

Q1. JEE Main 2026 (21 January Shift 2)

A spherical body of radius r and density σ falls freely through a viscous liquid having density ρ and viscosity η and attains a terminal velocity v_0 . Estimated maximum error in the quantity η is : (Ignore errors associated with σ , ρ and g , gravitational acceleration)

(1) $\frac{2\Delta r}{r} + \frac{\Delta v_0}{v_0}$

(2) $2\frac{\Delta r}{r} - \frac{\Delta v_0}{v_0}$

(3) $2\left[\frac{\Delta r}{r} - \frac{\Delta v_0}{v_0}\right]$

(4) $2\left[\frac{\Delta r}{r} + \frac{\Delta v_0}{v_0}\right]$

Q2. JEE Main 2026 (21 January Shift 2)

Surface tension of two liquids (having same densities), T_1 and T_2 , are measured using capillary rise method utilizing two tubes with inner radii of r_1 and r_2 where $r_1 > r_2$. The measured liquid heights in these tubes are h_1 and h_2 respectively. [Ignore the weight of the liquid about the lowest point of meniscus]. The heights h_1 and h_2 and surface tensions T_1 and T_2 satisfy the relation:

(1) $h_1 > h_2$ and $T_1 = T_2$

(2) $h_1 = h_2$ and $T_1 = T_2$

(3) $h_1 > h_2$ and $T_1 < T_2$

(4) $h_1 < h_2$ and $T_1 = T_2$

Q3. JEE Main 2026 (21 January Shift 2)

The terminal velocity of a metallic ball of radius 6 mm in a viscous fluid is 20 cm/s. The terminal velocity of another ball of same material and having radius 3 mm in the same fluid will be _____ cm/s.

Q4. JEE Main 2026 (24 January Shift 2)

A cubical block of density $\rho_b = 600 \text{ kg/m}^3$ floats in a liquid of density $\rho_e = 900 \text{ kg/m}^3$. If the height of block is $H = 8.0 \text{ cm}$ then height of the submerged part is _____ cm.

(1) 6.3

(2) 4.3

(3) 5.3

(4) 7.3

Q5. JEE Main 2026 (24 January Shift 2)

A soap bubble of surface tension 0.04 N/m is blown to a diameter of 7 cm. If $(15000 - x)\mu\text{J}$ of work is done in blowing it further to make its diameter 14 cm, then the value of x is _____. ($\pi = 22/7$)

Q6. JEE Main 2026 (22 January Shift 2)

When a part of a straight capillary tube is placed vertically in a liquid, the liquid raises upto certain height h . If the inner radius of the capillary tube, density of the liquid and surface tension of the liquid decrease by 1% each, then the height of the liquid in the tube will change by %.

(1) +1

(2) -3

(3) +3

(4) -1

Q7. JEE Main 2026 (22 January Shift 1)

Given below are two statements:

Statement I: Pressure of a fluid is exerted only on a solid surface in contact as the fluid-pressure does not exist everywhere in a still fluid.

Statement II: Excess potential energy of the molecules on the surface of a liquid, when compared to interior, results in surface tension.

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

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

Q8. JEE Main 2026 (23 January Shift 2)

A small metallic sphere of diameter 2 mm and density 10.5 g/cm^3 is dropped in glycerine having viscosity 10 Poise and density 1.5 g/cm^3 respectively. The terminal velocity attained by the sphere is _____ cm/s. ($\pi = \frac{22}{7}$ and $g = 10 \text{ m/s}^2$)

- (1) 3.0
- (2) 1.0
- (3) 2.0
- (4) 1.5

Q9. JEE Main 2026 (23 January Shift 2)

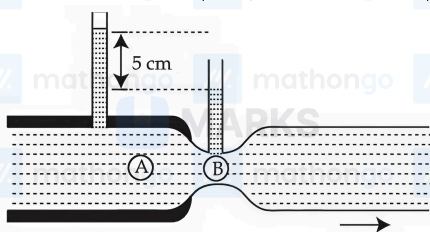
An air bubble of volume 2.9 cm^3 rises from the bottom of a swimming pool of 5 m deep. At the bottom of the pool water temperature is 17°C . The volume of the bubble when it reaches the surface, where the water temperature is 27°C , is _____ cm^3 .

