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# 3-1 vectors and projectiles answers

Loading... Two-dimensional movement and vectors Chapter 3 2. Introduction to Vectors • A scaler is a quantity that can be completely specified by its magnitude • A vector is a physical quantity that has both magnitude and direction. • Some examples of vector quantities are speed, acceleration, displacement and forces. • Vectors can be added graphically, but when adding vectors you need to make sure that they have the same units and that vectors describe similar amounts. • The answer found by adding vectors is called a result. 3. Vector operations The magnitude and direction of the result of two perpendicular vectors can be calculated using Pythagoras Theorem and Tangent Function. Vector scale → The Pythagoras Theorem Directorate of the vector → Tangent function 4. Basic vector operations Both a magnitude and a direction shall be specified for a vector quantity as opposed to a scalar quantity that can only be quantified by a number. Any number of vector quantities of the same type (i.e. the same units) may be combined by basic vector operations. 5. Add 2 Vectors 6. Add 3 Vectors 7. Set #9 P/3 A football player runs 15 m down on the field, and then turns left at an angle of 15o from its original direction and runs an additional 10 m before getting addressed Find the magnitude and direction 15 m 10m 15o Bx of 8. P/5 Set # 9 A person walking is the path shown below, what is the resulting person moving measured from the starting person 60 ° 30 ° 100 m 300 m 150 m 200 m? Ax = _____ Ay = _____ Bx = _____ By = _____ Cx = _____ Cy = _____ Dx = _____ Dy = _____ ∑x = _____ ∑y = _____ Vector result 9. Example 4: A plane flies from city A to city B. City B is 1,540 km west and 1,160 km south of city A. What is the total movement and direction of the plane? a) 1,930 km, 43° south of west b) 1,850 km, 43° southwest c) 1,850 km, 37° southwest d) 1,930 km, 37° southwest 10. A plane flies from city A to city B. City B is 1,540 km west and 1,160 km south of city A. What is the total movement and direction of the plane? A 1,540 km 1,160 km B 11. Example #5 During a rodeo, a clown runs 8 m north, turns 35o east north and runs 3.5 m. Then, after waiting for the bull to approach, the clown turns east and runs 5m to exit the arena. Find the clown's movement 35o 8 m 3.5 m 5 m Ax = _____ Ay = _____ Bx = _____ By = _____ Cx = _____ Cy = _____ ∑x = _____ ∑y = _____ Vector result 12. Example 6: A duck bends 2.5 m east and 6 m north. What is the magnitude and direction of the duck's movement in relation to its original position? (a) 3.5 m to 19° north east b) 6.3 m to 67° north east c) 6.5 m to 67° north east d) 6.5 m to 72° north of east 13. Physics Set # 10 Oct/2/2007 Student Name: _____ Class Period: _____ P/1 A person goes the path shown below: a) Find the movement of the resulting person measured from the starting point b) b) direction Answers: a)_ b) _____ P/2 A person walks the path shown below: a) Find the resulting movement of the person measured from the starting point b) Determination of direction Responses: a)_____ b) _____ _____ 150 m 150 m 300 m 150 m 30o 60o 120 m 20o 500 m 250 m 125 m 160 m 25o 15o 14. Physics Set # 11 Oct/3/2007 Student Name: _____ Class Period: _____ P/1 Mr. C designed play 2244 in football, which will send a receiver to the field after explaining in the following diagram. a) Find the movement of this receiver b) Find the direction Answers: a) _____ b) _____ P/2 Mr. C designed play 4877 in football, which will send a receiver to the field, as explained in the following diagram. a) Find the movement of this receiver b) Find the direction Answers: a) _____ b) _____ 50o 7 yds 6 yds 5 yds 30o 14 yds 10 yds 6 yds 20o 4 yds 12 yds 15. Physics Set # 12 Oct/4/2007 Student Name: _____ Class Period: _____ P/1 Lord C designed play 485 in football, which will send a receiver to the field after explaining in the following diagram. a) Find the movement of this receiver b) Find the direction Answers: a) _____ b) _____ P/2 Mr. C designed play 4877 in football, which will send a receiver to the field, as explained in the following diagram. a) Find the movement of this