Theoretical Question 3: Birthday Balloon
MARKING SCHEME

a) 1.8	Relation between $P - P_0$ and σ_t	0.8	
	Relation between $P - P_0$ and σ_L	0.6	
	Final answer	0.4	No credit for internal propagating error
b) 1.0	Finding $P(V)$	0.4	Relation between $P - P_0$ and σ_t - 0.1 Relation between r and V – 0.1 Final answer for $P(V)$ – 0.2
	Graph	0.4	Starts at $V > 0$ – 0.1 Starts at $P - P_0 = 0$ – 0.1 Monotonously rising – 0.1 Convex – 0.1
	Finding P_{max}	0.2	
c) 1.3	Graph	1.1	Starts at $V > 0$ – 0.1 Starts at $P - P_0 = 0$ – 0.1 Rising at the end – 0.1 Decreasing in the middle – 0.2 Maximum marked – 0.1 Minimum marked – 0.1 $r = 0.5$cm marked after the maximum – 0.2 $r = 2.5$cm marked after $r = 0.5$cm and before the minimum – 0.2 Penalty for negative $P - P_0$ - 0.3
	$P - P_0$ value at $r = 0.5$cm	0.1	
	$P - P_0$ value at $r = 2.5$cm	0.1	
d) 2.3	Result for P_c	1.2	Partial credit for writing the equal-areas law – 0.6 Writing the equal-areas law with misplaced P_0 - 0.3
	Equation for $V_{1,2}$	0.5	
	Result for V_1	0.3	
	Result for V_2	0.3	
e) 1.0	Starts at $V > 0$	0.1	
	Starts at $P - P_0 = 0$	0.1	
	Rising at the end	0.1	
	Horizontal in the middle	0.3	
	Slope discontinuity at the ends of the horizontal segment	0.1	
	$P_c - P_0$ coincides with the horizontal segment	0.1	
	V_1 coincides with the beginning of the horizontal segment	0.1	
	V_2 coincides with the end of the horizontal	0.1	

	segment			
	Penalty for negative $P - P_0$	-0.3		
f) 1.4	Finding V_{thin}	1.0	Partial credit for correct equations for V_{thin} – 0.6	
			Partial credit if there are less equations than unknowns – 0.2	
			Partial credit for linear relation between V_{thin} and V without correct equations – 0.3	
	Relation between V_{thin} and L_{thin}	0.2		
	Final answer	0.2	No credit for internal propagating error	
g) 1.2	Writing $\Delta W = P_c \Delta V$	0.3		
	Relation between ΔV and ΔV_{thin}	0.5	Partial credit for understanding that ΔV is not equal but proportional to ΔV_{thin} – 0.2	
	Relation between ΔV_{thin} and ΔL_{thin}	0.2		
	Final answer	0.2	No credit for internal propagating error	