

DAILY TEST SERIES FOR IIT-JEE 2009 FROM VIDYA DRISHTI

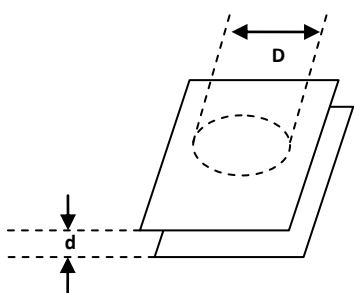
19.03.2009

Total time: 20 min

Multiple choice questions (one or more options correct)

Physics

1. Water, which wets glass, is stuck between two parallel glass plates. The distance between the plates is d and the diameter of the trapped water disc is $D \gg d$. Let S be the surface tension of water. The force acting between the plates is



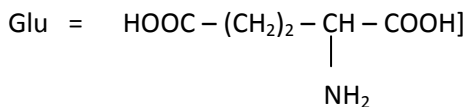
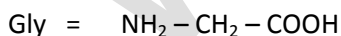
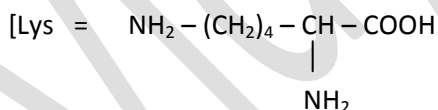
- (a) $\frac{\pi D^2 S}{D+d}$ (b) $\frac{\pi D^2 S}{D-d}$ (c) $\frac{\pi D^2 S}{d}$ (d) $\frac{\pi D^2 S}{2d}$

2. A train of length l is moving with a constant velocity v along a circular track of radius R . The engine of train emits a sound of frequency f . The frequency heard by the guard at the rear end of the train is

- (a) f (b) $2f$ (c) fl/R (d) $2fl/R$

Chemistry

3. Predict the direction of migration of following tripeptide at pH 6.0. Lys – Gly – Glu ;

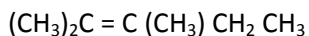


- (a) cathadol (b) anadol (c) stationary (d) unpredictable

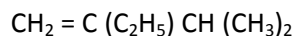
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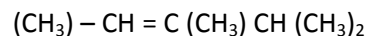
4. On reaction of 3 – bromo – 2, 3 – dimethyl pentane with alc. KOH, three products as given below are formed. Arrange these in order of decreasing yield.



(I)



(II)



(III)

- (a) I > II > III (b) I > III > II (c) III > II > I (d) same percentage yield

Mathematics

5. If (z_1, z_2) and (z_3, z_4) are two pairs of non zero conjugate complex numbers then

$$\arg\left(\frac{z_1}{z_3}\right) + \arg\left(\frac{z_2}{z_4}\right) =$$

- (a) 0 (b) $\pi/2$ (c) π (d) none

6. Let $z = \sum_{k=1}^{2007} ki^k$, then $\text{Re}(z) + \text{Im}(z) =$

- (a) – 2007
 (b) – 2008
 (c) 2007
 (d) 2008

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SOLUTION:

Physics

1. (d)

The cross-sectional edge of the disc of water is a semicircle of radius $r = \frac{1}{2}d$ (see figure).

Thus, the curvature of the surface of the water is $2/d$, which corresponds to a pressure of curvature of $\Delta p = \frac{2S}{d}$, where S is the surface tension.

The other component of the curvature is negligible because $D \gg d$.

The pressure inside the disc is therefore $p_0 - \frac{2S}{d}$ when the atmospheric pressure is p_0 .

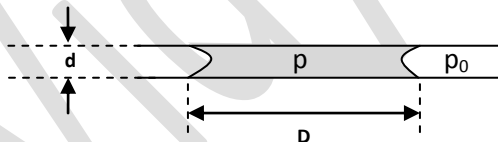
This pressure difference acts over a surface area between the water and each of the glass surfaces of $\frac{\pi D^2}{4}$.

This implies that a force,

$$F = \frac{\pi D^2}{4} \frac{2S}{d}$$

$$\Rightarrow F = \frac{\pi D^2 S}{2d}$$

pulls the glass together.



2. (a)

Clearly, $v_s = v_o = v$

where, v_s = speed of source

and v_o = speed of observer.

Let u be the speed of the sound.

Then using Doppler's effect,

Mathematics

5. (a)

Given $\bar{z}_1 = z_2 ; \bar{z}_3 = z_4$

$$\begin{aligned} \therefore \arg\left(\frac{z_1}{z_3}\right) + \arg\left(\frac{z_2}{z_4}\right) \\ = \arg\left(\frac{z_1 z_2}{z_3 z_4}\right) \\ = \arg\left(\frac{z_1 \bar{z}_1}{z_3 \bar{z}_3}\right) \\ = 0 \end{aligned}$$

6. (b)

$$z = \sum_{k=1}^{2007} ki^k$$

$$\Rightarrow z = i + 2i^2 + 3i^3 + \dots + 2007i^{2007} \quad \dots(1)$$

Multiplying both sides with i, we get

$$iz = i^2 + 2i^3 + \dots + 2006i^{2007} + 2007i^{2008} \quad \dots(2)$$

From (1) – (2), we have,

$$\begin{aligned} z - iz &= i + i^2 + i^3 \dots + i^{2007} - 2007i^{2008} \\ \Rightarrow z - iz &= (i + i^2 + i^3 \dots + i^{2004}) + i^{2005} + i^{2006} + i^{2007} - 2007i^{2008} \\ \Rightarrow z - iz &= (0) + i + (-1) + (-i) - 2007 \quad \text{(How?)} \\ \Rightarrow z - iz &= -2008 \end{aligned}$$

Let $z = x + iy$

Therefore,

$$z - iz = -2008$$

$$\Rightarrow (x + iy) - i(x + iy) = -2008$$

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$$\Rightarrow (x + y) - i(x - y) = -2008$$

$$\Rightarrow x + y = -2008 \quad \text{and} \quad x - y = 0$$

$$\Rightarrow x = -1004 \quad \text{and} \quad y = -1004$$

Therefore,

$$z = x + iy$$

$$\Rightarrow z = -1004 - i1004$$

Hence,

$$\operatorname{Re}(z) + \operatorname{Im}(z) = -2008$$