Name: _____
Date: _____ Block: _____

Physics Test Review
Accelerated & Projectile Motion

Horizontal Motion Equation:

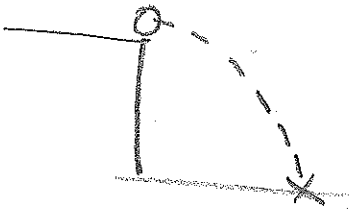
① $\Delta x = \frac{1}{2}at^2 + v_i t$ ③ $v_f^2 = v_i^2 + 2a\Delta x$
② $v_f = at + v_i$ ④ $\Delta x = \frac{1}{2}t(v_i + v_f)$

Vertical Motion Equations:

① $\Delta x_y = \frac{1}{2}at^2 + v_{iy}t$
② $v_{fy}^2 = v_{iy}^2 + 2a\Delta x_y$
③ $v_{fy} = at + v_{iy}$

Horizontal Projectiles:

① $\Delta x_x = v_{ix}t$



Hints for solving problems:

$a = -9.8 m/s^2$
$v_{iy} = 0 m/s$
$\Delta x_y$ is negative (falling)

1. Which of the following would be considered a "projectile" when in the air?
   a. an airplane taking off
   (b.) a tennis ball lobbed over a net
   c. a parachutist drifting to Earth
   (d.) a frog jumping from land into the water
   (e.) flat rock skipping across the surface of a lake
   (f.) a three-point shot in basketball
   (g.) a ball bouncing across a room
   (h.) a cliff diver

**Be sure to list all knowns and unknowns in columns. Show all calculations and CIRCLE YOUR ANSWERS.**

2. A tornado is holding a car 125 m above the ground. The tornado then flings the car horizontally with an initial speed of 90.0 m/s. How long does the car take to reach the ground? How far horizontally does the car travel before hitting the ground?


$\Delta x_y = -125m$
$a = g = -9.8 m/s^2$
$t = ? = 5.05s$
$\Delta x_x = ?$
$v_{ix} = 90 m/s$

$\Delta x_y = \frac{1}{2}at^2 + v_{iy}t$

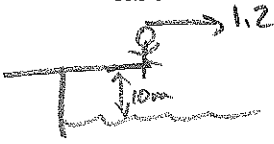
$\sqrt{\frac{2\Delta x_y}{a}} = t$

$t = \sqrt{\frac{2(-125)}{-9.8}} = \sqrt{\frac{-250}{-9.8}}$

$t = \sqrt{25.5} = 5.05s$

$\Delta x_x = v_{ix}t$
$= (90)(5.05)$
$\Delta x_x = 454.57m$

3. A diver runs horizontally with a speed of 1.20 m/s off a platform that is 10.0 m above the water. What is his speed just before striking the water?




$\Delta x_y = -10\text{m}$
$a = g = -9.8\text{m/s}^2$
$t = ? = 1.43\text{s}$
$v_{ix} = 1.2\text{m/s}$
$v_{fy} = ?$
$v_{iy} = 0\text{m/s}$

$\Delta x_y = \frac{1}{2}at^2 + v_{iy}t$

$t = \sqrt{\frac{2\Delta x_y}{a}} = \sqrt{\frac{2(-10)}{-9.8}}$

$= \sqrt{\frac{-20}{-9.8}} = \sqrt{2.04}$

$t = 1.43\text{s}$

$v_{fy} = at + v_{iy}$

$= (-9.8)(1.43) + 0$

$= -14\text{m/s}$

4. A car drives straight off the edge of a cliff that is 54 m high. The police at the scene note that the point of impact is 130 m from the base of the cliff. How fast was the car traveling when it went over the cliff?


$\Delta x_y = -54\text{m}$
$a = g = -9.8\text{m/s}^2$
$t = ?$
$\Delta x_x = 130\text{m}$
$v_{ix} = ?$

$\Delta x_y = \frac{1}{2}at^2 + v_{iy}t$

$t = \sqrt{\frac{2\Delta x_y}{a}} = \sqrt{\frac{2(-54)}{-9.8}}$

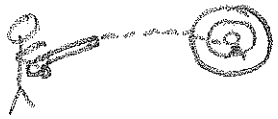
$= \sqrt{\frac{-108}{-9.8}} = \sqrt{11.02}$

$t = 3.32\text{s}$

$\frac{\Delta x_x}{t} = v_{ix}$

$v_{ix} = \frac{130}{3.32} = 39.16\text{m/s}$

5. A horizontal rifle is fired at a bull's-eye. The muzzle speed of the bullet is 670 m/s. The barrel is pointed directly at the center of the bull's-eye, but the bullet strikes the target 0.025 m below the center. What is the horizontal distance between the end of the rifle and the bull's-eye?



