Please state clearly all assumptions made in order for full credit to be given.

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Problem #1 (25)

Consider the following four matrices A, B, C, and D,

\[ A = \begin{bmatrix} -2 & 4 & 5 \\ 3 & 1 & -4 \\ 5 & 11 & -2 \end{bmatrix}, \quad B = \begin{bmatrix} 5 & -2 & 7 \\ 4 & 1 & -3 \end{bmatrix}, \quad C = \begin{bmatrix} 2 & 3 \\ -4 & 1 \end{bmatrix}, \quad \text{and } D = \begin{bmatrix} 6 & -8 \\ 3 & -3 \end{bmatrix} \]

Determine the following:

a) \((BC)D\)  

b) \(2C - 4B\)  

c) \(C + A\)  

d) \(\det(A)\) using the duplicate column method  

e) \((I-D)^{-1}\)  

Note: You need to show your work to receive credit.
Problem #2 (25)

A container of weight $W$ is suspended from ring A, to which cables AC and AE are attached. A force $P$ is applied to the end F of a third cable that passes over a pulley at B and through ring A and that is attached to a support at D. Knowing that $W=1000$ N:

a) Draw a complete and separate FBD of the particle in this problem (6)
b) Express all forces in your FBD in Cartesian Vector Form (9)
c) Write down the equations of equilibrium (5)
d) Solve the equations of equilibrium to determine the magnitude of $P$ (5)

(Hint: The tension is the same in all portions of the cable FBAD).
Problem #3 (25)

A force $\mathbf{F}$ is applied at point C of the bent bar shown below. The magnitude of the force is 500 N.

1. Express the force $\mathbf{F}$ in a Cartesian vector form. (4)
2. Determine the moment of the force about point $O$. Express the moment in a Cartesian vector form. (6)
3. Determine the scalar component of the moment about the line $OA$. (5)
4. Determine the vector component of the moment along the line $OA$. (5)
5. Determine the vector component of the moment orthogonal to line $OA$. (5)
Problem #4 (25)

A beam $ABC$ is loaded and supported as shown below. The support at $A$ is a frictionless pin. The cable $BDC$ passes over a frictionless pulley at $D$. The beam has a uniform cross section and a mass of 20 kg. The force $F$ has a magnitude of 750 N.

1. Draw a complete free body diagram of the beam (separate from the figure below). Clearly label all forces acting on the beam. (10)
2. Write down the force equilibrium equations for the beam. (6)
3. Determine the tension in the cable. (4)
4. Determine the reaction forces at $A$. Express the reaction at $A$ in a Cartesian vector form. (5)