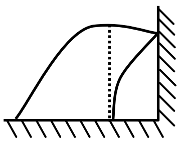
PHYSICS

Q.1 A stone is projected from a horizontal plane. It attains maximum height 'H' and strikes a stationary smooth wall and falls on the ground vertically below the maximum height. Assume the collision to be elastic, the height of the point on the wall where stone will strike is-



(A) H/2 (B) H/4
(C) 3H/4 (D) None of these **[C]**

Sol. $H = \frac{1}{2} g (2t)^2 = 2gt^2$ ···· (1)

$h = H - \frac{1}{2} gt^2$ ···· (2)

By (1) and (2)

$h = H - \frac{H}{4} = \frac{3H}{4}$

Q.2 A ball is projected with velocity u at an angle α with horizontal plane. Its speed when it makes an angle β with the horizontal is -

(A) $u \cos \alpha$ (B) $\frac{u}{\cos\beta}$

(C) $u \cos \alpha \ \cos \beta$ (D) $\frac{u\cos\alpha}{\cos\beta}$ **[D]**

Sol. $V \cos \beta = u \cos \alpha$

$V = \frac{u\cos\alpha}{\cos\beta}$

Q. 3 The range of a projectile when launched at an angle 15º with the horizontal is 1.5 km. What will be the range of that projectile when launched with the same velocity at an angle 45º to the horizontal ?

(A) 0.75 km (B) 1.5 km
(C) 3.0 km (D) 6.0 km **[C]**

Sol. At $\theta = 15^o$,

$R = \frac{u^2 \sin 30^o}{g} = 1.5$ km

$\Rightarrow \frac{u^2}{g} = 3$ km

AT $\theta = 45^o$, $R' = \frac{u^2 \sin 90^o}{g} = \frac{u^2}{g} = 3$ km

Q. 4 A projectile is fired at an angle of 30º to the horizontal such that the vertical component of its initial velocity is 80 m/s. Its time of flight is T. Its velocity at t = T/4 has a magnitude of nearly :

(A) 200 m/s (B) 300 m/s
(C) 140 m/s (D) 100 m/s **[C]**

Sol. $\frac{u_x}{u_y} = \cot 30^o = \sqrt{3} \ \therefore \ u_x = 80\sqrt{3}$ m/s

$T = \frac{2u_y}{g} \ \therefore \ T = 16$ s

At $t = \frac{T}{4} = 4$s, $v_x = 80\sqrt{3}$ m/s

$v_y = 80 - 10 \times 4 = 40$ m/s

$\therefore \ v = \sqrt{(80\sqrt{3})^2 + (40)^2} = 140$ m/s

Q.5 The range of projectile at an angle θ is equal to half of the maximum range if thrown at the same speed. The angle of projection θ is given by -

(A) 15º (B) 30º
(C) 60º (D) insufficient data **[A]**

Sol. $R_{max} = \frac{u^2}{g}$

$\frac{u^2 \sin_2 \theta}{g} = \frac{1}{2} \frac{u^2}{g}$

$\theta = 15^o$

Q.6 A projectile is thrown at angle β with vertical. It reaches a maximum height H. The time taken to reach highest point of its path is –

(A) $\sqrt{\frac{H}{g}}$ (B) $\sqrt{\frac{2H}{g}}$

(C) $\sqrt{\frac{H}{2g}}$ (D) $\sqrt{\frac{2H}{g\cos\beta}}$ **[B]**

Sol. $H = \frac{u^2 \cos^2 \beta}{2g} \Rightarrow u \cos \beta = \sqrt{2gH}$

$$t = \frac{u\cos\beta}{g} = \sqrt{\frac{2H}{g}}$$

Q.7 A stone thrown with the velocity V_0 = 14 m/s at an angle 45° to the horizontal, dropped to the ground at a distance 'S' from the point where it was thrown. From what height should the stone be thrown in horizontal direction with the same initial velocity so that it fall at the same spot -

