PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 28

Total Marks : 39

Max. Time : 43 min.

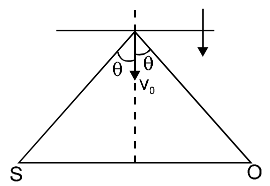
Topics : Geometrical Optics, Sound wave, Kinetic Theory of Gases, Rectilinear Motion, Projectile Motion, Electrostatics, Rigid Body Dynamics, Work, Power and Energy

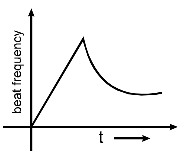
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Multiple choice objective ('–1' negative marking) Q.3 to Q.4	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.5 to Q.6	(4 marks, 5 min.)	[8, 10]
Comprehension ('–1' negative marking) Q.7 to Q.9	(3 marks, 3 min.)	[9, 9]
Match the Following (no negative marking) (2 × 4)Q.10	(8 marks, 10 min.)	[8, 10]

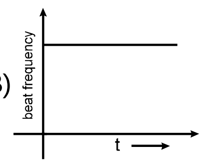
1. Two point objects are placed on principal axis of a thin converging lens. One is 20 cm from the lens and other is on the other side of lens at a distance of 40 cm from the lens. The images of both objects coincide. The magnitude of focal length of lens is

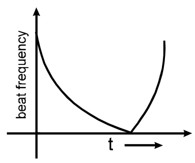
(A) $\frac{80}{3}$cm (B) $\frac{40}{3}$ cm (C) 40 cm (D) $\frac{20}{3}$cm

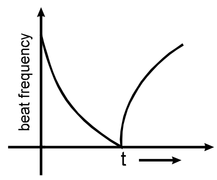
2. A stationary source 's' is producing sound of frequency ' f ' and an observer 'o' is at rest at some distance from source. A reflector is moving with constant speed ' v ' along perpendicular bisector of line joining source and observer. The variation of beat frequency registered by observer will be: [Reflector is moving from $-\infty$ to $+\infty$ along perpendicular bisector]



(A)


(B)


(C)


(D)


3. During an experiment, an ideal gas is found to obey a condition $\frac{P^2}{\rho}$ = constant [ρ = density of the gas]. The gas is initially at temperature T, pressure P and density ρ. The gas expands such that density changes to $\frac{\rho}{2}$

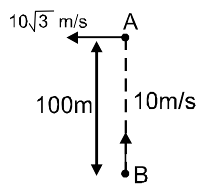
(A) The pressure of the gas changes to $\sqrt{2}$ P.

(B) The temperature of the gas changes to $\sqrt{2}$ T.

(C) The graph of the above process on the P-T diagram is parabola.

(D) The graph of the above process on the P-T diagram is hyperbola.

4. Consider two cars moving perpendicular to each other as shown. Initially distance between them is 100 m. Velocity of A is $10\sqrt{3}$ m/s and velocity of B is 10 m/s. Then:



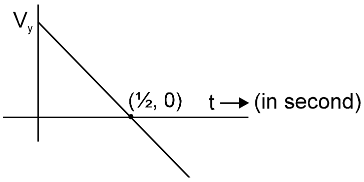
(A) magnitude of velocity of A w.r.t. B is 20 m/s

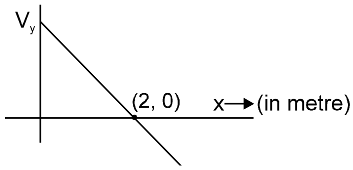
(B) minimum distance between them is 50 m

(C) minimum distance between them is $50\sqrt{3}$ m

(D) at t = 2 sec. they will be nearest to each other

5. Two graphs of the same projectile motion (in the xy plane) projected from origin are shown. X axis is along horizontal direction & Y axis is vertically upwards. Take $g = 10\ m/s^2$.



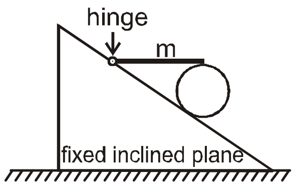


Find (i) Y component of initial velocity and (ii) X component of initial velocity

6. Electric dipole of moment $\vec{P} = p\,\hat{i}$ is kept at a point (x,y) in an electric field $\vec{E} = 4\,xy^2\,\hat{i} + 4\,x^2y\,\hat{j}$. Find the magnitude of force acting on the dipole.

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.



7. 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) $\frac{2mg}{3}$

8. 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) $\sqrt{2} : 1$

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

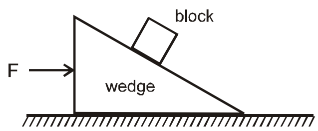
(A) mg (B) $\frac{3mg}{2}$ (C) 2mg (D) $\frac{5mg}{4}$

10. Match the statements in Column I with the results in Column II and indicate your answer by darkening appropriate bubbles in the 4 × 4 matrix given in the OMR.

