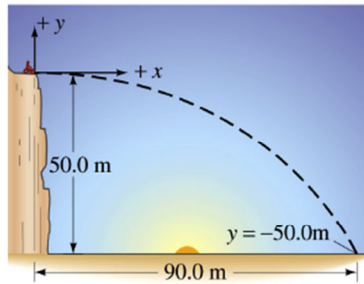


Tutorial Questions

Topic 3 Kinematics

Question 1

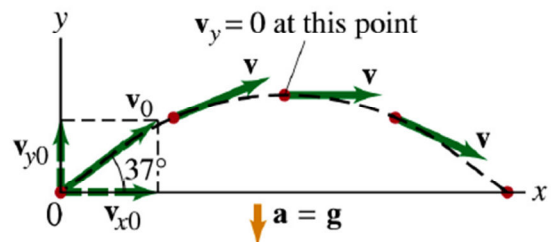
A movie stunt driver on a motorcycle speeds horizontally off a 50m high cliff. How fast must the motorcycle leave the cliff top so he can land on level ground below 90m from the base of the cliff where the camera are? Ignore the air resistance.



Question 2

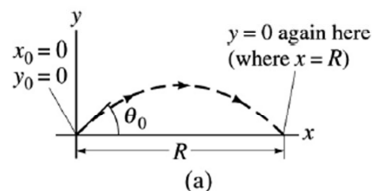
A football is kicked at an angle $\theta_0 = 37^\circ$ with a velocity of 20ms^{-1} . Calculate

- the maximum height
- the time of travel before the football hits the ground
- how far away it hits the ground
- the velocity vector at maximum height
- the acceleration vector at maximum height.



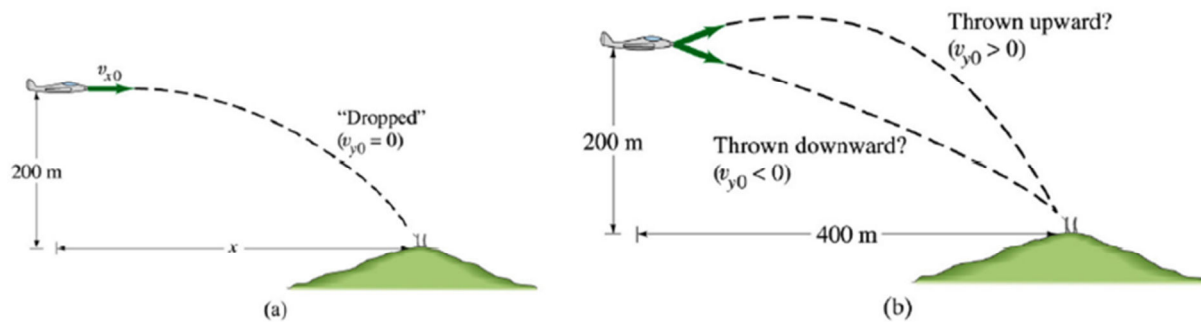
Question 3

- (a) Derive a formula for the horizontal range R of a Projectile in terms of its initial speed v_0 and angle θ_0 . The horizontal range is defined as the horizontal distance the projectile travels before returning to its original height (which is typical ground); that is $y(\text{final}) = y_0$.



- (b) Suppose one of the Napoleon's canons had a muzzle speed, v_0 of 60ms^{-1} . At what angle should it have been aimed to strike a target 320m away?

Question 4



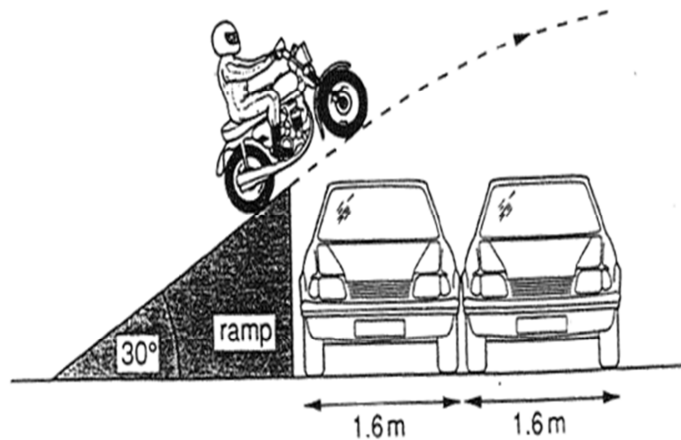
A rescue helicopter wants to drop a package of supplies to isolated mountain climbers on a rocky ridge 200 m below. If a helicopter is traveling horizontally with a speed of 70 ms^{-1} ,

