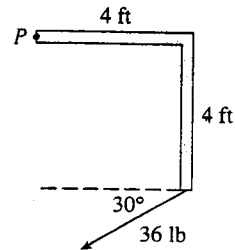


**HOMEWORK 3, MATH 233**  
**DUE MONDAY, JANUARY 28, 2002**

Each problem is worth 6 points for a total of 30 points.

- (1) (See #6, p. 674, §9.4) A 36 lb force is applied as shown in the following diagram (the whole diagram is in the plane of the paper):



- (a) Use the standard basis vectors  $\mathbf{i}$ ,  $\mathbf{j}$  and  $\mathbf{k}$  to express the position vector  $\mathbf{r}$ , which is the vector from  $P$  to the point where the force is applied.
- (b) Express the force vector  $\mathbf{F}$  in terms of  $\mathbf{i}$  and  $\mathbf{j}$ .
- (c) Find the torque vector  $\boldsymbol{\tau}$  in terms of  $\mathbf{i}$ ,  $\mathbf{j}$  and  $\mathbf{k}$ , and find its magnitude.
- (d) Will this torque screw a right-handed thread down into the page or up out of the page? Use your torque vector to explain.
- (2) (See #8, p. 683, §9.5) Consider the points  $P(-1, 0, 5)$  and  $Q(4, -3, 3)$  in space.
- (a) Find vector equations of the line through  $P$  and  $Q$ .
- (b) Find parametric equations of this line, so that  $P$  is the point given by parameter value  $t = 0$  and  $Q$  is the point given by parameter value  $t = 1$ .
- (c) Find symmetric equations for this line.
- (d) Determine whether or not the point  $R(-6, 3, 8)$  lies on this line.
- (e) Determine the point  $S$  where this line intersects the plane  $x + 2y + 3z = 1$ .
- (3) (Like #25, p. 684, §9.5) Find an equation of the plane that passes through the point  $A(5, 1, -3)$  and contains the line  $x = 4 + 2t$ ,  $y = 5 + 3t$ ,  $z = 2 + t$ .

(Continued on back)

- (4) (See §9.5 and #3, p. 110, §6.2.4 of ML) Use MATLAB to plot on the same graph the planes  $x + y + z = 2$  and  $3x - 4y + 5z = -8$  over  $0 \leq x \leq 4$  and  $0 \leq y \leq 4$ . Use MATLAB to calculate the angle between these planes and then use the `num2str` command to report this value in the title. Adjust the view as needed. On the printed graph, label by hand which plane goes with which equation.
- (5) (See §9.6 and §6.3.2 of ML) Use MATLAB to plot the hyperbolic paraboloid  $z = 2x^2 - 3y^2$  over the domain  $-3 \leq x \leq 3$  and  $-2 \leq y \leq 2$ . Make sure that the  $x = k$  traces are shown for  $k$  running from  $-3$  to  $3$  by fifths, and that the  $y = k$  traces are shown for  $k$  running from  $-2$  to  $2$  by fifths. Use the `contour3` command to show the horizontal traces  $z = k$  for  $k$  running from  $-5$  to  $5$  by twos. On the printed graph, label by hand the  $x = 2$  trace, the  $y = -1$  trace and the  $z = 1$  trace. As part of each label say whether the curve is an ellipse, parabola or hyperbola. Don't forget that hyperbolae come in pairs.