NAME_____ pd____

# PROJECTILE MOTION QUIZ REVIEW

**Define:**

1. Projectile object released with some initial velocity that is only affected by gravity once it is in the air
2. Parabolic resembles a parabola in shape; symmetric on the way up and down
3. Velocity displacement divided by time; how fast something travels with a direction given
4. Gravity an attractive force that pulls objects towards each other; on Earth the value is approximately $9.8 m/s^2$.
5. Acceleration Velocity divided by time; how fast a velocity is changing

**Questions:** Answer the questions in the space provided.

6. In which direction is vertical motion? Y ↕
7. In which direction is horizontal motion? X ↔
8. What affect does gravity have on an object's horizontal motion? none
9. What affect does gravity have on an object's vertical motion? It accelerates an object $9.8 m/s^2$ towards Earth.
10. How does gravity affect the trajectory of a projectile? Only in the vertical direction, causing parabolic motion
11. Ignoring air resistance, explain why the horizontal velocity of a projectile does not increase or decrease after the initial thrust of the object. Their is no net force acting on it in the horizontal direction.

**Multiple Choice**: Choose the correct answer.

21) A cannon fires a shell at a fixed angle above the horizontal. Which one of the following quantities is the same throughout the shell's flight? (Ignore the effects of air friction.)

A. Its speed. (B.) Its acceleration. C. its velocity.
D. The vertical component of its velocity.

22) A heavy ball is thrown straight down from a tower with an initial velocity of 50 m/s. $V_{iy}$
($g = 9.8 m/s^2$ down). After 2.0 s the magnitude of its velocity is:
$a_y$ $t$ $V_{fy}$

A) 2.5 m/s B) 30 m/s C) 62 m/s
D) 110 m/s (E) 70 m/s

$V_{fy} = V_{iy} + a_y t$
$V_{fy} = (50 m/s) + (9.8 m/s^2)(2 s)$
$V_{fy} = 69.6 m/s$

NAME_____ pd____

23) A baseball is thrown vertically upward into the air. What is the instantaneous acceleration of the ball at its highest point?

A. 9.8 m/s² up. B. zero. (C) 9.8 m/s² down.
D. changing from 9.8 m/s² up to 9.8 m/s² down.

24) A projectile is fired at an angle of 45° above the horizontal. Assume that air resistance is not significant. While the projectile is in flight, the horizontal component of the velocity remains constant.

A. False (B) True

25) A ball moving with an initial velocity of 100 m/s north is given an acceleration of 10 m/s² south. What will its velocity be after 6.0 s?

$V_{iy}$ $a_y$ $V_{fy}$ $t$

$V_{fy} = V_{iy} + a_y t$
$V_{fy} = 100\,m/s + (-10\,m/s^2)(6.0\,s)$
$V_{fy} = 100\,m/s + -60\,m/s$
$V_{fy} = 40\,m/s$

A. 60 m/s north (B) 40 m/s north
C. 40 m/s south D. 60 m/s south

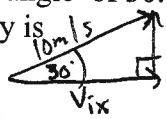
26) A 5.0 kg sphere initially at rest is allowed to fall toward the earth for a time of 5.0 s ($g = 9.8$ m/s²). Its velocity at the end of this time is:

$V_{iy}$ $t$ $a_y$ $V_{fy}$

$V_{fy} = V_{iy} + a_y t$
$V_{fy} = 0 + (9.8\,m/s^2)(5.0\,s)$
$V_{fy} = 49\,m/s$

A) 10 m/s down B) 20 m/s down C) 30 m/s down
D) 40 m/s down (E) 50 m/s down

28) A soccer player kicks a ball with an initial velocity of 10. meters per second at an angle of 30.° above the horizontal. The magnitude of the horizontal component of the ball's initial velocity is



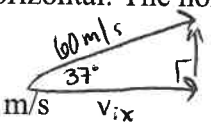

$\cos(30) = \frac{V_{ix}}{10\,m/s}$
$(10\,m/s)\cos(30) = V_{ix}$
$V_{ix} = 8.7\,m/s$

(A) 5.0 m/s (B) 8.7 m/s (C) 9.8 m/s (D) 10. m/s

29) A machine launches a tennis ball at an angle of 25° above the horizontal at a speed of 14 meters per second. The ball returns to level ground. Which combination of changes *must* produce an increase in time of flight of a second launch?

