ANSWERS

1 $0.40\ m^3$

2 (a) Volume of air would decrease.
The pressure of water increases with depth. By Boyle's law, a higher pressure of the air will give rise to a smaller volume of the same mass of air.

Also accept: pV = constant or $p_A V_A = p_B V_B$ or p is proportional to $1/V$, or p is inversely proportional to V

(b) The fish needs to add gas into the bladder at B to maintain its neutral buoyancy.
[Reason: Since the volume of air decreases from A to B, if the volume is to increase back to V_A, then more air must be added into the swim bladder.]

3 (a) As the balloon rises, the **external atmospheric pressure decreases**.
To equalise the pressure difference, the **volume of the balloon increases as the internal air pressure decreases.**

(b) Using $P_1 V_1 = P_2 V_2$,
P_1 = 1 atmosphere, $V_1 = 4.2 \times 10^{-6}\ m^3$
P_2 = 0.30 atmosphere, $V_2 = 4.2 \times 10^{-6}\ m^3 / 0.3$
$V_2 = 1.4 \times 10^{-5}\ m^3$

4 (a) Boyle's law states that for a fixed mass of gas at constant temperature, its pressure is inversely proportional to its volume.

(b) At bottom of lake → At surface of lake

$$p_1 V_1 = p_2 V_2$$
$$(h+10)\rho g\ (1.5) = 10\rho g\ (7.5)$$
$$h = 40\ m$$

5 (a) Pressure due to water = $35.0 \times 1000 \times 10 = 350\ 000$ Pa [1]
Pressure in bubble = pressure due to atmosphere + pressure due to water
= 350 000 + 101 000
= 451 000 Pa or 451 kPa

(b) Using $P_1 V_1 = P_2 V_2$,
P_1 = 451 kPa, $V_1 = 2.5\ cm^3$
P_2 = 101 kPa, V_2 = ?
$V_2 = 11.2\ cm^3$

6 The 2.4 mg of gas tells us that there is the same mass of gas in each tube and so we can apply Boyle's Law to the trapped gasses in each tube. (The actual value is not needed in answering this question.)

Let the atmospheric pressure be P_{atm}
All pressures will be assumed to be in mmHg, all volumes in mm^3

For P,

Pressure of trapped gas = P_{atm} + 30.0

Volume of trapped gas = A × 75.0

For Q,

Pressure of trapped gas = P_{atm} – 50.0

Volume of trapped gas = A × 83.4

Using $P_1 V_1 = P_2 V_2$,

$(P_{atm} + 30.0)\ (A \times 75.0) = (P_{atm} - 50.0)\ (A \times 83.4)$

P_{atm} = 764 mmHg