PHYSICS
DPP
DAILY PRACTICE PROBLEMS

DPP No. 46

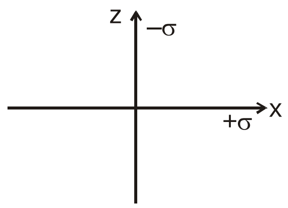
Total Marks : 29

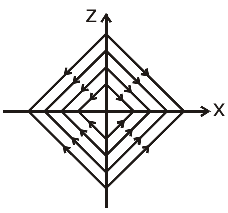
Max. Time : 31 min.

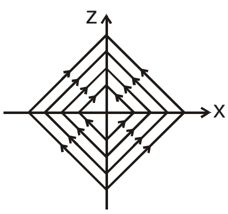
Topics : Electrostatics, Rectilinear Motion, Relative Motion, Simple Harmonic Motion

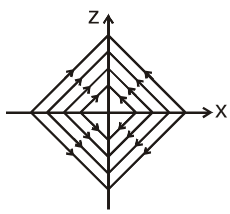
Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.4	**(3 marks, 3 min.)**	**[12, 12]**
Comprehension ('–1' negative marking) Q.5 to Q.7	**(3 marks, 3 min.)**	**[9, 9]**
Match the Following (no negative marking) (2 × 4) Q.8	**(8 marks, 10 min.)**	**[8, 10]**

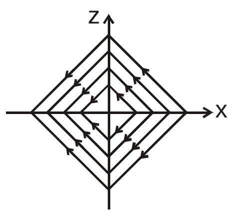
1. Two infinitely large charged planes having uniform surface charge density $+\sigma$ and $-\sigma$ are placed along x-y plane and yz plane respectively as shown in the figure. Then the nature of electric lines of forces in x-z plane is given by :



(A) 

(B) 

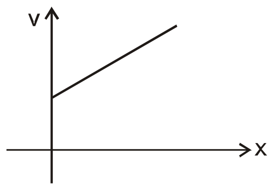
(C) 

(D) 

2. A point charge placed on the axis of a uniformly charged disc experiences a force f due to the disc. If the charge density on the disc is σ, the electric flux through the disc, due to the point charge will be :

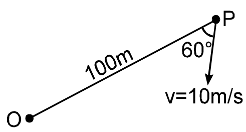
(A) $\frac{2\pi f}{\sigma}$ (B) $\frac{f}{2\pi\sigma}$ (C) $\frac{f^2}{\sigma}$ (D) $\frac{f}{\sigma}$

3. A particle moves along x-axis in positive direction. Its acceleration 'a' is given as a = cx + d, where x denotes the x-coordinate of particle, c and d are positive constants. For velocity-position graph of particle to be of type as shown in figure, the value of speed of particle at x = 0 should be.



(A) $\sqrt{\frac{4d^2}{c}}$ (B) $\sqrt{\frac{d^2}{c}}$ (C) $\sqrt{\frac{2d^2}{c}}$ (D) $\sqrt{\frac{8d^2}{c}}$

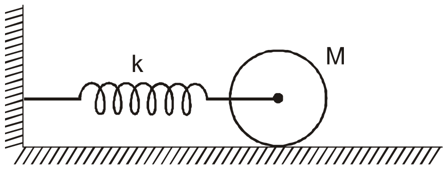
4. P is a point moving with constant speed 10 m/s such that its velocity vector always maintains an angle 60° with line OP as shown in figure (O is a fixed point in space). The initial distance between O and P is 100 m. After what time shall P reach O.



(A) 10 sec. (B) 15 sec. (C) 20 sec. (D) $20\sqrt{3}$ sec

COMPREHENSION

A solid cylinder attached with a horizontal massless spring (see figure) can roll without slipping along a horizontal surface. If the system is released from rest at a position in which spring is stretched by 0.3 m.



5. Period of oscillation of c.o.m of cylinder is

(A) $2\pi\sqrt{\frac{M}{k}}$ (B) $2\pi\sqrt{\frac{3M}{2k}}$ (C) $2\pi\sqrt{\frac{2M}{3k}}$ (D) $2\pi\sqrt{\frac{M}{2k}}$

6. If k = 20 N/m, Rotational K.E. of cylinder as it passes through mean position is

(A) 0.3 J (B) 0.45 J (C) 0.6 J (D) 0.9 J

7. Translation K.E. of cylinder as it passes through mean position is

(A) 0.3 J (B) 0.45 J (C) 0.6 J (D) 0.9 J

8. instruments are given. In column II, there are results corresponding to a given situation. Match the optical instrument of column I with the results in column II.

Column I	Column II
(A) concave mirror	(p) Parallel rays can be obtained by using point source.
(B) convex mirror	(q) Real image can be obtained for real object.
(C) concave lens	(r) Virtual and diminished image can be obtained for real object.
(D) convex lens	(s) Real and magnified image can be obtained for real object.
	(t) For a point object moving along optical axis, the image also moves in the same direction of motion of the object.