(A) decrease the launch angle and decrease the ball's initial speed
(B) decrease the launch angle and increase the ball's initial speed
(C) increase the launch angle and decrease the ball's initial speed
(D) increase the launch angle and increase the ball's initial speed

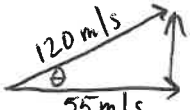
30) A golf ball is propelled with an initial velocity of 60. m/s at 37° above the horizontal. The horizontal component of the golf ball's initial velocity is




$\cos(37) = \frac{V_{ix}}{60\,m/s}$
$(60\,m/s)\cos(37) = V_{ix}$
$V_{ix} = 48\,m/s$

(A) 30. m/s (B) 36 m/s (C) 40. m/s (D) 48 m/s

31) A projectile is fired with an initial velocity of 120.0 m/s at an angle, θ, above the horizontal. If the projectile's initial horizontal speed is 55 meters per second, then angle θ measures approximately




$\cos\theta = \frac{55\,m/s}{120\,m/s}$
$\theta = \cos^{-1}\left(\frac{55\,m/s}{120\,m/s}\right)$
$\theta = 63°$

(A) 13° (B) 27° (C) 63° (D) 75°

32) A golf ball is hit at an angle of 45° above the horizontal. What is the acceleration of the golf ball at the highest point in its trajectory? [Neglect friction.]

NAME_____ pd____

(A) 9.8 m/s² upward
(B) 9.8 m/s² downward
(C) 6.9 m/s² horizontal
(D) 0.0 m/s²

33) A ball is thrown horizontally at a speed of 24 meters per second from the top of a cliff. If the ball hits the ground 4.0 seconds later, approximately how high is the cliff?

(A) 6.0 m (B) 39 m (C) 78 m (D) 96 m

$d_y = v_{iy}t + \frac{1}{2}a_y t^2$

$d_y = 0(4.0s) + \frac{1}{2}(9.8 m/s^2)(4.0s)^2$

$d_y = 78.4\ m$

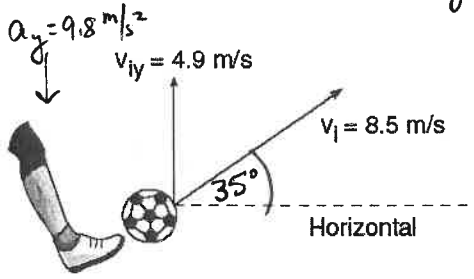
34) A 0.2-kilogram red ball is thrown horizontally at a speed of 4 meters per second from a height of 3 meters. A 0.4-kilogram green ball is thrown horizontally from the same height at a speed of 8 meters per second. Compared to the time it takes the red ball to reach the ground, the time it takes the green ball to reach the ground is

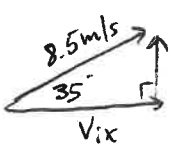
(A) one-half as great
(B) twice as great
(C) the same
(D) four times as great

35) A ball is thrown at an angle of 38° to the horizontal. What happens to the magnitude of the ball's vertical acceleration during the total time interval that the ball is in the air?

(A) It decreases, then increases.
(B) It decreases, then remains the same.
(C) It increases, then decreases.
(D) It remains the same.

Base your answers to questions 36 and 37 on the information and diagram below.
A child kicks a ball with an initial velocity of 8.5 meters per second at an angle of 35° with the horizontal, as shown. The ball has an initial vertical velocity of 4.9 meters per second and a total time of flight of 1.0 second. [Neglect air resistance.]




$\cos(35^\circ) = \frac{v_{ix}}{8.5 m/s}$

$(8.5 m/s)\cos(35^\circ) = v_{ix}$

$v_{ix} = 6.96 m/s$

36) The horizontal component of the ball's initial velocity is approximately

(A) 3.6 m/s (B) 4.9 m/s (C) 7.0 m/s (D) 13 m/s

37) The maximum height reached by the ball is approximately

(A) 1.2 m (B) 2.5 m (C) 4.9 m (D) 8.5 m

$v_{fy} = 0 \quad t = 0.5\ s$

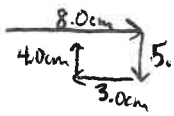
$d_y = v_{iy}t + \frac{1}{2}a_y t^2$

$d_y = (4.9 m/s)(0.5s) + \frac{1}{2}(9.8 m/s^2)(0.5s)^2$

$d_y = 2.45\ m + 1.225\ m$

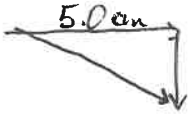
$d_y = 1.225\ m$

38) A bug starts at point A, crawls 8.0 cm east, then 5.0 cm south, 3.0 cm west, and 4.0 cm north to point B. (a) How far north and east is B from A? (b) Find the displacement from A to B both graphically and algebraically.