(A) 14.2 m (B) 16.9 m

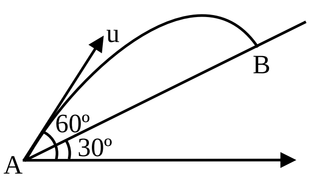
(C) 10.0 m (D) 9.6 m **[C]**

Sol. $$\frac{u^2 \sin 2\theta}{g} = u\sqrt{\frac{2h}{g}}$$

$$\frac{(14)^2 \sin 2(45)}{9.8} = 14\sqrt{\frac{2(h)}{9.8}}$$

h = 10 m

Q.8 Time taken by the projectile to reach from A to B is t. Then the distance AB is equal to :



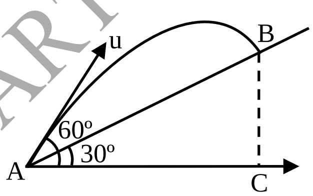
(A) $\frac{ut}{\sqrt{3}}$ (B) $\frac{\sqrt{3}ut}{2}$

(C) $\sqrt{3}$ ut (D) 2 ut **[A]**

Sol. Horizontal component of velocity

$$u_H = u\cos 60^o = \frac{u}{2}$$

$$\therefore\ AC = (u_H)t = \frac{ut}{2}$$



and AB = AC sec 30° $= \left(\frac{ut}{2}\right) = \left(\frac{2}{\sqrt{3}}\right) = \frac{ut}{\sqrt{3}}$ **]**

Q. 9 A circular disc of radius r = 5m is rotating in horizontal plane about y-axis. Y-axis is vertical axis passing through the centre of disc and x-z is the horizontal plane at ground. The height of disc above ground is h = 5 m. Small particles are ejecting from disc in horizontal direction with speed 12 m/s from the circumference of disc then the distance of these particles from origin when they hits the x-z plane is -

(A) 12 m (B) 13 m

(C) 5 m (D) None of these

[B]

Sol. [B] $R = u\sqrt{\frac{2h}{g}} = 12\sqrt{\frac{10}{10}} = 12$ m

$\therefore\ S = \sqrt{R^2 + r^2} = 13$ m

Q. 10 If T_1 and T_2 are the times of flight for two complementary angles, then the range of projectile R is given by -

(A) $R = 4g\,T_1T_2$ (B) $R = 2g\,T_1T_2$

(C) $R = \frac{1}{4}g\,T_1T_2$ (D) $R = \frac{1}{2}g\,T_1T_2$

[D]

Sol. For complimentary angles range is same

$$T_1 = \frac{2u\sin\theta}{g} \quad \text{and} \quad T_2 = \frac{2u\sin(90-\theta)}{g}$$

$$T_1T_2 = \frac{4u^2\sin\theta\cos\theta}{g^2}$$

$$\text{and } R = \frac{2u^2\sin\theta\cos\theta}{g}$$

$$\frac{R}{T_1T_2} = \frac{g}{2} \Rightarrow R = \frac{1}{2}g\,T_1T_2$$

Q.11 A person can throw a stone to a maximum distance of R meter. The greatest height to which he can throw the stone is -

(A) R/2 (B) R

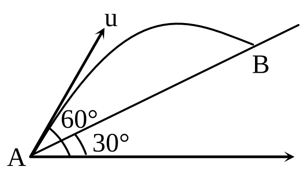
(C) 3R/2 (D) 2R **[A]**

Sol. $H_{max} = \frac{u^2}{2g}$ [θ = 90°]

but $\frac{u^2}{g} = R$

$\therefore\ H_{max} = \frac{R}{2}$

Q. 12 Time taken by the projectile to reach A to B is t. Then the distance AB is equal to –



(A) $\frac{ut}{\sqrt{3}}$ (B) $\frac{\sqrt{3}\,ut}{2}$

(C) $\sqrt{3}$ ut (D) 2 ut

Sol. **[A]**

Horizontal component of velocity

$u_H = u\cos 60° = \frac{u}{2}$

$\therefore$ AC = $(u_H)t = \frac{ut}{2}$

Q. 13 Two bullets are thrown simultaneously in the same vertical plane from same point with different speeds u_1 and u_2 at angles of projection θ_1 and θ_2 with horizontal such that $u_1\cos\theta_1 = u_2\cos\theta_2$ then the path followed by one as seen from other is a -

