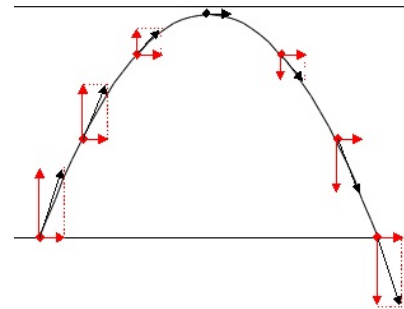


**Physics 3204  
Projectile Motion**

**Worksheet 3: Launch Horizontally and Lands on Point of Projection**

Student Name: \_\_\_\_\_



**PART A: MULTIPLE CHOICE**

*Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided*

1. What are the horizontal and vertical components of a projectile launched with a velocity of 16.0 m/s at an angle of 40.0° above the horizontal?

	$V_x$ (m/s)	$V_y$ (m/s)
(A)	10.3	12.3
(B)	12.3	10.3
(C)	12.3	16.0
(D)	16.0	12.3

2. Which represents the velocity components of a projectile?

<p>(A)</p>	<p>(B)</p>
<p>(C)</p>	<p>(D)</p>

3. An arrow is fired from a bow with an initial velocity of 18.0 m/s at an angle of 35.0° above the horizontal. How far, horizontally, has the arrow travelled in 1.45 s?

- (A) 12.4 m
- (B) 15.0 m
- (C) 21.4 m
- (D) 26.1 m

4. A ball is launched with an initial velocity of 28.0 m/s at 40.0° above the horizontal. How long does it take for the ball to reach its maximum height?

- (A) 1.68 s
- (B) 1.84 s
- (C) 2.19 s
- (D) 2.86 s

5. A golf ball is launched at an angle of  $15.0^\circ$  from the ground. What was the initial speed of the ball if it lands on the ground 3.42 s later?

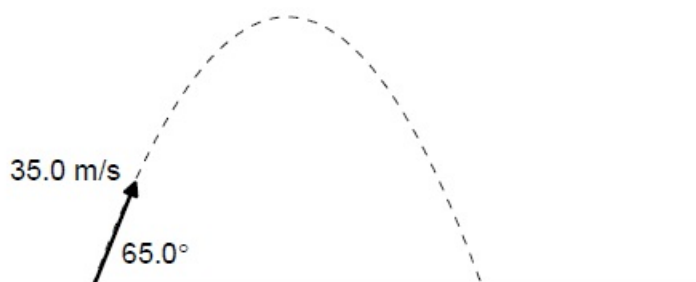
- (A) 16.8 m/s
- (B) 17.3 m/s
- (C) 64.7 m/s
- (D) 129 m/s

6. Soccer ball is kicked with a speed of 15.0 m/s at  $30.0^\circ$  above the ground. What is its height at 0.60 s?

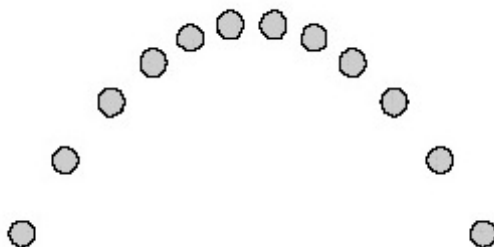
- (A) 1.6 m
- (B) 2.7 m
- (C) 6.0 m
- (D) 6.3 m

7. A catapult fires a large stone as shown. What is the maximum height reached by the stone?

- (A) 1.62 m
- (B) 11.2 m
- (C) 51.3 m
- (D) 103 m



8. Which describes a ball thrown in the air that traces the path shown?



- (A) The acceleration of the ball at the top of its motion is zero.
- (B) The acceleration of the ball keeps changing.
- (C) The velocity of the ball at the top of its motion is zero.
- (D) The velocity of the ball keeps changing.

9. A projectile is launched with an initial velocity of 14 m/s at an angle of  $25^\circ$  above the horizontal. What is the speed of the projectile at its maximum height?

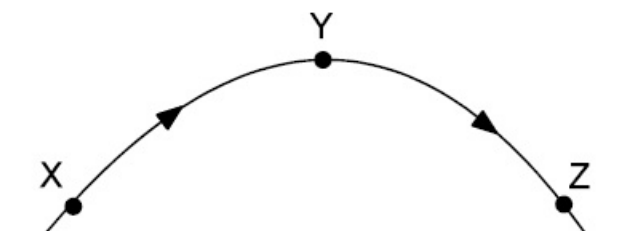
- (A) 0 m/s
- (B) 5.9 m/s
- (C) 13 m/s
- (D) 14 m/s

10. A golf ball is hit from ground level with an initial velocity of 63 m/s at an angle of  $31^\circ$  above the horizontal. How long will it take the ball to hit the ground?

