}\rho v^2$ (2) $\frac{3}{4}\rho v^2$

(3) $\frac{1}{2}\rho v^2$ (4) ρv^2

Q108. Water flows into a large tank with flat bottom at the rate of $10^{-4}\ m^3 s^{-1}$. Water is also leaking out of a hole of area 1 cm^2 at its bottom. If the height of the water in the tank remains steady then this height is: ***10 Jan 2019 (M)***

(1) 5.1 cm (2) 1.7 cm

(3) 2.9 cm (4) 4 cm

Q109. The top of a water tank is open to air and its water level is maintained. It is giving out 0.74 m^3 water per minute through a circular opening of 2 cm radius in its wall. The depth of the centre of the opening from the level of water in the tank is close to: ***09 Jan 2019 (E)***

(1) 2.9 m (2) 4.8 m

(3) 6.0 m (4) 9.6 m

ANSWER KEYS

1. (2)	**2.** (3)	**3.** (2)	**4.** (2)	**5.** (1)	**6.** (7)	**7.** (40)	**8.** (4)
9. (1)	**10.** (4)	**11.** (3)	**12.** (1000)	**13.** (177)	**14.** (2)	**15.** (1)	**16.** (7)
17. (9600)	**18.** (4)	**19.** (1)	**20.** (10)	**21.** (1)	**22.** (3)	**23.** (810)	**24.** (50)
25. (2)	**26.** (1150)	**27.** (3)	**28.** (3)	**29.** (4)	**30.** (160)	**31.** (264)	**32.** (2)
33. (4)	**34.** (80)	**35.** (4)	**36.** (10)	**37.** (4)	**38.** (4)	**39.** (3)	**40.** (2)
41. (1)	**42.** (2)	**43.** (3)	**44.** (3)	**45.** (25)	**46.** (4)	**47.** (1)	**48.** (7)
49. (25)	**50.** (1)	**51.** (4)	**52.** (11)	**53.** (3)	**54.** (2)	**55.** (2)	**56.** (3)
57. (1)	**58.** (20)	**59.** (2)	**60.** (24)	**61.** (1)	**62.** (2)	**63.** (300)	**64.** (3)
65. (363)	**66.** (2)	**67.** (100)	**68.** (1)	**69.** (2)	**70.** (2)	**71.** (3)	**72.** (3)
73. (6)	**74.** (3)	**75.** (3)	**76.** (1)	**77.** (3)	**78.** (1)	**79.** (25)	**80.** (1)
81. (4)	**82.** (4)	**83.** (25600)	**84.** (4)	**85.** (1)	**86.** (1)	**87.** (4)	**88.** (3)
89. (101)	**90.** (3)	**91.** (2)	**92.** (2)	**93.** (4)	**94.** (3)	**95.** (4)	**96.** (3)
97. (1)	**98.** (4)	**99.** (3)	**100.** (1)	**101.** (4)	**102.** (4)	**103.** (2)	**104.** (4)
105. (2)	**106.** (4)	**107.** (2)	**108.** (1)	**109.** (2)			