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Chapter 3 Homework

QUESTIONS

10. Does the odometer of a car measure a scalar or a vector quantity? What about the speedometer?

The odometer of a car measures a scalar quantity. The speedometer also measures a scalar quantity.

16. A projectile is launched at an upward angle of 30° to the horizontal with a speed of 30m/s. How does the horizontal component of its velocity 1.0s after launch compare with its horizontal component of velocity 2.0s after launch, ignoring air resistance? Explain.

The projectile will be farther away after 2 seconds than it is at 1 second. It's velocity in the horizontal direction will not change, though, because the force of gravity will only have an effect on the vertical velocity.

17. A projectile has the least speed at what point in its path?

A projectile has the least speed at the apex of it's climb and the termination of it's path.

19. A person sitting in an enclosed train car, moving at a constant velocity, throws a ball straight up into the air in her reference frame.

(a) Where does the ball land?

The ball lands where it started on the train.

(b) Where does the ball land if the car accelerates?

The ball lands in the negative x direction in relation to it's starting position in the train's reference frame.

(c) Where does the ball land if the car deccelerates?

In the train's reference frame, the ball will land +x from where it started.

(d) Where does the ball land if the car rounds a curve?

In this case, the ball will land offset by some value of z and likely an offset of x as well.

(e) Where does the ball land if the car moves with constant velocity but is open to the air?

Assuming air resistance, the ball will land behind it's starting position, that is the -x direction.

MISCONCEPTION QUESTIONS

4. Which of the following equations correctly expresses the relation beween vectors $\vec{A}, \vec{B},$ and $\vec{C},$ shown in Fig 3-36?

(b)$\vec{B} = \vec{A} + \vec{C}$

6. A bullet fired horizontally from a rifle begins to fall

(a) as soon as it leaves the barrel

9. Two balls having different speeds roll off the edge of a horizontal table at the same time. Which hits the floor sooner?

(c) Both the same.

10. You are riding in an enclosed train car moving at 90km/h. If you throw a baseball straight up, where will the baseball land?

(c) In your hand.

11. Which of the three kicks in Fig. 3-38 is in th eair for the longest time? They all reach the same maximum height h. Ignore air resistance.

(c)

13. A hunter is aiming horizontally at a monkey who is sitting in a tree. the monkey is so terrified when it sees the gun that it falls off the tree. At that very instant, the hunter pulls the trigger. What will happen?

(d) It depends on how far the hunter is from the monkey.

PROBLEMS

1. A car is driven 245 km west and then 118 km southwest ($45°$). What is the displacement of the car from the point of origin (magnitude and direction)? Draw a diagram.

$\vec{v}$	v_x	v_y
West	-245	
Southwest	-83.44	-83.44
Total	-328.44	-83.44

$$tan^{-1}\left(\frac{-83.44}{-328.44}\right) = 14.25$$

$$R = \sqrt{(-83.44)^2 + (-328.44)^2} = 338.9$$

$$Displacement = 338.9 \angle 14.25° Southwest$$

2. If $V_x = 9.40$ units and $V_y = -6.80$ units, determine the magnitude and direction of $\vec{V}$

$$tan^{-1}(\frac{9.40}{-6.80}) = -54.1°$$

$$V_r = \sqrt{9.40^2 + 6.80^2} = 11.6$$

$\vec{V} = 11.6 \angle 54.1°$ south of east

8. An airplane is traveling 815km/h in a direction $41.5°$ west of north.

(a) Find the components of the velocity vector in the northerly and westerly directions.

$$cos(41.5) = \frac{y}{815} \implies y = 815(cos(41.5)) = 610.4$$

610.4 km/h North

$$sin(41.5) = \frac{x}{815} \implies x = 815(sin(41.5)) = 540.0$$

540.0 km/h West

(b) How far north and how far west has the plane traveled after 1.75h?

