PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 16

Total Marks : 34

Max. Time : 38 min.

Topics : Projectile Motion, Rectilinear Motion

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.6	**(3 marks, 3 min.)**	**[18, 18]**
Subjective Questions ('–1' negative marking) Q.7 to Q.8	**(4 marks, 5 min.)**	**[8, 10]**
Match the Following (no negative marking) (2 × 4) Q.10	**(8 marks, 10 min.)**	**[8, 10]**

1. For ground to ground projectile motion equation of path is $y = 12x - 3/4\,x^2$. Given that $g = 10\ ms^{-2}$. What is the range of the projectile?

(A) 36m (B) 30.6 m (C) 16 m (D) 12.4 m

2. The vertical height of the projectile at time t is given by $y = 4t - t^2$ and the horizontal distance covered is given by $x = 3t$. What is the angle of projection with the horizontal?

(A) $\tan^{-1} 3/5$ (B) $\tan^{-1} 4/5$ (C) $\tan^{-1} 4/3$ (D) $\tan^{-1} 3/4$

3. A particle A is projected with speed V_A from a point making an angle 60° with the horizontal. At the same instant, second particle B (lie in the same horizontal plane) is thrown vertically upwards from a point directly below the maximum height point of parabolic path of A , with velocity V_B. If the two particles collide then the ratio of V_A/V_B should be ;

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

4. A car accelerates from rest at a constant rate α for some time after which it decelerates at a constant rate β to come to rest. If total time taken by car is t, then maximum velocity V will be :

(A) $V = t\dfrac{\alpha\beta}{\alpha-\beta}$ (B) $V = t\left(\dfrac{\beta^2}{\alpha-\beta}\right)$ (C) $V = t\left(\dfrac{\alpha^2}{\alpha+\beta}\right)$ (D) $V = t\left(\dfrac{\alpha\beta}{\alpha+\beta}\right)$

5. A lift is moving in upward direction with speed 20 m/s and having acceleration 5 m/s^2 in downward direction. A bolt drops from the ceiling of lift at that moment. Just after the drop, the :

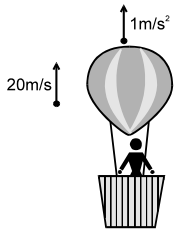
(A) velocity of bolt with respect to ground is zero

(B) velocity of bolt with respect to ground is 20 m/s in upward direction

(C) acceleration of bolt with respect to ground is 5 m/s^2

(D) none of these

6. A balloon is moving with constant upward acceleration of 1 m/s^2. A stone is thrown from the balloon downwards with speed 10 m/s with respect to the balloon. At the time of projection balloon is at height 120 m from the ground and is moving with speed 20 m/s upward. The time required to fall on the ground by the stone after the projection will be-



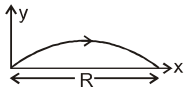
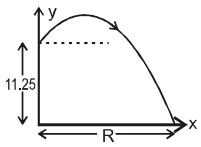
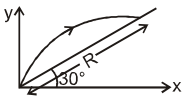
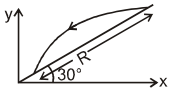
(A) 4 sec. (B) 5 sec.

(C) 6 sec. (D) None of these

7. A particle is projected under gravity at an angle of projection 45° with horizontal. Its horizontal range is 36 m. Find maximum Height attained by particle.

8. A bullet is fired with speed 50 m/s at 45° angle with horizontal. Find the height of the bullet when its direction of motion makes angle 30° with the horizontal.

9. In the column-I, the path of a projectile (initial velocity 10 m/s and angle of projection with horizontal 60° in all cases) is shown in different cases. Rangle 'R' is to be matched in each case from column-II. Take g = 10 m/s^2. Arrow on the trajectory indicates the direction of motion of projectile.

Column-I	**Column-II**
(A) 	(p) R = $\frac{15\sqrt{3}}{2}$ m
(B) 	(q) R = $\frac{40}{3}$m
(C) 	(r) R = $5\sqrt{3}$m
(D) 	(s) R = $\frac{20}{3}$m

Answers Key

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1. (C) **2.** (C) **3.** (B) **4.** (D) **5.** (B)
6. (C) **7.** 9

8. $h = \frac{125}{3}$ m above point of projection

9. (A) r (B) p (C) s (D) q

Hint & Solutions

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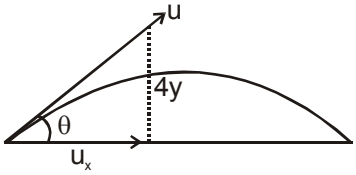
1. $y = x \tan\theta \left(1 - \frac{x}{R}\right)$ $y = (12\ x)\left(1 - \frac{x}{16}\right)$

$\Rightarrow$ Range = **16 m Ans.**

2.