X: 8.0cm − 3.0cm = 5.0cm East

Y: 5.0cm − 4.0cm = 1.0cm South




$a^2 + b^2 = c^2$

$(5cm)^2 + (1cm)^2 = c^2$

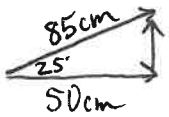
$26cm^2 = c^2$

$c = 5.1\ cm$

NAME_____ pd____

A. (a) 5.0 cm - EAST, 1.0 cm-SOUTH, (b) 5.10 cm - 11.3° SOUTH OF EAST
B. (a) 11.0 cm - EAST, 1.0 cm, SOUTH, (b) 11.1 cm - 5.2° SOUTH OF EAST
C. (a) 5.0 cm - EAST, 1.0 cm NORTH, (b) 5.1 cm - 11.3° NORTH OF EAST
D. (a) 5.0 cm - EAST, 9.0 cm SOUTH, (b) 10.1 cm - 60.9° SOUTH OF EAST

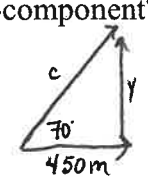
39) What displacement must be added to a 50 cm displacement in the +x-direction to give a resultant displacement of 85 cm at 25 degrees?




$a^2+b^2=c^2$
$50^2+b^2=85^2$
$2500+b^2=7225$
$b^2=4725$
$b=69\text{ cm}$

A. 69 cm at 90° B. 45 cm at 37°
C. 62 cm at 82° D. 45 cm at 53°

40) What displacement at 70 ° has an x-component of 450 m? What is its y-component?




$\cos(70)=\frac{450\text{m}}{c}$
$c\cos(70)=450\text{m}$
$c=\frac{450\text{m}}{\cos(70)}$
$c=1316\text{m}$
$c=1.3\text{km}$

$\tan(70)=\frac{y}{450\text{m}}$
$y=(450\text{m})\tan(70)$
$y=1236\text{m}$
$y=1.2\text{km}$

A. (a) 1.3 km, (b)1.2 km B. (a) 0.48 km, (b) 0.16 km
C. (a) 0.15 km, (b) 0.45 km D. (c) 0.42 km, (b) 0.42 km

41) A marble, rolling with speed 20 cm/s, rolls off the edge of a table that is 80 cm high. (a) How long does it take to drop to the floor? (b) How far, horizontally, from the table edge does the marble strike the floor?

$V_{ix}=.2\text{m/s}$ $d_y=.8\text{m}$ $t$

$d_y=V_{iy}t+\frac{1}{2}a_yt^2$
$0.8\text{m}=0t+\frac{1}{2}(9.8\text{m/s}^2)t^2$
$0.8\text{m}=(4.9\text{m/s}^2)t^2$
$t=0.4\text{s}$

$d_x=\left(\frac{V_{ix}+V_{fx}}{2}\right)t$
$d_x=\left(\frac{0.2\text{m/s}+0.2\text{m/s}}{2}\right)(0.4\text{s})$
$d_x=0.08\text{m}$
$dx=8\text{cm}$

A. (a) 4.0 s, (b) 4.0 cm B. (a) 8.2 s, (b) 0.8 cm
C. (a) 0.16 s, (b) 3.2 cm D. (a) 0.40 s, (b) 8.1 cm

42) A body projected upward from the level ground at an angle of 50° with the horizontal has an initial speed of 40 m/s. (a) How long will it take to hit the ground? (b) How far from the starting point will it strike? (c) At what angle with the horizontal will it strike?

A. (a) 3.1 s (b) 0.19 km (c) 90° B. (a) 6.3 s (b) 0.16 km (c) 50°
C. (a) 4.1 s (b) 0.25 km (c) 40° D. (a) 9.2 s (b) 0.08 km (c) 45°

43) A body is projected downward at an angle of 30° with the horizontal from the top of a building 170 m high. Its initial speed is 40 m/s. (a) How long will it take before striking the ground? (b) How far from the foot of the building will it strike? (c) At what angle with the horizontal will it strike?

A. (a) 8.3 s, (b) 0.084 km, (c) 90° B. (a) 4.4 s, (b) 0.167 km, (c) 45°
C. (a) 3.1 s, (b) 0.086 km, (c) 30° D. (a) 4.2 s, (b) 0.15 km, (c) 60°

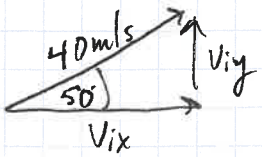
44) A hose lying on the ground shoots a stream of water upward at an angle of 40° to the horizontal. The speed of the water is 20 m/s as it leaves the hose. How high up will it strike a wall which is 8.0 m away?

