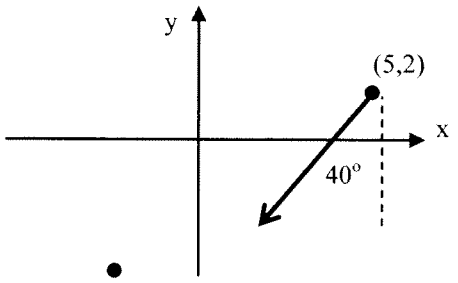
Problem 1 – Short Answer – 40 pts

(a) 6 pts: Find the magnitude and direction of the moment of the 120 lb force about the point *P* (-3,-4). Distance units are inches.



$M_P = r_x F_y - r_y F_x$

$= (+8)(-120\cos 40^\circ) - (+6)(-120\sin 40^\circ)$

$= -273 \text{ in lb}$ CW or $-273 \text{ in-lb}\ \vec{k}$

Minor (-1)
UNITS
NUMERICAL

Serious (-2)
SIGN ERROR in $\vec{R}$
SINE & COS CONFUSED
$\vec{F} \times \vec{r}$
ERROR IN CROSS PROD

MAJOR -4 to -6
Don't know cross prod
Mult. 10 * 120
Mixed up cross prod & scalar multiplic.

(b) 10 pts: Two equal and opposite forces of magnitude 100 N act on the sides of the cube as shown. If the cube has an edge that is 1.2 m long, calculate the moment due to the couple. Report your answer in Cartesian vector form

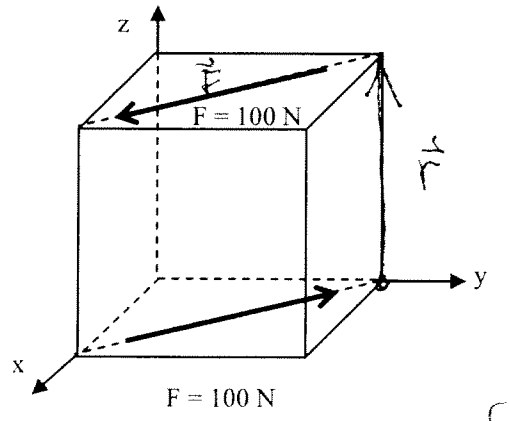
$\vec{r} = 1.2\vec{k}$

$\vec{F} = \frac{100\sqrt{2}}{2}\vec{i} - \frac{100\sqrt{2}}{2}\vec{j}$

$\vec{r} \times \vec{F}$

$= 1.2\vec{k} \times \left(\frac{100\sqrt{2}}{2}\vec{i} - \frac{100\sqrt{2}}{2}\vec{j}\right)$

$= 84.9\vec{i} + 84.9\vec{j}$



ERRORS

MINOR -1
UNITS

Serious (-2)
$\vec{F}$ or $\vec{r}$ sign
Numerical -2
Sign in c.prod
Factor of $\frac{1}{2}$ in final answer

COMMON -4
M (120 N.m) but No $\vec{m}$
$\vec{r}$ totally wrong
$\vec{F}$ totally wrong

DID PROBLEM using 2-vectors Not 3-vectors -8

NOTHING MUCH There -10

(c) 8 pts: A bar with a circular cross-section is made of 1040 steel with a yield strength of 55,000 psi and an ultimate tensile strength of 80,000 psi. The failure mode concerning the designers is yielding. The factor of safety is to be 3.0. If the maximum axial load to be carried is 12,500 lb, what should we choose for the diameter of the bar?

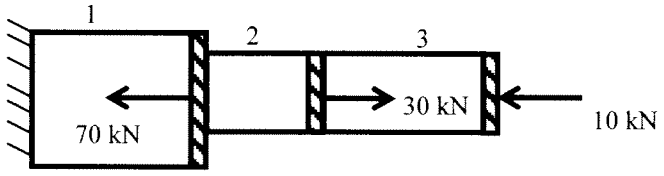
$\sigma_{work} = \frac{55000\ psi}{3} = 18{,}333\ psi$

$18333\ \frac{lb}{in^2} = \frac{12500\ lb}{\frac{\pi}{4} d^2}$ $\quad d = 0.932\ in$

ALGEBRA WRONG −3
No Safety factor −5
OBVIOUS NUMERICAL error −1
Used UTS −3

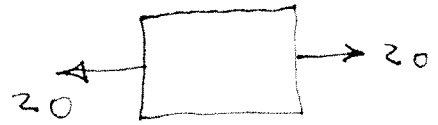
No use of stress, just load −7
UNITS Wrong −2
GOT AREA NOT diam (1.082 in²) −2

(d) 10 pts: You are given an axially loaded composite bar with the loading shown. It is supported by a rigid wall on the left. Draw a free body diagram that would be appropriate for calculating the stress in Section 2.



Body not free, force & wall drawn −2
Key force in 2 does Not appear −4
Put a load on cut −4
I do not accept this:

But give Some credit



−4

Got very confused, not much there −8 or −10
Depending on how irritated I was, ...