EvaluAIde Bonus Assignment

Instructions:

- Answer all questions in detail. Show your work where appropriate.

- Your submission must be a single PDF file. You may type your solutions or handwrite and scan them.

- This assignment is for bonus credit and will help improve our grading tools—thank you for participating!

- Submit your PDF via the usual course submission portal by the posted deadline.

1. **Constant Acceleration (1D):**
   A car starts from rest and accelerates uniformly at 2.5 m/s^2 for 8 seconds.
   a) What is its final velocity? **V(f) = v(0) + at = v = 0 +(2.5)(8) = <mark>20m/s</mark>**
   b) How far does it travel in this time? **D= v(0)t + ½ at^2 = d = ½ (2.5) (8)^2 = 0.5 * 2.5 * 64 = <mark>80m</mark>**

2. **Free Fall:**
   A ball is thrown straight upward with an initial speed of 12 m/s.
   a) How long does it take to reach its highest point? **V = v(0)+at = 0= 12+(-9.8)t= 9.8t=12 t=12/9.8 = <mark>t=1.224s</mark>**
   b) What is the maximum height it reaches? **H= v(0)t + 1/2at^2 = h=12*1.22+1/2*(-9.8)*(1.22)^2 = 12*1.22= 14.64 and ½ *(-9.8)*(1.22)^2= -7.29 so h= 14.64-7.29= <mark>7.35 meters</mark>**

3. **Projectile Motion (2D):**
   A soccer ball is kicked from ground level at 18 m/s at a 30° angle above the horizontal.
   a) How long is the ball in the air? **Vert of initial velo= V(0)y = V(0) sin (theta) = 18 * sin(30) = 19*0.5= 9m/s so vy =V(0)y – gt=0 so time= V(0)y/ g= 9/9.8 = 0.918 seconds to highest point so total time = 0.918 * 2 = <mark>1.836seconds</mark>**
   b) How far does it travel horizontally before hitting the ground? **Hori.component of initial velo=**

V(0)x = V(0)cos theta= 18 * cos(30) = 18*0.866= 15.59m/s so range = 15.59* 1.836= 28.62meters

4. **Relative Velocity:**

A river flows east at 2 m/s. A boat heads north at 4 m/s relative to the water.

a) What is the boat's speed relative to the ground? **V boat/ground = v boat/water + vriver (east direction = 2m/s and North direction = 4m/s) v= square root of v(x)^2+v(y)^2 = square root of 2^2 +4^2 = square root of 4+16= square root of 20= 4.47m/s**

b) At what angle (relative to north) does it move as seen from the shore? **Angle = inverse tan (v(x)/v(y) = inverse tan (2/4) = inverse tan(0.5)= 26.57 degrees (east of north)**

5. **Kinematics Challenge:**

A stone is dropped from a 45 m high cliff. At the same instant, a second stone is thrown upward from the base of the cliff with a speed of 15 m/s.

a) At what height above the ground do the stones pass each other?

Position of stone A(dropped from top): ya(t)= 45-1/2gt^2= 45-4.9t^2

Position of Stone B (thrown up): yB(t) = vB(0)t- 1/2gt^2 = 15t-4.9t^2

Set equal so 45-4.49t^2= 15t-4.9t^2 = 45=15t= t= 45/15 so t=3 seconds, now use B's equation

YB(3)= 15(3)-4.9(3)^2 = 0.9m,, so stones pass at 0.9m above ground
b) How much time after release does this occur?

The time after release that this happens is 3 seconds.