

Theoretical Problem 3: Cavitation

Q3 - Marking Scheme

Question part	Total marks	Partial marks	Explanation
A1	0.5	0.4	Derivation of the formula
		0.1	Numerical answer
A2	1	0.3	Pressure equilibrium condition
		0.1	Numerical answer for partial air pressure
		0.1	Equilibrium condition with isothermal law
		0.4	Formula for critical pressure
		0.1	Numerical answer for critical pressure
B1	1.5	0.3	Incompressibility condition
		0.5	Computation of radial acceleration
		0.3	Taking into account Newton's second law
		0.2	Final equation with p , where surface tension enters
		0.2	Final equation with p split and adiabatic law taken into account
B2	1	0.4	Formula for terminal speed
		0.1	Numerical answer for terminal speed
		0.4	Formula for time or for initial acceleration
		0.1	Numerical answer for time
B3	1	0.5	Formula for speed R'
		0.4	Formula for rebound radius
		0.1	Numerical answer for rebound radius
B4	0.5	0.2	Writing down the asymptotic equation for R'
		0.2	Substitution of the form into the equation

Question part	Total marks	Partial marks	Explanation
		0.1	Numerical answer for alpha
B5	1	0.4	Writing down the linear second order equation
		0.2	Recognition of the stability condition
		0.3	Formula for the natural frequency
		0.1	Numerical answer for the natural frequency
B6	1	0.2	Writing down the forced oscillator equation
		0.3	Solution of the equation
		0.1	Computation of volume
		0.1	Computation of pressure gradient
		0.3	Final answer
C1	2	0.1	Initial concentration of air in water
		0.1	Initial concentration of air near bubble
		0.1	Mass change rate in a shell in terms of concentration change rate
		0.1	Mass change rate in a shell in terms of flux
		0.1	Use of Fick's law
		0.2	Diffusion equation in terms of r and t
		0.2	Initial and boundary conditions
		0.2	Reformulation and solution
		0.2	Computing the air flux at the bubble wall
		0.1	Simplification due to smallness of the bubble
		0.2	Mass of the bubble in terms of pressure with ideal gas law taken into account
		0.1	Mass balance
		0.2	Final formula for resorption time

Question part	Total marks	Partial marks	Explanation
		0.1	Numerical answer for resorption time
C2	0.5	0.2	Condition of equilibrium
		0.3	Final condition on angles