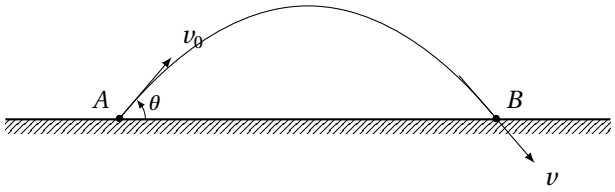
Module-Test-4
(Physics)

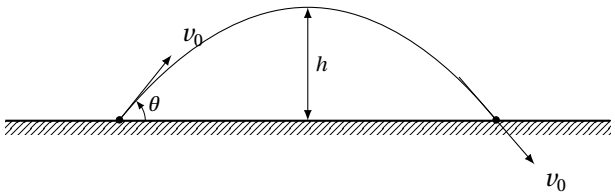
January 1, 2023

1. The velocity of a projectile at the initial point A is $(2\hat{i}+3\hat{j})\,\mathrm{m\,s^{-1}}$. Its velocity (in $\mathrm{m\,s^{-1}}$) at point B is



a) $-2\hat{i}-3\hat{j}$
b) $-2\hat{i}+3\hat{j}$
c) $2\hat{i}-3\hat{j}$ *Ans.*
d) $2\hat{i}+3\hat{j}$

2. A body is projected with an angle θ. The maximum height reached is h. If the time of flight is 4 s and $g = 10\,\mathrm{m\,s^{-2}}$, then value of h is



a) 40 m
b) 20 m *Ans.*
c) 5 m
d) 10 m

3. The velocity vector of the motion described by the position vector of a particle $\vec{r} = 2t\,\hat{i} + t^2\,\hat{j}$ is given by

a) $\vec{v} = 2\hat{i} + 2t\,\hat{j}$ *Ans.*
b) $\vec{v} = 2t\,\hat{i} + 2t\,\hat{j}$
c) $\vec{v} = t\,\hat{i} + t^2\,\hat{j}$
d) $\vec{v} = 2\hat{i} + t^2\,\hat{j}$

4. What is the range of a projectile thrown with velocity $98\,\mathrm{m\,s^{-1}}$ with angle 30° from horizontal ?

a) $490\sqrt{3}$ m *Ans.*
b) $245\sqrt{3}$ m
c) $980\sqrt{3}$ m
d) 100 m

5. Two bullets are fired horizontally and simultaneously towards each other from roof tops of two buildings 100 m apart and of same height of 200 m with the same velocity of $25\,\mathrm{m\,s^{-1}}$. When and where will the two bullets collides? (Take, $g = 10\,\mathrm{m\,s^{-2}}$)

a) After 2 s at a height of 180 m *Ans.*
b) After 2 s at a height of 180 m *Ans.*
c) After 4 s at a height of 120 m
d) They will not collide

6. The quantity $\int_{t_1}^{t_2} \vec{V}\,dt$ represents :

a) Distance travelled during t_1 to t_2
b) Displacement during t_1 to t_2 *Ans.*
c) Average acceleration during t_1 to t_2
d) None of these

7. An open lift is coming down from the top of a building at a constant speed $v = 10 m/s$. A boy standing on the lift throws a stone vertically upwards at a speed of $30 m/s$ w.r.t. himself. The time after which he will catch the stone is :

   a) $4s$
   b) $6s$ *Ans.*
   c) $8s$
   d) $10s$

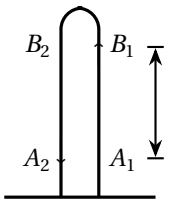
8. A body is thrown up from a lift with velocity u relative to lift. If its time of flight with respect to lift is t then acceleration of the lift is :

   a) $\frac{(u-gt)}{t}$ upwards
   b) $\frac{(u-gt)}{t}$ downwards
   c) $\frac{(2u-gt)}{t}$ upwards *Ans.*
   d) $\frac{(2u-gt)}{t}$ downwards

9. The motion of a body falling from rest in a resisting medium is described by the equation $\frac{dv}{dt} = A - Bv$, where A and B are constants. Then :

   a) maximum possible velocity is $\frac{A}{B} m/s$ *Ans.*
   b) initial acceleration is Am/s^2 *Ans.*
   c) velocity at any time t is $v = \frac{A}{B}(1 - e^{-Bt})$ *Ans.*
   d) velocity at any time t is $v = \frac{A}{B}(1 - e^{-At})$