- (A) 3.3 s
- (B) 5.5 s
- (C) 6.6 s
- (D) 11 s

11. What is the maximum height of a projectile launched at 120 m/s at an angle of  $30.0^\circ$  above the horizontal.
- (A) 3.1 m  
 (B) 5.3 m  
 (C) 180 m  
 (D) 550 m
12. If a projectile is launched from ground level with an initial velocity of 65 m/s at  $30.0^\circ$  above the horizontal, what is its total time in the air?
- (A) 3.3 s  
 (B) 6.6 s  
 (C) 12 s  
 (D) 13 s

13. What is the acceleration of the projectile at each point in the diagram below?

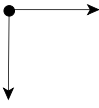


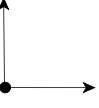


	x (m/s <sup>2</sup> )	y (m/s <sup>2</sup> )	z (m/s <sup>2</sup> )
(A)	-9.8	-9.8	-9.8
(B)	-9.8	0	-9.8
(C)	9.8	9.8	-9.8
(D)	9.8	0	-9.8

14. A ball kicked from the ground at 12.0 m/s and  $28^\circ$  from the horizontal, returns to the ground in 5.0 s. What is the ball's speed just before it hits the ground?
- (A) 0 m/s  
 (B) 5.6 m/s  
 (C) 11 m/s  
 (D) 12 m/s
15. If a ball is thrown at an angle of  $35^\circ$  from the ground, at a speed of 8.0 m/s, what is the magnitude of the vertical component of the initial velocity?
- (A) 4.6 m/s  
 (B) 5.6 m/s  
 (C) 6.6 m/s  
 (D) 8.0 m/s

16. An egg is thrown in the air with a velocity of 15 m/s at  $45^\circ$  above the horizontal. What is its horizontal velocity and vertical acceleration when it reaches the maximum height?

	Horizontal Velocity (m/s)	Vertical Acceleration (m/s <sup>2</sup> )
(A)	0	0
(B)	0	-9.8
(C)	11	0
(D)	11	-9.8

17. A juggler throws a ball at 0.22 m/s at an angle of  $60.0^\circ$  above the horizontal. What is the y-component of the velocity of the ball?
- (A) 0.11 m/s  
 (B) 0.19 m/s  
 (C) 0.25 m/s  
 (D) 0.44 m/s
18. How much time does it take a soccer ball to travel 50.0 m horizontally if it is kicked with a velocity of 18.4 m/s at an angle of  $30.0^\circ$  above the horizontal?
- (A) 0.184 s  
 (B) 0.319 s  
 (C) 3.14 s  
 (D) 5.43 s
19. Which best represents the velocity components of a projectile at its maximum height?
- (A) 
- (B) 
- (C) 
- (D) 
20. A ball is thrown at a  $60^\circ$  angle to the horizontal. As soon as the ball is released, the thrower runs along level ground, below the ball, and catches it 3.0 s later. If the thrower ran 12 m, what was the magnitude of the initial velocity?
- (A) 2.3 m/s  
 (B) 4.0 m/s  
 (C) 4.6 m/s  
 (D) 8.0 m/s
21. If a ball is thrown at an initial speed of 8.0 m/s at an angle of  $35^\circ$  above the ground, what is the speed of the ball when it returns to its original height?
- (A) 4.6 m/s  
 (B) 6.6 m/s  
 (C) 8.0 m/s  
 (D) 9.8 m/s
22. A ball kicked from the ground at 12.0 m/s and  $28^\circ$  from the horizontal, returns to the ground in 5.0 s. What is the ball's speed just before it hits the ground?
- (A) 0 m/s  
 (B) 5.6 m/s  
 (C) 11 m/s  
 (D) 12 m/s

23. Two arrows are launched at the same time with the same initial velocity. Arrow X is fired at an angle of  $60^\circ$  to the horizontal, and arrow Y is fired at an angle of  $45^\circ$  to the horizontal. Which best describes the motion of arrow X compared to the motion of arrow Y?

- (A) Arrow X has a longer flight time and longer horizontal range.
- (B) Arrow X has a longer flight time and shorter horizontal range.
- (C) Arrow X has a shorter flight time and longer horizontal range.
- (D) Arrow X has a shorter flight time and shorter horizontal range.

24. A rock is launched with a horizontal velocity of 3.0 m/s and a vertical velocity of 4.0 m/s. What is the magnitude of the velocity of the rock at its maximum height?

- (A) 0 m/s
- (B) 3.0 m/s
- (C) 4.0 m/s
- (D) 5.0 m/s

25. A projectile is launched from ground level with an initial velocity of 65 m/s at an angle of  $60.0^\circ$  above the horizontal. How much time does it take to return to ground level?

