

# State Examination Commission – Physics Higher Level, 2006

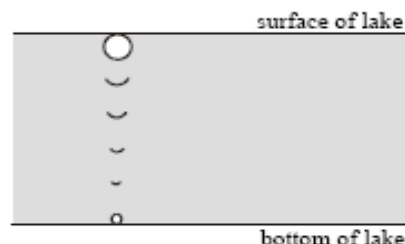
## Question 12a

Define pressure. (6)

Is pressure a vector quantity or a scalar quantity? Justify your answer. (6)

State Boyle's law. (6)

A small bubble of gas rises from the bottom of a lake. The volume of the bubble increases threefold when it reaches the surface of the lake where the atmospheric pressure is  $1.01 \times 10^5 \text{ Pa}$ . The temperature of the lake is  $4^\circ\text{C}$ .



Calculate

- (i) the pressure at the bottom of the lake;
- (ii) the depth of the lake.

(acceleration due to gravity =  $9.8 \text{ m s}^{-2}$ ; density of water =  $1.0 \times 10^3 \text{ kg m}^{-3}$ )

Define pressure.

(6)

Elementary definition

Is pressure a vector quantity or a scalar quantity? Justify your answer.

(6)

Scalar – it has no direction associated with it (it acts equally in all direction)

State Boyle's law. (6)

Elementary

A small bubble of gas rises from the bottom of a lake. The volume of the bubble increases threefold when it reaches the surface of the lake where the atmospheric pressure is  $1.01 \times 10^5 \text{ Pa}$ . The temperature of the lake is  $4^\circ\text{C}$ .

Calculate

- (i) the pressure at the bottom of the lake;

At the bottom of the lake the volume of the bubble was one third its volume at the top, therefore, the pressure at the bottom of the lake is three times the pressure at the top, atmospheric pressure.

$$P = 3 \times 1.01 \times 10^5 \text{ Pa} = 3.03 \times 10^5 \text{ Pa}$$

- (ii) the depth of the lake.

(10)

The pressure at the bottom of the lake is caused by the water *and* the atmosphere above it. If we subtract the pressure of the atmosphere from the pressure at the bottom of the lake, we get the pressure due to the water (of depth  $h$ ) in the lake.

$$\begin{aligned} \text{Pressure due to depth } h \text{ of water} &= 3.03 \times 10^5 - 1.01 \times 10^5 = 2.02 \times 10^5 \text{ Pa} \\ \rho gh &= 2.02 \times 10^5 \\ h &= 2.02 \times 10^5 / \rho g = 2.02 \times 10^5 / [(1.0 \times 10^3)(9.8)] \\ &= 20.6 \text{ m} \end{aligned}$$