(A) vertical straight line

(B) horizontal straight line

(C) parabola

(D) any straight line

Sol. **[A]**

$\vec{V}_1 = u_1\cos\theta_1\,\hat{i} + (u_1\sin\theta_1 - gt)\,\hat{j}$

$\vec{V}_2 = u_2\cos\theta_2\,\hat{i} + (u_2\sin\theta_2 - gt)\,\hat{j}$

$\vec{V}_{rel.} = (u_1\cos\theta_1 - u_2\cos\theta_2)\,\hat{i} + (u_1\sin\theta_1 - u_2\sin\theta_2)\,\hat{j}$

as $u_1\cos\theta_1 = u_2\cos\theta_2$

given

$\vec{V}_{rel.} = (u_1\sin\theta_1 - u_2\sin\theta_2)\,\hat{j}$

Q.14 A stone is thrown form a cliff of height h in a given direction then the speed with which it hits ground -

(A) must depends on speed of projection

(B) must be larger than the speed of projection

(C) must be independent of angle of projection

(D) All of of above

Sol. **[D]**

$V = \sqrt{u^2 + 2gh}$

Q.15 It was calculated that a shell when fired from a gun with a certain velocity and at an angle of elevation $\frac{5\pi}{36}$ radians should strike a given target. In actual practice it was found that a hill just prevented in the trajectory. At what angle of elevation should the gun be fired to hit the target.

(A) $\frac{5\pi}{36}$ radians (B) $\frac{11\pi}{36}$ radians

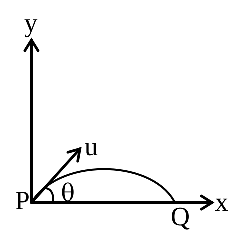
(C) $\frac{7\pi}{36}$ radians (D) $\frac{13\pi}{36}$ radians

Sol. **[D]**

For two angles of projection ranges are same.

i.e. for $\alpha + \beta = \frac{\pi}{2}$

Q.16 Average torque on a projectile of mass m, initial speed u and angle of projection θ between initial and final positions P and Q as shown in figure about the point of projection is –



(A) $\frac{mu^2\sin 2\theta}{2}$ (B) $mu^2\cos\theta$

(C) $mu^2\sin\theta$ (D) $\frac{mu^2\cos\theta}{2}$

Sol. **[A]**

$L_i = 0$, $L_f = m \times u\sin\theta \times R$

$\therefore \Delta L = L_f$

Now,

$$\tau_{av} = \frac{\Delta L}{\Delta t} = \frac{L_f}{T} = \frac{mu\sin\theta R}{\frac{2u\sin\theta}{g}} = \frac{mu^2\sin 2\theta}{2}$$

Q.17 A projectile thrown with initial velocity $(a\hat{i} + b\hat{j})$ and its range is twice the maximum height attained by it then -

(A) $b = \frac{a}{2}$

(B) b = a

(C) b = 2a

(D) b = 4a

Sol. **[C]**

$\tan\theta = \frac{b}{a} = \frac{4H}{R}$

Q.18 A body is thrown with speed of 30 m/s at angle 30º with horizontal from a perfectly inelastic horizontal floor. The time after which it is moving perpendicular to its initial direction of motion is -

(A) 6 sec. (B) 3 sec.

(C) 1.5 sec. (D) never

Sol. **[D]**

As $\theta < 45°$ body never moves perpendicular to its initial direction of motion.

