PROBLEM 3.37 A PRESSURE VESSEL CONSISTS OF A CIRCULAR CYLINDER CAPPED AT BOTH ENDS BY WELDING ON TWO HEMISPHERICAL CAPS. THE VESSEL IS THEN SUBJECTED TO AN INTERNAL PRESSURE OF 7.0 MPa. IF THE INNER DIAMETER AND THICKNESS OF EACH MEMBER ARE 500mm AND 12mm, RESPECTIVELY, DETERMINE THE MEMBRANE STRESSES OF EACH MEMBER.

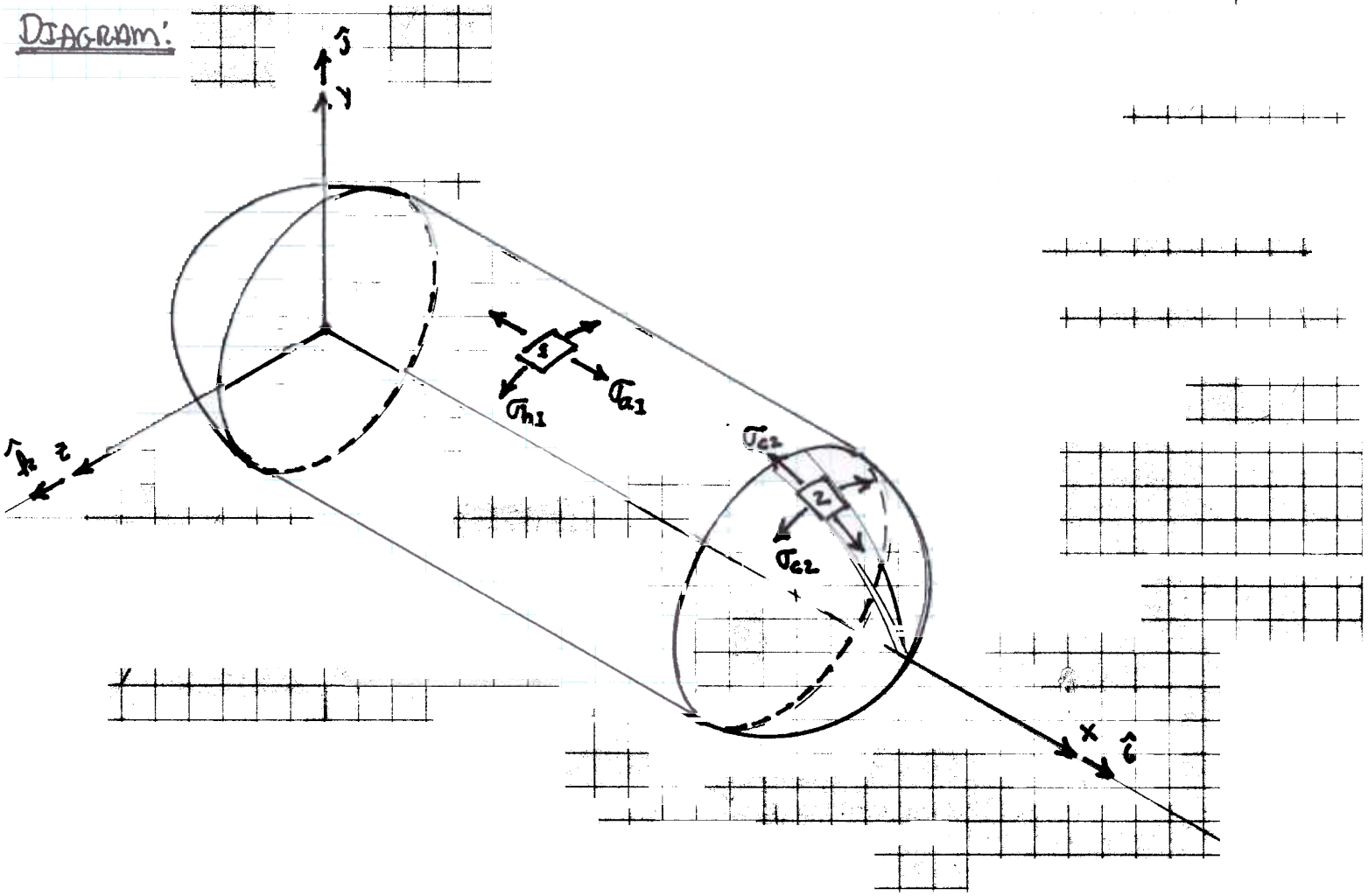
GIVEN:

CONSTRAINTS
1. CYLINDERICAL PRESSURE VESSEL, 500mm ID AND 12mm THICKNESS
2. 7.0MPa INTERNAL PRESSURE
3. VESSEL MANUFACTURED BY WELDING TWO HEMISPHERICAL CAPS ONTO THE CYLINDER.

ASSUMPTION
1. WALLS ARE THIN
2. LINEAR ELASTIC RESPONSE
3. SMALL DEFORMATIONS

FIND
1. DETERMINE THE MEMBRANE STRESSES IN THE END CAPS
2. DETERMINE THE MEMBRANE STRESSES IN THE CYLINDER

DIAGRAM:



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SOLUTION:

STARTING WITH A TYPICAL ELEMENT IN THE CYLINDER, ELEMENT 1

$$\sigma_{a1} = \frac{P \cdot r}{2t} = \frac{7.0(10^6)\frac{N}{m^2} \cdot .262\,m}{2 \cdot 0.012\,m} = \boxed{76.4\ MPa}$$

$$\sigma_{h1} = \frac{Pr}{t} = \frac{7.0(10^6)\frac{N}{m^2} \cdot .262\,m}{.012\,m} = \boxed{152.8\ MPa}$$

IN THE HEMISPHERES

$$\sigma_{c2} = \frac{P \cdot r}{2 \cdot t} = \frac{7.0(10^6)\frac{N}{m^2} \cdot .262m}{2 \cdot 0.012m} = \boxed{76.4MPa}$$

SUMMARY:

THE HIGHEST STATE OF STRESS IS IN THE CYLINDRICAL SECTION OF THE VESSEL.