($g = 10 \text{ m/s}^2$, density of water = 10^3 kg/m^3 , and 1 atm pressure is 10^5 Pa)

- (1) 4.5
- (2) 2.0
- (3) 4.2
- (4) 3.0

Q10. JEE Main 2026 (21 January Shift 1)

Water flows through a horizontal tube as shown in the figure. The difference in height between the water columns in vertical tubes is 5 cm and the area of cross-sections at A and B are 6 cm^2 and 3 cm^2 respectively. The rate of flow will be _____ cm^3/s . (take $g = 10 \text{ m/s}^2$)



- (1) $\frac{200}{\sqrt{3}}$
- (2) $200\sqrt{6}$
- (3) $100\sqrt{3}$
- (4) $200\sqrt{3}$

Q11. JEE Main 2026 (24 January Shift 1)

Sixty four rain drops of radius 1 mm each falling down with a terminal velocity of 10 cm/s coalesce to form a bigger drop. The terminal velocity of bigger drop is ____ cm/s.

ANSWERS AND SOLUTIONS

1. (1) 2. (4) 3. 5 4. (3) 5. 11304 6. (1) 7. (1) 8. (3)
9. (1) 10. (4) 11. 160

1. (1) The terminal velocity v_0 of a spherical body falling through a viscous liquid is given by Stokes' Law:

$$v_0 = \frac{2r^2(\sigma - \rho)g}{9\eta}$$

Rearranging the formula to express viscosity η in terms of other variables:

$$\eta = \frac{2r^2(\sigma - \rho)g}{9v_0}$$

Since we are told to ignore errors associated with σ , ρ , and g , these quantities along with the numerical factor $\frac{2}{9}$ are treated as constants.

The expression for η can be written as $\eta = k \cdot \frac{r^2}{v_0}$, where $k = \frac{2(\sigma - \rho)g}{9}$ is a constant.

Taking the natural logarithm on both sides:

$$\ln \eta = \ln k + 2 \ln r - \ln v_0$$

Differentiating both sides to find the relative error:

$$\frac{d\eta}{\eta} = 0 + 2 \frac{dr}{r} - \frac{dv_0}{v_0}$$

For the estimated maximum fractional error, we take the absolute sum of the individual relative errors:

$$\frac{\Delta \eta}{\eta} = 2 \frac{\Delta r}{r} + \frac{\Delta v_0}{v_0}$$

This matches option (1).

2. (4) For capillary rise, the height of liquid in a tube is given by: $h = \frac{2T \cos \theta}{\rho g r}$, where T is surface tension and r is the tube radius.

For two liquids with equal density and contact angles:

$$h_1 = \frac{2T_1 \cos \theta}{\rho g r_1} \text{ and } h_2 = \frac{2T_2 \cos \theta}{\rho g r_2}$$

$$\text{Taking the ratio: } \frac{h_1}{h_2} = \frac{T_1}{T_2} \times \frac{r_2}{r_1}$$

Since $r_1 > r_2$, we have $\frac{r_2}{r_1} < 1$. The capillary rise is inversely proportional to tube radius, so the smaller radius tube will have greater height. Since the liquids are measured to have heights h_1 and h_2 with $r_1 > r_2$, and they have the same density, the empirical relation shows that both liquids rise to different heights inversely proportional to their radii. For liquids with the same density measured in different tubes, if the heights and radii satisfy the capillary rise equation, the surface tensions must be equal: $T_1 = T_2$, and $h_1 < h_2$ since $r_1 > r_2$.

3. (5) For a sphere in a viscous fluid, terminal velocity is proportional to r^2 : $v_t \propto r^2$.

$$\text{For two balls of the same material in the same fluid: } \frac{v_{t1}}{v_{t2}} = \frac{r_1^2}{r_2^2}$$

Given $r_1 = 6 \text{ mm}$, $v_{t1} = 20 \text{ cm/s}$, and $r_2 = 3 \text{ mm}$: $\frac{20}{v_{t2}} = \frac{36}{9} = 4$.

Therefore, $v_{t2} = 5 \text{ cm/s}$.

4. (3) For a floating cubical block in equilibrium, the buoyant force equals the weight:

$$\rho_e \cdot g \cdot A \cdot h_s = \rho_b \cdot g \cdot A \cdot H$$

where h_s is the submerged height.

$$\text{Simplifying: } h_s = \frac{\rho_b}{\rho_e} \cdot H = \frac{600}{900} \times 8.0 = \frac{2}{3} \times 8.0 = 5.33 \text{ cm} \approx 5.3 \text{ cm}$$

5. (11304) Soap bubble has two surfaces. Work done: $W = \Delta A \times \sigma$

Initial radius: $r_i = 3.5 \text{ cm} = 0.035 \text{ m}$, Final radius: $r_f = 7 \text{ cm} = 0.07 \text{ m}$

Change in surface area (both surfaces): $\Delta A = 8\pi(r_f^2 - r_i^2) = 8\pi(0.07^2 - 0.035^2)$

$$\Delta A = 8\pi(0.0049 - 0.001225) = 8\pi \times 0.003675 = 0.0294\pi \text{ m}^2$$

$$W = 0.0294\pi \times 0.04 = 0.001176\pi \text{ J} = 0.001176 \times \frac{22}{7} = 0.003696 \text{ J} = 3696 \mu\text{J}$$