Q.19 A body is thrown from a point with speed 50 m/s at an angle 37º with horizontal. When it has moved a horizontal distance of 80 m then its distance from point of projection is -

(A) 40 m (B) $40\sqrt{2}$ m

(C) $40\sqrt{5}$ m (D) None

Sol. **[C]**

As $y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta}$

$y = 80 \times \frac{3}{4} - \frac{10\times80\times80\times25}{2\times50\times50\times16} = 40$ m

$\therefore$ distance from point of projection

$= \sqrt{(80)^2 + (40)^2}$ m

Q.20 A hunter aims his gun and fires a bullet directly at a monkey on a tree. At the instant bullet leaves the gun, monkey drops, the bullet -

(A) hits the monkey

(B) misses to hit the monkey

(C) can not be said

(D) None of these **[A]**

Q.21 Two projectile thrown from the same point at angles 60° and 30° with the horizontal attain the same height. The ratio of their initial velocities is -

(A) 1 (B) 2

(C) $\sqrt{3}$ (D) $\frac{1}{\sqrt{3}}$ **[D]**

Sol. $\frac{u_1^2\sin^2\theta_1}{2g} = \frac{u_2^2\sin^2\theta_2}{2g}$

$u_1\sin\theta_1 = u_2\sin\theta_2$

$\frac{u_1}{u_2} = \frac{\sin 30°}{\sin 60°} = \frac{1}{\sqrt{3}}$

Q.22 Two stones are projected with the same speed but making different angles with the horizontal. Their ranges are equal. If the angle of projection of one is $\pi/3$ and its maximum height is y_1 then the maximum height of the other will be –

(A) $3y_1$ (B) $2y_1$

(C) $y_1/2$ (D) $y_1/3$ **[D]**

Sol. For same range θ and $90 - \theta$ are angles of projection. 60º and 30º

$y_1 = \frac{u^2\sin^2 60}{2g}$ and $y_2 = \frac{u^2\sin^2 30}{2g}$

$\frac{y_2}{y_1} = \frac{1}{3} \Rightarrow y_2 = \frac{y_1}{3}$

Q.23 A body is projected horizontally with speed 20 m/s. What will be its speed nearly after 5 sec ?

(A) 54 m/s (B) 20 m/s

(C) 50 m/s (D) 70 m/s

Sol. **[A]**

$v_x = u = 20$ m/s

$v_y = u_y + gt = 0 + 10 \times 5 = 50$ m/s

$v = \sqrt{u_x^2 + u_y^2} = \sqrt{(20)^2 + (50)^2}$

Q.24 A particle projected with the speed u at an angle α with the horizontal acquires a velocity v when it is at an angle β with the horizontal. Then -

(A) $v = \dfrac{u}{\cos\beta}$ (B) $v = u\cos\beta$

(C) $v = \dfrac{u\cos\beta}{\cos\alpha}$ (D) $v = \dfrac{u\cos\alpha}{\cos\beta}$ **[D]**

Sol. $v\cos\beta = u\cos\alpha$

$v = \dfrac{u\cos\alpha}{\cos\beta}$

Q.25 The ceiling of a tunnel is of 5m high. What is the maximum horizontal distance that a ball thrown with a speed of 20 m/s, can go without hitting the ceiling of the tunnel ? (Take g = 10 m/s^2)

(A) 30 m (B) 40 m

(C) $30\sqrt{2}$ m (D) $20\sqrt{3}$ m **[D]**

Sol. $\because \quad \dfrac{u^2\sin^2\theta}{2g} = 5$ m

$\Rightarrow \quad \dfrac{(20)^2\sin^2\theta}{20} = 5$

$\Rightarrow \quad \sin\theta = \dfrac{1}{2} \qquad \Rightarrow \quad \theta = 30^\circ$

$\therefore \quad R = \dfrac{u^2\sin 2\theta}{g} = \dfrac{(20)^2\sin 60^\circ}{10} = 20\sqrt{3}$

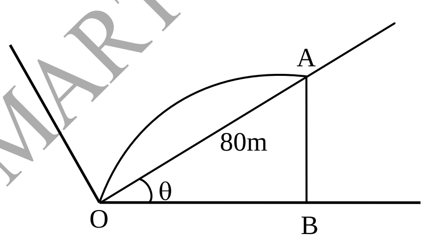
Q.26 A particle is projected up the inclined such that its component of velocity along the incline is 20 m/s. Time of flight is 4 sec. Horizontal displacement of the particle in 4 sec is 64 m. The angle made by the incline with the horizontal is –

(A) 30º (B) 37º

(C) 53º (D) Data is insufficient

[B]

Sol.



