TEST

JEE Mains PYQS Mechanical Properties of Fluids (Physics Master Academy)

QUESTIONS

SECTIONS

1. Section A - 25 Questions

Section 1 : Section A - 25 Questions

SECTION INSTRUCTIONS

This section contains 25 MCQs. +4 for every correct answer, -1 for every incorrect answer.

1 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 specikc gravity of the shell material is 27/8 w.r.t. water, the value of r is

- 8/9 R
- 4/9 R
- 2/3 R
- 1/3 R

Correct: +4 · Incorrect: -1

2 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]

- 46.3kg
- 87.5kg
- 65.4kg
- 30.1kg

Correct: +4 · Incorrect: -1

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

- 300m
- 400m
- 600m
- 500m

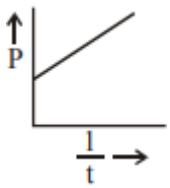
Correct: +4 · Incorrect: -1

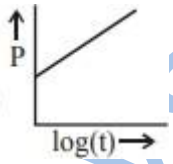
4 A wooden block floating in a bucket of water has 4/5 of its volume submerged. When certain amount of an oil poured into the bucket, it is found that the block is just under that oil surface with half of its volume under water and half in oil. The density of oil relative to that of water is

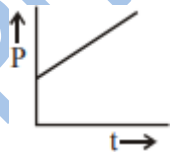
- 0.5
- 0.8
- 0.6
- 0.7

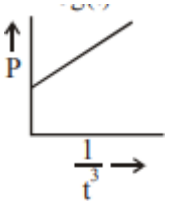
Correct: +4 · Incorrect: -1

5 A soap bubble blown v\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 bubble is given by



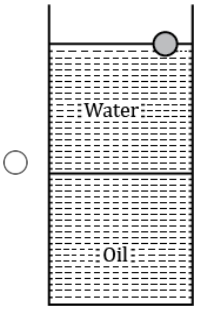


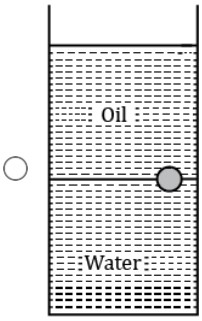


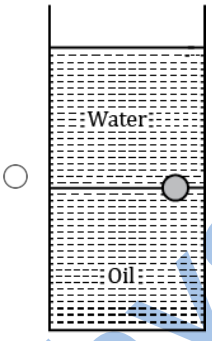


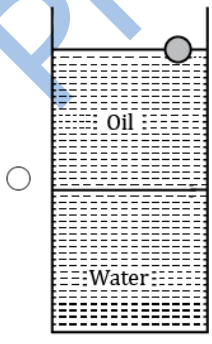
Correct: +4 · Incorrect: -1

6 A ball is made of a material of density ρ where $\rho_{oil} < \rho < \rho_{water}$ with ρ_{oil} and ρ_{water} representing the densities of oil and water receptively. The oil and water are immiscible. If the above ball is in equilibrium in a mixture of this oil and water, which of the following pictures represents its equilibrium position?

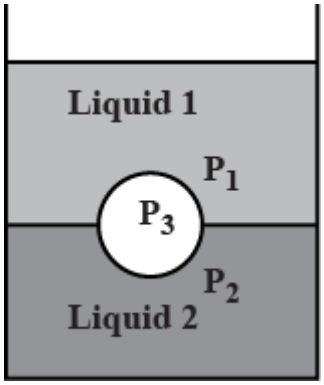








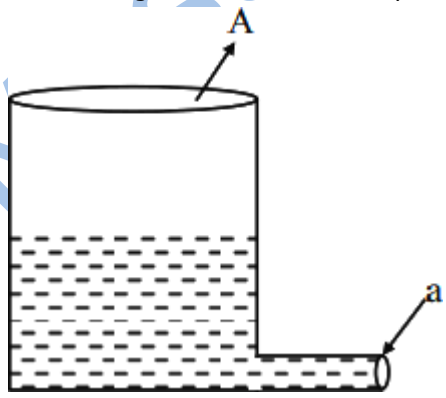
7 A jar is klled with two non mixing liquids 1 and 2 having densities ρ_1 and ρ_2 respectively. A solid ball made of a material of density ρ_3 is dropped in the jar. It comes to equilibrium in the position shown in the kgure. Which of the following is true for ρ_1, ρ_2 and ρ_3?



