Name: _____ **Date:** _____ **Period:** _____

AP Physics C
Projectile Motion HO4

1.) Rat rolls a tennis ball off the edge of a table 1.00 m above the floor and the ball strikes the floor at a point 2.80 m horizontally from the edge of the table. (3-10)

a.) Find the time of flight.

b.) Find the magnitude of the initial velocity.

c.) Find the magnitude and direction of the velocity of the ball just before it strikes the floor.

2.) A physics book slides off a horizontal tabletop with a speed of 1.25 m/s. It strikes the floor in 0.400 s. (3-11)

a.) Find the height of the tabletop above the floor.

b.) Find the horizontal distance from the edge of the table to the point where the book strikes the floor.

3.) Larry is flying his plane at a horizontal speed of 120 m/s and accidentally drops a bomb at an elevation of 2000 m. (3-12)

a.) How much time does it take for the bomb to reach the earth?

b.) Find the horizontal and vertical components of its velocity just before it hits the earth.

4.) Rat fires a rifle horizontally at a target. The bullet has a muzzle velocity of 275 m/s. How far does the bullet drop in flight if the target is 75 m away? (3-13)

5.) Sara throws a football with an initial upward velocity component of 15.0 m/s and a horizontal velocity component of 25.0 m/s. (3-14)

a.) How much time does it take for the ball to reach its maximum height?

b.) How high is this point?

c.) How far does the ball travel horizontally before Larry catches the ball (at the same height as it was release)?

6.) Rat stands on the roof of a building that is 30.0 m tall and throws a rock with a velocity of magnitude 40.0 m/s at an angle of 33.0˚ above the horizontal. (3-19)

a.) Calculate the maximum height above the roof reached by the rock.

b.) Calculate the horizontal distance from the base of the building to the point where the rock strikes the ground.

7.) Sara is standing on a mound and throws a ball with a velocity of 14.0 m/s, 49˚ above the horizontal. The ball hits the ground 2.40 s later. (3-16)

a.) What are the components of the ball's velocity at the beginning and end of its trajectory?

b.) How far did she throw the ball horizontally?

c.) How high was the ball above the ground when she released it?

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AP Physics C
Projectile Motion HO5

1.) An unhappy student throws an egg at an angle of 50.0° above the horizontal with a speed of 12.0 m/s. The egg is directed toward a teacher's car that is advancing toward the student at a constant speed of 8.00 m/s. If the egg is to hit the car, what is the maximum distance the car can be from the student when the egg is thrown? (3-44)

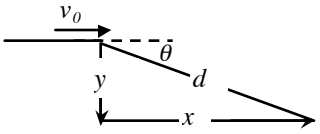
2.) Julia is attempting to jump across a river on a motorcycle. The takeoff ramp is inclined at 53.0°, the river is 40.0 m wide, and the far bank is 15.0 m lower than the top of the ramp. What should her speed be at the top of the ramp to just make it to the edge of the far bank? (3-55)

3.) Laura throws a baseball at an angle of 53.1° above the horizontal with an initial speed of 40.0 m/s. (3-15)

a.) At what two times is the baseball at a height of 25.0 m above the point from which it is thrown?

b.) Calculate the horizontal and vertical components of the baseball's velocity at each of the two times found in part (a).

c.) What are the magnitude and direction of the baseball's velocity when it returns to the level from which it is thrown?

4.) 

A skier is moving in the horizontal direction with a speed of $v_0 = 25.0$ m/s becomes airborne when she comes upon an incline that falls off with a slope of $\theta = 35.0°$. Selecting the origin ($x = y = 0$) at the beginning of the jump (S Ex 4.8)

a.) Where (x, y) does she land on the incline?

b.) Determine the vertical component of her velocity just before she lands.

5.) A cat is tossed from an upper-story window of a building. The cat is given an initial velocity of 8.00 m/s at an angle of 20.0° below the horizontal. It strikes the ground 3.00 s later. (S 4-26)

a.) How far horizontally from the base of the building does the cat strike the ground?

b.) Find the height from which the cat was tossed.

c.) How long does it take the cat to reach a point 10.0 m below the level of launching?

6.) The range R is the total horizontal distance that a projectile travels returning to the same height from which it was launched. Show that for a projectile launched at angle θ and initial velocity v_0 the range is

$$R = \frac{v_0^2 \sin 2\theta}{g}$$

7.) Show that for a projectile launched at angle θ, initial velocity v_0, and initial height y_0 the maximum height is

$$y_{max} = \frac{v_0^2 \sin^2\theta}{2g} + y_0$$

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AP Physics C
Circular Motion HO6

1.) Rat rotates a 1.00 kg discus along a circular path of radius 1.00 m. The maximum speed of the discus is 20.0 m/s. Find the magnitude of its maximum radial acceleration. (S4-29)

2.) The earth has a radius of 6.38×10^6 m and turns around on its axis in 24 hours. (3-23)

a.) What is the radial acceleration of an object at the earth's equator? Give you answer in m/s^2 and as a fraction of g.

b.) If a_{rad} at the equator is greater than or equal to g, objects would fly off the earth's surface and into space. What would the period of the earth's rotation have to be for this to occur?

3.) A ball on the end of a string is whirled around in a horizontal circle of radius 0.30 m. The plane if the circle is 1.2 m above the ground. The string breaks and the ball lands 2.0 m away from the point on the ground directly beneath the ball's location when the string breaks. Find the centripetal acceleration of the ball during its circular motion. (S4-33)

4.) The radius of the earth's orbit around the sun (assumed to be circular) is 1.50×10^{11} m, and the earth travels around this orbit in 365 days. (3-24)

a.) What is the magnitude of the orbital velocity of the earth in m/s?

b.) What is the radial acceleration of the earth toward the sun in m/s^2?

5.) A point on a rotating turntable 20.0 cm from the center accelerates from rest to 0.700 m/s in 1.75 s. At $t = 1.25$ s, find the magnitude and direction of (S4-36)

a.) the tangential acceleration b.) the centripetal acceleration c.) the total acceleration

6.) A train slows down as it rounds a sharp, level turn, slowing from 25.0 m/s to 14.0 m/s in the 15.0 s that it takes to round the bend. The radius of the curve is 150 m. Find the acceleration at the moment the train speed reaches 14.0 m/s. (S4-37)

7.) A rock tied to a rope moves in the xy-plane; its coordinates are given as functions of time by

$$x = R\cos\omega t \quad \text{and} \quad y = R\sin\omega t$$

where R and ω are constants. (3-61)

a.) Show that the rock's distance from the origin is constant and equal to R, that is, that its path is a circle of radius R.

b.) Show that the magnitude of the rock's velocity is constant and equal to ωR.

c.) Show that the rock's acceleration has magnitude $\omega^2 R$.

d.) Combine the results of parts (c) and (d) to show that the rock's acceleration has constant magnitude v^2/R.

8.) The velocity of a particle moving in a circular path of radius $r = 0.20$ m is given by the equation $v = \alpha t^2 - \beta t$, where $\alpha = 3.0$ m/s^3 and $\beta = 2.0$ m/s^2. At $t = 1.0$ s, find the magnitude and direction of

a.) the tangential acceleration b.) the centripetal acceleration c.) the total acceleration