PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 45

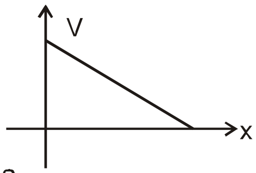
Total Marks : 31

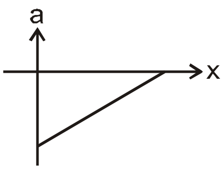
Max. Time : 35 min.

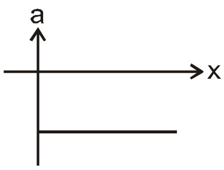
Topics : Rectilinear Motion, Relative Motion, Circular Motion, Sound Wave, Electrostatics

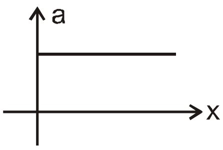
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(12 marks 12 min.)	[6, 6]
Subjective Questions ('–1' negative marking) Q.3 to Q.4	(4 marks, 5 min.)	[8, 10]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks, 3 min.)	[9, 9]
Match the Following (no negative marking) (2 × 4) Q.8	(8 marks, 10 min.)	[8, 10]

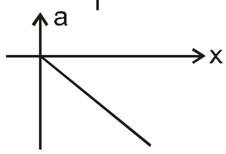
1. A particle moves along x-axis with initial position x = 0. Its velocity varies with x-coordinate as shown in graph. The acceleration 'a' of this particle varies with x as



(A) 

(B) 

(C) 

(D) 

2. A coin is released inside a lift at a height of 2 m from the floor of the lift. The height of the lift is 10 m. The lift is moving with an acceleration of 9 m/s^2 downwards. The time after which the coin will strike with the lift is : (g = 10 m/s^2)

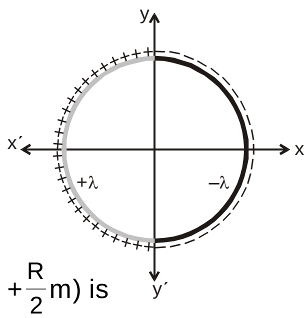
(A) 4 s (B) 2 s (C) $\frac{4}{\sqrt{21}}$ s (D) $\frac{2}{\sqrt{11}}$ s

3. A particle is projected from ground with an initial velocity 20 m/sec making an angle 60° with horizontal. If R_1 and R_2 are radius of curvatures of the particle at point of projection and highest point respectively, then find the value of $\frac{R_1}{R_2}$.

4. A point source of sound emiting sound of frequency 700 Hz and observer starts moving from a point along mutually perpendicular directions with velocity 20 m/s and 15 m/s respectively. If change in observed frequency by observer is 10x Hz then calculate 'x'. [speed of sound in 334 m/sec]

COMPREHENSION

A thin ring of radius R metres is placed in x-y plane such that its centre lies on origin. The half ring in region x< 0 carries uniform linear charge density +λ C/m and the remaining half ring in region x> 0 carries uniform linear charge density –λ C/m.



5. Then the electric potential (in volts) at point P whose coordinates are (0m, $+\frac{R}{2}$m) is

(A) $\frac{1}{4\pi\varepsilon_0}\frac{\lambda}{2}$ (B) 0 (C) $\frac{1}{4\pi\varepsilon_0}\frac{\lambda}{4}$ (D) cannot be determined

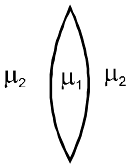
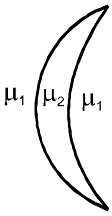
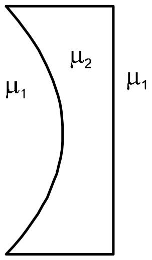
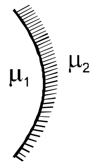
6. Then the direction of electric field at point P whose coordinates are (0m, $+\frac{R}{2}$m) is

(A) Along positive x-direction (B) Along negative x-direction
(C) Along negative y-direction (D) None of these

7. Then the dipole moment of the ring in C–m is

(A) $-(2\pi R^2\lambda)\,\hat{i}$ (B) $(2\pi R^2\lambda)\,\hat{i}$ (C) $-(4R^2\lambda)\,\hat{i}$ (D) $(4R^2\lambda)\,\hat{i}$

8. **Match the column :**

Column–I		**Column–II**
(A)	 If $\mu_2 > \mu_1$	(p) Optical power will be positive
(B)	 If $\mu_2 > \mu_1$	(q) Optical power will be negative
(C)	 If $\mu_2 < \mu_1$	(r) System will converge a parallel beam of light incident on it
(D)	 $\mu_1 = \mu_2$	(s) Focal length will be positive
		(t) Focal length will be negative

Answers Key

1. (A) **2.** (B) **3.** 8 **4.** x = 5

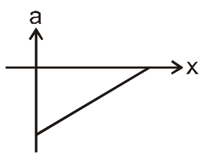
5. (B) **6.** (A) **7.** (C)

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

Hints & Solutions

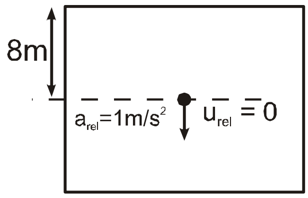
1. The linear relationship between V and x is
$V = -mx + C$ where m and C are positive constants.
$\therefore$ Acceleration

$$a = V\frac{dV}{dx} = -m(-mx + C)$$



$\therefore\ a = m^2x - mC$
Hence the graph relating a to x is.