receiver b) Find the direction Answers: a) _____ b) _____ 60o 6 yds 4 yds 3 yds 40o 16 yds 15 yds 7 yds 40o 5yds 11 yds 20o 8 yds 75o 16. Physics Set # 13 Oct/4/2007 Student Name: _____ Class Period: _____ P/1 Mr. C designed play 775 in football, which will send a receiver to the field after explaining in the following diagram. a) Find the movement of this receiver b) Find the direction Answers: a) _____ b) _____ P/2 Mr. C designed play 4877 in football, which will send a receiver to the field, as explained in the following diagram. a) Find the movement of this receiver b) Find the direction Answers: a) _____ b) _____ 60o 6 yds 4 yds 40o 12 yds 12 yds 7 yds 40o 5yds 8 yds 18 yds 65o 17. P/3 A person goes down the path shown below: a) Find the resulting movement of the measured person from the starting point b) Determination of the direction Responses: a)_ b) _____ P/4 A person goes on the path shown below: a) Find the resulting movement of the person measured from starting point b) Determination of direction Responses: a)_____ b) _____ 180 m 250 m 60o 60o 60o 50o 50o 500 m 250 m 125 m 160 m 25o 15o 20° 18. Vectors • Vector study allows a single vector to be broken into components: ▲ the vertical component ▲ the horizontal component. • By breaking a single vector into two components or resolving it in its components, the movement of an object can sometimes be more conveniently described in terms of directions, would be from north to south or up and down. vy vx vi 19. Essay: Wernher von 2 pages / 12 font Knock Paragraph: topic + 2 concrete details +4 comments + final sentence • Early childhood • Family • His achievements in Germany • His involvement in the Nazi Party • has he arrived in the United States? • Its achievements in the United States 20. Motion 21 projectile. Projectile movement • A projectile is any object on which the only force acting is gravity. • Projectiles travel on a parabolic trajectory due to the influence of gravity, • There are no horizontal forces to act on projectiles and therefore no horizontal acceleration, • The horizontal speed of a projectile is constant (never changes in value), • There is vertical acceleration caused by gravity; its value is -9.81 m/s2, down. • The vertical speed of a projectile changes by – 9.81 m/s every second. • The horizontal movement of a projectile is independent of its vertical motion. 22. Projectile movement A projectile is an object on which the only force acting is gravity. There are a variety of examples of projectiles 1. An object that is free disallowed is a projectile (provided that the influence of air resistance is negligible). 2. An object that is thrown vertically upwards is also a projectile (provided that the influence of air resistance is negligible). 3. An object that is thrown up at an angle is also a projectile (provided that the influence of air resistance is negligible). • A projectile is any object that, once designed, continues in motion by its own inertia and is influenced only by the downward force of gravity. 23. Projectile movement • By definition, a projectile has a single force acting on - the force of gravity. If there was any other force acting on an object, then that object would not be a projectile. Thus, the diagram of the free body of a projectile would show a single force acting downwards and labeled a force of gravity (or simply Fg). • This means that whether a projectile moves downwards, up, up and to the right, or down and to the left, the diagram of the projectile's free body is still described in the following diagram 24. Motion 25 projectile. Projectile Movement 26. Projectile Movement 27. Many Motion Projectile projectiles not only undergo a vertical motion, but also suffer a horizontal motion. That is, so moving up and/or down, they are also moving horizontally. There are two components of the projectile movement - horizontal and vertical motion. And since the perpendicular motion components are independent of each these two motion components can (and must) be discussed separately. • The purpose of this part of the lesson is to discuss the horizontal and vertical components of the movement of a projectile; particular attention will be paid to the presence/absence of forces, speed. 