Question Number	Answer		Mark
17(a)	Use of circumference = $2\pi r$	**(1)**	
	Use of $V = \frac{4\pi r^3}{3}$	**(1)**	
	Conversion of temperature to kelvin	**(1)**	
	Use of $pV = NkT$	**(1)**	
	Excess pressure calculated	**(1)**	
	Excess pressure is 79 kPa, so ball meets FA rules	**(1)**	**6**
	<u>Example of calculation</u> $r = \frac{0.685\ \text{m}}{2\pi} = 0.109\ \text{m}$ $V = \frac{4\pi}{3} \times (0.109\ \text{m})^3 = 5.42 \times 10^{-3}\ \text{m}^3$ $p = \frac{NkT}{V} = \frac{2.5 \times 10^{23} \times 1.38 \times 10^{-23}\ \text{J K}^{-1} \times (16+273)}{5.42 \times 10^{-3}\ \text{m}^3} = 1.84 \times 10^5\ \text{Pa}$ Excess pressure = 1.84×10^5 Pa – 1.05×10^5 Pa = 7.9×10^4 Pa (79 kPa)		

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>*17(b)</td><td>
This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.

Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.

The following table shows how the marks should be awarded for structure and lines of reasoning.

<table>
<tr><th></th><th>Number of marks awarded for structure of answer and sustained line of reasoning</th></tr>
<tr><td>Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout</td><td>2</td></tr>
<tr><td>Answer is partially structured with some linkages and lines of reasoning</td><td>1</td></tr>
<tr><td>Answer has no linkages between points and is unstructured</td><td>0</td></tr>
</table>

Total marks awarded is the sum of marks for indicative content and the marks for structure and lines of reasoning

<table>
<tr><th>IC points</th><th>IC mark</th><th>Max linkage mark</th><th>Max final mark</th></tr>
<tr><td>6</td><td>4</td><td>2</td><td>6</td></tr>
<tr><td>5</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td>4</td><td>3</td><td>1</td><td>4</td></tr>
<tr><td>3</td><td>2</td><td>1</td><td>3</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>

Indicative content

• As the temperature of the air decreases the average/mean kinetic energy of the molecules decreases

• So the (root mean square) velocity/speed of the molecules decreases
Or (Since $E_k = \frac{p^2}{2m}$) the (average) momentum of the molecules decreases

• The change of momentum of a molecule during a collision with the container walls decreases

• The rate of collision of molecules with the walls of the container decreases

• So the rate of change of momentum decreases and so the force on the container walls decrease s

• Hence the pressure exerted by the gas decreases, since $p = F/A$
</td><td>6</td></tr>
<tr><td></td><td>Total for question 17</td><td>12</td></tr>
</table>