10. The acceleration of gravity can be measured by projecting a body upward and measuring the time that it takes to pass two given lines in both directions (upward motion and downward motion). If the time the body takes to pass a horizontal line A in both direction (from A_1 to A_2) is T_A, and the time to go by a second line B in both directions is (from B_1 to B_2) T_B, then assuming that the acceleration due to gravity to be constant, its value is :

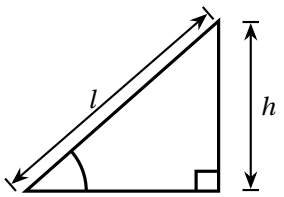


   a) $\frac{8h}{T_A^2 - T_B^2}$ *Ans.*
   b) $\frac{8h}{T_A^2 + T_B^2}$
   c) $\frac{8h}{T_A^2 T_B^2}$
   d) $\frac{8h T_A T_B}{T_A^2 T_B^2}$

11. A particle is projected vertically upwards in absence of air resistance with a velocity u from a point O. When it returns to the point of projection :

   a) its average velocity is zero *Ans.*
   b) its displacement is zero *Ans.*
   c) its average speed is $u/2$ *Ans.*
   d) its average speed is u

12. A smooth inclined plane is inclined at an angle θ with the horizontal. A body starts from rest and slides down the inclined surface. The time taken by the body to reach the bottom is :

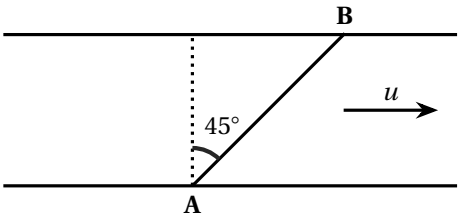


   a) $\sqrt{\frac{2h}{g}}$
   b) $\sqrt{\frac{2l}{g}}$
   c) $\frac{1}{\sin\theta}\sqrt{\frac{2h}{g}}$ *Ans.*
   d) $\sqrt{\frac{2l}{g \sin\theta}}$ *Ans.*

13. A man can row a boat $4\,\text{km}\,\text{h}^{-1}$ in still water. If he is crossing a river of width 4 km where the current is $2\,\text{km}\,\text{h}^{-1}$, and he wants to cross the river in shortest time. What would be the drift of the boat after reaching the other side of the river?

a) 2 km *Ans.*
b) 4 km
c) 6 km
d) 8 km

14. A man wants to reach point B on the opposite bank of a river flowing at a speed u as shown in the figure. What minimum speed relative to water should the man have so that he can reach point B? In which direction should he swim?

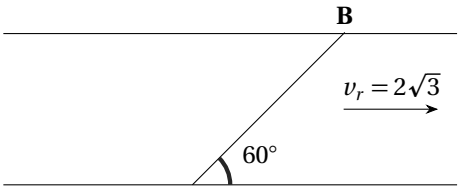


a) $v = \frac{u}{\sqrt{3}}$ at $\theta = 45°$
b) $v = \frac{u}{\sqrt{5}}$ at $\theta = 45°$
c) $v = \frac{u}{\sqrt{2}}$ at $\theta = 45°$ *Ans.*
d) None of these

15. If a boat can have a speed of $4km/h$ in still water, for what values of speed of river flow, it can be managed to row the boat right across the river, without any drift?

a) $\geq 4km/h$
b) > 0 but $< 4km/h$
c) Only $4km/h$
d) None of these *Ans.*

16. A river is flowing with the velocity of $2\sqrt{3}m/s$. A boat has to move from A to B. Find the minimum velocity of boat in still water.



a) $3\,\text{m}\,\text{s}^{-1}$ *Ans.*
b) $4\,\text{m}\,\text{s}^{-1}$
c) $5\,\text{m}\,\text{s}^{-1}$
d) None of these

