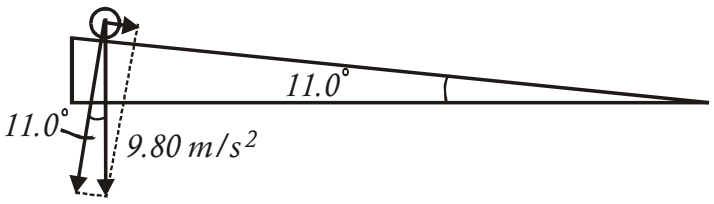
AP Physics – Vectors Go On and On – 4 ans

1. A ball is at rest on a ramp as shown. If the ramp makes an angle of 11.0° to the horizontal, what is the acceleration component down the ramp? If the ball rolls down the ramp a distance of 1.2 m, how much time did it take? As you can see, *g* is the resultant of the acceleration down the ramp and normal to the ramp.



$a = g\sin\theta \quad = 9.8\frac{m}{s^2}\sin 11^\circ \quad = 1.87\frac{m}{s^2}$

$x = \frac{1}{2}at^2 \qquad t = \sqrt{\frac{2x}{a}} \qquad t = \sqrt{\frac{2(1.2\ \cancel{m})}{1.87\frac{\cancel{m}}{s^2}}} \quad = \quad \boxed{1.13\ s}$

2. A kid runs straight off a diving board. The diving board is 3.0 m above the water. If the kid travels 2.5 m from the edge of the board when he hits the water, what was his horizontal speed?

$y = \frac{1}{2}at^2 \quad t = \sqrt{\frac{2y}{a}} \quad = \sqrt{\frac{2(3.0\ \cancel{m})}{9.80\frac{\cancel{m}}{s^2}}} \quad = 0.7825\ s \qquad v_x = \frac{x}{t} \quad = \frac{2.5\ m}{0.7825\ s} \quad = \quad \boxed{3.2\frac{m}{s}}$

3. The nose wheel falls off of a 767 when it is flying at an altitude of 12 500 m. Okay, (a) how much time for it to hit the ground? (b) If the plane has an air speed of 885 km/h, what is the horizontal distance that the wheel travels before it hits the ground.

(a) $y = \frac{1}{2}at^2 \qquad t = \sqrt{\frac{2y}{a}} \qquad t = \sqrt{\frac{2(12\,500\ \cancel{m})}{9.80\frac{\cancel{m}}{s^2}}} \quad = \quad \boxed{50.5\ s}$

(b) $v_x = \frac{x}{t} \qquad x = v_x t \quad = 885\frac{\cancel{km}}{\cancel{h}}(50.5\ \cancel{s})\left(\frac{1\ \cancel{h}}{3600\ \cancel{s}}\right)\left(\frac{1000\ m}{1\ \cancel{km}}\right) \quad = \quad \boxed{12\,400\ m}$

4. A 5 inch projectile is fired with a velocity of 288.7 m/s at an angle of 18.0° to the horizontal. How far does the projectile travel?

$v_y = v\sin\theta \quad = 288.7\frac{m}{s}\sin 18.0^\circ \quad = \quad 89.21\frac{m}{s} \qquad v_{x0} = v\cos\theta \quad = 288.7\frac{m}{s}\cos 18.0^\circ \quad = \quad 274.6\frac{m}{s}$

$v_y = v_{y0} + at \quad t = \frac{v_y - v_{y0}}{a} \quad = \quad \frac{-89.21\frac{\cancel{m}}{\cancel{s}} - 89.21\frac{\cancel{m}}{\cancel{s}}}{-9.8\frac{\cancel{m}}{s^{\cancel{2}}}} \quad = \quad 18.21\ s$

$v_x = \frac{x}{t} \qquad x = v_x t \quad = 274.6\frac{m}{\cancel{s}}(18.21\ \cancel{s}) \quad = 5000\ m \quad = \quad \boxed{5.00\ x10^3 m}$

5. An aircraft launches a bomb. The plane is flying upward at an angle of 55° to the horizon. When the bomb is launched, it has a speed of 745 km/h. At the time of launch, the bomb is 8 750 m above the ground. So (a) how high does the bomb go from where it was launched? (b) How far horizontally does it travel? (c) How much time till it hits?

(a) $v = 745\frac{\cancel{km}}{\cancel{h}}\left(\frac{1\ \cancel{h}}{3600\ \cancel{s}}\right)\left(\frac{1000\ m}{1\ \cancel{km}}\right) \quad = \quad 206.9\frac{m}{s} \qquad v_y = v\sin\theta \quad = 206.9\frac{m}{s}\sin 55^\circ \quad = \quad 169.5\frac{m}{s}$

$v_y^{\,2} = v_o^{\,2} + 2ay \qquad y = \frac{v_y^{\,2} - v_o^{\,2}}{2a} \quad = \frac{0 - \left(169.5\frac{m}{\cancel{s}}\right)^2}{2\left(-9.8\frac{\cancel{m}}{\cancel{s}^2}\right)} \quad = \quad \boxed{1470\ m}$

(c) Time up: $v_y = v_{y0} + at \qquad t = \dfrac{-v_{y0}}{a} = \dfrac{-169.5\ \frac{m}{s}}{-9.8\ \frac{m}{s^2}} = 17.30\ s$

Time down: $y = \dfrac{1}{2}at^2 \qquad t = \sqrt{\dfrac{2y}{a}} = \sqrt{\dfrac{2(1470\ m + 8750\ m)}{9.8\ \frac{m}{s^2}}} = 45.67\ s$

Total time: $t_{tot} = 17.30\ s + 45.67\ s =$ **63.0 *s***

(b) $v_x = v\cos\theta = 206.9\ \dfrac{m}{s}\cos 55^\circ = 118.7\ \dfrac{m}{s}$

$v_x = \dfrac{x}{t} \qquad x = v_x t = 118.7\ \dfrac{m}{s}(63.0\ s) =$ **7 480 *m***