- $\rho_3<\rho_1<\rho_2$
- $\rho_1>\rho_3>\rho_2$
- $\rho_1<\rho_2<\rho_3$
- $\rho_1<\rho_3<\rho_2$

Correct: +4 · Incorrect: -1

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



- A/2a
- none of these
- 2a/A
- a/A

Correct: +4 · Incorrect: -1

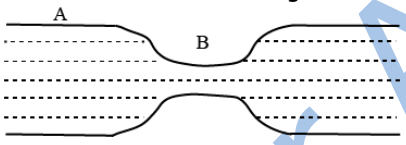
9 A fluid is flowing through a horizontal pipe of varying cross section, with speed v ms^{-1} at point where the pressure is P Pascal. At another point where pressure is P/2 Pascal its speed is V ms^{-1}. IF the density of the fluid is r kg m^{-3} and the flow is streamline, the V is equal

to

- $\sqrt{\frac{P}{\rho}+v}$
- $\sqrt{\frac{2P}{\rho}+v^2}$
- $\sqrt{\frac{P}{2\rho}+v^2}$
- $\sqrt{\frac{P}{\rho}+v^2}$

Correct: +4 · Incorrect: -1

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



- 3020 cm^3/s
- 2720 cm^3/s
- 2420 cm^3/s
- 1810 cm^3/s

Correct: +4 · Incorrect: -1

11 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

- 9/16
- $\sqrt{3}/2$
- 3/4
- 81/256

Correct: +4 · Incorrect: -1

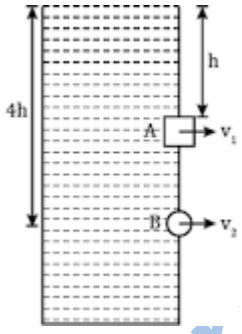
12 Two tubes of radii r_1 and r_2 and lengths l_1 and l_2 respectively, are connected in series and a liquid flows through each of them in

streamline conditions. P_1 and P_2 are pressure differences across the two tubes. If P_2 is $4P_1$ and l_2 is $l_1/4$, then the radius r_2 will be equal to

- r_1
- $2r_1$
- $4r_1$
- $r_1/2$

Correct: +4 · Incorrect: -1

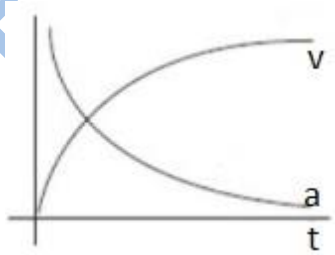
13 A square hole of side length l is made at a depth of h and a circular hole of radius r is made at the depth of 4h from the surface of water in a water tank kept on a horizontal surface. If l <<h, r <<h and rate of water flow from the holes is the same, the r is equal to

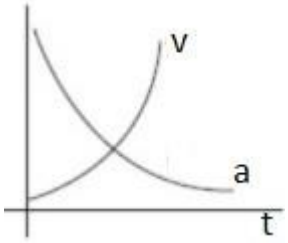


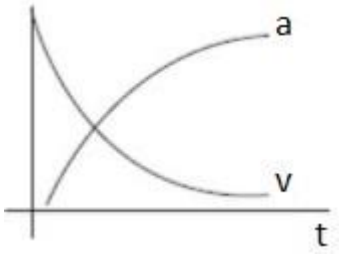
- $\frac{l}{\sqrt{2\pi}}$
- $\frac{l}{\sqrt{3\pi}}$
- $\frac{l}{3\pi}$
- $\frac{l}{2\pi}$

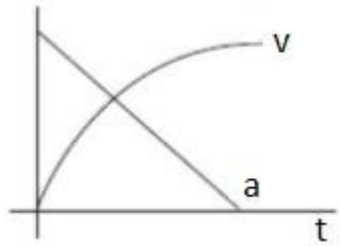
Correct: +4 · Incorrect: -1

14 Which of the following option correctly describes the variation of the speed v and acceleration a of a point mass falling vertically in a viscous medium that applies a force F = - kv where k is a constant, on the body> (Graphs are schematic and not drawn to scale)