A. 5.36 m B. 8.38 m C. 6.71 m D. 6.66 m

45) A ball is thrown upward at an angle of 30° to the horizontal and lands on the top edge of a building that is 20 m away. The top edge is 5.0 m above the throwing point. How fast was the ball thrown?

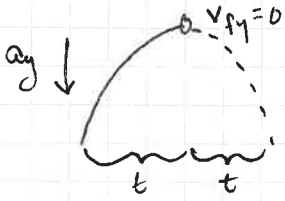
A. 11 m/s B. 20 m/s C. 16 m/s D. 5230 m/s

42. a) $\theta = 50°$
$v_i = 40\ m/s$
$t = ?$
$a_y = -9.8\ m/s^2$
$a_x = 0$




$\cos(50) = \frac{V_{ix}}{40\ m/s}$ $\quad (40\ m/s)\cos(50) = V_{ix}$ $\quad V_{ix} = 25.7\ m/s$

$\sin(50) = \frac{V_{iy}}{40\ m/s}$ $\quad (40\ m/s)\sin(50) = V_{iy}$ $\quad V_{iy} = 30.6\ m/s$




$V_{fy} = V_{iy} + a_y t$

$0 = (30.6\ m/s) + (-9.8\ m/s^2)t$

$-30.6\ m/s = (-9.8\ m/s^2)t$

$t = 3.13\ s$

$2t = 2(3.13\ s) = \boxed{6.3\ s}$

b) $d_x = ?$
$a_x = 0$
$t = 6.3\ s$
$V_{ix} = 25.7\ m/s$

$d_x = \left(\frac{V_{ix} + V_{fx}}{2}\right)t$

$d_x = \left(\frac{25.7\ m/s + 25.7\ m/s}{2}\right)(6.3\ s)$

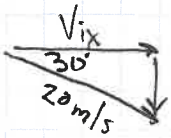
$d_x = (25.7\ m/s)(6.3\ s)$

$d_x = 162\ m$

$\boxed{d_x = 0.16\ km}$

c) Launched at 50°, and parabolic motion is symmetric horizontally, so it will also land at 50°.

43. a) $d_y = 170\ m$
$\theta = -30°$
$v_i = 20\ m/s$
$t = ?$
$a_y = 9.8\ m/s^2$




$\sin(30) = \frac{V_{iy}}{20\ m/s}$ $\quad (20\ m/s)\sin(30) = V_{iy}$ $\quad V_{iy} = 10\ m/s$

$\cos(30) = \frac{V_{ix}}{20\ m/s}$ $\quad (20\ m/s)\cos(30) = V_{ix}$ $\quad V_{ix} = 17.3\ m/s$

$d_y = v_{iy}t + \frac{1}{2}a_y t^2$

$170\ m = (10\ m/s)t + \frac{1}{2}(9.8\ m/s^2)t^2$

$0 = (4.9\ m/s^2)t^2 + (10\ m/s)t - 170\ m$

$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$t = \frac{-10 \pm \sqrt{10^2 - 4(4.9)(-170)}}{2(4.9)}$

$t = \frac{-10 \pm \sqrt{100 + 3332}}{9.8} = \frac{-10 \pm 58.6}{9.8}$

$+ \rightarrow \boxed{5.0\ s}$

$- \rightarrow -7.0\ s$

b) $d_x = ?$
$t = 5.0\ s$
$V_{ix} = 17.3\ m/s$
$a_x = 0$

$d_x = \left(\frac{V_{ix} + V_{fx}}{2}\right)t$

$d_x = \left(\frac{17.3\ m/s + 17.3\ m/s}{2}\right)(5.0\ s)$

$d_x = (17.3\ m/s)(5.0\ s)$

$d_x = 86.5\ m$

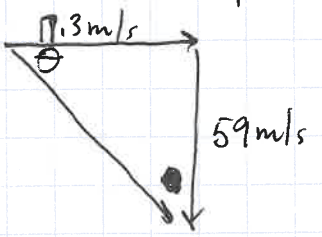
$\boxed{d_x = 0.087\ km}$

c) $V_{fx} = ?$
$V_{fy} = ?$
$a_y = -9.8 m/s^2$
$a_x = 0$

$V_{iy} = -10 m/s$
$V_{ix} = 17.3 m/s$
$t = 5.0 s$
$d_x = 86.5 m$
$d_y = 170 m$

$v_{ix} = V_{fx} = 17.3 m/s$

$V_{fy} = V_{iy} + a_y t$
$V_{fy} = -10 m/s + (-9.8 m/s^2)(5.0 s)$
$V_{fy} = -59 m/s$




$\tan\theta = \frac{59 m/s}{17.3 m/s}$

$\theta = 74°$