17. A boat is moving with velocity of $3\hat{i}+4\hat{j}$ in river and water is moving with a velocity of $-3\hat{i}-4\hat{j}$ with respect to ground. Relative velocity of boat with respect to water is

a) $-6\hat{i}-8\hat{j}$
b) $6\hat{i}+8\hat{j}$ *Ans.*
c) $8\hat{i}$
d) $6\hat{i}$

18. If R is the range of a projectile on a horizontal plane and h its maximum height, then maximum horizontal range with the same speed of projection is :

a) $2h$
b) $\frac{R^2}{8h}$
c) $2R+\frac{h^2}{8R}$
d) $2h+\frac{R^2}{8h}$ *Ans.*

19. An object is thrown horizontally from a tower H meter high with a velocity of $\sqrt{2gH}\,m/s$. Its speed on striking the ground will be :

a) $\sqrt{2gH}$
b) $\sqrt{6gH}$
c) $2\sqrt{gH}$ *Ans.*
d) $2\sqrt{2gH}$

20. Two bullets are fired at angles θ and $90^\circ - \theta$, the ratio of their time of flights is:

a) $1:1$
b) $\tan\theta : 1$ *Ans.*
c) $1:\tan\theta$
d) $\tan^2\theta : 1$

21. A particle is projected from a point O with a velocity u in a direction making an angle α upward with the horizontal. At P it is moving at right angles to its initial direction. Its velocity at P is :

a) $u\tan\alpha$
b) $u\cot\alpha$ *Ans.*
c) $u\alpha$
d) $u\sec\alpha$

22. Suppose a player hits several baseballs. Which baseballs will be in the air for the longest time?

a) The one with the farthest range.
b) The one which reaches maximum height. *Ans.*
c) The one with the greatest initial velocity.
d) The one leaving the bat at 45° with respect to the ground.

23. The velocity at the maximum height of a projectile is half of its initial velocity of projection. If magnitude of initial velocity is u, its range on the horizontal plane is :

a) $\dfrac{\sqrt{3}u^2}{2g}$ *Ans.*
b) $\dfrac{u^2}{2g}$
c) $\dfrac{3u^2}{2g}$
d) $\dfrac{3u^2}{g}$

24. A projectile is fired with a velocity u making an angle θ with the horizontal. What is the magnitude of change in velocity when it is at the highest point?

a) $u\cos\theta$
b) u
c) $u\sin\theta$ *Ans.*
d) $u\cos\theta - u$

25. A point moves in a straight line, so that its displacement x at time t is given by $x^2 = t^2 + 1$. Its acceleration is

a) $\dfrac{1}{x}$
b) $\dfrac{1}{x^3}$ *Ans.*
c) $-\dfrac{1}{x^2}$
d) $-\dfrac{1}{x^3}$

26. A point initially at rest moves along X-axis. Its acceleration varies with time as $a = (6t+5)\,\mathrm{m\,s^{-2}}$. If it starts from origin, then the distance covered in 2 s is

a) 20 m
b) 18 m *Ans.*
c) 16 m
d) 25 m

27. A particle moves along a straight line. Its position at any instant is given by $x = 32t - \dfrac{8t^3}{4}$, where x is in metre and t is in second. Find the acceleration of the particle at the instant when particle is at rest.

a) $-16\,\mathrm{m\,s^{-2}}$
b) $-27.6\,\mathrm{m\,s^{-2}}$ *Ans.*
c) $32\,\mathrm{m\,s^{-2}}$
d) $16\,\mathrm{m\,s^{-2}}$

28. The displacement of a particle is given by $x = (t-2)^2$, where x is in metre and t in second. The distance covered by the particle in first 4 seconds is

a) 4 m
b) 8 m *Ans.*
c) 12 m
d) 16 m

29. The position x of a particle with respect to time t along X-axis is given by $x = 9t^2 - t^3$, where x is in metres and t in second. What will be the position of this particle when it achieves maximum speed along the positive x-direction ?