28. Motion 29 Projectile. Motion Projectile • In this course, we will study 2 different situations about projectiles: • 1. Projectiles launched horizontally • 2. Projectiles launched at an angle of 30. Launched projectiles Horizontal motion of a projectile Δx = vx Δt vx = vi,x = constant vertical motion of a projectile Δy = 1/2 a(Δt)2 vy,f = a Δt vy,f 2 = 2 aΔy 31. Projectiles launched at an angle The horizontal movement of a projectile Δx = vi (cos ρΔt vx =vi -cos = constant vertical motion of a projectile Δy = vi sin-Δ Δ ρ 2 vy,f = vi-sin + a-Δt vy,f2 = vi2 (sin ρ)2 +2 a-Δy VX,i = vi cos Vyx,i = vi sin Vx v 32. Example #1 The New York Yankees, looking for their unprecedented 27. World Series Championships, have an extraordinary pitching rotation. One of our best pitchers is Mike Mussina, aka Moose, who is able to throw his fast ball at 92 mph. If he threw at the house-plate (horizontal) (60 ft away), how far will the ball fall vertically from the moment he gets home the board?. HORIZONTAL MOVEMENT OF A PROJECT Δx = vixΔt vix = constant vix = vx VERTICAL MOVEMENT of a projectile Δy = a (Δt)2 2 33. Example #1 Moose who is able to throw his fastball at 92 mph. If he threw at the house-plate (horizontal) (60 ft away), how far will the ball fall vertically from the moment he gets home the board?. Given: vix = 92 mi/h → vix = 41 m/s Δx = 60 ft → Δx = 18.29 m Unknown: Δt =?, Δy=? Solution: • First find the time it takes for baseball to reach the starting plate: Δx = vix Δt Δt = Δx/vix Δt = 18.29 m / 41 m/s = 0.44 s • Now find the vertical fall: Δy = 1/2 a(Δt)2 = 1/2 (-9.81 m/s2) (0.44 s)2 = - 0.95 m 34. Example #2 A plane wants to throw a package of cargo into a drop zone. The aircraft is 120 m above ground and is moving at a speed of 40 m/s in the positive direction x. Find out how long the cargo load will take to get to the ground, and how long the horizontal distance will take to drop it into the landing area. • Data: Δy = -120 m a = -9.81 m/s2 vx = 40 m/s • Unknown: Δt, Δx Δx 120 m Drop Zone 35. Example 2: A plane wants to dump a cargo package into a drop zone. The aircraft is 120 m above ground and is moving at a speed of 40 m/s in the positive direction x. Find out how long the cargo load will take to get to the ground, and how long the horizontal distance will take to drop it into the landing area. • Given: Δy = -120 m a = -9.81 m/s2 vi,x = 40 m/s • vi,y = 0 m/s • Unknown: Δt, Δx • Solution: Δy = 1/2 a Δt2 → Δt2 = 2Δy/a Δt2 = (2) (-12) 0 m )/ (- 9.81 m/s2) Δt2 = 24,464 → Δt = √ 24.64 Δt = 4.96 s Δx = vi.x Δt Δx = (40 m/s) (4.96 s) Δx = 198.40 m 36. Example #3 People in movies often jump from buildings into swimming pools. If a person jumps from a 10th. floor (30 m) to a pool that is 5 m from the building, at what initial horizontal speed must the person jump? • Considering: • ρy = - 30 m ρx = 5 m a = - 9.81 m/s2 30 m 5 m 37. Example 4: A zookeeper finds an escaped monkey hanging from a light pole. Targeting the tranquilizer gun at the monkey, the garden caretaker kneels 12 m from the light pole which is 6 m high. The top of the weapon is 1 m above the ground. The monkey tries to trick the zookeeper into throwing a banana, then continues to hold on to the light. Light. The moment the monkey releases the banana, the zookeeper pulls. If the tranquilizer arrow travels at 50 m/s, will the arrow hit the monkey or banana? 6 m 12 m 1m 38. Steps • 1. Find the angle : © = bronze (5/12) = 23o • 2. Find the time it takes to reach the target: Δx = vi -cos ρ-Δt Δt = Δx / vi (cos ρ Δt = 39). Example 3: O is pulled from the ground at an initial speed of 1,700 m/s at an initial angle of 30° to the horizontal. Neglect of air resistance, find: a) Horizontal radius of the ball b) The period of time during which the ball was moving • Considering: vi = 1,700 m/s © = 30° a = -9.81 m/s2 • Unknown: Δt, Δx, Δy • Steps: Δx = vi cos © Δt → Δx = (1,700 m/s) cos 30°Δt Δx = 1,472.24 m/s Δt Δy = vi sin © Δt + 1/2 a (Δt)2 → Δy = (1,700 m/s) sin 30° Δt + 1/2 (- 9.81 m/s2) Δt2 Δ = 850 m/s Δt – 4.91 Δt2 Δy = 0 (because it ends in the same vertical position) 4.91 Δt2- 850 Δt = 0 4.91 Δt- 850 = 0 Δt = 173 s Δx = (1.472.24 m/s) (173 s) Δx = 254.697.52 m 40. Golf