Column – I **Column – II**

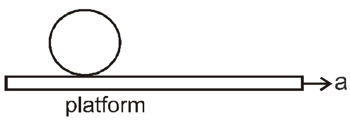
(A) Work done by ideal gas during free expansion (p) zero

(B) A wedge block system is as shown in the fig. (q) non zero
The wedge lying on horizontal surface is accelerated to right by a horizontal force F. All surfaces are smooth. Work done by normal reaction exerted by wedge on block in any time interval is



(C) Two identical conducting spheres of radius 'a' are separated by a distance 'b' (b>>a). Both spheres carry equal and opposite charge. Net electrostatic potential energy of system of both spheres is (r) negative

(D) A uniform cylinder lies over a rough horizontal platform. The platform is accelerated horizontally as shown with acceleration a. The cylinder does not slip over the platform.The work done by the force of friction on the cylinder w.r.t ground in any time interval is (s) positive



Answers Key

1. (A) **2.** (D) **3.** (B, D) **4.** (A, C)
5. (i) $u_y = 5$ m/s (ii) $u_x = 4$ m/s
6. $4py\ (y^2 + 4x^2)^{1/2}$ **7.** (C) **8.** (A)
9. (B) **10.** (A) p (B) q,s (C) q,s (D) q,s

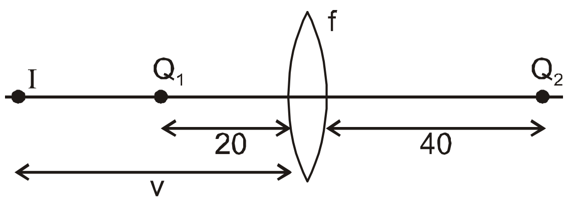
Hints & Solutions

1. for object O_1O_1

$$\frac{1}{v} + \frac{1}{20} = \frac{1}{f} \quad .... (1)$$

for object O_2O_2

$$\frac{1}{v} - \frac{1}{40} = -\frac{1}{f} \quad .... (2)$$



from equation 1 and 2 we get
f = 80/3

2. As the reflector approaches OS, the beat frequency will decrease to zero. After this, the reflector moves away from OS thereby increasing the beat frequency but after a long time the beat frequency will to become constant. Hence the correct option is (D).

3. Equation of process

$$\Rightarrow \frac{P^2}{\rho} = \text{constant} = C \quad .... (1)$$

Equation of State $\frac{P}{\rho} = \frac{R}{M}T$ .... (2)

From 1 and 2
PT = constant
$\Rightarrow$ C is false, D is true.

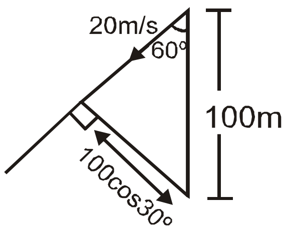
As ρ-changes to $\frac{\rho}{2}$

$\Rightarrow$ P changes to $\frac{P}{\sqrt{2}}$ from equation (1)

$\Rightarrow$ A is false.

Hence T changes to $\sqrt{2}T$ $\Rightarrow$ B is true

4. w.r.t.



5. From graph (1) : $v_y = 0$ at $t = \frac{1}{2}$ sec.

i.e., time taken to reach maximum height H is

$$t = \frac{u_y}{g} = \frac{1}{2}$$

$\Rightarrow$ $u_y = 5$ m/s . **..Ans.(i)**

from graph (2) : $v_y = 0$ at $x = 2$m

i.e., when the particle is at maximum height, its displacement along horizontal x = 2 m

$x = u_x \times t$

$$\Rightarrow \quad 2 = u_x \times \frac{1}{2}$$

$\Rightarrow$ $u_x = 4$ m/s **....Ans (ii)**

6. **$4py\ (y^2 + 4x^2)^{1/2}$**

$$\text{Force} = p\left|\frac{dE}{dx}\right|$$

{y is not changing since $\overline{p}$ is directed along x axis}

$$= p\left|[4y^2\hat{i} + 8xy\hat{j}]\right|$$

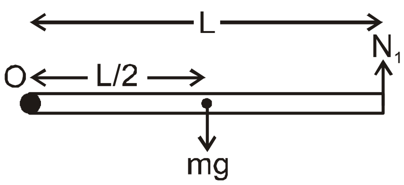
$$= p4y\left|[y\hat{i} + 2x\hat{j}]\right|$$

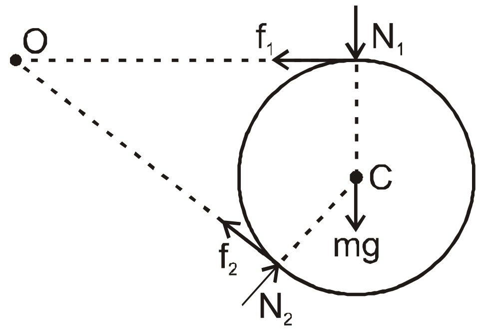
$$= 4py\sqrt{y^2 + 4x^2}$$

Ans. $4py\ (y^2 + 4x^2)^{1/2}$

Sol.7 to 9.

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.

$\therefore f_1R = f_2 R$

or $\boxed{f_1 = f_2}$

Net torque on cylinder about hinge O is zero.

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

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

10. (A) p (B) q,s (C) q,s (D) q,s

(A) Work done by an ideal gas during free expansion is zero.

(B) The angle between normal reaction on block and velocity of block is acute (whether the block moves up or down the incline). Hence work done by this force is non-zero and positive.

(C) Net electrostatic potential energy

$$= S_1 + S_2 + M_{12} = \frac{Q^2}{8\pi \epsilon_0 a} + \frac{Q^2}{8\pi \epsilon_0 a} - \frac{Q^2}{4\pi \epsilon_0 b}$$

$$= \frac{Q^2}{4\pi \epsilon_0 a} - \frac{Q^2}{4\pi \epsilon_0 b} = \text{non-zero and positive.}$$

($\because$ b > > a)

(D) The kinetic energy of cylinder is increasing and work is done on cylinder by only force of friction. Therefore work done by force of friction on cylinder is non-zero and positive.