OA = 20 m/s × 4 s = 80 m

OB = 64 m

$\cos\theta = \dfrac{OB}{OA} = \dfrac{64}{80} = \dfrac{4}{5}$

$\theta = 37^\circ$

Q.27 During a projectile motion if the maximum height equals the horizontal range, then the angle of projection with the horizontal is:

(A) $\tan^{-1}(1)$ (B) $\tan^{-1}(2)$

(C) $\tan^{-1}(3)$ (D) $\tan^{-1}(4)$

Sol. **[D]** Given that

H = R

i.e. $\dfrac{u_y^2}{2g} = \dfrac{2.u_x u_y}{g}$

or $\dfrac{u_y}{u_x} = 4$ or $\tan\theta = 4$ or $\theta = \tan^{-1}(4)$

Q.28 Ratio of minimum kinetic energies of two projectiles of same mass is 4 : 1. The ratio of the maximum height attained by them is also 4 : 1. The ratio of their ranges would be:

(A) 16 : 1 (B) 4 : 1

(C) 8 : 1 (D) 2 : 1

Sol. **[B]** $\dfrac{\frac{1}{2}mu_1^2\cos^2\theta_1}{\frac{1}{2}mu_2^2\cos^2\theta_2} = \dfrac{4}{1}$

$\Rightarrow \dfrac{u_1\cos\theta_1}{u_2\cos\theta_2} = 2 \qquad \ldots(1)$

and $\dfrac{u_1^2\sin^2\theta_1}{u_2^2\sin^2\theta_2} = \dfrac{4}{1}$

or $\dfrac{u_1\sin\theta_1}{u_2\sin\theta_2} = \dfrac{2}{1} \qquad \ldots(2)$

from equation no. (1) and (2)

$\dfrac{u_1\sin\theta_1.u_1\cos\theta_1}{u_2\sin\theta_2.u_2\cos\theta_2} = \dfrac{4}{1}$

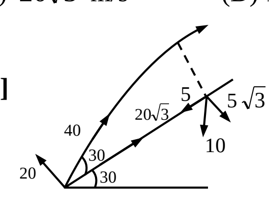
$\dfrac{gR_1/2}{gR_2/2} = \dfrac{4}{1} \qquad \Rightarrow \dfrac{R_1}{R_2} = \dfrac{4}{1}$

Q.29 A particle is projected from the bottom of an inclined plane & inclination 30° (with the horizontal) with speed 40 m/s at an angle 60° with the horizontal. The speed of the particle when its velocity vector is parallel to inclined plane is (g = 10 m/s^2)

(A) $\dfrac{40}{\sqrt{3}}$ m/s (B) 20 m/s

(C) $20\sqrt{3}$ m/s (D) 10 m/s

Sol. **[A]**



$V_y = u_y + a_y t$ or $0 = 20 - 5\sqrt{3}\,t$ or $t = 4/\sqrt{3}$

$V_x = u_x + a_xt$ =

$20\sqrt{3} - 5\times\frac{4}{\sqrt{3}} = \frac{40}{\sqrt{3}}$ m/s

Q.30 A projectile is thrown with an initial velocity of $(v_x\hat{i} + v_y\hat{j})$ m s^{-1}. If the range of the projectile is double the maximum height, then v_y =

(A) v_x (B) $2v_x$

(C) $3v_x$ (D) $4v_x$ **[B]**

Sol. $\tan\theta = \frac{v_y}{v_x}$ …..(1)

R = 2 H

$\tan\theta = 2$ …...(2)

$\frac{v_y}{v_x} = 2 \Rightarrow v_y = 2v_x$

Q.31 A ball is thrown from ground level so as to just clear a wall 4 meters high at a distance of 4 meters and falls at a distance of 14 meters from the wall, then the magnitude of the velocity of the ball is –

