Exam

Name__________________________

**SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.**

1) Albert uses as his unit of length (for walking to visit his neighbors or plowing his fields) the albert (A), the distance Albert can throw a small rock. One albert is 92 meters. How many square alberts is equal to one acre? (1 acre = 43,560 ft$^2$ = 4050 m$^2$)

2) A foul ball is hit straight up into the air with a speed of 30.0 m/s.
   (a) Calculate the time required for the ball to rise to its maximum height.
   (b) Calculate the maximum height reached by the ball.
   (c) Determine the time at which the ball pass a point 25.0 m above the point of contact between the bat and ball.
   (d) Explain why there are two answers to part (c).

3) The figure shows a graph of the velocity as a function of time for a basketball player traveling up and down the court in a straight-line path. For the 10 s shown on the graph, find
   (a) the net displacement of the player.
   (b) the total distance run by the player.

![Velocity-time graph](image)

4) As part of an exercise program, a woman walks south at a speed of 2.00 m/s for 60.0 minutes. She then turns around and walks north a distance 3000 m in 25.0 minutes
   (a) What is the woman's average velocity during her entire motion?
      A) 0.824 m/s south
      B) 1.93 m/s south
      C) 2.00 m/s south
      D) 1.79 m/s south
      E) 800 m/s south
   (b) What is the woman's average speed during her entire motion?
      A) 0.824 m/s
      B) 1.93 m/s
      C) 2.00 m/s
      D) 1.79 m/s
      E) 800 m/s
5) Arthur and Betty start walking toward each other when they are 100 m apart. Arthur has a speed of 3.0 m/s and Betty has a speed of 2.0 m/s. Their dog, Spot, starts by Arthur’s side at the same time and runs back and forth between them at 5.0 m/s. By the time Arthur and Betty meet, what distance has Spot run?

6) A rocket takes off vertically from the launchpad with no initial velocity but a constant upward acceleration of 2.25 m/s². At 15.4 s after blastoff, the engines fail completely so the only force on the rocket from then on is the pull of gravity.
   (a) What is the maximum height the rocket will reach above the launchpad?
   (b) How fast is the rocket moving at the instant before it crashes onto the launchpad?
   (c) How long after engine failure does it take for the rocket to crash onto the launchpad?

7) The graph in the figure shows the position of an object as a function of time. The letters H-L represent particular moments of time. At which moments shown (H, I, etc.) is the speed of the object
   (a) the greatest?
   (b) the smallest?

8) The position of an object as a function of time is given by \( x(t) = at^3 - bt^2 + ct - d \), where \( a = 3.6 \text{ m/s}^3 \), \( b = 4.0 \text{ m/s}^2 \), \( c = 60 \text{ m/s} \) and \( d = 7.0 \text{ m} \).
   (a) Find the instantaneous acceleration at \( t = 2.4 \text{ s} \).
   (b) Find the average acceleration over the first 2.4 seconds.

9) Vector \( \vec{A} \) has a magnitude of 5.5 cm and points along the x-axis. Vector \( \vec{B} \) has a magnitude of 7.5 cm and points at \( 45^\circ \) above the negative x-axis.
   (a) Determine the x and y components of Vector \( \vec{A} \).
   (b) Determine the x and y components of Vector \( \vec{B} \).
   (c) Determine x and y components of the sum of these two vectors.
   (d) Determine the magnitude and direction of the sum of these two vectors.
10) In the figure, the magnitude of vector \( \vec{A} \) is 18.0 units, and the magnitude of vector \( \vec{B} \) is 12.0 units. What vector \( \vec{C} \) must be added to the vectors \( \vec{A} \) and \( \vec{B} \) so that the resultant of these three vectors points in the -x direction and has a magnitude of 7.50 units? Use vector components to find your answer, and express vector \( \vec{C} \) by giving its magnitude and the angle it makes with the +x-axis taking counterclockwise to be positive.

11) For the vectors shown in the figure, express vector \( \vec{S} \) in terms of vectors \( \vec{M} \) and \( \vec{N} \).

12) Vector \( \vec{A} \) has a magnitude of 75.0 cm and points at 30° above the positive x-axis. Vector \( \vec{B} \) has a magnitude of 25.0 cm and points along the negative x-axis. Vector \( \vec{C} \) has a magnitude of 40.0 cm and points at 45° below the negative x-axis.

