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

**Ch. 3**

**1.** Two vectors are given by $\vec{a} = (4.0\text{ m})\hat{\imath} - (3.0\text{ m})\hat{\jmath} + (1.0\text{ m})\hat{k}$ and $\vec{b} = (-1.0\text{ m})\hat{\imath} + (1.0\text{ m})\hat{\jmath} + (4.0\text{ m})\hat{k}$. 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) $(3.0\text{ m})\hat{\imath} + (-2.0\text{ m})\hat{\jmath} + (5.0\text{ m})\hat{k}$;
(b) $(5.0\text{ m})\hat{\imath} + (-4.0\text{ m})\hat{\jmath} + (-3.0\text{ m})\hat{k}$;
(c) $(-5.0\text{ m})\hat{\imath} + (4.0\text{ m})\hat{\jmath} + (3.0\text{ m})\hat{k}$].

**2.** A car is driven east for a distance of 43 km, then north for 26 km, and then in a direction 31° 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°].

**3.** Two vectors are given by $\vec{a} = 9.4\hat{\imath} + 7.9\hat{\jmath}$ and $\vec{b} = 8.6\hat{\imath} + 9.3\hat{\jmath}$. 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° and 67°, 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**

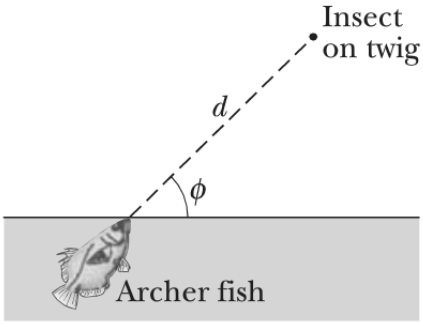
**5.** The position $\vec{r}$ of a particle moving in an xy plane is given by $\vec{r} = (4t^3 - 6t)\hat{\imath} + (3 - t^4)\hat{\jmath}$ with in $\vec{r}$ meters and t in seconds. In unit-vector notation, calculate (a) $\vec{r}$ (b) $\vec{v}$, and (c) $\vec{a}$ for t = 3 s. (d) What is the angle between 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°; 180°). [Answer: (a) $(90.0\hat{\imath} - 78.0\hat{\jmath})$m; (b) $(102\hat{\imath} - 108\hat{\jmath})$m/s; (c) $(72.0\hat{\imath} - 108\hat{\jmath})$m/s$^2$; (d) -46.6°].

**6.** A proton initially has $\vec{v} = -1.3\hat{\imath} + 14\hat{\jmath} + 12\hat{k}$ and then 5.7 s later has $\vec{v} = 13\hat{\imath} + 14\hat{\jmath} + 15\hat{k}$ (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) $\left(-2.05\hat{\imath} + 0.53\hat{k}\right)$m/s$^2$; (b) 2.12 m/s$^2$; (c) 165°].

**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° 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 φ (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 φ = 36.0° 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°]




**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°; (d) 36.8 m].