and physics When you play golf, you have a variety of golf clubs to hit for different distances. Most people use the driver to tee off on 4's hair, and then an iron 7 from the middle of the fairway. The driver usually has an angle of 10°, and 7 iron swells an angle of 35°, Calculate the horizontal and vertical displacement of a golfer who hits golf balls at an average initial speed of 120 mi/h for the initial 10s after impact. www,explore the axis science.com Y Axis X (0.0) Height Time (t.0) 41. Driver 10° vi = 120 mi/h (53.63 m/s) Δt Δx = vi cosρ Δt Δy = vi sin ρ Δt + 1/2 a Δt 2 1s 52.82 m 4.41 m 2s 105.63 m - 1.63 m 00 m 3s 158.45 m 4s 211.26 m 5s 264.08 m 6s 316.89 m 7s 369.71 m 8s 417.22 m 9s 469.37 m 10s 521.52 m 42. 7 iron 35° vi = 120 mi/h (53.63 m/s) Δt Δx = vi cosρ Δt Δy = vi sin ρ Δt + 1/2 a Δ 2 1s 43.93 m 25.86 m 2s 87.86 m 41.90 m 3s 131.79 m 48.14 m 4s 17 5.72 m 44.56 m 5s 219.66 m 31.18 m 6s 263.59 m (241 yd) 7.9 9 m 7s 307.52 m - 25.02 m 8s 351.45 m 9s 395.38 m 10s 439.31 m 43. Something's wrong??? • The average displacement for an iron 7 is 150 yds!! • Calculate the angle for: • Vi = 120 mi/h → 53.63 m/s • Δx = 150 yds → 137.16 m • Δt = 6.3s ? • θ = ????? 44. BONUS POINTS The great pyramid of Giza has a height of about 150 m and a square base of about 230 m on one side. What is the approximate surface of a horizontal cross-section of the pyramid taken 50 m above its base? (Determine this by using 3 different methods!!) a) 5,880 m2 b) 11,760 m2 c) 23,510 m2 d) 35,270 m2 45. A B C E D F G 46. A B CD = 230 m AG = 150 m GF = 50 m C E D F G 47. AG = AF CD BE = 153.33 m BE2 = 23,511 m2 A B CD = 230 m AG = 150 m GF = 50 m AF = 100 m C E D F G 50 m 100 m 230 m 48. BONUS POINTS Using a protractor, a student measures the sum of the inner angles in a triangle and obtains 176°. What is the percentage error of this measurement? a) 0.04% b) 2.22% 2.27% d) 4.00% 49. BONUS POINTS For what value c will the function below have exactly a vertical asymptotes? y = ____4_____ x2 – cx + 9 a) 0 b) 4 4 6 (d) 9 50. Comparing a driver and an iron Δ 7 (m) Δx (m) 50 100 75 m 100 m 150 m 25 51. Example #3 From the top of a tall building, a gun is fired. The bullet leaves the weapon at a speed of 340 m/s, parallel to the ground. The bullet makes a hole in a window of another building and hits the wall facing the window. (y = 0,60 m and x = 6,8 m.) Using the data in the drawing, determine the distances D and H, which locate the point at which the weapon was fired. Suppose the bullet doesn't slow down as it passes through window 52. Example 4: A golfer practices driving balls off a cliff and in the water below. The cliff is 15 m above the water. If the golf ball is launched at 51 m/s at an angle of 15°. How far does the ball go horizontally before hitting the water? 15 m 53. • For ax2 + bx + c = 0 the value of x is given by: 54. Summer School Physics Set # June 9/16/2008 Student name: _____ Class Period: _____ P/1 A golfer practices driving balls of a rock and into the water below. The cliff is 12 m above the water. If the golf ball is launched at 61 m/s at an angle of 25°. How far does the ball go horizontally before hitting the water? Answer: _____ P/2 A footballer must hit a football from a point of 36 m (about 40 yd) from the goal, and the ball must release the crossbar, which is 3.05 m high. When hit, the ball leaves the ground at a speed of 20 m/s at an angle of 53° to the horizontal. A. By how much does the clear ball fall short by clearing the crossbar? B. The ball approaches the crossbar while still rising or while falling Answers: A = _____ B = _____ P/3 A daredevil jumps a canon 12 m wide. To do this, he drives a car on a 15° slope. A) What minimum speed must it reach to empty the canyon? B) If daredevil jumps at this minimum speed, what will his speed be when he reaches the other side? Answers: A = _____ B = _____ 55. Example 4: A golfer practices driving balls off a cliff and in the water below. The cliff is 15 m from the water. If the golf ball is launched at 51 m/s at an angle of 15°. How far does the ball go horizontally before hitting the water? • Data: Δy = - 15 m, v = 51 m/s, Find time that it takes the golf ball to hit the water • 2. Find horizontal