13. a. A projectile move in a parabolic path without air resistance. Is there any point at which its acceleration is?
    i. Parallel to the velocity? Explain.
    ii. Perpendicular to velocity? Explain
  b. An airplane is flying with a velocity of $90m/s$ at an angle of 23^0 above the horizontal. When the plane is 114m directly above a dog that is standing on level ground, a suitcase drops out of luggage compartment. How far from the dog will the suitcase land? You can ignore the air resistance. [$Ans: 787.7m\ from\ dog$]
  c. A baseball is thrown towards a player with an initial velocity 20m/s and 45° with the horizontal. At that moment the ball is thrown, the player is 50m from the thrower. At what speed and in what direction must he run to catch a ball at the same height at which it was released?

Relative Velocity questions:

1. A swimmer's speed along the river (downstream) is 20kmph and upstream is 8kmph. Calculate the velocity of the stream and the swimmer's possible speed in still water. [$Ans: 14kmph, 6kmph$]
2. Rain is falling vertically with a speed of $30m/s$. A woman rides a bicycle with a speed 10m/s from west to east direction. What is the direction she should hold her umbrella? [18.43]
3. A man wishes to swim across a river 600m wide. If he can swim at the rate of 4km/hr in still water and the river flows at 2km/hr. Then in what direction must he swim to reach a point exactly opposite to starting point and when will he reach it? [$Ans: 120^0\ with\ water\ and\ 10.4\ min$]
4. A person running with velocity $3m/s$ encounter rain falling vertically downwards with velocity $4m/s$. What is the velocity of rain with respect to man? What should be the angle of inclination of his umbrella?
5. To a person going due east in a car with a velocity of $25km/hr$, a train appears to move due north with a velocity of $25\sqrt{3}km/hr$. What is the actual velocity and direction of motion of the train?
6. A man walking on a road with a speed of $5km/hr$, encounters rain falling vertically with a velocity of $12km/hr$. Calculate the velocity of rain relative to man. At what angle should he hold his umbrella in order to protect himself from the rain? [$Ans: 13km\ hr, 22.6\ 0with\ verticle$]
7. A man standing on a road has to hold his umbrella at **300** with the vertical to keep the rain away. He throws the umbrella and starts running at **$10km/hr$**. He finds that raindrops are hitting his head vertically. Find the speed of raindrops with respect to the road and to the moving man. [$Ans: 10km\ hr, 20km\ hr$]
8. A man wishes to cross a river to an exactly opposite point on the other bank. The river is flowing at $1m/s$ and the velocity of the man in still water is $2m/s$. In what direction should he strike out in order to reach the opposite point? [$Ans: At\ an\ angle\ of\ 120^0\ with\ the\ current$]
9. A swimmer's speed along the river (downstream) is $20km/hr$ and he can swim upstream at 8km/hr. Calculate the velocity of the stream and the swimmer's possible speed in still water.
10. A river, **$1km$** wide is flowing at **$4km/hr$**. A swimmer whose velocity in still water is **$3km/hr$** can swim only for **$5mins$**. Do you advise him to go to the opposite bank on swimming?