

Theoretical Question 3: Birthday Balloon  
MARKING SCHEME

<b>a) 1.8</b>	Relation between $P - P_0$ and $\sigma_t$	0.8	
	Relation between $P - P_0$ and $\sigma_L$	0.6	
	Final answer	0.4	No credit for internal propagating error
<b>b) 1.0</b>	Finding $P(V)$	0.4	Relation between $P - P_0$ and $\sigma_t$ - 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	
<b>c) 1.3</b>	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 $r = 0.5\text{cm}$ marked after the maximum - 0.2 $r = 2.5\text{cm}$ marked after $r = 0.5\text{cm}$ and before the minimum - 0.2 Penalty for negative $P - P_0$ - 0.3
	$P - P_0$ value at $r = 0.5\text{cm}$	0.1	
	$P - P_0$ value at $r = 2.5\text{cm}$	0.1	
<b>d) 2.3</b>	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	
<b>e) 1.0</b>	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	
<b>f) 1.4</b>	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
<b>g) 1.2</b>	Writing $\Delta W = P_c \Delta V$	0.3	
	Relation between $\Delta V$ and $\Delta V_{thin}$	0.5	Partial credit for understanding that $\Delta V$ is not equal but proportional to $\Delta V_{thin}$ – 0.2
	Relation between $\Delta V_{thin}$ and $\Delta L_{thin}$	0.2	
	Final answer	0.2	No credit for internal propagating error