displacement • To find time: Δy = vi sinA Δt + 1/2 a Δt2 - 15 =(51 m/s) sin15°Δt - 1/2 (9.81) Δt2 • - 15 = 13.2 Δt - 4.91 Δt 2 4.91 Δ Δ 13.2 Δt – 15 = 0 Δt = - b ±√b2 , 4 needle 2 Δt = 13.20 ± 21.65 Δt = 3.55 s Δx = vi cosO-Δt Δx = 174.87 m 56. Example #5 A kicker place must kick a football from a point of 36 m (about 40 yd) from the goal, and the ball must clear the crossbar, which is 3.05 m high. When it is the ball leaves the ground at a speed of 20 m/s at an angle of 53° to the horizontal. A. By how much does the clear ball fall short by clearing the crossbar? B. Does the ball approach the crossbar while still rising or falling? Δx = 36 m Δy = 3.05 m A instead kicker must kick a football from a point of 36 m (about 40 yd) from the goal, and the ball must clear the crossbar, which is 3.05 m high. When hit, the ball leaves the ground at a speed of 20 m/s at an angle of 53° to the horizontal. • Considering: Δx = 36 m,, =53°, a = - 9.81 m/s2, vi = 20 m/s • Δy = 3.05 m ? • Unknown: Δt • Solution: • First find the time it takes for the ball to reach the goal station, then determine how big the ball will be at that point to see if it releases the goal post. • Δx = vi cosO Δt → • 36 m = (20 m/s) (cos 53°) Δt • 36 m = (12.04 m/s) Δt • Δt = 36 m/ 12.04 m/s • 2.99 s 58. Example #6: A daredevil jumps a canon 12 m wide. To do this, he drives a car on a 15° slope. A) What minimum speed must it reach to empty the canyon? B) If daredevil jumps at this minimum speed, what will his speed be when he reaches the other side? 59. Physics Set # October 14, 2007 Student Name: _____ Class Period: ___ P/1 If you throw a baseball horizontally at 85 mph to the home board (60 ft away), how much will the baseball drop once you get to the home board (neglect of air resistance)? Answer: _____ P/2 If you throw a baseball horizontally at 75 mph to the home board (60 ft away), how much will the baseball drop once you get to the home board (neglect of air resistance)? Answer: _____ P/3 A plane wants to throw a package of cargo into a drop zone. The aircraft is 150 m above ground and is moving at a speed of 50 m/s in the positive direction x. Find out how long the cargo load will take to get to the ground, and how long the horizontal distance will take to drop it into the landing area. Answer: _____ P/4 A plane wants to dump a cargo package in a drop zone. The aircraft is 250 m above ground and is moving at a speed of 80 m/s in the positive direction x. Find out how long the cargo load will take to get to the ground, and how long the horizontal distance will take to drop it into the landing area. Answer: _____ 60. Physics Set # November 15, 2007 Student Name: _____ Class Period: _____ P/1 O is pulled from the ground at an initial speed of 500 m/s at an initial angle of 40 ° to the horizontal. Neglect of air resistance, find: a) Horizontal ball radius Answer: _____ b) The amount of time the ball was moving Response: ____ c) Maximum height at which the ball reaches Answer: _____ P/2 O is pulled from the ground at an initial speed of 400 m/s at an initial angle of 60° from the horizontal. Neglect of air resistance, find: a) Horizontal radius of the ball Answer: _____ b) Time during which the ball was moving Answer: ____ c) Maximum height at Get the ball Answer: _ ___ P/3 A golfer practices steering the balls of a cliff and in the water below. The cliff is 15 m from the water. If the golf ball is launched at 60 m/s at an angle of 10°. a) How far does the ball go horizontally horizontally hitting the water? 61. Δy = 1/2 a (Δt)2 _____ Δt = √ 2 Δy a Δt = 4.95 s Δx = VxΔt = (40 m/s) (4.95 s) = 198 m 62. Bonus Points • A fifth-grade class uses pattern blocks in the form of congruent equilateral triangles to design and solve problems involving fractions. A group conceives the problem illustrated below. • Since the sum of forms A and B is 5/8, which of the following represents 1 1/4? • A) 63. Physics of projectile movement 64. Driver 10° vi = 120 mi/h Δt Δx = vi cosρ Δt Δy = vi sin Δ ρt + 1/2 a Δt 2 1s 2s 3s 4s 5s 6s 7s 8s 9s 10s 65. 7 iron 35° vi = 120 mi/h Δt Δx = vi cosρ Δt Δy = vi sin Δt + 1/2 a Δt 2 1s 2s 3s 4s 5s 6s 7s 8s 9s 10s 10s

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