

Mechanical Properties of Fluids — NEET Physics PYQ (2013-2021)

Class 11 Physics · 11 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2021

1. The velocity of a small ball of mass M and density d , 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 :

- (A) $Mg/2$
- (B) Mg
- (C) $(3/2) Mg$
- (D) $2Mg$

NEET 2020 · Q178

2. A capillary tube of radius r is immersed in water and water rises in it to a height h . The mass of the water in the capillary is 5 g. Another capillary tube of radius $2r$ is immersed in water. The mass of water that will rise in this tube is :

- (A) 2.5 g
- (B) 5.0 g
- (C) 10.0 g
- (D) 20.0 g

NEET 2019 · Q7

3. A soap bubble, having radius of 1 mm, is blown from a detergent solution having a surface tension of 2.5×10^{-2} N/m. The pressure inside the bubble equals at a point Z_0 below the free surface of water in a container. Taking $g = 10$ m/s², density of water = 10^3 kg/m³, the value of Z_0 is:

- (A) 100 cm
- (B) 10 cm
- (C) 1 cm
- (D) 0.5 cm

NEET 2019 · Q38

4. A small hole of area of cross-section 2 mm^2 is present near the bottom of a fully filled open tank of height 2 m. Taking $g = 10$ m/s², the rate of flow of water through the open hole would be nearly:

- (A) $12.6 \times 10^{-6} \text{ m}^3/\text{s}$
- (B) $8.9 \times 10^{-6} \text{ m}^3/\text{s}$
- (C) $2.23 \times 10^{-6} \text{ m}^3/\text{s}$
- (D) $6.4 \times 10^{-6} \text{ m}^3/\text{s}$

NEET 2018 · Q42

5. A small sphere of radius ' r ' falls from rest in a viscous liquid. As a result, heat is produced due to viscous force. The rate of production of heat when the sphere attains its terminal velocity, is proportional to

- (A) r^5
- (B) r^2
- (C) r^3
- (D) r^4

NEET 2016 Phase 2 · Q13

6. A rectangular film of liquid is extended from $(4 \text{ cm} \times 2 \text{ cm})$ to $(5 \text{ cm} \times 4 \text{ cm})$. If the work done is 3×10^{-4} J, the value of the surface tension of the liquid is

- (A) 0.250 N m^{-1}
- (B) 0.125 N m^{-1}
- (C) 0.2 N m^{-1}
- (D) 8.0 N m^{-1}

NEET 2016 Phase 2 · Q14

7. Three liquids of densities ρ_1 , ρ_2 and ρ_3 (with $\rho_1 > \rho_2 > \rho_3$), having the same value of surface tension T , rise to the same height in three identical capillaries. The angles of contact θ_1 , θ_2 and θ_3 obey

- (A) $\pi/2 > \theta_1 > \theta_2 > \theta_3 \geq 0$
- (B) $0 \leq \theta_1 < \theta_2 < \theta_3 < \pi/2$
- (C) $\pi/2 < \theta_1 < \theta_2 < \theta_3 < \pi$
- (D) $\pi > \theta_1 > \theta_2 > \theta_3 > \pi/2$

NEET 2016 Phase 1 · Q33

8. Two non-mixing liquids of densities ρ and $n\rho$ ($n > 1$) are put in a container. The height of each liquid is h . A solid cylinder of length L and density d is put in this container. The cylinder floats with its axis vertical and length pL ($p < 1$) in the denser liquid. The density d is equal to:

- (A) $\{1 + (n + 1)p\}\rho$
- (B) $\{2 + (n + 1)p\}\rho$
- (C) $\{2 + (n - 1)p\}\rho$
- (D) $\{1 + (n - 1)p\}\rho$

AIPMT 2015

9. A wind with speed 40 m/s blows parallel to the roof of a house. The area of the roof is 250 m². Assuming that the pressure inside the house is atmospheric pressure, the force exerted by the wind on the roof and the direction of the force will be: ($\rho_{\text{air}} = 1.2 \text{ kg/m}^3$)

- (A) $2.4 \times 10^5 \text{ N}$, downwards
- (B) $4.8 \times 10^5 \text{ N}$, downwards
- (C) $4.8 \times 10^5 \text{ N}$, upwards
- (D) $2.4 \times 10^5 \text{ N}$, upwards

AIPMT 2014

10. A certain number of spherical drops of a liquid of radius ' r ' coalesce to form a single drop of radius ' R ' and volume ' V '. If ' T ' is the surface tension of the liquid, then:

- (A) energy = $3VT(1/r + 1/R)$ is absorbed
- (B) energy = $3VT(1/r - 1/R)$ is released
- (C) energy is neither released nor absorbed
- (D) energy = $4VT(1/r - 1/R)$ is released

NEET 2013

11. The wettability of a surface by a liquid depends primarily on -

- (A) viscosity
- (B) surface tension
- (C) density
- (D) angle of contact between the surface and the liquid

Answer key and explanations

1. Answer: (A) $Mg/2$

At terminal velocity the net force is zero: weight = buoyant force + viscous force. Ball volume = M/d , so buoyancy = $(M/d)(d/2)g = Mg/2$, giving viscous force = $Mg - Mg/2 = Mg/2$. Taking viscous force equal to the full weight Mg ignores buoyancy.

