

- For material covering Ch. 3 and Ch. 4-1 thru 4-4, 10<sup>th</sup> edition (4-1 thru 4-6, 9<sup>th</sup> edition).
- Due Friday, Sept. 12 at 5 pm

**Ch. 3**

1. Two vectors are given by  $\vec{a} = (4.0 \text{ m})\hat{i} - (3.0 \text{ m})\hat{j} + (1.0 \text{ m})\hat{k}$  and  $\vec{b} = (-1.0 \text{ m})\hat{i} + (1.0 \text{ m})\hat{j} + (4.0 \text{ m})\hat{k}$ . In unit-vector notation, find (a)  $\vec{a} + \vec{b}$ , (b)  $\vec{a} - \vec{b}$ , (c) a third vector  $\vec{c}$  such that  $\vec{a} - \vec{b} + \vec{c} = 0$ .

[Answer: (a)  $(3.0 \text{ m})\hat{i} + (-2.0 \text{ m})\hat{j} + (5.0 \text{ m})\hat{k}$ ;

(b)  $(5.0 \text{ m})\hat{i} + (-4.0 \text{ m})\hat{j} + (-3.0 \text{ m})\hat{k}$ ;

(c)  $(-5.0 \text{ m})\hat{i} + (4.0 \text{ m})\hat{j} + (3.0 \text{ m})\hat{k}$ ].

2. A car is driven east for a distance of 43 km, then north for 26 km, and then in a direction  $31^\circ$  east of north for 23 km. Determine (a) the magnitude of the car's total displacement from its starting point and (b) the angle (from east) of the car's total displacement measured from its starting direction. [Answer: (a) 71 km; (b)  $40^\circ$ ].

3. Two vectors are given by  $\vec{a} = 9.4\hat{i} + 7.9\hat{j}$  and  $\vec{b} = 8.6\hat{i} + 9.3\hat{j}$ . Find (a)  $|\vec{a} \times \vec{b}|$ ; (b)  $\vec{a} \cdot \vec{b}$ ; (c)  $(\vec{a} + \vec{b}) \cdot \vec{b}$ ; and (d) the component of  $\vec{a}$  along the direction of  $\vec{b}$ ? [Answer: (a) 19; (b) 150; (c) 310; (d) 12].

4. Two vectors,  $\vec{r}$  and  $\vec{s}$  lie in the xy plane. Their magnitudes are 3.56 and 6.46 units, respectively, and their directions are  $295^\circ$  and  $67^\circ$ , respectively, as measured counterclockwise from the positive x axis. What are the values of (a)  $\vec{r} \cdot \vec{s}$  and (b)  $|\vec{r} \times \vec{s}|$ ? [Answer: (a) -15.4; (b) 17.1].

**Ch. 4**

5. The position  $\vec{r}$  of a particle moving in an xy plane is given by  $\vec{r} = (4t^3 - 6t)\hat{i} + (3 - t^4)\hat{j}$  with  $\vec{r}$  in meters and t in seconds. In unit-vector notation, calculate (a)  $\vec{r}$  (b)  $\vec{v}$ , and (c)  $\vec{a}$  for t = 3 s. (d) What is the angle between the positive direction of the x axis and a line tangent to the particle's path at t = 3 s? Give your answer in the

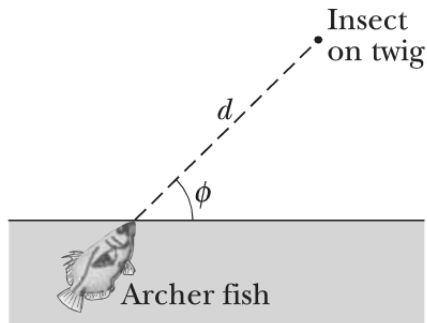
range of  $(-180^\circ; 180^\circ)$ . [Answer: (a)  $(90.0\hat{i} - 78.0\hat{j})\text{m}$ ; (b)  $(102\hat{i} - 108\hat{j})\text{m/s}$ ; (c)  $(72.0\hat{i} - 108\hat{j})\text{m/s}^2$ ; (d)  $-46.6^\circ$ ].

6. A proton initially has  $\vec{v} = -1.3\hat{i} + 14\hat{j} + 12\hat{k}$  and then 5.7 s later has  $\vec{v} = -13\hat{i} + 14\hat{j} + 15\hat{k}$  (in m/s). (a) For that 5.7 s, what is the proton's average acceleration  $\vec{a}_{avg}$  in unit vector notation, (b) in magnitude, and (c) the angle between  $\vec{a}_{avg}$  and the positive direction of the x axis? [Answer: (a)  $(-2.05\hat{i} + 0.53\hat{k})\text{m/s}^2$ ; (b)  $2.12 \text{ m/s}^2$ ; (c)  $165^\circ$ ].

7. A small ball rolls horizontally off the edge of a tabletop of height h. It strikes the floor a distance x horizontally away from the edge of the table. (a) How long is the ball in the air? (b) What is its speed at the instant it leaves the table? Please give your answer in terms of the given variables and g. [Answer: (a)  $\sqrt{2h/g}$ ; (b)  $x\sqrt{g/2h}$ ].

8. The current world-record motorcycle jump is 77.0 m, set by Jason Renie. Assume that he left the take-off ramp at  $11.0^\circ$  to the horizontal and that the take-off and landing heights are the same. Neglecting air drag, determine his take-off speed. [Answer: 44.9 m/s].

9. Upon spotting an insect on a twig overhanging water, an archer fish squirts water drops at the insect to knock it into the water. Although the insect is at distance d from the fish along a straight-line path at angle  $\phi$  (as in the figure here), a drop must be launched at a different angle  $\theta_0$  if its parabolic path is to intersect the insect. If  $\phi = 36.0^\circ$  and d = 0.900 m, what  $\theta_0$  is required for the drop to be at the top of the parabolic path when it reaches the insect? [Answer:  $55.5^\circ$ ]



**10.** In the figure, a baseball is hit at a height  $h = 1.20$  m and then caught at the same height. It travels alongside a wall, moving up past the top of the wall  $1.4$  s after it is hit and then down past the top of the wall  $3.8$  s later, at distance  $D = 44$  m farther along the wall. **(a)** What horizontal distance is traveled by the ball from hit to catch? What are the **(b)** magnitude and **(c)** angle (relative to the horizontal) of the ball's velocity just after being hit? **(d)** How high is the wall? [Answer: (a) 76.4 m; (b) 34.3 m/s; (c)  $70.3^\circ$ ; (d) 36.8 m].

