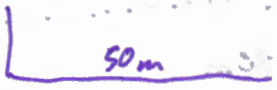
Equations: $d_y = V_{0y}t + \frac{1}{2}at^2$ / $V - V_0 = at$ / $d_x = vt$ / $g = -9.8\ m/s^2$

26. A ball is thrown from a roof. It lands 50 m away 0.79 s later.

a. What is the horizontal velocity right before hitting the ground?



$d_x = vt$
$50 = v(.79)$
$v = 63.29\ m/s$

b. What is the vertical velocity right before hitting the ground?

$v - v_0 = at$
$v - 0 = (-9.8)(.79)$
$v = -7.74\ m/s$

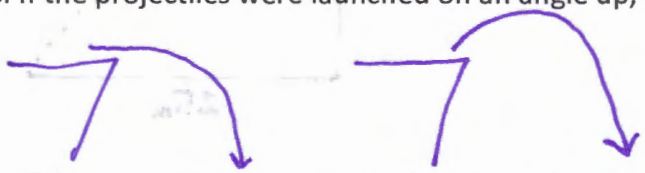
c. How high up is the roof?

$d_y = V_{0y}t + \frac{1}{2}at^2$
$d_y = 10(.79) + \frac{1}{2}(-9.8)(.79)^2$
$d_y = 3.06\ m$

27. For a projectile launched horizontally, what can we say about the horizontal velocity?

It will be constant
$V = V_0$

28. If the projectiles were launched on an angle up, how would it affect the total time? Why?



Longer time

29. If the projectile were launched on an angle down, how would it affect the total time? Why?

Shorter time

30. A swimmer dives off a cliff that is 78.4 m above the Pacific Ocean. His horizontal velocity is 4.0 m/s.

a. How long does it take him to hit the water?

$d_y = V_{0y}t + \frac{1}{2}at^2$
$78.4 = (0)t + \frac{1}{2}(-9.8)t^2$
$78.4 = -4.9t^2$
$\sqrt{t^2} = \sqrt{16}$
$t = 4\ s$

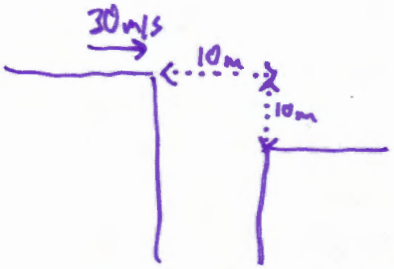
b. How far out does his dive take him, if there is no wind and no waves?

$d_x = vt$
$d_x = (4)(4)$
$d_x = 16\ m$

2D Motion Problems Problems

Equations: $d_y = V_{0y}t + \frac{1}{2}at^2$ / $V - V_0 = at$ / $d_x = Vt$ / $g = -9.8\ m/s^2$

31. A man is driving his car along a rural road. He became distracted and does not see a "Road Closed" sign. He realizes that there is a 10 m ditch he is approaching. Instead of breaking, he accidentally raises his speed to 30 m/s. If he continues at the same rate, will his car make it over the ditch to the other side, where the road is 10 m lower?



$d_y = V_{0y}t + \frac{1}{2}at^2$
$10 = (0)t + \frac{1}{2}(-9.8)t^2$
$10 = -4.9t^2$
$\sqrt{t^2} = \sqrt{2.04}$
$t = 1.43\ s$

Time links horizontal & vertical components, so we need it.

$d_x = Vt$
$d_x = (30)(1.43)$
$d_x = 42.9\ m$

Makes it over 10 m.

$d_x = Vt$
$10 = 30t$
or $t = 0.33\ s$

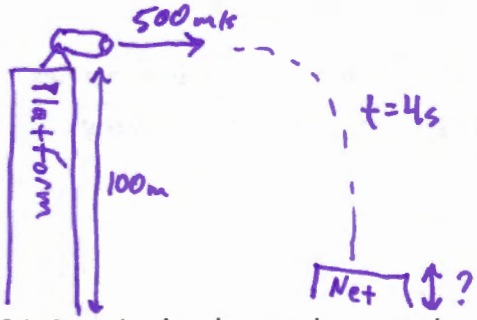
Needs to be in air for at least .33 s; 1.43 s is for 1.43 s.

32. Mr. Fred is parachuting out of a plane going 400 m/s. He sees the target area approaching, and knows his altitude is 5000 m. How far away from the target must he jump to land on top of it? (Do not consider the friction of the parachute)

$d_y = V_{0y}t + \frac{1}{2}at^2$
$5000 = (0)t + \frac{1}{2}(-9.8)t^2$
$5000 = -4.9t^2$
$\sqrt{t^2} = \sqrt{1020.41}$
$t = 31.94\ s$

$d_x = Vt$
$d_x = (400)(31.94)$
$d_x = 12,777.53\ m$
or
$d_x = 12,776\ m$
depends on rounding

33. At the circus, a clown is fired out of a cannon, so his velocity is 500 m/s. If he is on a platform 100 m above the ground and lands in a net 4 seconds after "takeoff", how far off the ground is the net?



$d_y = V_{0y}t + \frac{1}{2}at^2$
$d_y = (0)(4) + \frac{1}{2}(-9.8)(4^2)$
$d_y = 78.4\ m$

This value represents how far the clown fell. If we know the platform is 100 m tall, we can now find the height of the net.

$100\ m - 78.4\ m = 21.6\ m$

This is how high off of the ground the net is.

34. America has been taken over by giant frogs. Each frog has a horizontal component of 400 m/s, and a vertical component of 98 m/s when they jump. How far does the frog go in 3 jumps?

$V - V_0 = at$
$-98 - 98 = -9.8t$
$-196 = -9.8t$
$t = 20$

$d_x = Vt$
$d_x = (400)(20)$
$d_x = 8000\ m \times 3\ \text{jumps} = 24,000\ m$

or $20 \times 3 = 60$ sec then $d_x = Vt$