(a) Determine the x and y components of Vector \( \vec{A} \).
(b) Determine the x and y components of Vector \( \vec{B} \).
(c) Determine the x and y components of Vector \( \vec{C} \).
(d) Determine x and y components of the sum of these three vectors.
(e) Determine the magnitude and direction of the sum of these three vectors.
13) A hiker throws a stone from the upper edge of a vertical cliff. The stone's initial velocity is 25.0 m/s directed at 40.0° with the face of the cliff, as shown in the figure. The stone hits the ground 3.75 s after being thrown and feels no appreciable air resistance as it falls.
(a) What is the height of the cliff?
(b) How far from the foot of the cliff does the stone land?
(c) How fast is the stone moving just before it hits the ground?

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14) A projectile is fired from point 0 at the edge of a cliff, with initial velocity components of \( v_0x = 60 \text{ m/s} \) and \( v_0y = 175 \text{ m/s} \), as shown in the figure. The projectile rises and then falls into the sea at point P. The time of flight of the projectile is 40.0 s, and it experiences no appreciable air resistance in flight. What is the magnitude of the velocity of the projectile 21.0 s after it is fired?

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15) An airplane is flying at a speed of \( 2.00 \times 10^2 \text{ m/s} \) in level flight at an altitude of \( 8.00 \times 10^2 \text{ m} \). A package is to be dropped from the airplane to land on a target on the ground. Ignore air resistance.
(a) At what horizontal distance away from the target should the package be released so that it lands on the target?
(b) In what direction relative to the horizontal will the package be traveling when it hits the ground?
16) A projectile returns to its original height 4.08 s after being launched, during which time it travels 76.2 m horizontally. If air resistance can be neglected, what was the projectile's initial speed?

17) A rock is thrown directly upward from the edge of the roof of a building that is 66.2 meters tall. The rock misses the building on its way down, and is observed to strike the ground 4.00 seconds after being thrown. Neglect any effects of air resistance. With what speed was the rock thrown?

18) A cat runs along a straight line (the x-axis) from point A to point B to point C, as shown in the figure. The distance between points A and C is 5.00 m, the distance between points B and C is 10.0 m, and the positive direction of the x-axis points to the right. The time to run from A to B is 20.0 s, and the time from B to C is 8.00 s. As the cat runs along the x-axis between points A and C
   (a) what is the magnitude of its average velocity?
   (b) what is its average speed?

19) A soccer ball is released from rest at the top of a grassy incline. After 8.6 seconds, the ball travels 87 meters and 1.0 s after this, the ball reaches the bottom of the incline.
   (a) What was the magnitude of the ball's acceleration, assume it to be constant?
   (b) How long was the incline?

20) A hockey puck slides off the edge of a table at point A with an initial velocity of 20.0 m/s and experiences no air resistance. The height of the tabletop above the ground is 2.00 m.
   (a) What is the speed (not the velocity) of the puck just before it touches the ground?
   (b) What is the distance between point A and the point where the puck hits the ground?

21) A disk-shaped space station 175 m in diameter spins uniformly about an axis perpendicular to the plane of the disk through its center. How many rpm (rev./min) must this disk make so that the acceleration of all points on its rim is g/2?
22) The figure shows the position of an object as a function of time, with all numbers accurate to two significant figures. Between time $t = 0.0 \text{ s}$ and time $t = 9.0 \text{ s}$

(a) what is the average speed of the object?
(b) what is the average velocity of the object?

23) The figure represents the position of a particle as it travels along the $x$-axis. Between $t = 2 \text{ s}$ and $t = 4 \text{ s}$, what is (a) the average speed of the particle and (b) the average velocity of the particle?

24) A child throws a ball with an initial speed of 8.00 m/s at an angle of 40.0° above the horizontal. The ball leaves her hand 1.00 m above the ground and experience negligible air resistance.

(a) What is the magnitude of the ball's velocity just before it hits the ground?
(b) At what angle below the horizontal does the ball approach the ground?
25) The figure shows the position of an object as a function of time. During the time interval from time \( t = 0.0 \) s and time \( t = 9.0 \) s
(a) what is the length of the path the object followed?
(b) what is the displacement of the object?