- (A) 2.4 s
- (B) 3.4 s
- (C) 5.6 s
- (D) 11 s

26. What is the maximum height of a projectile launched at 120 m/s at an angle of  $30.0^\circ$  above the horizontal.

- (A) 3.1 m
- (B) 5.3 m
- (C) 180 m
- (D) 550 m

27. A golfer hits a golf ball with a velocity of 75 m/s at an angle of  $15^\circ$  to the horizontal. What are the horizontal and vertical components of the initial velocity?

	horizontal velocity (m/s)	vertical velocity (m/s <sup>2</sup> )
(A)	0	75
(B)	19	72
(C)	72	19
(D)	75	0

28. What are the horizontal and vertical components of a projectile launched with a velocity of 16.0 m/s at an angle of  $40.0^\circ$  above the horizontal?

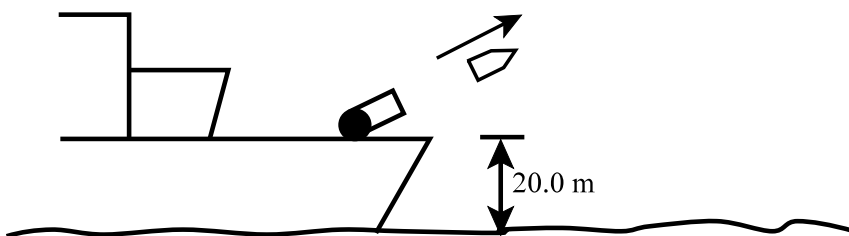
	$v_x$ (m/s)	$v_y$ (m/s)
(A)	10.3	12.3
(B)	12.3	10.3
(C)	12.3	16

(D)	16	12.3
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29. A soccer ball is kicked with a speed of 15.0 m/s at  $30.0^\circ$  above the ground. What is its height at 0.60 s?
- (A) 1.6 m  
 (B) 2.7 m  
 (C) 6.0 m  
 (D) 6.3 m
30. If a projectile is launched from ground level with an initial velocity of 65 m/s at  $30.0^\circ$  above the horizontal, what is its total time in the air?
- (A) 3.3 s  
 (B) 6.6 s  
 (C) 12 s  
 (D) 13 s

**PART B: WRITTEN RESPONSE**

1. In the diagram below, a shell is shot from a cannon, with an initial speed of  $4.4 \times 10^2$  m/s, at  $30.0^\circ$  from the deck of a ship. If the ship is at rest and the shell is launched 20.0 m above sea level, how far will the shell travel horizontally from its original position into the sea? Assume friction is negligible. **JUNE 2004**



2. A juggler throws a ball upward at an angle of  $65^\circ$  to the horizontal, with an initial speed of 3.2 m/s. How far apart should the juggler hold her hands in order to catch the ball at the same level from which it was thrown? **JUNE 2007**
3. Explain why beginning jugglers prefer large dwell ratios, while professional jugglers prefer smaller dwell ratios. **AUGUST 2007**

4. A golfer hits a golf ball from ground level with a speed of 25 m/s at  $35^\circ$  above the horizontal. Calculate the magnitude of the velocity of the ball when it has travelled a horizontal distance of 42 m. **AUGUST 2008**
  
5. A golfer hits a golf ball from ground level with a speed of 25 m/s at  $35^\circ$  above the horizontal. Calculate the magnitude of the velocity of the ball when it has travelled a horizontal distance of 42 m.
  
  
  
  
  
  
  
  
  
  
6. A juggler throws a ball upward at an angle of  $65^\circ$  to the horizontal, with an initial speed of 3.2 m/s. How far apart should the juggler hold her hands in order to catch the ball at the same level from which it was thrown?
  
  
  
  
  
  
  
  
  
  
7. A juggler throws a ball at a  $70^\circ$  angle to the horizontal from a height of 1.6 m. If the room is 2.8 m high, what is the maximum velocity at which the ball can be thrown to avoid hitting the ceiling?
  
  
  
  
  
  
  
  
  
  
8. An object is thrown from the ground into the air at an angle of  $40.0^\circ$  from the horizontal at a velocity of 18.0 m/s. How far will this object travel horizontally?

9. An object is thrown from the ground into the air with a velocity of 20.0 m/s at an angle of  $27.0^\circ$  to the horizontal. What is the maximum height reached by this object?
10. An object is thrown from the ground into the air at an angle of  $30.0^\circ$  to the horizontal. If this object reaches a maximum height of 5.75 m, at what velocity was it thrown?
11. An object is projected from the ground into the air at an angle of  $35.0^\circ$  to the horizontal. If this object is in the air for 9.26 s, at what velocity was it thrown?