Answers Key

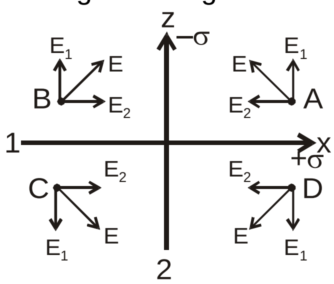
1. (C) **2.** (D) **3.** (B) **4.** (C)

5. (B) **6.** (A) **7.** (C)

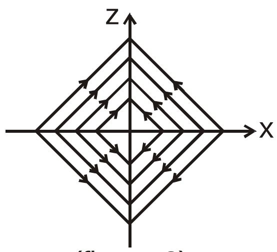
8. (A) – p,q,s, (B) – r, (C) – r,t ; (D) – p,q,s,t.

Hints & Solutions

1. The electric field intensity due to each uniformly charged infinite plane is uniform. The electric field intensity at points A, B, C and D due to plane 1, plane 2 and both planes are given by E_1, E_2 and E as shown in figure 1. Hence the electric lines of forces are as given in figure 2.



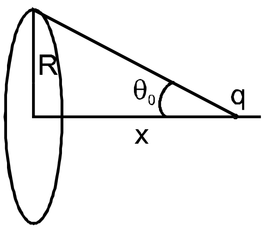
(figure 1)



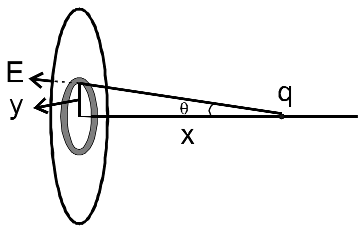
(figure 2)

Aliter : Electric lines of forces originate from positively charged plane and terminate at negatively charged plane. Hence the correct representation of ELOF is as shown figure 2.

2.



Force on q = Eq = $\dfrac{\sigma}{2\varepsilon_0}(1-\cos\theta_o)\,q = f$

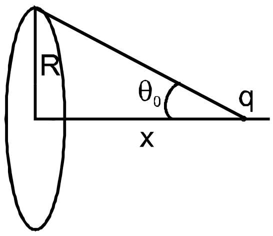


Consider a ring of radius y and thickness dy. Flux through this ring $d\phi = (E\cos\theta)2\pi y dy$

$\therefore$ Total flux = $\displaystyle\int_0^{\theta_0} \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2} 2\pi y dy \cos\theta$

$= \dfrac{q}{2\varepsilon_0}(1-\cos\theta_0)$

So, $\phi = \dfrac{f}{\sigma}$



3. **(Moderate)** $a = v\dfrac{dv}{dx} = cx + d$

Let at x = 0 v = u

$\therefore \displaystyle\int_u^v v\,dv = \int_0^x (cx+d)\,dx$

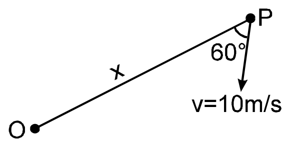
or $v^2 = cx^2 + 2dx + u^2$

v shall be linear function of x if $cx^2 + 2dx + u^2$ is perfect square

4. **(C)**

Velocity of approach of P and O is

$-\dfrac{dx}{dt} = v \cos 60° = 5$ m/s



It can be seen that velocity of approach is always constant.

$\therefore$ P reaches O after = $\dfrac{100}{5}$ = 20 sec.

5. a = (kx – f)/m

f × R = mR^2 / 2 × a/R

6. by energy conservation

$$\frac{1}{2}\times 20\times 0.3\times 0.3 = \frac{1}{2}\times\frac{mR^2}{2}\times\frac{v^2}{R^2}+\frac{1}{2}mv^2$$

$mv^2 = 1.2$ J

Rotational K.E. = $\dfrac{mv^2}{4}$ = 0.3 J

7. by energy conservation

$$\frac{1}{2}\times 20\times 0.3\times 0.3=\frac{1}{2}\times\frac{mR^2}{2}\times\frac{v^2}{R^2}+\frac{1}{2}mv^2$$

$mv^2 = 1.2$ J

Translation K.E. $= \dfrac{mv^2}{2} = 0.6$ J

<u>8.</u> (A) – p,q,s, (B) – r, (C) – r,t ; (D) – p,q,s,t.

(p) Parallel beam can be obtained from concave mirror and convex lens when point object is at focus.

(q) Real image for real object is for concave mirror and convex lens.

(r) Virtual and diminished images are obtained for convex mirror and concave lens.

(s) Real and magnified image is obtained for concave mirror and convex lens.

(t) The direction of motion of image is in the same direction as motion of object in lens and opposite in mirror.