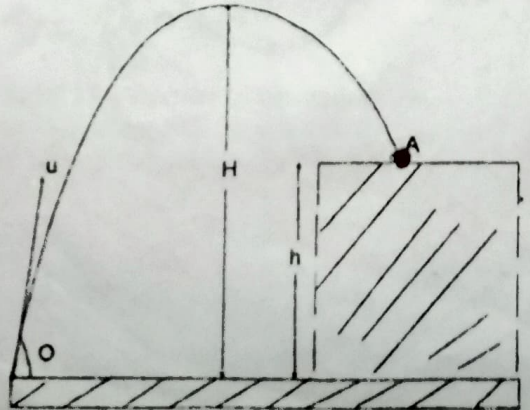
1. At what point of projectile motion velocity and acceleration are perpendicular to each other.
2. At what point velocity of projectile is minimum.
3. What are the assumptions made in projectile motion.
4. An object thrown vertically upwards from a top of a building reaches the foot in time t_1. It takes time t_2 if thrown vertically down with same velocity. If the time of free fall is t show that $t = \sqrt{t_1 t_2}$
5. Rain drops hitting the side windows of a car in motion often leave diagonal streaks, why?
6. If the displacement of a body is proportional to the square of time. State the nature of motion of body.
7. What will be the maximum range on doubling the initial velocity of a projectile?
8. A package is dropped out of an airplane in level flight. If air resistance would be neglected, how will be the motion of the package look to the pilot.
9. Can we have such an example where velocity is zero but acceleration is not zero?
10. A man wants to cross the river just opposite to his position. How should he swim?
11. Suppose you are sitting along a roadside and you see a person dropping a ball from window of moving bus. How will you observe the path of ball?
12. A man standing on the edge of a cliff at some height above the ground bellow throws a ball straight up with initial velocity V and then throws another ball straight down with the same speed V. Which ball, has the larger speed when it hits the ground?
13. What will be the effect on maximum height of a projectile when its angle of projection is changed from 30° to 60°, keeping the same initial velocity of projection?
14. A bomb is dropped from a fitting plane when it is flying vertically above target will it hit the target?

Numerical

15. A stone thrown vertically upward from a point on a bridge located 40 m above the water. Knowing that it strike the water 4 second after release, determine. **Ans: a. 9.6m/s, b. 29.6m/s**
    a. The velocity with which the stone was thrown upward.
    b. The velocity with which the stone strike the water.
16. Two guns, situated on the top of a hill of height 10m, fire one shot each with the same speed $5\sqrt{3}$ m/s at some interval of time one guns fire horizontally and other fires upward at an angle of 60° with the horizontal. The shots collide in air at a point p. find the time interval between the firings and the co-ordinates of the point p. **Ans: 1 sec, $(5\sqrt{3}, 5)$**
17. A baseball is thrown towards a player with an initial velocity $20ms^{-1}$ and 45° with the horizontal. At the moment the ball is thrown the player is 50 m from the thrower. At what speed and in what direction must he run to catch the ball at the same height at which it was release. **Ans: 3.45m/s towards thrower**
18. An airplane is flying with velocity of 90 m/s at an angle of 23° above the horizontal. When the plane is 114m directly above a dog that is standing on a level ground a suitcase drops out of the luggage. How far from the dog will the suitable land. **Ans: 795m**
19. In figure a stone is projected at a cliff of height 'h' with an initial speed of 42m/s directed at an angle θ = 60° above the horizontal. The strike at a 5.50s after launching. Find, **Ans: 51.8m, 27.4m/s 67.5m**
    a) The height (h) of the cliff
    b) The speed of the stone just before impact at A.
    c) The maximum height H reach above the ground.



20. A rifle that shots bullets at 460m/s is to be aimed at a target 45.7 m away. If the center of the target is level with the rifle how high above the target most the rifle borrel be pointed so that bullets hits dead center. Ans: $\theta = 0.0606°$, 0.0484m

21. A ball is dropped from the cornice of a build takes 0.25s to pass a window 2.2m high. How far is the top of the window below the cornice. Ans: 8m

22. A ball is dropped from a height of 20m and rebounds with a velocity which is $\frac{3}{4}$ of the velocity with which it hits the ground. What is the time interval between the first and second bounces. Ans: 3s

23. A man can row boat at 4km/hr in a still water. A river flows at 2 km/hr.
    a. If he is crossing the river, in what direction the boat should go to reach a point directly opposite to his starting point.
    b. If the river is 4km wide how long will it take him to cross the river?
    c. How long will it take him to row 2km down the river and back to his starting point.
    d. In what direction the boat should go, if he wants to cross the river in the smallest possible time.

    Ans: a) 30° to vertical b) $^{2}/_{\sqrt{3}}$ hr c) $^{4}/_{3}$hr d) Perpendicular to shore

24. A man wishes to swim across a river 600m wide. If he can swim the rate of 4km/hr in still water and river flows at 1km/hr. Then in what direction must he swim to reach a point exactly opposite to the starting point and when will he reach it?

25. A batter hits a baseball so that it leaves a bat with an initial speed 37m/s at an angle of 53° find the position of ball and the magnitude and direction of its velocity after 2s. Ans: 24.23m/s 23.21°

26. A projectile is projected with a velocity u making an angle θ with the horizontal, derive relation for its trajectory. Also show the component of velocity at any instant on the trajectory in diagram.

27. Show the path of the projectile fired horizontally from the top of the tower is parabolic in nature.

28. A projectile is fired with velocity u making an angle θ with horizontal derive expression for
    a. Maximum height
    b. Time to reach maximum height
    c. horizontal range

29. A man is going due east with a velocity of 3km/hr. Rain is falling vertically and with a speed of 10km/hr. Calculate the angle at which he should hold his umbrella to save himself from rain. Also calculate velocity of rain relative to man. Ans: 16.7° with vertical $\sqrt{109}$ km/hr

*End *