(A) $\sqrt{281}$ m/sec (B) $\sqrt{812}$ m/sec

(C) $\sqrt{182}$ m /sec (D) None of the above

[C]

Q.32 Two stones are projected with the same speed but making different angles with the horizontal. Their ranges are equal. If the angle of projection of one is $\pi/3$ and its maximum height is y_1 then the maximum height of the other will be –

(A) $3y_1$ (B) $2y_1$

(C) $y_1/2$ (D) $y_1/3$ **[D]**

Q.33 An object is thrown at an angle α to the horizontal ($0^\circ < \alpha < 90^\circ$) with a velocity . Then during ascent (ignoring air drag) the acceleration –

(A) With which the object moves is $\vec{g}$ at all points

(B) Tangential to the path decreases

(C) Normal to the path increases, becoming equal to g at the highest point

(D) All of the above **[A]**

Q.34 A shell is fired from a cannon at a velocity of 300 m/s to hit a target 3km away. At what angle above the horizontal should the cannon be aimed –

(A) Nearly 9.5º (B) Nearly 19º

(C) Nearly(1/3)º (D) Nearly(1/6)º **[A]**

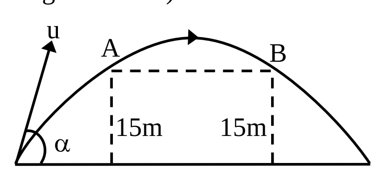
Q.35 A projectile is thrown with a velocity of 20 m/s, at an angle of 60º with the horizontal. After how much time the velocity vector will make an angle of 45º with the horizontal –

(take $g = 10 m/s^2$)

(A) $\sqrt{3}$ sec (B) $1/\sqrt{3}$ sec

(C) ($\sqrt{3}$ + 1) sec (D) ($\sqrt{3}$ – 1) sec **[D]**

Q.36 A golfer standing on level ground hits a ball with a velocity of u = 52 m/s at an angle α above the horizontal. If $\tan\alpha = 5/12$, then the time for which the ball is at least 15m above the ground (i.e. between A and B) will be (take $g = 10 m/s^2$) –



(A) 1 sec (B) 2 sec (C) 3 sec (D) 4 sec

[B]

Q.37 Two balls are projected from the same point in direction inclined at 60º and 30º to the horizontal. If they attain the same maximum height, what is the ratio of their velocities of projection ?

(A) $1 : \sqrt{3}$ (B) $\sqrt{3} : 1$

(C) 1 : 1 (D) 1 : 2 **[A]**

Q.38 An aeroplane is flying horizontally with a velocity of 720 km/h at an altitude of 490 m.

When it is just vertically above the target a bomb is dropped from it. How far horizontally it missed the target ?

(A) 1000 m (B) 2000 m

(C) 100 m (D) 200 m **[B]**

Q.39 An aeroplane is moving with a horizontal velocity u at a height h above the ground, if a packet is dropped from it; the speed of the packet when it reaches the ground will be –

(A) $\sqrt{u^2+2gh}$ (B) $\sqrt{2gh}$

(C) $\sqrt{u^2-2gh}$ (D) 2gh **[A]**

Q.40 From the top of a tower of height h a body of mass m is projected in the horizontal direction with a velocity v, it falls on the ground at a distance x from the tower. If a body of mass 2m is projected from the top of another tower of height 2h in the horizontal direction so that it falls on the ground at a distance 2x from the tower, the horizontal velocity of the second body is -

(A) 2v (B) $\sqrt{2}$ V

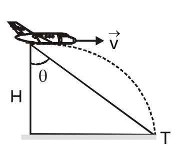
(C) $\frac{V}{2}$ (D) $\frac{V}{\sqrt{2}}$ **[B]**

Q.41 A stone is thrown from a bridge at an angle of 30º down with the horizontal with a velocity of 25 m/s if the stone strikes the water after 2.5 sec then calculate the height of the bridge from the water surface –