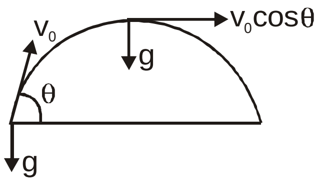
2. Relative to lift initial velocity and acceleration of coin are 0 m/s and 1 m/s² downward



$$\therefore\quad 2 = \frac{1}{2}(1)\ t^2 \quad \text{or} \quad t = 2 \text{ second}$$

3. $R_1 = \dfrac{v_0^2}{g\cos\theta}$

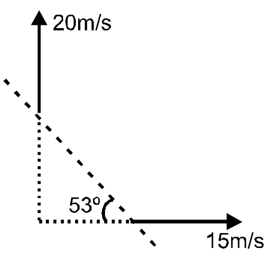
$R_2 = \dfrac{(v_0\cos\theta)^2}{g}$



$$\therefore\quad \frac{R_1}{R_2} = \frac{1}{(\cos\theta)^3} = 8$$

Ans. 8

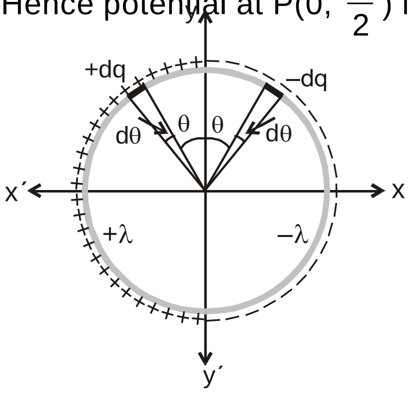
4.



$$f' = \left(\frac{334-9}{334+16}\right)700 = \frac{325}{350} \times 700 = 650 \text{ Hz.}$$

5. Consider two small elements of ring having charges +dq and – dq symmetrically located about y-axis. The potential due to this pair at any point on y-axis is zero. The sum of potential due to all such possible pairs is zero at all points on y-axis.

Hence potential at P(0, $\frac{R}{2}$) is zero.



6. Since all charge lies in x-y plane, hence direction of electric field at point P should be in x-y plane Also y-axis is an equipotential (zero potential) line. Hence direction of electric field at all point on y-axis should be normal to y-axis.
$\therefore$ The direction of electric field at P should be in x-y plane and normal to y-axis. Hence direction of electric field is along positive-x direction.

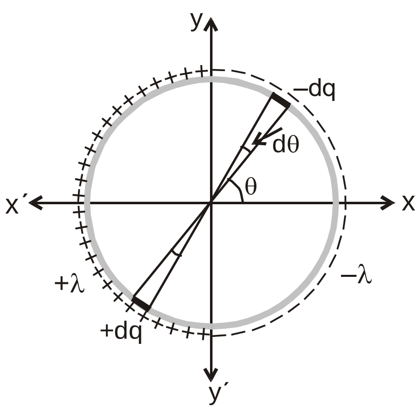
7. Consider two small elements of ring having charge +dq and –dq as shown in figure.
The pair constitutes a dipole of dipole moment.

$dp = dq\, 2R = (\lambda R d\theta)\, 2R$

The net dipole moment of system is vector sum of dipole moments of all such pairs of elementary charges.

By symmetry the resultant dipole moment is

along negative x-direction.



$\therefore$ net dipole moment

$$= -\int_{-\pi/2}^{+\pi/2} (dp\cos\theta)\ \hat{i} = -\int_{-\pi/2}^{+\pi/2} (2\lambda R^2 \cos\theta\, d\theta)\ \hat{i}$$

$$= -4R^2 \lambda \hat{i}$$

8. (A) $\frac{1}{f} = \underbrace{\left(\frac{n_\ell}{n_s} - 1\right)}_{-} \underbrace{\left(\frac{1}{R_1} - \frac{1}{R_2}\right)}_{+}$

$f = -ve$

$P = \frac{1}{f} = -ve$ q,t

(B) $\frac{1}{f} = \underbrace{\left(\frac{n_\ell}{n_s} - 1\right)}_{+} \underbrace{\left(\frac{1}{R_1} - \frac{1}{R_2}\right)}_{+}$

$f = +ve$

$P = \frac{1}{f} = +ve$ p,r,s

(C) $\frac{1}{f} = \underbrace{\left(\frac{n_\ell}{n_s} - 1\right)}_{-} \underbrace{\left(\frac{1}{R_1} - \frac{1}{R_2}\right)}_{-}$

$f = +$, $P = \frac{1}{f} = +ve$ p,r,s

(D) $f = \frac{R}{2}$

$P = \frac{1}{f} = -ve$ r,q,t