![Position vs. Time Graph]

26) A child throws a ball with an initial speed of 8.00 m/s at an angle of 40.0° above the horizontal. The ball leaves her hand 1.00 m above the ground and experience negligible air resistance.
(a) How far from where the child is standing does the ball hit the ground?
(b) How long is the ball in flight before it hits the ground?

27) A projectile is fired from point 0 at the edge of a cliff, with initial velocity components of \( v_{0x} = 60.0 \) m/s and \( v_{0y} = 175 \) m/s, as shown in the figure. The projectile rises and then falls into the sea at point P. The time of flight of the projectile is 40.0 s, and it experiences no appreciable air resistance in flight. What is the height of the cliff?

![Projectile Motion Diagram]

28) The horizontal coordinates of a Frisbee™ in a strong wind are given by
\[ x = -12t + 4t^2 \]  and \[ y = 10t - 3t^2 \], where \( x \) and \( y \) are in meters, and \( t \) is in seconds.
(a) What is the acceleration of the Frisbee? Give a magnitude and a direction, measuring angles from the positive \( x \) direction.
(b) What is the magnitude of the velocity at \( t = 2.0 \) s, accurate to the nearest m/s?
29) A wind farm generator uses a two-bladed propeller (see figure) mounted on a pylon at a height of 20 m. The length of each propeller blade is 12 m. A small piece from the tip of the propeller breaks off when the propeller is vertical. At that instant, the period of the motion of the propeller is 1.2 s. The fragment flies off horizontally, falls with negligible air resistance, and strikes the ground at \( P \).

(a) How far is point \( P \) from the base of the pylon?

(b) At what angle with respect to the vertical is the fragment moving just as it strikes the ground at \( P \)?

![Diagram of a wind farm generator with a break-off fragment](image)

30) A swimmer heading directly across a river 200 m wide reaches the opposite bank in 6 min 40 s, during which time she is swept downstream 480 m.

(a) How fast can she swim in still water?

(b) What is the speed of the current?
Answer Key
Testname: REVIEWTEST1

1) 1.29 A^2
2) (a) 3.06 s  (b) 45.9 m  (c) 0.995 s and 5.13
   (d) One value is for the ball traveling upward; one value is for the ball traveling downward.
3) (a) 18 m  (b) 20 m
4) (a) A  (b) C
5) 100 m
6) (a) 328 m  (b) 80.2 m/s  (c) 11.7 s
7) (a) I  (b) I
8) (a) 44 m/s^2
    (b) 18 m/s^2
9) (a) A_x = 5.5 cm, A_y = 0
    (b) B_x = -6.5 cm, B_y = 3.8 cm
    (c) R_x = -1.0 cm, R_y = 3.8 cm
    (d) 3.9 cm at 75° above -x- axis
10) 15.5, 209°
11) \vec{S} = \vec{M} - \vec{N}
12) (a) A_x = 65 cm, A_y = 38 cm
    (b) B_x = -25 cm, B_y = 0
    (c) C_x = -28 cm, C_y = -28 cm
    (d) R_x = 12 cm, R_y = 9.2 cm
    (e) 15 cm at 38° above +x- axis
13) (a) 141 m  (b) 60.3 m  (c) 58.2 m/s
14) 67.4 m/s
15) (a) 2.56 km  (b) 32.1° below the horizontal
16) 27.4 m/s
17) 3.05 m/s
18) (a) 0.179 m/s  (b) 0.893 m/s
19) a) 2.4 m/s^2  b) 110 m
20) (a) 21.0 m/s  (b) 12.9 m
21) 2.26 rev/min
22) (a) 0.56 m/s  (b) 0.11 m/s
23) (a) 1.0 m/s  (b) 0.00 m/s
24) (a) 9.14 m/s  (b) 47.9°
25) (a) 5.0 m  (b) 1.0 m
26) (a) 7.46 m  (b) 1.22 s
27) 840 m
28) (a) 10 m/s^2, 323°
    (b) 4 m/s
29) (a) 160 m  (b) 68°
30) (a) 0.50 m/s  (b) 1.2 m/s