$v_{ix} = 670\text{m/s}$
$\Delta x_y = -.025\text{m}$
$a = g = -9.8\text{m/s}^2$
$\Delta x_x = ?$
$t = ?$

$\Delta x_y = \frac{1}{2}at^2 + v_{iy}t$

$t = \sqrt{\frac{2\Delta x_y}{a}} = \sqrt{\frac{2(-.025)}{-9.8}}$

$= \sqrt{\frac{-.05}{-9.8}} = \sqrt{.0051}$

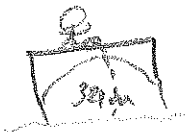
$t = .071\text{s}$

$\Delta x_x = v_{ix}t$

$= (670)(.071)$

$\Delta x_x = 47.86\text{m}$

6. The Royal Gorge Bridge in Colorado rises 321 m above the Arkansas River. Suppose you kick a rock horizontally off the bridge. The magnitude of the rock's horizontal displacement is 45.0 m. Find the speed at which the rock was kicked.




$\Delta x_y = -321\text{m}$
$a = g = -9.8\text{m/s}^2$
$t = ?$
$\Delta x_x = 45\text{m}$
$v_{ix} = ?$

$\Delta x_y = \frac{1}{2}at^2 + v_{iy}t$

$t = \sqrt{\frac{2\Delta x_y}{a}} = \sqrt{\frac{2(-321)}{-9.8}}$

$= \sqrt{\frac{-642}{-9.8}} = \sqrt{65.51}$

$t = 8.09\text{s}$

$\frac{\Delta x_x}{t} = v_{ix}$

$v_{ix} = \frac{\Delta x_x}{t}$

$= \frac{45\text{m}}{8.09\text{s}}$

$v_{ix} = 5.56\text{m/s}$

7. A baseball rolls off a 0.70 m high desk and strikes the floor 0.25 m away from the base of the desk. How fast was the ball rolling?

$\Delta x_y = -.7m$

$a = g = -9.8 m/s^2$

$t = ?$

$\Delta x_x = .25m$

$V_{ix} = ?$

$\Delta x_y = \frac{1}{2}at^2 + v_{iy}t$

$t = \sqrt{\frac{2\Delta x_y}{a}} = \sqrt{\frac{2(-.7)}{-9.8}}$

$= \sqrt{\frac{-1.4}{-9.8}} = \sqrt{.143}$

$t = .378 s$

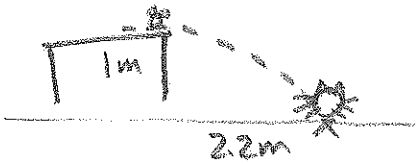
$\Delta x_x = V_{ix}t$

$V_{ix} = \frac{\Delta x_x}{t}$

$= \frac{.25}{.378}$

$V_{ix} = .661 m/s$

8. A cat chases a mouse across a 1.0 m high table. The mouse steps out of the way, and the cat slides off the table and strikes the floor 2.2 m from the edge of the table. When the cat slid off the table, what was its speed?



$\Delta x_y = -1m$

$a = g = -9.8 m/s^2$

$t = ?$

$\Delta x_x = 2.2m$

$V_{ix} = ?$

$\Delta x_y = \frac{1}{2}at^2 + v_{iy}t$

$t = \sqrt{\frac{2\Delta x_y}{a}} = \sqrt{\frac{2(-1)}{-9.8}}$

$= \sqrt{\frac{-2}{-9.8}} = \sqrt{.204}$

$t = .452 s$

$\Delta x_x = V_{ix}t$

$V_{ix} = \frac{\Delta x_x}{t}$

$= \frac{2.2}{.452}$

$V_{ix} = 4.87 m/s$

9. A pelican flying along a horizontal path drops a fish from a height of 5.4 m. The fish travels 8.0 m horizontally before it hits the water below. What was the pelican's speed?

