

Advanced Symmetrical Projectile Motion (ANSWER KEY)

1. A football is kicked at an angle of 45° and travels 82 m before hitting the ground.
 - a) Find its **initial velocity**
 - b) **How long** was it in the air?
 - c) What is its **maximum height**?
 $v_o = 28.3 \text{ m/s}$
 $t = 4.08 \text{ s}$
 $y_{\max} = 20.43 \text{ m}$
2. A shot put is released with a velocity of 12 m/s and stays in the air for 2.0 sec.
 - a) At what **angle** was it released? [HINT: Think of **ALL** the kinematic equations with **θ** in it!]
 - b) What was the shot put's **range**?
 $\theta = 55^\circ$
 $R = 13.81 \text{ m}$
3. Find the **angle of elevation θ** of a tank's cannon which fires a shell with a muzzle velocity of 120 m/s and hits a target on the same level (What is Δy ?) but 1300 m distant.
 $\theta = 59^\circ \text{ or } 31^\circ$
4. A baseball is thrown straight downward with initial velocity of 8 m/s from a height of 25 m. Compute the following:
 - a) Compute the **time** it takes the baseball to reach the ground.
 - b) Calculate the **velocity** the baseball strikes the ground with.
 $t = 1.59 \text{ s}$
 $v_f = 23.5 \text{ m/s}$
5. A marble dropped from a bridge strikes the water in 5 sec.
 - a) Calculate the **impact velocity** (v_y).
 - b) What is the **height** of the bridge?
 $v_f = 49 \text{ m/s}$
Height = 122.5 m
6. Morten Anderson, a place kicker, tries for a field goal. He kicks the ball 40° above the horizontal. The initial velocity (v_i) of the ball is 23 m/s.
 - a. Determine the maximum height that the ball attains.
 - b. Determine the time of flight between kickoff and landing.
 - c. Determine the range of the football.
 - d. If the uprights were 27 yards away, and the uprights are 10 feet off the ground, does he make the field goal? [hint: find y at the time t where $x = 22$ yards.] [convert!]
 $y_{\max} = 11.15 \text{ m}$
 $t = 3.02$
 $R = 53.16$
Yes
7. A hunter aims *directly* at a target 120 m away.
 - a) If the bullet leaves the gun at a velocity of 250 m/s, by how much will it miss the target?
 - b) **At what angle** *should* the gun be aimed so the target will be hit?
Misses by 1.13m
Aim at 0.9°
8. A projectile is launched from ground level to the top of a cliff which is 195 m away and 155 m high. If the projectile lands on top of the cliff 7.6 sec after it is fired, find the **initial velocity** of the projectile (**BOTH magnitude AND direction**). Neglect drag.
 $v_{ox} = 25.7 \text{ m/s}$
 $v_{oy} = 57.6 \text{ m/s}$
 $v_o = 63.1 \text{ m/s @ } 65.95^\circ$

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Chapter 3: Two Dimensional Motion