**2-Dimensional Motion (2DM)**

Directions: Show the solutions (i.e. your work) to these on a separate sheet of paper.

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| 1.56 s  7.5 m  4.8 m/s x +  -15.3 m/s y | 1. Fred leaves the edge of a 12m tall cliff with a horizontal velocity of 4.8 m/s. What time is he in the air? How far from the base of the cliff does he land? What is his velocity upon impact with the water in terms of x and y components? |
| 3.1m  3.52m  8.99 m/s | 2. Mr. Murray leaps from the edge of the retaining wall trying to get away from an angry motorist. He is in the air for 0.80 seconds before face-planting into the snow. If he has a horizontal velocity of 4.4 m/s, how high was the wall? How far into his neighbor’s yard does he land? What is his speed of impact? |
| 3.96 m  12.2 m/s  7.1 m | 3. Rachel leaps from the edge of a cliff with a velocity of 3.3 m/s horizontally. She hits the water 1.2 seconds later. How far out does she land? What is her speed when she hits? How high is the cliff? |
| 67.6 m/s  10.8 s  454 m | 4. A golf ball leaves the ground with an initial vertical velocity of 53 m/s and a horizontal velocity of 42 m/s. a) Draw the initial velocity vector. Find the initial speed. b) For what time is the ball in the air? c) How far does it go in this time? |
| 12.9 m/s  15.3 m/s  3.1 s  40m | 5. A football is kicked by Joe at an angle of 50 degrees above the horizontal at a speed of 20 m/s. a) Draw a picture of the initial velocity vector. b) What is the horizontal velocity? c) What is the initial vertical velocity component? d) What time will the ball be in the air? e) What distance will it go in that time? |
| 590 m/s  413 m/s  84.3 s  49,700 m | 6. A rifle is fired at an angle 35o above the horizontal at a speed of 720 m/s. a) Draw a picture of the initial velocity vector. b) What is the horizontal velocity? c) What is the initial vertical velocity component? d) What time will the shell be in the air? e) What distance will it go in that time? |
| 1.74 m/s  50.6 s  75.8 m | 7. A river has a current of 1.5 m/s, and a swimmer has a velocity of .89 m/s. If they head straight across the river, what will be their speed (hypotenuse) with respect to the shore? If the river is 45 m wide, how much time will it take them to cross? How far downstream will they drift in that time? |
| 2.14 m/s  28 m  2.29 m/s | 8. A canoe heads straight across a river with a current of .80 m/s. It takes the canoe 35 seconds to cross the 75 m wide river. What is the speed of the canoe with respect to the water? How far does the canoe drift downstream? What is the speed of the canoe with respect to the shore? |
| 5.3 m/s  630m  720m  48s  Apple  From the time calculations | 9. Red Elk has to swim across the river where his friend Magenta Antelope has a pie that they are going to share. The river has a current of 4 m/s, and Red Elk can swim at 3.5 m/s when he’s really hungry. And he is really hungry. What is his speed with respect to the shore? If it takes him 180 seconds to cross the river, how wide is it? How far downstream does he get swept? If he can run back along the shore toward the pie at 15 m/s, how long does it take him to meet his friend? What kind of pie was it? How do you know? |
|  | Use the range and angle equations for this part:  , |
| 12,948 m, 23o | 10. Angle = 67o, Speed = 420 m/s, Range = ? Other angle with same range? |
| 84 m, 78o | 11. Angle = 12o, Speed = 45 m/s, Range = ? Other angle with same range? |
| 16.2m, 8o | 11. Angle = 82o, Speed = 24 m/s, Range = ? Other angle with same range? |
| 15.9o, 74.1o | 12. Speed = 34 m/s, Range = 62 m, Angles = ? |
| 24.2o, 65.8o | 13 Speed = 12 m/s, Range = 11 m, Angles = ? |
| Can't be done! | 14 Speed = 24 m/s, Range = 62 m, Angle = ? |

**Son of 2-D Motion (SO2DM)**

Directions: Show the solutions (i.e. your work) to these on a separate sheet of paper.

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| 11 m  3 m/s | 1. Marlene jumps off the edge of a cliff and hits the water 1.5 seconds later, about 4.5 m from the base of the cliff. What height was the cliff? With what speed did she leave the edge? |
| 2.07 s  1.64 m/s | 2. Kyle wants to jump into the water from a cliff that is 21 m tall. There are rocks that stick out 3.4 m from the base of the cliff. What time will he be in the air? What must his speed be in order to clear the rocks? |
| 14.9 m/s  23 m/s  4.7 sec  70 m  76.6 m | 3. A football leaves the ground at a speed of 27.4 m/s at an angle above the horizontal of 57o. a) Draw a picture of the initial velocity vector. b) What is the horizontal velocity? c) What is the initial vertical velocity component? d) What time will the ball be in the air? e) What distance will it go in that time? f) what is the maximum distance you could make a football go with that speed? (Use the range equation and plug in the angle which gives you the best range) |
| a) 27.1 m/s x + 20.5 m/s y  b) 4.1 s  c) 113 m  d) 27 m/s  e) 27.1 m/s x + 14.9 m/s y  f) 31 m/s | 4. A projectile leaves the ground with a speed of 34 m/s at an angle of 37o above the horizontal. a) What is the initial velocity in vector component notation? b) What time is the projectile in the air? c) What is its range? d) What is its speed at the highest point? e) What is the velocity of the projectile in vector component notation when it is on the way up at elevation 10 m? f) Speed at elevation 10 m? |
| .6 m/s  4.2 m/s  400 s  57 s | 5. A motorboat can go 2.4 m/s on a river where the current is 1.8 m/s. The motorboat must go 240 m upstream, and then back. What is the speed of the boat with respect to the shore as it travels upstream? Downstream? How much time does it take it to go upstream? Downstream? |
| 31.9 s  2.22 m/s  23.3o | 6. The current in a river 117 m wide is 1.45 m/s, and your boat can go 3.67 m/s. What time will it take you to cross the river if you point straight across? What Speed would you go if you pointed straight in to the current? What angle upstream of straight across must you point your boat to actually go straight across? |
| 2.0 m/s  2.7 m/s  42o | 7. A ferry boat points upstream at some angle to go straight across a river. The river current is 1.8 m/s, and it takes the boat 30 seconds to cross the 60 m wide river. What is the speed of the boat with respect to the shore? What is the speed of the boat on still water? What angle upstream of straight across does the boat point? |