(A) 61.9 m (B) 35 m

(C) 70 m (D) None **[A]**

Q.42 A bomber is moving with a velocity v (m/s) above H meter from the ground. The bomber releases a bomb to hit a target T when the sighting angle is θ. Then the relation between θ, H and v is –

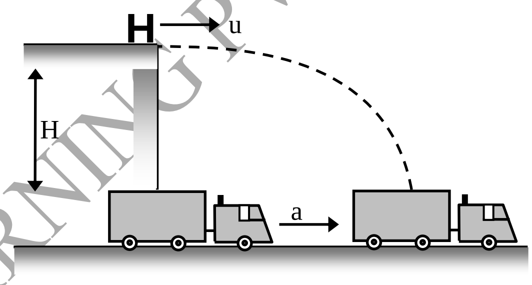


(A) $\theta = \tan^{-1} v\sqrt{2Hg}$ (B) $\theta = \tan^{-1} v\sqrt{2/gH}$

(C) $\theta = \tan^{-1} v\sqrt{H/2g}$ (D) None of the above

[B]

Q.43 A stunt performer is to run and dive off a tall platform and land in a net in the back of a truck below. Originally the truck is directly under the platform, it starts forward with a constant acceleration a at the same instant the performer leaves the platform. If the platform is H above the net in the truck, then the horizontal velocity u that the performer must have as he leaves the platform is –



(A) $a\sqrt{2H/g}$ (B) $a\sqrt{H/2g}$

(C) $\sqrt{g/2H}$ (D) None of these **[B]**

Q.44 A shell is fired from a gun from the bottom of a hill along its slope. The slope of the hill is α = 30º, and the angle of the barrel to the horizontal β = 60º. The initial velocity v of the shell is 21 m/sec. Then distance of point from the gun at which shell will fall –

(A) 10 m (B) 20 m

(C) 30 m (D) 40 m **[C]**

Q.45 An aircraft drives towards a stationary target which is at sea level and when it is at a height of 1390m above sea level it launches a missile towards the target. The initial velocity of the missile is 410 m/s in a direction making an angle θ below the horizontal where tanθ = 9/40. Then the time of flight of the missile from the instant it was launched until it reaches sea level is nearly –

(A) 10 sec (B) 15 sec

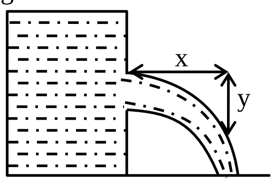
(C) 20 sec (D) 25 sec **[A]**

Q.46 A bomber is flying horizontally with a constant speed of 150 m/s at a height of 78.4m. The pilot has to drop a bomb at the enemy target. At what horizontal distance from the target should he release the bomb -

(A) Zero (B) 300 m

(C) 600 m (D) 750 m **[C]**

Q.47 A jet of water is issued horizontal from a small vertical opening of a tank. If a point on the centre line of the jet is at a horizontal distance x and at a depth 'y' below the centre of the opening, find the velocity of the jet through the opening ?



(A) $x\sqrt{\frac{g}{2y}}$ (B) 2gy (C) $\sqrt{\frac{xg}{2y}}$ (D) $\frac{xg}{\sqrt{2y}}$

[A]

Q.48 To an observer moving along East, the wind appears to blow from North. If he doubles his speed , the air would appear to come from -

(A) North (B) East

(C) North-East (D) North-West **[C]**

Q.49 A car A is going north-east at 80km/hr. and another car B is going south-east at 60km/hr. Then the direction of the velocity of A relative to B makes with the north an angle α such that $\tan\alpha$ is –

(A) 1/7 (B) 3/4

(C) 4/3 (D) 3/5 **[A]**

Q.50 A boat man could row his boat with a speed 10m/sec. He wants to take his boat from P to a point Q just opposite on the other bank of the river flowing at a speed 4m/sec. He should row his boat –

(A) at right angle to the stream

(B) at an angle of $\sin^{-1}$ (2/5) with PQ up the stream

(C) at an angle of $\sin^{-1}$ (2/5) with PQ down the stream

(D) at an angle $\cos^{-1}$ (2/5) with PQ down the stream **[B]**