$$610.4 \times 1.75 = 1068.2$$

1068.2 km North

$$540.0 \times 1.75 = 945$$

945 km West

9. The summit of a mountain, 2450 m above base camp, is measured on a map to be 4580 m horizontally from the camp in a direction 38.4° west of north. What are the components of the displacement vector from camp to summit? What is its magnitude? Choose the x axis east, y axis north, and z axis up.

$$sin38.4 = \frac{x}{4580} \implies x = 4580sin38.4 \implies x = 2844.9m$$
$$cos38.4 = \frac{y}{4580} \implies y = 4580cos38.4 \implies y = 3589.3m$$

z: 2450m

magnitude: 4580m

10. Three vectors magnitudes are given in arbitrary units. Determine the sum of the three vectors. Give the resultant in terms of

(a) components

Vector	Resultant	Degree	Calculations	$\vec{V}_x$	$\vec{V}_y$
$\vec{A}$	42.0	28.0	$\vec{A}_x = 42cos(28)$	37.08	
			$\vec{A}_y = 42sin(28)$		19.72
$\vec{B}$	29.7	56.0	$\vec{B}_x = 29.7cos(56.0)$	-16.61	
			$\vec{B}_y = 29.7sin(56.0)$		24.62
$\vec{C}$	31.0				-31.0
$\vec{D}$			$\vec{D}_x = 37.08 - 16.61$	20.47	
			$\vec{D}_y = 19.72 + 24.62 - 31.0$		13.34
		33.09	$tan^{-1}(\frac{13.34}{20.47})$		
	24.43		$\vec{D}_R = \sqrt{(13.34)^2 + (20.47)^2}$		

(b) magnitude and angle with the +x axis

$\vec{D} = 24.43\angle 33.09^\circ$

32. A tiger leaps horizontally from a 7.5-m-high rock with a speed of 3.0m/s. How far from the base of the rock will he land?

$$\Delta y = v_{0y}t - \frac{1}{2}gt^2 \implies -7.5 = -4.9t^2 \implies \sqrt{\frac{-7.5}{-4.9}} = t = 1.24s$$
$$\Delta x = v_{x0}t \implies \Delta x = 3.0(1.24) \implies \Delta x = 3.72m$$

34. A ball is thrown horizontally from the roof of a building 7.5m tall and lands 9.5m from the base. What was the ball's initial speed?

$$\Delta y = v_{0y}t - \frac{1}{2}gt^2 \implies -7.5 = -4.9t^2 \implies \sqrt{\frac{-7.5}{-4.9}} = t = 1.24s$$

$$v_{0x} = \frac{\Delta x}{t} \implies v_{0x} = \frac{9.5}{1.24} \implies v_{0x} = 7.66m/s$$

36. A football is kicked at ground level with a speed of 18.0m/s at an angle of $31.0°$ to the horizontal. How much later does it hit the ground?

$$R = \frac{v_0^2 sin2\theta}{g} \implies R = \frac{18.0sin(62)}{9.8} \implies R = 1.62m$$

$$\Delta x = v_{0x}t \implies t = \frac{\Delta x}{v_{0x}} \implies t = \frac{1.62}{18.0} \implies t = 0.09s$$

47. A rescue plane wants to drop supplies to isolated mountain climbers on a rocky ridge 265m below. If the plane is traveling horizontally with a speed of 125km/h, how far in advance of the recipients (horizontal distance) must the goods be dropped?

Given:

$$\Delta y = -265m$$

$$v_{x0} = 34.72m/s = \left(\frac{125km}{h} \times \frac{1h}{3600s} \times \frac{1000m}{1km}\right)$$

Find: Δx

$$\Delta y = v_{y0}t - \frac{1}{2}gt^2 \implies -265 = -4.9t^2 \implies t = \sqrt{\frac{-265}{-4.9}} \implies t = 7.354$$

$$\Delta x = v_{x0}t \implies \Delta x = (34.72m/s)(7.354s) \implies \Delta x = 255.3m$$