PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 38

Total Marks : 29

Max. Time : 30 min.

Topics : Elasticity & Viscosity, Electrostatics, Geometrical Optics, String Wave, Rigid Body Dynamics

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Multiple choice objective ('–1' negative marking) Q.5	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.6	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.7 to Q.9	(3 marks, 3 min.)	[9, 9]

1. If η represents the coefficient of viscosity and T the surface tension, then the dimension of $\frac{T}{\eta}$ is same as that of:

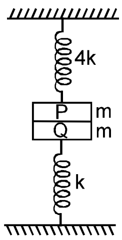
(A) length (B) mass (C) time (D) speed

2. The elongation in a metallic rod hinged at one end and rotating in a horizontal plane becomes four times of the initial value. The angular velocity of rotation becomes :

(A) two times the initial value (B) half of initial value

(C) one third of initial value (D) four times the initial value.

3. In the figure shown, blocks P and Q are in contact but do not stick to each other. The lower face of P behaves as a plane mirror. The springs are in their natural lengths. The system is released from rest. Then the distance between P and Q when Q is at the lowest point first time will be



(A) $\frac{2mg}{K}$ (B) $\frac{4mg}{K}$ (C) $\frac{3mg}{K}$ (D) 0

4. In the above question, the velocity of the image of Q in plane mirror of block P with respect to ground when Q is at the lowest point first time is :

(A) $\sqrt{\frac{2mg^2}{K}}$ (B) $\sqrt{\frac{4mg^2}{K}}$ (C) $\sqrt{\frac{3mg^2}{K}}$ (D) 0

5. The length, tension, diameter and density of a wire B are double than the corresponding quantities for another stretched wire A. Then (both are fixed at the ends)

(A) Fundamental frequency of B is $\frac{1}{2\sqrt{2}}$ times that of A.

(B) The velocity of wave in B is $\frac{1}{\sqrt{2}}$ times that of velocity in A.

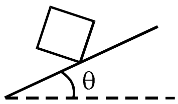
(C) The fundamental frequency of A is equal to the third overtone of B.

(D) The velocity of wave in B is half that of velocity in A.

6. A sample of a liquid has an initial volume of 1.5 L. The volume is reduced by 0.2 mL, when the pressure increases by 140 kPa. What is the bulk modulus of the liquid.

COMPREHENSION

A square frame of mass m is made of four identical uniform rods of length L each. This frame is placed on an inclined plane such that one of its diagonals is parallel to the inclined plane as shown in figure, and is released.



7. The moment of inertia of square frame about the axis of the frame is :

(A) $\frac{mL^2}{3}$ (B) $\frac{2mL^2}{3}$ (C) $\frac{4mL^2}{3}$ (D) $\frac{mL^2}{12}$

8. The frictional force acting on the frame just after the release of the frame assuming that it does not slide is :

(A) $\frac{mg\sin\theta}{3}$ (B) $\frac{2mg\sin\theta}{7}$ (C) $\frac{3mg\sin\theta}{5}$ (D) $\frac{2mg\sin\theta}{5}$

9. The acceleration of the center of square frame just after the release of the frame assuming that it does not slide is :

(A) $\frac{g\sin\theta}{3}$ (B) $\frac{2g\sin\theta}{7}$ (C) $\frac{3g\sin\theta}{5}$ (D) $\frac{2g\sin\theta}{5}$

Answers Key

1. (D) **2.** (A) **3.** (A) **4.** (D)
5. (C) (D) **6.** 1.05×10^9 Pa.
7. (A) **8.** (D) **9.** (C)

Hints & Solutions

1. $T = \frac{F}{L}$ ....(i)

$F = \eta A \frac{dv}{dx} \equiv \eta L^2 \frac{V}{L} = \eta LV$

$\eta = \frac{F}{LV}$ ....(ii)

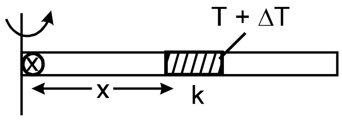
From (i) (ii),(i) (ii)

$\left[\frac{F}{\eta}\right] \equiv [V].$

2. $-\int_T^0 \Delta T = \int_0^{\ell} \frac{m}{\ell} dx\omega^2 x$

$\Rightarrow \quad T = \frac{m}{\ell}\omega^2 \frac{x^2}{2}$

$\Rightarrow \quad Y = \frac{F\ell}{A\Delta\ell} \quad \Delta\ell = \frac{F\ell}{Ay}$



$\Delta\ell = \frac{\frac{m}{\ell}\frac{\omega^2 x^2}{2} dx}{AY}$

$\Delta\ell = \frac{m}{\ell}\frac{\omega^2 \ell^3}{6AY}$

$\Delta\ell = \frac{\rho\omega^2\ell^3}{6y}$

$\Delta\ell = \omega^2$

$\omega_2 = 2\omega_1$

3. Both blocks loose contact immediately after the release.

$T_P = 2\pi\sqrt{\frac{m}{4K}}$,

$T_Q = 2\pi\sqrt{\frac{m}{K}}$

$\Rightarrow \quad \therefore \quad T_Q = 2T_P$

Q comes at lowest position at time $\frac{T_Q}{2}$ travelling a distance $\frac{2mg}{K}$ downwards.

In time $\frac{T_Q}{2}$, i.e. time period of P (T_P) the block P come back to original position

$\therefore$ The distance between P and Q is $\frac{2mg}{K}$

4. At t = $\frac{T_Q}{2}$ both the blocks are at extreme position and their velocity is zero. **[Soln. of SSI Sir]**

$\therefore \quad V_P = V_Q = 0$

6. $B = -\frac{\Delta P}{\Delta V / V} = -\frac{V\,\Delta P}{\Delta V} = -\frac{1.5 \times 140 \times 10^3}{-0.2 \times 10^{-3}}$

$= 1.05 \times 10^9$ Pa .

Ans. 1.05×10^9 Pa.

7. Moment of inertia of one rod about the axis of frame

$= \left(\frac{m}{4}\right)\frac{L^2}{12} + \frac{m}{4}\left(\frac{L}{2}\right)^2 = \frac{m}{4}L^2\left(\frac{1}{12} + \frac{1}{4}\right)$

$= \frac{mL^2}{12}$

$\therefore$ Moment of inertia of frame = $ML^2/3$.

9. **(For the above two questions)**

Newton's law applied on C.M. gives

$mg\sin\theta - f = ma$ .... (1)

Writing $\tau = I\alpha$ about C.M., we have

$f.\frac{L}{\sqrt{2}} = \frac{mL^2}{3}\alpha$ .... (2)

from the condition of rolling, we have

$a = \frac{L}{\sqrt{2}}\alpha$ .... (3)

from (1), (2) and (3)

$f = \frac{2mg\sin\theta}{5}$ and $a = \frac{3}{5}g\sin\theta$