$\Delta x_y = 5.4m$

$a = -9.8 m/s^2$

$\Delta x_x = 8m$

$V_{fx} = 0 m/s$

$V_{ix} = ?$

$t = ? = 1.05s$

$\Delta x_y = \frac{1}{2}at^2 + v_{iy}t$

$\sqrt{\frac{2\Delta x_y}{a}} = t$

$t = \sqrt{\frac{2(5.4)}{-9.8}} = \sqrt{\frac{-10.8}{-9.8}}$

$= \sqrt{1.10} = 1.05s$

$\Delta x_x = V_{ix}t$

$\frac{\Delta x_x}{t} = V_{ix}$

$V_{ix} = \frac{8m}{1.05s} = 7.62 m/s$

10. If the pelican in problem 4 was traveling at the same speed but was only 2.7 m above the water, how far would the fish travel horizontally before hitting the water below?

$\Delta x_y = -2.7m$

$a = -9.8 m/s^2$

$t = ? = .74s$

$\Delta x_x = ?$

$V_{ix} = 7.62 m/s$

$\sqrt{\frac{2\Delta x_y}{a}} = t$

$t = \sqrt{\frac{2(-2.7)}{-9.8}}$

$t = \sqrt{\frac{-5.4}{-9.8}} = \sqrt{.55}$

$t = .74s$

$\Delta x_x = V_{ix}t$

$= (7.62)(.74)$

$\Delta x_x = 5.66m$

11. Luke Autbeloe is riding in a hot air balloon drops his camera from an altitude of 70 m. How long does it take the camera to reach the ground? What is the velocity of the camera just before it hits the ground?


$\Delta x_y = -70m$
$a = -9.8 m/s^2$
$t = ?$
$V_{iy} = 0 m/s$
$V_{fy} = ?$

$\Delta x_y = \frac{1}{2} a t^2 + V_{iy} t$

$t = \sqrt{\frac{2\Delta x_y}{a}}$

$t = \sqrt{\frac{2(-70)}{-9.8}} = \sqrt{\frac{-140}{-98}}$

$t = \sqrt{14.29} = \boxed{3.78 s}$

$V_{fy} = at + V_{iy}$

$= (-9.8 m/s^2)(3.78s) + 0$

$\boxed{V_{fy} = -37.04 m/s}$

12. A car moving on a straight road increases its speed at a uniform rate of 10 m/s to 20 m/s in 5.0 s. What is its acceleration? How far did it go during those 5.0 s?

$V_f = 20 m/s$
$V_i = 10 m/s$
$t = 5s$
$a = ?$
$\Delta x = ?$

$a = \frac{V_f - V_i}{t}$

$a = \frac{20 - 10}{5}$

$a = \frac{10}{5} = \boxed{2 m/s^2}$

$\Delta x = \frac{1}{2} t (V_i + V_f)$

$= \frac{1}{2}(5)(10+20)$

$= (2.5)(30)$

$\boxed{\Delta x = 75m}$

13. A ball rolls down a hill with a constant acceleration of 3.0 m/s$^2$. If it starts from rest, what is its speed at the end of 4.0 s? How far did the ball move in that 4.0 s?

$a = 3 m/s^2$
$V_i = 0 m/s$
$t = 4s$
$V_f = ?$
$\Delta x = ?$

$a = \frac{V_f - V_i}{t}$

$at = V_f - V_i$

$at + V_i = V_f = (3)(4) + 0$

$\boxed{V_f = 12 m/s}$

$\Delta x = \frac{1}{2} a t^2 + V_i t$

$\Delta x = \frac{1}{2}(3)(4^2) + 0(4)$

$\Delta x = (1.5)(16) + 0$

$\boxed{\Delta x = 24m}$

14. According to Guinness, the tallest man to have ever lived was Robert Pershing Wadlow of Alton, Illinois. He was last measured in 1940 to be 2.72 meters tall (8 feet, 11 inches). Determine the speed which a quarter would have reached before contact with the ground if dropped from rest from the top of his head.

$\Delta x_y = -2.72m$
$a = -9.8 m/s^2$
$V_{iy} = 0 m/s$
$V_{fy} = ?$

$V_{fy}^2 = \sqrt{V_{iy}^2 + 2a\Delta x_y}$

$V_{fy} = \sqrt{0^2 + 2(-9.8)(-2.72)}$

$= \sqrt{53.312}$

$\boxed{V_{fy} = 7.30 m/s}$