$y = 4t - t^2$, $x = 3t$

$V_y = \frac{dy}{dt} = 4 - 2t$, $V_x = \frac{dx}{dt} = 3$

$\Rightarrow u_y = v_y\big|_{t=0} = 4,\ u_x = v_x\big|_{t=0} = 3$

The angle of projection :

$\tan\theta = \frac{V_y}{V_x} = \frac{4}{3} \Rightarrow \theta = \tan^{-1}\left(\frac{4}{3}\right)$ **Ans.**

3. $V_A \sin 60^\circ = V_B$

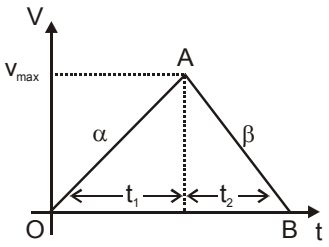
$\Rightarrow \frac{V_A}{V_B} = \frac{2}{\sqrt{3}}$

4. $t = t_1 + t_2$

slope of OA curve = $\tan\theta = \alpha = \frac{v_{max}}{t_1}$

slope of AB curve = $\beta = \frac{v_{max}}{t_2}$

$t = t_1 + t_2$



$$\Rightarrow t = \frac{v_{max}}{\alpha} + \frac{v_{max}}{\beta} \Rightarrow v_{max} = \left(\frac{\alpha\beta}{\alpha+\beta}\right) t$$

5. The velocity of an object released in a moving frame is equal to that of the frame as observed from the frame.

6. velocity of ball w.r.t. ground = 20 – 10 = 10 m/sec upwards.

$x = ut + \frac{1}{2} at^2$

$120 = -10t + \frac{1}{2} \times 10 t^2$

$24 = -2t + t^2$

$t^2 - 2t - 24 = 0$

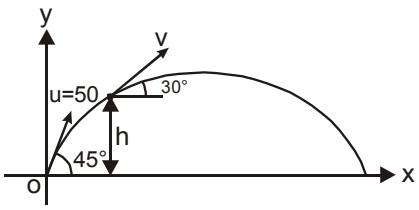
$t = 6$ sec.

7. $\frac{H}{R} = \frac{\tan\theta}{4}$

$\theta = 45°$ & $R = 36$ m

$H = 9$ m

8.



h = height of the point where velocity makes 30º with horizontal.

As the horizontal component of velocity remain same

$50\cos45° = v\cos30°$

$$v = 50\sqrt{\frac{2}{3}}$$

Now by equation

$$v^2 = u^2 + 2a_y y$$

$$\left(50\times\sqrt{\frac{2}{3}}\right)^2 = 50^2 - 2gxh$$

$$\Rightarrow 2gh = 50^2 - 50^2 \times \frac{2}{3}$$

$$\Rightarrow \quad 2gh = \frac{1}{3} \times 50^2$$

$$\Rightarrow \quad h \quad = \frac{2500}{60} = \frac{125}{3}$$

$$h = \frac{125}{3} \text{ m above point of projection}$$

9. (A) $R = \dfrac{u^2 \sin 2\theta}{g} = \dfrac{100\sqrt{3}}{2(10)} = 5\sqrt{3}\text{m}$

(B) $11.25 = -10\sin 60^\circ t + \dfrac{1}{2}(10)t^2$

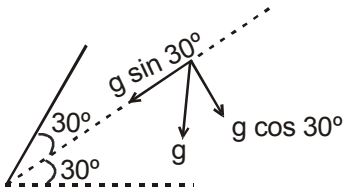
$$\Rightarrow \quad 5t^2 - 5\sqrt{3}\,t - 11.25 = 0$$

$$t = \frac{5\sqrt{3} \pm \sqrt{25(3) + 4(5)(11.25)}}{10}$$

$$= \frac{5\sqrt{3} \pm \sqrt{3}(10)}{10}$$

$$= \frac{15}{10}\sqrt{3} = \frac{3}{2}\sqrt{3}$$

$$R = 10 \cos 60 \left(\frac{3}{2}\sqrt{3}\right) = 7.5\sqrt{3} \text{ m}$$



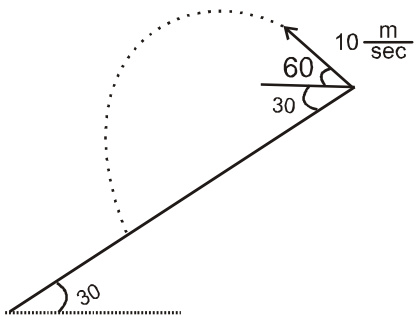
$$\text{(C) } t = \frac{2u\sin 30^\circ}{g\cos 30^\circ} = \frac{2(10)\left(\frac{1}{2}\right)}{10\left(\frac{\sqrt{3}}{2}\right)} = \frac{2}{\sqrt{3}} \text{ sec.}$$

$$R = 10 \cos 30^\circ t - \frac{1}{2} g \sin 30^\circ t^2$$

$$= \frac{10\sqrt{3}}{2}\left(\frac{2}{\sqrt{3}}\right) - \frac{1}{2}(10)\left(\frac{1}{2}\right)\frac{4}{3}$$

$$= 10 - \frac{10}{3} = \frac{20}{3} \text{ m}$$

$$\text{(D) } T = \frac{2(10)}{g\cos 30} = \frac{2(10)}{10\left(\frac{\sqrt{3}}{2}\right)} = \frac{4}{\sqrt{3}} \text{ sec.}$$



$$R = \frac{1}{2} g \sin 30^\circ t^2$$

$$= \frac{1}{2} (10) \left(\frac{1}{2}\right) \frac{16}{3} = \frac{40}{3} \text{m}$$