a) 24 m
b) 32 m
c) 54 m *Ans.*
d) 81 m

30. It is possible to project a particle on a level ground with a given velocity in 2 possible ways so as to have the same range R. The product of the corresponding times of flight is then :

a) $\frac{R}{g}$
b) $\frac{2R}{g}$ *Ans.*
c) $\frac{R}{2g}$
d) None of these

31. A particle is projected vertically upwards from a point A on the ground. It takes time t_1 to reach a point B, but it still continues to move up. If it takes further t_2 time to reach the ground from point B. Then height of point B from the ground is

a) $\frac{1}{2}g(t_1+t_2)^2$
b) $g\,t_1\,t_2$
c) $\frac{1}{8}g(t_1+t_2)^2$
d) $\frac{1}{2}g\,t_1\,t_2$ *Ans.*

32. A very broad elevator is going up vertically with a constant acceleration of $2m/s^2$. At the instant when its velocity is $4m/s$ a ball is projected from the floor of the lift with a speed of $4m/s$ relative to the floor at an elevation of 30°. The time taken by the ball to return the floor is

a) $\frac{1}{2}s$
b) $\frac{1}{3}s$ *Ans.*
c) $\frac{1}{4}s$
d) $1s$

33. A body freely falling from the rest has a velocity v after it falls through a height h. The distance it has to fall down for its velocity to become double, is

a) $2h$
b) $4h$ *Ans.*
c) $6h$
d) $8h$

34. A ball is thrown vertically upwards from the ground. It crosses a point at the height of $25m$ twice at an interval of $4s$. The ball was thrown with the velocity of :

a) $20m/s$
b) $25m/s$
c) $30m/s$ *Ans.*
d) $35m/s$

35. A man in a balloon rising vertically with an acceleration of $4.9m/s^2$ releases a ball $2s$ after the balloon is let go from the ground. The greatest height above the ground reached by the ball is ($g = 9.8m/s^2$)

a) $14.7m$ *Ans.*
b) $19.6m$
c) $9.8m$
d) $24.5m$

Section-B

1. A particle is projected with velocity $20m/s$, so that it just clears two walls of equal height $10m$, which are at a distance $20m$ from each other. The time of passing between the walls is :

(a) $2s$ *Ans.* (b) $2\sqrt{10}s$ (c) $10\sqrt{2}s$ (d) $1/2s$

2. A food packet is dropped from the plane moving horizontally with velocity $50ms^{-1}$ and at a height of $500m$. Find the angle with horizontal which the velocity vector makes at the time when it reaches the ground. Neglect air resistance.

(a) $\tan^{-1}(-2)$ *Ans.* (b) $\tan^{-1}(1/2)$ (c) $-45°$ (d) $53°$

3. A rescue plane is flying horizontally at a speed of $30m/s$ and at an altitude of $125m$ when it drops a warning flare. Neglecting air resistance and assuming that the plane doesn't change its course, speed, altitude, how far from the plane is the flare when it hits the ground?

(a) $146m$ (b) $195m$ (c) $125m$ (d) $150m$ *Ans.*

4. Two particles are simultaneously projected in opposite directions horizontally from a given point in space where gravity 'g' is uniform. If u_1 and u_2 be their initial speeds then the time t after which their velocities are mutually perpendicular is given by :

(a) $\dfrac{\sqrt{u_1 u_2}}{g}$ *Ans.* (b) $\dfrac{\sqrt{u_1^2 u_2^2}}{g}$ (c) $\dfrac{\sqrt{u_1(u_1+u_2)}}{g}$ (d) $\dfrac{\sqrt{u_2(u_1+u_2)}}{g}$

5. A ball is projected from a point at two different angles with same speed u and land at same point in both the cases :

(a) the difference between two angles of projection is 90°

(b) the maximum height attained by the ball in both the cases is equal

(c) the sum of maximum heights for the two cases is $u^2/(2g)$ *Ans.*

(d) the maximum height attained by the ball in one case must be twice of the maximum height attained by the ball in second case

