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Question 1

Part A) Derivation of **Lame-Emden Equation**

( 1 )

( 2 )

( 3 )

Then

( 4 )

( 5 )

Multiply both sides with r2, which results.

( 6 )

The equation of state (EOS) is the relation between P and . Take an example from the ideal gas equation

( 7 )

Assume polytropic EOS

( 8 )

Where

( 9 )

Which makes

( 10 )

Insert equaiton 10 into 6.

( 11 )

Say that , where

( 12 )

Then

( 13 )

This is nothing but **Lame-Emden Equation:**

( 14 )

Derivation of **Total Mass of the Star**

( 15 )

From and

( 16 )

Thanand from Lane-Emden equation wiht that

( 17 )

Which makes

( 18 )

**Mass and Radius Proportionality**.

The proportionality relation can be found by looking at central density() term power such that

( 19 )

( 20 )

Which results

( 21 )