Correct: +4 · Incorrect: -1

15 The terminal velocity of a small sphere of radius a in a viscous liquid is proportional to

- a^2
- a^3
- a
- a^{-1}

Correct: +4 · Incorrect: -1

16 Two small drops of mercury each of radius R coalesce to form a single drop large drop. The ratio of total surface energy before and after the change is

- $2^{1/3}:1$
- $1:2^{1/3}$
- 2:1
- 1:2

Correct: +4 · Incorrect: -1

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

- 15
- 20
- 25
- 30

Correct: +4 · Incorrect: -1

18 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 HJ, the rise in heat energy per unit volume will be

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

Correct: +4 · Incorrect: -1

19 When a long glass capillary tube of radius 0.015cm is dipped in a liquid, the liquid rises to a height of 15cm within it. IF the contact angle between the liquid and glass is close to 0°, the surface tension of the liquid, in milliNewton m^{-1}, is [$\rho_{(liquid)}$ = 900 kgm^{-3}, g = 10ms^{-2}] (Give answer in closest integer)

- 100
- 99
- 101
- 102

Correct: +4 · Incorrect: -1

20 A capillary tube made of glass of radius 0.15mm is dipped vertically in a beaker klled with methylene iodide (surface tension = $0.05Nm^{-1}$, density = $667kgm^{-2}$) which rises to height h in the tube. It is 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 ($g = 10ms^{-2}$)

- 0.049m
- 0.087m
- 0.137m
- 0.172m

Correct: +4 · Incorrect: -1

21 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)

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

Correct: +4 · Incorrect: -1

22 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. 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. The ratio (r_1/r_2) is then close to

- 4/5
- 2/5
- 3/5
- 2/3

Correct: +4 · Incorrect: -1

23 If 'M' is the mss 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
23

- M
- M/2
- 4M
- 2M

Correct: +4 · Incorrect: -1

24 If two glass plates have water between them and are separated by very small distance (See kg), it is very difkcult to pull them apart. It is because the water in between forms cylindrical surface on the side that give rise to lower pressure in the water in comparison to atmosphere. If the radius of the cylindrical surface is R and surface tension of water is T then the pressure in water between the plates is lower by

- 2T/R
- 4T/R
- T/4R
- T/R

Correct: +4 · Incorrect: -1

25 This question has statement 1 and statement 2. OF the four choices given after the statements, choose the one that best describes the two statements.
Statement 1: A capillary is dipped in a liquid and liquid rises to a height h in it. As the temperature of the liquid is raised, the height h increases (if the density of the liquid raised and angle of contact remain the same).
Statement 2: Surface tension of a liquid decreases with the rise in its temperature.

- Statement 1 is true, statement 2 is true; statement 2 is not the correct explanation for statement 1.
- Statement 1 is false, statement 2 is true
- Statement 1 is true, statement 2 is false
- Statement 1 is true, statement 2 is true; statement 2 is the correct explanation for statement 1.

Correct: +4 · Incorrect: -1

TEST

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ANSWERS

SECTIONS

1. Section A - 25 Questions

Section 1 : Section A - 25 Questions

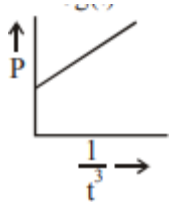
1 8/9 R

2 87.5kg

3 300m

4 0.6

5



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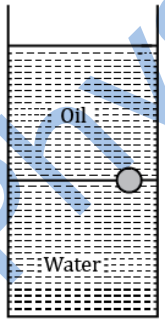


7 $\rho_1 < \rho_3 < \rho_2$

8 2a/A

9 $\sqrt{\frac{P}{\rho}+v^2}$

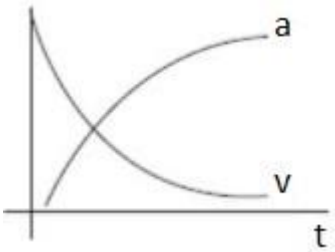
10 2720 cm^3/s

11 9/16

12 $r_1/2$

13 $\frac{l}{\sqrt{2}\pi}$

14



15 a^2

16 $2^{1/3}:1$

17 25

18 $\frac{3T}{J}\left(\frac{1}{r}-\frac{1}{R}\right)$

19 101

20 0.087m

21 $r=\sqrt{\frac{3T}{(2d-\rho)g}}$

22 2/5

23 2M

24 T/R

25 Statement 1 is false, statement 2 is true