PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 81

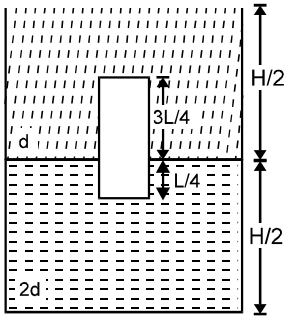
Total Marks : 24

Max. Time : 24 min.

Topics : Fluid, Electromagnet Induction, Rotation, Magnetic Effect of Current and Magnetic Force on Charge/current

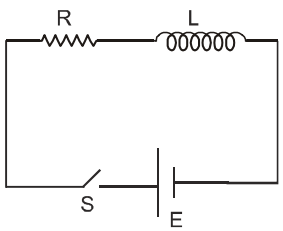
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks, 3 min.)	[9, 9]
Assertion and Reason (no negative marking) Q. 8	(3 marks, 3 min.)	[3, 3]

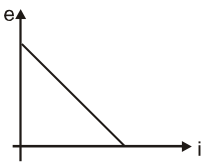
1. A container of a large uniform cross-sectional area A resting on a horizontal surface holds two immiscible, non-viscous and incompressible liquids of densities ' d ' and ' 2 d ' each of height (1/2)H as shown. The smaller density liquid is open to atmosphere. A homogeneous solid cylinder of length $L\left(< \frac{1}{2} H\right)$ cross-sectional area (1/5) A is immersed such that it floats with its axis vertical to the liquid-liquid interface with length (1/4) L in denser liquid. If D is the density of the solid cylinder then :

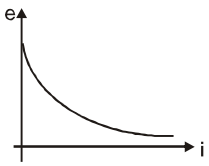


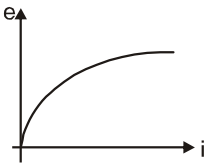
(A) $D = \frac{3d}{2}$ (B) $D = \frac{d}{2}$ (C) $D = \frac{2d}{3}$ (D) $D = \frac{5d}{4}$

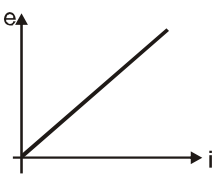
2. In an L-R circuit connected to a battery of constant e.m.f. E switch S is closed at time t = 0. If e denotes the induced e.m.f. across inductor and i the current in the circuit at any time t. Then which of the following graphs shows the variation of e with i ?



(A) 

(B) 

(C) 

(D) 

3. The effective value of current $i = 2 \sin 100 \pi t + 2 \cos (100 \pi t + 30°)$ is:

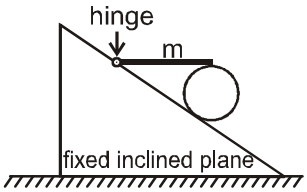
(A) $\sqrt{2}$ A (B) 2 A (C) 4 A (D) $2\sqrt{2}$ A

4. The angular momentum of an electron in first orbit of Li^{++} ion is :

(A) $\frac{3h}{2\pi}$ (B) $\frac{9h}{2\pi}$ (C) $\frac{h}{2\pi}$ (D) $\frac{h}{6\pi}$

COMPREHENSION

A horizontal uniform rod of mass 'm' has its left end hinged to the fixed incline plane, while its right end rests on the top of a uniform cylinder of mass 'm' which in turn is at rest on the fixed inclined plane as shown. The coefficient of friction between the cylinder and rod, and between the cylinder and inclined plane, is sufficient to keep the cylinder at rest.



5. The magnitude of normal reaction exerted by the rod on the cylinder is

(A) $\frac{mg}{4}$ (B) $\frac{mg}{3}$ (C) $\frac{mg}{2}$ (D) $\frac{2mg}{3}$

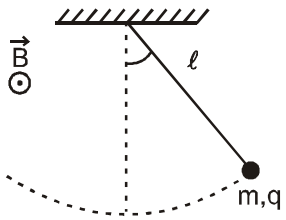
6. The ratio of magnitude of frictional force on the cylinder due to the rod and the magnitude of frictional force on the cylinder due to the inclined plane is:

(A) 1 : 1 (B) $2 : \sqrt{3}$ (C) 2 : 1 (D) $\sqrt{2} : 1$

7. The magnitude of normal reaction exerted by the inclined plane on the cylinder is:

(A) mg (B) $\frac{3mg}{2}$ (C) 2mg (D) $\frac{5mg}{4}$

8. **STATEMENT-1 :** A pendulum made of an insulated rigid massless rod of length ℓ is attached to a small sphere of mass m and charge q. The pendulum is undergoing oscillations of small amplitude having time period T. Now a uniform horizontal magnetic field $\vec{B}$ out of plane of page is switched on. As a result of this change, the time period of oscillations does not change.



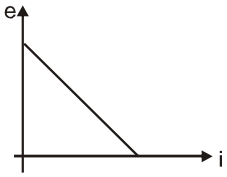
STATEMENT-2 : A force acting along the string on the bob of a simple pendulum (such that tension in string is never zero) does not produce any restoring torque on the bob about the hinge.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

Answers Key

1.	(D)	**2.**	(A)	**3.**	(A)
4.	(C)	**5.**	(C)	**6.**	(A)
7.	(B)	**8.**	(A)		

2. The potential difference across the inductor is e
= E– iR.
Hence the plot of e versus i is a straight line with negative slope.



3. Equation can be written as i = 2 sin 100 π t + 2 sin (100 π t + 120°)
so phase difference ϕ = 120°

$= \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$

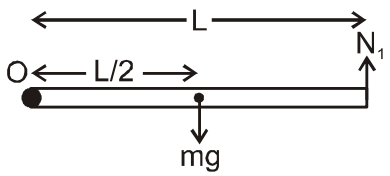
$= \sqrt{4+4+2\times2\times2\left(-\frac{1}{2}\right)}$ = 2 so effective value will

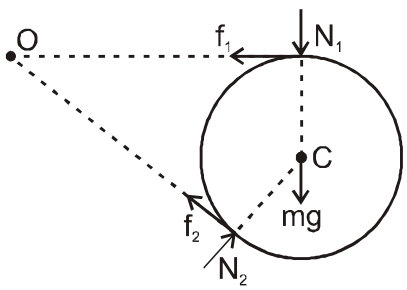
rms. value = $2/\sqrt{2} = \sqrt{2}$ A

4. Angular momentum $= \frac{nh}{2\pi} = \frac{h}{2\pi}$ ($\because$ n = 1)

$(mvr) = n.\frac{h}{2\pi} = \frac{h}{2\pi}$ (n = 1)

Sol.5 to 7.
FBD of rod and cylinder is as shown.





Net torque on rod about hinge 'O' = 0

$\therefore N_1 \times L = mg \times \frac{L}{2}$

or $\boxed{N_1 = \frac{mg}{2}}$

Net torque on cylinder about its centre C is zero.

$\therefore \quad f_1 R = f_2 R \quad$ or $\quad \boxed{f_1 = f_2}$

Net torque on cylinder about hinge O is zero.

$\therefore N_2 \times L = N_1 \times L + mgL$

or $N_2 = \boxed{\frac{3mg}{2}}$

8. The magnetic force on bob does not produce any restoring torque on bob about the hinge. Hence this force has no effect on time period of oscillation. Therefore both statements are correct and statement-2 is the correct explanation.