Pressure in a Robotics Diving Bell

Base your answers on the information provided and your knowledge of chemistry. Use the 2025 Chemistry Reference Tables as needed.

A school robotics team models a sensor test in a deep training pool. The team lowers an upside-down clear bell that is closed at the top and open at the bottom. Air is trapped above the water that enters through the opening. The team lowers the bell slowly. In this model no air enters, dissolves, or escapes, and the air temperature stays constant.

Trial position	**Absolute pressure of trapped air (kPa)**	**Volume of trapped air (L)**
Just below surface	100	2.40
Depth A	120	2.00
Depth B	150	1.60

1 Explain why the bell contains less air volume at depth B than at depth A even though the number of trapped air molecules is unchanged. [1]

Answer and work

The team’s water sensor stays dry while the trapped air volume is at least 1.50 L. The team plans to lower the bell to a new point where the trapped air pressure is 170 kPa.

2 Predict the trapped air volume at the new point. Use one trial from the table and show your setup. [1]

Answer and work

3 Use your result and the sensor requirement to decide whether the sensor will stay dry. [1]

Answer and work

4 Which change could let a replacement bell keep the sensor dry at the same test point and temperature?

(1) Trap less air before lowering the bell.

(2) Use the same trapped air amount in a heavier bell.

(3) Trap more air before lowering the bell.

(4) Trap the same air amount but wait longer at the new point.

5 In a separate test the team holds the trapped air at a constant pressure of 150 kPa. If that air warms and no air escapes, which change is expected?

(1) Its volume increases.

(2) Its volume stays the same.

(3) The number of trapped particles increases.

(4) The number of trapped particles decreases.