6. An arrow is shot into air. Its range is 200 m and its time of flight is 5 s. If $g = 10\,\mathrm{m\,s^{-2}}$, then horizontal component of velocity and the maximum height will be respectively

a) $20\,\mathrm{m\,s^{-1}}$, 62.50 m b) $40\,\mathrm{m\,s^{-1}}$, 31.25 m *Ans.*

c) $80\,\mathrm{m\,s^{-1}}$, 62.5 m d) None of these

7. A body is projected from the ground with a velocity $\vec{v} = (3\hat{i} + 10\hat{j})\,\mathrm{m\,s^{-1}}$. The maximum height attained and the range of the body respectively are (Take, $g = 10\,\mathrm{m\,s^{-2}}$)

a) 5 m and 6 m *Ans.* b) 3 m and 10 m

c) 6 m and 5 m d) 3 m and 5 m

8. A particle moves along a parabolic path $y = -9x^2$ in such a way that the x-component of velocity remains constant and has a value $\dfrac{1}{3}\,\mathrm{m\,s^{-1}}$. The acceleration of the particle is

a) $\dfrac{1}{3}\,\mathrm{m\,s^{-2}}$ b) $3\,\mathrm{m\,s^{-2}}$

c) $\dfrac{2}{3}\,\mathrm{m\,s^{-2}}$ d) $2\,\mathrm{m\,s^{-2}}$ *Ans.*

9. A projectile can have same range from two angles of projection with same initial speed. If h_1 and h_2 be the maximum heights, then

a) $R = \sqrt{h_1 h_2}$ b) $R = \sqrt{2h_1 h_2}$

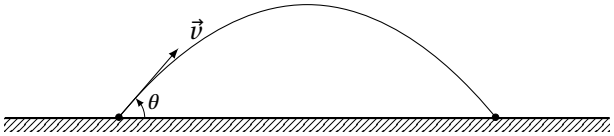
c) $R = 2\sqrt{h_1 h_2}$ d) $R = 4\sqrt{h_1 h_2}$ *Ans.*

10. A boy can throw a stone up to a maximum height of 10 m. The maximum horizontal distance that the boy can throw the same stone up to will be

a) $20\sqrt{2}\,\mathrm{m}$ b) 10 m

c) $10\sqrt{2}\,\mathrm{m}$ d) 20 m *Ans.*

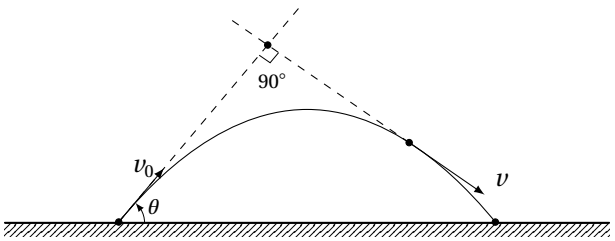
11. If the instantaneous velocity of a particle projected as shown in figure by $\vec{v} = a\hat{i} + (b - ct)\hat{j}$. Where a, b and c are positive constants, the range on the horizontal plane will be



a) $\dfrac{2ab}{c}$ *Ans.* b) $\dfrac{ab}{c}$

c) $\dfrac{ac}{b}$ d) $\dfrac{a}{2bc}$

12. A particle is projected from the ground at an angle θ with the horizontal with an initial speed u. Time after which velocity vector of the projectile is perpendicular to the initial velocity.



a) $\dfrac{u}{g\sin\theta}$ *Ans.*

b) $\dfrac{u}{g\cos\theta}$

c) $\dfrac{2u}{g\sin\theta}$

d) $2u\tan\theta$

13. A particle is projected from horizontal making an angle of 53° with initial velocity of $100\,\mathrm{m\,s^{-1}}$. The time taken by the particle to make angle 45° from horizontal is

a) 14 s

b) 2 s

c) Both (a) and (b) *Ans.*

d) None of these

14. A large number of bullets are fired in all directions with same speed v. What is the maximum area on the ground on which these bullets will spread?

a) $\dfrac{\pi v^2}{g}$

b) $\dfrac{\pi v^4}{g^2}$ *Ans.*

c) $\dfrac{\pi^2 v^4}{g^2}$

d) $\dfrac{\pi^2 v^2}{g^2}$

15. A bomber plane moves horizontally with a speed of $500\,\mathrm{m\,s^{-1}}$ and a bomb released from it, strikes the ground in 10 s. Angle at which it strikes the ground will be (Take, $g = 10\,\mathrm{m\,s^{-2}}$)

a) $\tan^{-1}\left(\dfrac{1}{5}\right)$ *Ans.*

b) $\tan^{-1}\left(\dfrac{1}{2}\right)$

c) $\tan^{-1}(1)$

d) $\tan^{-1}(5)$