**Projectile Motion (PM)**

Show the solutions (i.e. your work) to these on a separate sheet of paper. Use g = -9.81 m/s/s.

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| a) 7.1 m  b) 4.5 m/s  c) 4.5 m/s x + -12 m/s y  d) 13 m/s 69o below horiz  e) 9.0 m/s 60.o below horiz  f) 3.6 m x + -3.1 m y | 1. Rachel jumps off the edge of a cliff and hits the water 1.2 seconds later, about 5.4 m from the base of the cliff. a) What height was the cliff? b) With what horizontal velocity did she leave the edge? c) What were her components of velocity upon striking the water? d) What was her velocity of impact? e) what was her velocity exactly 0.80 seconds after leaving the cliff edge? (Express as an angle and magnitude) f) what was her displacement exactly 0.80 s after leaving the cliff edge in terms of components? (how far out, how far down) |
| a) 2.07 s  b) 4.59 m/s  c) 20.8 m/s 77.3o below horiz  d) 4.59 m/s x + -17.2 m/s y  e) 17.8 m/s 75.0o below horiz | 2. Kyle wants to jump into the water from a cliff that is 21.0 m tall. He must land 9.50 m from the base of the cliff to avoid rocks in the water. a) What time will he be in the air? b) What must his horizontal speed be in order to clear the rocks? c) What is his velocity of impact? What is his velocity when he is 6.00 m above the water? Give it in d) vector components and e) angle-magnitude (Hint – you need to use how far down from the cliff edge he is, not his height above the water…) |
| a) 41.4 m/s x + 17.6 m/s y  b) 3.58 s  c) 148 m | 3. A golf ball leaves the ground at a speed of 45.0 m/s at an angle of 23.0o above the horizontal on level ground. a) What are the initial components of velocity in terms of x and y? b) What time is the ball in the air? c) How far does the ball go before striking the ground? |
| a) 4.57 m/s x + 21.5 m/s y  b) 20.1 m  c) 23.6 m  d) 4.57 m/s | 4. An air rocket leaves the launch pad with a speed of 22.0 m/s at an angle of 78.0o above the horizontal on level ground. a) What are the initial components of velocity in terms of x and y? b) How far does it go before striking the ground? c) What is its greatest height? d) What is the rocket’s speed at its highest point? |
| a) 26.9 m  b) 4.15 s  c) 10.8 m above the ground  d) 14.9 m/s x + -17.8 m/s y,  23.2 m/s 50.0o below horiz | 5. An ordinary projectile leaves the ground at a speed of 27.4 m/s at an angle above the horizontal of 57.0o and strikes a wall 62.0 m distant. a) What is the greatest height the projectile reaches? b) In what time does it hit the wall? c) How high does it hit the wall? (Assume the land is level) d) What is its velocity of impact with the wall in terms of x and y components and angle-magnitude? |
| a) 113 m  b) 27.2 m/s  c) 31.0 m/s 28.8o above horiz  d) 27.2 m/s 1.78o above horiz  e) 54.3m x + 21.3 m y | 6. A flaming projectile leaves the ground with a speed of 34.0 m/s at an angle of 37.0o above the horizontal. a) What is its range? b) What is its speed at the highest point? c) What is the velocity of the projectile in angle-magnitude notation at an elevation of 10.0 m going up? d) What is the velocity in angle-magnitude notation at exactly 2.00 seconds? e) What is its position at 2.00 seconds? (how far over, how far up) |
| a) 804 m  b) 55.9 m/s x + -74.4 m/s y  93.1 m/s 53.1o below horiz | 7. A flaming explosive projectile is launched at an angle of 50.0o and a speed of 87.0 m/s from the top of a 56.0 m tall cliff above the ocean.  a) What is its range? b) What is its velocity of impact with the water in terms of x and y components and angle-magnitude? |
| a) 15.6 m/s x + -6.64 m/s y  b) 38.6 m  c) 15.6 m/s x + 17.6 m/s y  23.5 m/s 48.3o above horiz | 8. A water balloon enters a window that is 13.5 m above the ground with a velocity of 17.0 m/s and an angle of 23.0o below the horizontal. a) What are the final components of velocity as it goes through the window? b) From what distance from the base of the building was the water balloon launched? c) What was the launch velocity in terms of x and y components and angle and magnitude? |