2. Answer: (C) 10.0 g

Jurin's law gives $h \propto 1/r$, and the mass of the raised column $m = \pi r^2 h \propto r^2/r = r$. Doubling the radius doubles the mass, from 5 g to 10 g. Assuming the height stays the same would give 20 g.

3. Answer: (C) 1 cm

Excess pressure in a soap bubble (two surfaces) = $4T/r = 4 \times 2.5 \times 10^{-2}/10^{-3} = 100 \text{ Pa}$. Setting $pgZ_0 = 100$ gives $Z_0 = 100/(10^3 \times 10) = 0.01 \text{ m} = 1 \text{ cm}$. Using $2T/r$ (single surface) would give 0.5 cm.

4. Answer: (A) $12.6 \times 10^{-6} \text{ m}^3/\text{s}$

Torricelli: $v = \sqrt{2gh} = \sqrt{40} \approx 6.32 \text{ m/s}$. Flow rate $= Av = 2 \times 10^{-6} \times 6.32 \approx 12.6 \times 10^{-6} \text{ m}^3/\text{s}$. $6.4 \times 10^{-6} \text{ m}^3/\text{s}$ is roughly the speed alone without multiplying by the 2 mm^2 area.

5. Answer: (A) r^5

At terminal velocity the heating rate equals $F \cdot v = 6\pi\eta r v \cdot v$. Since $v_t \propto r^2$, power $\propto r \times r^4 = r^5$. Taking only the force ($\propto r^3$ at terminal speed) misses the extra factor of velocity.

6. Answer: (B) 0.125 N m^{-1}

Area increases from 8 cm^2 to 20 cm^2 , i.e. by $12 \times 10^{-4} \text{ m}^2$, and a film has two surfaces, so the total new surface is $24 \times 10^{-4} \text{ m}^2$. $T = W/\Delta A = 3 \times 10^{-4}/24 \times 10^{-4} = 0.125 \text{ N/m}$. Forgetting the two surfaces gives 0.250 N/m .

7. Answer: (B) $0 \leq \theta_1 < \theta_2 < \theta_3 < \pi/2$

From $h = 2T \cos\theta/(r\rho g)$, equal h , T and r means $\cos\theta \propto \rho$. The densest liquid has the largest $\cos\theta$ and hence the smallest angle, so $\theta_1 < \theta_2 < \theta_3$; since the liquids rise, all angles are below $\pi/2$. Angles above $\pi/2$ would mean capillary depression.

8. Answer: (D) $\{1 + (n - 1)p\}\rho$

Length pL is in the denser liquid and $(1 - p)L$ in the lighter one. Weight = buoyancy: $dLAg = np(pL)Ag + \rho(1 - p)LAg$, so $d = \rho[1 + (n - 1)p]$. Using $(n + 1)$ comes from adding instead of subtracting the lighter-liquid share.

9. Answer: (D) $2.4 \times 10^5 \text{ N}$, upwards

By Bernoulli the pressure above the roof is lower by $\frac{1}{2}\rho v^2 = 0.5 \times 1.2 \times 40^2 = 960 \text{ Pa}$. Force $= 960 \times 250 = 2.4 \times 10^5 \text{ N}$, acting upwards because the higher pressure is inside the house.

10. Answer: (B) energy = $3VT(1/r - 1/R)$ is released

With $n = R^3/r^3$ drops, the area lost is $4\pi(nr^2 - R^2) = 4\pi R^3(1/r - 1/R) = 3V(1/r - 1/R)$. Since surface area decreases, surface energy $3VT(1/r - 1/R)$ is released, not absorbed.

11. Answer: (D) angle of contact between the surface and the liquid

Whether a liquid wets a surface is decided by the angle of contact: an acute angle means wetting, an obtuse angle means non-wetting. Surface tension alone does not decide this, since the contact angle depends on the balance of adhesive and cohesive forces.

Questions as set in the AIPMT/NEET papers conducted by CBSE and NTA. Answers checked and explanations written by the RankUp team. RankUp is not affiliated with CBSE or NTA.