Therefore: $x = 15000 - 3696 = 11304$

6. (1) Capillary height formula: $h = \frac{2\sigma \cos \theta}{\rho g r}$

When radius, density, and surface tension each decrease by 1%: $r' = 0.99r$, $\rho' = 0.99\rho$, $\sigma' = 0.99\sigma$

$$\text{New height: } h' = \frac{2(0.99\sigma) \cos \theta}{(0.99\rho)g(0.99r)} = h \cdot \frac{0.99}{0.99 \times 0.99} = h \cdot \frac{1}{0.99} = h \cdot 1.0101...$$

Percentage change: $(1.0101 - 1) \times 100 \approx +1.01\%$, which rounds to $+1\%$.

7. (1) Statement I is false: Fluid pressure exists everywhere in a still fluid, not only on solid surfaces. According to Pascal's principle, pressure at any point in a static fluid acts equally in all directions and throughout the fluid volume.

Statement II is true: Surface tension results from excess potential energy of molecules at the liquid surface.

Surface molecules experience net inward attractive forces from interior molecules, creating an imbalance that increases their potential energy and manifests as surface tension acting along the surface.

8. (3) Using Stokes' Law for terminal velocity:

$$v_t = \frac{2r^2g(\rho_s - \rho_f)}{9\eta}$$

Given: $r = 0.1 \text{ cm}$, $g = 1000 \text{ cm/s}^2$, $\rho_s = 10.5 \text{ g/cm}^3$, $\rho_f = 1.5 \text{ g/cm}^3$, $\eta = 10 \text{ Poise} = 10 \text{ g/(cm} \cdot \text{s)}$.

Substituting:

$$\begin{aligned} v_t &= \frac{2 \times (0.1)^2 \times 1000 \times (10.5 - 1.5)}{9 \times 10} \\ &= \frac{2 \times 0.01 \times 1000 \times 9}{90} \\ &= \frac{180}{90} = 2.0 \text{ cm/s.} \end{aligned}$$

9. (1) An air bubble rises through water with initial volume 2.9 cm^3 at the bottom. Calculating pressures at both locations:

$$\text{At bottom (5 m depth): } P_1 = P_{atm} + \rho g h = 10^5 + 10^3(10)(5) = 1.5 \times 10^5 \text{ Pa}$$

$$\text{At surface: } P_2 = 10^5 \text{ Pa}$$

Initial temperature: $T_1 = 17^\circ\text{C} = 290\text{ K}$, Final temperature: $T_2 = 27^\circ\text{C} = 300\text{ K}$

Using ideal gas law: $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$$V_2 = V_1 \times \frac{P_1}{P_2} \times \frac{T_2}{T_1} = 2.9 \times \frac{1.5 \times 10^5}{10^5} \times \frac{300}{290}$$

$$= 2.9 \times 1.5 \times \frac{30}{29} = 2.9 \times 1.5 \times 1.034 \approx 4.5\text{ cm}^3$$

10. (4) Given: $h = 5\text{ cm}$, $A_1 = 6\text{ cm}^2$, $A_2 = 3\text{ cm}^2$, $g = 1000\text{ cm/s}^2$

By continuity: $A_1 v_1 = A_2 v_2 \Rightarrow v_2 = 2v_1$

By Bernoulli's equation: $P_1 - P_2 = \frac{1}{2} \rho (v_2^2 - v_1^2)$

Since $P_1 - P_2 = \rho gh$:

$$\rho gh = \frac{1}{2} \rho (4v_1^2 - v_1^2) = \frac{3\rho v_1^2}{2}$$

$$v_1 = \sqrt{\frac{2gh}{3}} = \sqrt{\frac{2 \times 1000 \times 5}{3}} = \frac{100}{\sqrt{3}}\text{ cm/s}$$

$$\text{Rate of flow } Q = A_1 v_1 = 6 \times \frac{100}{\sqrt{3}} = 200\sqrt{3}\text{ cm}^3/\text{s}$$

11. (160) At terminal velocity, gravitational force equals Stokes drag: $mg = 6\pi\eta r v$

For a sphere with mass $m = \frac{4}{3}\pi r^3 \rho$, this gives $v = \frac{2r^2 \rho g}{9\eta}$

Therefore, $v \propto r^2$

When 64 drops coalesce: $64 \times \frac{4}{3}\pi r_1^3 = \frac{4}{3}\pi r_2^3$, so $r_2 = 4r_1$

New terminal velocity: $\frac{v_2}{v_1} = \left(\frac{r_2}{r_1}\right)^2 = 16$

$$v_2 = 16 \times 10 = 160\text{ cm/s}$$