

**AP Physics Problem Set**  
**Week 3**

29. (II) A football is kicked with an initial velocity of 20 m/s at  $37^\circ$ . This is attempted 36.0 m from the goalposts, whose crossbar is 3.00 m above the ground. If the football is directed correctly between the goalposts, will it pass over the bar and be a field goal? Show why or why not.
31. (II) A projectile is shot from the edge of a cliff 125 m above ground level with an initial speed of  $65.0 \text{ m/s}$  at an angle of  $37.0^\circ$  with the horizontal. (a) Determine the time taken by the projectile to hit point P at ground level. (b) Determine the range  $X$  of the projectile as measured from the base of the cliff. At the instant just before the projectile hits point P, find (c) the horizontal and the vertical components of its velocity, (d) the magnitude of the velocity, and (e) the angle made by the velocity vector with the horizontal. (f) Find the maximum height above the cliff top reached by the projectile.
32. (II) A shotputter throws the shot with an initial speed of  $15.5 \text{ m/s}$  at a  $34.0^\circ$  angle to the horizontal. Calculate the horizontal distance traveled by the shot if it leaves the athlete's hand at a height of 2.20 m above the ground.
33. (II) At what projection angle will the range of a projectile equal its maximum height?
34. (III) A boy on a small hill aims his water-balloon slingshot and aims directly at a boy in a tree. At the instant the water balloon is released, the second boy lets go and falls from the tree, hoping to avoid being hit. Show that again the boy in the tree makes the wrong move by letting go at the moment the water balloon is shot.
35. (III) A rescue plane wants to drop supplies to isolated mountain climbers on a rocky ridge 235 m below. If the plane is traveling horizontally with a speed of  $250 \text{ km/h}$  ( $69.4 \text{ m/s}$ ) (a) how far in advance of the recipients (horizontal distance) must the goods be dropped? (b) Suppose, instead, that the plane releases the supplies a horizontal distance of 425 m in advance of the mountain climbers. What vertical velocity (up or down) should the supplies be given so that they arrive precisely at the climbers' position? (c) With what speed do the supplies land in the latter case?
3. (I) How much tension must a rope withstand if it is used to accelerate a 960-kg car horizontally along a frictionless surface at  $1.20 \text{ m/s}^2$ ?
4. (I) What is the weight of a 76-kg astronaut (a) on Earth, (b) on the Moon ( $g = 1.7 \text{ m/s}^2$ ), (c) on Mars ( $g = 3.7 \text{ m/s}^2$ ), (d) in outer space traveling with constant velocity?