- How far in advance the recipients (horizontal distance) must the package be dropped?
- Suppose, instead that the helicopter releases the package a horizontal distance of 400 m in advance of the climbers. What vertical velocity should the package be given (up and down) so that it arrives precisely at the climber's position?
- With what speed does the package land in the latter case?

Question 5

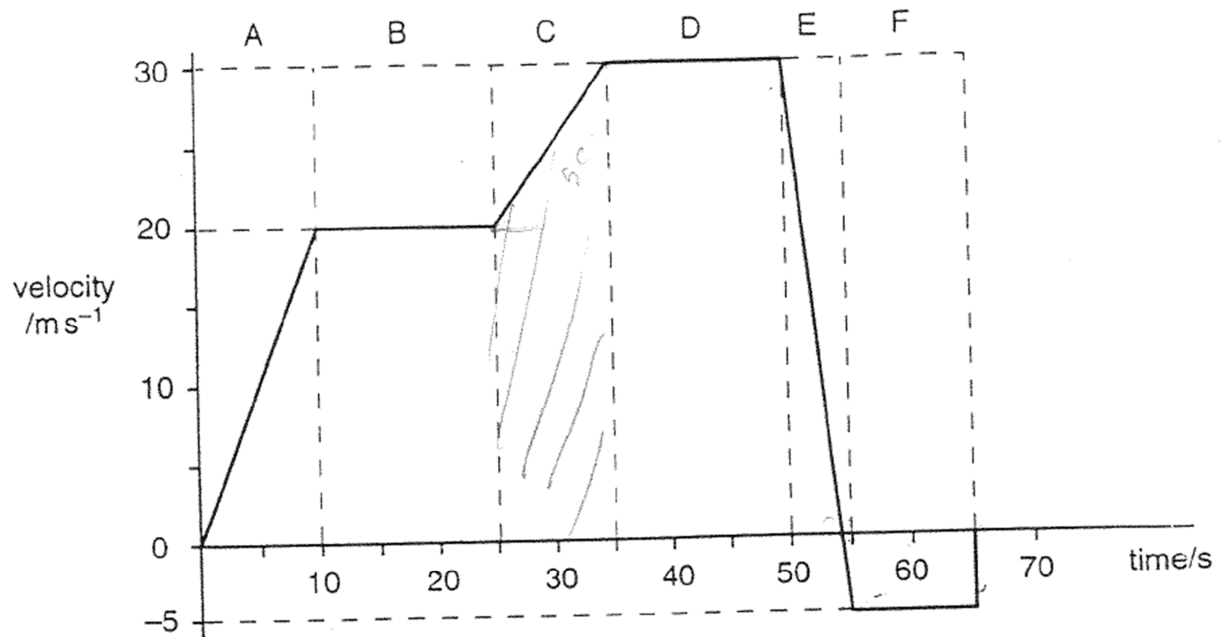
A stuntman on a motorcycle plans to ride up a ramp in order to jump over a number of cars, as illustrated on the right. The speed of the motorcycle as it leaves the ramp is 14 ms^{-1} . Neglect air resistance,

- Determine the horizontal component of the velocity.
- Determine the vertical component of the velocity.
- Calculate the time interval between leaving the end of the ramp and reaching maximum height.
- The cars are each of width 1.6 m and the same height as the ramp. Estimate the maximum number of cars which the motorcyclist can jump for the take-off speed of 14 ms^{-1} .



Question 6

Figure below shows a velocity-time graph for a journey lasting 65 s. It has been divided into six sections for ease of reference.



Using information from the graph obtain:

- the velocity 10s after the start
- the acceleration in section A
- the acceleration in section E
- the distance travelled in section B
- the distance travelled in section C
- Describe qualitatively in words what happens in sections E and F of the journey
- Sketch the shape of the corresponding distance-time graph. You are not expected to make detail calculations of the distance travelled.

