Oblique Projectile Motion

41. (c) $\frac{2u\sin\theta}{g} = 2sec \Rightarrow u\sin\theta = 10$

$\therefore H = \frac{u^2\sin^2\theta}{2g} = \frac{100}{2g} = 5m$

42. (b) Only horizontal component of velocity $(u\cos\theta)$.

43. (a) For complementary angles range is same.

44. (b) $T = \frac{2u\sin\theta}{g} = \frac{2\times 9.8\times \sin 30}{9.8} = 1s$

45. (a) $x = 36t \therefore v_x = \frac{dx}{dt} = 36m/s$

$y = 48t - 4.9t^2 \therefore v_y = 48 - 9.8t$

at $t = 0$ $v_x = 36$ and $v_y = 48m/s$

So, angle of projection $\theta = tan^{-1}\left(\frac{v_y}{v_x}\right) = tan^{-1}\left(\frac{4}{3}\right)$

Or $\theta = sin^{-1}(4/5)$

46. (b) For same range angle of projection should be θ and $90-\theta$

So, time of flights $t_1 = \frac{2u\sin\theta}{g}$ and

$$t_2 = \frac{2u\sin(90-\theta)}{g} = \frac{2u\cos\theta}{g}$$

By multiplying= $t_1t_2 = \frac{4u^2\sin\theta\cos\theta}{g^2}$

$t_1t_2 = \frac{2}{g}\frac{(u^2\sin 2\theta)}{g} = \frac{2R}{g} \Rightarrow t_1t_2 \propto R$

47. (c) Instantaneous velocity of rising mass after *t* sec will be $v_t = \sqrt{v_x^2 + v_y^2}$

where $v_x = v\cos\theta$ =Horizontal component of velocity

$v_y = v\sin\theta - gt$ =Vertical component of velocity

$$v_t = \sqrt{(v\cos\theta)^2 + (v\sin\theta - gt)^2}$$

$v_t = \sqrt{v^2 + g^2t^2 - 2v\sin\theta\, gt}$

48. (d) Maximum range= $\frac{u^2}{g} = 100m$

Maximum height= $\frac{u^2}{2g} = \frac{100}{2} = 50m$

49. (c) $R\frac{u^2}{g}_{max} \Rightarrow u = 10\sqrt{10} = 32m/s$

50. (c) Since horizontal component of velocity is constant, hence momentum is constant.

51. (a) Time of flight = $\frac{2u\sin\theta}{g} = \frac{2u_y}{g} = \frac{2\times u_{\text{vertical}}}{g}$

52. (a) Person will catch the ball if its velocity will be equal to horizontal component of velocity of the ball.

$\frac{v_0}{2} = v_0\cos\theta \Rightarrow \cos\theta = \frac{1}{2} \Rightarrow \theta = 60°$

53. (b) $H = \frac{u^2\sin^2\theta}{2g}$ and $T = \frac{2u\sin\theta}{g} \Rightarrow T^2 = \frac{4u^2\sin^2\theta}{g^2}$

$\therefore \frac{T^2}{H} = \frac{8}{g} \Rightarrow T = \sqrt{\frac{8H}{g}} = 2\sqrt{\frac{2H}{g}}$

54. (d) $R = 4H\cot\theta$, if $R = 4\sqrt{3}H$ then $\cot\theta = \sqrt{3} \Rightarrow \theta = 30°$

55. (c) The vertical component of velocity of projection $= -50\sin 30° = -25m/s$

If t be the time taken to reach the ground,

$h = ut + \frac{1}{2}gt^2 \Rightarrow 70 = -25t + \frac{1}{2}\times 10t^2$

$\Rightarrow 70 = -25t + 5t^2 \Rightarrow t^2 - 5t - 14 = 0 \Rightarrow$ t= – 2s and 7s

Since, t = – 2 s is not valid $\therefore$ t = 7 s

56. (c) $H_{max} = \frac{u^2 \sin^2 \theta}{2g}$

According to problem $\frac{u_1{}^2 \sin^2 45°}{2g} = \frac{u_2{}^2 \sin^2 60°}{2g}$

$\Rightarrow \frac{u_1{}^2}{u_2{}^2} = \frac{\sin^2 60°}{\sin^2 45°} \Rightarrow \frac{u_1}{u_2} = \frac{\sqrt{3}/2}{1/\sqrt{2}} = \sqrt{\frac{3}{2}}.$

57. (c)

58. (d) $R = 4H \cot \theta$, if $\theta = 45°$then $R = 4H \Rightarrow \frac{R}{H} = \frac{4}{1}$

59. (b) $R \frac{u^2}{g}{}_{max} = 400m \qquad (\text{For } \theta = 45°)$

$H \frac{u^2}{2g} \frac{400}{2}{}_{max} \qquad (\text{For } \theta = 90°)$