E2: Jumping Beads - a model for phase transitions and instabilities

Marking Scheme

Part			Maximum points		Total points
A:	Determination of the critical driving amplitude for the loudspeaker				3.3
A1	Observation table	Measurements covering the critical range with 9 or more readings at different settings of the amplitude	0.2	1.2	
		Measurements covering the critical range with 5 to 8 readings at different settings of the amplitude	0.1		
		Measurement interval at least 100mV	0.1		
		Interval smaller at the critical point (50mV)	0.2		
		Proper table header	0.1		
		Writing unit for X	0.2		
		Statistics: 5 or more readings at the same amplitude	0.3		
		Average N_2 derived from N_1	0.1		
A2	Graph	Computed error and written uncertainty for each measured data point	0.2	1.1	
		Proper choice of scale for X axis (at least half of the full width of the paper used and all data points fit in the plot)	0.1		
		Proper choice of scale for Y axis (at least half of the full height of the paper used and all data points fit in the plot)	0.1		
		Variables written along axes	0.2		
		Units mentioned (X axis)	0.1		
		Correct plotting of points	0.2		
		Plotted uncertainty	0.2		
A3	Calculations	Critical amplitude determined in a reasonable way	0.4	1	
		The range for the determination is correct (flat parts far from the critical region not included)	0.3		

Part			Maximum points		Total points
		Result is within (1.0V ≤ $A_{D,\,crit}$ ≤ 1.5V)	0.3		
		Result is within (0.7V ≤ $A_{D,\,crit}$ <1.0V)	0.1		
		Result is within (1.5V < $A_{D,\,crit}$ ≤ 1.7V)	0.1		
B: Calibration of the loudspeaker driving amplitude					3.2
B1	Sketch	Sketch present and makes sense (ignoring the text description)	0.5	0.5	
B2	Table	Proper table header	0.2	0.8	
		Units mentioned	0.2		
		Uncertainty is written and is in the reasonable range (0.3 to 1mm)	0.2		
		At least 5 data points in the proper (linear) range	0.2		
B3	Graph	Proper choice of scale for X axis (at least half of the full width of the paper used and all data points fit in the plot)	0.1	1	
		Proper choice of scale for Y axis (at least half of the full height of the paper used and all data points fit in the plot)	0.1		
		Variables written along axes	0.2		
		Units mentioned	0.2		
		Correct plotting of points	0.2		
		Plotted uncertainty as error bars	0.2		
B4	Calculation	Fit present on the plot in the correct range (plateau not included)	0.2	0.8	
		Functional form written	0.1		
		Linear function is used for the fit	0.1		
		Slope written and within range (2.5–3.5)	0.1		
		Written unit for the slope [mm/V]	0.1		
		Offset written and within range (–0.5 to +0.5)	0.1		
		Written unit for the offset [mm]	0.1		

Part			Maximum points		Total points
B5	Critical amplitude	Critical driving amplitude computed using computed calibration curves	0.1	0.1	
C: Critical exponent					3.5
C1	Table	Proper table header	0.1	1.1	
		Writing unit for X	0.2		
		Imbalance calculated correctly (ranges from 0 to 1)	0.2		
		$\lvert A^2 - A_c^2 \rvert$ computed for the driving amplitude of the speaker (in mm), not for the excitation amplitude of the signal (in V)	0.2		
		Proper conversion from A_D to A using calibration curve determined in Part B	0.2		
		Maximum value of imbalance is at least 10 times larger than its minimum value	0.2		
C2	Graph	Double-logarithmic paper used correctly (or logarithm computed and normal paper used)	0.2	1	
		Scale chosen appropriately (at least half of the full width/height of the paper used and all data points fit in the plot)	0.2		
		Variables written along axes	0.2		
		Units present (X axis)	0.2		
		Correct plotting of points	0.2		
C3	Calculation	Fit does not include values where $A > A_c$	0.3	1.4	
		Method to determine the critical exponent b is correct (understanding that it is related to the slope of the straight line in double-logarithmic plot, hence line is drawn)	0.3		
		The method to calculate the slope is correct	0.2		
		Exponent within range (0.0–1.0)	0.2		
		Error written	0.2		
		Error within range (0.1–0.5)	0.2		
Total number of points:					10